247 Tottenham Court Road
London

Energy Strategy
Appendices

Planning Submission

Client Name: Prudential UK Real Estate Nominee 1 Limited and Prudential UK Real Estate Nominee 2 Limited.

Client Address: 10 Fenchurch Avenue
London
EC3H 5AG
10 Fenchurch Avenue

Property: 247 Tottenham Court Road, London, W1T 7HH;
3 Bayley Street, London, WC1B 3HA;
1 Morwell Street, London, WC1B 3AR;
2-3 Morwell Street, London, WC1B 3AR; and
4 Morwell Street, London, W1T 7QT.

Project Reference: 4650

Issue: Planning Submission

Date: July 2020

Prepared by: JH/MW

Checked by: MDC

Validated by: MDC

CONTENTS

Appendix 1 – Office BRUKL Reports

BRUKL – Lean Scheme

BRUKL - Green Scheme

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

247 TCR - Offices FCU Lean

As designed

Date: Wed Jul 22 16:48:59 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jeremy Holgate

Telephone number: 01932753

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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	21.9
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	21.9
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	15.9
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	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.23	0.23	Basement Walls
Floor	0.25	0.22	0.22	Ground Floor (Bmt)
Roof	0.25	0.21	0.21	Roof
Windows***, roof windows, and rooflights	2.2	1.49	1.5	G Single (1.7 x 2.6)
Personnel doors	2.2	1.32	1.37	1F vent
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* 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	3.03

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- FCU Large spaces (47 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.3	-	-	0.75
Standard value	0.91*	2.7	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- FCU small spaces (B1_Office Misc 1 (Security))

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0	3.3	-	-	0.75
Standard value	N/A	2.7	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

3- Extract only by adjacent (14 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

4- Local Extract only Electric (B1_Toilet FlrRoof 1)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

5- MVHR Heat Only (19 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

6- Electric NatVent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- DHW (LTHW)

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.91	0
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

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
B1_Office Flr1 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr1 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr1 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr1 4	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Reception 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Toilet FlrG 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet FlrG 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Office Misc 1 (Security)	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Store F	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Changing (Basement) 1 (Changing)	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Changing (Basement) 2 (Changing)	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Changing (Basement) 4 (Changing)	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Store 3 (Cycle B1)	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Basement 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Basement 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Basement 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Basement 4	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Basement 5	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Basement 6	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Basement 7	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Basement 8	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Plant 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Plant 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Plant 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Plant 4	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr1 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr1 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A

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
B1_Office Flr2 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr2 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr2 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr2 4	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr3 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr3 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr3 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr3 4	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr4 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr4 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr4 4	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr4 5	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr5 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr5 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr5 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office Flr5 4	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office FlrG 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr2 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr2 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr2 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation FlrG 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation FlrG 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation FlrG 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation FlrG 4	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation FlrG 5	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation FlrG 6	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr3 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr3 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr3 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr4 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr4 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr4 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Toilet Flr1 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr1 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr2 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr2 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr3 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr3 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr4 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr4 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr5 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr5 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Circulation Flr5 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A

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
B1_Circulation Flr5 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation Flr5 3	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office FlrBmt 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Store M	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Toilet FlrG 3	-	-	0.5	-	-	-	-	-	-	-	N/A
Cafe 1	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Circulation FlrG 21	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Toilet Bmt 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Changing (Basement) 3 (Changing)	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Office FlrG 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
Cafe 2	-	-	-	1.9	-	-	-	0.3	-	-	N/A
B1_Toilet FlrRoof 1	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1_Office Flr1 1	120	-	-	2386
B1_Office Flr1 2	120	-	-	1309
B1_Office Flr1 3	120	-	-	670
B1_Office Flr1 4	120	-	-	1829
B1_Reception 1	-	120	80	29
B1_Circulation (Staircase) 1	-	80	-	38
B1_Circulation (Staircase) 2	-	80	-	39
B1_Circulation (Staircase) 3	-	80	-	38
B1_Circulation (Staircase) 4	-	80	-	39
B1_Circulation (Staircase) 5	-	80	-	40
B1_Circulation (Staircase) 6	-	80	-	42
B1_Circulation (Staircase) 7	-	80	-	41
B1_Circulation (Staircase) 8	-	80	-	40
B1_Circulation (Staircase) 9	-	80	-	39
B1_Circulation (Staircase) 10	-	80	-	37
B1_Circulation (Staircase) 11	-	80	-	36
B1_Circulation (Staircase) 12	-	80	-	37
B1_Circulation (Staircase) 13	-	80	-	36
B1_Circulation (Staircase) 14	-	80	-	37
B1_Circulation (Staircase) 15	-	80	-	36
B1_Circulation (Staircase) 16	-	80	-	38
B1_Circulation (Staircase) 17	-	80	-	37
B1_Circulation (Staircase) 18	-	80	-	35
B1_Circulation (Staircase) 19	-	80	-	36
B1_Toilet FlrG 1	-	80	-	47
B1_Toilet FlrG 2	-	80	-	33
B1_Office Misc 1 (Security)	100	-	-	130

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1_Store F	80	-	-	34
B1_Changing (Basement) 1 (Changing)	-	80	-	32
B1_Changing (Basement) 2 (Changing)	-	80	-	17
B1_Changing (Basement) 4 (Changing)	-	80	-	31
B1_Store 3 (Cycle B1)	80	-	-	129
B1_Circulation Basement 1	-	80	-	14
B1_Circulation Basement 2	-	80	-	13
B1_Circulation Basement 3	-	80	-	42
B1_Circulation Basement 4	-	80	-	31
B1_Circulation Basement 5	-	80	-	192
B1_Circulation Basement 6	-	80	-	62
B1_Circulation Basement 7	-	80	-	32
B1_Circulation Basement 8	-	80	-	32
B1_Plant 1	80	-	-	496
B1_Plant 2	80	-	-	815
B1_Plant 3	80	-	-	125
B1_Plant 4	80	-	-	131
B1_Store 5 (Refuse)	80	-	-	28
B1_Circulation Flr1 1	-	80	-	39
B1_Circulation Flr1 3	-	80	-	33
B1_Office Flr2 1	120	-	-	2218
B1_Office Flr2 2	120	-	-	1305
B1_Office Flr2 3	120	-	-	668
B1_Office Flr2 4	120	-	-	1416
B1_Office Flr3 1	120	-	-	2218
B1_Office Flr3 2	120	-	-	1305
B1_Office Flr3 3	120	-	-	668
B1_Office Flr3 4	120	-	-	1416
B1_Office Flr4 1	120	-	-	2788
B1_Office Flr4 3	120	-	-	302
B1_Office Flr4 4	120	-	-	668
B1_Office Flr4 5	120	-	-	1416
B1_Office Flr5 1	120	-	-	1587
B1_Office Flr5 2	120	-	-	1427
B1_Office Flr5 3	120	-	-	563
B1_Office Flr5 4	120	-	-	1417
B1_Office FlrG 1	120	-	-	571
B1_Circulation Flr2 1	-	80	-	35
B1_Circulation Flr2 2	-	80	-	23
B1_Circulation Flr2 3	-	80	-	29
B1_Circulation FlrG 1	-	80	-	105
B1_Circulation FlrG 2	-	80	-	28
B1_Circulation FlrG 3	-	80	-	163

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1_Circulation FlrG 4	-	80	-	27
B1_Circulation FlrG 5	-	80	-	26
B1_Circulation FlrG 6	-	80	-	61
B1_Circulation Flr3 1	-	80	-	35
B1_Circulation Flr3 2	-	80	-	23
B1_Circulation Flr3 3	-	80	-	29
B1_Circulation Flr4 1	-	80	-	35
B1_Circulation Flr4 2	-	80	-	23
B1_Circulation Flr4 3	-	80	-	29
B1_Toilet Flr1 1	-	80	-	100
B1_Toilet Flr1 2	-	80	-	146
B1_Toilet Flr2 1	-	80	-	95
B1_Toilet Flr2 2	-	80	-	92
B1_Toilet Flr3 1	-	80	-	95
B1_Toilet Flr3 2	-	80	-	92
B1_Toilet Flr4 1	-	80	-	95
B1_Toilet Flr4 2	-	80	-	92
B1_Toilet Flr5 1	-	80	-	96
B1_Toilet Flr5 2	-	80	-	93
B1_Circulation Flr5 1	-	80	-	36
B1_Circulation Flr5 2	-	80	-	24
B1_Circulation Flr5 3	-	80	-	30
B1_Office FlrBmt 1	120	-	-	1449
B1_Store M	80	-	-	32
B1_Circulation FlrRoof 3	-	80	-	18
B1_Toilet FlrG 3	-	80	-	70
Cafe 1	-	100	-	220
B1_Circulation FlrG 21	-	80	-	26
B1_Toilet Bmt 1	-	80	-	43
B1_Circulation (Staircase) 20	-	80	-	44
B1_Changing (Basement) 3 (Changing)	-	80	-	17
B1_Office FlrG 2	120	-	-	871
B1_Circulation (Staircase) 21	-	80	-	42
Cafe 2	-	100	-	31
B1_Toilet FlrRoof 1	-	80	-	47
B1_Circulation FlrRoof 23	-	80	-	34

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?
B1_Office Flr1 1	NO (-87%)	NO
B1_Office Flr1 2	NO (-63%)	NO
B1_Office Flr1 3	NO (-64%)	NO
B1_Office Flr1 4	NO (-50%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Reception 1	NO (-86%)	NO
B1_Office Misc 1 (Security)	N/A	N/A
B1_Circulation Flr1 1	N/A	N/A
B1_Circulation Flr1 3	N/A	N/A
B1_Office Flr2 1	NO (-91%)	NO
B1_Office Flr2 2	NO (-66%)	NO
B1_Office Flr2 3	NO (-67%)	NO
B1_Office Flr2 4	NO (-56%)	NO
B1_Office Flr3 1	NO (-91%)	NO
B1_Office Flr3 2	NO (-66%)	NO
B1_Office Flr3 3	NO (-67%)	NO
B1_Office Flr3 4	NO (-56%)	NO
B1_Office Flr4 1	NO (-53%)	NO
B1_Office Flr4 3	NO (-73%)	NO
B1_Office Flr4 4	NO (-66%)	NO
B1_Office Flr4 5	NO (-55%)	NO
B1_Office Flr5 1	NO (-90%)	NO
B1_Office Flr5 2	NO (-64%)	NO
B1_Office Flr5 3	NO (-66%)	NO
B1_Office Flr5 4	NO (-58%)	NO
B1_Office FlrG 1	NO (-51%)	NO
B1_Circulation Flr2 1	N/A	N/A
B1_Circulation Flr2 2	N/A	N/A
B1_Circulation Flr2 3	N/A	N/A
B1_Circulation FlrG 1	NO (-38%)	NO
B1_Circulation FlrG 2	NO (-92%)	NO
B1_Circulation FlrG 3	NO (-58%)	NO
B1_Circulation FlrG 4	NO (-74%)	NO
B1_Circulation FlrG 5	N/A	N/A
B1_Circulation FlrG 6	N/A	N/A
B1_Circulation Flr3 1	N/A	N/A
B1_Circulation Flr3 2	N/A	N/A
B1_Circulation Flr3 3	N/A	N/A
B1_Circulation Flr4 1	N/A	N/A
B1_Circulation Flr4 2	N/A	N/A
B1_Circulation Flr4 3	N/A	N/A
B1_Circulation Flr5 1	N/A	N/A
B1_Circulation Flr5 2	N/A	N/A
B1_Circulation Flr5 3	N/A	N/A
B1_Office FlrBmt 1	N/A	N/A
Cafe 1	NO (-54%)	NO
B1_Circulation FlrG 21	N/A	N/A
B1_Office FlrG 2	NO (-90%)	NO
Cafe 2	NO (-66%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	8096	8096
External area [m^2]	4746	4746
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	2683	2246
Average U-value [W/m^{2}K]	0.57	0.47
Alpha value* [%]	17.94	17.94

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**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
	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	1.85	1.35
Cooling	8.91	11.03
Auxiliary	9.91	9.48
Lighting	8.4	18.82
Hot water	8.05	8.05
Equipment*	44.71	44.7
TOTAL**	**37.12**	**48.73**

* 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]	111.92	154.69
Primary energy* [kWh/m^2]	93.56	129.18
Total emissions [kg/m^2]	15.9	21.9

* 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] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	5.9	126.9	1.9	11.3	11.8	0.86	3.13	0.91	3.3
	Notional	3.3	180.6	1.1	13.9	11.3	0.82	3.6	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	0	438.9	0	38.9	10.8	0	3.13	0	3.3
	Notional	0	533	0	41.1	10.8	0	3.6	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	9.6	0	3.1	0	9.2	0.86	0	0.91	0
	Notional	10.9	0	3.7	0	10.9	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	85.8	0	27.6	0	2.5	0.86	0	0.91	0
	Notional	10.9	0	3.7	0	3	0.82	0	----	----
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	4.8	0	1.6	0	4.1	0.86	0	0.91	0
	Notional	2.4	0	0.8	0	2.9	0.82	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	90.8	0	29.2	0	1.1	0.86	0	0.91	0
	Notional	117.6	0	39.9	0	1.1	0.82	0	----	----

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	0.18	External Wall Resi 0.4
Floor	0.2	0.22	Ground Floor (Bmt)
Roof	0.15	0.16	Offices Roof/Internal Floor/Ceiling (No Ins)
Windows, roof windows, and rooflights	1.5	1.23	Resi Glazing 3.6 West
Personnel doors	1.5	1.3	2-5F vent
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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	3.03

BRUKL Output Document

Compliance with England Building Regulations Part L 2013

HM Government

Project name

247 TCR - Offices VRF Green

As designed

Date: Thu Jul 23 10:27:38 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jeremy Holgate

Telephone number: 01932753

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

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	18.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	18.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	10
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	0.23	0.23	Basement Walls
Floor	0.25	0.22	0.22	Ground Floor (Bmt)
Roof	0.25	0.21	0.21	Roof
Windows***, roof windows, and rooflights	2.2	1.49	1.5	G Single (1.7 x 2.6)
Personnel doors	2.2	1.32	1.37	1F vent
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* 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	3

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- Extract only with adjacent heat (14 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	-	-	-	-
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.

2- VRF Central MVHR Large spaces (46 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	5.8	-	1.9	0.75
Standard value	2.5*	2.6	N/A	1.6^	0.65
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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

3- VRF Zonal MVHR small spaces (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	5.8	-	1.9	0.75
Standard value	2.5*	2.6	N/A	1.6^	0.65
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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

4- MVHR Heat Only (19 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	-	-	1.1	0.75
Standard value	2.5*	N/A	N/A	1.1^	0.65
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.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- NatVent Electric

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

6- Extract only Electric (B1_Toilet FlrRoof 1)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- DHW 1800ltr ASHP&ELEC

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.07	0
Standard value	2*	N/A
* Standard shown is for all types except absorption and gas engine heat pumps.		

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
B1_Toilet FlrG 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet FlrG 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr1 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr1 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr2 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr2 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr3 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr3 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr4 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr4 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr5 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Flr5 2	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet FlrG 3	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet Bmt 1	-	-	0.5	-	-	-	-	-	-	-	N/A
B1_Toilet FlrRoof 1	0.3	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1_Office Flr1 1	120	-	-	2386
B1_Office Flr1 2	120	-	-	1309

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1_Office Flr1 3	120	-	-	670
B1_Office Flr1 4	120	-	-	1829
B1_Reception 1	-	120	80	29
B1_Circulation (Staircase) 1	-	80	-	38
B1_Circulation (Staircase) 2	-	80	-	39
B1_Circulation (Staircase) 3	-	80	-	38
B1_Circulation (Staircase) 4	-	80	-	39
B1_Circulation (Staircase) 5	-	80	-	40
B1_Circulation (Staircase) 6	-	80	-	42
B1_Circulation (Staircase) 7	-	80	-	41
B1_Circulation (Staircase) 8	-	80	-	40
B1_Circulation (Staircase) 9	-	80	-	39
B1_Circulation (Staircase) 10	-	80	-	37
B1_Circulation (Staircase) 11	-	80	-	36
B1_Circulation (Staircase) 12	-	80	-	37
B1_Circulation (Staircase) 13	-	80	-	36
B1_Circulation (Staircase) 14	-	80	-	37
B1_Circulation (Staircase) 15	-	80	-	36
B1_Circulation (Staircase) 16	-	80	-	38
B1_Circulation (Staircase) 17	-	80	-	37
B1_Circulation (Staircase) 18	-	80	-	35
B1_Circulation (Staircase) 19	-	80	-	36
B1_Toilet FlrG 1	-	80	-	47
B1_Toilet FlrG 2	-	80	-	33
B1_Office Misc 1 (Security)	100	-	-	130
B1_Store F	80	-	-	34
B1_Changing (Basement) 1 (Changing)	-	80	-	32
B1_Changing (Basement) 2 (Changing)	-	80	-	17
B1_Changing (Basement) 4 (Changing)	-	80	-	31
B1_Store 3 (Cycle B1)	80	-	-	129
B1_Circulation Basement 1	-	80	-	14
B1_Circulation Basement 2	-	80	-	13
B1_Circulation Basement 3	-	80	-	42
B1_Circulation Basement 4	-	80	-	31
B1_Circulation Basement 5	-	80	-	192
B1_Circulation Basement 6	-	80	-	62
B1_Circulation Basement 7	-	80	-	32
B1_Circulation Basement 8	-	80	-	32
B1_Plant 1	80	-	-	496
B1_Plant 2	80	-	-	815
B1_Plant 3	80	-	-	125
B1_Plant 4	80	-	-	131
B1_Store 5 (Refuse)	80	-	-	28

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1_Circulation Flr1 1	-	80	-	39
B1_Circulation Flr1 3	-	80	-	33
B1_Office Flr2 1	120	-	-	2218
B1_Office Flr2 2	120	-	-	1305
B1_Office Flr2 3	120	-	-	668
B1_Office Flr2 4	120	-	-	1416
B1_Office Flr3 1	120	-	-	2218
B1_Office Flr3 2	120	-	-	1305
B1_Office Flr3 3	120	-	-	668
B1_Office Flr3 4	120	-	-	1416
B1_Office Flr4 1	120	-	-	2788
B1_Office Flr4 3	120	-	-	302
B1_Office Flr4 4	120	-	-	668
B1_Office Flr4 5	120	-	-	1416
B1_Office Flr5 1	120	-	-	1587
B1_Office Flr5 2	120	-	-	1427
B1_Office Flr5 3	120	-	-	563
B1_Office Flr5 4	120	-	-	1417
B1_Office FlrG 1	120	-	-	571
B1_Circulation Flr2 1	-	80	-	35
B1_Circulation Flr2 2	-	80	-	23
B1_Circulation Flr2 3	-	80	-	29
B1_Circulation FlrG 1	-	80	-	105
B1_Circulation FlrG 2	-	80	-	28
B1_Circulation FlrG 3	-	80	-	163
B1_Circulation FlrG 4	-	80	-	27
B1_Circulation FlrG 5	-	80	-	26
B1_Circulation FlrG 6	-	80	-	61
B1_Circulation Flr3 1	-	80	-	35
B1_Circulation Flr3 2	-	80	-	23
B1_Circulation Flr3 3	-	80	-	29
B1_Circulation Flr4 1	-	80	-	35
B1_Circulation Flr4 2	-	80	-	23
B1_Circulation Flr4 3	-	80	-	29
B1_Toilet Flr1 1	-	80	-	100
B1_Toilet Flr1 2	-	80	-	146
B1_Toilet Flr2 1	-	80	-	95
B1_Toilet Flr2 2	-	80	-	92
B1_Toilet Flr3 1	-	80	-	95
B1_Toilet Flr3 2	-	80	-	92
B1_Toilet Flr4 1	-	80	-	95
B1_Toilet Flr4 2	-	80	-	92
B1_Toilet Flr5 1	-	80	-	96

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1_Toilet Flr5 2	-	80	-	93
B1_Circulation Flr5 1	-	80	-	36
B1_Circulation Flr5 2	-	80	-	24
B1_Circulation Flr5 3	-	80	-	30
B1_Office FlrBmt 1	120	-	-	1449
B1_Store M	80	-	-	32
B1_Circulation FlrRoof 3	-	80	-	18
B1_Toilet FlrG 3	-	80	-	70
Cafe 1	-	100	-	220
B1_Circulation FlrG 21	-	80	-	26
B1_Toilet Bmt 1	-	80	-	43
B1_Circulation (Staircase) 20	-	80	-	44
B1_Changing (Basement) 3 (Changing)	-	80	-	17
B1_Office FlrG 2	120	-	-	871
B1_Circulation (Staircase) 21	-	80	-	42
Cafe 2	-	100	-	31
B1_Toilet FlrRoof 1	-	80	-	47
B1_Circulation FlrRoof 23	-	80	-	34

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?
B1_Office Flr1 1	NO (-87%)	NO
B1_Office Flr1 2	NO (-63%)	NO
B1_Office Flr1 3	NO (-64%)	NO
B1_Office Flr1 4	NO (-50%)	NO
B1_Reception 1	NO (-86%)	NO
B1_Office Misc 1 (Security)	N/A	N/A
B1_Circulation Flr1 1	N/A	N/A
B1_Circulation Flr1 3	N/A	N/A
B1_Office Flr2 1	NO (-91%)	NO
B1_Office Flr2 2	NO (-66%)	NO
B1_Office Flr2 3	NO (-67%)	NO
B1_Office Flr2 4	NO (-56%)	NO
B1_Office Flr3 1	NO (-91%)	NO
B1_Office Flr3 2	NO (-66%)	NO
B1_Office Flr3 3	NO (-67%)	NO
B1_Office Flr3 4	NO (-56%)	NO
B1_Office Flr4 1	NO (-53%)	NO
B1_Office Flr4 3	NO (-73%)	NO
B1_Office Flr4 4	NO (-66%)	NO
B1_Office Flr4 5	NO (-55%)	NO
B1_Office Flr5 1	NO (-90%)	NO
B1_Office Flr5 2	NO (-64%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Office Flr5 3	NO (-66%)	NO
B1_Office Flr5 4	NO (-58%)	NO
B1_Office FlrG 1	NO (-51%)	NO
B1_Circulation Flr2 1	N/A	N/A
B1_Circulation Flr2 2	N/A	N/A
B1_Circulation Flr2 3	N/A	N/A
B1_Circulation FlrG 1	NO (-38%)	NO
B1_Circulation FlrG 2	NO (-92%)	NO
B1_Circulation FlrG 3	NO (-58%)	NO
B1_Circulation FlrG 4	NO (-74%)	NO
B1_Circulation FlrG 5	N/A	N/A
B1_Circulation FlrG 6	N/A	N/A
B1_Circulation Flr3 1	N/A	N/A
B1_Circulation Flr3 2	N/A	N/A
B1_Circulation Flr3 3	N/A	N/A
B1_Circulation Flr4 1	N/A	N/A
B1_Circulation Flr4 2	N/A	N/A
B1_Circulation Flr4 3	N/A	N/A
B1_Circulation Flr5 1	N/A	N/A
B1_Circulation Flr5 2	N/A	N/A
B1_Circulation Flr5 3	N/A	N/A
B1_Office FlrBmt 1	N/A	N/A
B1_Circulation FlrRoof 3	N/A	N/A
Cafe 1	NO (-54%)	NO
B1_Office FlrG 2	NO (-90%)	NO
Cafe 2	NO (-66%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	8096	8096
External area [m^2]	4746	4746
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	2683	2246
Average U-value [W/m^{2}K]	0.57	0.47
Alpha value* [%]	17.94	17.94

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**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
	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	0.49	0.45
Cooling	3.93	11
Auxiliary	6.6	3.32
Lighting	8.4	18.82
Hot water	4	3.51
Equipment*	44.71	44.7
TOTAL**	**23.42**	**37.1**

* 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	3.62	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]	88.27	153.61
Primary energy* [kWh/m^2]	70.09	108.6
Total emissions [kg/m^2]	10	18.5

* 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] Other local room heater - unfanned, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	10.5	0	0.7	0	8.4	4	0	4	0
	Notional	11.9	0	1.6	0	10	2.1	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	6.2	98.2	0.4	4.7	7.5	4	5.8	4	5.8
	Notional	3.3	180.2	0.4	13.9	3.7	2.43	3.6	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	19.1	318	1.3	15.2	7.6	4	5.8	4	5.8
	Notional	21.3	434	2.4	33.5	3.7	2.43	3.6	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	5.9	0	0.4	0	1.4	4	0	4	0
	Notional	2.5	0	0.3	0	1.6	2.43	0	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	29.3	0	8.1	0	0	1	0	1	0
	Notional	29.8	0	10.1	0	0	0.82	0	----	----
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Electricity										
	Actual	86.1	0	23.9	0	8	1	0	1	0
	Notional	11.9	0	1.6	0	10.6	2.1	0	----	----

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	0.18	External Wall Resi 0.4
Floor	0.2	0.22	Ground Floor (Bmt)
Roof	0.15	0.16	Offices Roof/Internal Floor/Ceiling (No Ins)
Windows, roof windows, and rooflights	1.5	1.23	Resi Glazing 3.6 West
Personnel doors	1.5	1.3	2-5F vent
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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	3

Appendix 2 – Retail BRUKL Reports

BRUKL – Lean Scheme

BRUKL - Green Scheme

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

247 TCR S&C Retail FCU Lean

As designed

Date: Tue Jun 30 18:38:29 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jeremy Holgate

Telephone number: 01932753

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	45.1
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	45.1
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	50.5
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	0.23	0.23	External Wall Office
Floor	0.25	0.22	0.22	Ground Floor (Bmt)
Roof	0.25	-	-	No roofs in project
Windows***, roof windows, and rooflights	2.2	1.5	1.5	G Single Doors (.85 x 2.6) (Display)
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* 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	3

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- FCU Retail S&C (3 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	3.3	-	1.9	0.75
Standard value	0.91*	2.55	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- New HWS Circuit

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	0.91	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

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**
Retail 1	-	-	-	-	-	-	-	0.3	-	-	N/A
Retail 2	-	-	-	-	-	-	-	0.3	-	-	N/A
Retail 21	-	-	-	-	-	-	-	0.3	-	-	N/A

Shell and core configuration

Zone	**Assumed shell?**
Retail 1	YES
Retail 2	YES
Retail 21	YES

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 1	-	60	60	5698

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 2	-	60	60	3670
Retail 21	-	60	60	6875

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?
Retail 1	YES (+98%)	NO
Retail 2	YES (+344%)	NO
Retail 21	N/A	N/A

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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1092	1092
External area [m^2]	1001	1001
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	1044	482
Average U-value [W/m^{2}K]	1.04	0.48
Alpha value* [%]	16.03	16.03

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	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
	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	3.7	0.54
Cooling	16.18	18.42
Auxiliary	24.09	15.41
Lighting	57.09	54.16
Hot water	1.86	1.86
Equipment*	20.26	20.26
TOTAL**	**102.92**	**90.4**

* 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]	204.34	252.97
Primary energy* [kWh/m^2]	298.2	266.32
Total emissions [kg/m^2]	50.5	45.1

* 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] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	12.1	192.2	3.9	17	25.4	0.86	3.13	0.91	3.3
	Notional	1.7	251.3	0.6	19.4	16.2	0.82	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	0.23	External Wall Office
Floor	0.2	0.22	Ground Floor (Bmt)
Roof	0.15	-	No roofs in project
Windows, roof windows, and rooflights	1.5	1.5	G Single 0.3
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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**
$m^3/(h.m^2)$ at 50 Pa	5	3

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

247 TCR S&C Retail VRF Green

As designed

Date: Tue Jun 30 18:36:01 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Jeremy Holgate

Telephone number: 01932753

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	39.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	39.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	41.1
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	0.23	0.23	External Wall Office
Floor	0.25	0.22	0.22	Ground Floor (Bmt)
Roof	0.25	-	-	No roofs in project
Windows***, roof windows, and rooflights	2.2	1.5	1.5	G Single Doors (.85 x 2.6) (Display)
Personnel doors	2.2	-	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* 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	3

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF MVHR Zonal Retail S&C (3 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.26	4.4	-	-	0.75
Standard value	2.5*	2.55	N/A	N/A	0.65
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- POU HWS 200 Lt

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	0.01
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

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**
Retail 1	-	-	-	1.9	-	-	-	-	-	-	N/A
Retail 2	-	-	-	1.9	-	-	-	-	-	-	N/A
Retail 21	-	-	-	1.9	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	**Assumed shell?**
Retail 1	YES
Retail 2	YES
Retail 21	YES

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 1	-	60	60	5698

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Retail 2	-	60	60	3670
Retail 21	-	60	60	6875

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?
Retail 1	YES (+98%)	NO
Retail 2	YES (+344%)	NO
Retail 21	N/A	N/A

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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	1092	1092
External area [m^2]	1001	1001
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	1044	482
Average U-value [W/m^{2}K]	1.04	0.48
Alpha value* [%]	16.03	16.03

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	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
	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	1.03	0.18
Cooling	12.13	18.42
Auxiliary	8.92	4.15
Lighting	57.09	54.16
Hot water	2.06	1.86
Equipment*	20.26	20.26
TOTAL**	**81.23**	**78.77**

* 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]	204.34	253.01
Primary energy* [kWh/m^2]	243.15	232.26
Total emissions [kg/m^2]	41.1	39.5

* 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	12.1	192.2	1	12.1	8.9	3.26	4.4	3.26	4.4
	Notional	1.7	251.3	0.2	19.4	4.4	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	0.23	External Wall Office
Floor	0.2	0.22	Ground Floor (Bmt)
Roof	0.15	-	No roofs in project
Windows, roof windows, and rooflights	1.5	1.5	G Single 0.3
Personnel doors	1.5	-	No personal doors in project
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = 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**
$m^3/(h.m^2)$ at 50 Pa	5	3

Appendix 3 – Residential SAP Worksheets

DER-TER Calculations – Lean Scheme

DER-TER Calculations - Green Scheme

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A1-F1	Issued on Date	24/07/2020
Assessment Reference	A1-F1	Prop Type Ref	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	84 B	DER	16.82	TER	17.19
Environmental	86 B	% DER<TER	2.17		
CO_2 Emissions (t/year)	1.43	DFEE	49.60	TFEE	53.61
General Requirements Compliance	Pass	% DFEE<TFEE	7.48		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	Assessor ID	T613-0001
Client	CO-RE, 4650		

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 106 m^2

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.19 $kgCO_2/m^2$
Dwelling Carbon Dioxide Emission Rate (DER) 16.82 $kgCO_2/m^2$OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.6 kWh/m^2/yr
Dwelling Fabric Energy Efficiency (DFEE)49.6 kWh/m^2/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.09 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC plus 825 VUW 196/5-5 (H-GB) R6
Combi boiler
Efficiency: 89.5% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls

Space heating controls:	Programmer, room thermostat and TRVs	OK
Hot water controls:	No cylinder	
Boiler interlock	Yes	OK

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

8 Mechanical ventilation
Continuous supply and extract system

Specific fan power:	0.66	
Maximum	1.5	OK
MVHR efficiency:	85%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Medium	OK
Based on:		
Overshading:	Average	
Windows facing North East:	22.95 m^2, No overhang	
Windows facing South East:	6.57 m^2, No overhang	
Air change rate:	3.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

10 Key features

External wall U-value	0.13 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Floor U-value	0.11 W/m^2K
Exposed floor U-value	0.11 W/m^2K
Air permeability	3.0 m^3/m^2h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)			Storey height (m)			Volume (m3)	
Ground floor		106.0000	(1b)	x	2.8000	(2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.0000								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	296.8000	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			3.0000	
Infiltration rate			0.1500	(18)
Number of sides sheltered			4	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 72.2500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2726	0.2700	0.2674	0.2543	0.2516	0.2385	0.2385	0.2359	0.2438	0.2516	0.2569	0.2621	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			29.5200	1.2357	36.4791			(27)
Heat Loss Floor 2			74.2000	0.1100	8.1620			(28a)
Heat Loss Floor 1			31.8000	0.0550	1.7490			(28b)
External Wall 1	75.0200	29.5200	45.5000	0.1300	5.9150			(29a)
Total net area of external elements Aum(A, m2)			181.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.3051			(33)
Party Wall 1			15.0100	0.0000	0.0000			(32)
Party Wall 2			28.4800	0.0000	0.0000			(32)
Party Wall 3			43.5400	0.0000	0.0000			(32)
Party Ceilings 1			106.0000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area) 27.1530 (36)
Total fabric heat loss (33) + (36) = 79.4581 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.7020	26.4449	26.1878	24.9023	24.6452	23.3596	23.3596	23.1025	23.8739	24.6452	25.1594	25.6736	(38)
Heat transfer coeff	106.1601	105.9030	105.6459	104.3603	104.1032	102.8177	102.8177	102.5606	103.3319	104.1032	104.6175	105.1317	(39)
Average = Sum(39)m / 12 =												104.2961	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0015	0.9991	0.9967	0.9845	0.9821	0.9700	0.9700	0.9676	0.9748	0.9821	0.9870	0.9918	(40)
HLP (average)												0.9839	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7886 (42)
Average daily hot water use (litres/day) 105.7140 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	116.2854	112.0569	107.8283	103.5998	99.3712	95.1426	95.1426	99.3712	103.5998	107.8283	112.0569	116.2854	(44)
Energy conte	172.4480	150.8241	155.6369	135.6881	130.1959	112.3492	104.1080	119.4655	120.8923	140.8883	153.7906	167.0066	(45)
Energy content (annual)										Total = Sum(45)m =		1663.2935	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m													
	25.8672	22.6236	23.3455	20.3532	19.5294	16.8524	15.6162	17.9198	18.1338	21.1332	23.0686	25.0510	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.6385	46.9197	48.4836	50.6385	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	223.4069	196.8515	206.5958	185.0031	180.8344	159.2688	152.5917	170.1040	170.2074	191.8472	203.1057	217.9655	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	223.4069	196.8515	206.5958	185.0031	180.8344	159.2688	152.5917	170.1040	170.2074	191.8472	203.1057	217.9655	(64)
Total per year (kWh/year) = Sum(64)m =												2257.7820	(64)
Heat gains from water heating, kWh/month													
	70.0787	61.6559	64.4890	57.4450	55.9498	49.0860	46.7368	52.3819	52.5255	59.5851	63.4641	68.2694	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)													
	94.1918	91.7498	86.6788	79.7848	75.2013	68.1750	62.8183	70.4058	72.9520	80.0875	88.1446	91.7600	(72)
Total internal gains													
	451.3844	449.0511	433.1042	407.2639	380.7403	354.6590	338.2381	345.7169	359.1391	385.2209	415.2181	437.8885	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	22.9500	11.2829	0.6000	0.9000	0.7700	96.9018	(75)
Southeast	6.5700	36.7938	0.6000	0.9000	0.7700	90.4623	(77)

Solar gains	187.3641	351.3372	566.2090	844.8616	1077.1141	1126.8589	1062.4692	880.4026	661.3187	411.3539	230.2805	156.5518	(83)
Total gains	638.7485	800.3883	999.3132	1252.1255	1457.8544	1481.5179	1400.7074	1226.1195	1020.4578	796.5748	645.4987	594.4403	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	69.3397	69.5081	69.6772	70.5355	70.7097	71.5938	71.5938	71.7733	71.2375	70.7097	70.3622	70.0180	
alpha	5.6226	5.6339	5.6451	5.7024	5.7140	5.7729	5.7729	5.7849	5.7492	5.7140	5.6908	5.6679	
util living area													
	0.9979	0.9925	0.9669	0.8544	0.6411	0.4419	0.3227	0.3838	0.6693	0.9476	0.9945	0.9986	(86)
MIT	19.9660	20.1703	20.4844	20.8237	20.9694	20.9969	20.9996	20.9989	20.9725	20.7003	20.2583	19.9303	(87)
Th 2	20.0821	20.0841	20.0861	20.0962	20.0983	20.1084	20.1084	20.1105	20.1044	20.0983	20.0942	20.0902	(88)
util rest of house													
	0.9973	0.9900	0.9568	0.8199	0.5864	0.3814	0.2575	0.3101	0.5939	0.9262	0.9924	0.9982	(89)
MIT 2	19.1365	19.3410	19.6493	19.9666	20.0805	20.1072	20.1083	20.1102	20.0912	19.8688	19.4378	19.1074	(90)
Living area fraction									fLA = Living area / (4) =			0.5218	(91)
MIT	19.5693	19.7738	20.0851	20.4138	20.5443	20.5714	20.5734	20.5739	20.5511	20.3027	19.8660	19.5368	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.4193	19.6238	19.9351	20.2638	20.3943	20.4214	20.4234	20.4239	20.4011	20.1527	19.7160	19.3868	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9885	0.9548	0.8267	0.6047	0.4027	0.2805	0.3362	0.6197	0.9277	0.9912	0.9977	(94)
Useful gains	636.5811	791.1821	954.1267	1035.1909	881.6245	596.6360	392.9269	412.1932	632.4014	738.9801	639.8210	593.0586	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1605.0684	1559.2890	1419.3612	1185.9349	905.1045	598.5458	393.1114	412.6967	651.1001	994.4683	1319.8499	1596.6112	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	720.5546	516.1678	346.1345	108.5357	17.4691	0.0000	0.0000	0.0000	0.0000	190.0832	489.6208	746.6432	(98)
Space heating												3135.2088	(98)
Space heating per m2											(98) / (4) =	29.5774	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	966.4867	760.8512	779.4608	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9880	0.9951	0.9900	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	954.8975	757.1597	771.6758	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1830.1605	1733.6927	1530.9807	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	630.1894	726.5405	564.9228	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1921.6527	(104)
Cooled fraction									fC = cooled area / (4) =			0.6902	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	108.7374	125.3625	97.4758	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												331.5757	(107)
Space cooling per m2												3.1281	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3468.1513	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	720.5546	516.1678	346.1345	108.5357	17.4691	0.0000	0.0000	0.0000	0.0000	190.0832	489.6208	746.6432	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	797.0736	570.9821	382.8921	120.0616	19.3242	0.0000	0.0000	0.0000	0.0000	210.2690	541.6159	825.9327	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	223.4069	196.8515	206.5958	185.0031	180.8344	159.2688	152.5917	170.1040	170.2074	191.8472	203.1057	217.9655	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7868	87.3662	86.3409	83.7602	81.0982	80.3000	80.3000	80.3000	80.3000	85.0280	87.1848	87.9017	(217)
Fuel for water heating, kWh/month	254.4881	225.3177	239.2793	220.8724	222.9820	198.3423	190.0270	211.8356	211.9643	225.6284	232.9599	247.9650	(219)
Water heating fuel used												2681.6620	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	27.1843	31.3406	24.3690	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												82.8939	(221)

Annual totals kWh/year		
Space heating fuel - main system	3468.1513	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	298.7292	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	373.7292	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	7024.7290	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3468.1513	0.2160	749.1207	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2681.6620	0.2160	579.2390	(264)
Space and water heating			1328.3597	(265)
Space cooling	82.8939	0.5190	43.0220	(266)
Pumps and fans	373.7292	0.5190	193.9655	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/year			1782.4409	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.8200	(273)

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

DER		16.8200	ZC1
Total Floor Area	TFA	106.0000	
Assumed number of occupants	N	2.7886	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8524	ZC2
CO2 emissions from cooking, equation (L16)		1.7540	ZC3
Total CO2 emissions		33.4264	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.4264	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)			Storey height (m)			Volume (m3)	
Ground floor		106.0000	(1b)	x	2.8000	(2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.0000								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	296.8000	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1348	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3848	(18)
Number of sides sheltered			4	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.2693	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3434	0.3367	0.3299	0.2963	0.2895	0.2559	0.2559	0.2491	0.2693	0.2895	0.3030	0.3165	(22b)
Effective ac	0.5590	0.5567	0.5544	0.5439	0.5419	0.5327	0.5327	0.5310	0.5363	0.5419	0.5459	0.5501	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			26.5100	1.3258	35.1458			(27)
Heat Loss Floor 2			74.2000	0.1300	9.6460			(28a)
Heat Loss Floor 1			31.8000	0.1300	4.1340			(28b)
External Wall 1	75.0200	29.5200	45.5000	0.1800	8.1900			(29a)
Total net area of external elements Aum(A, m2)			178.0100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.1158			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		8.9005	(36)
Total fabric heat loss	(33) + (36) =	66.0163	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.7472	54.5230	54.3031	53.2707	53.0775	52.1782	52.1782	52.0117	52.5246	53.0775	53.4683	53.8768	(38)
Heat transfer coeff	120.7636	120.5393	120.3195	119.2870	119.0938	118.1946	118.1946	118.0280	118.5409	119.0938	119.4846	119.8932	(39)
Average = Sum(39)m / 12 =												119.2861	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1393	1.1372	1.1351	1.1253	1.1235	1.1150	1.1150	1.1135	1.1183	1.1235	1.1272	1.1311	(40)
HLP (average)												1.1253	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7886	(42)
Average daily hot water use (litres/day)	100.4283	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4712	106.4540	102.4369	98.4198	94.4026	90.3855	90.3855	94.4026	98.4198	102.4369	106.4540	110.4712	(44)
Energy conte	163.8256	143.2829	147.8551	128.9037	123.6861	106.7317	98.9026	113.4922	114.8477	133.8439	146.1011	158.6563	(45)
Energy content (annual)										Total = Sum(45)m =		1580.1288	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5738	21.4924	22.1783	19.3355	18.5529	16.0098	14.8354	17.0238	17.2272	20.0766	21.9152	23.7984	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.5358	48.1065	44.5737	46.0595	48.1065	48.5358	50.9589	49.3151	50.9589	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total heat required for water heating calculated for each month	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(64)
Total per year (kWh/year) = Sum(64)m =												2163.2247	(64)
Heat gains from water heating, kWh/month	67.2117	59.1484	61.9015	54.9944	53.1523	46.6317	44.4000	49.7628	50.3208	57.2428	60.9074	65.4929	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)	90.3383	88.0185	83.2010	76.3811	71.4412	64.7663	59.6774	66.8855	69.8900	76.9393	84.5936	88.0282	(72)
Total internal gains	447.5310	445.3198	429.6264	403.8602	376.9802	351.2502	335.0972	342.1966	356.0771	382.0727	411.6671	434.1567	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	20.6100	11.2829	0.6300	0.7000	0.7700	71.0677	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	137.4113	257.6680	415.2539	619.6166	789.9498	826.4326	779.2095	645.6823	485.0070	301.6839	168.8858	114.8137	(83)
Total gains	584.9423	702.9878	844.8803	1023.4768	1166.9300	1177.6828	1114.3067	987.8789	841.0840	683.7566	580.5529	548.9704	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.9547	61.0681	61.1797	61.7092	61.8093	62.2796	62.2796	62.3675	62.0976	61.8093	61.6072	61.3973	
alpha	5.0636	5.0712	5.0786	5.1139	5.1206	5.1520	5.1520	5.1578	5.1398	5.1206	5.1071	5.0932	
util living area	0.9987	0.9963	0.9869	0.9429	0.8140	0.6172	0.4618	0.5380	0.8252	0.9780	0.9970	0.9990	(86)
MIT	19.7282	19.8985	20.1908	20.5743	20.8596	20.9736	20.9951	20.9898	20.8896	20.4927	20.0373	19.6968	(87)
Th 2	19.9689	19.9706	19.9723	19.9802	19.9817	19.9886	19.9886	19.9898	19.9859	19.9817	19.9787	19.9755	(88)
util rest of house	0.9982	0.9950	0.9822	0.9228	0.7592	0.5301	0.3582	0.4258	0.7503	0.9670	0.9957	0.9987	(89)
MIT 2	18.2678	18.5175	18.9428	19.4884	19.8508	19.9721	19.9868	19.9858	19.8989	19.3869	18.7267	18.2266	(90)
Living area fraction									fLA = Living area / (4) =			0.5218	(91)
MIT	19.0298	19.2381	19.5940	20.0550	20.3772	20.4947	20.5129	20.5097	20.4158	19.9639	19.4106	18.9937	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0298	19.2381	19.5940	20.0550	20.3772	20.4947	20.5129	20.5097	20.4158	19.9639	19.4106	18.9937	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9938	0.9800	0.9245	0.7819	0.5748	0.4124	0.4846	0.7848	0.9667	0.9947	0.9982	(94)
Useful gains	583.5343	698.6141	827.9503	946.2247	912.4366	676.8952	459.5591	478.6798	660.1122	661.0092	577.4958	548.0044	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1778.8255	1728.3075	1575.4624	1330.6479	1033.3985	696.7189	462.4874	485.0576	748.6860	1115.1811	1470.9254	1773.6687	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	889.2966	691.9540	556.1491	276.7847	89.9956	0.0000	0.0000	0.0000	0.0000	337.9039	643.2693	911.8943	(98)
Space heating												4397.2475	(98)
Space heating per m2											(98) / (4) =	41.4835	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4707.9737	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	889.2966	691.9540	556.1491	276.7847	89.9956	0.0000	0.0000	0.0000	0.0000	337.9039	643.2693	911.8943	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	952.1377	740.8501	595.4487	296.3433	96.3551	0.0000	0.0000	0.0000	0.0000	361.7815	688.7252	976.3322	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2409	88.0217	87.5017	86.1663	83.5074	80.3000	80.3000	80.3000	80.3000	86.5512	87.8261	88.3236	(217)
Fuel for water heating, kWh/month	243.4070	215.0722	227.2116	205.9268	205.7216	188.4252	180.5256	201.2438	203.4663	213.5185	222.5035	237.3263	(219)

Water heating fuel used	2544.3484	(219)
Annual totals kWh/year		
Space heating fuel - main system	4707.9737	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	7745.6147	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4707.9737	0.2160	1016.9223	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2544.3484	0.2160	549.5793	(264)
Space and water heating			1566.5016	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/m2/year			1822.5204	(272)
Emissions per m2 for space and water heating			14.7783	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0481	(272b)
Emissions per m2 for pumps and fans			0.3672	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7783 * 1.00) + 2.0481 + 0.3672, rounded to 2 d.p.			17.1900	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A2-F2	**Issued on Date**	24/07/2020
Assessment Reference	A2-F2	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	86 B	**DER**	13.23	**TER**	14.81
Environmental	89 B	**% DER<TER**	10.65		
CO_2 Emissions (t/year)	1.16	**DFEE**	35.06	**TFEE**	41.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.06		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 106 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 14.81 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.23 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)41.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)35.1 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.13 (max. 0.30)        0.13 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.30 (max. 2.00)        1.30 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                                OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC plus 825 VUW 196/5-5 (H-GB) R6
Combi boiler
Efficiency: 89.5% SEDBUK2009
Minimum: 88.0%                                    OK

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer, room thermostat and TRVs                OK


Hot water controls:                     No cylinder


Boiler interlock                        Yes                                                 OK
----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                 OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.66
Maximum                                 1.5                                                 OK
MVHR efficiency:                        85%
Minimum:                                70%                                                 OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                              OK
Based on:
Overshading:                            Average
Windows facing North East:              20.83 m², No overhang
Windows facing South East:              5.96 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Light-coloured venetian blind, closed 50% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Party wall U-value                      0.00 W/m²K
Party wall U-value                      0.00 W/m²K
Air permeability                        3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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------------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
------------------------------------------------------------------------------------------------------
                                                                                Area         Storey height              Volume
                                                                                (m2)              (m)                   (m3)
Ground floor                                                                106.0000 (1b)    x       2.8000 (2b)    =     296.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            106.0000                                                   (4)
Dwelling volume                                                                    (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     296.8000 (5)



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

                                                                                                                Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                 0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                      Yes
Measured/design AP50                                                                                                            3.0000
Infiltration rate                                                                                                               0.1500 (18)
Number of sides sheltered                                                                                                            4 (19)

Shelter factor                                                                           (20) = 1  -  [0.075 x (19)]  =      0.7000 (20)
Infiltration rate adjusted to include shelter factor                                               (21) = (18) x (20)  =      0.1050 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1339     0.1313     0.1286     0.1155     0.1129     0.0998     0.0998     0.0971     0.1050     0.1129     0.1181     0.1234 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                      0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                   72.2500 (23c)

Effective ac     0.2726     0.2700     0.2674     0.2543     0.2516     0.2385     0.2385     0.2359     0.2438     0.2516     0.2569     0.2621 (25)



------------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
------------------------------------------------------------------------------------------------------
Element                                         Gross        Openings         NetArea        U-value         A x U        K-value         A x K
                                                   m2              m2              m2           W/m2K           W/K         kJ/m2K          kJ/K
Opening Type 1 (Uw = 1.30)                                                    26.7900         1.2357       33.1055                                  (27)
External Wall 1                                72.3200         26.7900        45.5300         0.1300        5.9189                                  (29a)
Total net area of external elements Aum(A, m2)                                72.3200                                                               (31)
Fabric heat loss, W/K = Sum (A x U)                                                (26)...(30) + (32) =     39.0244                                  (33)
Party Wall 1                                                                  15.0400         0.0000        0.0000                                  (32)
Party Wall 2                                                                  28.4800         0.0000        0.0000                                  (32)
Party Wall 3                                                                  43.5400         0.0000        0.0000                                  (32)
Party Floor 1                                                                106.0000                                                               (32d)
Party Ceilings 1                                                             106.0000                                                               (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                             250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area)                                                                     10.8480 (36)
Total fabric heat loss                                                                                        (33) + (36) =    49.8724 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          26.7020    26.4449    26.1878    24.9023    24.6452    23.3596    23.3596    23.1025    23.8739    24.6452    25.1594    25.6736 (38)
Heat transfer coeff
               76.5744    76.3173    76.0602    74.7747    74.5176    73.2321    73.2321    72.9750    73.7463    74.5176    75.0318    75.5460 (39)
Average = Sum(39)m / 12 =                                                                                                     74.7104 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.7224     0.7200     0.7175     0.7054     0.7030     0.6909     0.6909     0.6884     0.6957     0.7030     0.7078     0.7127 (40)
HLP (average)                                                                                                                  0.7048 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



------------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
------------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                              2.7886 (42)
Average daily hot water use (litres/day)                                                                                     105.7140 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               116.2854   112.0569   107.8283   103.5998    99.3712    95.1426    95.1426    99.3712   103.5998   107.8283   112.0569   116.2854 (44)
Energy conte   172.4480   150.8241   155.6369   135.6881   130.1959   112.3492   104.1080   119.4655   120.8923   140.8883   153.7906   167.0066 (45)
Energy content (annual)                                                                                      Total = Sum(45)m =   1663.2935 (45)
Distribution loss  (46)m = 0.15 x (45)m
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	25.8672	22.6236	23.3455	20.3532	19.5294	16.8524	15.6162	17.9198	18.1338	21.1332	23.0686	25.0510	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.6385	46.9197	48.4836	50.6385	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	223.4069	196.8515	206.5958	185.0031	180.8344	159.2688	152.5917	170.1040	170.2074	191.8472	203.1057	217.9655	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	223.4069	196.8515	206.5958	185.0031	180.8344	159.2688	152.5917	170.1040	170.2074	191.8472	203.1057	217.9655	(64)
Total per year (kWh/year) = Sum(64)m =												2257.7820	(64)
Heat gains from water heating, kWh/month	70.0787	61.6559	64.4890	57.4450	55.9498	49.0860	46.7368	52.3819	52.5255	59.5851	63.4641	68.2694	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)	94.1918	91.7498	86.6788	79.7848	75.2013	68.1750	62.8183	70.4058	72.9520	80.0875	88.1446	91.7600	(72)
Total internal gains	451.3844	449.0511	433.1042	407.2639	380.7403	354.6590	338.2381	345.7169	359.1391	385.2209	415.2181	437.8885	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	20.8300	11.2829	0.6000	0.9000	0.7700	87.9506	(75)
Southeast	5.9600	36.7938	0.6000	0.9000	0.7700	82.0632	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	170.0137	318.8098	513.8062	766.6946	977.4780	1022.6287	964.1919	798.9546	600.1219	373.2749	208.9573	142.0538	(83)
Total gains	621.3982	767.8610	946.9104	1173.9584	1358.2183	1377.2876	1302.4300	1144.6715	959.2610	758.4958	624.1755	579.9423	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	96.1302	96.4540	96.7801	98.4439	98.7836	100.5176	100.5176	100.8717	99.8167	98.7836	98.1066	97.4388	
alpha	7.4087	7.4303	7.4520	7.5629	7.5856	7.7012	7.7012	7.7248	7.6544	7.5856	7.5404	7.4959	
util living area	0.9975	0.9884	0.9373	0.7431	0.5087	0.3402	0.2474	0.2932	0.5285	0.8928	0.9915	0.9985	(86)
MIT	20.3669	20.5484	20.7929	20.9687	20.9980	20.9999	21.0000	21.0000	20.9982	20.9057	20.5914	20.3356	(87)
Th 2	20.3211	20.3232	20.3254	20.3360	20.3382	20.3489	20.3489	20.3511	20.3446	20.3382	20.3339	20.3296	(88)
util rest of house	0.9968	0.9850	0.9225	0.7091	0.4731	0.3057	0.2108	0.2519	0.4792	0.8631	0.9886	0.9980	(89)
MIT 2	19.7375	19.9188	20.1541	20.3142	20.3371	20.3489	20.3489	20.3510	20.3438	20.2697	19.9717	19.7138	(90)
Living area fraction									fLA = Living area / (4) =			0.5223	(91)
MIT	20.0662	20.2476	20.4877	20.6561	20.6822	20.6889	20.6889	20.6900	20.6856	20.6018	20.2953	20.0385	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.9162	20.0976	20.3377	20.5061	20.5322	20.5389	20.5389	20.5400	20.5356	20.4518	20.1453	19.8885	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9837	0.9228	0.7180	0.4835	0.3157	0.2215	0.2639	0.4936	0.8686	0.9876	0.9976	(94)
Useful gains	619.0513	755.3613	873.7755	842.9337	656.7623	434.8760	288.4551	302.1061	473.4976	658.8278	616.4049	578.5436	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1195.8009	1159.8423	1052.5008	867.8388	658.1575	434.9176	288.4571	302.1136	474.5980	734.1343	978.8138	1185.2063	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	429.1017	271.8113	132.9716	17.9316	1.0380	0.0000	0.0000	0.0000	0.0000	56.0280	260.9344	451.3571	(98)
Space heating												1621.1737	(98)
Space heating per m2											(98) / (4) =	15.2941	(99)

8c. Space cooling requirement

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	688.3813	541.9172	554.6097	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9995	0.9999	0.9996	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	688.0064	541.8384	554.3904	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1708.3329	1618.8230	1435.7818	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	734.6351	801.2766	655.7552	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2191.6669	(104)
Cooled fraction									fC = cooled area / (4) =			0.6920	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	127.0884	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												127.0884	(107)
Space cooling per m2												1.1989	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1793.3337	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	429.1017	271.8113	132.9716	17.9316	1.0380	0.0000	0.0000	0.0000	0.0000	56.0280	260.9344	451.3571	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	474.6700	300.6762	147.0924	19.8359	1.1483	0.0000	0.0000	0.0000	0.0000	61.9779	288.6442	499.2888	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	223.4069	196.8515	206.5958	185.0031	180.8344	159.2688	152.5917	170.1040	170.2074	191.8472	203.1057	217.9655	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.6677	85.8638	83.9739	81.1006	80.3512	80.3000	80.3000	80.3000	80.3000	82.3804	85.6830	86.8429	(217)
Fuel for water heating, kWh/month	257.7740	229.2602	246.0238	228.1155	225.0549	198.3423	190.0270	211.8356	211.9643	232.8796	237.0432	250.9882	(219)
Water heating fuel used												2719.3086	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	31.7721	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												31.7721	(221)

Annual totals kWh/year

Space heating fuel - main system	1793.3337	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)

mechanical ventilation fans (SFP = 0.8250)	298.7292	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	373.7292	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	5336.4362	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1793.3337	0.2160	387.3601	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2719.3086	0.2160	587.3707	(264)
Space and water heating			974.7307	(265)
Space cooling	31.7721	0.5190	16.4897	(266)
Pumps and fans	373.7292	0.5190	193.9655	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/year			1402.2798	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.2300	(273)

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

DER		13.2300	ZC1
Total Floor Area	TFA	106.0000	
Assumed number of occupants	N	2.7886	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8524	ZC2
CO2 emissions from cooking, equation (L16)		1.7540	ZC3
Total CO2 emissions		29.8364	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.8364	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		106.0000 (1b)	x	2.8000 (2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	296.8000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1348	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3848	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2693	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3434	0.3367	0.3299	0.2963	0.2895	0.2559	0.2559	0.2491	0.2693	0.2895	0.3030	0.3165	(22b)
Effective ac	0.5590	0.5567	0.5544	0.5439	0.5419	0.5327	0.5327	0.5310	0.5363	0.5419	0.5459	0.5501	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			26.5000	1.3258	35.1326			(27)
External Wall 1	72.3200	26.7900	45.5300	0.1800	8.1954			(29a)
Total net area of external elements Aum(A, m2)			72.0300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.3280			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		3.6015	(36)
Total fabric heat loss	(33) + (36) =	46.9295	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.7472	54.5230	54.3031	53.2707	53.0775	52.1782	52.1782	52.0117	52.5246	53.0775	53.4683	53.8768	(38)
Heat transfer coeff	101.6767	101.4524	101.2326	100.2001	100.0070	99.1077	99.1077	98.9412	99.4541	100.0070	100.3978	100.8063	(39)
Average = Sum(39)m / 12 =												100.1992	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9592	0.9571	0.9550	0.9453	0.9435	0.9350	0.9350	0.9334	0.9382	0.9435	0.9471	0.9510	(40)
HLP (average)												0.9453	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7886	(42)
Average daily hot water use (litres/day)	100.4283	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4712	106.4540	102.4369	98.4198	94.4026	90.3855	90.3855	94.4026	98.4198	102.4369	106.4540	110.4712	(44)
Energy conte	163.8256	143.2829	147.8551	128.9037	123.6861	106.7317	98.9026	113.4922	114.8477	133.8439	146.1011	158.6563	(45)
Energy content (annual)										Total = Sum(45)m =		1580.1288	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5738	21.4924	22.1783	19.3355	18.5529	16.0098	14.8354	17.0238	17.2272	20.0766	21.9152	23.7984	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.5358	48.1065	44.5737	46.0595	48.1065	48.5358	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(62)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(64)
Total per year (kWh/year) = Sum(64)m =												2163.2247	(64)
Heat gains from water heating, kWh/month	67.2117	59.1484	61.9015	54.9944	53.1523	46.6317	44.4000	49.7628	50.3208	57.2428	60.9074	65.4929	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)	90.3383	88.0185	83.2010	76.3811	71.4412	64.7663	59.6774	66.8855	69.8900	76.9393	84.5936	88.0282	(72)
Total internal gains	447.5310	445.3198	429.6264	403.8602	376.9802	351.2502	335.0972	342.1966	356.0771	382.0727	411.6671	434.1567	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	20.6000	11.2829	0.6300	0.7000	0.7700	71.0332	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)

Solar gains	137.3768	257.5978	415.1274	619.4089	789.6706	826.1350	778.9310	645.4604	484.8529	301.5981	168.8425	114.7856	(83)
Total gains	584.9078	702.9176	844.7538	1023.2691	1166.6508	1177.3852	1114.0282	987.6570	840.9299	683.6708	580.5095	548.9422	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.3972	72.5573	72.7148	73.4641	73.6060	74.2738	74.2738	74.3989	74.0152	73.6060	73.3195	73.0223	
alpha	5.8265	5.8372	5.8477	5.8976	5.9071	5.9516	5.9516	5.9599	5.9343	5.9071	5.8880	5.8682	
util living area	0.9987	0.9958	0.9828	0.9168	0.7436	0.5324	0.3905	0.4584	0.7566	0.9696	0.9967	0.9991	(86)
MIT	19.9776	20.1429	20.4143	20.7476	20.9424	20.9931	20.9991	20.9978	20.9539	20.6527	20.2484	19.9473	(87)
Th 2	20.1175	20.1192	20.1210	20.1292	20.1307	20.1379	20.1379	20.1392	20.1351	20.1307	20.1276	20.1244	(88)
util rest of house	0.9982	0.9945	0.9771	0.8923	0.6898	0.4635	0.3145	0.3739	0.6832	0.9558	0.9953	0.9988	(89)
MIT 2	18.7403	18.9828	19.3763	19.8433	20.0789	20.1336	20.1375	20.1383	20.1004	19.7267	19.1438	18.7011	(90)
Living area fraction										fLA = Living area / (4) =		0.5223	(91)
MIT	19.3865	19.5887	19.9184	20.3156	20.5299	20.5825	20.5875	20.5872	20.5462	20.2103	19.7207	19.3520	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3865	19.5887	19.9184	20.3156	20.5299	20.5825	20.5875	20.5872	20.5462	20.2103	19.7207	19.3520	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9934	0.9755	0.8981	0.7153	0.4993	0.3543	0.4181	0.7197	0.9573	0.9945	0.9984	(94)
Useful gains	583.5911	698.2676	824.0923	918.9810	834.5416	587.9079	394.6562	412.9230	605.1779	654.5058	577.3202	548.0742	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1533.9436	1490.2006	1358.3810	1143.8413	883.0529	592.9128	395.1909	414.2826	641.0988	961.0985	1267.0877	1527.4124	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	707.0623	532.1789	397.5108	161.8995	36.0924	0.0000	0.0000	0.0000	0.0000	228.1050	496.6326	728.6276	(98)
Space heating												3288.1090	(98)
Space heating per m2											(98) / (4) =	31.0199	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3520.4593	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	707.0623	532.1789	397.5108	161.8995	36.0924	0.0000	0.0000	0.0000	0.0000	228.1050	496.6326	728.6276	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	757.0260	569.7847	425.6004	173.3399	38.6428	0.0000	0.0000	0.0000	0.0000	244.2238	531.7265	780.1152	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8262	87.5119	86.7617	84.8214	81.8884	80.3000	80.3000	80.3000	80.3000	85.5822	87.2994	87.9292	(217)
Fuel for water heating, kWh/month	244.5562	216.3253	229.1495	209.1919	209.7887	188.4252	180.5256	201.2438	203.4663	215.9359	223.8458	238.3910	(219)

Water heating fuel used	2560.8453	(219)
Annual totals kWh/year		
Space heating fuel - main system	3520.4593	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	6574.5972	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3520.4593	0.2160	760.4192	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2560.8453	0.2160	553.1426	(264)
Space and water heating			1313.5618	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/m2/year			1569.5807	(272)
Emissions per m2 for space and water heating			12.3921	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0481	(272b)
Emissions per m2 for pumps and fans			0.3672	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.3921 * 1.00) + 2.0481 + 0.3672, rounded to 2 d.p.			14.8100	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A3-F2	**Issued on Date**	24/07/2020
Assessment Reference	A3-F2	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	84 B	**DER**	14.94	**TER**	15.41
Environmental	87 B	**% DER<TER**	3.03		
CO_2 Emissions (t/year)	1.24	**DFEE**	37.87	**TFEE**	43.74
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.42		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 100 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.41 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.94 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)43.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)37.9 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.13 (max. 0.30)       0.13 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)        -                        OK
Floor           0.06 (max. 0.25)       0.06 (max. 0.70)          OK
Roof            (no roof)
Openings        1.30 (max. 2.00)       1.30 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                               OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC plus 825 VUW 196/5-5 (H-GB) R6
Combi boiler
Efficiency: 89.5% SEDBUK2009
Minimum: 88.0%                                   OK

Secondary heating system:              None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Programmer, room thermostat and TRVs               OK


Hot water controls:                    No cylinder


Boiler interlock                       Yes                                                OK
----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                                OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.79
Maximum                                1.5                                                OK
MVHR efficiency:                       84%
Minimum:                               70%                                                OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):      Medium                                             OK
Based on:
Overshading:                           Average
Windows facing South East:             9.54 m², No overhang
Windows facing South West:             19.72 m², No overhang
Air change rate:                       3.00 ach
Blinds/curtains:                       Light-coloured venetian blind, closed 50% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                  0.13 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Floor U-value                          0.11 W/m²K
Air permeability                       3.0 m³/m²h



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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE      09 Jan 2014
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-------------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------------
                                                                                Area        Storey height                Volume
                                                                                (m2)             (m)                      (m3)
Ground floor                                                                100.0000 (1b)    x       2.8000 (2b)    =    280.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            100.0000                                                    (4)
Dwelling volume                                                                    (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    280.0000 (5)



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

                                                                                                                   Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                   0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                         Yes
Measured/design AP50                                                                                                               3.0000
Infiltration rate                                                                                                                  0.1500 (18)
Number of sides sheltered                                                                                                               4 (19)

Shelter factor                                                                                  (20) = 1 - [0.075 x (19)] =       0.7000 (20)
Infiltration rate adjusted to include shelter factor                                                      (21) = (18) x (20) =       0.1050 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1339     0.1313     0.1286     0.1155     0.1129     0.0998     0.0998     0.0971     0.1050     0.1129     0.1181     0.1234 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                         0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                      71.4000 (23c)

Effective ac     0.2769     0.2743     0.2716     0.2585     0.2559     0.2428     0.2428     0.2401     0.2480     0.2559     0.2611     0.2664 (25)



-------------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------------------
Element                                               Gross       Openings         NetArea        U-value          A x U         K-value          A x K
                                                         m2             m2              m2          W/m2K            W/K          kJ/m2K           kJ/K
Opening Type 1 (Uw = 1.30)                                                         29.2600         1.2357        36.1578                                (27)
Heat Loss Floor 1                                                                 100.0000         0.0550         5.5000                                (28a)
External Wall 1                                     73.6100        29.2600         44.3500         0.1300         5.7655                                (29a)
Total net area of external elements Aum(A, m2)                                    173.6100                                                              (31)
Fabric heat loss, W/K = Sum (A x U)                                                    (26)...(30) + (32) =      47.4233                                (33)
Party Wall 1                                                                       17.8100         0.0000         0.0000                                (32)
Party Wall 2                                                                       36.1200         0.0000         0.0000                                (32)
Party Wall 3                                                                       22.9900         0.0000         0.0000                                (32)
Party Ceilings 1                                                                  100.0000                                                              (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area)                                                                        26.0415 (36)
Total fabric heat loss                                                                                           (33) + (36) =     73.4648 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           25.5833    25.3407    25.0982    23.8854    23.6429    22.4301    22.4301    22.1876    22.9152    23.6429    24.1280    24.6131 (38)
Heat transfer coeff
                99.0480    98.8055    98.5629    97.3502    97.1076    95.8949    95.8949    95.6523    96.3800    97.1076    97.5927    98.0778 (39)
Average = Sum(39)m / 12 =                                                                                                          97.2896 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.9905     0.9881     0.9856     0.9735     0.9711     0.9589     0.9589     0.9565     0.9638     0.9711     0.9759     0.9808 (40)
HLP (average)                                                                                                                      0.9729 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



-------------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                  2.7395 (42)
Average daily hot water use (litres/day)                                                                                         104.4881 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               114.9370   110.7574   106.5779   102.3984    98.2189    94.0393    94.0393    98.2189   102.3984   106.5779   110.7574   114.9370 (44)
Energy conte   170.4482   149.0751   153.8321   134.1146   128.6861   111.0463   102.9008   118.0801   119.4904   139.2545   152.0072   165.0700 (45)
Energy content (annual)                                                                                     Total = Sum(45)m =    1644.0054 (45)
Distribution loss  (46)m = 0.15 x (45)m
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	25.5672	22.3613	23.0748	20.1172	19.3029	16.6570	15.4351	17.7120	17.9236	20.8882	22.8011	24.7605	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.0513	46.3756	47.9214	50.0513	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	221.4071	195.1025	204.7910	183.4296	178.7374	157.4219	150.8222	168.1314	168.8054	190.2134	201.3223	216.0289	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	221.4071	195.1025	204.7910	183.4296	178.7374	157.4219	150.8222	168.1314	168.8054	190.2134	201.3223	216.0289	(64)
								Total per year (kWh/year) = Sum(64)m =				2236.2131	(64)
Heat gains from water heating, kWh/month													
	69.4138	61.0743	63.8889	56.9219	55.3010	48.5168	46.1949	51.7745	52.0593	59.0419	62.8712	67.6255	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.8518	20.2968	16.5064	12.4964	9.3412	7.8863	8.5214	11.0764	14.8667	18.8768	22.0320	23.4869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	256.3278	258.9876	252.2848	238.0153	220.0027	203.0733	191.7634	189.1036	195.8064	210.0759	228.0885	245.0179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	(71)
Water heating gains (Table 5)													
	93.2981	90.8844	85.8722	79.0581	74.3292	67.3844	62.0899	69.5893	72.3046	79.3573	87.3211	90.8945	(72)
Total internal gains													
	439.5705	437.2617	421.7564	396.6628	370.7660	345.4369	329.4676	336.8622	350.0706	375.4028	404.5344	426.4922	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	9.5400	36.7938	0.6000	0.9000	0.7700	131.3561	(77)
Southwest	19.7200	36.7938	0.6000	0.9000	0.7700	271.5244	(79)

Solar gains	402.8806	686.2547	938.9636	1163.4214	1303.1290	1293.7054	1247.2701	1143.0420	1016.6990	758.4576	482.5581	344.7818	(83)
Total gains	842.4511	1123.5164	1360.7200	1560.0842	1673.8950	1639.1423	1576.7376	1479.9042	1366.7696	1133.8605	887.0925	771.2740	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.1119	70.2840	70.4569	71.3347	71.5129	72.4172	72.4172	72.6009	72.0528	71.5129	71.1574	70.8054	
alpha	5.6741	5.6856	5.6971	5.7556	5.7675	5.8278	5.8278	5.8401	5.8035	5.7675	5.7438	5.7204	
util living area													
	0.9892	0.9549	0.8707	0.7119	0.5323	0.3737	0.2675	0.2971	0.4827	0.7987	0.9680	0.9930	(86)
MIT	20.2061	20.4988	20.7634	20.9346	20.9883	20.9988	20.9999	20.9997	20.9949	20.8988	20.5171	20.1455	(87)
Th 2	20.0913	20.0933	20.0953	20.1055	20.1075	20.1177	20.1177	20.1197	20.1136	20.1075	20.1034	20.0994	(88)
util rest of house													
	0.9860	0.9434	0.8441	0.6698	0.4837	0.3225	0.2139	0.2404	0.4224	0.7527	0.9577	0.9909	(89)
MIT 2	19.3818	19.6663	19.9100	20.0609	20.1010	20.1172	20.1177	20.1197	20.1114	20.0397	19.6966	19.3289	(90)
Living area fraction									fLA = Living area / (4) =			0.4066	(91)
MIT	19.7170	20.0048	20.2570	20.4162	20.4618	20.4757	20.4764	20.4775	20.4706	20.3890	20.0302	19.6609	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.5670	19.8548	20.1070	20.2662	20.3118	20.3257	20.3264	20.3275	20.3206	20.2390	19.8802	19.5109	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9836	0.9399	0.8445	0.6776	0.4950	0.3346	0.2266	0.2538	0.4366	0.7599	0.9547	0.9891	(94)
Useful gains	828.6746	1055.9928	1149.0600	1057.1097	828.5536	548.4378	357.2903	375.5814	596.7127	861.6654	846.8691	762.8816	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1512.1660	1477.6178	1341.1459	1106.4976	836.2702	549.0608	357.3387	375.6748	599.5422	936.0238	1247.2593	1501.6631	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	508.5176	283.3320	142.9119	35.5593	5.7411	0.0000	0.0000	0.0000	0.0000	55.3227	288.2809	549.6534	(98)
Space heating												1869.3189	(98)
Space heating per m2											(98) / (4) =	18.6932	(99)

8c. Space cooling requirement

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	901.4120	709.6222	726.9578	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9948	0.9982	0.9972	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	896.7642	708.3266	724.9270	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2011.2850	1936.4227	1824.5148	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	802.4550	913.7036	818.0934	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2534.2519	(104)
Cooled fraction									fC = cooled area / (4) =			0.5284	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	106.0043	120.7002	108.0701	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												334.7747	(107)
Space cooling per m2												3.3477	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2067.8306	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	508.5176	283.3320	142.9119	35.5593	5.7411	0.0000	0.0000	0.0000	0.0000	55.3227	288.2809	549.6534	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	562.5195	313.4204	158.0884	39.3355	6.3508	0.0000	0.0000	0.0000	0.0000	61.1977	318.8948	608.0237	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	221.4071	195.1025	204.7910	183.4296	178.7374	157.4219	150.8222	168.1314	168.8054	190.2134	201.3223	216.0289	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.0778	85.9895	84.1650	81.7837	80.5802	80.3000	80.3000	80.3000	80.3000	82.3736	85.9545	87.3019	(217)
Fuel for water heating, kWh/month	254.2636	226.8911	243.3210	224.2863	221.8131	196.0422	187.8234	209.3791	210.2185	230.9155	234.2196	247.4503	(219)
Water heating fuel used												2686.6237	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	26.5011	30.1751	27.0175	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												83.6937	(221)

Annual totals kWh/year

Space heating fuel - main system	2067.8306	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)

mechanical ventilation fans (SFP = 0.9875)	337.3300	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	412.3300	(231)
Electricity for lighting (calculated in Appendix L)	403.5701	(232)
Total delivered energy for all uses	5654.0480	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2067.8306	0.2160	446.6514	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2686.6237	0.2160	580.3107	(264)
Space and water heating			1026.9621	(265)
Space cooling	83.6937	0.5190	43.4370	(266)
Pumps and fans	412.3300	0.5190	213.9993	(267)
Energy for lighting	403.5701	0.5190	209.4529	(268)
Total CO2, kg/year			1493.8513	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.9400	(273)

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

DER		14.9400	ZC1
Total Floor Area	TFA	100.0000	
Assumed number of occupants	N	2.7395	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1894	ZC2
CO2 emissions from cooking, equation (L16)		1.8475	ZC3
Total CO2 emissions		31.9769	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.9769	ZC8

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP elmhurst energy

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	100.0000 (1b)	x	2.8000 (2b)	=	280.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 100.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	280.0000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1071	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3571	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3188	0.3125	0.3063	0.2750	0.2688	0.2375	0.2375	0.2313	0.2500	0.2688	0.2813	0.2938	(22b)
Effective ac	0.5508	0.5488	0.5469	0.5378	0.5361	0.5282	0.5282	0.5267	0.5313	0.5361	0.5396	0.5431	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			25.0000	1.3258	33.1439			(27)
Heat Loss Floor 1			100.0000	0.1300	13.0000			(28a)
External Wall 1	73.6100	29.2600	44.3500	0.1800	7.9830			(29a)
Total net area of external elements Aum(A, m2)			169.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.1269			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		8.4675	(36)
Total fabric heat loss	(33) + (36) =	62.5944	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.8940	50.7117	50.5331	49.6939	49.5369	48.8060	48.8060	48.6706	49.0875	49.5369	49.8545	50.1866	(38)
Heat transfer coeff	113.4884	113.3062	113.1275	112.2883	112.1313	111.4004	111.4004	111.2651	111.6819	112.1313	112.4489	112.7810	(39)
Average = Sum(39)m / 12 =												112.2876	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1349	1.1331	1.1313	1.1229	1.1213	1.1140	1.1140	1.1127	1.1168	1.1213	1.1245	1.1278	(40)
HLP (average)												1.1229	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7395	(42)
Average daily hot water use (litres/day)	99.2637	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.1901	105.2196	101.2490	97.2785	93.3079	89.3374	89.3374	93.3079	97.2785	101.2490	105.2196	109.1901	(44)
Energy conte	161.9258	141.6213	146.1405	127.4088	122.2518	105.4940	97.7557	112.1761	113.5159	132.2918	144.4068	156.8165	(45)
Energy content (annual)										Total = Sum(45)m =		1561.8051	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2889	21.2432	21.9211	19.1113	18.3378	15.8241	14.6634	16.8264	17.0274	19.8438	21.6610	23.5225	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.9729	47.5487	44.0568	45.5253	47.5487	47.9729	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	212.8847	187.6487	197.0994	175.3818	169.8005	149.5508	143.2811	159.7248	161.4888	183.2507	193.7219	207.7754	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	212.8847	187.6487	197.0994	175.3818	169.8005	149.5508	143.2811	159.7248	161.4888	183.2507	193.7219	207.7754	(64)
Total per year (kWh/year) = Sum(64)m =												2141.6086	(64)
Heat gains from water heating, kWh/month	66.5800	58.5959	61.3314	54.3567	52.5359	46.0910	43.8851	49.1857	49.7373	56.7267	60.3440	64.8812	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.8518	20.2968	16.5064	12.4964	9.3412	7.8863	8.5214	11.0764	14.8667	18.8768	22.0320	23.4869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	256.3278	258.9876	252.2848	238.0153	220.0027	203.0733	191.7634	189.1036	195.8064	210.0759	228.0885	245.0179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	(71)
Water heating gains (Table 5)	89.4893	87.1963	82.4347	75.4954	70.6128	64.0152	58.9854	66.1099	69.0795	76.2456	83.8112	87.2059	(72)
Total internal gains	435.7618	433.5736	418.3189	393.1001	367.0496	342.0677	326.3631	333.3827	346.8455	372.2911	401.0246	422.8036	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	8.1500	36.7938	0.6300	0.7000	0.7700	91.6441	(77)
Southwest	16.8500	36.7938	0.6300	0.7000	0.7700	189.4727	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	281.1168	478.8460	655.1779	811.7972	909.2806	902.7051	870.3041	797.5771	709.4192	529.2268	336.7132	240.5774	(83)
Total gains	716.8786	912.4196	1073.4969	1204.8973	1276.3301	1244.7728	1196.6672	1130.9599	1056.2647	901.5180	737.7377	663.3811	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.1908	61.2892	61.3860	61.8448	61.9314	62.3377	62.3377	62.4135	62.1806	61.9314	61.7564	61.5746	
alpha	5.0794	5.0859	5.0924	5.1230	5.1288	5.1558	5.1558	5.1609	5.1454	5.1288	5.1171	5.1050	
util living area	0.9955	0.9850	0.9569	0.8825	0.7424	0.5585	0.4072	0.4484	0.6841	0.9236	0.9886	0.9969	(86)
MIT	19.8872	20.1282	20.4222	20.7213	20.9100	20.9832	20.9972	20.9955	20.9546	20.6851	20.2133	19.8370	(87)
Th 2	19.9724	19.9739	19.9754	19.9822	19.9835	19.9894	19.9894	19.9905	19.9871	19.9835	19.9809	19.9782	(88)
util rest of house	0.9941	0.9804	0.9438	0.8499	0.6825	0.4764	0.3150	0.3522	0.6008	0.8941	0.9842	0.9959	(89)
MIT 2	18.5021	18.8515	19.2697	19.6775	19.9036	19.9793	19.9885	19.9888	19.9554	19.6431	18.9826	18.4330	(90)
Living area fraction									fLA = Living area / (4) =			0.4066	(91)
MIT	19.0653	19.3706	19.7383	20.1019	20.3128	20.3875	20.3986	20.3982	20.3617	20.0668	19.4830	19.0038	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0653	19.3706	19.7383	20.1019	20.3128	20.3875	20.3986	20.3982	20.3617	20.0668	19.4830	19.0038	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9923	0.9768	0.9402	0.8541	0.7029	0.5094	0.3525	0.3914	0.6330	0.8969	0.9814	0.9946	(94)
Useful gains	711.3519	891.2877	1009.2606	1029.1347	897.0933	634.0842	421.8818	442.6626	668.5660	808.5932	724.0137	659.7746	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1675.6875	1639.6074	1497.6118	1257.8435	965.7628	644.7256	423.1702	444.8565	699.3177	1061.5262	1392.4576	1669.5918	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	717.4658	502.8708	363.3333	164.6704	51.0901	0.0000	0.0000	0.0000	0.0000	188.1821	481.2796	751.3040	(98)
Space heating												3220.1961	(98)
Space heating per m2											(98) / (4) =	32.2020	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3447.7474	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	717.4658	502.8708	363.3333	164.6704	51.0901	0.0000	0.0000	0.0000	0.0000	188.1821	481.2796	751.3040	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	768.1646	538.4056	389.0079	176.3066	54.7003	0.0000	0.0000	0.0000	0.0000	201.4798	515.2887	804.3940	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	212.8847	187.6487	197.0994	175.3818	169.8005	149.5508	143.2811	159.7248	161.4888	183.2507	193.7219	207.7754	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8710	87.4122	86.5705	84.8930	82.4301	80.3000	80.3000	80.3000	80.3000	85.1181	87.2505	88.0021	(217)
Fuel for water heating, kWh/month	242.2696	214.6710	227.6749	206.5916	205.9934	186.2401	178.4322	198.9101	201.1069	215.2900	222.0297	236.1029	(219)

Water heating fuel used	2535.3124	(219)
Annual totals kWh/year		
Space heating fuel - main system	3447.7474	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	403.5701	(232)
Total delivered energy for all uses	6461.6298	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3447.7474	0.2160	744.7134	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2535.3124	0.2160	547.6275	(264)
Space and water heating			1292.3409	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	403.5701	0.5190	209.4529	(268)
Total CO2, kg/m2/year			1540.7188	(272)
Emissions per m2 for space and water heating			12.9234	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0945	(272b)
Emissions per m2 for pumps and fans			0.3893	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.9234 * 1.00) + 2.0945 + 0.3893, rounded to 2 d.p.			15.4100	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A4-F3	Issued on Date	24/07/2020
Assessment Reference	A4-F3	Prop Type Ref	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	86 B	DER	13.68	TER	15.15
Environmental	88 B	% DER<TER	9.70		
CO_2 Emissions (t/year)	1.19	DFEE	37.11	TFEE	43.46
General Requirements Compliance	Pass	% DFEE<TFEE	14.61		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	Assessor ID	T613-0001
Client	CO-RE, 4650		

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 106 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.15 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.68 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)43.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)37.1 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.13 (max. 0.30)        0.13 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.11 (max. 0.20)        0.11 (max. 0.35)          OK
Openings        1.30 (max. 2.00)        1.30 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                                OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC plus 825 VUW 196/5-5 (H-GB) R6
Combi boiler
Efficiency: 89.5% SEDBUK2009
Minimum: 88.0%                                    OK

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Programmer, room thermostat and TRVs              OK


Hot water controls:                     No cylinder


Boiler interlock                        Yes                                                 OK
----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                                 OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.66
Maximum                                 1.5                                                 OK
MVHR efficiency:                        85%
Minimum:                                70%                                                 OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                              OK
Based on:
Overshading:                            Average
Windows facing North East:              20.83 m², No overhang
Windows facing South East:              5.96 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Light-coloured venetian blind, closed 50% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Party wall U-value                      0.00 W/m²K
Party wall U-value                      0.00 W/m²K
Roof U-value                            0.11 W/m²K
Air permeability                        3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)			Storey height (m)			Volume (m3)	
Ground floor		106.0000	(1b)	x	2.8000	(2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.0000								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	296.8000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.2500	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2726	0.2700	0.2674	0.2543	0.2516	0.2385	0.2385	0.2359	0.2438	0.2516	0.2569	0.2621	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			26.7900	1.2357	33.1055			(27)
External Wall 1	72.3200	26.7900	45.5300	0.1300	5.9189			(29a)
External Roof 1	15.2200		15.2200	0.1100	1.6742			(30)
Total net area of external elements Aum(A, m2)			87.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.6986			(33)
Party Wall 1			15.0400	0.0000	0.0000			(32)
Party Wall 2			28.4800	0.0000	0.0000			(32)
Party Wall 3			43.5400	0.0000	0.0000			(32)
Party Floor 1			106.0000					(32d)
Party Ceilings 1			90.7800					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		13.1310	(36)
Total fabric heat loss	(33) + (36) =	53.8296	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.7020	26.4449	26.1878	24.9023	24.6452	23.3596	23.3596	23.1025	23.8739	24.6452	25.1594	25.6736	(38)
Heat transfer coeff	80.5316	80.2745	80.0174	78.7319	78.4748	77.1893	77.1893	76.9322	77.7035	78.4748	78.9890	79.5032	(39)
Average = Sum(39)m / 12 =												78.6676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7597	0.7573	0.7549	0.7428	0.7403	0.7282	0.7282	0.7258	0.7331	0.7403	0.7452	0.7500	(40)
HLP (average)												0.7421	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7886	(42)
Average daily hot water use (litres/day)	105.7140	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	116.2854	112.0569	107.8283	103.5998	99.3712	95.1426	95.1426	99.3712	103.5998	107.8283	112.0569	116.2854	(44)
Energy conte	172.4480	150.8241	155.6369	135.6881	130.1959	112.3492	104.1080	119.4655	120.8923	140.8883	153.7906	167.0066	(45)
Energy content (annual)											Total = Sum(45)m =	1663.2935	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
             25.8672    22.6236    23.3455    20.3532    19.5294    16.8524    15.6162    17.9198    18.1338    21.1332    23.0686    25.0510 (46)
Water storage loss:
Total storage loss
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
              0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss   50.9589    46.0274    50.9589    49.3151    50.6385    46.9197    48.4836    50.6385    49.3151    50.9589    49.3151    50.9589 (61)
Total heat required for water heating calculated for each month
            223.4069   196.8515   206.5958   185.0031   180.8344   159.2688   152.5917   170.1040   170.2074   191.8472   203.1057   217.9655 (62)
Solar input   0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                Solar input (sum of months) = Sum(63)m =        0.0000 (63)
Output from w/h
            223.4069   196.8515   206.5958   185.0031   180.8344   159.2688   152.5917   170.1040   170.2074   191.8472   203.1057   217.9655 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =     2257.7820 (64)
Heat gains from water heating, kWh/month
             70.0787    61.6559    64.4890    57.4450    55.9498    49.0860    46.7368    52.3819    52.5255    59.5851    63.4641    68.2694 (65)


----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m       139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
             23.6855    21.0372    17.1086    12.9523     9.6820     8.1740     8.8323    11.4805    15.4091    19.5654    22.8357    24.3438 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
            265.6788   268.4357   261.4884   246.6983   228.0285   210.4816   198.7591   196.0022   202.9495   217.7396   236.4094   253.9563 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
             36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428 (69)
Pumps, fans   3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
           -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425 (71)
Water heating gains (Table 5)
             94.1918    91.7498    86.6788    79.7848    75.2013    68.1750    62.8183    70.4058    72.9520    80.0875    88.1446    91.7600 (72)
Total internal gains
            451.3844   449.0511   433.1042   407.2639   380.7403   354.6590   338.2381   345.7169   359.1391   385.2209   415.2181   437.8885 (73)


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6. Solar gains
----------------------------------------------------------------------------------------------------

[Jan]                                       Area          Solar flux              g                FF             Access                Gains
                                              m2          Table 6a      Specific data      Specific data          factor                   W
                                                              W/m2       or Table 6b        or Table 6c         Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                20.8300           11.2829            0.6000            0.9000            0.7700              87.9506 (75)
Southeast                                 5.9600           36.7938            0.6000            0.9000            0.7700              82.0632 (77)
----------------------------------------------------------------------------------------------------

Solar gains     170.0137   318.8098   513.8062   766.6946   977.4780  1022.6287   964.1919   798.9546   600.1219   373.2749   208.9573   142.0538 (83)
Total gains     621.3982   767.8610   946.9104  1173.9584  1358.2183  1377.2876  1302.4300  1144.6715   959.2610   758.4958   624.1755   579.9423 (84)


----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          91.4065    91.6993    91.9939    93.4959    93.8023    95.3645    95.3645    95.6832    94.7334    93.8023    93.1916    92.5889
alpha         7.0938     7.1133     7.1329     7.2331     7.2535     7.3576     7.3576     7.3789     7.3156     7.2535     7.2128     7.1726
util living area
              0.9977     0.9899     0.9466     0.7704     0.5346     0.3586     0.2608     0.3091     0.5554     0.9085     0.9926     0.9986 (86)

MIT          20.3086    20.4920    20.7481    20.9538    20.9964    20.9998    21.0000    21.0000    20.9968    20.8784    20.5424    20.2770 (87)
Th 2         20.2884    20.2905    20.2926    20.3032    20.3053    20.3160    20.3160    20.3181    20.3117    20.3053    20.3011    20.2968 (88)
util rest of house
              0.9970     0.9869     0.9331     0.7357     0.4956     0.3203     0.2202     0.2633     0.5015     0.8806     0.9899     0.9981 (89)
MIT 2        19.6512    19.8347    20.0825    20.2706    20.3033    20.3159    20.3160    20.3181    20.3102    20.2157    19.8947    19.6271 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5223 (91)
MIT          19.9946    20.1780    20.4301    20.6274    20.6653    20.6731    20.6732    20.6742    20.6688    20.5618    20.2330    19.9665 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  19.8446    20.0280    20.2801    20.4774    20.5153    20.5231    20.5232    20.5242    20.5188    20.4118    20.0830    19.8165 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9965     0.9855     0.9329     0.7446     0.5074     0.3319     0.2325     0.2772     0.5178     0.8853     0.9889     0.9977 (94)
Useful gains 619.2143   756.7601   883.3431   874.1802   689.2238   457.1088   302.8250   317.2670   496.7510   671.5235   617.2575   578.6249 (95)
Ext temp.      4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
            1251.8276  1214.3898  1102.6481   911.5103   691.7772   457.2003   302.8301   317.2848   498.7607   769.9759  1025.5122  1241.5631 (97)
Month fracti   1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
             470.6643   307.5272   163.1629    26.8777     1.8998     0.0000     0.0000     0.0000     0.0000    73.2486   293.9434   493.2261 (98)
Space heating                                                                                                                  1830.5499 (98)
Space heating per m2                                                                                        (98) / (4) =      17.2693 (99)


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8c. Space cooling requirement
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	725.5790	571.2005	584.6844	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9989	0.9997	0.9992	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	724.8122	571.0270	584.2262	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1708.3329	1618.8230	1435.7818	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	708.1349	779.5602	633.5574	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2121.2525	(104)
Cooled fraction									fC = cooled area / (4) =			0.6920	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	122.5040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												122.5040	(107)
Space cooling per m2												1.1557	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2024.9446	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	470.6643	307.5272	163.1629	26.8777	1.8998	0.0000	0.0000	0.0000	0.0000	73.2486	293.9434	493.2261	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	520.6463	340.1849	180.4900	29.7320	2.1015	0.0000	0.0000	0.0000	0.0000	81.0273	325.1586	545.6041	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	223.4069	196.8515	206.5958	185.0031	180.8344	159.2688	152.5917	170.1040	170.2074	191.8472	203.1057	217.9655	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.8825	86.1700	84.4642	81.4544	80.3934	80.3000	80.3000	80.3000	80.3000	82.8579	85.9809	87.0446	(217)
Fuel for water heating, kWh/month	257.1367	228.4456	244.5958	227.1247	224.9369	198.3423	190.0270	211.8356	211.9643	231.5376	236.2218	250.4068	(219)
Water heating fuel used												2712.5751	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	30.6260	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												30.6260	(221)

Annual totals kWh/year		
Space heating fuel - main system	2024.9446	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	298.7292	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	373.7292	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	5560.1675	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2024.9446	0.2160	437.3880	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2712.5751	0.2160	585.9162	(264)
Space and water heating			1023.3043	(265)
Space cooling	30.6260	0.5190	15.8949	(266)
Pumps and fans	373.7292	0.5190	193.9655	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/year			1450.2585	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.6800	(273)

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

DER		13.6800	ZC1
Total Floor Area	TFA	106.0000	
Assumed number of occupants	N	2.7886	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8524	ZC2
CO2 emissions from cooking, equation (L16)		1.7540	ZC3
Total CO2 emissions		30.2864	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.2864	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		106.0000 (1b)	x	2.8000 (2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	296.8000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1348	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3848	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2693	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3434	0.3367	0.3299	0.2963	0.2895	0.2559	0.2559	0.2491	0.2693	0.2895	0.3030	0.3165	(22b)
Effective ac	0.5590	0.5567	0.5544	0.5439	0.5419	0.5327	0.5327	0.5310	0.5363	0.5419	0.5459	0.5501	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			26.5000	1.3258	35.1326			(27)
External Wall 1	72.3200	26.7900	45.5300	0.1800	8.1954			(29a)
External Roof 1	15.2200		15.2200	0.1300	1.9786			(30)
Total net area of external elements Aum(A, m2)			87.2500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.3066			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		4.3625	(36)
Total fabric heat loss	(33) + (36) =	49.6691	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.7472	54.5230	54.3031	53.2707	53.0775	52.1782	52.1782	52.0117	52.5246	53.0775	53.4683	53.8768	(38)
Heat transfer coeff	104.4163	104.1920	103.9722	102.9397	102.7466	101.8473	101.8473	101.6808	102.1937	102.7466	103.1374	103.5459	(39)
Average = Sum(39)m / 12 =												102.9388	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9851	0.9829	0.9809	0.9711	0.9693	0.9608	0.9608	0.9593	0.9641	0.9693	0.9730	0.9768	(40)
HLP (average)												0.9711	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7886	(42)
Average daily hot water use (litres/day)	100.4283	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4712	106.4540	102.4369	98.4198	94.4026	90.3855	90.3855	94.4026	98.4198	102.4369	106.4540	110.4712	(44)
Energy conte	163.8256	143.2829	147.8551	128.9037	123.6861	106.7317	98.9026	113.4922	114.8477	133.8439	146.1011	158.6563	(45)
Energy content (annual)										Total = Sum(45)m =		1580.1288	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5738	21.4924	22.1783	19.3355	18.5529	16.0098	14.8354	17.0238	17.2272	20.0766	21.9152	23.7984	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.5358	48.1065	44.5737	46.0595	48.1065	48.5358	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

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

Output from w/h													
	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(64)

Total per year (kWh/year) = Sum(64)m = 2163.2247 (64)

Heat gains from water heating, kWh/month													
	67.2117	59.1484	61.9015	54.9944	53.1523	46.6317	44.4000	49.7628	50.3208	57.2428	60.9074	65.4929	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)													
	90.3383	88.0185	83.2010	76.3811	71.4412	64.7663	59.6774	66.8855	69.8900	76.9393	84.5936	88.0282	(72)
Total internal gains													
	447.5310	445.3198	429.6264	403.8602	376.9802	351.2502	335.0972	342.1966	356.0771	382.0727	411.6671	434.1567	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	20.6000	11.2829	0.6300	0.7000	0.7700	71.0332	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	137.3768	257.5978	415.1274	619.4089	789.6706	826.1350	778.9310	645.4604	484.8529	301.5981	168.8425	114.7856	(83)
Total gains	584.9078	702.9176	844.7538	1023.2691	1166.6508	1177.3852	1114.0282	987.6570	840.9299	683.6708	580.5095	548.9422	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.4977	70.6495	70.7988	71.5089	71.6434	72.2759	72.2759	72.3943	72.0310	71.6434	71.3719	71.0903	
alpha	5.6998	5.7100	5.7199	5.7673	5.7762	5.8184	5.8184	5.8263	5.8021	5.7762	5.7581	5.7394	
util living area													
	0.9987	0.9959	0.9837	0.9219	0.7559	0.5456	0.4011	0.4704	0.7687	0.9713	0.9967	0.9991	(86)
MIT	19.9408	20.1068	20.3814	20.7232	20.9326	20.9913	20.9988	20.9971	20.9462	20.6294	20.2172	19.9103	(87)
Th 2	20.0958	20.0976	20.0993	20.1075	20.1090	20.1161	20.1161	20.1174	20.1134	20.1090	20.1059	20.1027	(88)
util rest of house													
	0.9982	0.9946	0.9782	0.8982	0.7016	0.4738	0.3212	0.3818	0.6946	0.9581	0.9954	0.9988	(89)
MIT 2	18.6704	18.9140	19.3125	19.7928	20.0479	20.1107	20.1157	20.1163	20.0725	19.6769	19.0821	18.6309	(90)

Living area fraction fLA = Living area / (4) = 0.5223 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.3338	19.5369	19.8708	20.2787	20.5099	20.5706	20.5769	20.5763	20.5288	20.1744	19.6749	19.2991	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3338	19.5369	19.8708	20.2787	20.5099	20.5706	20.5769	20.5763	20.5288	20.1744	19.6749	19.2991	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9935	0.9765	0.9032	0.7270	0.5111	0.3629	0.4282	0.7311	0.9593	0.9946	0.9984	(94)
Useful gains	583.5853	698.3441	824.8709	924.2663	848.1217	601.7291	404.3182	422.8712	614.7993	655.8150	577.3637	548.0648	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1569.7784	1525.0533	1390.1885	1171.3232	905.1915	608.0916	405.0344	424.6475	656.9821	983.7336	1296.9440	1563.4483	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	733.7276	555.5486	420.5963	177.8810	42.4599	0.0000	0.0000	0.0000	0.0000	243.9714	518.0979	755.4453	(98)

Space heating 3447.7281 (98)

Space heating per m2 (98) / (4) = 32.5257 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3691.3577	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	733.7276	555.5486	420.5963	177.8810	42.4599	0.0000	0.0000	0.0000	0.0000	243.9714	518.0979	755.4453	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	785.5756	594.8058	450.3172	190.4507	45.4603	0.0000	0.0000	0.0000	0.0000	261.2114	554.7086	808.8280	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	214.7845	189.3103	198.8140	177.4394	171.7927	151.3054	144.9621	161.5988	163.3835	184.8028	195.4161	209.6152	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8966	87.5997	86.8920	85.0575	82.1182	80.3000	80.3000	80.3000	80.3000	85.7514	87.3896	87.9960	(217)
Fuel for water heating, kWh/month	244.3605	216.1084	228.8058	208.6113	209.2017	188.4252	180.5256	201.2438	203.4663	215.5101	223.6149	238.2100	(219)

Water heating fuel used	2558.0834	(219)
Annual totals kWh/year		
Space heating fuel - main system	3691.3577	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	6742.7337	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3691.3577	0.2160	797.3333	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2558.0834	0.2160	552.5460	(264)
Space and water heating			1349.8793	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/m2/year			1605.8981	(272)
Emissions per m2 for space and water heating			12.7347	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0481	(272b)
Emissions per m2 for pumps and fans			0.3672	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.7347 * 1.00) + 2.0481 + 0.3672, rounded to 2 d.p.			15.1500	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A5-F3	**Issued on Date**	24/07/2020
Assessment Reference	A5-F3	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	86 B	**DER**	12.42	**TER**	13.22
Environmental	89 B	**% DER<TER**	6.03		
CO_2 Emissions (t/year)	1.10	**DFEE**	28.00	**TFEE**	32.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.63		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 100 m^2

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 13.22 kgCO$_2$/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 12.42 kgCO$_2$/m^{2}OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)32.8 kWh/m^2/yr
Dwelling Fabric Energy Efficiency (DFEE)28.0 kWh/m^2/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC plus 825 VUW 196/5-5 (H-GB) R6
Combi boiler
Efficiency: 89.5% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls

Space heating controls:	Programmer, room thermostat and TRVs	OK
Hot water controls:	No cylinder	
Boiler interlock	Yes	OK

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

8 Mechanical ventilation
Continuous supply and extract system

Specific fan power:	0.79	
Maximum	1.5	OK
MVHR efficiency:	84%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing South East:	9.54 m^2, No overhang	
Windows facing South West:	19.72 m^2, No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

10 Key features

External wall U-value	0.13 W/m^{2}K
Party wall U-value	0.00 W/m^{2}K
Party wall U-value	0.00 W/m^{2}K
Party wall U-value	0.00 W/m^{2}K
Air permeability	3.0 m^3/m^{2}h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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


----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                              Area         Storey height              Volume
                                                                              (m2)              (m)                    (m3)
Ground floor                                                              100.0000 (1b)    x       2.8000 (2b)    =    280.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            100.0000                                                  (4)
Dwelling volume                                                                  (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    280.0000 (5)



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

                                                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                 0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                      Yes
Measured/design AP50                                                                                                            3.0000
Infiltration rate                                                                                                               0.1500 (18)
Number of sides sheltered                                                                                                            4 (19)

Shelter factor                                                                                (20) = 1 - [0.075 x (19)] =      0.7000 (20)
Infiltration rate adjusted to include shelter factor                                                    (21) = (18) x (20) =      0.1050 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1339     0.1313     0.1286     0.1155     0.1129     0.0998     0.0998     0.0971     0.1050     0.1129     0.1181     0.1234 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                      0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                  71.4000 (23c)

Effective ac     0.2769     0.2743     0.2716     0.2585     0.2559     0.2428     0.2428     0.2401     0.2480     0.2559     0.2611     0.2664 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                          Gross        Openings          NetArea        U-value          A x U        K-value          A x K
                                                    m2              m2               m2          W/m2K            W/K          kJ/m2K           kJ/K
Opening Type 1 (Uw = 1.30)                                                      29.2600         1.2357        36.1578                                 (27)
External Wall 1                                73.6100         29.2600          44.3500         0.1300         5.7655                                 (29a)
Total net area of external elements Aum(A, m2)                                  73.6100                                                                (31)
Fabric heat loss, W/K = Sum (A x U)                                          (26)...(30) + (32) =        41.9233                                 (33)
Party Wall 1                                                                    17.8100         0.0000         0.0000                                 (32)
Party Wall 2                                                                    36.1200         0.0000         0.0000                                 (32)
Party Wall 3                                                                    22.9900         0.0000         0.0000                                 (32)
Party Floor 1                                                                  100.0000                                                                (32d)
Party Ceilings 1                                                               100.0000                                                                (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                           250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area)                                                                   11.0415 (36)
Total fabric heat loss                                                                                          (33) + (36) =   52.9648 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           25.5833    25.3407    25.0982    23.8854    23.6429    22.4301    22.4301    22.1876    22.9152    23.6429    24.1280    24.6131 (38)
Heat transfer coeff
                78.5480    78.3055    78.0629    76.8502    76.6076    75.3949    75.3949    75.1523    75.8800    76.6076    77.0927    77.5778 (39)
Average = Sum(39)m / 12 =                                                                                                     76.7896 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.7855     0.7831     0.7806     0.7685     0.7661     0.7539     0.7539     0.7515     0.7588     0.7661     0.7709     0.7758 (40)
HLP (average)                                                                                                                   0.7679 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                               2.7395 (42)
Average daily hot water use (litres/day)                                                                                      104.4881 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               114.9370   110.7574   106.5779   102.3984    98.2189    94.0393    94.0393    98.2189   102.3984   106.5779   110.7574   114.9370 (44)
Energy conte   170.4482   149.0751   153.8321   134.1146   128.6861   111.0463   102.9008   118.0801   119.4904   139.2545   152.0072   165.0700 (45)
Energy content (annual)                                                                                      Total = Sum(45)m =   1644.0054 (45)
Distribution loss  (46)m = 0.15 x (45)m
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	25.5672	22.3613	23.0748	20.1172	19.3029	16.6570	15.4351	17.7120	17.9236	20.8882	22.8011	24.7605	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.0513	46.3756	47.9214	50.0513	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	221.4071	195.1025	204.7910	183.4296	178.7374	157.4219	150.8222	168.1314	168.8054	190.2134	201.3223	216.0289	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	221.4071	195.1025	204.7910	183.4296	178.7374	157.4219	150.8222	168.1314	168.8054	190.2134	201.3223	216.0289	(64)
Total per year (kWh/year) = Sum(64)m =												2236.2131	(64)
Heat gains from water heating, kWh/month	69.4138	61.0743	63.8889	56.9219	55.3010	48.5168	46.1949	51.7745	52.0593	59.0419	62.8712	67.6255	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.8518	20.2968	16.5064	12.4964	9.3412	7.8863	8.5214	11.0764	14.8667	18.8768	22.0320	23.4869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	256.3278	258.9876	252.2848	238.0153	220.0027	203.0733	191.7634	189.1036	195.8064	210.0759	228.0885	245.0179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	(71)
Water heating gains (Table 5)	93.2981	90.8844	85.8722	79.0581	74.3292	67.3844	62.0899	69.5893	72.3046	79.3573	87.3211	90.8945	(72)
Total internal gains	439.5705	437.2617	421.7564	396.6628	370.7660	345.4369	329.4676	336.8622	350.0706	375.4028	404.5344	426.4922	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	9.5400	36.7938	0.6000	0.9000	0.7700	131.3561	(77)
Southwest	19.7200	36.7938	0.6000	0.9000	0.7700	271.5244	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	402.8806	686.2547	938.9636	1163.4214	1303.1290	1293.7054	1247.2701	1143.0420	1016.6990	758.4576	482.5581	344.7818	(83)
Total gains	842.4511	1123.5164	1360.7200	1560.0842	1673.8950	1639.1423	1576.7376	1479.9042	1366.7696	1133.8605	887.0925	771.2740	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	88.4102	88.6840	88.9596	90.3634	90.6495	92.1076	92.1076	92.4049	91.5188	90.6495	90.0791	89.5158	
alpha	6.8940	6.9123	6.9306	7.0242	7.0433	7.1405	7.1405	7.1603	7.1013	7.0433	7.0053	6.9677	
util living area	0.9826	0.9180	0.7810	0.5896	0.4250	0.2943	0.2104	0.2336	0.3828	0.6842	0.9412	0.9893	(86)
MIT	20.5131	20.7691	20.9303	20.9898	20.9990	20.9999	21.0000	21.0000	20.9996	20.9788	20.7613	20.4555	(87)
Th 2	20.2659	20.2680	20.2702	20.2807	20.2828	20.2934	20.2934	20.2955	20.2892	20.2828	20.2786	20.2744	(88)
util rest of house	0.9779	0.9015	0.7517	0.5563	0.3925	0.2619	0.1766	0.1978	0.3435	0.6424	0.9260	0.9863	(89)
MIT 2	19.8331	20.0763	20.2177	20.2740	20.2823	20.2934	20.2934	20.2955	20.2890	20.2693	20.0823	19.7842	(90)
Living area fraction									fLA = Living area / (4) =			0.4066	(91)
MIT	20.1096	20.3580	20.5075	20.5651	20.5737	20.5807	20.5807	20.5820	20.5780	20.5578	20.3584	20.0572	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.9596	20.2080	20.3575	20.4151	20.4237	20.4307	20.4307	20.4320	20.4280	20.4078	20.2084	19.9072	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9756	0.9000	0.7553	0.5626	0.3989	0.2682	0.1832	0.2047	0.3512	0.6499	0.9243	0.9844	(94)
Useful gains	821.8794	1011.2148	1027.7839	877.7205	667.6770	439.5768	288.8150	303.0092	479.9805	736.8553	819.9255	759.2664	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1230.0323	1198.7007	1081.7534	884.9341	668.3013	439.6035	288.8163	303.0120	480.1656	751.3543	1010.5614	1218.5271	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	303.6658	125.9905	40.1533	5.1938	0.4645	0.0000	0.0000	0.0000	0.0000	10.7873	137.2578	341.6900	(98)
Space heating												965.2030	(98)
Space heating per m2											(98) / (4) =	9.6520	(99)

8c. Space cooling requirement

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	708.7120	557.9222	571.1578	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9996	0.9999	0.9998	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	708.4446	557.8673	571.0619	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2011.2850	1936.4227	1824.5148	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	938.0451	1025.6453	932.5690	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2896.2594	(104)
Cooled fraction									fC = cooled area / (4) =			0.5284	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												0.0000	(107)
Space cooling per m2												0.0000	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1067.7024	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	303.6658	125.9905	40.1533	5.1938	0.4645	0.0000	0.0000	0.0000	0.0000	10.7873	137.2578	341.6900	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	335.9135	139.3701	44.4174	5.7454	0.5138	0.0000	0.0000	0.0000	0.0000	11.9328	151.8339	377.9757	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	221.4071	195.1025	204.7910	183.4296	178.7374	157.4219	150.8222	168.1314	168.8054	190.2134	201.3223	216.0289	(64)
Efficiency of water heater												80.3000	(216)
(217)m	85.8469	83.9817	81.7981	80.5478	80.3233	80.3000	80.3000	80.3000	80.3000	80.7844	84.1096	86.2004	(217)
Fuel for water heating, kWh/month	257.9091	232.3156	250.3615	227.7277	222.5226	196.0422	187.8234	209.3791	210.2185	235.4581	239.3572	250.6125	(219)
Water heating fuel used												2719.7274	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												0.0000	(221)

Annual totals kWh/year		
Space heating fuel - main system	1067.7024	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)		
mechanical ventilation fans (SFP = 0.9875)	337.3300	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	412.3300	(231)
Electricity for lighting (calculated in Appendix L)	403.5701	(232)
Total delivered energy for all uses	4603.3299	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1067.7024	0.2160	230.6237	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2719.7274	0.2160	587.4611	(264)
Space and water heating			818.0848	(265)
Space cooling	0.0000	0.5190	0.0000	(266)
Pumps and fans	412.3300	0.5190	213.9993	(267)
Energy for lighting	403.5701	0.5190	209.4529	(268)
Total CO2, kg/year			1241.5370	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.4200	(273)

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

DER		12.4200	ZC1
Total Floor Area	TFA	100.0000	
Assumed number of occupants	N	2.7395	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1894	ZC2
CO2 emissions from cooking, equation (L16)		1.8475	ZC3
Total CO2 emissions		29.4569	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.4569	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	100.0000	(1b)	x	2.8000	(2b)	=	280.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.0000							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	280.0000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1071	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3571	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3188	0.3125	0.3063	0.2750	0.2688	0.2375	0.2375	0.2313	0.2500	0.2688	0.2813	0.2938	(22b)
Effective ac	0.5508	0.5488	0.5469	0.5378	0.5361	0.5282	0.5282	0.5267	0.5313	0.5361	0.5396	0.5431	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			25.0000	1.3258	33.1439			(27)
External Wall 1	73.6100	29.2600	44.3500	0.1800	7.9830			(29a)
Total net area of external elements Aum(A, m2)			69.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.1269			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		3.4675	(36)
Total fabric heat loss	(33) + (36) =	44.5944	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.8940	50.7117	50.5331	49.6939	49.5369	48.8060	48.8060	48.6706	49.0875	49.5369	49.8545	50.1866	(38)
Heat transfer coeff	95.4884	95.3062	95.1275	94.2883	94.1313	93.4004	93.4004	93.2651	93.6819	94.1313	94.4489	94.7810	(39)
Average = Sum(39)m / 12 =												94.2876	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9549	0.9531	0.9513	0.9429	0.9413	0.9340	0.9340	0.9327	0.9368	0.9413	0.9445	0.9478	(40)
HLP (average)												0.9429	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7395	(42)
Average daily hot water use (litres/day)	99.2637	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.1901	105.2196	101.2490	97.2785	93.3079	89.3374	89.3374	93.3079	97.2785	101.2490	105.2196	109.1901	(44)
Energy conte	161.9258	141.6213	146.1405	127.4088	122.2518	105.4940	97.7557	112.1761	113.5159	132.2918	144.4068	156.8165	(45)
Energy content (annual)										Total = Sum(45)m =		1561.8051	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2889	21.2432	21.9211	19.1113	18.3378	15.8241	14.6634	16.8264	17.0274	19.8438	21.6610	23.5225	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.9729	47.5487	44.0568	45.5253	47.5487	47.9729	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	212.8847	187.6487	197.0994	175.3818	169.8005	149.5508	143.2811	159.7248	161.4888	183.2507	193.7219	207.7754	(62)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	212.8847	187.6487	197.0994	175.3818	169.8005	149.5508	143.2811	159.7248	161.4888	183.2507	193.7219	207.7754	(64)
								Total per year (kWh/year) = Sum(64)m =				2141.6086	(64)
Heat gains from water heating, kWh/month	66.5800	58.5959	61.3314	54.3567	52.5359	46.0910	43.8851	49.1857	49.7373	56.7267	60.3440	64.8812	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.8518	20.2968	16.5064	12.4964	9.3412	7.8863	8.5214	11.0764	14.8667	18.8768	22.0320	23.4869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	256.3278	258.9876	252.2848	238.0153	220.0027	203.0733	191.7634	189.1036	195.8064	210.0759	228.0885	245.0179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	(71)
Water heating gains (Table 5)	89.4893	87.1963	82.4347	75.4954	70.6128	64.0152	58.9854	66.1099	69.0795	76.2456	83.8112	87.2059	(72)
Total internal gains	435.7618	433.5736	418.3189	393.1001	367.0496	342.0677	326.3631	333.3827	346.8455	372.2911	401.0246	422.8036	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	8.1500	36.7938	0.6300	0.7000	0.7700	91.6441	(77)
Southwest	16.8500	36.7938	0.6300	0.7000	0.7700	189.4727	(79)

Solar gains	281.1168	478.8460	655.1779	811.7972	909.2806	902.7051	870.3041	797.5771	709.4192	529.2268	336.7132	240.5774	(83)
Total gains	716.8786	912.4196	1073.4969	1204.8973	1276.3301	1244.7728	1196.6672	1130.9599	1056.2647	901.5180	737.7377	663.3811	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.7255	72.8646	73.0014	73.6512	73.7740	74.3513	74.3513	74.4592	74.1279	73.7740	73.5259	73.2683	
alpha	5.8484	5.8576	5.8668	5.9101	5.9183	5.9568	5.9568	5.9639	5.9419	5.9183	5.9017	5.8846	
util living area	0.9948	0.9801	0.9380	0.8309	0.6609	0.4770	0.3430	0.3786	0.5987	0.8882	0.9851	0.9966	(86)
MIT	20.1417	20.3764	20.6371	20.8637	20.9689	20.9961	20.9995	20.9992	20.9863	20.8260	20.4282	20.0920	(87)
Th 2	20.1211	20.1226	20.1241	20.1312	20.1325	20.1387	20.1387	20.1398	20.1363	20.1325	20.1298	20.1271	(88)
util rest of house	0.9932	0.9744	0.9217	0.7948	0.6072	0.4143	0.2761	0.3082	0.5292	0.8534	0.9799	0.9955	(89)
MIT 2	18.9820	19.3212	19.6865	19.9864	20.1057	20.1364	20.1385	20.1395	20.1270	19.9496	19.4042	18.9143	(90)
Living area fraction									fLA = Living area / (4) =			0.4066	(91)
MIT	19.4535	19.7503	20.0730	20.3431	20.4567	20.4859	20.4886	20.4891	20.4764	20.3060	19.8206	19.3932	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4535	19.7503	20.0730	20.3431	20.4567	20.4859	20.4886	20.4891	20.4764	20.3060	19.8206	19.3932	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9714	0.9206	0.8041	0.6277	0.4397	0.3033	0.3369	0.5571	0.8611	0.9775	0.9943	(94)
Useful gains	710.8798	886.3615	988.2342	968.9046	801.2046	547.3823	362.9905	380.9804	588.4056	776.2998	721.1530	659.6233	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1446.9841	1415.3210	1291.1658	1078.9478	824.2774	549.7501	363.1987	381.3671	597.3535	913.6352	1201.4438	1440.0259	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	547.6616	355.4607	225.3812	79.2311	17.1662	0.0000	0.0000	0.0000	0.0000	102.1776	345.8093	580.6195	(98)
Space heating												2253.5072	(98)
Space heating per m2											(98) / (4) =	22.5351	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2412.7486	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	547.6616	355.4607	225.3812	79.2311	17.1662	0.0000	0.0000	0.0000	0.0000	102.1776	345.8093	580.6195	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	586.3614	380.5789	241.3075	84.8298	18.3792	0.0000	0.0000	0.0000	0.0000	109.3979	370.2455	621.6483	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	212.8847	187.6487	197.0994	175.3818	169.8005	149.5508	143.2811	159.7248	161.4888	183.2507	193.7219	207.7754	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.3256	86.6351	85.3894	83.1924	81.1323	80.3000	80.3000	80.3000	80.3000	83.6454	86.4938	87.4996	(217)
Fuel for water heating, kWh/month	243.7828	216.5967	230.8242	210.8148	209.2885	186.2401	178.4322	198.9101	201.1069	219.0803	223.9720	237.4587	(219)

Water heating fuel used	2556.5074	(219)
Annual totals kWh/year		
Space heating fuel - main system	2412.7486	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	403.5701	(232)
Total delivered energy for all uses	5447.8261	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2412.7486	0.2160	521.1537	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2556.5074	0.2160	552.2056	(264)
Space and water heating			1073.3593	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	403.5701	0.5190	209.4529	(268)
Total CO2, kg/m2/year			1321.7372	(272)
Emissions per m2 for space and water heating			10.7336	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0945	(272b)
Emissions per m2 for pumps and fans			0.3893	(272c)
Target Carbon Dioxide Emission Rate (TER) = (10.7336 * 1.00) + 2.0945 + 0.3893, rounded to 2 d.p.			13.2200	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A6-F4&5	Issued on Date	24/07/2020
Assessment Reference	A6-F4&5	Prop Type Ref	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	86 B	DER	13.57	TER	14.25
Environmental	87 B	% DER<TER	4.77		
CO_2 Emissions (t/year)	2.00	DFEE	45.24	TFEE	51.16
General Requirements Compliance	Pass	% DFEE<TFEE	11.56		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	Assessor ID	T613-0001
Client	CO-RE, 4650		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 188 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 14.25 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.57 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.2 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.13 (max. 0.30)       0.13 (max. 0.70)         OK
Party wall      0.00 (max. 0.20)        -                       OK
Floor           (no floor)
Roof            0.11 (max. 0.20)       0.11 (max. 0.35)         OK
Openings        1.30 (max. 2.00)       1.30 (max. 3.30)         OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                              OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC plus 825 VUW 196/5-5 (H-GB) R6
Combi boiler
Efficiency: 89.5% SEDBUK2009
Minimum: 88.0%                                   OK

Secondary heating system:              None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Time and temperature zone control                 OK


Hot water controls:                    No cylinder


Boiler interlock                       Yes                                               OK
----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                               OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.79
Maximum                                1.5                                               OK
MVHR efficiency:                       84%
Minimum:                               70%                                               OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):      Not significant                                   OK
Based on:
Overshading:                           Average
Windows facing North East:             37.54 m², No overhang
Air change rate:                       8.00 ach
Blinds/curtains:                       Light-coloured venetian blind, closed 50% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                  0.13 W/m²K
External wall U-value                  0.13 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Roof U-value                           0.11 W/m²K
Air permeability                       3.0 m³/m²h



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	86.8500	(1b)	x	2.8000	(2b)	=	243.1800	(1b) - (3b)
First floor	101.0000	(1c)	x	2.8000	(2c)	=	282.8000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 187.8500								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	525.9800	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	71.4000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3056	0.3024	0.2992	0.2833	0.2801	0.2641	0.2641	0.2609	0.2705	0.2801	0.2864	0.2928	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			37.5400	1.2357	46.3897			(27)
External Wall 1	54.2800	18.7200	35.5600	0.1300	4.6228			(29a)
External Wall 2	54.3800	18.8200	35.5600	0.1300	4.6228			(29a)
External Roof 1	101.0000		101.0000	0.1100	11.1100			(30)
Total net area of external elements Aum(A, m2)			209.6600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.7453			(33)
Party Wall 1			15.9000	0.0000	0.0000			(32)
Party Wall 2			21.4800	0.0000	0.0000			(32)
Party Wall 3			43.5100	0.0000	0.0000			(32)
Party Wall 4			15.9600	0.0000	0.0000			(32)
Party Wall 5			23.3000	0.0000	0.0000			(32)
Party Wall 6			86.6600	0.0000	0.0000			(32)
Party Floor 1			86.8500					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		31.4490	(36)
Total fabric heat loss	(33) + (36) =	98.1943	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.0375	52.4843	51.9310	49.1647	48.6114	45.8451	45.8451	45.2918	46.9516	48.6114	49.7179	50.8245	(38)
Heat transfer coeff	151.2319	150.6786	150.1253	147.3590	146.8057	144.0394	144.0394	143.4861	145.1459	146.8057	147.9123	149.0188	(39)
Average = Sum(39)m / 12 =												147.2207	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8051	0.8021	0.7992	0.7845	0.7815	0.7668	0.7668	0.7638	0.7727	0.7815	0.7874	0.7933	(40)
HLP (average)												0.7837	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9861	(42)
Average daily hot water use (litres/day)	110.6522	(43)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	121.7175	117.2914	112.8653	108.4392	104.0131	99.5870	99.5870	104.0131	108.4392	112.8653	117.2914	121.7175	(44)
Energy conte	180.5035	157.8695	162.9072	142.0264	136.2777	117.5973	108.9712	125.0461	126.5395	147.4696	160.9746	174.8080	(45)
Energy content (annual)										Total = Sum(45)m =		1740.9905	(45)
Distribution loss (46)m = 0.15 x (45)m													
	27.0755	23.6804	24.4361	21.3040	20.4417	17.6396	16.3457	18.7569	18.9809	22.1204	24.1462	26.2212	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.1114	50.7484	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	231.4624	203.8969	213.8661	191.3415	187.2366	166.7087	159.7197	176.0050	175.8546	198.4285	210.2897	225.7669	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	231.4624	203.8969	213.8661	191.3415	187.2366	166.7087	159.7197	176.0050	175.8546	198.4285	210.2897	225.7669	(64)
								Total per year (kWh/year) = Sum(64)m =				2340.5764	(64)
Heat gains from water heating, kWh/month													
	72.7571	63.9985	66.9064	59.5526	58.0521	51.3790	48.9200	54.3175	54.4032	61.7734	65.8528	70.8634	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	32.0360	28.4541	23.1404	17.5188	13.0955	11.0558	11.9462	15.5281	20.8417	26.4634	30.8867	32.9264	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	359.3466	363.0755	353.6788	333.6744	308.4223	284.6890	268.8337	265.1048	274.5015	294.5059	319.7579	343.4913	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	(71)
Water heating gains (Table 5)													
	97.7918	95.2358	89.9279	82.7119	78.0270	71.3597	65.7527	73.0074	75.5599	83.0287	91.4622	95.2465	(72)
Total internal gains													
	559.9658	557.5567	537.5385	504.6964	470.3362	437.8958	417.3239	424.4316	441.6945	474.7893	512.8982	542.4555	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	37.5400	11.2829	0.6000	0.9000	0.7700	158.5052	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	158.5052	322.6420	581.2982	954.6587	1283.2486	1368.0788	1279.8097	1020.2791	708.3210	394.2941	199.4406	129.4433	(83)
Total gains	718.4710	880.1987	1118.8367	1459.3550	1753.5847	1805.9746	1697.1336	1444.7107	1150.0155	869.0834	712.3388	671.8988	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	86.2592	86.5759	86.8950	88.5262	88.8599	90.5665	90.5665	90.9157	89.8760	88.8599	88.1951	87.5402	
alpha	6.7506	6.7717	6.7930	6.9017	6.9240	7.0378	7.0378	7.0610	6.9917	6.9240	6.8797	6.8360	
util living area													
	0.9999	0.9993	0.9947	0.9427	0.7432	0.5082	0.3732	0.4559	0.8069	0.9912	0.9996	0.9999	(86)
MIT	20.0359	20.1746	20.4318	20.7818	20.9668	20.9979	20.9998	20.9992	20.9605	20.6434	20.2806	20.0206	(87)
Th 2	20.2489	20.2515	20.2540	20.2668	20.2694	20.2822	20.2822	20.2848	20.2771	20.2694	20.2643	20.2592	(88)
util rest of house													
	0.9998	0.9991	0.9928	0.9250	0.6955	0.4523	0.3125	0.3855	0.7447	0.9868	0.9994	0.9999	(89)
MIT 2	18.9256	19.1306	19.5078	20.0118	20.2392	20.2809	20.2821	20.2845	20.2455	19.8283	19.2958	18.9111	(90)
Living area fraction										fLA = Living area / (4) =		0.3627	(91)
MIT	19.3284	19.5093	19.8429	20.2911	20.5031	20.5409	20.5425	20.5437	20.5049	20.1240	19.6530	19.3136	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1784	19.3593	19.6929	20.1411	20.3531	20.3909	20.3925	20.3937	20.3549	19.9740	19.5030	19.1636	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9997	0.9987	0.9909	0.9215	0.7012	0.4608	0.3218	0.3963	0.7519	0.9843	0.9991	0.9998	(94)
Useful gains	718.2510	879.0644	1108.6603	1344.8430	1229.6045	832.1660	546.1361	572.5408	864.7516	855.4398	711.6886	671.7699	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2250.0822	2178.7095	1980.5936	1656.4832	1270.3311	834.1247	546.2632	573.0458	907.8689	1376.1526	1834.5556	2229.8563	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1139.6825	873.3615	648.7184	224.3810	30.3006	0.0000	0.0000	0.0000	0.0000	387.4103	808.4642	1159.2163	(98)
Space heating												5271.5348	(98)
Space heating per m2											(98) / (4) =	28.0625	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1353.9704	1065.8916	1090.4947	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9883	0.9959	0.9889	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1338.1473	1061.5383	1078.3939	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2238.5856	2108.3683	1815.6648	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	648.3156	778.8415	548.5296	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1975.6866	(104)
Cooled fraction									fC = cooled area / (4) =			0.5109	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	82.8125	99.4852	70.0664	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												252.3641	(107)
Space cooling per m2												1.3434	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5831.3438	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1139.6825	873.3615	648.7184	224.3810	30.3006	0.0000	0.0000	0.0000	0.0000	387.4103	808.4642	1159.2163	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	1260.7107	966.1079	717.6088	248.2090	33.5184	0.0000	0.0000	0.0000	0.0000	428.5513	894.3189	1282.3189	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	231.4624	203.8969	213.8661	191.3415	187.2366	166.7087	159.7197	176.0050	175.8546	198.4285	210.2897	225.7669	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.5205	88.2979	87.6661	85.4530	81.5694	80.3000	80.3000	80.3000	80.3000	86.7061	88.1123	88.5838	(217)
Fuel for water heating, kWh/month	261.4789	230.9192	243.9552	223.9142	229.5427	207.6074	198.9037	219.1843	218.9970	228.8517	238.6608	254.8626	(219)
Water heating fuel used												2756.8778	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	20.7031	24.8713	17.5166	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												63.0910	(221)

Annual totals kWh/year		
Space heating fuel - main system	5831.3438	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)		
mechanical ventilation fans (SFP = 0.9875)	633.6744	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	708.6744	(231)
Electricity for lighting (calculated in Appendix L)	565.7660	(232)
Total delivered energy for all uses	9925.7530	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5831.3438	0.2160	1259.5703	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2756.8778	0.2160	595.4856	(264)
Space and water heating			1855.0559	(265)
Space cooling	63.0910	0.5190	32.7442	(266)
Pumps and fans	708.6744	0.5190	367.8020	(267)
Energy for lighting	565.7660	0.5190	293.6325	(268)
Total CO2, kg/year			2549.2347	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.5700	(273)

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

DER		13.5700	ZC1
Total Floor Area	TFA	187.8500	
Assumed number of occupants	N	2.9861	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.3357	ZC2
CO2 emissions from cooking, equation (L16)		1.0150	ZC3
Total CO2 emissions		25.9207	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.9207	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)
Ground floor	86.8500 (1b)	x	2.8000 (2b)	=	243.1800 (1b) - (3b)
First floor	101.0000 (1c)	x	2.8000 (2c)	=	282.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 187.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	525.9800 (5)

2. Ventilation rate

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

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0760 (8)
Pressure test		Yes
Measured/design AP50		5.0000
Infiltration rate		0.3260 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2771 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3534	0.3464	0.3395	0.3049	0.2979	0.2633	0.2633	0.2564	0.2771	0.2979	0.3118	0.3256	(22b)
Effective ac	0.5624	0.5600	0.5576	0.5465	0.5444	0.5347	0.5347	0.5329	0.5384	0.5444	0.5486	0.5530	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			37.5400	1.3258	49.7689			(27)
External Wall 1	54.2800	18.7200	35.5600	0.1800	6.4008			(29a)
External Wall 2	54.3800	18.8200	35.5600	0.1800	6.4008			(29a)
External Roof 1	101.0000		101.0000	0.1300	13.1300			(30)
Total net area of external elements Aum(A, m2)			209.6600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.7005			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		10.4830 (36)
Total fabric heat loss	(33) + (36) =	86.1835 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	97.6229	97.2021	96.7896	94.8524	94.4899	92.8026	92.8026	92.4902	93.4525	94.4899	95.2232	95.9897	(38)
Heat transfer coeff	183.8064	183.3856	182.9732	181.0359	180.6735	178.9862	178.9862	178.6737	179.6361	180.6735	181.4067	182.1733	(39)
Average = Sum(39)m / 12 =												181.0342	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9785	0.9762	0.9740	0.9637	0.9618	0.9528	0.9528	0.9512	0.9563	0.9618	0.9657	0.9698	(40)
HLP (average)												0.9637	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9861	(42)
Average daily hot water use (litres/day)	105.1196	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.6316	111.4268	107.2220	103.0172	98.8124	94.6077	94.6077	98.8124	103.0172	107.2220	111.4268	115.6316	(44)
Energy conte	171.4783	149.9760	154.7618	134.9251	129.4638	111.7175	103.5226	118.7937	120.2125	140.0961	152.9259	166.0676	(45)
Energy content (annual)										Total = Sum(45)m =		1653.9410	(45)
Distribution loss (46)m = 0.15 x (45)m	25.7217	22.4964	23.2143	20.2388	19.4196	16.7576	15.5284	17.8191	18.0319	21.0144	22.9389	24.9101	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Combi loss       50.9589     46.0274     50.9589     49.3151     50.3537     46.6558     48.2110     50.3537     49.3151     50.9589     49.3151     50.9589 (61)
Total heat required for water heating calculated for each month
                222.4372    196.0034    205.7207    184.2402    179.8176    158.3733    151.7337    169.1475    169.5276    191.0550    202.2409    217.0265 (62)
Solar input       0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (63)
                                                                                              Solar input (sum of months) = Sum(63)m =        0.0000 (63)
Output from w/h
                222.4372    196.0034    205.7207    184.2402    179.8176    158.3733    151.7337    169.1475    169.5276    191.0550    202.2409    217.0265 (64)
                                                                                                Total per year (kWh/year) = Sum(64)m =     2247.3235 (64)
Heat gains from water heating, kWh/month
                 69.7563     61.3739     64.1980     57.1914     55.6352     48.8100     46.4740     52.0874     52.2994     59.3217     63.1766     67.9572 (65)


-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                     Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
(66)m           149.3045    149.3045    149.3045    149.3045    149.3045    149.3045    149.3045    149.3045    149.3045    149.3045    149.3045    149.3045 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 32.2644     28.6569     23.3054     17.6437     13.1889     11.1346     12.0313     15.6388     20.9903     26.6520     31.1068     33.1611 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                359.3466    363.0755    353.6788    333.6744    308.4223    284.6890    268.8337    265.1048    274.5015    294.5059    319.7579    343.4913 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 37.9304     37.9304     37.9304     37.9304     37.9304     37.9304     37.9304     37.9304     37.9304     37.9304     37.9304     37.9304 (69)
Pumps, fans       3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000      3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -119.4436   -119.4436   -119.4436   -119.4436   -119.4436   -119.4436   -119.4436   -119.4436   -119.4436   -119.4436   -119.4436   -119.4436 (71)
Water heating gains (Table 5)
                 93.7584     91.3302     86.2877     79.4324     74.7784     67.7917     62.4651     70.0099     72.6381     79.7334     87.7453     91.3403 (72)
Total internal gains
                556.1607    553.8539    534.0632    501.5418    467.1810    434.4066    414.1214    421.5448    438.9212    471.6827    509.4014    538.7840 (73)


-----------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------

[Jan]                                       Area          Solar flux               g               FF              Access                Gains
                                              m2            Table 6a   Specific data   Specific data              factor                    W
                                                                W/m2     or Table 6b     or Table 6c            Table 6d
-----------------------------------------------------------------------------------------------------
Northeast                                37.5400             11.2829          0.6300          0.7000              0.7700             129.4459 (75)
-----------------------------------------------------------------------------------------------------

Solar gains     129.4459    263.4909    474.7269    779.6379   1047.9863   1117.2643   1045.1779    833.2279    578.4621    322.0068    162.8765    105.7121 (83)
Total gains     685.6067    817.3449   1008.7901   1281.1797   1515.1673   1551.6710   1459.2993   1254.7727   1017.3834    793.6895    672.2779    644.4961 (84)


-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                               21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                     Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
tau              70.9722     71.1350     71.2954     72.0583     72.2029     72.8835     72.8835     73.0110     72.6198     72.2029     71.9110     71.6084
alpha             5.7315      5.7423      5.7530      5.8039      5.8135      5.8589      5.8589      5.8674      5.8413      5.8135      5.7941      5.7739
util living area
                  0.9999      0.9995      0.9976      0.9810      0.8935      0.7009      0.5329      0.6350      0.9237      0.9961      0.9997      0.9999 (86)

MIT              19.7696     19.8974     20.1495     20.5168     20.8310     20.9700     20.9949     20.9870     20.8447     20.4365     20.0432     19.7511 (87)
Th 2             20.1013     20.1032     20.1050     20.1137     20.1153     20.1228     20.1228     20.1242     20.1199     20.1153     20.1120     20.1086 (88)
util rest of house
                  0.9998      0.9994      0.9967      0.9733      0.8547      0.6198      0.4303      0.5242      0.8786      0.9939      0.9995      0.9999 (89)
MIT 2            18.4241     18.6126     18.9825     19.5201     19.9444     20.1025     20.1208     20.1184     19.9776     19.4099     18.8326     18.4023 (90)
Living area fraction                                                                                          fLA = Living area / (4) =        0.3627 (91)
MIT              18.9122     19.0786     19.4058     19.8817     20.2660     20.4172     20.4379     20.4335     20.2921     19.7823     19.2718     18.8915 (92)
Temperature adjustment                                                                                                                         0.0000
adjusted MIT     18.9122     19.0786     19.4058     19.8817     20.2660     20.4172     20.4379     20.4335     20.2921     19.7823     19.2718     18.8915 (93)


-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                     Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation       0.9997      0.9991      0.9957      0.9708      0.8621      0.6482      0.4677      0.5647      0.8891      0.9928      0.9993      0.9998 (94)
Useful gains    685.4028    816.6161   1004.4430   1243.7311   1306.2647   1005.8225    682.5030    708.5571    904.5068    787.9566    671.8019    644.3644 (95)
Ext temp.         4.3000      4.9000      6.5000      8.9000     11.7000     14.6000     16.6000     16.4000     14.1000     10.6000      7.1000      4.2000 (96)
Heat loss rate W
               2685.8130   2600.1606   2361.4103   1988.0765   1547.6473   1041.1931    686.9273    720.6779   1112.3227   1659.0000   2208.0393   2676.4077 (97)
Month fracti      1.0000      1.0000      1.0000      1.0000      1.0000      0.0000      0.0000      0.0000      0.0000      1.0000      1.0000      1.0000 (97a)
Space heating kWh
               1488.3052   1198.5420   1009.5837    535.9287    179.5886      0.0000      0.0000      0.0000      0.0000    648.0563   1106.0909   1511.8402 (98)
Space heating                                                                                                                               7677.9356 (98)
Space heating per m2                                                                                                       (98) / (4) =      40.8727 (99)


-----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
-----------------------------------------------------------------------------------------------------
Not applicable


-----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                      0.0000 (201)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	8220.4878	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1488.3052	1198.5420	1009.5837	535.9287	179.5886	0.0000	0.0000	0.0000	0.0000	648.0563	1106.0909	1511.8402	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	1593.4745	1283.2355	1080.9247	573.7995	192.2791	0.0000	0.0000	0.0000	0.0000	693.8504	1184.2515	1618.6726	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	222.4372	196.0034	205.7207	184.2402	179.8176	158.3733	151.7337	169.1475	169.5276	191.0550	202.2409	217.0265	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.9454	88.8297	88.5154	87.5818	85.0480	80.3000	80.3000	80.3000	80.3000	87.8832	88.6759	88.9949	(217)
Fuel for water heating, kWh/month	250.0829	220.6509	232.4123	210.3635	211.4307	197.2270	188.9585	210.6444	211.1178	217.3965	228.0675	243.8641	(219)

Water heating fuel used	2622.2162	(219)
Annual totals kWh/year		
Space heating fuel - main system	8220.4878	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	569.7989	(232)
Total delivered energy for all uses	11487.5029	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8220.4878	0.2160	1775.6254	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2622.2162	0.2160	566.3987	(264)
Space and water heating			2342.0241	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	569.7989	0.5190	295.7256	(268)
Total CO2, kg/m2/year			2676.6747	(272)
Emissions per m2 for space and water heating			12.4675	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.5743	(272b)
Emissions per m2 for pumps and fans			0.2072	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.4675 * 1.00) + 1.5743 + 0.2072, rounded to 2 d.p.			14.2500	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A7-F4	Issued on Date	24/07/2020
Assessment Reference	A7-F4	Prop Type Ref	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	85 B	DER	13.87	TER	14.51
Environmental	89 B	% DER<TER	4.43		
CO_2 Emissions (t/year)	1.00	DFEE	31.70	TFEE	34.40
General Requirements Compliance	Pass	% DFEE<TFEE	7.84		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	Assessor ID	T613-0001
Client	CO-RE, 4650		

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

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

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 83 m^2

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 14.51 kgCO□/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 13.87 kgCO□/m^2OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)34.4 kWh/m^2/yr
Dwelling Fabric Energy Efficiency (DFEE)31.7 kWh/m^2/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC plus 825 VUW 196/5-5 (H-GB) R6
Combi boiler
Efficiency: 89.5% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage: No cylinder

---

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	
Boiler interlock	Yes	OK

---

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

---

8 Mechanical ventilation
Continuous supply and extract system

Specific fan power:	0.66	
Maximum	1.5	OK
MVHR efficiency:	85%	
Minimum:	70%	OK

---

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing South East:	9.54 m^2, No overhang	
Windows facing South West:	19.72 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

---

10 Key features

External wall U-value	0.13 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.11 W/m^2K
Air permeability	3.0 m^3/m^2h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)			Storey height (m)			Volume (m3)	
Ground floor		83.0500	(1b)	x	2.8000	(2b)	=	232.5400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.0500								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	232.5400	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 72.2500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2726	0.2700	0.2674	0.2543	0.2516	0.2385	0.2385	0.2359	0.2438	0.2516	0.2569	0.2621	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			29.2600	1.2357	36.1578			(27)
External Wall 1	73.6100	29.2600	44.3500	0.1300	5.7655			(29a)
External Roof 1	3.3500		3.3500	0.1100	0.3685			(30)
Total net area of external elements Aum(A, m2)			76.9600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.2918			(33)
Party Wall 1			17.8100	0.0000	0.0000			(32)
Party Wall 2			16.4100	0.0000	0.0000			(32)
Party Wall 3			23.1800	0.0000	0.0000			(32)
Party Wall 4			19.5400	0.0000	0.0000			(32)
Party Floor 1			83.0500					(32d)
Party Ceilings 1			79.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		11.5440	(36)
Total fabric heat loss	(33) + (36) =	53.8358	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	20.9208	20.7193	20.5179	19.5107	19.3092	18.3021	18.3021	18.1006	18.7049	19.3092	19.7121	20.1150	(38)
Heat transfer coeff	74.7565	74.5551	74.3537	73.3465	73.1450	72.1379	72.1379	71.9364	72.5407	73.1450	73.5479	73.9508	(39)
Average = Sum(39)m / 12 =												73.2961	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9001	0.8977	0.8953	0.8832	0.8807	0.8686	0.8686	0.8662	0.8735	0.8807	0.8856	0.8904	(40)
HLP (average)												0.8826	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5182	(42)
Average daily hot water use (litres/day)	98.9547	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.8502	104.8920	100.9338	96.9756	93.0175	89.0593	89.0593	93.0175	96.9756	100.9338	104.8920	108.8502	(44)
Energy conte	161.4217	141.1805	145.6856	127.0122	121.8713	105.1656	97.4514	111.8269	113.1625	131.8800	143.9573	156.3283	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)											Total = Sum(45)m =	1556.9433	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.2133	21.1771	21.8528	19.0518	18.2807	15.7748	14.6177	16.7740	16.9744	19.7820	21.5936	23.4492	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.8236	47.4007	43.9196	45.3836	47.4007	47.8236	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	212.3806	187.2079	196.6445	174.8358	169.2719	149.0853	142.8350	159.2276	160.9861	182.8389	193.2724	207.2872	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.3806	187.2079	196.6445	174.8358	169.2719	149.0853	142.8350	159.2276	160.9861	182.8389	193.2724	207.2872	(64)
								Total per year (kWh/year) = Sum(64)m =				2135.8732	(64)
Heat gains from water heating, kWh/month													
	66.4124	58.4494	61.1802	54.1875	52.3724	45.9475	43.7485	49.0326	49.5824	56.5898	60.1946	64.7189	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1210	17.8713	14.5339	11.0031	8.2250	6.9439	7.5031	9.7528	13.0902	16.6210	19.3992	20.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	225.6967	228.0387	222.1369	209.5726	193.7125	178.8061	168.8478	166.5058	172.4076	184.9719	200.8321	215.7384	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	(71)
Water heating gains (Table 5)													
	89.2640	86.9782	82.2314	75.2604	70.3930	63.8159	58.8017	65.9041	68.8645	76.0616	83.6036	86.9878	(72)
Total internal gains													
	398.8546	396.6611	382.6751	359.6089	336.1032	313.3388	298.9255	305.9355	318.1351	341.4273	367.6076	387.1792	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	9.5400	36.7938	0.6000	0.9000	0.7700	131.3561	(77)
Southwest	19.7200	36.7938	0.6000	0.9000	0.7700	271.5244	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	402.8806	686.2547	938.9636	1163.4214	1303.1290	1293.7054	1247.2701	1143.0420	1016.6990	758.4576	482.5581	344.7818	(83)
Total gains	801.7352	1082.9158	1321.6387	1523.0304	1639.2322	1607.0442	1546.1955	1448.9775	1334.8341	1099.8849	850.1657	731.9611	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	77.1486	77.3570	77.5666	78.6317	78.8483	79.9492	79.9492	80.1730	79.5051	78.8483	78.4164	77.9892	
alpha	6.1432	6.1571	6.1711	6.2421	6.2566	6.3299	6.3299	6.3449	6.3003	6.2566	6.2278	6.1993	
util living area													
	0.9754	0.9005	0.7600	0.5742	0.4140	0.2872	0.2053	0.2284	0.3745	0.6688	0.9275	0.9842	(86)
MIT	20.4474	20.7330	20.9127	20.9846	20.9981	20.9999	21.0000	21.0000	20.9992	20.9702	20.7222	20.3804	(87)
Th 2	20.1674	20.1694	20.1715	20.1818	20.1839	20.1943	20.1943	20.1963	20.1901	20.1839	20.1798	20.1756	(88)
util rest of house													
	0.9689	0.8808	0.7277	0.5377	0.3780	0.2511	0.1677	0.1885	0.3308	0.6230	0.9088	0.9798	(89)
MIT 2	19.4570	19.8491	20.0763	20.1671	20.1824	20.1942	20.1943	20.1963	20.1896	20.1564	19.8503	19.3686	(90)
Living area fraction									fLA = Living area / (4) =			0.5645	(91)
MIT	20.0161	20.3480	20.5484	20.6285	20.6428	20.6490	20.6491	20.6500	20.6466	20.6158	20.3425	19.9397	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.8661	20.1980	20.3984	20.4785	20.4928	20.4990	20.4991	20.5000	20.4966	20.4658	20.1925	19.7897	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9661	0.8816	0.7368	0.5511	0.3917	0.2648	0.1819	0.2035	0.3473	0.6391	0.9092	0.9773	(94)
Useful gains	774.5506	954.6563	973.8102	839.2962	642.0280	425.4693	281.2663	294.9276	463.6273	702.9895	772.9352	715.3408	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1163.6646	1140.5475	1033.4004	849.2443	643.1506	425.5388	281.2710	294.9372	464.0164	721.6317	962.9250	1152.8739	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	289.5008	124.9189	44.3351	7.1626	0.8353	0.0000	0.0000	0.0000	0.0000	13.8698	136.7927	325.5246	(98)
Space heating												942.9397	(98)
Space heating per m2											(98) / (4) =	11.3539	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Calculated for June, July and August. See Table 10b
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Ext. temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000
Heat loss rate W
                  0.0000     0.0000     0.0000     0.0000     0.0000   678.0958   533.8201   546.7168     0.0000     0.0000     0.0000     0.0000 (100)
Utilisation       0.0000     0.0000     0.0000     0.0000     0.0000     0.9992     0.9998     0.9996     0.0000     0.0000     0.0000     0.0000 (101)
Useful loss       0.0000     0.0000     0.0000     0.0000     0.0000   677.5648   533.6921   546.5035     0.0000     0.0000     0.0000     0.0000 (102)
Total gains       0.0000     0.0000     0.0000     0.0000     0.0000  1963.1647  1890.4103  1777.8163     0.0000     0.0000     0.0000     0.0000 (103)
Month fracti      0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000 (103a)
Space cooling kWh
                  0.0000     0.0000     0.0000     0.0000     0.0000   925.6320  1009.3983   916.0967     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                      2851.1270 (104)
Cooled fraction                                                                                      fC = cooled area / (4) =         0.7115 (105)
Intermittency factor (Table 10b)
                  0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                  0.0000     0.0000     0.0000     0.0000     0.0000   164.6466     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                       164.6466 (107)
Space cooling per m2                                                                                                                  1.9825 (108)


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9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                 0.0000 (201)
Fraction of space heat from main system(s)                                                                                            1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                     90.4000 (206)
Efficiency of secondary/supplementary heating system, %                                                                               0.0000 (208)
Space heating requirement                                                                                                          1043.0749 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)                                                                                4.0000 (209)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
                289.5008   124.9189    44.3351     7.1626     0.8353     0.0000     0.0000     0.0000     0.0000    13.8698   136.7927   325.5246 (98)
Space heating efficiency (main heating system 1)
                 90.4000    90.4000    90.4000    90.4000    90.4000     0.0000     0.0000     0.0000     0.0000    90.4000    90.4000    90.4000 (210)
Space heating fuel (main heating system)
                320.2443   138.1846    49.0432     7.9232     0.9240     0.0000     0.0000     0.0000     0.0000    15.3427   151.3193   360.0936 (211)
Water heating requirement
                  0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
                212.3806   187.2079   196.6445   174.8358   169.2719   149.0853   142.8350   159.2276   160.9861   182.8389   193.2724   207.2872 (64)
Efficiency of water heater                                                                                                           80.3000 (216)
(217)m           85.8316    84.0587    81.9852    80.6546    80.3441    80.3000    80.3000    80.3000    80.3000    80.9376    84.1987    86.1828 (217)
Fuel for water heating, kWh/month
                247.4388   222.7110   239.8536   216.7710   210.6838   185.6604   177.8768   198.2909   200.4808   225.9010   229.5431   240.5204 (219)
Water heating fuel used                                                                                                            2595.7315 (219)
Space cooling fuel requirement
(221)m            0.0000     0.0000     0.0000     0.0000     0.0000    41.1616     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (221)
Cooling                                                                                                                              41.1616 (221)
Annual totals kWh/year
Space heating fuel - main system                                                                                                   1043.0749 (211)
Space heating fuel - secondary                                                                                                        0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)
   mechanical ventilation fans (SFP =       0.8250)                                                                                 234.0515 (230a)
   central heating pump                                                                                                              30.0000 (230c)
   main heating flue fan                                                                                                             45.0000 (230e)
Total electricity for the above, kWh/year                                                                                           309.0515 (231)
Electricity for lighting (calculated in Appendix L)                                                                                 355.3436 (232)
Total delivered energy for all uses                                                                                                4344.3632 (238)


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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
-----------------------------------------------------------------------------------------------------
                                                                                     Energy      Emission factor           Emissions
                                                                                   kWh/year          kg CO2/kWh         kg CO2/year
Space heating - main system 1                                                     1043.0749              0.2160            225.3042 (261)
Space heating - secondary                                                            0.0000              0.0000              0.0000 (263)
Water heating (other fuel)                                                        2595.7315              0.2160            560.6780 (264)
Space and water heating                                                                                                    785.9822 (265)
Space cooling                                                                       41.1616              0.5190             21.3629 (266)
Pumps and fans                                                                     309.0515              0.5190            160.3977 (267)
Energy for lighting                                                                355.3436              0.5190            184.4233 (268)
Total CO2, kg/year                                                                                                        1152.1662 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                  13.8700 (273)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                          13.8700 ZC1
Total Floor Area                                                                                                  TFA       83.0500
Assumed number of occupants                                                                                         N        2.5182
CO2 emission factor in Table 12 for electricity displaced from grid                                                EF        0.5190
CO2 emissions from appliances, equation (L14)                                                                                16.1039 ZC2
CO2 emissions from cooking, equation (L16)                                                                                    2.1606 ZC3
Total CO2 emissions                                                                                                          32.1345 ZC4
Residual CO2 emissions offset from biofuel CHP                                                                                0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                                      0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                                               0.0000 ZC7
Net CO2 emissions                                                                                                            32.1345 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	83.0500 (1b)	x	2.8000 (2b)	=	232.5400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 83.0500						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	232.5400	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1290	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3790	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2653	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3383	0.3316	0.3250	0.2918	0.2852	0.2520	0.2520	0.2454	0.2653	0.2852	0.2985	0.3117	(22b)
Effective ac	0.5572	0.5550	0.5528	0.5426	0.5407	0.5318	0.5318	0.5301	0.5352	0.5407	0.5445	0.5486	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			20.7700	1.3258	27.5360			(27)
External Wall 1	73.6100	29.2600	44.3500	0.1800	7.9830			(29a)
External Roof 1	3.3500		3.3500	0.1300	0.4355			(30)
Total net area of external elements Aum(A, m2)			68.4700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		35.9545			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		3.4235	(36)
Total fabric heat loss	(33) + (36) =	39.3780	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.7595	42.5890	42.4219	41.6370	41.4901	40.8065	40.8065	40.6799	41.0698	41.4901	41.7872	42.0978	(38)
Heat transfer coeff	82.1374	81.9670	81.7998	81.0150	80.8681	80.1845	80.1845	80.0579	80.4478	80.8681	81.1652	81.4758	(39)
Average = Sum(39)m / 12 =												81.0142	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9890	0.9870	0.9849	0.9755	0.9737	0.9655	0.9655	0.9640	0.9687	0.9737	0.9773	0.9810	(40)
HLP (average)												0.9755	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5182	(42)
Average daily hot water use (litres/day)	94.0070	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.4077	99.6474	95.8871	92.1269	88.3666	84.6063	84.6063	88.3666	92.1269	95.8871	99.6474	103.4077	(44)
Energy conte	153.3506	134.1214	138.4013	120.6616	115.7777	99.9073	92.5788	106.2356	107.5044	125.2860	136.7594	148.5119	(45)
Energy content (annual)										Total = Sum(45)m =		1479.0961	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0026	20.1182	20.7602	18.0992	17.3667	14.9861	13.8868	15.9353	16.1257	18.7929	20.5139	22.2768	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.8651	48.8630	45.4324	45.0306	41.7237	43.1144	45.0306	45.4324	48.8630	49.1412	50.9589	(61)

Total heat required for water heating calculated for each month

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	204.3095	179.9866	187.2643	166.0940	160.8083	141.6310	135.6933	151.2662	152.9368	174.1490	185.9006	199.4708	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	204.3095	179.9866	187.2643	166.0940	160.8083	141.6310	135.6933	151.2662	152.9368	174.1490	185.9006	199.4708	(64)
Total per year (kWh/year) = Sum(64)m =												2039.5105	(64)
Heat gains from water heating, kWh/month	63.7288	56.0617	58.2342	51.4781	49.7537	43.6501	41.5611	46.5810	47.1033	53.8733	57.7578	62.1199	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.1210	17.8713	14.5339	11.0031	8.2250	6.9439	7.5031	9.7528	13.0902	16.6210	19.3992	20.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.6967	228.0387	222.1369	209.5726	193.7125	178.8061	168.8478	166.5058	172.4076	184.9719	200.8321	215.7384	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	(71)
Water heating gains (Table 5)	85.6570	83.4251	78.2718	71.4974	66.8733	60.6251	55.8617	62.6089	65.4213	72.4104	80.2192	83.4945	(72)
Total internal gains	395.2476	393.1080	378.7155	355.8459	332.5836	310.1480	295.9854	302.6403	314.6919	337.7761	364.2232	383.6860	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.7700	36.7938	0.6300	0.7000	0.7700	76.1264	(77)
Southwest	14.0000	36.7938	0.6300	0.7000	0.7700	157.4254	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	233.5519	397.8252	544.3218	674.4412	755.4303	749.9674	723.0486	662.6271	589.3854	439.6816	279.7413	199.8717	(83)
Total gains	628.7995	790.9332	923.0373	1030.2871	1088.0139	1060.1154	1019.0340	965.2674	904.0773	777.4578	643.9645	583.5577	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.2160	70.3620	70.5058	71.1888	71.3181	71.9261	71.9261	72.0399	71.6907	71.3181	71.0571	70.7862	
alpha	5.6811	5.6908	5.7004	5.7459	5.7545	5.7951	5.7951	5.8027	5.7794	5.7545	5.7371	5.7191	
util living area	0.9935	0.9775	0.9347	0.8298	0.6635	0.4803	0.3457	0.3806	0.5993	0.8833	0.9824	0.9956	(86)
MIT	20.1298	20.3631	20.6231	20.8536	20.9647	20.9953	20.9994	20.9990	20.9845	20.8197	20.4214	20.0808	(87)
Th 2	20.0925	20.0942	20.0959	20.1038	20.1053	20.1122	20.1122	20.1135	20.1095	20.1053	20.1023	20.0992	(88)
util rest of house	0.9915	0.9711	0.9176	0.7929	0.6084	0.4154	0.2762	0.3078	0.5280	0.8471	0.9762	0.9942	(89)
MIT 2	18.9430	19.2793	19.6431	19.9485	20.0749	20.1094	20.1120	20.1131	20.0990	19.9169	19.3727	18.8770	(90)
Living area fraction									fLA = Living area / (4) =			0.5645	(91)
MIT	19.6129	19.8911	20.1963	20.4594	20.5772	20.6095	20.6129	20.6132	20.5989	20.4265	19.9646	19.5565	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6129	19.8911	20.1963	20.4594	20.5772	20.6095	20.6129	20.6132	20.5989	20.4265	19.9646	19.5565	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9902	0.9694	0.9197	0.8082	0.6380	0.4520	0.3155	0.3489	0.5677	0.8611	0.9751	0.9932	(94)
Useful gains	622.6151	766.6920	848.9193	832.7220	694.1320	479.1308	321.4977	336.8053	513.2806	669.4725	627.9256	579.5628	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1257.7624	1228.7732	1120.3521	936.4841	717.8790	481.8684	321.7742	337.2973	522.8182	794.6492	1044.1612	1251.1850	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	472.5496	310.5186	201.9460	74.7087	17.6678	0.0000	0.0000	0.0000	0.0000	93.1315	299.6897	499.6870	(98)
Space heating												1969.8988	(98)
Space heating per m2											(98) / (4) =	23.7194	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2109.0993	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	472.5496	310.5186	201.9460	74.7087	17.6678	0.0000	0.0000	0.0000	0.0000	93.1315	299.6897	499.6870	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	505.9417	332.4610	216.2163	79.9879	18.9163	0.0000	0.0000	0.0000	0.0000	99.7125	320.8669	534.9967	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	204.3095	179.9866	187.2643	166.0940	160.8083	141.6310	135.6933	151.2662	152.9368	174.1490	185.9006	199.4708	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.0934	86.4118	85.2415	83.1834	81.1981	80.3000	80.3000	80.3000	80.3000	83.5527	86.2470	87.2684	(217)
Fuel for water heating, kWh/month	234.5867	208.2893	219.6869	199.6722	198.0446	176.3773	168.9829	188.3764	190.4568	208.4302	215.5444	228.5716	(219)

Water heating fuel used	2437.0193	(219)
Annual totals kWh/year		
Space heating fuel - main system	2109.0993	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	355.3436	(232)
Total delivered energy for all uses	4976.4623	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2109.0993	0.2160	455.5655	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2437.0193	0.2160	526.3962	(264)
Space and water heating			981.9616	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3436	0.5190	184.4233	(268)
Total CO2, kg/m2/year			1205.3100	(272)
Emissions per m2 for space and water heating			11.8237	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2206	(272b)
Emissions per m2 for pumps and fans			0.4687	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.8237 * 1.00) + 2.2206 + 0.4687, rounded to 2 d.p.			14.5100	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A8-F5	**Issued on Date**	24/07/2020
Assessment Reference	A8-F5	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	85 B	**DER**	14.82	**TER**	15.63
Environmental	88 B	**% DER<TER**	5.17		
CO_2 Emissions (t/year)	1.15	**DFEE**	38.74	**TFEE**	42.25
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.30		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 94 m^2

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

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.63 $kgCO_2/m^2$
Dwelling Carbon Dioxide Emission Rate (DER) 14.82 $kgCO_2/m^2$OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)42.2 $kWh/m^2/yr$
Dwelling Fabric Energy Efficiency (DFEE)38.7 $kWh/m^2/yr$OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using default y-value of 0.15

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC plus 825 VUW 196/5-5 (H-GB) R6
Combi boiler
Efficiency: 89.5% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage: No cylinder

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	
Boiler interlock	Yes	OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous supply and extract system

Specific fan power:	0.56	
Maximum	1.5	OK
MVHR efficiency:	86%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Not significant	OK
Based on:		
Overshading:	Average	
Windows facing South West:	19.08 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

10 Key features

External wall U-value	0.13 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.11 W/m^2K
Air permeability	3.0 m^3/m^2h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	94.2600 (1b)	x	2.8000 (2b)	=	263.9280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 94.2600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9280	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2684	0.2658	0.2631	0.2500	0.2474	0.2343	0.2343	0.2316	0.2395	0.2474	0.2526	0.2579	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			19.0800	1.2357	23.5779			(27)
External Wall 1	55.2600	19.0800	36.1800	0.1300	4.7034			(29a)
External Roof 1	94.2600		94.2600	0.1100	10.3686			(30)
Total net area of external elements Aum(A, m2)			149.5200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.6499			(33)
Party Wall 1			26.9100	0.0000	0.0000			(32)
Party Wall 2			44.1000	0.0000	0.0000			(32)
Party Wall 3			18.9000	0.0000	0.0000			(32)
Party Floor 1			94.2600					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		22.4280	(36)
Total fabric heat loss	(33) + (36) =	61.0779	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	23.3745	23.1458	22.9172	21.7741	21.5454	20.4023	20.4023	20.1737	20.8595	21.5454	22.0027	22.4599	(38)
Heat transfer coeff	84.4524	84.2238	83.9951	82.8520	82.6234	81.4802	81.4802	81.2516	81.9375	82.6234	83.0806	83.5379	(39)
Average = Sum(39)m / 12 =												82.7948	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8960	0.8935	0.8911	0.8790	0.8765	0.8644	0.8644	0.8620	0.8693	0.8765	0.8814	0.8862	(40)
HLP (average)												0.8784	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6797	(42)
Average daily hot water use (litres/day)	102.9915	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.2906	109.1710	105.0513	100.9317	96.8120	92.6923	92.6923	96.8120	100.9317	105.0513	109.1710	113.2906	(44)
Energy conte	168.0067	146.9398	151.6287	132.1935	126.8429	109.4557	101.4268	116.3888	117.7788	137.2599	149.8299	162.7055	(45)
Energy content (annual)											Total = Sum(45)m =	1620.4570	(45)

Distribution loss (46)m = 0.15 x (45)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	25.2010	22.0410	22.7443	19.8290	19.0264	16.4184	15.2140	17.4583	17.6668	20.5890	22.4745	24.4058	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	49.3343	45.7113	47.2350	49.3343	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	218.9656	192.9672	202.5876	181.5086	176.1772	155.1670	148.6618	165.7231	167.0939	188.2188	199.1449	213.6645	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	218.9656	192.9672	202.5876	181.5086	176.1772	155.1670	148.6618	165.7231	167.0939	188.2188	199.1449	213.6645	(64)
Total per year (kWh/year) = Sum(64)m =												2209.8802	(64)
Heat gains from water heating, kWh/month	68.6020	60.3643	63.1563	56.2831	54.5088	47.8219	45.5332	51.0329	51.4902	58.3786	62.1472	66.8393	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.9935	19.5345	15.8865	12.0271	8.9904	7.5901	8.2013	10.6604	14.3084	18.1678	21.2045	22.6048	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	246.7006	249.2605	242.8095	229.0759	211.7398	195.4462	184.5611	182.0012	188.4522	202.1858	219.5219	235.8155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	(71)
Water heating gains (Table 5)	92.2069	89.8279	84.8874	78.1710	73.2646	66.4192	61.2005	68.5925	71.5142	78.4659	86.3156	89.8378	(72)
Total internal gains	427.0959	424.8177	409.7783	385.4689	360.1896	335.6504	320.1579	327.4490	340.4697	365.0144	393.2369	414.4530	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	19.0800	36.7938	0.6000	0.9000	0.7700	262.7123	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	262.7123	447.4962	612.2838	758.6494	849.7505	843.6056	813.3258	745.3603	662.9739	494.5787	314.6688	224.8270	(83)
Total gains	689.8082	872.3140	1022.0621	1144.1183	1209.9401	1179.2560	1133.4837	1072.8093	1003.4436	859.5930	707.9056	639.2799	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	77.5091	77.7195	77.9311	79.0063	79.2250	80.3365	80.3365	80.5625	79.8881	79.2250	78.7889	78.3577	
alpha	6.1673	6.1813	6.1954	6.2671	6.2817	6.3558	6.3558	6.3708	6.3259	6.2817	6.2526	6.2238	
util living area	0.9938	0.9756	0.9243	0.7995	0.6212	0.4408	0.3161	0.3481	0.5568	0.8625	0.9813	0.9959	(86)
MIT	20.2428	20.4722	20.7143	20.9079	20.9824	20.9983	20.9998	20.9997	20.9930	20.8764	20.5180	20.1975	(87)
Th 2	20.1709	20.1730	20.1751	20.1854	20.1875	20.1978	20.1978	20.1999	20.1937	20.1875	20.1833	20.1792	(88)
util rest of house	0.9919	0.9689	0.9059	0.7624	0.5715	0.3862	0.2586	0.2877	0.4945	0.8250	0.9750	0.9946	(89)
MIT 2	19.1670	19.4977	19.8340	20.0892	20.1725	20.1968	20.1978	20.1998	20.1890	20.0601	19.5746	19.1077	(90)
Living area fraction									fLA = Living area / (4) =			0.5739	(91)
MIT	19.7844	20.0570	20.3392	20.5591	20.6373	20.6568	20.6581	20.6589	20.6505	20.5286	20.1160	19.7331	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.6344	19.9070	20.1892	20.4091	20.4873	20.5068	20.5081	20.5089	20.5005	20.3786	19.9660	19.5831	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9903	0.9663	0.9063	0.7731	0.5901	0.4073	0.2809	0.3111	0.5185	0.8345	0.9730	0.9934	(94)
Useful gains	683.1081	842.9595	926.2795	884.4694	714.0064	480.3304	318.3624	333.7188	520.2724	717.3656	688.7644	635.0885	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1295.0277	1263.9488	1149.8276	953.5514	726.0378	481.2888	318.4341	333.8543	524.4380	807.9410	1068.9170	1285.0758	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	455.2682	282.9048	166.3198	49.7390	8.9514	0.0000	0.0000	0.0000	0.0000	67.3881	273.7099	483.5906	(98)
Space heating												1787.8718	(98)
Space heating per m2											(98) / (4) =	18.9674	(99)

8c. Space cooling requirement

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

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	765.9143	602.9538	617.5123	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9924	0.9975	0.9962	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	760.0560	601.4226	615.1651	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1470.4885	1415.1596	1345.4382	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	511.5114	605.4203	543.3232	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling		1660.2549 (104)
Cooled fraction	fC = cooled area / (4) =	0.7278 (105)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	93.0662	110.1523	98.8542	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling	302.0727 (107)
Space cooling per m2	3.2047 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.4000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	1977.7343 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	455.2682	282.9048	166.3198	49.7390	8.9514	0.0000	0.0000	0.0000	0.0000	67.3881	273.7099	483.5906	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	503.6153	312.9478	183.9821	55.0210	9.9020	0.0000	0.0000	0.0000	0.0000	74.5444	302.7765	534.9453	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	218.9656	192.9672	202.5876	181.5086	176.1772	155.1670	148.6618	165.7231	167.0939	188.2188	199.1449	213.6645	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.8523	86.0130	84.5593	82.2772	80.7362	80.3000	80.3000	80.3000	80.3000	82.7370	85.8522	87.0450	(217)
Fuel for water heating, kWh/month	252.1128	224.3464	239.5804	220.6062	218.2135	193.2342	185.1330	206.3800	208.0870	227.4903	231.9625	245.4643	(219)
Water heating fuel used												2652.6106	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	23.2666	27.5381	24.7135	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												75.5182	(221)

Annual totals kWh/year	
Space heating fuel - main system	1977.7343 (211)
Space heating fuel - secondary	0.0000 (215)

Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7000)	
mechanical ventilation fans (SFP = 0.7000)	225.3945 (230a)
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	300.3945 (231)
Electricity for lighting (calculated in Appendix L)	388.4127 (232)
Total delivered energy for all uses	5394.6702 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1977.7343	0.2160	427.1906	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2652.6106	0.2160	572.9639	(264)
Space and water heating			1000.1545	(265)
Space cooling	75.5182	0.5190	39.1939	(266)
Pumps and fans	300.3945	0.5190	155.9048	(267)
Energy for lighting	388.4127	0.5190	201.5862	(268)
Total CO2, kg/year			1396.8394	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.8200	(273)

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

DER		14.8200	ZC1
Total Floor Area	TFA	94.2600	
Assumed number of occupants	N	2.6797	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5092	ZC2
CO2 emissions from cooking, equation (L16)		1.9447	ZC3
Total CO2 emissions		32.2739	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.2739	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)			Volume (m3)	
Ground floor		94.2600	(1b)	x	2.8000 (2b)	=	263.9280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2600							(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9280	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1137	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3637	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2546	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3246	0.3182	0.3118	0.2800	0.2737	0.2418	0.2418	0.2355	0.2546	0.2737	0.2864	0.2991	(22b)
Effective ac	0.5527	0.5506	0.5486	0.5392	0.5374	0.5292	0.5292	0.5277	0.5324	0.5374	0.5410	0.5447	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			19.0800	1.3258	25.2955			(27)
External Wall 1	55.2600	19.0800	36.1800	0.1800	6.5124			(29a)
External Roof 1	94.2600		94.2600	0.1300	12.2538			(30)
Total net area of external elements Aum(A, m2)			149.5200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.0617			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		7.4760	(36)
Total fabric heat loss	(33) + (36) =	51.5377	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.1358	47.9577	47.7831	46.9629	46.8094	46.0951	46.0951	45.9628	46.3702	46.8094	47.1199	47.4444	(38)
Heat transfer coeff	99.6735	99.4953	99.3207	98.5005	98.3471	97.6327	97.6327	97.5004	97.9079	98.3471	98.6575	98.9821	(39)
Average = Sum(39)m / 12 =												98.4998	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0574	1.0555	1.0537	1.0450	1.0434	1.0358	1.0358	1.0344	1.0387	1.0434	1.0467	1.0501	(40)
HLP (average)												1.0450	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6797	(42)
Average daily hot water use (litres/day)	97.8419	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.6261	103.7124	99.7987	95.8851	91.9714	88.0577	88.0577	91.9714	95.8851	99.7987	103.7124	107.6261	(44)
Energy conte	159.6064	139.5928	144.0472	125.5839	120.5007	103.9830	96.3555	110.5693	111.8899	130.3969	142.3384	154.5703	(45)
Energy content (annual)										Total = Sum(45)m =		1539.4342	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9410	20.9389	21.6071	18.8376	18.0751	15.5974	14.4533	16.5854	16.7835	19.5595	21.3508	23.1855	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.8563	47.2858	46.8676	43.4257	44.8732	46.8676	47.2858	50.8563	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	210.5653	185.6202	194.9036	172.8697	167.3683	147.4087	141.2287	157.4370	159.1757	181.2532	191.6535	205.5292	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

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

Output from w/h

210.5653	185.6202	194.9036	172.8697	167.3683	147.4087	141.2287	157.4370	159.1757	181.2532	191.6535	205.5292	(64)

Total per year (kWh/year) = Sum(64)m = 2115.0129 (64)

Heat gains from water heating, kWh/month

65.8089	57.9214	60.6098	53.5781	51.7834	45.4308	43.2565	48.4812	49.0248	56.0710	59.6563	64.1343	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.1217	19.6483	15.9791	12.0972	9.0428	7.6343	8.2491	10.7226	14.3918	18.2737	21.3281	22.7366	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	246.7006	249.2605	242.8095	229.0759	211.7398	195.4462	184.5611	182.0012	188.4522	202.1858	219.5219	235.8155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	(71)
Water heating gains (Table 5)	88.4528	86.1926	81.4648	74.4140	69.6013	63.0983	58.1405	65.1629	68.0900	75.3643	82.8559	86.2021	(72)
Total internal gains	423.4699	421.2964	406.4482	381.7820	356.5788	332.3737	317.1457	324.0815	337.1290	362.0187	389.9009	410.9490	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	19.0800	36.7938	0.6300	0.7000	0.7700	214.5484	(79)

Solar gains	214.5484	365.4553	500.0318	619.5637	693.9629	688.9446	664.2161	608.7109	541.4287	403.9059	256.9795	183.6087	(83)
Total gains	638.0183	786.7516	906.4800	1001.3457	1050.5417	1021.3183	981.3617	932.7924	878.5577	765.9246	646.8804	594.5577	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.6728	65.7904	65.9060	66.4548	66.5585	67.0455	67.0455	67.1364	66.8571	66.5585	66.3491	66.1315	
alpha	5.3782	5.3860	5.3937	5.4303	5.4372	5.4697	5.4697	5.4758	5.4571	5.4372	5.4233	5.4088	
util living area	0.9964	0.9888	0.9678	0.9079	0.7808	0.5949	0.4350	0.4762	0.7171	0.9383	0.9910	0.9975	(86)
MIT	19.9574	20.1647	20.4292	20.7128	20.9041	20.9825	20.9973	20.9957	20.9537	20.6910	20.2584	19.9143	(87)
Th 2	20.0357	20.0373	20.0388	20.0460	20.0474	20.0536	20.0536	20.0548	20.0512	20.0474	20.0446	20.0418	(88)
util rest of house	0.9953	0.9853	0.9578	0.8806	0.7253	0.5142	0.3429	0.3808	0.6377	0.9136	0.9875	0.9967	(89)
MIT 2	18.6502	18.9520	19.3311	19.7245	19.9596	20.0427	20.0527	20.0531	20.0178	19.7061	19.0953	18.5919	(90)
Living area fraction									fLA = Living area / (4) =			0.5739	(91)
MIT	19.4005	19.6481	19.9613	20.2917	20.5017	20.5821	20.5948	20.5941	20.5549	20.2713	19.7629	19.3509	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4005	19.6481	19.9613	20.2917	20.5017	20.5821	20.5948	20.5941	20.5549	20.2713	19.7629	19.3509	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9943	0.9835	0.9568	0.8883	0.7529	0.5600	0.3959	0.4357	0.6814	0.9202	0.9862	0.9959	(94)
Useful gains	634.3665	773.7980	867.3318	889.4829	790.9810	571.9594	388.5122	406.4003	598.6226	704.8311	637.9626	592.1433	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1505.1154	1467.3620	1336.9894	1122.0880	865.6169	584.0461	390.0269	408.9242	631.9872	951.1476	1249.2858	1499.6697	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	647.8372	466.0750	349.4253	167.4757	55.5291	0.0000	0.0000	0.0000	0.0000	183.2595	440.1527	675.1997	(98)
Space heating												2984.9541	(98)
Space heating per m2											(98) / (4) =	31.6672	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Efficiency of secondary/supplementary heating system, %                                                                                          0.0000 (208)
Space heating requirement                                                                                                                     3195.8824 (211)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
               647.8372   466.0750   349.4253   167.4757    55.5291     0.0000     0.0000     0.0000     0.0000   183.2595   440.1527   675.1997 (98)
Space heating efficiency (main heating system 1)
                93.4000    93.4000    93.4000    93.4000    93.4000     0.0000     0.0000     0.0000     0.0000    93.4000    93.4000    93.4000 (210)
Space heating fuel (main heating system)
               693.6158   499.0097   374.1170   179.3102    59.4530     0.0000     0.0000     0.0000     0.0000   196.2093   471.2556   722.9118 (211)
Water heating requirement
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
               210.5653   185.6202   194.9036   172.8697   167.3683   147.4087   141.2287   157.4370   159.1757   181.2532   191.6535   205.5292 (64)
Efficiency of water heater                                                                                                                      80.3000 (216)
(217)m          87.6943    87.2734    86.5042    84.9715    82.5990    80.3000    80.3000    80.3000    80.3000    85.0789    87.0777    87.8222 (217)
Fuel for water heating, kWh/month
               240.1128   212.6881   225.3112   203.4442   202.6275   183.5725   175.8764   196.0610   198.2262   213.0413   220.0949   234.0286 (219)
Water heating fuel used                                                                                                                       2505.0846 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                                              3195.8824 (211)
Space heating fuel - secondary                                                                                                                   0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                                         30.0000 (230c)
   main heating flue fan                                                                                                                        45.0000 (230e)
Total electricity for the above, kWh/year                                                                                                       75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                                            390.6768 (232)
Total delivered energy for all uses                                                                                                           6166.6438 (238)


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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
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                                                                                           Energy      Emission factor        Emissions
                                                                                         kWh/year           kg CO2/kWh      kg CO2/year
Space heating - main system 1                                                           3195.8824               0.2160         690.3106 (261)
Space heating - secondary                                                                  0.0000               0.0000           0.0000 (263)
Water heating (other fuel)                                                              2505.0846               0.2160         541.0983 (264)
Space and water heating                                                                                                       1231.4089 (265)
Pumps and fans                                                                            75.0000               0.5190          38.9250 (267)
Energy for lighting                                                                      390.6768               0.5190         202.7613 (268)
Total CO2, kg/m2/year                                                                                                         1473.0951 (272)
Emissions per m2 for space and water heating                                                                                    13.0640 (272a)
Fuel factor (mains gas)                                                                                                          1.0000
Emissions per m2 for lighting                                                                                                    2.1511 (272b)
Emissions per m2 for pumps and fans                                                                                              0.4130 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.0640 * 1.00) + 2.1511 + 0.4130, rounded to 2 d.p.                               15.6300 (273)
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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A1-F1+PV	**Issued on Date**	24/07/2020
Assessment Reference	A1-F1+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	89 B	**DER**	12.19	**TER**	24.74
Environmental	90 B	**% DER<TER**	50.72		
CO_2 Emissions (t/year)	0.95	**DFEE**	49.68	**TFEE**	53.61
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.33		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 106 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 24.74 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.19 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.7 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.13 (max. 0.30)        0.13 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           0.09 (max. 0.25)        0.11 (max. 0.70)          OK
Roof            (no roof)
Openings        1.30 (max. 2.00)        1.30 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                              OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Heat pump with radiators or underfloor - Electric
Panasonic WH-ADC0309G3E5UK + WH-UD07FE5



Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Time and temperature zone control                 OK


Hot water controls:                     No cylinder


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.66
Maximum                                 1.5                                               OK
MVHR efficiency:                        85%
Minimum:                                70%                                               OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                                            OK
Based on:
Overshading:                            Average
Windows facing North East:              22.95 m², No overhang
Windows facing South East:              6.57 m², No overhang
Air change rate:                        3.00 ach
Blinds/curtains:                        Light-coloured venetian blind, closed 50% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Party wall U-value                      0.00 W/m²K
Party wall U-value                      0.00 W/m²K
Floor U-value                           0.11 W/m²K
Exposed floor U-value                   0.11 W/m²K
Air permeability                        3.0 m³/m²h
Photovoltaic array                      0.66 kW



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		106.0000 (1b)	x	2.8000 (2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	296.8000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 72.2500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2726	0.2700	0.2674	0.2543	0.2516	0.2385	0.2385	0.2359	0.2438	0.2516	0.2569	0.2621	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			29.5200	1.2357	36.4791			(27)
Heat Loss Floor 2			74.2000	0.1100	8.1620			(28a)
Heat Loss Floor 1			31.8000	0.0550	1.7490			(28b)
External Wall 1	75.0200	29.5200	45.5000	0.1300	5.9150			(29a)
Total net area of external elements Aum(A, m2)			181.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.3051			(33)
Party Wall 1			15.0100	0.0000	0.0000			(32)
Party Wall 2			28.4800	0.0000	0.0000			(32)
Party Wall 3			43.5400	0.0000	0.0000			(32)
Party Ceilings 1			106.0000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		27.1530	(36)
Total fabric heat loss	(33) + (36) =	79.4581	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.7020	26.4449	26.1878	24.9023	24.6452	23.3596	23.3596	23.1025	23.8739	24.6452	25.1594	25.6736	(38)
Heat transfer coeff	106.1601	105.9030	105.6459	104.3603	104.1032	102.8177	102.8177	102.5606	103.3319	104.1032	104.6175	105.1317	(39)
Average = Sum(39)m / 12 =												104.2961	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0015	0.9991	0.9967	0.9845	0.9821	0.9700	0.9700	0.9676	0.9748	0.9821	0.9870	0.9918	(40)
HLP (average)												0.9839	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7886 (42)
Average daily hot water use (litres/day) 100.4283 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4712	106.4540	102.4369	98.4198	94.4026	90.3855	90.3855	94.4026	98.4198	102.4369	106.4540	110.4712	(44)
Energy conte	163.8256	143.2829	147.8551	128.9037	123.6861	106.7317	98.9026	113.4922	114.8477	133.8439	146.1011	158.6563	(45)
Energy content (annual)										Total = Sum(45)m =		1580.1288	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m													
	24.5738	21.4924	22.1783	19.3355	18.5529	16.0098	14.8354	17.0238	17.2272	20.0766	21.9152	23.7984	(46)
Water storage loss:													
Store volume												184.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1394	(55)
Total storage loss													
	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(56)
If cylinder contains dedicated solar storage													
	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Total heat required for water heating calculated for each month													
	199.1470	175.1861	183.1765	163.0857	159.0075	140.9137	134.2240	148.8136	149.0297	169.1653	180.2831	193.9777	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	199.1470	175.1861	183.1765	163.0857	159.0075	140.9137	134.2240	148.8136	149.0297	169.1653	180.2831	193.9777	(64)
								Total per year (kWh/year) = Sum(64)m =				1996.0098	(64)
Heat gains from water heating, kWh/month													
	54.4720	47.6416	49.1618	42.8605	41.1256	35.4883	32.8851	37.7362	38.1869	44.5031	48.5786	52.7532	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)													
	73.2151	70.8952	66.0777	59.5284	55.2764	49.2893	44.2004	50.7206	53.0373	59.8160	67.4703	70.9049	(72)
Total internal gains													
	427.4077	425.1965	409.5031	384.0075	357.8154	332.7733	316.6202	323.0318	336.2244	361.9494	391.5438	414.0334	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	22.9500	11.2829	0.6000	0.9000	0.7700	96.9018	(75)
Southeast	6.5700	36.7938	0.6000	0.9000	0.7700	90.4623	(77)

Solar gains	187.3641	351.3372	566.2090	844.8616	1077.1141	1126.8589	1062.4692	880.4026	661.3187	411.3539	230.2805	156.5518	(83)
Total gains	614.7718	776.5337	975.7122	1228.8691	1434.9295	1459.6322	1379.0895	1203.4343	997.5431	773.3033	621.8243	570.5851	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	69.3397	69.5081	69.6772	70.5355	70.7097	71.5938	71.5938	71.7733	71.2375	70.7097	70.3622	70.0180	
alpha	5.6226	5.6339	5.6451	5.7024	5.7140	5.7729	5.7729	5.7849	5.7492	5.7140	5.6908	5.6679	
util living area													
	0.9983	0.9935	0.9701	0.8621	0.6498	0.4483	0.3277	0.3910	0.6818	0.9534	0.9954	0.9989	(86)
Tweekday	18.6656	18.9656	19.4214	19.8952	20.0703	20.1065	20.1083	20.1100	20.0830	19.7413	19.1025	18.6193	
Tweekend	20.3176	20.4502	20.6551	20.8799	20.9788	20.9978	20.9997	20.9992	20.9805	20.7959	20.5070	20.2945	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.9469	20.1495	20.4677	20.8125	20.9674	20.9967	20.9996	20.9988	20.9696	20.6850	20.2302	19.9112	(87)
Th 2	20.0821	20.0841	20.0861	20.0962	20.0983	20.1084	20.1084	20.1105	20.1044	20.0983	20.0942	20.0902	(88)
util rest of house													
	0.9977	0.9914	0.9607	0.8285	0.5947	0.3870	0.2615	0.3159	0.6060	0.9338	0.9936	0.9985	(89)
Tweekday	18.6656	18.9656	19.4214	19.8952	20.0703	20.1065	20.1083	20.1100	20.0830	19.7413	19.1025	18.6193	
Tweekend	18.6656	18.9656	19.4214	19.8952	20.0703	20.1065	20.1083	20.1100	20.0830	19.7413	19.1025	18.6193	
MIT 2	18.6656	18.9656	19.4214	19.8952	20.0703	20.1065	20.1083	20.1100	20.0830	19.7413	19.1025	18.6193	(90)
Living area fraction									fLA = Living area / (4) =			0.5218	(91)
MIT	19.3341	19.5834	19.9674	20.3738	20.5384	20.5710	20.5733	20.5738	20.5456	20.2337	19.6909	19.2934	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3341	19.5834	19.9674	20.3738	20.5384	20.5710	20.5733	20.5738	20.5456	20.2337	19.6909	19.2934	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9899	0.9593	0.8395	0.6221	0.4190	0.2960	0.3551	0.6444	0.9372	0.9926	0.9981	(94)
Useful gains	612.9991	768.6812	936.0161	1031.6935	892.6594	611.5172	408.2732	427.3684	642.8176	724.7500	617.2117	569.4744	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1596.0253	1555.0109	1422.7701	1197.4121	920.1043	613.9213	408.5294	428.0668	666.0379	1002.9000	1317.2276	1586.7903	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Month fracti      1.0000      1.0000      1.0000      1.0000      1.0000      0.0000      0.0000      0.0000      0.0000      1.0000      1.0000      1.0000 (97a)
Space heating kWh
                731.3714    528.4135    362.1450    119.3173     20.4190      0.0000      0.0000      0.0000      0.0000    206.9436    504.0115    756.8830 (98)
Space heating                                                                                                                                   3229.5043 (98)
Space heating per m2                                                                                                              (98) / (4) =     30.4670 (99)


----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Calculated for June, July and August. See Table 10b
                   Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Ext. temp.        4.3000      4.9000      6.5000      8.9000     11.7000     14.6000     16.6000     16.4000     14.1000     10.6000      7.1000      4.2000
Heat loss rate W
                  0.0000      0.0000      0.0000      0.0000      0.0000    966.4867    760.8512    779.4608      0.0000      0.0000      0.0000      0.0000 (100)
Utilisation       0.0000      0.0000      0.0000      0.0000      0.0000      0.9874      0.9949      0.9894      0.0000      0.0000      0.0000      0.0000 (101)
Useful loss       0.0000      0.0000      0.0000      0.0000      0.0000    954.3140    756.9546    771.1761      0.0000      0.0000      0.0000      0.0000 (102)
Total gains       0.0000      0.0000      0.0000      0.0000      0.0000   1811.2748   1715.0748   1511.2956      0.0000      0.0000      0.0000      0.0000 (103)
Month fracti      0.0000      0.0000      0.0000      0.0000      0.0000      1.0000      1.0000      1.0000      0.0000      0.0000      0.0000      0.0000 (103a)
Space cooling kWh
                  0.0000      0.0000      0.0000      0.0000      0.0000    617.0118    712.8415    550.6489      0.0000      0.0000      0.0000      0.0000 (104)
Space cooling                                                                                                                                   1880.5021 (104)
Cooled fraction                                                                                               fC = cooled area / (4) =      0.6902 (105)
Intermittency factor (Table 10b)
                  0.0000      0.0000      0.0000      0.0000      0.0000      0.2500      0.2500      0.2500      0.0000      0.0000      0.0000      0.0000 (106)
Space cooling kWh
                  0.0000      0.0000      0.0000      0.0000      0.0000    106.4636    122.9988     95.0129      0.0000      0.0000      0.0000      0.0000 (107)
Space cooling                                                                                                                                    324.4753 (107)
Space cooling per m2                                                                                                                               3.0611 (108)


----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                              0.0000 (201)
Fraction of space heat from main system(s)                                                                                                         1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                                 238.0832 (206)
Efficiency of secondary/supplementary heating system, %                                                                                          100.0000 (208)
Space heating requirement                                                                                                                       1356.4606 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)                                                                                             4.0500 (209)

                   Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Space heating requirement
                731.3714    528.4135    362.1450    119.3173     20.4190      0.0000      0.0000      0.0000      0.0000    206.9436    504.0115    756.8830 (98)
Space heating efficiency (main heating system 1)
                238.0832    238.0832    238.0832    238.0832    238.0832      0.0000      0.0000      0.0000      0.0000    238.0832    238.0832    238.0832 (210)
Space heating fuel (main heating system)
                307.1916    221.9449    152.1086     50.1158      8.5764      0.0000      0.0000      0.0000      0.0000     86.9207    211.6956    317.9070 (211)
Water heating requirement
                  0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (215)

Water heating
Water heating requirement
                199.1470    175.1861    183.1765    163.0857    159.0075    140.9137    134.2240    148.8136    149.0297    169.1653    180.2831    193.9777 (64)
Efficiency of water heater                                                                                                                       270.4650 (216)
(217)m          270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650 (217)
Fuel for water heating, kWh/month
                 73.6313     64.7722     67.7265     60.2982     58.7904     52.1005     49.6271     55.0214     55.1013     62.5461     66.6567     71.7201 (219)
Water heating fuel used                                                                                                                          737.9919 (219)
Space cooling fuel requirement
(221)m            0.0000      0.0000      0.0000      0.0000      0.0000     26.2873     30.3701     23.4600      0.0000      0.0000      0.0000      0.0000 (221)
Cooling                                                                                                                                           80.1174 (221)
Annual totals kWh/year
Space heating fuel - main system                                                                                                                1356.4606 (211)
Space heating fuel - secondary                                                                                                                     0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)
   mechanical ventilation fans (SFP =       0.8250)                                                                                              298.7292 (230a)
Total electricity for the above, kWh/year                                                                                                        298.7292 (231)
Electricity for lighting (calculated in Appendix L)                                                                                              418.2926 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.66 * 951 * 0.80) =                                                                          -401.5402                       -401.5402 (233)
Total delivered energy for all uses                                                                                                             2490.0514 (238)


----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                             Energy      Emission factor           Emissions
                                                                                           kWh/year          kg CO2/kWh         kg CO2/year
Space heating - main system 1                                                             1356.4606              0.5190            704.0030 (261)
Space heating - secondary                                                                    0.0000              0.5190              0.0000 (263)
Water heating (other fuel)                                                                 737.9919              0.5190            383.0178 (264)
Space and water heating                                                                                                            1087.0208 (265)
Space cooling                                                                               80.1174              0.5190             41.5809 (266)
Pumps and fans                                                                             298.7292              0.5190            155.0405 (267)
Energy for lighting                                                                        418.2926              0.5190            217.0939 (268)

 Energy saving/generation technologies
PV Unit                                                                                   -401.5402              0.5190           -208.3994 (269)
Total CO2, kg/year                                                                                                                  1292.3367 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                           12.1900 (273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                                   12.1900 ZC1
Total Floor Area                                                                                                              TFA    106.0000
Assumed number of occupants                                                                                                     N      2.7886
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8524	ZC2
CO2 emissions from cooking, equation (L16)		1.7540	ZC3
Total CO2 emissions		28.7964	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.7964	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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


----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                                Area        Storey height           Volume
                                                                                (m2)             (m)                 (m3)
Ground floor                                                                106.0000 (1b)    x      2.8000 (2b)    =    296.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            106.0000                                                  (4)
Dwelling volume                                                                   (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    296.8000 (5)


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

                                                                                                                  Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                              40.0000 / (5) =       0.1348 (8)
Pressure test                                                                                                                    Yes
Measured/design AP50                                                                                                          5.0000
Infiltration rate                                                                                                             0.3848 (18)
Number of sides sheltered                                                                                                          4 (19)

Shelter factor                                                                         (20) = 1 - [0.075 x (19)] =       0.7000 (20)
Infiltration rate adjusted to include shelter factor                                            (21) = (18) x (20) =       0.2693 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.3434     0.3367     0.3299     0.2963     0.2895     0.2559     0.2559     0.2491     0.2693     0.2895     0.3030     0.3165 (22b)
Effective ac     0.5590     0.5567     0.5544     0.5439     0.5419     0.5327     0.5327     0.5310     0.5363     0.5419     0.5459     0.5501 (25)


----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                        Gross       Openings        NetArea        U-value          A x U        K-value          A x K
                                                  m2             m2             m2          W/m2K            W/K        kJ/m2K            kJ/K
TER Opening Type (Uw = 1.40)                                               26.5100         1.3258        35.1458                                  (27)
Heat Loss Floor 2                                                          74.2000         0.1300         9.6460                                  (28a)
Heat Loss Floor 1                                                          31.8000         0.1300         4.1340                                  (28b)
External Wall 1                              75.0200        29.5200        45.5000         0.1800         8.1900                                  (29a)
Total net area of external elements Aum(A, m2)                            178.0100                                                                (31)
Fabric heat loss, W/K = Sum (A x U)                                            (26)...(30) + (32) =      57.1158                                  (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                       250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)                                                                            8.9005 (36)
Total fabric heat loss                                                                                               (33) + (36) =      66.0163 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          54.7472    54.5230    54.3031    53.2707    53.0775    52.1782    52.1782    52.0117    52.5246    53.0775    53.4683    53.8768 (38)
Heat transfer coeff
              120.7636   120.5393   120.3195   119.2870   119.0938   118.1946   118.1946   118.0280   118.5409   119.0938   119.4846   119.8932 (39)
Average = Sum(39)m / 12 =                                                                                                                119.2861 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              1.1393     1.1372     1.1351     1.1253     1.1235     1.1150     1.1150     1.1135     1.1183     1.1235     1.1272     1.1311 (40)
HLP (average)                                                                                                                              1.1253 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)


----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                         2.7886 (42)
Average daily hot water use (litres/day)                                                                                                100.4283 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              110.4712   106.4540   102.4369    98.4198    94.4026    90.3855    90.3855    94.4026    98.4198   102.4369   106.4540   110.4712 (44)
Energy conte  163.8256   143.2829   147.8551   128.9037   123.6861   106.7317    98.9026   113.4922   114.8477   133.8439   146.1011   158.6563 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =    1580.1288 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.5738    21.4924    22.1783    19.3355    18.5529    16.0098    14.8354    17.0238    17.2272    20.0766    21.9152    23.7984 (46)
Water storage loss:
Store volume                                                                                                                            150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                             1.3938 (48)
  Temperature factor from Table 2b                                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                0.7527 (55)
Total storage loss
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(64)
Total per year (kWh/year) = Sum(64)m =												2128.7462	(64)
Heat gains from water heating, kWh/month													
	91.7479	81.3101	86.4377	78.9339	78.4016	71.5618	70.1610	75.0121	74.2603	81.7790	84.6521	90.0291	(65)

---

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)													
	123.3171	120.9972	116.1798	109.6305	105.3784	99.3913	94.3025	100.8227	103.1393	109.9180	117.5723	121.0069	(72)
Total internal gains													
	480.5098	478.2986	462.6052	437.1095	410.9174	385.8753	369.7223	376.1338	389.3264	415.0514	444.6458	467.1354	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	20.6100	11.2829	0.6300	0.7000	0.7700	71.0677	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)

Solar gains	137.4113	257.6680	415.2539	619.6166	789.9498	826.4326	779.2095	645.6823	485.0070	301.6839	168.8858	114.8137	(83)
Total gains	617.9210	735.9665	877.8591	1056.7261	1200.8672	1212.3079	1148.9317	1021.8161	874.3334	716.7353	613.5317	581.9492	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.9547	61.0681	61.1797	61.7092	61.8093	62.2796	62.2796	62.3675	62.0976	61.8093	61.6072	61.3973	
alpha	5.0636	5.0712	5.0786	5.1139	5.1206	5.1520	5.1520	5.1578	5.1398	5.1206	5.1071	5.0932	
util living area													
	0.9983	0.9954	0.9846	0.9361	0.8010	0.6021	0.4484	0.5216	0.8080	0.9735	0.9961	0.9987	(86)
MIT	19.7573	19.9271	20.2179	20.5958	20.8703	20.9764	20.9957	20.9911	20.9007	20.5185	20.0661	19.7260	(87)
Th 2	19.9689	19.9706	19.9723	19.9802	19.9817	19.9886	19.9886	19.9898	19.9859	19.9817	19.9787	19.9755	(88)
util rest of house													
	0.9977	0.9939	0.9791	0.9143	0.7448	0.5161	0.3476	0.4121	0.7306	0.9605	0.9945	0.9983	(89)
MIT 2	18.3101	18.5591	18.9815	19.5168	19.8619	19.9740	19.9871	19.9864	19.9090	19.4224	18.7686	18.2691	(90)
Living area fraction									fLA = Living area / (4) =			0.5218	(91)
MIT	19.0652	19.2730	19.6267	20.0798	20.3881	20.4970	20.5134	20.5106	20.4264	19.9943	19.4456	19.0293	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0652	19.2730	19.6267	20.0798	20.3881	20.4970	20.5134	20.5106	20.4264	19.9943	19.4456	19.0293	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9925	0.9768	0.9168	0.7686	0.5603	0.4004	0.4694	0.7669	0.9607	0.9934	0.9977	(94)
Useful gains	616.0316	730.4264	857.5355	968.7900	923.0418	679.2975	459.9839	479.6477	670.4968	688.5501	609.4522	580.6222	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1783.1019	1732.5061	1579.3928	1333.6057	1034.6971	696.9947	462.5381	485.1712	749.9409	1118.8068	1475.1092	1777.9324	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	868.3004	673.3976	537.0618	262.6673	83.0716	0.0000	0.0000	0.0000	0.0000	320.1110	623.2730	890.7988	(98)
Space heating												4258.6813	(98)
Space heating per m2											(98) / (4) =	40.1762	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4554.7394	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	868.3004	673.3976	537.0618	262.6673	83.0716	0.0000	0.0000	0.0000	0.0000	320.1110	623.2730	890.7988	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	928.6635	720.2113	574.3976	280.9276	88.8466	0.0000	0.0000	0.0000	0.0000	342.3647	666.6021	952.7260	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.1933	87.9543	87.3854	85.9100	83.0184	79.8000	79.8000	79.8000	79.8000	86.3274	87.7383	88.2833	(217)
Fuel for water heating, kWh/month	238.5901	210.7555	222.5201	202.5324	205.1125	190.2551	182.3277	200.6104	200.4255	209.0169	217.9126	232.4916	(219)

Water heating fuel used	2512.5504	(219)
Annual totals kWh/year		
Space heating fuel - main system	4554.7394	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	7560.5824	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4554.7394	0.2160	983.8237	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2512.5504	0.2160	542.7109	(264)
Space and water heating			1526.5346	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/m2/year			1782.5535	(272)
Emissions per m2 for space and water heating			14.4013	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0481	(272b)
Emissions per m2 for pumps and fans			0.3672	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.4013 * 1.55) + 2.0481 + 0.3672, rounded to 2 d.p.			24.7400	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A2-F2+PV	**Issued on Date**	24/07/2020
Assessment Reference	A2-F2+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	92 A	**DER**	9.38	**TER**	21.06
Environmental	93 A	**% DER<TER**	55.47		
CO_2 Emissions (t/year)	0.71	**DFEE**	35.14	**TFEE**	41.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.87		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 106 m^2

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 21.06 kgCO_2/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 9.38 kgCO_2/m^2OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE) 41.8 kWh/m^2/yr
Dwelling Fabric Energy Efficiency (DFEE) 35.1 kWh/m^2/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system:	Heat pump with radiators or underfloor - Electric	
Panasonic WH-ADC0309G3E5UK + WH-UD07FE5		
Secondary heating system:	None	

5 Cylinder insulation

Hot water storage	No cylinder

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	

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

Minimum	75%	OK

8 Mechanical ventilation
Continuous supply and extract system

Specific fan power:	0.66	
Maximum	1.5	OK
MVHR efficiency:	85%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Medium	OK
Based on:		
Overshading:	Average	
Windows facing North East:	20.83 m^2, No overhang	
Windows facing South East:	5.96 m^2, No overhang	
Air change rate:	3.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

10 Key features

External wall U-value	0.13 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Air permeability	3.0 m^3/m^2h
Photovoltaic array	0.66 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)			Volume (m3)	
Ground floor	106.0000	(1b) x	2.8000	(2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	296.8000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.2500	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2726	0.2700	0.2674	0.2543	0.2516	0.2385	0.2385	0.2359	0.2438	0.2516	0.2569	0.2621	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			26.7900	1.2357	33.1055			(27)
External Wall 1	72.3200	26.7900	45.5300	0.1300	5.9189			(29a)
Total net area of external elements Aum(A, m2)			72.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		39.0244			(33)
Party Wall 1			15.0400	0.0000	0.0000			(32)
Party Wall 2			28.4800	0.0000	0.0000			(32)
Party Wall 3			43.5400	0.0000	0.0000			(32)
Party Floor 1			106.0000					(32d)
Party Ceilings 1			106.0000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		10.8480	(36)
Total fabric heat loss	(33) + (36) =	49.8724	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.7020	26.4449	26.1878	24.9023	24.6452	23.3596	23.3596	23.1025	23.8739	24.6452	25.1594	25.6736	(38)
Heat transfer coeff	76.5744	76.3173	76.0602	74.7747	74.5176	73.2321	73.2321	72.9750	73.7463	74.5176	75.0318	75.5460	(39)
Average = Sum(39)m / 12 =												74.7104	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7224	0.7200	0.7175	0.7054	0.7030	0.6909	0.6909	0.6884	0.6957	0.7030	0.7078	0.7127	(40)
HLP (average)												0.7048	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7886	(42)
Average daily hot water use (litres/day)	100.4283	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4712	106.4540	102.4369	98.4198	94.4026	90.3855	90.3855	94.4026	98.4198	102.4369	106.4540	110.4712	(44)
Energy conte	163.8256	143.2829	147.8551	128.9037	123.6861	106.7317	98.9026	113.4922	114.8477	133.8439	146.1011	158.6563	(45)
Energy content (annual)										Total = Sum(45)m =		1580.1288	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
               24.5738    21.4924    22.1783    19.3355    18.5529    16.0098    14.8354    17.0238    17.2272    20.0766    21.9152    23.7984 (46)
Water storage loss:
Store volume                                                                                                                            184.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                             2.1100 (48)
  Temperature factor from Table 2b                                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                1.1394 (55)
Total storage loss
               35.3214    31.9032    35.3214    34.1820    35.3214    34.1820    35.3214    35.3214    34.1820    35.3214    34.1820    35.3214 (56)
If cylinder contains dedicated solar storage
               35.3214    31.9032    35.3214    34.1820    35.3214    34.1820    35.3214    35.3214    34.1820    35.3214    34.1820    35.3214 (57)
Primary loss    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Total heat required for water heating calculated for each month
              199.1470   175.1861   183.1765   163.0857   159.0075   140.9137   134.2240   148.8136   149.0297   169.1653   180.2831   193.9777 (62)
Solar input     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                           Solar input (sum of months) = Sum(63)m =       0.0000 (63)
Output from w/h
              199.1470   175.1861   183.1765   163.0857   159.0075   140.9137   134.2240   148.8136   149.0297   169.1653   180.2831   193.9777 (64)
                                                                                             Total per year (kWh/year) = Sum(64)m =    1996.0098 (64)
Heat gains from water heating, kWh/month
               54.4720    47.6416    49.1618    42.8605    41.1256    35.4883    32.8851    37.7362    38.1869    44.5031    48.5786    52.7532 (65)


----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               23.6855    21.0372    17.1086    12.9523     9.6820     8.1740     8.8323    11.4805    15.4091    19.5654    22.8357    24.3438 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              265.6788   268.4357   261.4884   246.6983   228.0285   210.4816   198.7591   196.0022   202.9495   217.7396   236.4094   253.9563 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428 (69)
Pumps, fans     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
             -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425 (71)
Water heating gains (Table 5)
               73.2151    70.8952    66.0777    59.5284    55.2764    49.2893    44.2004    50.7206    53.0373    59.8160    67.4703    70.9049 (72)
Total internal gains
              427.4077   425.1965   409.5031   384.0075   357.8154   332.7733   316.6202   323.0318   336.2244   361.9494   391.5438   414.0334 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------

[Jan]                                       Area         Solar flux             g              FF             Access             Gains
                                              m2           Table 6a     Specific data   Specific data         factor                W
                                                               W/m2     or Table 6b     or Table 6c          Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                20.8300          11.2829          0.6000          0.9000          0.7700            87.9506 (75)
Southeast                                 5.9600          36.7938          0.6000          0.9000          0.7700            82.0632 (77)
----------------------------------------------------------------------------------------------------

Solar gains   170.0137   318.8098   513.8062   766.6946   977.4780  1022.6287   964.1919   798.9546   600.1219   373.2749   208.9573   142.0538 (83)
Total gains   597.4215   744.0064   923.3093  1150.7021  1335.2934  1355.4019  1280.8121  1121.9864   936.3463   735.2243   600.5011   556.0872 (84)


----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                              21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           96.1302    96.4540    96.7801    98.4439    98.7836   100.5176   100.5176   100.8717    99.8167    98.7836    98.1066    97.4388
alpha          7.4087     7.4303     7.4520     7.5629     7.5856     7.7012     7.7012     7.7248     7.6544     7.5856     7.5404     7.4959
util living area
               0.9981     0.9904     0.9443     0.7550     0.5173     0.3457     0.2516     0.2992     0.5411     0.9054     0.9933     0.9988 (86)

Tweekday      19.4333    19.7005    20.0545    20.3004    20.3363    20.3489    20.3489    20.3510    20.3432    20.2246    19.7724    19.3944
Tweekend      20.5761    20.6943    20.8564    20.9776    20.9986    20.9999    21.0000    21.0000    20.9986    20.9318    20.7219    20.5558
24 / 16             0          0          0          0          0          0          0          0          0          0          0          0
24 / 9              0          0          0          0          0          0          0          0          0          0          0          0
16 / 9              0          0          0          0          0          0          0          0          0          0          0          0
MIT           20.3457    20.5272    20.7783    20.9650    20.9978    20.9999    21.0000    21.0000    20.9979    20.8948    20.5658    20.3145 (87)
Th 2          20.3211    20.3232    20.3254    20.3360    20.3382    20.3489    20.3489    20.3511    20.3446    20.3382    20.3339    20.3296 (88)
util rest of house
               0.9975     0.9876     0.9306     0.7212     0.4811     0.3106     0.2143     0.2570     0.4907     0.8777     0.9910     0.9985 (89)
Tweekday      19.4333    19.7005    20.0545    20.3004    20.3363    20.3489    20.3489    20.3510    20.3432    20.2246    19.7724    19.3944
Tweekend      19.4333    19.7005    20.0545    20.3004    20.3363    20.3489    20.3489    20.3510    20.3432    20.2246    19.7724    19.3944
MIT 2         19.4333    19.7005    20.0545    20.3004    20.3363    20.3489    20.3489    20.3510    20.3432    20.2246    19.7724    19.3944 (90)
Living area fraction                                                                                 fLA = Living area / (4) =       0.5223 (91)
MIT           19.9098    20.1322    20.4325    20.6475    20.6818    20.6889    20.6889    20.6900    20.6851    20.5746    20.1867    19.8749 (92)
Temperature adjustment                                                                                                                0.0000
adjusted MIT  19.9098    20.1322    20.4325    20.6475    20.6818    20.6889    20.6889    20.6900    20.6851    20.5746    20.1867    19.8749 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9971     0.9866     0.9330     0.7374     0.4999     0.3289     0.2338     0.2790     0.5170     0.8883     0.9903     0.9982 (94)
Useful gains  595.6627   734.0521   861.4369   848.4776   667.5247   445.8441   299.4387   313.0479   484.0851   653.0887   594.6928   555.0645 (95)
Ext temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
             1195.3121  1162.4827  1059.7100   878.4150   669.3002   445.9014   299.4419   313.0597   485.6257   743.2860   981.9197  1184.1777 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Space heating kWh
                446.1391   287.9054   147.5152    21.5549     1.3210     0.0000     0.0000     0.0000     0.0000    67.1068   278.8033   468.0602 (98)
Space heating                                                                                                                            1718.4060 (98)
Space heating per m2                                                                                                 (98) / (4) =       16.2114 (99)

----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Calculated for June, July and August. See Table 10b
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Ext. temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000
Heat loss rate W
                  0.0000     0.0000     0.0000     0.0000     0.0000   688.3813   541.9172   554.6097     0.0000     0.0000     0.0000     0.0000 (100)
Utilisation       0.0000     0.0000     0.0000     0.0000     0.0000     0.9994     0.9998     0.9996     0.0000     0.0000     0.0000     0.0000 (101)
Useful loss       0.0000     0.0000     0.0000     0.0000     0.0000   687.9759   541.8315   554.3678     0.0000     0.0000     0.0000     0.0000 (102)
Total gains       0.0000     0.0000     0.0000     0.0000     0.0000  1689.4472  1600.2051  1416.0967     0.0000     0.0000     0.0000     0.0000 (103)
Month fracti      0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000 (103a)
Space cooling kWh
                  0.0000     0.0000     0.0000     0.0000     0.0000   721.0593   787.4300   641.1262     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                            2149.6156 (104)
Cooled fraction                                                                                   fC = cooled area / (4) =       0.6920 (105)
Intermittency factor (Table 10b)
                  0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                  0.0000     0.0000     0.0000     0.0000     0.0000   124.7399     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                             124.7399 (107)
Space cooling per m2                                                                                                                        1.1768 (108)

----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                          0.0000 (201)
Fraction of space heat from main system(s)                                                                                     1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                             206.8966 (206)
Efficiency of secondary/supplementary heating system, %                                                                      100.0000 (208)
Space heating requirement                                                                                                    830.5625 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)                                                                         4.0500 (209)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
                446.1391   287.9054   147.5152    21.5549     1.3210     0.0000     0.0000     0.0000     0.0000    67.1068   278.8033   468.0602 (98)
Space heating efficiency (main heating system 1)
                206.8966   206.8966   206.8966   206.8966   206.8966     0.0000     0.0000     0.0000     0.0000   206.8966   206.8966   206.8966 (210)
Space heating fuel (main heating system)
                215.6338   139.1542    71.2990    10.4182     0.6385     0.0000     0.0000     0.0000     0.0000    32.4349   134.7549   226.2290 (211)
Water heating requirement
                  0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
                199.1470   175.1861   183.1765   163.0857   159.0075   140.9137   134.2240   148.8136   149.0297   169.1653   180.2831   193.9777 (64)
Efficiency of water heater                                                                                                   270.4650 (216)
(217)m          270.4650   270.4650   270.4650   270.4650   270.4650   270.4650   270.4650   270.4650   270.4650   270.4650   270.4650   270.4650 (217)
Fuel for water heating, kWh/month
                 73.6313    64.7722    67.7265    60.2982    58.7904    52.1005    49.6271    55.0214    55.1013    62.5461    66.6567    71.7201 (219)
Water heating fuel used                                                                                                      737.9919 (219)
Space cooling fuel requirement
(221)m            0.0000     0.0000     0.0000     0.0000     0.0000    30.8000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (221)
Cooling                                                                                                                       30.8000 (221)
Annual totals kWh/year
Space heating fuel - main system                                                                                             830.5625 (211)
Space heating fuel - secondary                                                                                                 0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)
   mechanical ventilation fans (SFP =        0.8250)                                                                         298.7292 (230a)
Total electricity for the above, kWh/year                                                                                    298.7292 (231)
Electricity for lighting (calculated in Appendix L)                                                                          418.2926 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.66 * 951 * 0.80) =                                                                -401.5402             -401.5402 (233)
Total delivered energy for all uses                                                                                         1914.8360 (238)

----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                Energy      Emission factor          Emissions
                                                                              kWh/year        kg CO2/kWh           kg CO2/year
Space heating - main system 1                                                 830.5625            0.5190              431.0619 (261)
Space heating - secondary                                                       0.0000            0.5190                0.0000 (263)
Water heating (other fuel)                                                    737.9919            0.5190              383.0178 (264)
Space and water heating                                                                                               814.0797 (265)
Space cooling                                                                  30.8000            0.5190               15.9852 (266)
Pumps and fans                                                                298.7292            0.5190              155.0405 (267)
Energy for lighting                                                           418.2926            0.5190              217.0939 (268)

 Energy saving/generation technologies
PV Unit                                                                      -401.5402            0.5190             -208.3994 (269)
Total CO2, kg/year                                                                                                    993.7999 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                             9.3800 (273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                     9.3800 ZC1
Total Floor Area                                                                                                  TFA   106.0000
Assumed number of occupants                                                                                         N     2.7886
CO2 emission factor in Table 12 for electricity displaced from grid                                                EF     0.5190
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

CO2 emissions from appliances, equation (L14)	14.8524	ZC2
CO2 emissions from cooking, equation (L16)	1.7540	ZC3
Total CO2 emissions	25.9864	ZC4
Residual CO2 emissions offset from biofuel CHP	0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year	0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation	0.0000	ZC7
Net CO2 emissions	25.9864	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	106.0000 (1b)	x	2.8000 (2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 106.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	296.8000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1348	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3848	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2693	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3434	0.3367	0.3299	0.2963	0.2895	0.2559	0.2559	0.2491	0.2693	0.2895	0.3030	0.3165	(22b)
Effective ac	0.5590	0.5567	0.5544	0.5439	0.5419	0.5327	0.5327	0.5310	0.5363	0.5419	0.5459	0.5501	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			26.5000	1.3258	35.1326			(27)
External Wall 1	72.3200	26.7900	45.5300	0.1800	8.1954			(29a)
Total net area of external elements Aum(A, m2)			72.0300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.3280			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		3.6015	(36)
Total fabric heat loss	(33) + (36) =	46.9295	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.7472	54.5230	54.3031	53.2707	53.0775	52.1782	52.1782	52.0117	52.5246	53.0775	53.4683	53.8768	(38)
Heat transfer coeff	101.6767	101.4524	101.2326	100.2001	100.0070	99.1077	99.1077	98.9412	99.4541	100.0070	100.3978	100.8063	(39)
Average = Sum(39)m / 12 =												100.1992	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9592	0.9571	0.9550	0.9453	0.9435	0.9350	0.9350	0.9334	0.9382	0.9435	0.9471	0.9510	(40)
HLP (average)												0.9453	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7886	(42)
Average daily hot water use (litres/day)	100.4283	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4712	106.4540	102.4369	98.4198	94.4026	90.3855	90.3855	94.4026	98.4198	102.4369	106.4540	110.4712	(44)
Energy conte	163.8256	143.2829	147.8551	128.9037	123.6861	106.7317	98.9026	113.4922	114.8477	133.8439	146.1011	158.6563	(45)
Energy content (annual)											Total = Sum(45)m =	1580.1288	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5738	21.4924	22.1783	19.3355	18.5529	16.0098	14.8354	17.0238	17.2272	20.0766	21.9152	23.7984	(46)

Water storage loss:

Store volume	150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.3938	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.7527	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(64)
Total per year (kWh/year) = Sum(64)m =												2128.7462	(64)
Heat gains from water heating, kWh/month													
	91.7479	81.3101	86.4377	78.9339	78.4016	71.5618	70.1610	75.0121	74.2603	81.7790	84.6521	90.0291	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)													
	123.3171	120.9972	116.1798	109.6305	105.3784	99.3913	94.3025	100.8227	103.1393	109.9180	117.5723	121.0069	(72)
Total internal gains													
	480.5098	478.2986	462.6052	437.1095	410.9174	385.8753	369.7223	376.1338	389.3264	415.0514	444.6458	467.1354	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	20.6000	11.2829	0.6300	0.7000	0.7700	71.0332	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	137.3768	257.5978	415.1274	619.4089	789.6706	826.1350	778.9310	645.4604	484.8529	301.5981	168.8425	114.7856	(83)
Total gains	617.8866	735.8964	877.7326	1056.5184	1200.5880	1212.0103	1148.6533	1021.5942	874.1793	716.6496	613.4883	581.9210	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.3972	72.5573	72.7148	73.4641	73.6060	74.2738	74.2738	74.3989	74.0152	73.6060	73.3195	73.0223	
alpha	5.8265	5.8372	5.8477	5.8976	5.9071	5.9516	5.9516	5.9599	5.9343	5.9071	5.8880	5.8682	
util living area													
	0.9982	0.9947	0.9795	0.9068	0.7280	0.5180	0.3789	0.4435	0.7357	0.9627	0.9955	0.9988	(86)
MIT	20.0076	20.1723	20.4414	20.7659	20.9485	20.9940	20.9992	20.9981	20.9603	20.6776	20.2780	19.9774	(87)
Th 2	20.1175	20.1192	20.1210	20.1292	20.1307	20.1379	20.1379	20.1392	20.1351	20.1307	20.1276	20.1244	(88)
util rest of house													
	0.9977	0.9930	0.9729	0.8805	0.6739	0.4506	0.3051	0.3616	0.6617	0.9465	0.9938	0.9983	(89)
MIT 2	18.7841	19.0255	19.4147	19.8665	20.0848	20.1342	20.1376	20.1384	20.1057	19.7601	19.1867	18.7451	(90)
Living area fraction									fLA = Living area / (4) =			0.5223	(91)
MIT	19.4231	19.6244	19.9509	20.3362	20.5358	20.5833	20.5876	20.5874	20.5520	20.2393	19.7567	19.3887	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4231	19.6244	19.9509	20.3362	20.5358	20.5833	20.5876	20.5874	20.5520	20.2393	19.7567	19.3887	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9918	0.9713	0.8873	0.6999	0.4857	0.3437	0.4044	0.6987	0.9489	0.9928	0.9979	(94)
Useful gains	616.0602	729.8602	852.5616	937.4995	840.2699	588.6572	394.7475	413.1700	610.8182	680.0167	609.0993	580.6842	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1537.6619	1493.8287	1361.6670	1145.9124	883.6455	592.9877	395.2005	414.3083	641.6771	963.9987	1270.7019	1531.1169	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	685.6716	513.3868	378.7744	150.0573	32.2715	0.0000	0.0000	0.0000	0.0000	211.2826	476.3539	707.1220	(98)
Space heating												3154.9201	(98)
Space heating per m2											(98) / (4) =	29.7634	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3374.2461	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	685.6716	513.3868	378.7744	150.0573	32.2715	0.0000	0.0000	0.0000	0.0000	211.2826	476.3539	707.1220	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	733.3386	549.0768	405.1063	160.4891	34.5149	0.0000	0.0000	0.0000	0.0000	225.9707	509.4694	756.2802	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7375	87.3914	86.5627	84.4220	81.3321	79.8000	79.8000	79.8000	79.8000	85.2355	87.1530	87.8501	(217)
Fuel for water heating, kWh/month	239.8295	212.1130	224.6348	206.1020	209.3652	190.2551	182.3277	200.6104	200.4255	211.6943	219.3761	233.6381	(219)

Water heating fuel used	2530.3718	(219)
Annual totals kWh/year		
Space heating fuel - main system	3374.2461	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	6397.9105	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3374.2461	0.2160	728.8372	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2530.3718	0.2160	546.5603	(264)
Space and water heating			1275.3975	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/m2/year			1531.4163	(272)
Emissions per m2 for space and water heating			12.0321	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0481	(272b)
Emissions per m2 for pumps and fans			0.3672	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.0321 * 1.55) + 2.0481 + 0.3672, rounded to 2 d.p.			21.0600	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A3-F2+PV	Issued on Date	24/07/2020
Assessment Reference	A3-F2+PV	Prop Type Ref	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	91 B	DER	10.23	TER	21.99
Environmental	92 A	% DER<TER	53.48		
CO_2 Emissions (t/year)	0.77	DFEE	37.94	TFEE	43.74
General Requirements Compliance	Pass	% DFEE<TFEE	13.27		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	Assessor ID	T613-0001
Client	CO-RE, 4650		

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 100 m^2

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

1a TER and DER

Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 21.99 $kgCO_2/m^2$
Dwelling Carbon Dioxide Emission Rate (DER) 10.23 $kgCO_2/m^2$ OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 43.7 $kWh/m^2/yr$
Dwelling Fabric Energy Efficiency (DFEE) 37.9 $kWh/m^2/yr$ OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.06 (max. 0.25)	0.06 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using default y-value of 0.15

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system:	Heat pump with radiators or underfloor - Electric
Panasonic WH-ADC0309G3E5UK + WH-UD07FE5	
Secondary heating system:	None

5 Cylinder insulation

Hot water storage	No cylinder

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	

7 Low energy lights

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

Minimum	75%	OK

8 Mechanical ventilation

Continuous supply and extract system

Specific fan power:	0.79	
Maximum	1.5	OK
MVHR efficiency:	84%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Medium	OK
Based on:		
Overshading:	Average	
Windows facing South East:	9.54 m^2, No overhang	
Windows facing South West:	19.72 m^2, No overhang	
Air change rate:	3.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

10 Key features

External wall U-value	0.13 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Floor U-value	0.11 W/m^2K
Air permeability	3.0 m^3/m^2h
Photovoltaic array	0.66 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	100.0000 (1b)	x	2.8000 (2b)	=	280.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	280.0000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 71.4000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2769	0.2743	0.2716	0.2585	0.2559	0.2428	0.2428	0.2401	0.2480	0.2559	0.2611	0.2664	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			29.2600	1.2357	36.1578			(27)
Heat Loss Floor 1			100.0000	0.0550	5.5000			(28a)
External Wall 1	73.6100	29.2600	44.3500	0.1300	5.7655			(29a)
Total net area of external elements Aum(A, m2)			173.6100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.4233			(33)
Party Wall 1			17.8100	0.0000	0.0000			(32)
Party Wall 2			36.1200	0.0000	0.0000			(32)
Party Wall 3			22.9900	0.0000	0.0000			(32)
Party Ceilings 1			100.0000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area) 26.0415 (36)
Total fabric heat loss (33) + (36) = 73.4648 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	25.5833	25.3407	25.0982	23.8854	23.6429	22.4301	22.4301	22.1876	22.9152	23.6429	24.1280	24.6131	(38)
Heat transfer coeff	99.0480	98.8055	98.5629	97.3502	97.1076	95.8949	95.8949	95.6523	96.3800	97.1076	97.5927	98.0778	(39)
Average = Sum(39)m / 12 =												97.2896	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9905	0.9881	0.9856	0.9735	0.9711	0.9589	0.9589	0.9565	0.9638	0.9711	0.9759	0.9808	(40)
HLP (average)												0.9729	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7395 (42)
Average daily hot water use (litres/day) 99.2637 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.1901	105.2196	101.2490	97.2785	93.3079	89.3374	89.3374	93.3079	97.2785	101.2490	105.2196	109.1901	(44)
Energy conte	161.9258	141.6213	146.1405	127.4088	122.2518	105.4940	97.7557	112.1761	113.5159	132.2918	144.4068	156.8165	(45)
Energy content (annual)											Total = Sum(45)m =	1561.8051	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	24.2889	21.2432	21.9211	19.1113	18.3378	15.8241	14.6634	16.8264	17.0274	19.8438	21.6610	23.5225	(46)
Water storage loss:													
Store volume												184.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1394	(55)
Total storage loss	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(56)
If cylinder contains dedicated solar storage	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Total heat required for water heating calculated for each month	197.2472	173.5245	181.4619	161.5908	157.5732	139.6760	133.0771	147.4975	147.6979	167.6132	178.5888	192.1379	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	197.2472	173.5245	181.4619	161.5908	157.5732	139.6760	133.0771	147.4975	147.6979	167.6132	178.5888	192.1379	(64)
Total per year (kWh/year) = Sum(64)m =												1977.6861	(64)
Heat gains from water heating, kWh/month	53.8403	47.0891	48.5917	42.3634	40.6487	35.0768	32.5038	37.2986	37.7440	43.9870	48.0153	52.1415	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.8518	20.2968	16.5064	12.4964	9.3412	7.8863	8.5214	11.0764	14.8667	18.8768	22.0320	23.4869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	256.3278	258.9876	252.2848	238.0153	220.0027	203.0733	191.7634	189.1036	195.8064	210.0759	228.0885	245.0179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	(71)
Water heating gains (Table 5)	72.3660	70.0731	65.3115	58.8381	54.6354	48.7177	43.6879	50.1325	52.4223	59.1223	66.6879	70.0826	(72)
Total internal gains	415.6385	413.4504	398.1956	373.4428	348.0722	323.7702	308.0656	314.4053	327.1883	352.1678	380.9013	402.6804	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	9.5400	36.7938	0.6000	0.9000	0.7700	131.3561	(77)
Southwest	19.7200	36.7938	0.6000	0.9000	0.7700	271.5244	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	402.8806	686.2547	938.9636	1163.4214	1303.1290	1293.7054	1247.2701	1143.0420	1016.6990	758.4576	482.5581	344.7818	(83)
Total gains	818.5191	1099.7051	1337.1592	1536.8642	1651.2011	1617.4756	1555.3357	1457.4473	1343.8873	1110.6255	863.4594	747.4622	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	70.1119	70.2840	70.4569	71.3347	71.5129	72.4172	72.4172	72.6009	72.0528	71.5129	71.1574	70.8054	
alpha	5.6741	5.6856	5.6971	5.7556	5.7675	5.8278	5.8278	5.8401	5.8035	5.7675	5.7438	5.7204	
util living area	0.9906	0.9587	0.8775	0.7200	0.5392	0.3786	0.2712	0.3017	0.4906	0.8089	0.9715	0.9940	(86)
Tweekday	19.0208	19.4431	19.8099	20.0361	20.0973	20.1169	20.1176	20.1196	20.1100	20.0006	19.4809	18.9388	
Tweekend	20.4727	20.6644	20.8399	20.9552	20.9920	20.9992	20.9999	20.9998	20.9964	20.9300	20.6754	20.4333	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	20.1862	20.4808	20.7529	20.9301	20.9876	20.9987	20.9999	20.9997	20.9944	20.8919	20.4932	20.1253	(87)
Th 2	20.0913	20.0933	20.0953	20.1055	20.1075	20.1177	20.1177	20.1197	20.1136	20.1075	20.1034	20.0994	(88)
util rest of house	0.9877	0.9479	0.8516	0.6780	0.4901	0.3268	0.2169	0.2441	0.4294	0.7636	0.9622	0.9922	(89)
Tweekday	19.0208	19.4431	19.8099	20.0361	20.0973	20.1169	20.1176	20.1196	20.1100	20.0006	19.4809	18.9388	
Tweekend	19.0208	19.4431	19.8099	20.0361	20.0973	20.1169	20.1176	20.1196	20.1100	20.0006	19.4809	18.9388	
MIT 2	19.0208	19.4431	19.8099	20.0361	20.0973	20.1169	20.1176	20.1196	20.1100	20.0006	19.4809	18.9388	(90)
Living area fraction — fLA = Living area / (4) =												0.4066	(91)
MIT	19.4946	19.8650	20.1933	20.3996	20.4593	20.4755	20.4763	20.4775	20.4696	20.3630	19.8925	19.4212	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4946	19.8650	20.1933	20.3996	20.4593	20.4755	20.4763	20.4775	20.4696	20.3630	19.8925	19.4212	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9448	0.8546	0.6922	0.5096	0.3479	0.2390	0.2675	0.4542	0.7773	0.9595	0.9904	(94)
Useful gains	806.5299	1038.9660	1142.7480	1063.8755	841.5010	562.6392	371.6540	389.8901	610.3518	863.3219	828.5223	740.2584	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1505.0001	1478.6264	1349.6520	1119.4867	850.5950	563.4264	371.7214	390.0197	613.9035	948.0637	1248.4535	1492.8636	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating kWh	519.6618	295.4518	153.9366	40.0401	6.7659	0.0000	0.0000	0.0000	0.0000	63.0479	302.3504	559.9383	(98)

Space heating 1941.1928 (98)
Space heating per m2 (98) / (4) = 19.4119 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	901.4120	709.6222	726.9578	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9946	0.9981	0.9970	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	896.5406	708.2599	724.8109	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1992.6183	1918.0208	1805.0580	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	789.1759	900.0621	803.7038	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling 2492.9418 (104)
Cooled fraction fC = cooled area / (4) = 0.5284 (105)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	104.2501	118.8982	106.1693	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling 329.3176 (107)
Space cooling per m2 3.2932 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	237.0564	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	818.8738	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0500	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	519.6618	295.4518	153.9366	40.0401	6.7659	0.0000	0.0000	0.0000	0.0000	63.0479	302.3504	559.9383	(98)
Space heating efficiency (main heating system 1)	237.0564	237.0564	237.0564	237.0564	237.0564	0.0000	0.0000	0.0000	0.0000	237.0564	237.0564	237.0564	(210)
Space heating fuel (main heating system)	219.2144	124.6335	64.9367	16.8905	2.8541	0.0000	0.0000	0.0000	0.0000	26.5962	127.5437	236.2046	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	197.2472	173.5245	181.4619	161.5908	157.5732	139.6760	133.0771	147.4975	147.6979	167.6132	178.5888	192.1379	(64)
Efficiency of water heater												270.4650	(216)
(217)m	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	(217)
Fuel for water heating, kWh/month	72.9289	64.1578	67.0926	59.7456	58.2601	51.6429	49.2031	54.5348	54.6089	61.9722	66.0303	71.0398	(219)
Water heating fuel used												731.2170	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	25.7408	29.3576	26.2146	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												81.3130	(221)

Annual totals kWh/year

Space heating fuel - main system	818.8738	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)

mechanical ventilation fans (SFP = 0.9875)	337.3300	(230a)
Total electricity for the above, kWh/year	337.3300	(231)
Electricity for lighting (calculated in Appendix L)	403.5701	(232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 0.66 * 951 * 0.80) =	-401.5402	-401.5402	(233)
Total delivered energy for all uses		1970.7636	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	818.8738	0.5190	424.9955	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	731.2170	0.5190	379.5016	(264)
Space and water heating			804.4971	(265)
Space cooling	81.3130	0.5190	42.2014	(266)
Pumps and fans	337.3300	0.5190	175.0743	(267)
Energy for lighting	403.5701	0.5190	209.4529	(268)
Energy saving/generation technologies				
PV Unit	-401.5402	0.5190	-208.3994	(269)
Total CO2, kg/year			1022.8263	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.2300	(273)

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

DER		10.2300	ZC1
Total Floor Area	TFA	100.0000	
Assumed number of occupants	N	2.7395	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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CO2 emissions from appliances, equation (L14)                                                    15.1894 ZC2
CO2 emissions from cooking, equation (L16)                                                        1.8475 ZC3
Total CO2 emissions                                                                              27.2669 ZC4
Residual CO2 emissions offset from biofuel CHP                                                    0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                          0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                   0.0000 ZC7
Net CO2 emissions                                                                                27.2669 ZC8


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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		100.0000 (1b)	x	2.8000 (2b)	=	280.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	280.0000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1071	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3571	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3188	0.3125	0.3063	0.2750	0.2688	0.2375	0.2375	0.2313	0.2500	0.2688	0.2813	0.2938	(22b)
Effective ac	0.5508	0.5488	0.5469	0.5378	0.5361	0.5282	0.5282	0.5267	0.5313	0.5361	0.5396	0.5431	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			25.0000	1.3258	33.1439			(27)
Heat Loss Floor 1			100.0000	0.1300	13.0000			(28a)
External Wall 1	73.6100	29.2600	44.3500	0.1800	7.9830			(29a)
Total net area of external elements Aum(A, m2)			169.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.1269			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		8.4675	(36)
Total fabric heat loss	(33) + (36) =	62.5944	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.8940	50.7117	50.5331	49.6939	49.5369	48.8060	48.8060	48.6706	49.0875	49.5369	49.8545	50.1866	(38)
Heat transfer coeff	113.4884	113.3062	113.1275	112.2883	112.1313	111.4004	111.4004	111.2651	111.6819	112.1313	112.4489	112.7810	(39)
Average = Sum(39)m / 12 =												112.2876	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1349	1.1331	1.1313	1.1229	1.1213	1.1140	1.1140	1.1127	1.1168	1.1213	1.1245	1.1278	(40)
HLP (average)												1.1229	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7395	(42)
Average daily hot water use (litres/day)	99.2637	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.1901	105.2196	101.2490	97.2785	93.3079	89.3374	89.3374	93.3079	97.2785	101.2490	105.2196	109.1901	(44)
Energy conte	161.9258	141.6213	146.1405	127.4088	122.2518	105.4940	97.7557	112.1761	113.5159	132.2918	144.4068	156.8165	(45)
Energy content (annual)										Total = Sum(45)m =		1561.8051	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2889	21.2432	21.9211	19.1113	18.3378	15.8241	14.6634	16.8264	17.0274	19.8438	21.6610	23.5225	(46)

Water storage loss:

Store volume	150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.3938	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.7527	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	208.5207	183.7070	192.7354	172.5007	168.8467	150.5859	144.3506	158.7710	158.6077	178.8867	189.4987	203.4114	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	208.5207	183.7070	192.7354	172.5007	168.8467	150.5859	144.3506	158.7710	158.6077	178.8867	189.4987	203.4114	(64)
Total per year (kWh/year) = Sum(64)m =												2110.4225	(64)
Heat gains from water heating, kWh/month	91.1162	80.7577	85.8676	78.4369	77.9247	71.1502	69.7797	74.5745	73.8175	81.2629	84.0887	89.4174	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.8518	20.2968	16.5064	12.4964	9.3412	7.8863	8.5214	11.0764	14.8667	18.8768	22.0320	23.4869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	256.3278	258.9876	252.2848	238.0153	220.0027	203.0733	191.7634	189.1036	195.8064	210.0759	228.0885	245.0179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	(71)
Water heating gains (Table 5)	122.4681	120.1751	115.4135	108.9402	104.7374	98.8198	93.7899	100.2345	102.5243	109.2244	116.7899	120.1847	(72)
Total internal gains	468.7405	466.5524	451.2977	426.5448	401.1742	376.8722	361.1676	367.5074	380.2903	405.2699	434.0033	455.7824	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	8.1500	36.7938	0.6300	0.7000	0.7700	91.6441	(77)
Southwest	16.8500	36.7938	0.6300	0.7000	0.7700	189.4727	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	281.1168	478.8460	655.1779	811.7972	909.2806	902.7051	870.3041	797.5771	709.4192	529.2268	336.7132	240.5774	(83)
Total gains	749.8574	945.3984	1106.4756	1238.3421	1310.4548	1279.5774	1231.4717	1165.0845	1089.7095	934.4967	770.7165	696.3598	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.1908	61.2892	61.3860	61.8448	61.9314	62.3377	62.3377	62.4135	62.1806	61.9314	61.7564	61.5746	
alpha	5.0794	5.0859	5.0924	5.1230	5.1288	5.1558	5.1558	5.1609	5.1454	5.1288	5.1171	5.1050	
util living area	0.9945	0.9827	0.9518	0.8729	0.7289	0.5448	0.3959	0.4357	0.6676	0.9141	0.9862	0.9962	(86)
MIT	19.9175	20.1566	20.4466	20.7378	20.9173	20.9850	20.9976	20.9961	20.9593	20.7055	20.2424	19.8675	(87)
Th 2	19.9724	19.9739	19.9754	19.9822	19.9835	19.9894	19.9894	19.9905	19.9871	19.9835	19.9809	19.9782	(88)
util rest of house	0.9928	0.9773	0.9375	0.8387	0.6686	0.4641	0.3061	0.3420	0.5847	0.8822	0.9811	0.9949	(89)
MIT 2	18.5459	18.8922	19.3030	19.6977	19.9106	19.9804	19.9886	19.9891	19.9590	19.6685	19.0241	18.4774	(90)
Living area fraction									fLA = Living area / (4) =			0.4066	(91)
MIT	19.1036	19.4063	19.7680	20.1206	20.3199	20.3889	20.3988	20.3985	20.3658	20.0901	19.5195	19.0426	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1036	19.4063	19.7680	20.1206	20.3199	20.3889	20.3988	20.3985	20.3658	20.0901	19.5195	19.0426	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9907	0.9736	0.9341	0.8438	0.6895	0.4966	0.3427	0.3802	0.6170	0.8860	0.9780	0.9933	(94)
Useful gains	742.9080	920.4261	1033.5496	1044.9496	903.5703	635.3946	422.0645	442.9779	672.3276	827.9810	753.7790	691.7172	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1680.0366	1643.6531	1500.9789	1259.9463	966.5652	644.8812	423.1932	444.8954	699.7714	1064.1403	1396.5561	1673.9623	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	697.2237	486.0086	347.7674	154.7976	46.8682	0.0000	0.0000	0.0000	0.0000	175.7025	462.7995	730.7903	(98)
Space heating												3101.9578	(98)
Space heating per m2											(98) / (4) =	31.0196	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3317.6019	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	697.2237	486.0086	347.7674	154.7976	46.8682	0.0000	0.0000	0.0000	0.0000	175.7025	462.7995	730.7903	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	745.6938	519.7953	371.9438	165.5589	50.1264	0.0000	0.0000	0.0000	0.0000	187.9172	494.9727	781.5939	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	208.5207	183.7070	192.7354	172.5007	168.8467	150.5859	144.3506	158.7710	158.6077	178.8867	189.4987	203.4114	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7900	87.2895	86.3704	84.5266	81.9040	79.8000	79.8000	79.8000	79.8000	84.7660	87.1069	87.9328	(217)
Fuel for water heating, kWh/month	237.5221	210.4573	223.1499	204.0786	206.1521	188.7041	180.8905	198.9612	198.7565	211.0358	217.5472	231.3260	(219)
Water heating fuel used												2508.5814	(219)

Annual totals kWh/year		
Space heating fuel - main system	3317.6019	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	403.5701	(232)
Total delivered energy for all uses	6304.7534	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3317.6019	0.2160	716.6020	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2508.5814	0.2160	541.8536	(264)
Space and water heating			1258.4556	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	403.5701	0.5190	209.4529	(268)
Total CO2, kg/m2/year			1506.8335	(272)
Emissions per m2 for space and water heating			12.5846	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0945	(272b)
Emissions per m2 for pumps and fans			0.3893	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.5846 * 1.55) + 2.0945 + 0.3893, rounded to 2 d.p.			21.9900	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A4-F3+PV	**Issued on Date**	24/07/2020
Assessment Reference	A4-F3+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	91 B	**DER**	9.74	**TER**	21.59
Environmental	92 A	**% DER<TER**	54.89		
CO_2 Emissions (t/year)	0.74	**DFEE**	37.19	**TFEE**	43.46
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.43		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 106 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 21.59 kgCO_2/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.74 kgCO_2/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)43.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)37.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system:	Heat pump with radiators or underfloor - Electric
Panasonic WH-ADC0309G3E5UK + WH-UD07FE5	
Secondary heating system:	None

5 Cylinder insulation

Hot water storage	No cylinder

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	

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

Minimum	75%	OK

8 Mechanical ventilation
Continuous supply and extract system

Specific fan power:	0.66	
Maximum	1.5	OK
MVHR efficiency:	85%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Medium	OK
Based on:		
Overshading:	Average	
Windows facing North East:	20.83 m², No overhang	
Windows facing South East:	5.96 m², No overhang	
Air change rate:	3.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

10 Key features

External wall U-value	0.13 W/m²K
Party wall U-value	0.00 W/m²K
Party wall U-value	0.00 W/m²K
Party wall U-value	0.00 W/m²K
Roof U-value	0.11 W/m²K
Air permeability	3.0 m³/m²h
Photovoltaic array	0.66 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	106.0000	(1b)	x	2.8000	(2b)	=	296.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.0000							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	296.8000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.2500	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2726	0.2700	0.2674	0.2543	0.2516	0.2385	0.2385	0.2359	0.2438	0.2516	0.2569	0.2621	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			26.7900	1.2357	33.1055			(27)
External Wall 1	72.3200	26.7900	45.5300	0.1300	5.9189			(29a)
External Roof 1	15.2200		15.2200	0.1100	1.6742			(30)
Total net area of external elements Aum(A, m2)			87.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.6986			(33)
Party Wall 1			15.0400	0.0000	0.0000			(32)
Party Wall 2			28.4800	0.0000	0.0000			(32)
Party Wall 3			43.5400	0.0000	0.0000			(32)
Party Floor 1			106.0000					(32d)
Party Ceilings 1			90.7800					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		13.1310	(36)
Total fabric heat loss	(33) + (36) =	53.8296	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.7020	26.4449	26.1878	24.9023	24.6452	23.3596	23.3596	23.1025	23.8739	24.6452	25.1594	25.6736	(38)
Heat transfer coeff	80.5316	80.2745	80.0174	78.7319	78.4748	77.1893	77.1893	76.9322	77.7035	78.4748	78.9890	79.5032	(39)
Average = Sum(39)m / 12 =												78.6676	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7597	0.7573	0.7549	0.7428	0.7403	0.7282	0.7282	0.7258	0.7331	0.7403	0.7452	0.7500	(40)
HLP (average)												0.7421	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7886	(42)
Average daily hot water use (litres/day)	100.4283	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4712	106.4540	102.4369	98.4198	94.4026	90.3855	90.3855	94.4026	98.4198	102.4369	106.4540	110.4712	(44)
Energy conte	163.8256	143.2829	147.8551	128.9037	123.6861	106.7317	98.9026	113.4922	114.8477	133.8439	146.1011	158.6563	(45)
Energy content (annual)										Total = Sum(45)m =		1580.1288	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
                24.5738    21.4924    22.1783    19.3355    18.5529    16.0098    14.8354    17.0238    17.2272    20.0766    21.9152    23.7984 (46)
Water storage loss:
Store volume                                                                                                                           184.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                            2.1100 (48)
  Temperature factor from Table 2b                                                                                                       0.5400 (49)
Enter (49) or (54) in (55)                                                                                                               1.1394 (55)
Total storage loss
                35.3214    31.9032    35.3214    34.1820    35.3214    34.1820    35.3214    35.3214    34.1820    35.3214    34.1820    35.3214 (56)
If cylinder contains dedicated solar storage
                35.3214    31.9032    35.3214    34.1820    35.3214    34.1820    35.3214    35.3214    34.1820    35.3214    34.1820    35.3214 (57)
Primary loss     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Total heat required for water heating calculated for each month
               199.1470   175.1861   183.1765   163.0857   159.0075   140.9137   134.2240   148.8136   149.0297   169.1653   180.2831   193.9777 (62)
Solar input      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                         Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
               199.1470   175.1861   183.1765   163.0857   159.0075   140.9137   134.2240   148.8136   149.0297   169.1653   180.2831   193.9777 (64)
                                                                                           Total per year (kWh/year) = Sum(64)m =   1996.0098 (64)
Heat gains from water heating, kWh/month
                54.4720    47.6416    49.1618    42.8605    41.1256    35.4883    32.8851    37.7362    38.1869    44.5031    48.5786    52.7532 (65)


-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281   139.4281 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                23.6855    21.0372    17.1086    12.9523     9.6820     8.1740     8.8323    11.4805    15.4091    19.5654    22.8357    24.3438 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               265.6788   268.4357   261.4884   246.6983   228.0285   210.4816   198.7591   196.0022   202.9495   217.7396   236.4094   253.9563 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428    36.9428 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425  -111.5425 (71)
Water heating gains (Table 5)
                73.2151    70.8952    66.0777    59.5284    55.2764    49.2893    44.2004    50.7206    53.0373    59.8160    67.4703    70.9049 (72)
Total internal gains
               427.4077   425.1965   409.5031   384.0075   357.8154   332.7733   316.6202   323.0318   336.2244   361.9494   391.5438   414.0334 (73)


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6. Solar gains
-----------------------------------------------------------------------------------------------------
[Jan]                                        Area        Solar flux              g               FF            Access              Gains
                                               m2          Table 6a    Specific data    Specific data          factor                  W
                                                               W/m2      or Table 6b      or Table 6c        Table 6d
-----------------------------------------------------------------------------------------------------
Northeast                                 20.8300           11.2829           0.6000           0.9000          0.7700            87.9506 (75)
Southeast                                  5.9600           36.7938           0.6000           0.9000          0.7700            82.0632 (77)
-----------------------------------------------------------------------------------------------------

Solar gains    170.0137   318.8098   513.8062   766.6946   977.4780  1022.6287   964.1919   798.9546   600.1219   373.2749   208.9573   142.0538 (83)
Total gains    597.4215   744.0064   923.3093  1150.7021  1335.2934  1355.4019  1280.8121  1121.9864   936.3463   735.2243   600.5011   556.0872 (84)


-----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                             21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             91.4065    91.6993    91.9939    93.4959    93.8023    95.3645    95.3645    95.6832    94.7334    93.8023    93.1916    92.5889
alpha            7.0938     7.1133     7.1329     7.2331     7.2535     7.3576     7.3576     7.3789     7.3156     7.2535     7.2128     7.1726
util living area
                 0.9982     0.9916     0.9526     0.7818     0.5434     0.3643     0.2652     0.3154     0.5684     0.9195     0.9941     0.9989 (86)

Tweekday        19.3223    19.5922    19.9633    20.2504    20.3020    20.3159    20.3160    20.3181    20.3091    20.1588    19.6748    19.2829
Tweekend        20.5385    20.6578    20.8267    20.9672    20.9974    20.9999    21.0000    21.0000    20.9976    20.9133    20.6902    20.5180
24 / 16               0          0          0          0          0          0          0          0          0          0          0          0
24 / 9                0          0          0          0          0          0          0          0          0          0          0          0
16 / 9                0          0          0          0          0          0          0          0          0          0          0          0
MIT             20.2877    20.4707    20.7326    20.9488    20.9960    20.9998    21.0000    21.0000    20.9962    20.8662    20.5163    20.2562 (87)
Th 2            20.2884    20.2905    20.2926    20.3032    20.3053    20.3160    20.3160    20.3181    20.3117    20.3053    20.3011    20.2968 (88)
util rest of house
                 0.9977     0.9890     0.9402     0.7475     0.5039     0.3255     0.2239     0.2686     0.5135     0.8938     0.9920     0.9986 (89)
Tweekday        19.3223    19.5922    19.9633    20.2504    20.3020    20.3159    20.3160    20.3181    20.3091    20.1588    19.6748    19.2829
Tweekend        19.3223    19.5922    19.9633    20.2504    20.3020    20.3159    20.3160    20.3181    20.3091    20.1588    19.6748    19.2829
MIT 2           19.3223    19.5922    19.9633    20.2504    20.3020    20.3159    20.3160    20.3181    20.3091    20.1588    19.6748    19.2829 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.5223 (91)
MIT             19.8265    20.0510    20.3650    20.6152    20.6645    20.6731    20.6732    20.6742    20.6680    20.5282    20.1143    19.7912 (92)
Temperature adjustment                                                                                                               0.0000
adjusted MIT    19.8265    20.0510    20.3650    20.6152    20.6645    20.6731    20.6732    20.6742    20.6680    20.5282    20.1143    19.7912 (93)


-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9972     0.9880     0.9416     0.7632     0.5244     0.3458     0.2455     0.2930     0.5421     0.9027     0.9913     0.9982 (94)
Useful gains   595.7625   735.0822   869.4067   878.2637   700.2805   468.6522   314.4006   328.7969   507.5967   663.7125   595.2682   555.1093 (95)
Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              1250.3740  1216.2387  1109.4451   922.3563   703.4842   468.7764   314.4084   328.8241   510.3542   779.1157  1027.9842  1239.5483 (97)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
Month fracti      1.0000      1.0000      1.0000      1.0000      1.0000      0.0000      0.0000      0.0000      0.0000      1.0000      1.0000      1.0000 (97a)
Space heating kWh
                487.0309    323.3372    178.5886     31.7467      2.3836      0.0000      0.0000      0.0000      0.0000     85.8600    311.5555    509.2226 (98)
Space heating                                                                                                                               1929.7251 (98)
Space heating per m2                                                                                                       (98)  /  (4) =     18.2050 (99)


----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Calculated for June, July and August. See Table 10b
                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Ext. temp.        4.3000      4.9000      6.5000      8.9000     11.7000     14.6000     16.6000     16.4000     14.1000     10.6000      7.1000      4.2000
Heat loss rate W
                  0.0000      0.0000      0.0000      0.0000      0.0000    725.5790    571.2005    584.6844      0.0000      0.0000      0.0000      0.0000 (100)
Utilisation       0.0000      0.0000      0.0000      0.0000      0.0000      0.9989      0.9997      0.9991      0.0000      0.0000      0.0000      0.0000 (101)
Useful loss       0.0000      0.0000      0.0000      0.0000      0.0000    724.7537    571.0128    584.1819      0.0000      0.0000      0.0000      0.0000 (102)
Total gains       0.0000      0.0000      0.0000      0.0000      0.0000   1689.4472   1600.2051   1416.0967      0.0000      0.0000      0.0000      0.0000 (103)
Month fracti      0.0000      0.0000      0.0000      0.0000      0.0000      1.0000      1.0000      1.0000      0.0000      0.0000      0.0000      0.0000 (103a)
Space cooling kWh
                  0.0000      0.0000      0.0000      0.0000      0.0000    694.5794    765.7191    618.9446      0.0000      0.0000      0.0000      0.0000 (104)
Space cooling                                                                                                                               2079.2431 (104)
Cooled fraction                                                                                     fC = cooled area / (4) =                  0.6920 (105)
Intermittency factor (Table 10b)
                  0.0000      0.0000      0.0000      0.0000      0.0000      0.2500      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (106)
Space cooling kWh
                  0.0000      0.0000      0.0000      0.0000      0.0000    120.1590      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (107)
Space cooling                                                                                                                                120.1590 (107)
Space cooling per m2                                                                                                                           1.1336 (108)


----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                         0.0000 (201)
Fraction of space heat from main system(s)                                                                                                    1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                            212.9118 (206)
Efficiency of secondary/supplementary heating system, %                                                                                     100.0000 (208)
Space heating requirement                                                                                                                   906.3496 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)                                                                                        4.0500 (209)

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Space heating requirement
                487.0309    323.3372    178.5886     31.7467      2.3836      0.0000      0.0000      0.0000      0.0000     85.8600    311.5555    509.2226 (98)
Space heating efficiency (main heating system 1)
                212.9118    212.9118    212.9118    212.9118    212.9118      0.0000      0.0000      0.0000      0.0000    212.9118    212.9118    212.9118 (210)
Space heating fuel (main heating system)
                228.7478    151.8644     83.8791     14.9107      1.1195      0.0000      0.0000      0.0000      0.0000     40.3266    146.3308    239.1707 (211)
Water heating requirement
                  0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (215)

Water heating
Water heating requirement
                199.1470    175.1861    183.1765    163.0857    159.0075    140.9137    134.2240    148.8136    149.0297    169.1653    180.2831    193.9777 (64)
Efficiency of water heater                                                                                                                  270.4650 (216)
(217)m          270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650    270.4650 (217)
Fuel for water heating, kWh/month
                 73.6313     64.7722     67.7265     60.2982     58.7904     52.1005     49.6271     55.0214     55.1013     62.5461     66.6567     71.7201 (219)
Water heating fuel used                                                                                                                     737.9919 (219)
Space cooling fuel requirement
(221)m            0.0000      0.0000      0.0000      0.0000      0.0000     29.6689      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (221)
Cooling                                                                                                                                      29.6689 (221)
Annual totals kWh/year
Space heating fuel - main system                                                                                                            906.3496 (211)
Space heating fuel - secondary                                                                                                                0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)
   mechanical ventilation fans (SFP =       0.8250)                                                                                         298.7292 (230a)
Total electricity for the above, kWh/year                                                                                                   298.7292 (231)
Electricity for lighting (calculated in Appendix L)                                                                                         418.2926 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.66 * 951 * 0.80) =                                                                      -401.5402                      -401.5402 (233)
Total delivered energy for all uses                                                                                                        1989.4920 (238)


----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                            Energy      Emission factor             Emissions
                                                                                         kWh/year          kg CO2/kWh            kg CO2/year
Space heating - main system 1                                                            906.3496              0.5190               470.3955 (261)
Space heating - secondary                                                                  0.0000              0.5190                 0.0000 (263)
Water heating (other fuel)                                                               737.9919              0.5190               383.0178 (264)
Space and water heating                                                                                                             853.4133 (265)
Space cooling                                                                             29.6689              0.5190                15.3981 (266)
Pumps and fans                                                                           298.7292              0.5190               155.0405 (267)
Energy for lighting                                                                      418.2926              0.5190               217.0939 (268)

 Energy saving/generation technologies
PV Unit                                                                                 -401.5402              0.5190              -208.3994 (269)
Total CO2, kg/year                                                                                                                 1032.5464 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                           9.7400 (273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                                   9.7400 ZC1
Total Floor Area                                                                                                              TFA   106.0000
Assumed number of occupants                                                                                                     N     2.7886
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8524	ZC2
CO2 emissions from cooking, equation (L16)		1.7540	ZC3
Total CO2 emissions		26.3464	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.3464	ZC8

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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------------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
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------------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
------------------------------------------------------------------------------------------------------
                                                                                          Area        Storey height            Volume
                                                                                          (m2)             (m)                  (m3)
Ground floor                                                                          106.0000 (1b)    x      2.8000 (2b)    =   296.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)             106.0000                                                   (4)
Dwelling volume                                                                              (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   296.8000 (5)



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

                                                                                                                     Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                  40.0000 / (5) =      0.1348 (8)
Pressure test                                                                                                                        Yes
Measured/design AP50                                                                                                              5.0000
Infiltration rate                                                                                                                 0.3848 (18)
Number of sides sheltered                                                                                                              4 (19)

Shelter factor                                                                                (20) = 1 - [0.075 x (19)]  =      0.7000 (20)
Infiltration rate adjusted to include shelter factor                                                    (21) = (18) x (20)  =      0.2693 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.3434     0.3367     0.3299     0.2963     0.2895     0.2559     0.2559     0.2491     0.2693     0.2895     0.3030     0.3165 (22b)
Effective ac     0.5590     0.5567     0.5544     0.5439     0.5419     0.5327     0.5327     0.5310     0.5363     0.5419     0.5459     0.5501 (25)



------------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
------------------------------------------------------------------------------------------------------
Element                                          Gross       Openings        NetArea        U-value          A x U        K-value           A x K
                                                    m2             m2             m2          W/m2K            W/K          kJ/m2K            kJ/K
TER Opening Type (Uw = 1.40)                                                 26.5000         1.3258        35.1326                              (27)
External Wall 1                                72.3200        26.7900        45.5300         0.1800         8.1954                              (29a)
External Roof 1                                15.2200                       15.2200         0.1300         1.9786                              (30)
Total net area of external elements Aum(A, m2)                               87.2500                                                            (31)
Fabric heat loss, W/K = Sum (A x U)                                   (26)...(30) + (32) =     45.3066                                          (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                 250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)                                                                     4.3625 (36)
Total fabric heat loss                                                                                          (33) + (36) =      49.6691 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m           54.7472    54.5230    54.3031    53.2707    53.0775    52.1782    52.1782    52.0117    52.5246    53.0775    53.4683    53.8768 (38)
Heat transfer coeff
               104.4163   104.1920   103.9722   102.9397   102.7466   101.8473   101.8473   101.6808   102.1937   102.7466   103.1374   103.5459 (39)
Average = Sum(39)m / 12 =                                                                                                         102.9388 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.9851     0.9829     0.9809     0.9711     0.9693     0.9608     0.9608     0.9593     0.9641     0.9693     0.9730     0.9768 (40)
HLP (average)                                                                                                                       0.9711 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



------------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
------------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                   2.7886 (42)
Average daily hot water use (litres/day)                                                                                          100.4283 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               110.4712   106.4540   102.4369    98.4198    94.4026    90.3855    90.3855    94.4026    98.4198   102.4369   106.4540   110.4712 (44)
Energy conte   163.8256   143.2829   147.8551   128.9037   123.6861   106.7317    98.9026   113.4922   114.8477   133.8439   146.1011   158.6563 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =     1580.1288 (45)
Distribution loss  (46)m = 0.15 x (45)m
                24.5738    21.4924    22.1783    19.3355    18.5529    16.0098    14.8354    17.0238    17.2272    20.0766    21.9152    23.7984 (46)
Water storage loss:
Store volume                                                                                                                      150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                       1.3938 (48)
  Temperature factor from Table 2b                                                                                                  0.5400 (49)
Enter (49) or (54) in (55)                                                                                                          0.7527 (55)
Total storage loss
                23.3325    21.0745    23.3325    22.5798    23.3325    22.5798    23.3325    23.3325    22.5798    23.3325    22.5798    23.3325 (56)
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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(64)
Total per year (kWh/year) = Sum(64)m =												2128.7462	(64)
Heat gains from water heating, kWh/month	91.7479	81.3101	86.4377	78.9339	78.4016	71.5618	70.1610	75.0121	74.2603	81.7790	84.6521	90.0291	(65)

---

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	139.4281	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.6855	21.0372	17.1086	12.9523	9.6820	8.1740	8.8323	11.4805	15.4091	19.5654	22.8357	24.3438	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.6788	268.4357	261.4884	246.6983	228.0285	210.4816	198.7591	196.0022	202.9495	217.7396	236.4094	253.9563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	36.9428	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	-111.5425	(71)
Water heating gains (Table 5)	123.3171	120.9972	116.1798	109.6305	105.3784	99.3913	94.3025	100.8227	103.1393	109.9180	117.5723	121.0069	(72)
Total internal gains	480.5098	478.2986	462.6052	437.1095	410.9174	385.8753	369.7223	376.1338	389.3264	415.0514	444.6458	467.1354	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	20.6000	11.2829	0.6300	0.7000	0.7700	71.0332	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)

Solar gains	137.3768	257.5978	415.1274	619.4089	789.6706	826.1350	778.9310	645.4604	484.8529	301.5981	168.8425	114.7856	(83)
Total gains	617.8866	735.8964	877.7326	1056.5184	1200.5880	1212.0103	1148.6533	1021.5942	874.1793	716.6496	613.4883	581.9210	(84)

---

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.4977	70.6495	70.7988	71.5089	71.6434	72.2759	72.2759	72.3943	72.0310	71.6434	71.3719	71.0903	
alpha	5.6998	5.7100	5.7199	5.7673	5.7762	5.8184	5.8184	5.8263	5.8021	5.7762	5.7581	5.7394	
util living area	0.9983	0.9949	0.9806	0.9126	0.7407	0.5310	0.3891	0.4552	0.7483	0.9649	0.9957	0.9988	(86)
MIT	19.9706	20.1361	20.4086	20.7423	20.9393	20.9924	20.9989	20.9975	20.9532	20.6545	20.2467	19.9403	(87)
Th 2	20.0958	20.0976	20.0993	20.1075	20.1090	20.1161	20.1161	20.1174	20.1134	20.1090	20.1059	20.1027	(88)
util rest of house	0.9977	0.9932	0.9741	0.8870	0.6858	0.4607	0.3115	0.3693	0.6733	0.9493	0.9940	0.9983	(89)
MIT 2	18.7139	18.9565	19.3510	19.8169	20.0545	20.1115	20.1157	20.1165	20.0785	19.7109	19.1249	18.6747	(90)
Living area fraction									fLA = Living area / (4) =			0.5223	(91)
MIT	19.3702	19.5726	19.9033	20.3002	20.5166	20.5715	20.5770	20.5766	20.5353	20.2037	19.7108	19.3357	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3702	19.5726	19.9033	20.3002	20.5166	20.5715	20.5770	20.5766	20.5353	20.2037	19.7108	19.3357	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9920	0.9725	0.8931	0.7118	0.4972	0.3521	0.4142	0.7105	0.9513	0.9930	0.9979	(94)
Useful gains	616.0621	729.9828	853.5637	943.5359	854.5660	602.6529	404.4375	423.1855	621.1387	681.7262	609.1806	580.6783	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1573.5792	1528.7667	1393.5742	1173.5340	905.8757	608.1860	405.0472	424.6808	657.6486	986.7486	1300.6432	1567.2355	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	712.3928	536.7828	401.7679	165.5986	38.1744	0.0000	0.0000	0.0000	0.0000	226.9367	497.8530	733.9986	(98)
Space heating												3313.5047	(98)
Space heating per m2											(98) / (4) =	31.2595	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3543.8553	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	712.3928	536.7828	401.7679	165.5986	38.1744	0.0000	0.0000	0.0000	0.0000	226.9367	497.8530	733.9986	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	761.9174	574.0992	429.6983	177.1108	40.8282	0.0000	0.0000	0.0000	0.0000	242.7130	532.4631	785.0252	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement	210.4205	185.3686	194.4500	173.9955	170.2810	151.8236	145.4975	160.0871	159.9395	180.4388	191.1929	205.2512	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.8151	87.4888	86.7082	84.6823	81.5661	79.8000	79.8000	79.8000	79.8000	85.4265	87.2537	87.9237	(217)
Fuel for water heating, kWh/month	239.6176	211.8770	224.2579	205.4686	208.7646	190.2551	182.3277	200.6104	200.4255	211.2211	219.1230	233.4423	(219)

Water heating fuel used	2527.3907	(219)
Annual totals kWh/year		
Space heating fuel - main system	3543.8553	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	418.2926	(232)
Total delivered energy for all uses	6564.5386	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3543.8553	0.2160	765.4727	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2527.3907	0.2160	545.9164	(264)
Space and water heating			1311.3891	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	418.2926	0.5190	217.0939	(268)
Total CO2, kg/m2/year			1567.4080	(272)
Emissions per m2 for space and water heating			12.3716	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0481	(272b)
Emissions per m2 for pumps and fans			0.3672	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.3716 * 1.55) + 2.0481 + 0.3672, rounded to 2 d.p.			21.5900	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A5-F3+PV	**Issued on Date**	24/07/2020
Assessment Reference	A5-F3+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	92 A	**DER**	8.26	**TER**	18.64
Environmental	93 A	**% DER<TER**	55.69		
CO_2 Emissions (t/year)	0.64	**DFEE**	28.06	**TFEE**	32.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.45		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 100 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 18.64 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER)  8.26 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)32.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)28.1 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.13 (max. 0.30)       0.13 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)        -                        OK
Floor           (no floor)
Roof            (no roof)
Openings        1.30 (max. 2.00)       1.30 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:        3.00 (design value)
Maximum                                10.0                                                    OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Heat pump with radiators or underfloor - Electric
Panasonic WH-ADC0309G3E5UK + WH-UD07FE5



Secondary heating system:              None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Time and temperature zone control                       OK


Hot water controls:                    No cylinder


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                                     OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                    0.79
Maximum                                1.5                                                     OK
MVHR efficiency:                       84%
Minimum:                               70%                                                     OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):      Slight                                                  OK
Based on:
Overshading:                           Average
Windows facing South East:             9.54 m², No overhang
Windows facing South West:             19.72 m², No overhang
Air change rate:                       6.00 ach
Blinds/curtains:                       Light-coloured venetian blind, closed 50% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                  0.13 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Party wall U-value                     0.00 W/m²K
Air permeability                       3.0 m³/m²h
Photovoltaic array                     0.66 kW



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		100.0000 (1b)	x	2.8000 (2b)	=	280.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	280.0000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 71.4000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2769	0.2743	0.2716	0.2585	0.2559	0.2428	0.2428	0.2401	0.2480	0.2559	0.2611	0.2664	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			29.2600	1.2357	36.1578			(27)
External Wall 1	73.6100	29.2600	44.3500	0.1300	5.7655			(29a)
Total net area of external elements Aum(A, m2)			73.6100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.9233			(33)
Party Wall 1			17.8100	0.0000	0.0000			(32)
Party Wall 2			36.1200	0.0000	0.0000			(32)
Party Wall 3			22.9900	0.0000	0.0000			(32)
Party Floor 1			100.0000					(32d)
Party Ceilings 1			100.0000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area) 11.0415 (36)
Total fabric heat loss (33) + (36) = 52.9648 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	25.5833	25.3407	25.0982	23.8854	23.6429	22.4301	22.4301	22.1876	22.9152	23.6429	24.1280	24.6131	(38)
Heat transfer coeff	78.5480	78.3055	78.0629	76.8502	76.6076	75.3949	75.3949	75.1523	75.8800	76.6076	77.0927	77.5778	(39)

Average = Sum(39)m / 12 = 76.7896 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7855	0.7831	0.7806	0.7685	0.7661	0.7539	0.7539	0.7515	0.7588	0.7661	0.7709	0.7758	(40)
HLP (average)												0.7679	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7395 (42)
Average daily hot water use (litres/day) 99.2637 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.1901	105.2196	101.2490	97.2785	93.3079	89.3374	89.3374	93.3079	97.2785	101.2490	105.2196	109.1901	(44)
Energy conte	161.9258	141.6213	146.1405	127.4088	122.2518	105.4940	97.7557	112.1761	113.5159	132.2918	144.4068	156.8165	(45)

Energy content (annual) Total = Sum(45)m = 1561.8051 (45)
Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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              24.2889     21.2432     21.9211     19.1113     18.3378     15.8241     14.6634     16.8264     17.0274     19.8438     21.6610     23.5225 (46)
Water storage loss:
Store volume                                                                                                                                   184.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                    2.1100 (48)
  Temperature factor from Table 2b                                                                                                               0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                       1.1394 (55)
Total storage loss
              35.3214     31.9032     35.3214     34.1820     35.3214     34.1820     35.3214     35.3214     34.1820     35.3214     34.1820     35.3214 (56)
If cylinder contains dedicated solar storage
              35.3214     31.9032     35.3214     34.1820     35.3214     34.1820     35.3214     35.3214     34.1820     35.3214     34.1820     35.3214 (57)
Primary loss   0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (59)
Total heat required for water heating calculated for each month
             197.2472    173.5245    181.4619    161.5908    157.5732    139.6760    133.0771    147.4975    147.6979    167.6132    178.5888    192.1379 (62)
Solar input    0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (63)
                                                                                    Solar input (sum of months) = Sum(63)m =         0.0000 (63)
Output from w/h
             197.2472    173.5245    181.4619    161.5908    157.5732    139.6760    133.0771    147.4975    147.6979    167.6132    178.5888    192.1379 (64)
                                                                                      Total per year (kWh/year) = Sum(64)m =      1977.6861 (64)
Heat gains from water heating, kWh/month
              53.8403     47.0891     48.5917     42.3634     40.6487     35.0768     32.5038     37.2986     37.7440     43.9870     48.0153     52.1415 (65)


----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
(66)m        136.9763    136.9763    136.9763    136.9763    136.9763    136.9763    136.9763    136.9763    136.9763    136.9763    136.9763    136.9763 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              22.8518     20.2968     16.5064     12.4964      9.3412      7.8863      8.5214     11.0764     14.8667     18.8768     22.0320     23.4869 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             256.3278    258.9876    252.2848    238.0153    220.0027    203.0733    191.7634    189.1036    195.8064    210.0759    228.0885    245.0179 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              36.6976     36.6976     36.6976     36.6976     36.6976     36.6976     36.6976     36.6976     36.6976     36.6976     36.6976     36.6976 (69)
Pumps, fans    0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -109.5810   -109.5810   -109.5810   -109.5810   -109.5810   -109.5810   -109.5810   -109.5810   -109.5810   -109.5810   -109.5810   -109.5810 (71)
Water heating gains (Table 5)
              72.3660     70.0731     65.3115     58.8381     54.6354     48.7177     43.6879     50.1325     52.4223     59.1223     66.6879     70.0826 (72)
Total internal gains
             415.6385    413.4504    398.1956    373.4428    348.0722    323.7702    308.0656    314.4053    327.1883    352.1678    380.9013    402.6804 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------

[Jan]                                       Area         Solar flux              g                 FF            Access             Gains
                                              m2           Table 6a      Specific data     Specific data        factor                 W
                                                               W/m2        or Table 6b       or Table 6c      Table 6d
----------------------------------------------------------------------------------------------------
Southeast                                 9.5400            36.7938            0.6000            0.9000          0.7700          131.3561 (77)
Southwest                                19.7200            36.7938            0.6000            0.9000          0.7700          271.5244 (79)
----------------------------------------------------------------------------------------------------

Solar gains  402.8806    686.2547    938.9636   1163.4214   1303.1290   1293.7054   1247.2701   1143.0420   1016.6990    758.4576    482.5581    344.7818 (83)
Total gains  818.5191   1099.7051   1337.1592   1536.8642   1651.2011   1617.4756   1555.3357   1457.4473   1343.8873   1110.6255    863.4594    747.4622 (84)


----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
tau           88.4102     88.6840     88.9596     90.3634     90.6495     92.1076     92.1076     92.4049     91.5188     90.6495     90.0791     89.5158
alpha          6.8940      6.9123      6.9306      7.0242      7.0433      7.1405      7.1405      7.1603      7.1013      7.0433      7.0053      6.9677
util living area
               0.9851      0.9248      0.7907      0.5979      0.4308      0.2983      0.2133      0.2372      0.3893      0.6964      0.9480      0.9910 (86)

Tweekday      19.6013     19.9682     20.1869     20.2700     20.2819     20.2934     20.2934     20.2955     20.2889     20.2607     19.9691     19.5243
Tweekend      20.6713     20.8415     20.9514     20.9928     20.9993     21.0000     21.0000     21.0000     20.9997     20.9848     20.8350     20.6335
24 / 16             0           0           0           0           0           0           0           0           0           0           0           0
24 / 9              0           0           0           0           0           0           0           0           0           0           0           0
16 / 9              0           0           0           0           0           0           0           0           0           0           0           0
MIT           20.4927     20.7548     20.9250     20.9888     20.9989     20.9999     21.0000     21.0000     20.9996     20.9765     20.7423     20.4343 (87)
Th 2          20.2659     20.2680     20.2702     20.2807     20.2828     20.2934     20.2934     20.2955     20.2892     20.2828     20.2786     20.2744 (88)
util rest of house
               0.9810      0.9093      0.7617      0.5644      0.3978      0.2654      0.1790      0.2009      0.3493      0.6544      0.9340      0.9885 (89)
Tweekday      19.6013     19.9682     20.1869     20.2700     20.2819     20.2934     20.2934     20.2955     20.2889     20.2607     19.9691     19.5243
Tweekend      19.6013     19.9682     20.1869     20.2700     20.2819     20.2934     20.2934     20.2955     20.2889     20.2607     19.9691     19.5243
MIT 2         19.6013     19.9682     20.1869     20.2700     20.2819     20.2934     20.2934     20.2955     20.2889     20.2607     19.9691     19.5243 (90)
Living area fraction                                                                                fLA = Living area / (4) =        0.4066 (91)
MIT           19.9637     20.2880     20.4870     20.5623     20.5735     20.5807     20.5807     20.5820     20.5779     20.5518     20.2835     19.8943 (92)
Temperature adjustment                                                                                                             0.0000
adjusted MIT  19.9637     20.2880     20.4870     20.5623     20.5735     20.5807     20.5807     20.5820     20.5779     20.5518     20.2835     19.8943 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation    0.9790      0.9098      0.7706      0.5776      0.4112      0.2788      0.1930      0.2156      0.3656      0.6705      0.9341      0.9868 (94)
Useful gains 801.3310   1000.5086   1030.3742    887.6759    679.0026    450.8764    300.1235    314.2806    491.2950    744.6304    806.5793    737.6249 (95)
Ext temp.      4.3000      4.9000      6.5000      8.9000     11.7000     14.6000     16.6000     16.4000     14.1000     10.6000      7.1000      4.2000 (96)
Heat loss rate W
            1230.3556   1204.9672   1091.8690    896.2470    679.7745    450.9120    300.1255    314.2848    491.5417    762.3822   1016.3501   1217.5289 (97)
Month fracti   1.0000      1.0000      1.0000      1.0000      0.0000      0.0000      0.0000      0.0000      0.0000      1.0000      1.0000      1.0000 (97a)
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating kWh	319.1943	137.3962	45.7521	6.1712	0.5743	0.0000	0.0000	0.0000	0.0000	13.2073	151.0350	357.0486	(98)
Space heating												1030.3790	(98)
Space heating per m2											(98) / (4) =	10.3038	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	708.7120	557.9222	571.1578	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9996	0.9999	0.9998	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	708.4276	557.8636	571.0547	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1992.6183	1918.0208	1805.0580	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	924.6173	1011.9569	918.0984	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2854.6726	(104)
Cooled fraction									fC = cooled area / (4) =			0.5284	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	122.1419	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												122.1419	(107)
Space cooling per m2												1.2214	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	210.0915	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	490.4431	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0500	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	319.1943	137.3962	45.7521	6.1712	0.5743	0.0000	0.0000	0.0000	0.0000	13.2073	151.0350	357.0486	(98)
Space heating efficiency (main heating system 1)	210.0915	210.0915	210.0915	210.0915	210.0915	0.0000	0.0000	0.0000	0.0000	210.0915	210.0915	210.0915	(210)
Space heating fuel (main heating system)	151.9311	65.3983	21.7772	2.9374	0.2734	0.0000	0.0000	0.0000	0.0000	6.2865	71.8901	169.9491	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	197.2472	173.5245	181.4619	161.5908	157.5732	139.6760	133.0771	147.4975	147.6979	167.6132	178.5888	192.1379	(64)
Efficiency of water heater												270.4650	(216)
(217)m	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	270.4650	(217)
Fuel for water heating, kWh/month	72.9289	64.1578	67.0926	59.7456	58.2601	51.6429	49.2031	54.5348	54.6089	61.9722	66.0303	71.0398	(219)
Water heating fuel used												731.2170	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	30.1585	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												30.1585	(221)

Annual totals kWh/year		
Space heating fuel - main system	490.4431	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)

mechanical ventilation fans (SFP = 0.9875)	337.3300	(230a)
Total electricity for the above, kWh/year	337.3300	(231)
Electricity for lighting (calculated in Appendix L)	403.5701	(232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 0.66 * 951 * 0.80) =	-401.5402	-401.5402	(233)
Total delivered energy for all uses		1591.1785	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	490.4431	0.5190	254.5399	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	731.2170	0.5190	379.5016	(264)
Space and water heating			634.0416	(265)
Space cooling	30.1585	0.5190	15.6523	(266)
Pumps and fans	337.3300	0.5190	175.0743	(267)
Energy for lighting	403.5701	0.5190	209.4529	(268)
Energy saving/generation technologies				
PV Unit	-401.5402	0.5190	-208.3994	(269)
Total CO2, kg/year			825.8216	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.2600	(273)

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

DER		8.2600	ZC1
Total Floor Area	TFA	100.0000	
Assumed number of occupants	N	2.7395	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

CO2 emissions from appliances, equation (L14)	15.1894	ZC2
CO2 emissions from cooking, equation (L16)	1.8475	ZC3
Total CO2 emissions	25.2969	ZC4
Residual CO2 emissions offset from biofuel CHP	0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year	0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation	0.0000	ZC7
Net CO2 emissions	25.2969	ZC8

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	100.0000 (1b)	x	2.8000 (2b)	=	280.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	280.0000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1071	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3571	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3188	0.3125	0.3063	0.2750	0.2688	0.2375	0.2375	0.2313	0.2500	0.2688	0.2813	0.2938	(22b)
Effective ac	0.5508	0.5488	0.5469	0.5378	0.5361	0.5282	0.5282	0.5267	0.5313	0.5361	0.5396	0.5431	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			25.0000	1.3258	33.1439			(27)
External Wall 1	73.6100	29.2600	44.3500	0.1800	7.9830			(29a)
Total net area of external elements Aum(A, m2)			69.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.1269			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		3.4675	(36)
Total fabric heat loss	(33) + (36) =	44.5944	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.8940	50.7117	50.5331	49.6939	49.5369	48.8060	48.8060	48.6706	49.0875	49.5369	49.8545	50.1866	(38)
Heat transfer coeff	95.4884	95.3062	95.1275	94.2883	94.1313	93.4004	93.4004	93.2651	93.6819	94.1313	94.4489	94.7810	(39)
Average = Sum(39)m / 12 =												94.2876	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9549	0.9531	0.9513	0.9429	0.9413	0.9340	0.9340	0.9327	0.9368	0.9413	0.9445	0.9478	(40)
HLP (average)												0.9429	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7395	(42)
Average daily hot water use (litres/day)	99.2637	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.1901	105.2196	101.2490	97.2785	93.3079	89.3374	89.3374	93.3079	97.2785	101.2490	105.2196	109.1901	(44)
Energy conte	161.9258	141.6213	146.1405	127.4088	122.2518	105.4940	97.7557	112.1761	113.5159	132.2918	144.4068	156.8165	(45)
Energy content (annual)										Total = Sum(45)m =		1561.8051	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2889	21.2432	21.9211	19.1113	18.3378	15.8241	14.6634	16.8264	17.0274	19.8438	21.6610	23.5225	(46)

Water storage loss:

Store volume	150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.3938	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.7527	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	208.5207	183.7070	192.7354	172.5007	168.8467	150.5859	144.3506	158.7710	158.6077	178.8867	189.4987	203.4114	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	208.5207	183.7070	192.7354	172.5007	168.8467	150.5859	144.3506	158.7710	158.6077	178.8867	189.4987	203.4114	(64)
								Total per year (kWh/year) = Sum(64)m =				2110.4225	(64)
Heat gains from water heating, kWh/month													
	91.1162	80.7577	85.8676	78.4369	77.9247	71.1502	69.7797	74.5745	73.8175	81.2629	84.0887	89.4174	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	136.9763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.8518	20.2968	16.5064	12.4964	9.3412	7.8863	8.5214	11.0764	14.8667	18.8768	22.0320	23.4869	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	256.3278	258.9876	252.2848	238.0153	220.0027	203.0733	191.7634	189.1036	195.8064	210.0759	228.0885	245.0179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	36.6976	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	-109.5810	(71)
Water heating gains (Table 5)													
	122.4681	120.1751	115.4135	108.9402	104.7374	98.8198	93.7899	100.2345	102.5243	109.2244	116.7899	120.1847	(72)
Total internal gains													
	468.7405	466.5524	451.2977	426.5448	401.1742	376.8722	361.1676	367.5074	380.2903	405.2699	434.0033	455.7824	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	8.1500	36.7938	0.6300	0.7000	0.7700	91.6441	(77)
Southwest	16.8500	36.7938	0.6300	0.7000	0.7700	189.4727	(79)

Solar gains	281.1168	478.8460	655.1779	811.7972	909.2806	902.7051	870.3041	797.5771	709.4192	529.2268	336.7132	240.5774	(83)
Total gains	749.8574	945.3984	1106.4756	1238.3421	1310.4548	1279.5774	1231.4717	1165.0845	1089.7095	934.4967	770.7165	696.3598	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.7255	72.8646	73.0014	73.6512	73.7740	74.3513	74.3513	74.4592	74.1279	73.7740	73.5259	73.2683	
alpha	5.8484	5.8576	5.8668	5.9101	5.9183	5.9568	5.9568	5.9639	5.9419	5.9183	5.9017	5.8846	
util living area													
	0.9935	0.9767	0.9304	0.8180	0.6463	0.4645	0.3334	0.3676	0.5821	0.8746	0.9817	0.9957	(86)
MIT	20.1726	20.4047	20.6591	20.8752	20.9722	20.9966	20.9996	20.9993	20.9881	20.8421	20.4573	20.1234	(87)
Th 2	20.1211	20.1226	20.1241	20.1312	20.1325	20.1387	20.1387	20.1398	20.1363	20.1325	20.1298	20.1271	(88)
util rest of house													
	0.9916	0.9701	0.9127	0.7808	0.5930	0.4032	0.2683	0.2992	0.5138	0.8375	0.9754	0.9943	(89)
MIT 2	19.0269	19.3612	19.7157	19.9996	20.1088	20.1367	20.1386	20.1396	20.1283	19.9686	19.4455	18.9600	(90)
Living area fraction									fLA = Living area / (4) =			0.4066	(91)
MIT	19.4928	19.7855	20.0993	20.3556	20.4598	20.4863	20.4887	20.4891	20.4779	20.3238	19.8569	19.4330	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4928	19.7855	20.0993	20.3556	20.4598	20.4863	20.4887	20.4891	20.4779	20.3238	19.8569	19.4330	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9897	0.9670	0.9121	0.7909	0.6136	0.4281	0.2948	0.3271	0.5412	0.8464	0.9730	0.9929	(94)
Useful gains	742.1377	914.2061	1009.2309	979.4645	804.0354	547.7348	363.0248	381.0455	589.7836	790.9897	749.8841	691.3905	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1450.7324	1418.6783	1293.6650	1080.1299	824.5760	549.7868	363.2026	381.3742	597.4971	915.3122	1204.8766	1443.8031	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	527.1944	339.0053	211.6190	72.4791	15.2823	0.0000	0.0000	0.0000	0.0000	92.4959	327.5946	559.7949	(98)
Space heating												2145.4654	(98)
Space heating per m2											(98) / (4) =	21.4547	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2294.6154	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	527.1944	339.0053	211.6190	72.4791	15.2823	0.0000	0.0000	0.0000	0.0000	92.4959	327.5946	559.7949	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	563.8443	362.5725	226.3304	77.5177	16.3447	0.0000	0.0000	0.0000	0.0000	98.9261	350.3685	598.7112	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	208.5207	183.7070	192.7354	172.5007	168.8467	150.5859	144.3506	158.7710	158.6077	178.8867	189.4987	203.4114	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.1866	86.4272	85.0635	82.6926	80.5908	79.8000	79.8000	79.8000	79.8000	83.1507	86.2613	87.3774	(217)
Fuel for water heating, kWh/month	239.1659	212.5570	226.5784	208.6048	209.5111	188.7041	180.8905	198.9612	198.7565	215.1354	219.6799	232.7963	(219)

Water heating fuel used	2531.3411	(219)
Annual totals kWh/year		
Space heating fuel - main system	2294.6154	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	403.5701	(232)
Total delivered energy for all uses	5304.5266	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2294.6154	0.2160	495.6369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2531.3411	0.2160	546.7697	(264)
Space and water heating			1042.4066	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	403.5701	0.5190	209.4529	(268)
Total CO2, kg/m2/year			1290.7845	(272)
Emissions per m2 for space and water heating			10.4241	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0945	(272b)
Emissions per m2 for pumps and fans			0.3893	(272c)
Target Carbon Dioxide Emission Rate (TER) = (10.4241 * 1.55) + 2.0945 + 0.3893, rounded to 2 d.p.			18.6400	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A6-F4&5+PV	**Issued on Date**	24/07/2020
Assessment Reference	A6-F4&5+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	88 B	**DER**	11.42	**TER**	20.72
Environmental	89 B	**% DER<TER**	44.88		
CO_2 Emissions (t/year)	1.59	**DFEE**	45.30	**TFEE**	51.16
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.46		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 188 m^2

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

1a TER and DER

Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 20.72 kgCO_2/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 11.42 kgCO_2/m^2OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.2 kWh/m^2/yr
Dwelling Fabric Energy Efficiency (DFEE)45.3 kWh/m^2/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using default y-value of 0.15

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system:	Heat pump with radiators or underfloor - Electric
Panasonic WH-ADC1216G6E5UK + WH-UD16FE5	
Secondary heating system:	None

5 Cylinder insulation

Hot water storage	No cylinder

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	

7 Low energy lights

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

Minimum	75%	OK

8 Mechanical ventilation

Continuous supply and extract system

Specific fan power:	0.79	
Maximum	1.5	OK
MVHR efficiency:	84%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Not significant	OK
Based on:		
Overshading:	Average	
Windows facing North East:	37.54 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

10 Key features

External wall U-value	0.13 W/m^2K
External wall U-value	0.13 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.11 W/m^2K
Air permeability	3.0 m^3/m^2h
Photovoltaic array	0.66 kW

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)
Ground floor	86.8500 (1b)	x	2.8000 (2b)	=	243.1800 (1b) - (3b)
First floor	101.0000 (1c)	x	2.8000 (2c)	=	282.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 187.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	525.9800 (5)

2. Ventilation rate

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

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Measured/design AP50		3.0000
Infiltration rate		0.1500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 71.4000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3056	0.3024	0.2992	0.2833	0.2801	0.2641	0.2641	0.2609	0.2705	0.2801	0.2864	0.2928	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			37.5400	1.2357	46.3897			(27)
External Wall 1	54.2800	18.7200	35.5600	0.1300	4.6228			(29a)
External Wall 2	54.3800	18.8200	35.5600	0.1300	4.6228			(29a)
External Roof 1	101.0000		101.0000	0.1100	11.1100			(30)
Total net area of external elements Aum(A, m2)			209.6600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.7453			(33)
Party Wall 1			15.9000	0.0000	0.0000			(32)
Party Wall 2			21.4800	0.0000	0.0000			(32)
Party Wall 3			43.5100	0.0000	0.0000			(32)
Party Wall 4			15.9600	0.0000	0.0000			(32)
Party Wall 5			23.3000	0.0000	0.0000			(32)
Party Wall 6			86.6600	0.0000	0.0000			(32)
Party Floor 1			86.8500					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area)		31.4490 (36)
Total fabric heat loss	(33) + (36) =	98.1943 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.0375	52.4843	51.9310	49.1647	48.6114	45.8451	45.8451	45.2918	46.9516	48.6114	49.7179	50.8245	(38)
Heat transfer coeff	151.2319	150.6786	150.1253	147.3590	146.8057	144.0394	144.0394	143.4861	145.1459	146.8057	147.9123	149.0188	(39)
Average = Sum(39)m / 12 =												147.2207	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8051	0.8021	0.7992	0.7845	0.7815	0.7668	0.7668	0.7638	0.7727	0.7815	0.7874	0.7933	(40)
HLP (average)												0.7837	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9861 (42)
Average daily hot water use (litres/day) 105.1196 (43)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.6316	111.4268	107.2220	103.0172	98.8124	94.6077	94.6077	98.8124	103.0172	107.2220	111.4268	115.6316	(44)
Energy conte	171.4783	149.9760	154.7618	134.9251	129.4638	111.7175	103.5226	118.7937	120.2125	140.0961	152.9259	166.0676	(45)
Energy content (annual)										Total = Sum(45)m =		1653.9410	(45)
Distribution loss (46)m = 0.15 x (45)m	25.7217	22.4964	23.2143	20.2388	19.4196	16.7576	15.5284	17.8191	18.0319	21.0144	22.9389	24.9101	(46)
Water storage loss:													
Store volume												184.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1394	(55)
Total storage loss	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(56)
If cylinder contains dedicated solar storage	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Total heat required for water heating calculated for each month	206.7997	181.8792	190.0832	169.1071	164.7852	145.8995	138.8440	154.1151	154.3945	175.4175	187.1079	201.3890	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	206.7997	181.8792	190.0832	169.1071	164.7852	145.8995	138.8440	154.1151	154.3945	175.4175	187.1079	201.3890	(64)
								Total per year (kWh/year) = Sum(64)m =				2069.8220	(64)
Heat gains from water heating, kWh/month	57.0165	49.8670	51.4583	44.8626	43.0467	37.1461	34.4213	39.4989	39.9707	46.5820	50.8478	55.2175	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.0360	28.4541	23.1404	17.5188	13.0955	11.0558	11.9462	15.5281	20.8417	26.4634	30.8867	32.9264	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	359.3466	363.0755	353.6788	333.6744	308.4223	284.6890	268.8337	265.1048	274.5015	294.5059	319.7579	343.4913	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	(71)
Water heating gains (Table 5)	76.6351	74.2069	69.1644	62.3092	57.8585	51.5917	46.2652	53.0899	55.5148	62.6102	70.6220	74.2170	(72)
Total internal gains	535.8091	533.5278	513.7750	481.2936	447.1677	415.1279	394.8363	401.5141	418.6494	451.3708	489.0579	518.4260	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	37.5400	11.2829	0.6000	0.9000	0.7700	158.5052	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	158.5052	322.6420	581.2982	954.6587	1283.2486	1368.0788	1279.8097	1020.2791	708.3210	394.2941	199.4406	129.4433	(83)
Total gains	694.3143	856.1698	1095.0732	1435.9523	1730.4163	1783.2067	1674.6460	1421.7933	1126.9703	845.6649	688.4985	647.8694	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	86.2592	86.5759	86.8950	88.5262	88.8599	90.5665	90.5665	90.9157	89.8760	88.8599	88.1951	87.5402	
alpha	6.7506	6.7717	6.7930	6.9017	6.9240	7.0378	7.0378	7.0610	6.9917	6.9240	6.8797	6.8360	
util living area	0.9999	0.9994	0.9953	0.9467	0.7509	0.5145	0.3782	0.4631	0.8177	0.9925	0.9996	0.9999	(86)
Tweekday	18.9068	19.1119	19.4900	20.0004	20.2372	20.2808	20.2821	20.2844	20.2424	19.8114	19.2772	18.8923	
Tweekend	20.3684	20.4582	20.6247	20.8533	20.9772	20.9985	20.9999	20.9995	20.9722	20.7618	20.5267	20.3586	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	20.0253	20.1619	20.4208	20.7709	20.9648	20.9977	20.9998	20.9992	20.9566	20.6324	20.2609	20.0100	(87)
Th 2	20.2489	20.2515	20.2540	20.2668	20.2694	20.2822	20.2822	20.2848	20.2771	20.2694	20.2643	20.2592	(88)
util rest of house	0.9998	0.9992	0.9936	0.9299	0.7033	0.4579	0.3166	0.3917	0.7564	0.9886	0.9995	0.9999	(89)
Tweekday	18.9068	19.1119	19.4900	20.0004	20.2372	20.2808	20.2821	20.2844	20.2424	19.8114	19.2772	18.8923	
Tweekend	18.9068	19.1119	19.4900	20.0004	20.2372	20.2808	20.2821	20.2844	20.2424	19.8114	19.2772	18.8923	
MIT 2	18.9068	19.1119	19.4900	20.0004	20.2372	20.2808	20.2821	20.2844	20.2424	19.8114	19.2772	18.8923	(90)
Living area fraction									fLA = Living area / (4) =			0.3627	(91)
MIT	19.3125	19.4928	19.8277	20.2799	20.5011	20.5408	20.5424	20.5437	20.5015	20.1092	19.6340	19.2978	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3125	19.4928	19.8277	20.2799	20.5011	20.5408	20.5424	20.5437	20.5015	20.1092	19.6340	19.2978	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9990	0.9924	0.9303	0.7189	0.4784	0.3390	0.4177	0.7767	0.9875	0.9993	0.9999	(94)
Useful gains	694.1523	855.2893	1086.7353	1335.8392	1244.0020	853.1687	567.6817	593.8273	875.3412	835.0985	688.0233	647.7765	(95)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Ext temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
              2270.3664  2198.8202  2000.8191  1676.9290  1292.0506   855.7124   567.8675   594.5615   929.1471  1396.0053  1853.9349  2249.8518 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
              1172.7033   902.8527   680.0783   245.5846    35.7482     0.0000     0.0000     0.0000     0.0000   417.3147   839.4563  1191.9440 (98)
Space heating                                                                                                                       5485.6823 (98)
Space heating per m2                                                                                                (98) / (4) =      29.2025 (99)
```

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----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Calculated for June, July and August. See Table 10b
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Ext. temp.       4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000
Heat loss rate W
                 0.0000     0.0000     0.0000     0.0000     0.0000  1353.9704  1065.8916  1090.4947     0.0000     0.0000     0.0000     0.0000 (100)
Utilisation      0.0000     0.0000     0.0000     0.0000     0.0000     0.9877     0.9957     0.9882     0.0000     0.0000     0.0000     0.0000 (101)
Useful loss      0.0000     0.0000     0.0000     0.0000     0.0000  1337.3358  1061.2871  1077.6119     0.0000     0.0000     0.0000     0.0000 (102)
Total gains      0.0000     0.0000     0.0000     0.0000     0.0000  2218.8177  2088.8807  1795.7473     0.0000     0.0000     0.0000     0.0000 (103)
Month fracti     0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000 (103a)
Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000   634.6670   764.5296   534.2928     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                       1933.4893 (104)
Cooled fraction                                                                                     fC = cooled area / (4) =          0.5109 (105)
Intermittency factor (Table 10b)
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000    81.0691    97.6571    68.2478     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                        246.9741 (107)
Space cooling per m2                                                                                                                   1.3147 (108)
```

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----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                  0.0000 (201)
Fraction of space heat from main system(s)                                                                                             1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                     221.8653 (206)
Efficiency of secondary/supplementary heating system, %                                                                              100.0000 (208)
Space heating requirement                                                                                                           2472.5287 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)                                                                                 4.0500 (209)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
              1172.7033   902.8527   680.0783   245.5846    35.7482     0.0000     0.0000     0.0000     0.0000   417.3147   839.4563  1191.9440 (98)
Space heating efficiency (main heating system 1)
               221.8653   221.8653   221.8653   221.8653   221.8653     0.0000     0.0000     0.0000     0.0000   221.8653   221.8653   221.8653 (210)
Space heating fuel (main heating system)
               528.5655   406.9374   306.5276   110.6909    16.1126     0.0000     0.0000     0.0000     0.0000   188.0938   378.3631   537.2378 (211)
Water heating requirement
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
               206.7997   181.8792   190.0832   169.1071   164.7852   145.8995   138.8440   154.1151   154.3945   175.4175   187.1079   201.3890 (64)
Efficiency of water heater                                                                                                           258.5900 (216)
(217)m         258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900 (217)
Fuel for water heating, kWh/month
                79.9720    70.3350    73.5076    65.3958    63.7245    56.4212    53.6927    59.5983    59.7063    67.8362    72.3570    77.8796 (219)
Water heating fuel used                                                                                                              800.4262 (219)
Space cooling fuel requirement
(221)m           0.0000     0.0000     0.0000     0.0000     0.0000    20.0171    24.1129    16.8513     0.0000     0.0000     0.0000     0.0000 (221)
Cooling                                                                                                                               60.9812 (221)
Annual totals kWh/year
Space heating fuel - main system                                                                                                    2472.5287 (211)
Space heating fuel - secondary                                                                                                         0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)
   mechanical ventilation fans (SFP =       0.9875)                                                                                  633.6744 (230a)
Total electricity for the above, kWh/year                                                                                            633.6744 (231)
Electricity for lighting (calculated in Appendix L)                                                                                  565.7660 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.66 * 951 * 0.80) =                                                                     -401.5402                -401.5402 (233)
Total delivered energy for all uses                                                                                                 4131.8363 (238)
```

```
----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                  Energy      Emission factor              Emissions
                                                                                kWh/year         kg CO2/kWh              kg CO2/year
Space heating - main system 1                                                  2472.5287             0.5190                1283.2424 (261)
Space heating - secondary                                                         0.0000             0.5190                   0.0000 (263)
Water heating (other fuel)                                                      800.4262             0.5190                 415.4212 (264)
Space and water heating                                                                                                    1698.6636 (265)
Space cooling                                                                    60.9812             0.5190                  31.6493 (266)
Pumps and fans                                                                  633.6744             0.5190                 328.8770 (267)
Energy for lighting                                                             565.7660             0.5190                 293.6325 (268)

 Energy saving/generation technologies
PV Unit                                                                        -401.5402             0.5190                -208.3994 (269)
Total CO2, kg/year                                                                                                          2144.4230 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                   11.4200 (273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

DER		11.4200	ZC1
Total Floor Area	TFA	187.8500	
Assumed number of occupants	N	2.9861	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.3357	ZC2
CO2 emissions from cooking, equation (L16)		1.0150	ZC3
Total CO2 emissions		23.7707	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		23.7707	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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



----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
----------------------------------------------------------------------------------------------------
                                                                          Area         Storey height            Volume
                                                                          (m2)              (m)                  (m3)
Ground floor                                                           86.8500 (1b)    x      2.8000 (2b)    =    243.1800 (1b) - (3b)
First floor                                                           101.0000 (1c)    x      2.8000 (2c)    =    282.8000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              187.8500                                                (4)
Dwelling volume                                                          (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    525.9800 (5)



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

                                                                                                               Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                            40.0000 / (5) =       0.0760 (8)
Pressure test                                                                                                                   Yes
Measured/design AP50                                                                                                         5.0000
Infiltration rate                                                                                                            0.3260 (18)
Number of sides sheltered                                                                                                         2 (19)

Shelter factor                                                                          (20) =  1  -  [0.075 x (19)]  =       0.8500 (20)
Infiltration rate adjusted to include shelter factor                                              (21) = (18) x (20)  =       0.2771 (21)


                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed      5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor     1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                0.3534     0.3464     0.3395     0.3049     0.2979     0.2633     0.2633     0.2564     0.2771     0.2979     0.3118     0.3256 (22b)
Effective ac    0.5624     0.5600     0.5576     0.5465     0.5444     0.5347     0.5347     0.5329     0.5384     0.5444     0.5486     0.5530 (25)



----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                           Gross        Openings          NetArea         U-value          A x U         K-value          A x K
                                                     m2              m2               m2           W/m2K            W/K          kJ/m2K           kJ/K
TER Opening Type (Uw = 1.40)                                                     37.5400          1.3258        49.7689                                  (27)
External Wall 1                                 54.2800         18.7200          35.5600          0.1800         6.4008                                  (29a)
External Wall 2                                 54.3800         18.8200          35.5600          0.1800         6.4008                                  (29a)
External Roof 1                                101.0000                         101.0000          0.1300        13.1300                                  (30)
Total net area of external elements Aum(A, m2)                                  209.6600                                                                 (31)
Fabric heat loss, W/K = Sum (A x U)                                     (26)...(30) + (32) =        75.7005                                  (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                     250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)                                                                        10.4830 (36)
Total fabric heat loss                                                                                              (33) + (36) =      86.1835 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          97.6229    97.2021    96.7896    94.8524    94.4899    92.8026    92.8026    92.4902    93.4525    94.4899    95.2232    95.9897 (38)
Heat transfer coeff
              183.8064   183.3856   182.9732   181.0359   180.6735   178.9862   178.9862   178.6737   179.6361   180.6735   181.4067   182.1733 (39)
Average = Sum(39)m / 12 =                                                                                                            181.0342 (39)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             0.9785     0.9762     0.9740     0.9637     0.9618     0.9528     0.9528     0.9512     0.9563     0.9618     0.9657     0.9698 (40)
HLP (average)                                                                                                                          0.9637 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)



----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                      2.9861 (42)
Average daily hot water use (litres/day)                                                                                             105.1196 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              115.6316   111.4268   107.2220   103.0172    98.8124    94.6077    94.6077    98.8124   103.0172   107.2220   111.4268   115.6316 (44)
Energy conte  171.4783   149.9760   154.7618   134.9251   129.4638   111.7175   103.5226   118.7937   120.2125   140.0961   152.9259   166.0676 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =  1653.9410 (45)
Distribution loss  (46)m = 0.15 x (45)m
               25.7217    22.4964    23.2143    20.2388    19.4196    16.7576    15.5284    17.8191    18.0319    21.0144    22.9389    24.9101 (46)
Water storage loss:
Store volume                                                                                                                         150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                          1.3938 (48)
  Temperature factor from Table 2b                                                                                                     0.5400 (49)
Enter (49) or (54) in (55)                                                                                                             0.7527 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.0732	192.0617	201.3567	180.0169	176.0587	156.8093	150.1175	165.3887	165.3044	186.6910	198.0177	212.6625	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.0732	192.0617	201.3567	180.0169	176.0587	156.8093	150.1175	165.3887	165.3044	186.6910	198.0177	212.6625	(64)
								Total per year (kWh/year) = Sum(64)m =				2202.5584	(64)
Heat gains from water heating, kWh/month													
	94.2925	83.5356	88.7342	80.9361	80.3227	73.2195	71.6972	76.7748	76.0441	83.8579	86.9213	92.4934	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	149.3045	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	32.2644	28.6569	23.3054	17.6437	13.1889	11.1346	12.0313	15.6388	20.9903	26.6520	31.1068	33.1611	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	359.3466	363.0755	353.6788	333.6744	308.4223	284.6890	268.8337	265.1048	274.5015	294.5059	319.7579	343.4913	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	37.9304	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	-119.4436	(71)
Water heating gains (Table 5)													
	126.7372	124.3089	119.2664	112.4112	107.9606	101.6938	96.3672	103.1920	105.6169	112.7122	120.7241	124.3191	(72)
Total internal gains													
	589.1395	586.8327	567.0419	534.5206	500.3631	468.3087	448.0235	454.7269	471.9000	504.6615	542.3802	571.7628	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	37.5400	11.2829	0.6300	0.7000	0.7700	129.4459	(75)

Solar gains	129.4459	263.4909	474.7269	779.6379	1047.9863	1117.2643	1045.1779	833.2279	578.4621	322.0068	162.8765	105.7121	(83)
Total gains	718.5854	850.3236	1041.7688	1314.1585	1548.3494	1585.5731	1493.2014	1287.9548	1050.3621	826.6683	705.2566	677.4748	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.9722	71.1350	71.2954	72.0583	72.2029	72.8835	72.8835	73.0110	72.6198	72.2029	71.9110	71.6084	
alpha	5.7315	5.7423	5.7530	5.8039	5.8135	5.8589	5.8589	5.8674	5.8413	5.8135	5.7941	5.7739	
util living area													
	0.9998	0.9994	0.9972	0.9787	0.8857	0.6890	0.5215	0.6208	0.9144	0.9952	0.9996	0.9999	(86)
MIT	19.7866	19.9144	20.1662	20.5320	20.8401	20.9725	20.9954	20.9884	20.8554	20.4532	20.0602	19.7681	(87)
Th 2	20.1013	20.1032	20.1050	20.1137	20.1153	20.1228	20.1228	20.1242	20.1199	20.1153	20.1120	20.1086	(88)
util rest of house													
	0.9997	0.9992	0.9961	0.9702	0.8454	0.6081	0.4207	0.5114	0.8660	0.9926	0.9994	0.9998	(89)
MIT 2	18.4490	18.6374	19.0069	19.5413	19.9549	20.1044	20.1211	20.1191	19.9895	19.4339	18.8575	18.4272	(90)
Living area fraction									fLA = Living area / (4) =			0.3627	(91)
MIT	18.9342	19.1006	19.4274	19.9007	20.2760	20.4193	20.4382	20.4344	20.3036	19.8036	19.2938	18.9136	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9342	19.1006	19.4274	19.9007	20.2760	20.4193	20.4382	20.4344	20.3036	19.8036	19.2938	18.9136	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9996	0.9989	0.9950	0.9676	0.8535	0.6365	0.4574	0.5513	0.8778	0.9913	0.9991	0.9997	(94)
Useful gains	718.3125	849.3971	1036.5385	1271.6056	1321.5748	1009.2920	683.0434	710.1123	922.0568	819.4577	704.6179	677.2947	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2689.8622	2604.1914	2365.3686	1991.5189	1549.4566	1041.5694	686.9875	720.8481	1114.3908	1662.8536	2212.0373	2680.4292	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1466.8330	1179.2218	988.6496	518.3376	169.5441	0.0000	0.0000	0.0000	0.0000	627.4866	1085.3420	1490.3321	(98)
Space heating												7525.7466	(98)
Space heating per m2											(98) / (4) =	40.0625	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	8048.9269	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1466.8330	1179.2218	988.6496	518.3376	169.5441	0.0000	0.0000	0.0000	0.0000	627.4866	1085.3420	1490.3321	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1568.8053	1261.1997	1057.3792	554.3718	181.3305	0.0000	0.0000	0.0000	0.0000	671.1086	1160.7936	1593.9380	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	218.0732	192.0617	201.3567	180.0169	176.0587	156.8093	150.1175	165.3887	165.3044	186.6910	198.0177	212.6625	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.9562	88.8317	88.4923	87.4765	84.7135	79.8000	79.8000	79.8000	79.8000	87.8005	88.6656	89.0096	(217)
Fuel for water heating, kWh/month	245.1466	216.2084	227.5416	205.7889	207.8284	196.5029	188.1172	207.2539	207.1483	212.6309	223.3309	238.9208	(219)

Water heating fuel used	2576.4189	(219)
Annual totals kWh/year		
Space heating fuel - main system	8048.9269	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	569.7989	(232)
Total delivered energy for all uses	11270.1446	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8048.9269	0.2160	1738.5682	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2576.4189	0.2160	556.5065	(264)
Space and water heating			2295.0747	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	569.7989	0.5190	295.7256	(268)
Total CO2, kg/m2/year			2629.7253	(272)
Emissions per m2 for space and water heating			12.2176	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.5743	(272b)
Emissions per m2 for pumps and fans			0.2072	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.2176 * 1.55) + 1.5743 + 0.2072, rounded to 2 d.p.			20.7200	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A7-F4+PV	**Issued on Date**	24/07/2020
Assessment Reference	A7-F4+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	91 B	**DER**	10.59	**TER**	20.53
Environmental	92 A	**% DER<TER**	48.42		
CO_2 Emissions (t/year)	0.62	**DFEE**	31.77	**TFEE**	34.40
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.65		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 83 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 20.53 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.59 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)34.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)31.8 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average               Highest
External wall   0.13 (max. 0.30)      0.13 (max. 0.70)        OK
Party wall      0.00 (max. 0.20)       -                      OK
Floor           (no floor)
Roof            0.11 (max. 0.20)      0.11 (max. 0.35)        OK
Openings        1.30 (max. 2.00)      1.30 (max. 3.30)        OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:       3.00 (design value)
Maximum                               10.0                                                OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                  Heat pump with radiators or underfloor - Electric
Panasonic WH-ADC1216G6E5UK + WH-UD16FE5



Secondary heating system:             None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                     No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:               Time and temperature zone control                   OK


Hot water controls:                   No cylinder


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                               75%                                                 OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                   0.66
Maximum                               1.5                                                 OK
MVHR efficiency:                      85%
Minimum:                              70%                                                 OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):     Slight                                              OK
Based on:
Overshading:                          Average
Windows facing South East:            9.54 m², No overhang
Windows facing South West:            19.72 m², No overhang
Air change rate:                      8.00 ach
Blinds/curtains:                      Light-coloured venetian blind, closed 50% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                 0.13 W/m²K
Party wall U-value                    0.00 W/m²K
Party wall U-value                    0.00 W/m²K
Party wall U-value                    0.00 W/m²K
Party wall U-value                    0.00 W/m²K
Roof U-value                          0.11 W/m²K
Air permeability                      3.0 m³/m²h
Photovoltaic array                    0.66 kW


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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		83.0500 (1b)	x	2.8000 (2b)	=	232.5400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.0500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	232.5400	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.2500	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2726	0.2700	0.2674	0.2543	0.2516	0.2385	0.2385	0.2359	0.2438	0.2516	0.2569	0.2621	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			29.2600	1.2357	36.1578			(27)
External Wall 1	73.6100	29.2600	44.3500	0.1300	5.7655			(29a)
External Roof 1	3.3500		3.3500	0.1100	0.3685			(30)
Total net area of external elements Aum(A, m2)			76.9600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.2918			(33)
Party Wall 1			17.8100	0.0000	0.0000			(32)
Party Wall 2			16.4100	0.0000	0.0000			(32)
Party Wall 3			16.4100	0.0000	0.0000			(32)
Party Wall 4			19.5400	0.0000	0.0000			(32)
Party Floor 1			83.0500					(32d)
Party Ceilings 1			79.7000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		11.5440	(36)
Total fabric heat loss	(33) + (36) =	53.8358	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	20.9208	20.7193	20.5179	19.5107	19.3092	18.3021	18.3021	18.1006	18.7049	19.3092	19.7121	20.1150	(38)
Heat transfer coeff	74.7565	74.5551	74.3537	73.3465	73.1450	72.1379	72.1379	71.9364	72.5407	73.1450	73.5479	73.9508	(39)
Average = Sum(39)m / 12 =												73.2961	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9001	0.8977	0.8953	0.8832	0.8807	0.8686	0.8686	0.8662	0.8735	0.8807	0.8856	0.8904	(40)
HLP (average)												0.8826	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5182	(42)
Average daily hot water use (litres/day)	94.0070	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.4077	99.6474	95.8871	92.1269	88.3666	84.6063	84.6063	88.3666	92.1269	95.8871	99.6474	103.4077	(44)
Energy conte	153.3506	134.1214	138.4013	120.6616	115.7777	99.9073	92.5788	106.2356	107.5044	125.2860	136.7594	148.5119	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1479.0961 (45)

Distribution loss (46)m = 0.15 x (45)m

23.0026	20.1182	20.7602	18.0992	17.3667	14.9861	13.8868	15.9353	16.1257	18.7929	20.5139	22.2768	(46)

Water storage loss:

Store volume 184.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.1100 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.1394 (55)

Total storage loss	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(56)
If cylinder contains dedicated solar storage	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Total heat required for water heating calculated for each month	188.6720	166.0246	173.7227	154.8436	151.0991	134.0893	127.9002	141.5570	141.6864	160.6074	170.9414	183.8333	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

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

Output from w/h	188.6720	166.0246	173.7227	154.8436	151.0991	134.0893	127.9002	141.5570	141.6864	160.6074	170.9414	183.8333	(64)

Total per year (kWh/year) = Sum(64)m = 1894.9771 (64)

Heat gains from water heating, kWh/month	50.9891	44.5954	46.0184	40.1200	38.4961	33.2192	30.7825	35.3233	35.7452	41.6576	45.4725	49.3802	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.1210	17.8713	14.5339	11.0031	8.2250	6.9439	7.5031	9.7528	13.0902	16.6210	19.3992	20.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.6967	228.0387	222.1369	209.5726	193.7125	178.8061	168.8478	166.5058	172.4076	184.9719	200.8321	215.7384	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	(71)
Water heating gains (Table 5)	68.5337	66.3622	61.8527	55.7222	51.7420	46.1378	41.3743	47.4776	49.6461	55.9914	63.1563	66.3712	(72)
Total internal gains	375.1243	373.0451	359.2964	337.0708	314.4523	292.6606	278.4980	284.5090	295.9167	318.3571	344.1603	363.5627	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	9.5400	36.7938	0.6000	0.9000	0.7700	131.3561	(77)
Southwest	19.7200	36.7938	0.6000	0.9000	0.7700	271.5244	(79)

Solar gains	402.8806	686.2547	938.9636	1163.4214	1303.1290	1293.7054	1247.2701	1143.0420	1016.6990	758.4576	482.5581	344.7818	(83)
Total gains	778.0049	1059.2998	1298.2600	1500.4922	1617.5813	1586.3660	1525.7681	1427.5510	1312.6157	1076.8147	826.7184	708.3445	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	77.1486	77.3570	77.5666	78.6317	78.8483	79.9492	79.9492	80.1730	79.5051	78.8483	78.4164	77.9892	
alpha	6.1432	6.1571	6.1711	6.2421	6.2566	6.3299	6.3299	6.3449	6.3003	6.2566	6.2278	6.1993	
util living area	0.9786	0.9079	0.7697	0.5821	0.4195	0.2909	0.2080	0.2318	0.3808	0.6808	0.9350	0.9866	(86)
Tweekday	19.4225	19.8285	20.0691	20.1659	20.1822	20.1942	20.1943	20.1963	20.1896	20.1535	19.8261	19.3320	
Tweekend	20.6270	20.8172	20.9395	20.9893	20.9987	20.9999	21.0000	21.0000	20.9995	20.9788	20.8085	20.5829	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	20.4243	20.7172	20.9067	20.9832	20.9979	20.9998	21.0000	21.0000	20.9991	20.9672	20.7010	20.3563	(87)
Th 2	20.1674	20.1694	20.1715	20.1818	20.1839	20.1943	20.1943	20.1963	20.1901	20.1839	20.1798	20.1756	(88)
util rest of house	0.9729	0.8893	0.7376	0.5454	0.3830	0.2544	0.1699	0.1913	0.3363	0.6348	0.9178	0.9828	(89)
Tweekday	19.4225	19.8285	20.0691	20.1659	20.1822	20.1942	20.1943	20.1963	20.1896	20.1535	19.8261	19.3320	
Tweekend	19.4225	19.8285	20.0691	20.1659	20.1822	20.1942	20.1943	20.1963	20.1896	20.1535	19.8261	19.3320	
MIT 2	19.4225	19.8285	20.0691	20.1659	20.1822	20.1942	20.1943	20.1963	20.1896	20.1535	19.8261	19.3320	(90)

Living area fraction fLA = Living area / (4) = 0.5645 (91)

MIT	19.9880	20.3302	20.5419	20.6273	20.6427	20.6490	20.6491	20.6500	20.6466	20.6128	20.3200	19.9102	(92)

Temperature adjustment 0.0000

adjusted MIT	19.9880	20.3302	20.5419	20.6273	20.6427	20.6490	20.6491	20.6500	20.6466	20.6128	20.3200	19.9102	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9714	0.8931	0.7523	0.5655	0.4035	0.2750	0.1914	0.2142	0.3614	0.6594	0.9210	0.9813	(94)
Useful gains	755.7730	946.1093	976.6622	848.5630	652.7603	436.2694	292.0849	305.7139	474.3913	710.0188	761.4224	695.0999	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
                 1172.7787  1150.3977  1044.0661   860.1531   654.1126   436.3589   292.0916   305.7275   474.8924   732.3899   972.3010  1161.7819 (97)
Month fracti        1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
                  310.2522   137.2818    50.1485     8.3448     1.0061     0.0000     0.0000     0.0000     0.0000    16.6441   151.8326   347.2114 (98)
Space heating                                                                                                                          1022.7215 (98)
Space heating per m2                                                                                                  (98) / (4) =       12.3145 (99)


----------------------------------------------------------------------------------------------------
8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Calculated for June, July and August. See Table 10b
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Ext. temp.        4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000
Heat loss rate W
                  0.0000     0.0000     0.0000     0.0000     0.0000   678.0958   533.8201   546.7168     0.0000     0.0000     0.0000     0.0000 (100)
Utilisation       0.0000     0.0000     0.0000     0.0000     0.0000     0.9992     0.9997     0.9996     0.0000     0.0000     0.0000     0.0000 (101)
Useful loss       0.0000     0.0000     0.0000     0.0000     0.0000   677.5362   533.6849   546.4900     0.0000     0.0000     0.0000     0.0000 (102)
Total gains       0.0000     0.0000     0.0000     0.0000     0.0000  1945.4866  1872.9829  1759.3899     0.0000     0.0000     0.0000     0.0000 (103)
Month fracti      0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000 (103a)
Space cooling kWh
                  0.0000     0.0000     0.0000     0.0000     0.0000   912.9243   996.4377   902.3975     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                         2811.7594 (104)
Cooled fraction                                                                                   fC = cooled area / (4) =              0.7115 (105)
Intermittency factor (Table 10b)
                  0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                  0.0000     0.0000     0.0000     0.0000     0.0000   162.3862     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          162.3862 (107)
Space cooling per m2                                                                                                                     1.9553 (108)


----------------------------------------------------------------------------------------------------
9a. Energy requirements - Individual heating systems, including micro-CHP
----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                    0.0000 (201)
Fraction of space heat from main system(s)                                                                                               1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                       139.2987 (206)
Efficiency of secondary/supplementary heating system, %                                                                                100.0000 (208)
Space heating requirement                                                                                                              734.1931 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)                                                                                   4.0500 (209)

                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
                310.2522   137.2818    50.1485     8.3448     1.0061     0.0000     0.0000     0.0000     0.0000    16.6441   151.8326   347.2114 (98)
Space heating efficiency (main heating system 1)
                139.2987   139.2987   139.2987   139.2987   139.2987     0.0000     0.0000     0.0000     0.0000   139.2987   139.2987   139.2987 (210)
Space heating fuel (main heating system)
                222.7244    98.5521    36.0007     5.9906     0.7223     0.0000     0.0000     0.0000     0.0000    11.9485   108.9979   249.2567 (211)
Water heating requirement
                  0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
                188.6720   166.0246   173.7227   154.8436   151.0991   134.0893   127.9002   141.5570   141.6864   160.6074   170.9414   183.8333 (64)
Efficiency of water heater                                                                                                             258.5900 (216)
(217)m          258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900   258.5900 (217)
Fuel for water heating, kWh/month
                 72.9618    64.2038    67.1808    59.8800    58.4319    51.8540    49.4606    54.7419    54.7919    62.1089    66.1052    71.0906 (219)
Water heating fuel used                                                                                                                732.8114 (219)
Space cooling fuel requirement
(221)m            0.0000     0.0000     0.0000     0.0000     0.0000    40.0954     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (221)
Cooling                                                                                                                                 40.0954 (221)
Annual totals kWh/year
Space heating fuel - main system                                                                                                       734.1931 (211)
Space heating fuel - secondary                                                                                                           0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)
   mechanical ventilation fans (SFP =        0.8250)                                                                                   234.0515 (230a)
Total electricity for the above, kWh/year                                                                                              234.0515 (231)
Electricity for lighting (calculated in Appendix L)                                                                                    355.3436 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.66 * 951 * 0.80) =                                                                -401.5402                       -401.5402 (233)
Total delivered energy for all uses                                                                                                   1694.9548 (238)


----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                        Energy       Emission factor            Emissions
                                                                                      kWh/year            kg CO2/kWh          kg CO2/year
Space heating - main system 1                                                         734.1931                0.5190             381.0462 (261)
Space heating - secondary                                                               0.0000                0.5190               0.0000 (263)
Water heating (other fuel)                                                            732.8114                0.5190             380.3291 (264)
Space and water heating                                                                                                          761.3754 (265)
Space cooling                                                                          40.0954                0.5190              20.8095 (266)
Pumps and fans                                                                        234.0515                0.5190             121.4727 (267)
Energy for lighting                                                                   355.3436                0.5190             184.4233 (268)

 Energy saving/generation technologies
PV Unit                                                                              -401.5402                0.5190            -208.3994 (269)
Total CO2, kg/year                                                                                                               879.6816 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                                       10.5900 (273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                               10.5900 ZC1
Total Floor Area                                                                                                        TFA       83.0500
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Assumed number of occupants	N	2.5182	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.1039	ZC2
CO2 emissions from cooking, equation (L16)		2.1606	ZC3
Total CO2 emissions		28.8545	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.8545	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		83.0500 (1b)	x	2.8000 (2b)	=	232.5400	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.0500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	232.5400	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1290	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3790	(18)
Number of sides sheltered			4	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.2653	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3383	0.3316	0.3250	0.2918	0.2852	0.2520	0.2520	0.2454	0.2653	0.2852	0.2985	0.3117	(22b)
Effective ac	0.5572	0.5550	0.5528	0.5426	0.5407	0.5318	0.5318	0.5301	0.5352	0.5407	0.5445	0.5486	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			20.7700	1.3258	27.5360			(27)
External Wall 1	73.6100	29.2600	44.3500	0.1800	7.9830			(29a)
External Roof 1	3.3500		3.3500	0.1300	0.4355			(30)
Total net area of external elements Aum(A, m2)			68.4700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		35.9545			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		3.4235	(36)
Total fabric heat loss	(33) + (36) =	39.3780	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.7595	42.5890	42.4219	41.6370	41.4901	40.8065	40.8065	40.6799	41.0698	41.4901	41.7872	42.0978	(38)
Heat transfer coeff	82.1374	81.9670	81.7998	81.0150	80.8681	80.1845	80.1845	80.0579	80.4478	80.8681	81.1652	81.4758	(39)
Average = Sum(39)m / 12 =												81.0142	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9890	0.9870	0.9849	0.9755	0.9737	0.9655	0.9655	0.9640	0.9687	0.9737	0.9773	0.9810	(40)
HLP (average)												0.9755	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5182	(42)
Average daily hot water use (litres/day)	94.0070	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.4077	99.6474	95.8871	92.1269	88.3666	84.6063	84.6063	88.3666	92.1269	95.8871	99.6474	103.4077	(44)
Energy conte	153.3506	134.1214	138.4013	120.6616	115.7777	99.9073	92.5788	106.2356	107.5044	125.2860	136.7594	148.5119	(45)
Energy content (annual)										Total = Sum(45)m =		1479.0961	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0026	20.1182	20.7602	18.0992	17.3667	14.9861	13.8868	15.9353	16.1257	18.7929	20.5139	22.2768	(46)

Water storage loss:

Store volume	150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.3938	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.7527	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	199.9455	176.2072	184.9962	165.7535	162.3726	144.9992	139.1737	152.8305	152.5962	171.8809	181.8513	195.1068	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Output from w/h	199.9455	176.2072	184.9962	165.7535	162.3726	144.9992	139.1737	152.8305	152.5962	171.8809	181.8513	195.1068	(64)
Heat gains from water heating, kWh/month	88.2650	78.2640	83.2944	76.1935	75.7720	69.2927	68.0584	72.5993	71.8187	78.9335	81.5460	86.6561	(65)

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

Total per year (kWh/year) = Sum(64)m = 2027.7135 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	125.9095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.1210	17.8713	14.5339	11.0031	8.2250	6.9439	7.5031	9.7528	13.0902	16.6210	19.3992	20.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.6967	228.0387	222.1369	209.5726	193.7125	178.8061	168.8478	166.5058	172.4076	184.9719	200.8321	215.7384	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	35.5909	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	-100.7276	(71)
Water heating gains (Table 5)	118.6358	116.4642	111.9548	105.8243	101.8441	96.2398	91.4763	97.5796	99.7482	106.0934	113.2583	116.4733	(72)
Total internal gains	428.2263	426.1471	412.3985	390.1728	367.5543	345.7626	331.6000	337.6110	349.0188	371.4591	397.2624	416.6648	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	6.7700	36.7938	0.6300	0.7000	0.7700	76.1264	(77)
Southwest	14.0000	36.7938	0.6300	0.7000	0.7700	157.4254	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	233.5519	397.8252	544.3218	674.4412	755.4303	749.9674	723.0486	662.6271	589.3854	439.6816	279.7413	199.8717	(83)
Total gains	661.7782	823.9724	956.7203	1064.6140	1122.9846	1095.7301	1054.6487	1000.2381	938.4042	811.1408	677.0037	616.5365	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	70.2160	70.3620	70.5058	71.1888	71.3181	71.9261	71.9261	72.0399	71.6907	71.3181	71.0571	70.7862	
alpha	5.6811	5.6908	5.7004	5.7459	5.7545	5.7951	5.7951	5.8027	5.7794	5.7545	5.7371	5.7191	
util living area	0.9917	0.9731	0.9256	0.8145	0.6461	0.4653	0.3341	0.3675	0.5796	0.8669	0.9779	0.9942	(86)
MIT	20.1666	20.3965	20.6495	20.8678	20.9690	20.9960	20.9995	20.9992	20.9869	20.8390	20.4558	20.1182	(87)
Th 2	20.0925	20.0942	20.0959	20.1038	20.1053	20.1122	20.1122	20.1135	20.1095	20.1053	20.1023	20.0992	(88)
util rest of house	0.9892	0.9656	0.9067	0.7763	0.5915	0.4021	0.2669	0.2970	0.5097	0.8281	0.9704	0.9924	(89)
MIT 2	18.9961	19.3264	19.6781	19.9649	20.0789	20.1098	20.1120	20.1132	20.1007	19.9394	19.4211	18.9311	(90)
MIT	19.6568	19.9304	20.2265	20.4745	20.5813	20.6101	20.6130	20.6133	20.6009	20.4472	20.0051	19.6012	(92)
adjusted MIT	19.6568	19.9304	20.2265	20.4745	20.5813	20.6101	20.6130	20.6133	20.6009	20.4472	20.0051	19.6012	(93)

Living area fraction: fLA = Living area / (4) = 0.5645 (91)

Temperature adjustment 0.0000

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9877	0.9640	0.9097	0.7928	0.6211	0.4377	0.3049	0.3368	0.5487	0.8440	0.9695	0.9912	(94)
Useful gains	653.6092	794.3032	870.3508	844.0056	697.4315	479.5943	321.5496	336.8995	514.9414	684.5894	656.3339	611.1036	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1261.3687	1231.9988	1122.8230	937.7115	718.2178	481.9152	321.7798	337.3072	522.9865	796.3212	1047.4484	1254.8229	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	452.1731	294.1314	187.8394	67.4683	15.4650	0.0000	0.0000	0.0000	0.0000	83.1285	281.6024	478.9271	(98)

Space heating 1860.7352 (98)

Space heating per m2 (98) / (4) = 22.4050 (99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1990.0911	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	452.1731	294.1314	187.8394	67.4683	15.4650	0.0000	0.0000	0.0000	0.0000	83.1285	281.6024	478.9271	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	483.6076	314.5791	200.8977	72.1586	16.5402	0.0000	0.0000	0.0000	0.0000	88.9075	301.1791	512.2215	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	199.9455	176.2072	184.9962	165.7535	162.3726	144.9992	139.1737	152.8305	152.5962	171.8809	181.8513	195.1068	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.9263	86.1713	84.8545	82.6261	80.6290	79.8000	79.8000	79.8000	79.8000	82.9989	85.9765	87.1187	(217)
Fuel for water heating, kWh/month	230.0173	204.4847	218.0158	200.6067	201.3824	181.7032	174.4032	191.5169	191.2233	207.0881	211.5127	223.9551	(219)

Water heating fuel used	2435.9094	(219)
Annual totals kWh/year		
Space heating fuel - main system	1990.0911	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	355.3436	(232)
Total delivered energy for all uses	4856.3442	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1990.0911	0.2160	429.8597	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2435.9094	0.2160	526.1564	(264)
Space and water heating			956.0161	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3436	0.5190	184.4233	(268)
Total CO2, kg/m2/year			1179.3645	(272)
Emissions per m2 for space and water heating			11.5113	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2206	(272b)
Emissions per m2 for pumps and fans			0.4687	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.5113 * 1.55) + 2.2206 + 0.4687, rounded to 2 d.p.			20.5300	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A8-F5+PV	Issued on Date	24/07/2020
Assessment Reference	A8-F5+PV	Prop Type Ref	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	89 B	DER	12.66	TER	22.24
Environmental	90 B	% DER<TER	43.09		
CO_2 Emissions (t/year)	0.82	DFEE	38.82	TFEE	42.25
General Requirements Compliance	Pass	% DFEE<TFEE	8.11		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	Assessor ID	T613-0001
Client	CO-RE, 4650		

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

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

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DWELLING AS DESIGNED

Top-floor flat, total floor area 94 m^2

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.24 kgCO□/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 12.66 kgCO□/m^2OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)42.2 kWh/m^2/yr
Dwelling Fabric Energy Efficiency (DFEE)38.8 kWh/m^2/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.13 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

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4 Heating efficiency

Main heating system:	Heat pump with radiators or underfloor - Electric
Panasonic WH-ADC1216G6E5UK + WH-UD16FE5	
Secondary heating system:	None

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5 Cylinder insulation

Hot water storage	No cylinder

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6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	

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

Minimum	75%	OK

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8 Mechanical ventilation
Continuous supply and extract system

Specific fan power:	0.56	
Maximum	1.5	OK
MVHR efficiency:	86%	
Minimum:	70%	OK

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9 Summertime temperature

Overheating risk (Thames Valley):	Not significant	OK
Based on:		
Overshading:	Average	
Windows facing South West:	19.08 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	Light-coloured venetian blind, closed 50% of daylight hours	

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10 Key features

External wall U-value	0.13 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.11 W/m^2K
Air permeability	3.0 m^3/m^2h
Photovoltaic array	0.66 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		94.2600 (1b)	x	2.8000 (2b)	=	263.9280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.2600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9280	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1339	0.1313	0.1286	0.1155	0.1129	0.0998	0.0998	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2684	0.2658	0.2631	0.2500	0.2474	0.2343	0.2343	0.2316	0.2395	0.2474	0.2526	0.2579	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.30)			19.0800	1.2357	23.5779			(27)
External Wall 1	55.2600	19.0800	36.1800	0.1300	4.7034			(29a)
External Roof 1	94.2600		94.2600	0.1100	10.3686			(30)
Total net area of external elements Aum(A, m2)			149.5200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.6499			(33)
Party Wall 1			26.9100	0.0000	0.0000			(32)
Party Wall 2			44.1000	0.0000	0.0000			(32)
Party Wall 3			18.9000	0.0000	0.0000			(32)
Party Floor 1			94.2600					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area) 22.4280 (36)
Total fabric heat loss (33) + (36) = 61.0779 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	23.3745	23.1458	22.9172	21.7741	21.5454	20.4023	20.4023	20.1737	20.8595	21.5454	22.0027	22.4599	(38)
Heat transfer coeff	84.4524	84.2238	83.9951	82.8520	82.6234	81.4802	81.4802	81.2516	81.9375	82.6234	83.0806	83.5379	(39)

Average = Sum(39)m / 12 = 82.7948 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8960	0.8935	0.8911	0.8790	0.8765	0.8644	0.8644	0.8620	0.8693	0.8765	0.8814	0.8862	(40)
HLP (average)												0.8784	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6797 (42)
Average daily hot water use (litres/day) 97.8419 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.6261	103.7124	99.7987	95.8851	91.9714	88.0577	88.0577	91.9714	95.8851	99.7987	103.7124	107.6261	(44)
Energy conte	159.6064	139.5928	144.0472	125.5839	120.5007	103.9830	96.3555	110.5693	111.8899	130.3969	142.3384	154.5703	(45)

Energy content (annual) Total = Sum(45)m = 1539.4342 (45)
Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	23.9410	20.9389	21.6071	18.8376	18.0751	15.5974	14.4533	16.5854	16.7835	19.5595	21.3508	23.1855	(46)

Water storage loss:

Store volume 184.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.1100 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.1394 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(56)
If cylinder contains dedicated solar storage	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Total heat required for water heating calculated for each month	194.9278	171.4960	179.3686	159.7659	155.8221	138.1650	131.6769	145.8907	146.0719	165.7183	176.5204	189.8917	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	194.9278	171.4960	179.3686	159.7659	155.8221	138.1650	131.6769	145.8907	146.0719	165.7183	176.5204	189.8917	(64)

Total per year (kWh/year) = Sum(64)m = 1955.3152 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	53.0691	46.4146	47.8957	41.7566	40.0665	34.5743	32.0382	36.7643	37.2034	43.3570	47.3275	51.3946	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.9935	19.5345	15.8865	12.0271	8.9904	7.5901	8.2013	10.6604	14.3084	18.1678	21.2045	22.6048	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	246.7006	249.2605	242.8095	229.0759	211.7398	195.4462	184.5611	182.0012	188.4522	202.1858	219.5219	235.8155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	(71)
Water heating gains (Table 5)	71.3295	69.0693	64.3759	57.9953	53.8528	48.0199	43.0621	49.4144	51.6714	58.2755	65.7327	69.0788	(72)
Total internal gains	403.2185	401.0592	386.2668	362.2932	337.7779	314.2511	299.0195	305.2709	317.6269	341.8239	369.6540	390.6940	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	19.0800	36.7938	0.6000	0.9000	0.7700	262.7123	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	262.7123	447.4962	612.2838	758.6494	849.7505	843.6056	813.3258	745.3603	662.9739	494.5787	314.6688	224.8270	(83)
Total gains	665.9307	848.5555	998.5507	1120.9426	1187.5284	1157.8567	1112.3453	1050.6311	980.6008	836.4026	684.3227	615.5209	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	77.5091	77.7195	77.9311	79.0063	79.2250	80.3365	80.3365	80.5625	79.8881	79.2250	78.7889	78.3577	
alpha	6.1673	6.1813	6.1954	6.2671	6.2817	6.3558	6.3558	6.3708	6.3259	6.2817	6.2526	6.2238	
util living area	0.9948	0.9786	0.9308	0.8099	0.6316	0.4488	0.3221	0.3554	0.5689	0.8740	0.9842	0.9967	(86)
Tweekday	19.1321	19.4672	19.8130	20.0811	20.1710	20.1967	20.1978	20.1998	20.1884	20.0475	19.5432	19.0724	
Tweekend	20.4949	20.6449	20.8050	20.9359	20.9875	20.9988	20.9999	20.9998	20.9949	20.9131	20.6740	20.4655	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	20.2205	20.4507	20.6990	20.8999	20.9808	20.9981	20.9998	20.9997	20.9921	20.8658	20.4910	20.1751	(87)
Th 2	20.1709	20.1730	20.1751	20.1854	20.1875	20.1978	20.1978	20.1999	20.1937	20.1875	20.1833	20.1792	(88)
util rest of house	0.9932	0.9726	0.9136	0.7735	0.5815	0.3933	0.2635	0.2938	0.5057	0.8381	0.9787	0.9956	(89)
Tweekday	19.1321	19.4672	19.8130	20.0811	20.1710	20.1967	20.1978	20.1998	20.1884	20.0475	19.5432	19.0724	
Tweekend	19.1321	19.4672	19.8130	20.0811	20.1710	20.1967	20.1978	20.1998	20.1884	20.0475	19.5432	19.0724	
MIT 2	19.1321	19.4672	19.8130	20.0811	20.1710	20.1967	20.1978	20.1998	20.1884	20.0475	19.5432	19.0724	(90)

Living area fraction — fLA = Living area / (4) = 0.5739 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.7568	20.0317	20.3215	20.5510	20.6358	20.6567	20.6581	20.6589	20.6497	20.5172	20.0872	19.7053	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	19.7568	20.0317	20.3215	20.5510	20.6358	20.6567	20.6581	20.6589	20.6497	20.5172	20.0872	19.7053	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9922	0.9714	0.9169	0.7904	0.6094	0.4251	0.2972	0.3292	0.5417	0.8536	0.9780	0.9949	(94)
Useful gains	660.7512	824.2983	915.5765	886.0332	723.7378	492.2433	330.5508	345.8433	531.2331	713.9930	669.2471	612.3572	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1305.3622	1274.4469	1160.9424	965.3100	738.3031	493.4989	330.6549	346.0396	536.6625	819.3917	1078.9843	1295.2768	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Space heating kWh

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	479.5906	302.4999	182.5522	57.0792	10.8366	0.0000	0.0000	0.0000	0.0000	78.4167	295.0108	508.0922	(98)

Space heating 1914.0781 (98)
Space heating per m2 (98) / (4) = 20.3064 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	765.9143	602.9538	617.5123	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9918	0.9973	0.9959	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	759.6502	601.3075	614.9710	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1452.0892	1397.0212	1326.2601	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	498.5560	592.0110	529.1991	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling 1619.7661 (104)
Cooled fraction fC = cooled area / (4) = 0.7278 (105)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	90.7091	107.7126	96.2844	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling 294.7060 (107)
Space cooling per m2 3.1265 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	152.2435	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1257.2476	(211)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.0500	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	479.5906	302.4999	182.5522	57.0792	10.8366	0.0000	0.0000	0.0000	0.0000	78.4167	295.0108	508.0922	(98)
Space heating efficiency (main heating system 1)	152.2435	152.2435	152.2435	152.2435	152.2435	0.0000	0.0000	0.0000	0.0000	152.2435	152.2435	152.2435	(210)
Space heating fuel (main heating system)	315.0154	198.6947	119.9080	37.4921	7.1179	0.0000	0.0000	0.0000	0.0000	51.5074	193.7756	333.7365	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	194.9278	171.4960	179.3686	159.7659	155.8221	138.1650	131.6769	145.8907	146.0719	165.7183	176.5204	189.8917	(64)
Efficiency of water heater												258.5900	(216)
(217)m	258.5900	258.5900	258.5900	258.5900	258.5900	258.5900	258.5900	258.5900	258.5900	258.5900	258.5900	258.5900	(217)
Fuel for water heating, kWh/month	75.3810	66.3196	69.3641	61.7835	60.2584	53.4301	50.9211	56.4178	56.4878	64.0853	68.2626	73.4335	(219)
Water heating fuel used												756.1449	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	22.3973	26.5957	23.7739	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												72.7669	(221)

Annual totals kWh/year

Space heating fuel - main system	1257.2476	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7000)

mechanical ventilation fans (SFP = 0.7000)	225.3945	(230a)
Total electricity for the above, kWh/year	225.3945	(231)
Electricity for lighting (calculated in Appendix L)	388.4127	(232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 0.66 * 951 * 0.80) =	-401.5402	-401.5402	(233)
Total delivered energy for all uses		2298.4264	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1257.2476	0.5190	652.5115	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	756.1449	0.5190	392.4392	(264)
Space and water heating			1044.9507	(265)
Space cooling	72.7669	0.5190	37.7660	(266)
Pumps and fans	225.3945	0.5190	116.9798	(267)
Energy for lighting	388.4127	0.5190	201.5862	(268)
Energy saving/generation technologies				
PV Unit	-401.5402	0.5190	-208.3994	(269)
Total CO2, kg/year			1192.8833	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.6600	(273)

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

DER		12.6600	ZC1
Total Floor Area	TFA	94.2600	
Assumed number of occupants	N	2.6797	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5092	ZC2

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

CO2 emissions from cooking, equation (L16)	1.9447	ZC3
Total CO2 emissions	30.1139	ZC4
Residual CO2 emissions offset from biofuel CHP	0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year	0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation	0.0000	ZC7
Net CO2 emissions	30.1139	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	94.2600 (1b)	x	2.8000 (2b)	=	263.9280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 94.2600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9280	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1137	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3637	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2546	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3246	0.3182	0.3118	0.2800	0.2737	0.2418	0.2418	0.2355	0.2546	0.2737	0.2864	0.2991	(22b)
Effective ac	0.5527	0.5506	0.5486	0.5392	0.5374	0.5292	0.5292	0.5277	0.5324	0.5374	0.5410	0.5447	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			19.0800	1.3258	25.2955			(27)
External Wall 1	55.2600	19.0800	36.1800	0.1800	6.5124			(29a)
External Roof 1	94.2600		94.2600	0.1300	12.2538			(30)
Total net area of external elements Aum(A, m2)			149.5200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.0617			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		7.4760	(36)
Total fabric heat loss	(33) + (36) =	51.5377	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	48.1358	47.9577	47.7831	46.9629	46.8094	46.0951	46.0951	45.9628	46.3702	46.8094	47.1199	47.4444	(38)
Heat transfer coeff	99.6735	99.4953	99.3207	98.5005	98.3471	97.6327	97.6327	97.5004	97.9079	98.3471	98.6575	98.9821	(39)
Average = Sum(39)m / 12 =												98.4998	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0574	1.0555	1.0537	1.0450	1.0434	1.0358	1.0358	1.0344	1.0387	1.0434	1.0467	1.0501	(40)
HLP (average)												1.0450	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6797	(42)
Average daily hot water use (litres/day)	97.8419	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.6261	103.7124	99.7987	95.8851	91.9714	88.0577	88.0577	91.9714	95.8851	99.7987	103.7124	107.6261	(44)
Energy conte	159.6064	139.5928	144.0472	125.5839	120.5007	103.9830	96.3555	110.5693	111.8899	130.3969	142.3384	154.5703	(45)
Energy content (annual)										Total = Sum(45)m =		1539.4342	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9410	20.9389	21.6071	18.8376	18.0751	15.5974	14.4533	16.5854	16.7835	19.5595	21.3508	23.1855	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	206.2013	181.6785	190.6421	170.6757	167.0956	149.0748	142.9504	157.1642	156.9817	176.9918	187.4302	201.1652	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	206.2013	181.6785	190.6421	170.6757	167.0956	149.0748	142.9504	157.1642	156.9817	176.9918	187.4302	201.1652	(64)
Total per year (kWh/year) = Sum(64)m =												2088.0516	(64)
Heat gains from water heating, kWh/month													
	90.3450	80.0832	85.1716	77.8301	77.3424	70.6478	69.3141	74.0402	73.2769	80.6329	83.4010	88.6705	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	133.9830	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.1217	19.6483	15.9791	12.0972	9.0428	7.6343	8.2491	10.7226	14.3918	18.2737	21.3281	22.7366	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.7006	249.2605	242.8095	229.0759	211.7398	195.4462	184.5611	182.0012	188.4522	202.1858	219.5219	235.8155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	36.3983	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	-107.1864	(71)
Water heating gains (Table 5)													
	121.4315	119.1714	114.4780	108.0974	103.9549	98.1220	93.1641	99.5164	101.7734	108.3775	115.8347	119.1808	(72)
Total internal gains													
	456.4487	454.2751	439.4615	415.4654	390.9323	367.3974	352.1693	358.4350	370.8123	395.0319	422.8796	443.9278	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	19.0800	36.7938	0.6300	0.7000	0.7700	214.5484	(79)

Solar gains	214.5484	365.4553	500.0318	619.5637	693.9629	688.9446	664.2161	608.7109	541.4287	403.9059	256.9795	183.6087	(83)
Total gains	670.9971	819.7304	939.4933	1035.0290	1084.8952	1056.3419	1016.3854	967.1459	912.2410	798.9378	679.8591	627.5365	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.6728	65.7904	65.9060	66.4548	66.5585	67.0455	67.0455	67.1364	66.8571	66.5585	66.3491	66.1315	
alpha	5.3782	5.3860	5.3937	5.4303	5.4372	5.4697	5.4697	5.4758	5.4571	5.4372	5.4233	5.4088	
util living area													
	0.9955	0.9866	0.9629	0.8974	0.7646	0.5774	0.4205	0.4600	0.6970	0.9282	0.9887	0.9968	(86)
MIT	19.9900	20.1959	20.4569	20.7329	20.9135	20.9848	20.9977	20.9963	20.9596	20.7143	20.2900	19.9473	(87)
Th 2	20.0357	20.0373	20.0388	20.0460	20.0474	20.0536	20.0536	20.0548	20.0512	20.0474	20.0446	20.0418	(88)
util rest of house													
	0.9940	0.9824	0.9515	0.8683	0.7082	0.4981	0.3312	0.3675	0.6176	0.9008	0.9844	0.9958	(89)
MIT 2	18.6977	18.9968	19.3694	19.7496	19.9691	20.0442	20.0528	20.0534	20.0225	19.7357	19.1406	18.6399	(90)
Living area fraction									fLA = Living area / (4) =			0.5739	(91)
MIT	19.4394	19.6850	19.9935	20.3140	20.5111	20.5841	20.5951	20.5946	20.5603	20.2973	19.8003	19.3902	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4394	19.6850	19.9935	20.3140	20.5111	20.5841	20.5951	20.5946	20.5603	20.2973	19.8003	19.3902	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9929	0.9806	0.9509	0.8772	0.7368	0.5432	0.3825	0.4207	0.6616	0.9089	0.9831	0.9948	(94)
Useful gains	666.2019	803.7886	893.3894	907.9126	799.3361	573.7819	388.7777	406.8459	603.4980	726.1504	668.3419	624.2848	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1508.9990	1471.0401	1340.1876	1124.2809	866.5501	584.2402	390.0563	408.9730	632.5158	953.7040	1252.9798	1503.5620	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	627.0410	448.3930	332.4179	155.7852	50.0073	0.0000	0.0000	0.0000	0.0000	169.2999	420.9393	654.1823	(98)
Space heating												2858.0659	(98)
Space heating per m2											(98) / (4) =	30.3211	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Fraction of space heat from secondary/supplementary system (Table 11)                                                            0.0000 (201)
Fraction of space heat from main system(s)                                                                                       1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                          0.0000 (208)
Space heating requirement                                                                                                     3056.7549 (211)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
               627.0410   448.3930   332.4179   155.7852    50.0073     0.0000     0.0000     0.0000     0.0000   169.2999   420.9393   654.1823 (98)
Space heating efficiency (main heating system 1)
                93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
               670.6321   479.5647   355.5272   166.6152    53.4837     0.0000     0.0000     0.0000     0.0000   181.0694   450.2025   699.6602 (211)
Water heating requirement
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (215)

Water heating
Water heating requirement
               206.2013   181.6785   190.6421   170.6757   167.0956   149.0748   142.9504   157.1642   156.9817   176.9918   187.4302   201.1652 (64)
Efficiency of water heater                                                                                                       79.8000 (216)
(217)m          87.5935    87.1313    86.2833    84.5715    82.0341    79.8000    79.8000    79.8000    79.8000    84.6957    86.9098    87.7333 (217)
Fuel for water heating, kWh/month
               235.4071   208.5113   220.9491   201.8123   203.6905   186.8105   179.1358   196.9477   196.7190   208.9739   215.6607   229.2916 (219)
Water heating fuel used                                                                                                       2483.9095 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                              3056.7549 (211)
Space heating fuel - secondary                                                                                                   0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                         30.0000 (230c)
   main heating flue fan                                                                                                        45.0000 (230e)
Total electricity for the above, kWh/year                                                                                       75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                            390.6768 (232)
Total delivered energy for all uses                                                                                           6006.3413 (238)


----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                  Energy       Emission factor             Emissions
                                                                                kWh/year          kg CO2/kWh             kg CO2/year
Space heating - main system 1                                                  3056.7549              0.2160              660.2591 (261)
Space heating - secondary                                                         0.0000              0.0000                0.0000 (263)
Water heating (other fuel)                                                     2483.9095              0.2160              536.5245 (264)
Space and water heating                                                                                                   1196.7835 (265)
Pumps and fans                                                                   75.0000              0.5190               38.9250 (267)
Energy for lighting                                                             390.6768              0.5190              202.7613 (268)
Total CO2, kg/m2/year                                                                                                     1438.4698 (272)
Emissions per m2 for space and water heating                                                                                12.6966 (272a)
Fuel factor (electricity)                                                                                                    1.5500
Emissions per m2 for lighting                                                                                                2.1511 (272b)
Emissions per m2 for pumps and fans                                                                                          0.4130 (272c)
Target Carbon Dioxide Emission Rate (TER) = (12.6966 * 1.55) + 2.1511 + 0.4130, rounded to 2 d.p.                           22.2400 (273)
```

Appendix 4 – Residential Input Summary

Summary Information – Lean Scheme

Summary Information - Green Scheme

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A1-F1	**Issued on Date**	24/07/2020
Assessment Reference	A1-F1	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	84 B	**DER**	16.82	**TER**	17.19
Environmental	86 B	**% DER<TER**	2.17		
CO_2 Emissions (t/year)	1.43	**DFEE**	49.60	**TFEE**	53.61
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.48		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North East
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	16.25 m	106.00 m²	2.80 m

7.0 Living Area	55.31	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	75.02	45.50

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.01
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	28.48
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	43.54

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	106.00

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Heat Loss Floor 1	Exposed Floor - Solid	Other	0.11	31.80
Heat Loss Floor 2	Ground Floor - Solid	Slab on ground, screed over insulation	0.11	74.20

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A1-F1-01	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					5.69	50
A1-F1-02	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					6.66	50
A1-F1-03	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					6.57	50
A1-F1-04	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					10.60	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	3.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	2
MVHR Duct Insulated	Yes

Manufacturer SFP	0.66
Duct Type	Semi rigid
MVHR Efficiency	85.00
Wet Rooms	2

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	73.16	m^2
Data Source	SAP table	
Cooling Type	Split or Multi-Split	
Energy Class	A	
System Control	On/Off	

22.0 Lighting

Internal

Total number of light fittings	15	
Total number of L.E.L. fittings	15	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Boiler	
Percentage of Heat	100	%
Database Ref. No.	18218	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.4	
In Summer	80.3	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2	None

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	No
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A2-F2	**Issued on Date**	24/07/2020
Assessment Reference	A2-F2	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	86 B	**DER**	13.23	**TER**	14.81
Environmental	89 B	**% DER<TER**	10.65		
CO_2 Emissions (t/year)	1.16	**DFEE**	35.06	**TFEE**	41.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.06		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North East
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	16.26 m	106.00 m²	2.80 m

7.0 Living Area	55.36	m²

8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	72.32	45.53

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.04
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	28.48
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	43.54

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	106.00

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Concrete floor slab, carpeted	106.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A2-F2-01	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					5.17	50
A2-F2-02	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					6.04	50
A2-F2-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					5.96	50
A2-F2-05	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					9.62	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	3.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	2
MVHR Duct Insulated	Yes
Manufacturer SFP	0.66
Duct Type	Semi rigid

MVHR Efficiency	85.00
Wet Rooms	2

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	73.35	m²
Data Source	SAP table	
Cooling Type	Split or Multi-Split	
Energy Class	A	
System Control	On/Off	

22.0 Lighting

Internal

Total number of light fittings	15	
Total number of L.E.L. fittings	15	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Boiler	
Percentage of Heat	100	%
Database Ref. No.	18218	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.4	
In Summer	80.3	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2	None

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	No
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A3-F2	**Issued on Date**	24/07/2020
Assessment Reference	A3-F2	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	84 B	**DER**	14.94	**TER**	15.41
Environmental	87 B	**% DER<TER**	3.03		
CO_2 Emissions (t/year)	1.24	**DFEE**	37.87	**TFEE**	43.74
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.42		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	15.84 m	100.00 m²	2.80 m

7.0 Living Area	40.66	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	73.61	44.35

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	17.81
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	36.12
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	22.99

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	100.00

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Heat Loss Floor 1	Ground Floor - Solid	Slab on ground, screed over insulation	0.11	100.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A3-F2-01	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					9.62	50
A3-F2-02	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					4.93	50
A3-F2-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					9.54	50
A3-F2-05	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					5.17	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	3.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	3
MVHR Duct Insulated	Yes
Manufacturer SFP	0.79
Duct Type	Semi rigid

MVHR Efficiency	84.00
Wet Rooms	3

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	52.84	m^2
Data Source	SAP table	
Cooling Type	Split or Multi-Split	
Energy Class	A	
System Control	On/Off	

22.0 Lighting

Internal

Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Boiler	
Percentage of Heat	100	%
Database Ref. No.	18218	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.4	
In Summer	80.3	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2	None

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	No
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A4-F3	**Issued on Date**	24/07/2020
Assessment Reference	A4-F3	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	86 B	**DER**	13.68	**TER**	15.15
Environmental	88 B	**% DER<TER**	9.70		
CO_2 Emissions (t/year)	1.19	**DFEE**	37.11	**TFEE**	43.46
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.61		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North East
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	16.26 m	106.00 m²	2.80 m

7.0 Living Area	55.36	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	72.32	45.53

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.04
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	28.48
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	43.54

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	Plasterboard, insulated flat roof	0.11	15.22	15.22

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	90.78

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Concrete floor slab, carpeted	106.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A4-F3-01	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					5.17	50
A4-F3-02	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					6.04	50
A4-F3-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					5.96	50
A4-F3-05	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					9.62	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	3.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364

Configuration	2
MVHR Duct Insulated	Yes
Manufacturer SFP	0.66
Duct Type	Semi rigid
MVHR Efficiency	85.00
Wet Rooms	2

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	73.35	m^2
Data Source	SAP table	
Cooling Type	Split or Multi-Split	
Energy Class	A	
System Control	On/Off	

22.0 Lighting

Internal

Total number of light fittings	15	
Total number of L.E.L. fittings	15	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Boiler	
Percentage of Heat	100	%
Database Ref. No.	18218	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.4	
In Summer	80.3	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2	None
Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	No
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A5-F3	**Issued on Date**	24/07/2020
Assessment Reference	A5-F3	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	86 B	**DER**	12.42	**TER**	13.22
Environmental	89 B	**% DER<TER**	6.03		
CO_2 Emissions (t/year)	1.10	**DFEE**	28.00	**TFEE**	32.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.63		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	15.84 m	100.00 m²	2.80 m

7.0 Living Area	40.66	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	73.61	44.35

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	17.81
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	36.12
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	22.99

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	100.00

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Precast concrete planks floor, screed, carpeted	100.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A5-F3-01	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					9.62	50
A5-F3-02	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					4.93	50
A5-F3-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					9.54	50
A5-F3-05	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					5.17	50

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	6.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	3
MVHR Duct Insulated	Yes
Manufacturer SFP	0.79
Duct Type	Semi rigid

MVHR Efficiency	84.00
Wet Rooms	3

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	52.84	m^2
Data Source	SAP table	
Cooling Type	Split or Multi-Split	
Energy Class	A	
System Control	On/Off	

22.0 Lighting

Internal

Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Boiler	
Percentage of Heat	100	%
Database Ref. No.	18218	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.4	
In Summer	80.3	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2	None

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	No
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A6-F4&5	**Issued on Date**	24/07/2020
Assessment Reference	A6-F4&5	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	86 B	**DER**	13.57	**TER**	14.25
Environmental	87 B	**% DER<TER**	4.77		
CO_2 Emissions (t/year)	2.00	**DFEE**	45.24	**TFEE**	51.16
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.56		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North East
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2020
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	12.70 m	86.85 m²	2.80 m
1st Storey:	12.70 m	101.00 m²	2.80 m

7.0 Living Area	68.14	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.13	54.28	35.56
External Wall 2	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.13	54.38	35.56

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.90
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	21.48
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	43.51
Party Wall 4	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.96
Party Wall 5	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	23.30
Party Wall 6	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	86.66

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	Plasterboard, insulated flat roof	0.11	101.00	101.00

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Concrete floor slab, carpeted	86.85

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A6-F4&5-01-04	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					18.72	50
A6-F4&5-05-08	Window	[2] External Wall 2	North East	Light-coloured venean` blind	0.00					18.82	50

14.0 Conservatory None

15.0 Draught Proofing 100 %

16.0 Draught Lobby No

17.0 Thermal Bridging Default

Y-value 0.150 W/m²K

18.0 Pressure Testing Yes

Designed AP_{50} 3.00 m³/(h.m²) @ 50 Pa

Property Tested ?

As Built AP_{50} m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	8.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	3
MVHR Duct Insulated	Yes
Manufacturer SFP	0.79
Duct Type	Semi rigid

MVHR Efficiency	84.00
Wet Rooms	3

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	95.98	m²
Data Source	SAP table	
Cooling Type	Split or Multi-Split	
Energy Class	A	
System Control	On/Off	

22.0 Lighting

Internal

Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Boiler	
Percentage of Heat	100	%
Database Ref. No.	18218	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.4	
In Summer	80.3	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2	None

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	No
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A7-F4	**Issued on Date**	24/07/2020
Assessment Reference	A7-F4	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	85 B	**DER**	13.87	**TER**	14.51
Environmental	89 B	**% DER<TER**	4.43		
CO_2 Emissions (t/year)	1.00	**DFEE**	31.70	**TFEE**	34.40
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.84		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	15.84 m	83.05 m²	2.80 m

7.0 Living Area 46.88 m²

8.0 Thermal Mass Parameter Simple calculation - Medium

Thermal Mass 250.00 kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	73.61	44.35

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	17.81
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	16.41
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	23.18
Party Wall 4	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	19.54

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	Plasterboard, insulated flat roof	0.11	3.35	3.35

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Precast concrete planks floor, screed, carpeted	79.70

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Precast concrete planks floor, screed, carpeted	83.05

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A7-F4-01	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					9.62	50
A7-F4-02	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					4.93	50
A7-F4-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					9.54	50
A7-F4-05	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					5.17	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	8.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364

Configuration	2
MVHR Duct Insulated	Yes
Manufacturer SFP	0.66
Duct Type	Semi rigid
MVHR Efficiency	85.00
Wet Rooms	2

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	59.09	m²
Data Source	SAP table	
Cooling Type	Split or Multi-Split	
Energy Class	A	
System Control	On/Off	

22.0 Lighting

Internal

Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Boiler	
Percentage of Heat	100	%
Database Ref. No.	18218	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.4	
In Summer	80.3	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2	None
Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	No
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP elmhurst energy

Property Reference	A8-F5	Issued on Date	24/07/2020
Assessment Reference	A8-F5	Prop Type Ref	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	85 B	DER	14.82	TER	15.63
Environmental	88 B	% DER<TER	5.17		
CO_2 Emissions (t/year)	1.15	DFEE	38.74	TFEE	42.25
General Requirements Compliance	Pass	% DFEE<TFEE	8.30		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	Assessor ID	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	12.92 m	94.26 m²	2.80 m

7.0 Living Area	54.10	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	55.26	36.18

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	26.91
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	44.10
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	18.90

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	Plasterboard, insulated flat roof	0.11	94.26	94.26

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Precast concrete planks floor, screed, carpeted	94.26

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A8-F5-01-04	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					19.08	50

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	8.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	1
MVHR Duct Insulated	Yes
Manufacturer SFP	0.56
Duct Type	Semi rigid
MVHR Efficiency	86.00
Wet Rooms	1

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	68.60	m²
Data Source	SAP table	
Cooling Type	Split or Multi-Split	
Energy Class	A	
System Control	On/Off	
22.0 Lighting		
Internal		
Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	No	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Description	Boiler	
Percentage of Heat	100	%
Database Ref. No.	18218	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.4	
In Summer	80.3	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery	No	

Storage System	
Solar Panel	No
Water use <= 125 litres/person/day	No
SAP Code	901
29.0 Hot Water Cylinder	None

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A1-F1+PV	**Issued on Date**	24/07/2020
Assessment Reference	A1-F1+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	89 B	**DER**	12.19	**TER**	24.74
Environmental	90 B	**% DER<TER**	50.72		
CO_2 Emissions (t/year)	0.95	**DFEE**	49.68	**TFEE**	53.61
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.33		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North East
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	16.25 m	106.00 m²	2.80 m

7.0 Living Area	55.31	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	75.02	45.50

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.01
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	28.48
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	43.54

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	106.00

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Heat Loss Floor 1	Exposed Floor - Solid	Other	0.11	31.80
Heat Loss Floor 2	Ground Floor - Solid	Slab on ground, screed over insulation	0.11	74.20

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A1-F1-01	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					5.69	50
A1-F1-02	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					6.66	50
A1-F1-03	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					6.57	50
A1-F1-04	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					10.60	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	3.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	2
MVHR Duct Insulated	Yes

Manufacturer SFP	0.66
Duct Type	Semi rigid
MVHR Efficiency	85.00
Wet Rooms	2

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	73.16	m^2
Data Source	Manufacturer	
Cooling Type	Packaged	
Energy Efficiency Ratio	3.00	
System Control	Modulating	

22.0 Lighting

Internal

Total number of light fittings	15	
Total number of L.E.L. fittings	15	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Description	Heat Pump	
Percentage of Heat	100	%
Database Ref. No.	102594	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	0.0	
In Summer	0.0	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Fan Coil Units	
Flow Temperature	Normal (> 45°C)	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	

Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
Immersion Only Heating Hot Water	Yes	
29.0 Hot Water Cylinder	Internal Store	
Insulaon Typeą	Measured Loss	
Cylinder Volume	184.00	L
Loss	2.110	kWh/day
32.0 Photovoltaic Unit	One Dwelling	

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.66	South	Horizontal	Modest	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A2-F2+PV	**Issued on Date**	24/07/2020
Assessment Reference	A2-F2+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	92 A	**DER**	9.38	**TER**	21.06
Environmental	93 A	**% DER<TER**	55.47		
CO_2 Emissions (t/year)	0.71	**DFEE**	35.14	**TFEE**	41.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.87		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North East
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	16.26 m	106.00 m²	2.80 m

7.0 Living Area	55.36	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	72.32	45.53

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.04
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	28.48
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	43.54

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	106.00

11.1 Party Floors

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Description	Construction	Area (m²)
Party Floor 1	Concrete floor slab, carpeted	106.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A2-F2-01	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					5.17	50
A2-F2-02	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					6.04	50
A2-F2-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					5.96	50
A2-F2-05	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					9.62	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	3.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	2
MVHR Duct Insulated	Yes
Manufacturer SFP	0.66
Duct Type	Semi rigid

MVHR Efficiency	85.00
Wet Rooms	2

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	73.35	m²
Data Source	Manufacturer	
Cooling Type	Packaged	
Energy Efficiency Ratio	3.00	
System Control	Modulating	

22.0 Lighting

Internal

Total number of light fittings	15	
Total number of L.E.L. fittings	15	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Heat Pump	
Percentage of Heat	100	%
Database Ref. No.	102594	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	0.0	
In Summer	0.0	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Fan Coil Units	
Flow Temperature	Normal (> 45°C)	

25.0 Main Heating 2	None

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery	No

Instantaneous System 1		
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
Immersion Only Heating Hot Water	Yes	
29.0 Hot Water Cylinder	Internal Store	
Insulaon Typeą	Measured Loss	
Cylinder Volume	184.00	L
Loss	2.110	kWh/day
32.0 Photovoltaic Unit	One Dwelling	

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.66	South	Horizontal	Modest	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A3-F2+PV	**Issued on Date**	24/07/2020
Assessment Reference	A3-F2+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	91 B	**DER**	10.23	**TER**	21.99
Environmental	92 A	**% DER<TER**	53.48		
CO_2 Emissions (t/year)	0.77	**DFEE**	37.94	**TFEE**	43.74
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.27		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	15.84 m	100.00 m²	2.80 m

7.0 Living Area 40.66 m²

8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	73.61	44.35

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	17.81
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	36.12
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	22.99

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	100.00

11.0 Heat Loss Floors

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Heat Loss Floor 1	Ground Floor - Solid	Slab on ground, screed over insulation	0.11	100.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A3-F2-01	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					9.62	50
A3-F2-02	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					4.93	50
A3-F2-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					9.54	50
A3-F2-05	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					5.17	50

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	3.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	3
MVHR Duct Insulated	Yes
Manufacturer SFP	0.79
Duct Type	Semi rigid

MVHR Efficiency	84.00
Wet Rooms	3

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	52.84	m^2
Data Source	Manufacturer	
Cooling Type	Packaged	
Energy Efficiency Ratio	3.00	
System Control	Modulating	

22.0 Lighting

Internal

Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Heat Pump	
Percentage of Heat	100	%
Database Ref. No.	102594	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	0.0	
In Summer	0.0	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Fan Coil Units	
Flow Temperature	Normal (> 45°C)	

25.0 Main Heating 2	None

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery	No

Instantaneous System 1	
Waste Water Heat Recovery	No
Instantaneous System 2	
Waste Water Heat Recovery	No
Storage System	
Solar Panel	No
Water use <= 125 litres/person/day	Yes
SAP Code	901
Immersion Only Heating Hot Water	Yes

29.0 Hot Water Cylinder	Internal Store	
Insulaon Typeą	Measured Loss	
Cylinder Volume	184.00	L
Loss	2.110	kWh/day

32.0 Photovoltaic Unit One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.66	South	Horizontal	Modest	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A4-F3+PV	**Issued on Date**	24/07/2020
Assessment Reference	A4-F3+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	91 B	**DER**	9.74	**TER**	21.59
Environmental	92 A	**% DER<TER**	54.89		
CO_2 Emissions (t/year)	0.74	**DFEE**	37.19	**TFEE**	43.46
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.43		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North East
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	16.26 m	106.00 m²	2.80 m

7.0 Living Area	55.36	m²

8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	72.32	45.53

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.04
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	28.48
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	43.54

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	Plasterboard, insulated flat roof	0.11	15.22	15.22

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	90.78

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Concrete floor slab, carpeted	106.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A4-F3-01	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					5.17	50
A4-F3-02	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					6.04	50
A4-F3-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					5.96	50
A4-F3-05	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					9.62	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	3.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364

Configuration	2
MVHR Duct Insulated	Yes
Manufacturer SFP	0.66
Duct Type	Semi rigid
MVHR Efficiency	85.00
Wet Rooms	2

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	73.35	m^2
Data Source	Manufacturer	
Cooling Type	Packaged	
Energy Efficiency Ratio	3.00	
System Control	Modulating	

22.0 Lighting

Internal

Total number of light fittings	15	
Total number of L.E.L. fittings	15	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Heat Pump	
Percentage of Heat	100	%
Database Ref. No.	102594	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	0.0	
In Summer	0.0	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Fan Coil Units	
Flow Temperature	Normal (> 45°C)	

25.0 Main Heating 2	None

Community Heating	None

28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
Immersion Only Heating Hot Water	Yes	

29.0 Hot Water Cylinder	Internal Store	
Insulaon Typeą	Measured Loss	
Cylinder Volume	184.00	L
Loss	2.110	kWh/day

32.0 Photovoltaic Unit One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.66	South	Horizontal	Modest	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A5-F3+PV	**Issued on Date**	24/07/2020
Assessment Reference	A5-F3+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	92 A	**DER**	8.26	**TER**	18.64
Environmental	93 A	**% DER<TER**	55.69		
CO_2 Emissions (t/year)	0.64	**DFEE**	28.06	**TFEE**	32.80
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.45		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	15.84 m	100.00 m²	2.80 m

7.0 Living Area	40.66	m²

8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	73.61	44.35

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	17.81
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	36.12
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	22.99

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Concrete floor slab, carpeted	100.00

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Precast concrete planks floor, screed, carpeted	100.00

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A5-F3-01	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					9.62	50
A5-F3-02	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					4.93	50
A5-F3-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					9.54	50
A5-F3-05	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					5.17	50

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	6.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	3
MVHR Duct Insulated	Yes
Manufacturer SFP	0.79
Duct Type	Semi rigid

MVHR Efficiency	84.00
Wet Rooms	3

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	52.84	m^2
Data Source	Manufacturer	
Cooling Type	Packaged	
Energy Efficiency Ratio	3.00	
System Control	Modulating	

22.0 Lighting

Internal

Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Heat Pump	
Percentage of Heat	100	%
Database Ref. No.	102594	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	0.0	
In Summer	0.0	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Fan Coil Units	
Flow Temperature	Normal (> 45°C)	

25.0 Main Heating 2	None

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery	No

Instantaneous System 1	
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
SAP Code	901
Immersion Only Heating Hot Water	Yes

29.0 Hot Water Cylinder	Internal Store	
Insulaon Typeą	Measured Loss	
Cylinder Volume	184.00	L
Loss	2.110	kWh/day

32.0 Photovoltaic Unit One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.66	South	Horizontal	Modest	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A6-F4&5+PV	**Issued on Date**	24/07/2020
Assessment Reference	A6-F4&5+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	88 B	**DER**	11.42	**TER**	20.72
Environmental	89 B	**% DER<TER**	44.88		
CO_2 Emissions (t/year)	1.59	**DFEE**	45.30	**TFEE**	51.16
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.46		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	North East
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2020
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	12.70 m	86.85 m²	2.80 m
1st Storey:	12.70 m	101.00 m²	2.80 m

7.0 Living Area	68.14	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	54.28	35.56
External Wall 2	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	54.38	35.56

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.90
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	21.48
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	43.51
Party Wall 4	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	15.96
Party Wall 5	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	23.30
Party Wall 6	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	86.66

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	Plasterboard, insulated flat roof	0.11	101.00	101.00

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Concrete floor slab, carpeted	86.85

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A6-F4&5-01-04	Window	[1] External Wall 1	North East	Light-coloured venean` blind	0.00					18.72	50
A6-F4&5-05-08	Window	[2] External Wall 2	North East	Light-coloured venean` blind	0.00					18.82	50

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	8.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	3
MVHR Duct Insulated	Yes
Manufacturer SFP	0.79
Duct Type	Semi rigid

MVHR Efficiency	84.00
Wet Rooms	3

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	95.98	m^2
Data Source	Manufacturer	
Cooling Type	Packaged	
Energy Efficiency Ratio	3.00	
System Control	Modulating	

22.0 Lighting

Internal

Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Description	Heat Pump	
Percentage of Heat	100	%
Database Ref. No.	102602	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	0.0	
In Summer	0.0	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Fan Coil Units	
Flow Temperature	Normal (> 45°C)	
25.0 Main Heating 2	None	

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery	No

Instantaneous System 1		
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
Immersion Only Heating Hot Water	Yes	
29.0 Hot Water Cylinder	Internal Store	
Insulaon Typeą	Measured Loss	
Cylinder Volume	184.00	L
Loss	2.110	kWh/day
32.0 Photovoltaic Unit	One Dwelling	

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.66	South	Horizontal	Modest	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A7-F4+PV	**Issued on Date**	24/07/2020
Assessment Reference	A7-F4+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	91 B	**DER**	10.59	**TER**	20.53
Environmental	92 A	**% DER<TER**	48.42		
CO_2 Emissions (t/year)	0.62	**DFEE**	31.77	**TFEE**	34.40
General Requirements Compliance	Pass	**% DFEE<TFEE**	7.65		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	15.84 m	83.05 m²	2.80 m

7.0 Living Area 46.88 m²

8.0 Thermal Mass Parameter Simple calculation - Medium

Thermal Mass 250.00 kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	73.61	44.35

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	17.81
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	16.41
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	16.41
Party Wall 4	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	19.54

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	Plasterboard, insulated flat roof	0.11	3.35	3.35

10.1 Party Ceilings

Description	Construction	Area (m²)
Party Ceilings 1	Precast concrete planks floor, screed, carpeted	79.70

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Precast concrete planks floor, screed, carpeted	83.05

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A7-F4-01	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					9.62	50
A7-F4-02	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					4.93	50
A7-F4-04	Window	[1] External Wall 1	South East	Light-coloured venean` blind	0.00					9.54	50
A7-F4-05	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					5.17	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	8.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364

Configuration	2
MVHR Duct Insulated	Yes
Manufacturer SFP	0.66
Duct Type	Semi rigid
MVHR Efficiency	85.00
Wet Rooms	2

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	59.09	m^2
Data Source	Manufacturer	
Cooling Type	Packaged	
Energy Efficiency Ratio	3.00	
System Control	Modulating	

22.0 Lighting

Internal

Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No

23.0 Electricity Tariff	Standard

24.0 Main Heating 1	Database	
Description	Heat Pump	
Percentage of Heat	100	%
Database Ref. No.	102602	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	0.0	
In Summer	0.0	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Fan Coil Units	
Flow Temperature	Normal (> 45°C)	

25.0 Main Heating 2	None

Community Heating	None

28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
Immersion Only Heating Hot Water	Yes	
29.0 Hot Water Cylinder	Internal Store	
Insulaon Typeą	Measured Loss	
Cylinder Volume	184.00	L
Loss	2.110	kWh/day
32.0 Photovoltaic Unit	One Dwelling	

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.66	South	Horizontal	Modest	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	A8-F5+PV	**Issued on Date**	24/07/2020
Assessment Reference	A8-F5+PV	**Prop Type Ref**	Flat
Property	01, Tottenham Court Road, London, London, W1T 7QZ		

SAP Rating	89 B	**DER**	12.66	**TER**	22.24
Environmental	90 B	**% DER<TER**	43.09		
CO_2 Emissions (t/year)	0.82	**DFEE**	38.82	**TFEE**	42.25
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.11		

Assessor Details	Miss Moditha Wickramaratna, Moditha Wickramaratna, Tel: 01932781641, mwickramaratna@wppgroup.co.uk	**Assessor ID**	T613-0001
Client	CO-RE, 4650		

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	South West
Property Tenure	Rented (private)
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Flat, Semi-Detached
2.0 Number of Storeys	1
3.0 Date Built	2020
4.0 Sheltered Sides	4
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	12.92 m	94.26 m²	2.80 m

7.0 Living Area	54.10	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, lled cavity, any outside structure	0.13	55.26	36.18

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall 1	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	26.91
Party Wall 2	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	44.10
Party Wall 3	Solid Wall	Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill	0.00	18.90

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Flat Roof	Plasterboard, insulated flat roof	0.11	94.26	94.26

11.1 Party Floors

Description	Construction	Area (m²)
Party Floor 1	Precast concrete planks floor, screed, carpeted	94.26

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Opening Type 1	Manufacturer	Window	Double glazed			0.60		0.90	1.30

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
A8-F5-01-04	Window	[1] External Wall 1	South West	Light-coloured venean` blind	0.00					19.08	50

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

17.0 Thermal Bridging	Default	
Y-value	0.150	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	3.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	8.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Balanced mechanical ventilation with heat recovery
MV Reference Number	500364
Configuration	1
MVHR Duct Insulated	Yes
Manufacturer SFP	0.56
Duct Type	Semi rigid
MVHR Efficiency	86.00
Wet Rooms	1

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	Yes	
Cooled Area	68.60	m²
Data Source	Manufacturer	
Cooling Type	Packaged	
Energy Efficiency Ratio	3.00	
System Control	Modulating	
22.0 Lighting		
Internal		
Total number of light fittings	30	
Total number of L.E.L. fittings	30	
Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	No	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Description	Heat Pump	
Percentage of Heat	100	%
Database Ref. No.	102602	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	0.0	
In Summer	0.0	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Fan Coil Units	
Flow Temperature	Normal (> 45°C)	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
Immersion Only Heating Hot Water	Yes	

29.0 Hot Water Cylinder	Internal Store	
Insulaon Typeą	Measured Loss	
Cylinder Volume	184.00	L
Loss	2.110	kWh/day

32.0 Photovoltaic Unit One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.66	South	Horizontal	Modest	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

None

Appendix 5 – Correspondence with Camden Council for DHN

Jeremy Holgate

Subject: FW: .2019/4361/PRE - 247 Tottenham Court Road - Decentralised Heating and Cooling Network

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From: Hazelton, Laura <Laura.Hazelton@camden.gov.uk>
Sent: 03 July 2020 16:48
To: Liam Lawson Jones <LLawsonJones@geraldeve.com>
Subject: FW: .2019/4361/PRE - 247 Tottenham Court Road - Decentralised Heating and Cooling Network

Hi Liam,

Please see the comments below re: connection to the decentralised network – futureproofing is fine.

Kind regards,

Laura Hazelton
Senior Planning Officer

Telephone: 020 7974 1017

From: Davies, James <James.Davies@camden.gov.uk>
Sent: 30 June 2020 14:28
To: Berry-Khan, Gabriel <Gabriel.Berry-Khan@camden.gov.uk>; Hazelton, Laura <Laura.Hazelton@camden.gov.uk>
Subject: RE: .2019/4361/PRE - 247 Tottenham Court Road - Decentralised Heating and Cooling Network

Hi Both,

I don't know of any networks they could connect to around there. There ae the two university ones, but they are currently deep into planning upgrades focussed on new plant as opposed to expansion.

Thanks,

James

James Davies
Sustainability Projects Manager

Telephone: 020 7974 6892

From: Berry-Khan, Gabriel <Gabriel.Berry-Khan@camden.gov.uk>
Sent: 29 June 2020 12:54
To: Hazelton, Laura <Laura.Hazelton@camden.gov.uk>
Cc: Davies, James <James.Davies@camden.gov.uk>
Subject: RE: .2019/4361/PRE - 247 Tottenham Court Road - Decentralised Heating and Cooling Network

Hi Laura
Thanks for asking the question.

They should really refer to the Camden 2015 study as the more detailed reference for our borough. Being 5 years old it does come with its own caveats.

Our internal summary of local plan guidance suggests that:

- Sites within 500m of an **existing** network should connect unless demonstrated to be unfeasible
- Sites within 1km of a **potential** network should future-proof unless demonstrated to be unfeasible.
- Developments in locations where no heat networks are planned and that are not of the size/density to benefit from connection to a network would not be expected to future-proof.

The 247 TCR site (circled orange on the map below, extract from above study) is:

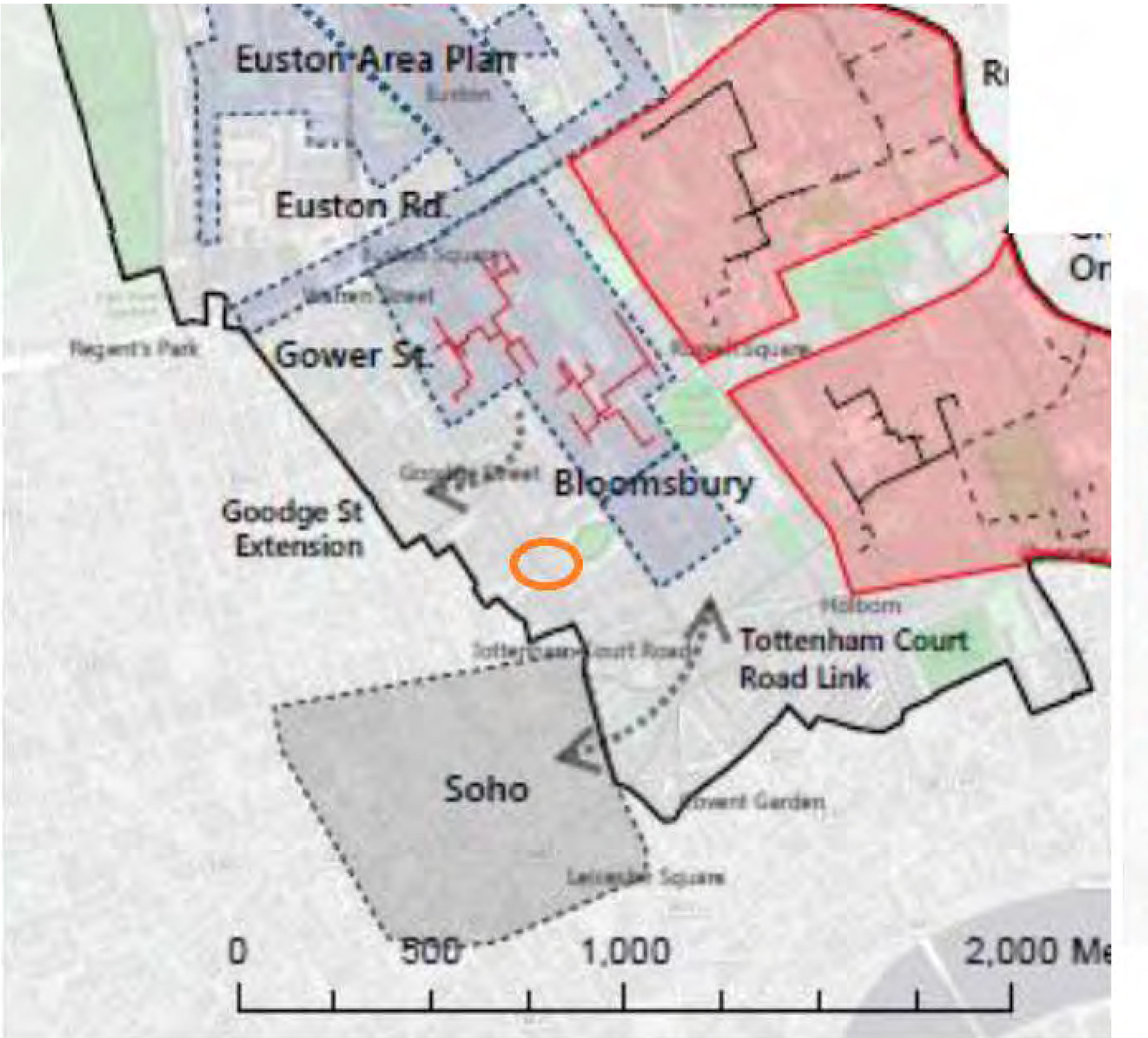
- Less than 500m from the existing Bloomsbury and Gower St networks.*
- Less than 1km from “potential” networks around Euston Road, Russell Square, Gower Street* & Soho. Also the “potential” Goodge Street and Tottenham Court Road expansion areas.

*From previous enquiries, I don’t believe either of these have capacity for new connections or any plans for expansion. I have **copied James here for confirmation – can you please advise?**. I think his comment should be sufficient to rule out need for a DEN connection.

Ideally, they should however look into the potential expansions/new networks mentioned to check if any suitable DENs are proposed. **James may be able to advise here too**.

That done, & unless James says otherwise, on balance it looks like they are correct to future-proof. Details should be secured via the standard s106 obligation and they should

- reserve space in the plant room for future heat exchanger equipment
- allow clear run for buried pipes to nearest likely street connection point.



Thanks,
Gabriel

Gabriel Berry-Khan
Senior Sustainability Officer (Planning)

Telephone: 020 7974 4550

The majority of Council staff are now working at home through remote, secure access to our systems.

Where possible please now communicate with us by telephone or email. We have limited staff in our offices to deal with post, but as most staff are homeworking due to the current situation with COVID-19, electronic communications will mean we can respond quickly.

From: Jeremy Holgate <jholgate@wppgroup.co.uk>
Sent: 24 June 2020 12:55
To: Planning <Planning@camden.gov.uk>
Cc: Mike Cousins <MCousins@wppgroup.co.uk>
Subject: 247 Tottenham Court Road - Decentralised Heating and Cooling Network

Dear Camden Planning,

To Whom it May Concern,

We are working on behalf of the building owner for the proposed redevelopment of 247 Tottenham Court Road, W1T 7QW. We are currently looking to fulfil our obligations under Camden Local Plan (paragraph 8.25) and GLA policy which requires us to investigate and demonstrate that connection to an existing or planned district heating network has been prioritised within our design.

Our investigations into existing decentralised heating and / or cooling systems has established that there are no such current open infrastructure arrangements within a reasonable distance from the proposed development site (see attached images taken from the London Heat Map). A potential network has been identified using the Heat Map, specifically on Euston Road, however this network is a considerable distance from the site and therefore is not considered within a viable distance to connect to due to the extent of infrastructure works required.

By referencing the Camden Local Plan, we are aware of the Bloomsbury Heat and Power Network managed by UCL. We will enquire directly as to any potential capacity to extend but understand it is a private network and may not be operating at conditions which would be synchronised with the systems at the proposed new development.

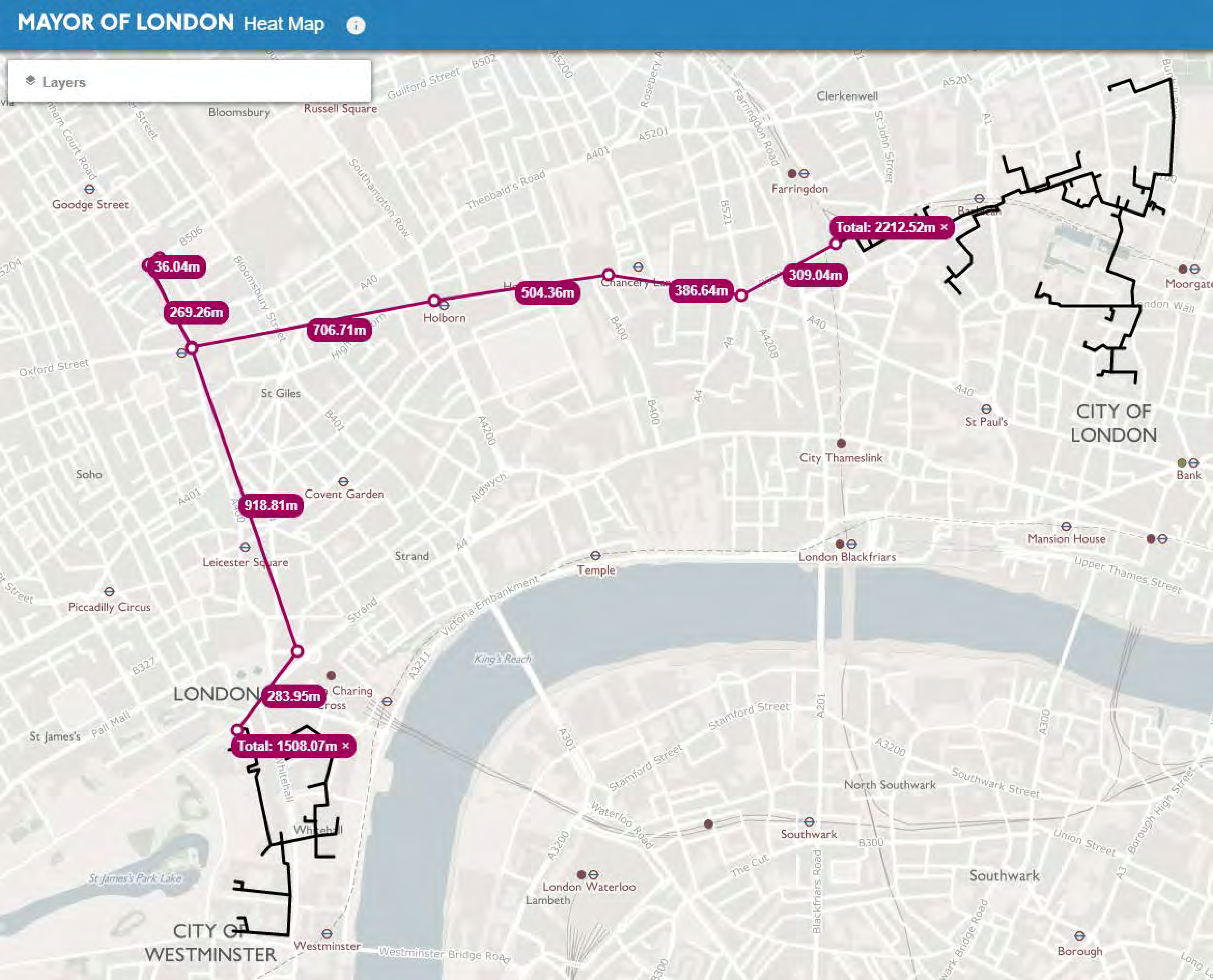
The London Heat Map has been reviewed and it is our current view that there is not a suitable decentralised energy scheme (DES) available. In this case a DHN is not a viable option for the proposed development, however the development will be future proofed such that it can connect to a district energy network in the future should one become available in close proximity.

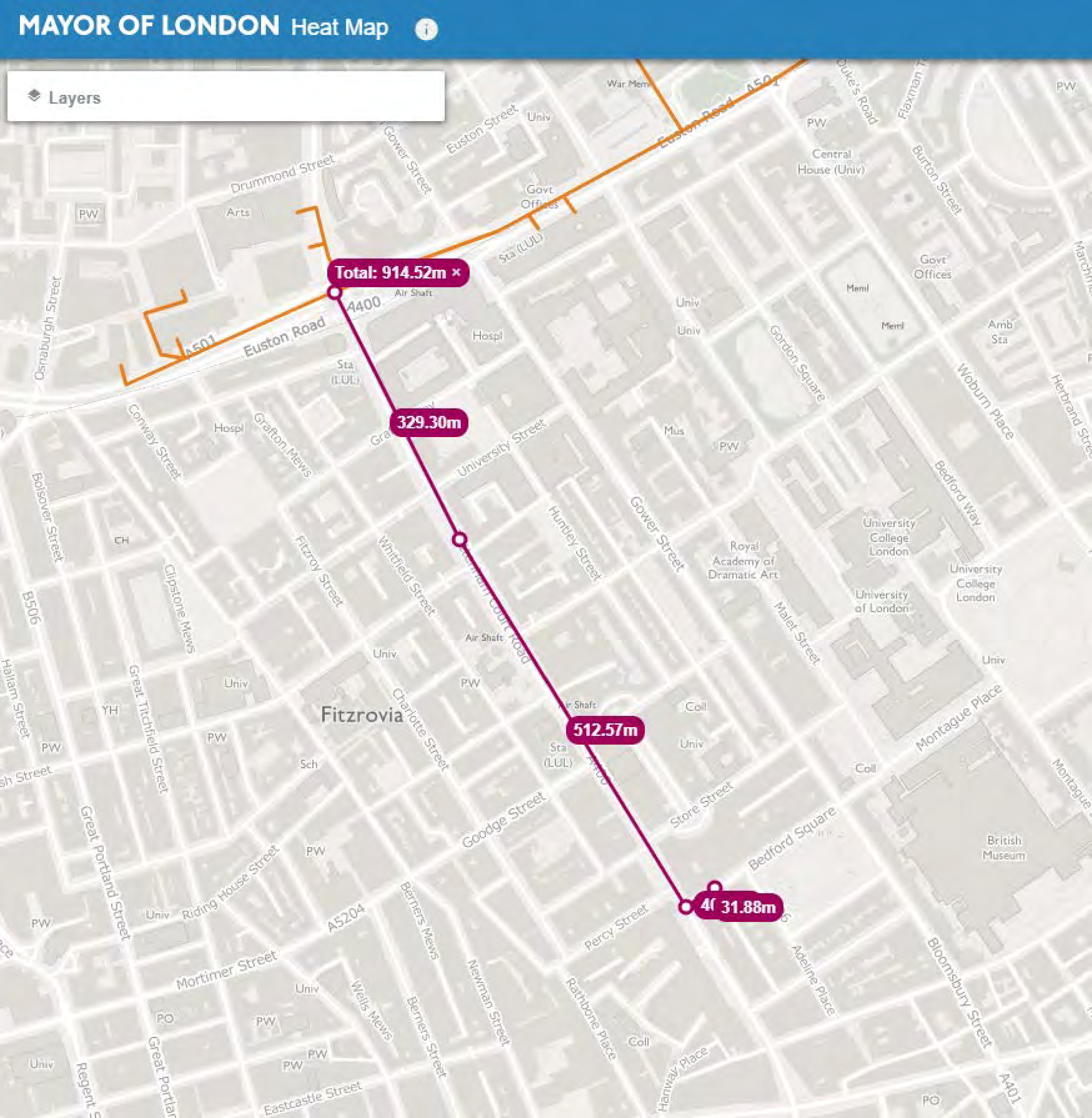
Please can you confirm that you are in agreement with the above analysis and that there are no further plans for additional district heating infrastructure above what is presently indicated on the London Heat Map.

Regards

Jeremy Holgate
Senior Sustainability Engineer
Watkins Payne

Mobile: 07801 206441
Main Office Number: 01932 781641
Website: www.watkinspayne.co.uk


MAYOR OF LONDON Heat Map
Layers
Total: 2212.52m ×
309.04m
386.64m
504.36m
706.71m
269.26m
36.04m
918.81m
283.95m
Total: 1508.07m ×
Bloomsbury
Russell Square
Clerkenwell
Farringdon
Goodge Street
Holborn
Chancery Lane
Barbican
Moorgate
St Giles
Soho
Covent Garden
Leicester Square
Piccadilly Circus
Strand
Temple
City Thameslink
St Paul's
CITY OF LONDON
Bank
Mansion House
London Blackfriars
Upper Thames Street
King's Reach
Victoria Embankment
LONDON
Charing Cross
St James's
Pall Mall
Whitehall
St James's Park Lake
CITY OF WESTMINSTER
Westminster
Westminster Bridge Road
London Waterloo
Lambeth
Southwark
North Southwark
Southwark Street
Union Street
Borough
Stamford Street
Waterloo Road
The Cut
Blackfriars Road
Oxford Street
Theobald's Road
Southampton Row
Guilford Street
Farringdon Road
St John Street
Aldwych



MAYOR OF LONDON Heat Map
Layers
Total: 914.52m
329.30m
512.57m
31.88m
Euston Road
A4400
A501
Drummond Street
Euston Street
Gower Street
Conway Street
Grafton Mews
University Street
Huntley Street
Gordon Square
Woburn Place
Bedford Way
Fitzroy Street
Whitfield Street
Charlotte Street
Clipstone Mews
Great Titchfield Street
Great Portland Street
Bolsover Street
Osnaburgh Street
Hallam Street
Malet Street
Store Street
Bedford Square
Montague Place
Goodge Street
Riding House Street
Mortimer Street
Berners Mews
Berners Street
Newman Street
Rathbone Place
Percy Street
Adeline Place
Bloomsbury Street
Hanway Place
Eastcastle Street
Wells Mews
Herbrand Street
Burton Street
Duke's Road
Fitzrovia
Royal Academy of Dramatic Art
University College London
University of London
British Museum
Central House (Univ)
Govt Offices
A5204
B506
A401

Appendix 6 – Cooling and Overheating Analysis Document – Commercial

COOLING AND OVERHEATING ANALYSIS – COMMERCIAL OFFICE

1.00 Introduction

1.01 Purpose

This document assesses the overheating risk to the commercial office accommodation and demonstrates how it attempts to comply with the new (intent to publish) London Plan Policy SI 4, Managing Heat Risk.

The commercial office area of the Proposed Development has been subjected to an overheating analysis as set out in the Draft GLA document Energy Assessment Guidance, Greater London Authority Guidance on preparing energy assessments as part of planning applications (April 2020) to assess the risk of the building overheating. The weather data used for the assessment has been taken from the CIBSE TM49 suite of data as recommended by the GLA energy strategy guidance. The assessment of the overheating criteria is based on the recommendations of the CIBSE Technical Memorandum document TM52 and the 2015 edition of the CIBSE Guide A that was published after TM52.

1.02 Proposed Development

The Proposed Development consists of demolition of the existing buildings and redevelopment to provide a ground plus 5 storeys building and two levels of basement comprising office (B1), retail (A1) and residential with associated cycle parking, landscaping and enabling works.

Five stories of office accommodation along with seven apartments are proposed with the entrance to the residential along Morwell Street.

Only the commercial office areas have been assessed for this report in order to determine the risk of overheating (assessment of the residential areas is described in Appendix 7). The servicing strategy for the commercial office accommodation which will be fitted out as follows:

Office area heating and cooling	Underfloor heating and cooling system coupled with variable refrigerant flow air source heat pumps to provide the heating and cooling requirements to the underfloor zone units
Reception & lift lobby heating and cooling	Refrigerant based fan coil units served by local air source heat pump (ASHP) installation
Core area heating	Electric panel heaters
Ventilation	Mechanical supply and extract ventilation systems with heat recovery thermal wheel to serve the office areas and basement areas. Dedicated extract systems serving the toilet accommodation, refuse area, cycle storage etc. The scheme is being future proofed with ventilation apertures adjacent to the windows to allow the commercial areas of the development to operate in mixed mode in the future when the air quality and noise along Tottenham Court Road allow.

Domestic hot water	Air source heat pump with electric immersion top-up to the commuter shower and toilets facilities
Lighting	LED lamp sources with daylight dimming and occupancy detection control

This overheating risk analysis has been carried out to assess the appropriateness of the servicing strategy and the mitigation measures.

1.03 Reservation

The thermal model assessment has been prepared for Prudential UK Real Estate Nominee 1 Limited and Prudential UK Real Estate Nominee 2 Limited only. Watkins Payne Partnership accepts no responsibility for its use by any third parties.

2.00 Cooling and Overheating

2.01 The Cooling Hierarchy

Based on the headings set out in the London Plan Policy 5.9 the passive and energy efficient design measures noted below are proposed for the development to help limit any overheating without the need for comfort cooling.

Minimising internal heat generation through energy efficient design:	Section 4.03 of this Energy Strategy summarises the energy efficient design proposed to be incorporated into the proposed development. Further information is included below.
Reducing the amount of heat entering the building in summer:	The glazing U-value is better than the Building Regulations Part L2A: 2013 minimum requirements. As shown on the BRUKL documents included in the Appendix, average U value of 1.5 W/m^2 K is proposed. The new glazing also has a low G-value, around 0.28, to reduce solar gain. In addition to this the roof and wall U values, as shown on the BRUKLs included in the Appendix are an improvement on the Building Regulations Part L2A: 2013 minimum requirements.
Use of thermal mass and high ceilings to manage the heat within the building:	The planning height and massing constraints don't allow for high ceilings however, the floor soffits will be exposed to allow a partly passive cooling strategy.
Passive ventilation:	Natural ventilation is not currently proposed however due to noise and air quality issues due to the current environment of Tottenham Court Road. However, as the current Camden Council West End project's aim is to reduce traffic on Tottenham Court Road and hence improve the air quality passive ventilation openings are being provided within the façade to facilitate the office areas of the building operating in a mixed mode scenario in the future.

Mechanical ventilation:	The office accommodation is to be mechanically ventilated. The supply and extract ventilation system will incorporate a heat recovery system between the intake and exhaust air.

2.02 Over Heating Risk Analysis

2.02.01 General

The “Testing for the presence or likelihood of overheating” criteria as set out in TM52 and the subsequent 2015 edition the CIBSE Guide A means that the overheating analysis is undertaken in two separate stages:

Stage	Operating Mode	Overheating Analysis Assessment Method
1	Free running i.e. MVHR but no mechanical comfort cooling provided	Indoor operative temperature
2	MVHR plus mechanical comfort cooling	Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD)

2.02.02 Software Utilised

The modelling software used to carry out this analysis is a product of Environmental Design Solutions Ltd (EDSL) called TAS, version 9.5. This is a dynamic simulation software which is constructed in accordance with CIBSE AM11. TAS can provide a full dynamic thermal analysis for simple or complex building HVAC systems. Using this software, it will be illustrated how the permanently occupied commercial spaces in 247 Tottenham Court Road perform against the overheating parameters, as set out in CIBSE TM52 and the subsequent 2015 edition of the CIBSE Guide A for mechanically cooled buildings.

2.03 Overheating Risk Criteria

2.03.01 Free Running Building

The TM52 overheating compliance criteria for a free running building to be regarded as not overheating is that two of the three criteria set out below need to be met for each zone assessed.

The pass / fail limits for the three criteria are summarised below:

Criterion 1	Hours of Exceedance (H_e)	The first criterion sets a limit of 3% for the number of occupied hours that the operative temperature (T_{op}) can exceed T_{max} during a typical non-heating season. T_{max} being exceeded is indicated by $\Delta T > 1K$
Criterion 2	Daily Weighted Exceedance (W_e)	The second criterion deals with the severity of overheating within any one day, which is given in terms of temperature rise and duration and sets a daily limit for acceptability. This is indicated by the weighted exceedance being less than or equal to 6

Criterion 3	Upper Limit Temperature (T_{upp})	The third criterion sets an absolute maximum acceptable temperature for a room. This is indicated by ΔT shall not exceed 4 K.

The terminology in the above table is defined as:

Operative temperature (T_{op})	The resultant hourly room air temperature calculated by the dynamic simulation software
Maximum acceptable temperature (T_{max})	T_{max} is calculated for each day from the running mean of the outdoor temperature. In accordance with Category II in BS EN 15251 T_{max} has been set at a maximum acceptable temperature of 3K above the comfort temperature.
Non-heating season	1st May to 30th September
Delta T (ΔT)	This is a simple equation where $\Delta T = T_{op} - T_{max}$

2.03.02 Mechanically Comfort Cooled Building

The TM52 overheating compliance criteria for a mechanically cooled building are as set out below in the extract from TM52.

"A mechanically cooled building should aim to provide an indoor environment where the PMV index is near to or equal to zero. According to Table 2, it will be considered as overheating if the value of the PMV index is above 0.5 (PPD ≥ 10%)."

However this criterion has been further refined in the 2015 edition of the CIBSE Guide A. The applicable extract from the 2015 CIBSE Guide A is as follows:

"A mechanically cooled building should aim to provide an indoor environment where the PMV index is near to or equal to zero. It will be considered as overheating if the value of the PMV index is above 0.5 (equivalent to a PPD of 10%).

The predicted indoor temperature or values of PMV should not exceed the tabulated values for more than 3% of occupied hours."

For heated and mechanically cooled buildings, the PMV (Predicted Mean Vote) is an index that predicts the mean votes of a large group of people on the seven-point thermal sensation scale (below) based on the heating balance of the human body. Thermal balance is obtained when the internal heat production in the body is equal to the loss of heat to the environment.

PPD (predicted percentage dissatisfied) is an index that establishes a quantitative prediction of the percentage of thermally dissatisfied people who feel too cool or too warm. For the purposes of ISO 7730, thermally dissatisfied people are those who will feel hot, warm, cool or cold.

Seven Point Thermal Sensation Scale	
3	Hot
2	Warm
1	Slightly warm
0	Neutral
-1	Slightly cool
-2	Cool

Seven Point Thermal Sensation Scale	
-3	Cold

Based on the ISO 7730 if you fall between 1 and -1 of the thermal sensation scale the occupants of the building are thermally satisfied.

The PPD results include dissatisfied people who are "slightly cool", "cool" or "cold". From an overheating perspective the occupants whose perception is that they are too cool needs to be discounted when applying the above compliance criteria.

2.03.04 Design Summer Year (DSY)

For CIBSE TM49, the GLA require overheating modelling for non-domestic developments should be conducted using the following design weather file:

- *DSY1 for the 2020s, high emissions, 50% percentile scenario.*

A further two TM49 DSY's are to be simulated using the 2020 versions, these years are as follows:

- *DSY2 -2003: a year with a very intense single warm spell.*
- *DSY3 - 1976: a year with a prolonged period of sustained warmth*

Also to take account of the urban heat island effect appropriate for the Proposed Development each of the DSY data is available for three different locations as set out below:

- *The Greater London Authority Central Activity Zone (CAZ) and other high-density urban areas (e.g. Canary Wharf): London Weather Centre data.*
- *Lower density urban and suburban areas: London Heathrow airport data.*
- *Rural and peri-urban areas around the edge of London: Gatwick Airport data.*

The location applicable to the Proposed Development is London Weather Centre.

3.00 Overheating Risk Analysis

3.01 General

In accordance with client's expectations the office accommodation is proposed to be mechanically comfort cooled. Therefore, the risk of overheating during occupied hours in these areas is minimised due to the provision of the comfort cooling.

This overheating risk analysis has been undertaken in two parts. Firstly, the initial risk analysis has been run with mechanical ventilation but without comfort cooling (the free running analysis described in paragraph 3.02) and secondly a comfort cooled analysis has been simulated (the mechanical comfort cooling analysis described in paragraph 3.03).

As with all mechanically comfort cooled buildings a slight risk of overheating still does exist if the prevailing ambient conditions are in excess of the design criteria external temperatures.

The applicable accommodation use/designation National Calculation Method (NCM) internal heat gains have been used in this Overheating Risk Analysis.

3.02 Free Running Analysis

The free running analysis has been dynamically simulated, and the subsequent associated results calculated for the office accommodation for each of the three TM49 DSY's in accordance with the recommendations of TM52. The results for each DSY are summarised in the following sub sections of this report.

Using the dynamic software, the resultant room air temperature has been calculated for each occupied hour in each room / zone for each of the three TM49 design summer years.
In addition, the running mean of the outdoor temperature (T_{rm}) has been calculated from the DSY weather data for the non-heating season, 1st May to 30th September and hence the limiting maximum acceptable temperature *(T_{max})* for the assessed rooms has been calculated.

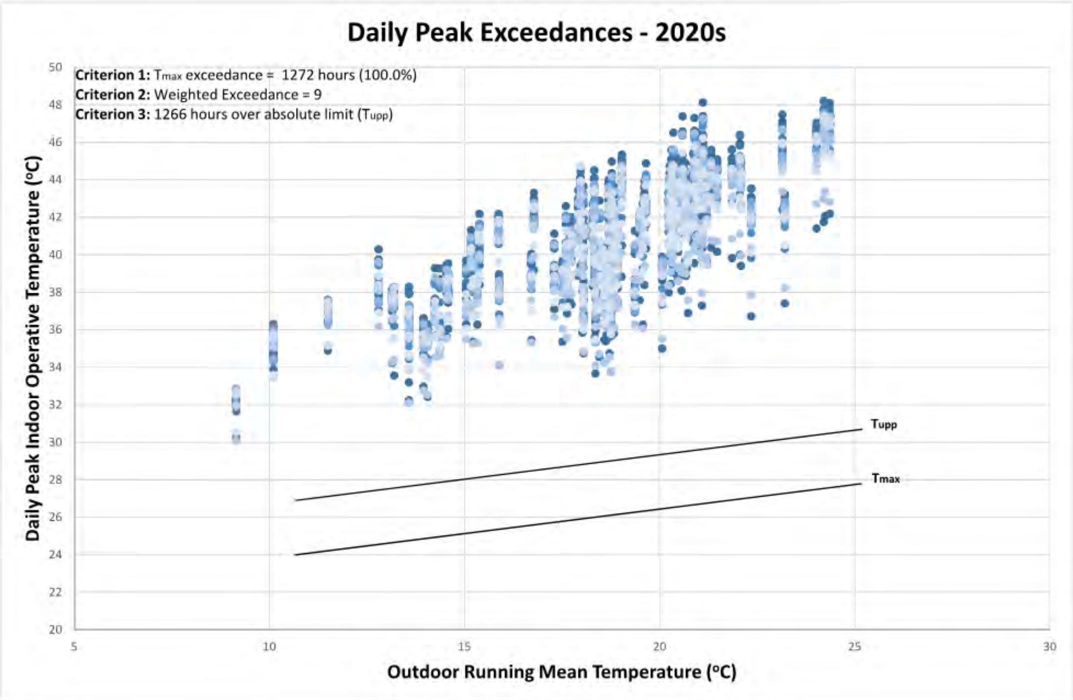
To be regarded as not at risk from overheating two of the three TM52 free running criteria must be met.

<u>Free Running Analysis - TM49 DSY1: 2020s LWC</u>

A summary of the dynamic simulation results is as follows:

TM49 DSY: 2020s LWC	
Criterion 1	ΔT > 1K during some occupied hours. The calculated resultant percentage of occupied hours where ΔT > 1K is 100.00%. The limiting value of percentage of occupied hours is 3% hence this criterion is failed.
Criterion 2	The calculated W_e is 12. The limiting value of W_e is 6 hence this criterion is failed.
Criterion 3	ΔT exceeds 4K for a total of 1266 occupied hours during the assessed summer period.
Summary	None of the 3 criteria have passed. The limiting criteria is a pass in 2 out of the 3 criteria. Hence overheating is at risk of occurring.

These results are shown graphically below:



Based on the recommendations of TM52 the office areas are shown to have a risk of overheating when operating in free running mode for the 2020s DSY.

Each zone has been shown to fail all of the 3 criteria and hence based on the recommendations of TM52 have a predicted risk of overheating during a 'moderately warm summer' when operating in free running mode for the 2020s DSY.

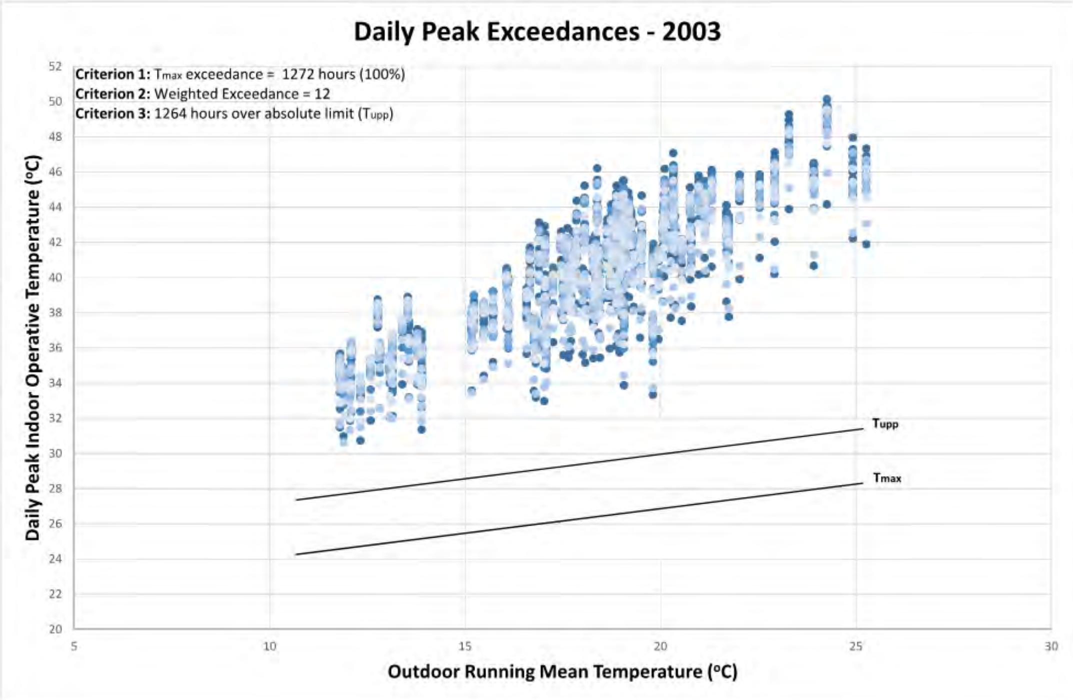
Therefore additional measures are to be employed to reduce the predicted risk of overheating. See section 4.00 of this report for further details.

<u>Free Running Analysis - TM49 DSY2: 2003 LWC</u>

A summary of the dynamic simulation results is as follows:

TM49 DSY: 2003 LWC	
Criterion 1	∆T > 1K during some occupied hours. The calculated resultant percentage of occupied hours where ∆T > 1K is 100.00%. The limiting value of percentage of occupied hours is 3% hence this criterion is failed.
Criterion 2	The calculated W_e is 12. The limiting value of W_e is 6 hence this criterion is failed.
Criterion 3	∆T exceeds 4K for a total of 1264 hours during the assessed summer period.
Summary	None of the 3 criteria have passed. The limiting criteria is a pass in 2 out of the 3 criteria. Hence overheating is at risk of occurring.

These results are shown graphically below:



Based on the recommendations of TM52 office areas are shown to have a risk of overheating when operating in free running mode for the 2003 DSY.

Each zone has been shown to fail all of the 3 criteria and hence based on the recommendations of TM52 have a predicted risk of overheating during prolonged periods of high external ambient temperature when operating in free running mode for the 2003 DSY.

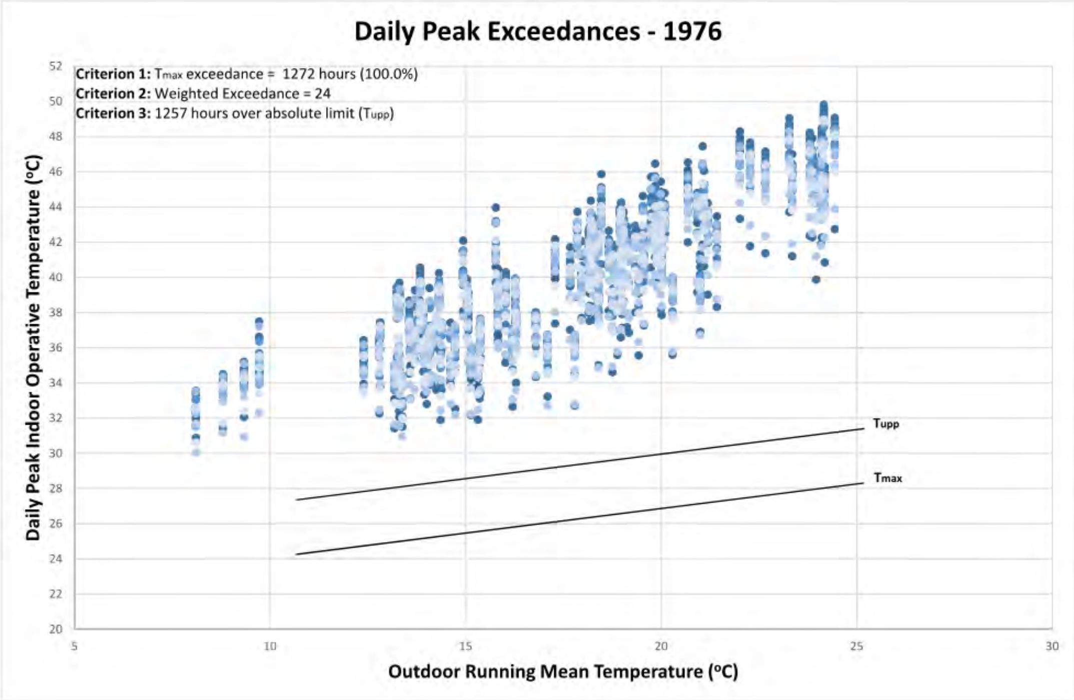
Therefore, additional measures are to be employed to reduce the predicted risk of overheating. See section 4.00 of this report for further details.

<u>Free Running Analysis - TM49 DSY3: 1976 LWC</u>

A summary of the dynamic simulation results is as follows:

TM49 DSY: 1976 LWC	
Criterion 1	ΔT > 1K during some occupied hours. The calculated resultant percentage of occupied hours where ΔT > 1K is 100.00%. The limiting value of percentage of occupied hours is 3% hence this criterion is failed.
Criterion 2	The calculated W_e is 24. The limiting value of W_e is 6 hence this criterion is failed.
Criterion 3	ΔT exceeds 4K for a total of 1257 occupied hours during the assessed summer period.
Summary	None of the 3 criteria have passed. The limiting criteria is a pass in 2 out of the 3 criteria. Hence overheating is at risk of occurring.

These results are shown graphically below:



Based on the recommendations of TM52 the office areas are shown to have a risk of overheating when operating in free running mode for the 1976 DSY.

Each zone has been shown to fail all of the 3 criteria and hence based on the recommendations of TM52 have a predicted risk of overheating during prolonged periods of high external ambient temperature when operating in free running mode for the 1976 DSY.

Therefore, additional measures are to be employed to reduce the predicted risk of overheating. See section 4.00 of this report for further details.

3.03 Mechanical Comfort Cooling Analysis

Using the dynamic software, the PMV and the PPD have been established for the office areas for each of the three TM49 design summer years.

In accordance with TM52, the building would be regarded as at risk from overheating the if the PMV index is above 5% for more than 3% of the occupied hours.

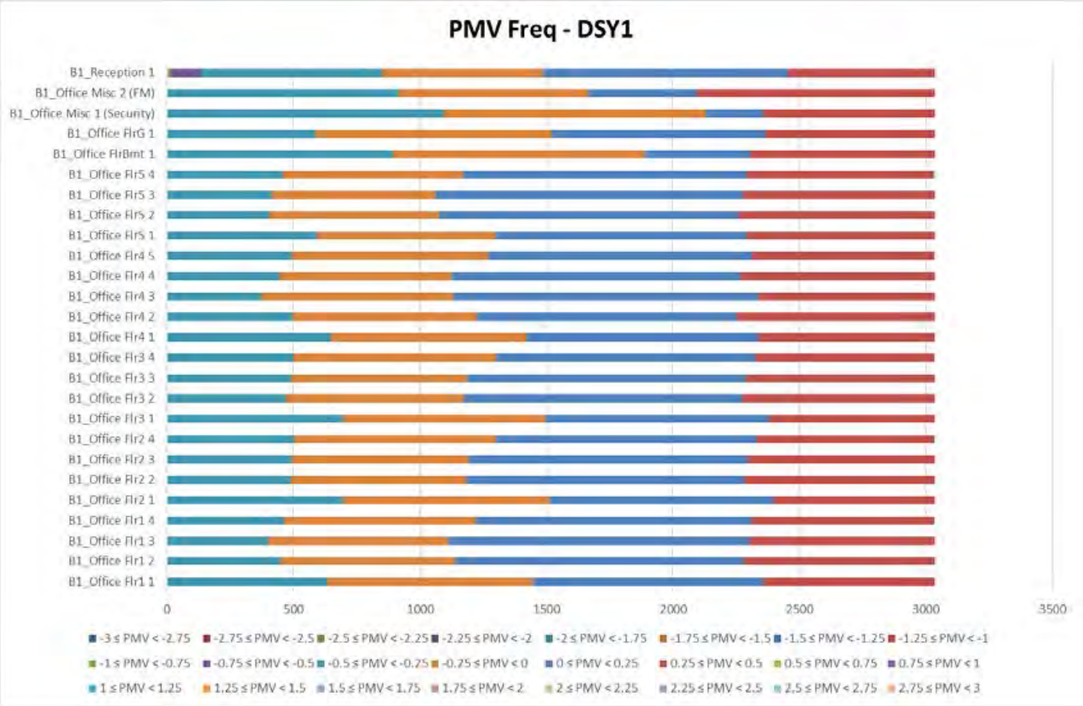
Mechanical Comfort Cooling Analysis – TM49 DSY1: 2020s LWC

The table below shows the range of the thermal sensation scale and the average hours for the year which meets the criterion.

	-3 ≤ PMV < -2.75	-2.75 ≤ PMV < -2.5	-2.5 ≤ PMV < -2.25	-2.25 ≤ PMV < -2	-2 ≤ PMV < -1.75	-1.75 ≤ PMV < -1.5	-1.5 ≤ PMV < -1.25	-1.25 ≤ PMV < -1	-1 ≤ PMV < -0.75	-0.75 ≤ PMV < -0.5	-0.5 ≤ PMV < -0.25	-0.25 ≤ PMV < 0	0 ≤ PMV < 0.25	0.25 ≤ PMV < 0.5	0.5 ≤ PMV < 0.75	0.75 ≤ PMV < 1	1 ≤ PMV < 1.25	1.25≤ PMV < 1.5	1.5 ≤ PMV < 1.75	1.75 ≤ PMV < 2	2 ≤ PMV < 2.25	2.25 ≤ PMV < 2.5	2.5 ≤ PMV < 2.75	2.75 ≤ PMV ≤ 3
Average (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	156.1	601.7	431.7	81.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	47.3	33.9	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Based on the results from a thermal comfort perspective the 100.0% of occupied hours fall between -1.0 ≤ PMV < 1.0 frequency. Therefore, based on the recommendations of ISO 7730 the occupants of the building are thermally satisfied.

This is graphically illustrated below.



The zones to the left of the graph represent how the building has been split within the thermal model.

Applying the TM52 & CIBSE Guide A 2015 issue risk of overheating criteria to the results indicates that the building is not at risk of overheating as the percentage of occupied hours that have a PMV of greater than 0.5 is 0% and is therefore below the prescribed tolerance of 3% of when a building would be regarded as overheating.

The PPD analysis results are indicated below.

	0% ≤ PPD < 10%	***10% ≤ PPD < 20%***	***20% ≤ PPD < 30%***	***30% ≤ PPD < 40%***	***40% ≤ PPD < 50%***	***50% ≤ PPD < 60%***	***60% ≤ PPD < 70%***	***70% ≤ PPD < 80%***	***80% ≤ PPD < 90%***	***90% ≤ PPD ≤ 100%***
Average (hr)	1271.3	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	99.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The results show that the office accommodation passes the TM52 criteria as the percentage of PPD greater than 10% is 0.1%.

Therefore, the mechanically comfort cooled building overheating risk analysis for the TM49 design summer year for the 2020s at the London Weather Centre indicates that the whole building is not at risk of overheating.

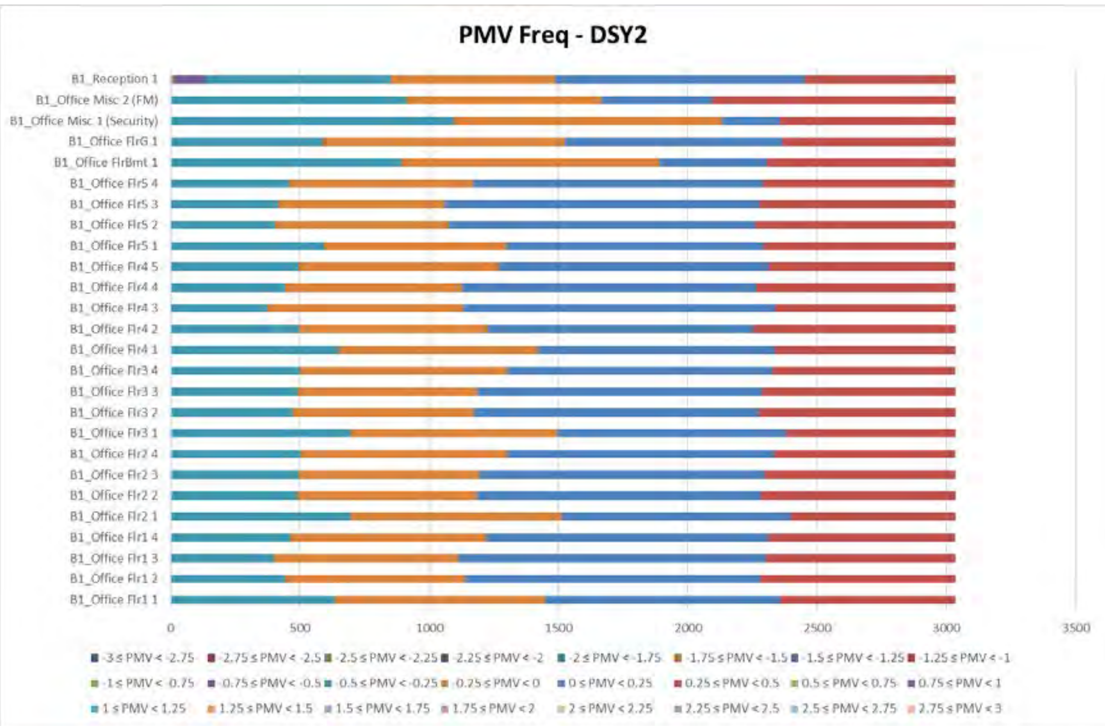
Mechanical Comfort Cooling Analysis – TM49 DSY2: 2003 LWC

The table below shows the range of the thermal sensation scale and the average hours for the year which meets the criterion.

	-3 ≤ PMV < -2.75	-2.75 ≤ PMV < -2.5	-2.5 ≤ PMV < -2.25	-2.25 ≤ PMV < -2	-2 ≤ PMV < -1.75	-1.75 ≤ PMV < -1.5	-1.5 ≤ PMV < -1.25	-1.25 ≤ PMV < -1	-1 ≤ PMV < -0.75	-0.75 ≤ PMV < -0.5	-0.5 ≤ PMV < -0.25	-0.25 ≤ PMV < 0	0 ≤ PMV < 0.25	0.25 ≤ PMV < 0.5	0.5 ≤ PMV < 0.75	0.75 ≤ PMV < 1	1 ≤ PMV < 1.25	1.25≤ PMV < 1.5	1.5 ≤ PMV < 1.75	1.75 ≤ PMV < 2	2 ≤ PMV < 2.25	2.25 ≤ PMV < 2.5	2.5 ≤ PMV < 2.75	2.75 ≤ PMV ≤ 3
Average (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	6.8	569.4	761.7	972.5	724.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	18.8	25.1	32.0	23.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Based on the results from a thermal comfort perspective the 100.0% of occupied hours fall between -1.0 ≤ PMV < 1.0 frequency. Therefore, based on the recommendations of ISO 7730 the occupants of the building are thermally satisfied.

This is graphically illustrated below.



The zones to the left of the graph represent how the building has been split within the thermal model.

Applying the TM52 & CIBSE Guide A 2015 issue risk of overheating criteria to the results indicates that the building is not at risk of overheating as the percentage of occupied hours that have a PMV of greater than 0.5 is 0.1% and is therefore below the prescribed tolerance of 3% of when a building would be regarded as overheating.

The PPD analysis results are indicated below.

	0% ≤ PPD < 10%	***10% ≤ PPD < 20%***	***20% ≤ PPD < 30%***	***30% ≤ PPD < 40%***	***40% ≤ PPD < 50%***	***50% ≤ PPD < 60%***	***60% ≤ PPD < 70%***	***70% ≤ PPD < 80%***	***80% ≤ PPD < 90%***	***90% ≤ PPD ≤ 100%***
Average (hr)	3028	8.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	99.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The results show that the office accommodation passes the TM52 criteria as the percentage of PPD greater than 10% is 0.3%.

Therefore, the mechanically comfort cooled building overheating risk analysis for the TM49 design summer year for 2003 at the London Weather Centre indicates that the whole building is not at risk of overheating.

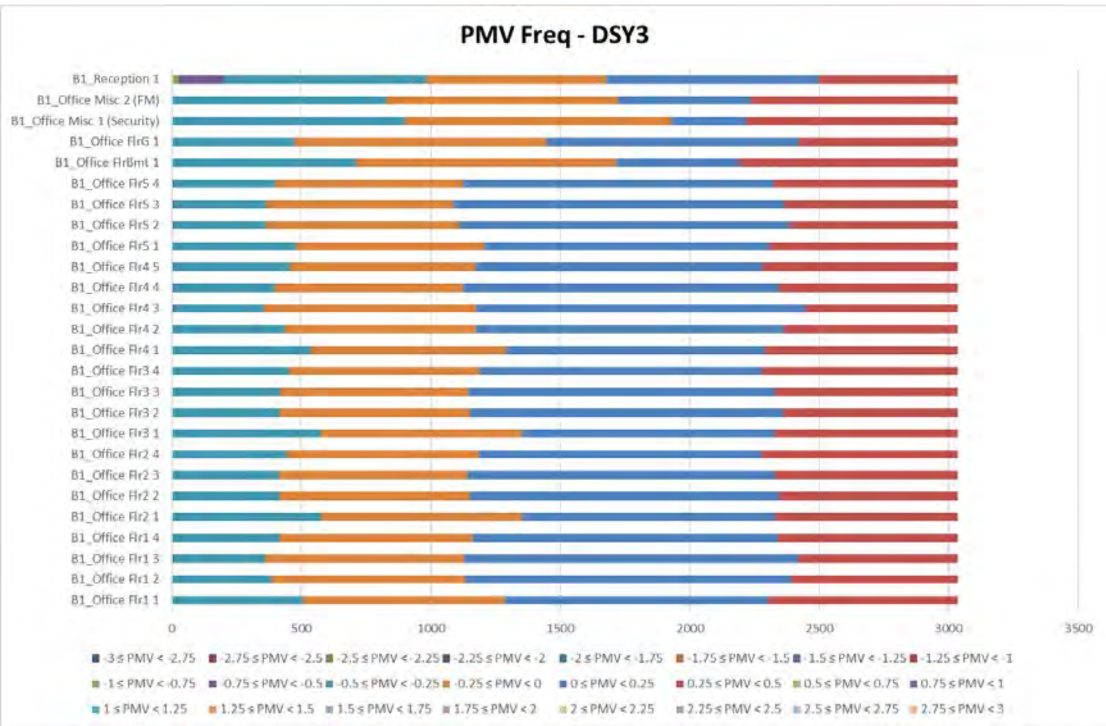
Mechanical Comfort Cooling Analysis – TM49 DSY3: 1976 LWC

The table below shows the range of the thermal sensation scale and the average hours for the year which meets the criterion.

	-3 ≤ PMV < -2.75	-2.75 ≤ PMV < -2.5	-2.5 ≤ PMV < -2.25	-2.25 ≤ PMV < -2	-2 ≤ PMV < -1.75	-1.75 ≤ PMV < -1.5	-1.5 ≤ PMV < -1.25	-1.25 ≤ PMV < -1	-1 ≤ PMV < -0.75	-0.75 ≤ PMV < -0.5	-0.5 ≤ PMV < -0.25	-0.25 ≤ PMV < 0	0 ≤ PMV < 0.25	0.25 ≤ PMV < 0.5	0.5 ≤ PMV < 0.75	0.75 ≤ PMV < 1	1 ≤ PMV < 1.25	1.25≤ PMV < 1.5	1.5 ≤ PMV < 1.75	1.75 ≤ PMV < 2	2 ≤ PMV < 2.25	2.25 ≤ PMV < 2.5	2.5 ≤ PMV < 2.75	2.75 ≤ PMV ≤ 3
Average (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	27.6	406.7	801.7	1194.1	604.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	13.4	26.4	39.3	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Based on the results from a thermal comfort perspective 100.0% of occupied hours fall between -1.0 ≤ PMV < 1.0 frequency. Therefore, based on the recommendations of ISO 7730, the occupants of the building are thermally satisfied.

This is graphically illustrated below.



The zones to the left of the graph represent how the building has been split within the thermal model.

Applying the TM52 & CIBSE Guide A 2015 edition risk of overheating criteria to the results indicates that the building is not at risk of overheating as the percentage of occupied hours that have a PMV of greater than 0.5 is 0% and is therefore below the prescribed tolerance of 3% of when a building would be regarded as overheating.

The PPD analysis results are indicated below.

	0% ≤ PPD < 10%	***10% ≤ PPD < 20%***	***20% ≤ PPD < 30%***	***30% ≤ PPD < 40%***	***40% ≤ PPD < 50%***	***50% ≤ PPD < 60%***	***60% ≤ PPD < 70%***	***70% ≤ PPD < 80%***	***80% ≤ PPD < 90%***	***90% ≤ PPD ≤ 100%***
Average (hr)	3004.6	31.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	99.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The results show that the office accommodation passes the TM52 criteria as the percentage of PPD greater than 10% is 1%.

Therefore, the mechanically comfort cooled building overheating risk analysis for the TM49 design summer year for 1976 at the London Weather Centre indicates that the whole building is not at risk of overheating.

4.00 Overheating / Thermal Comfort Strategy

The modelled scheme incorporates the following passive design features to reduce the risk of overheating:

- High performance glazing that has an average U-value of 1.5 W/m^2K and a G-value of around 0.28.
- LED lighting with daylight dimming to reduce internal casual heat gains
- Thermal mass exposed
- Good practice unregulated power loads

The proposed office building with passive design measures has been thermally modelled. The TM52 free running overheating results for each of the three TM49 design summer years indicate that each assessed zone has a risk of overheating due to failing two of the three TM52 criteria for each of the three TM49 design summer years.

To alleviate the predicted overheating the office accommodation will be provided with comfort cooling. The office accommodation passes the TM52 mechanical cooled building overheating criteria.

Therefore, the proposed comfort cooling systems to the office accommodation are appropriate for inclusion within the proposed development.

4.01 Active Cooling

The predicted cooling demand for the proposed development has been assessed against the Building Regulations Part L2A notional cooling demand as set out below.

The comparison is tabulated below:

	Area weighted average building cooling demand (MJ/m^2)
Actual Development	115
Notional Development	164

As can be seen from the above the predicted cooling demand for the office areas is less than the notional cooling demand. Hence additional passive / energy efficiency measures over and above those listed in Section 4.03 of the energy strategy report and included in the scheme are not required.

The overheating risk analysis indicates that overheating may occur within the office accommodation therefore it will be comfort cooled by an air source heat pump (ASHP) system. The plant efficiencies are set out in section 6.05 of the energy strategy report.

5.00 Conclusion

The Proposed Development has been thermally modelled to assess the risk of overheating and requirement for active cooling in accordance with the London Plan Policy.

The thermal modelling carried out in accordance with the London Plan Policy has demonstrated a risk of overheating and therefore requirement for active cooling.

This report accounts for all relevant design features and includes the anticipated building usage. Should the final design and/or use of the building differ from the described, or should the actual weather differ from the accredited weather files, then ‘out of range’ temperature may occur beyond that predicted.

Appendix 7 - Cooling and Overheating Analysis Document – Residential

COOLING AND OVERHEATING ANALYSIS – RESIDENTIAL

1.00 INTRODUCTION

1.01 Purpose

This document assesses the overheating risk to the residential accommodation and demonstrates how it attempts to comply with new (intent to publish) London Plan Policy SI4, managing heat risk.

The residential accommodation has been subjected to an overheating analysis as set out in the GLA document Energy Assessment Guidance, Greater London Authority Guidance on preparing energy assessments as part of planning applications (April 2020) to assess the risk of the building overheating. The weather data used for the assessment has been taken from the CIBSE TM49 suite of data as required by the CIBSE technical memorandum document TM59. The assessment of the overheating criteria is based on the recommendations of the CIBSE Technical Memorandum document TM59 and the 2015 edition of the CIBSE Guide A.

1.02 Proposed Development

The Proposed Development consists of demolition of the existing buildings and redevelopment to provide a ground plus 5 storeys building and two levels of basement comprising office (B1), retail (A1) and residential with associated cycle parking, landscaping and enabling works.

Five stories of office accommodation along with seven apartments are proposed with the entrance to the residential along Morwell Street.

Only the residential areas have been assessed for this report in order to determine the risk of overheating (assessment of the commercial areas is described in Appendix 6). The servicing strategy for the residential accommodation which will be fitted out as follows:

Residential heating and cooling	4 pipe fan coil units served by a central air to water heat pump installation
Core area heating	Electric heat panels
Ventilation (Mechanical)	Whole house mechanical ventilation unit with heat recovery which will extract air from the wet room and kitchen. Supply air will be to the living room and bedrooms. Windows and doors will be openable to provide natural ventilation at all times
Domestic hot water	Air to water heat pump shall provide domestic hot water and heating/cooling to the apartments.
Lighting	LED lamp sources

This overheating risk analysis has been carried out to assess the appropriateness of the servicing strategy and the mitigation measures.

1.03 Reservation

The thermal model assessment has been prepared for Prudential UK Real Estate Nominee 1 Limited and Prudential UK Real Estate Nominee 2 Limited only. Watkins Payne Partnership accepts no responsibility for its use by any third parties.

2.00 OVERHEATING RISK ANALYSIS PRINCIPLES

2.01 General

The "Design Methodology for the Assessment of Overheating in Homes" criteria as set out in TM59 is dependent on the primary ventilation strategy of the dwelling in question.

Dwellings that are predominantly naturally ventilated with no acoustic restrictions on openings and good opportunities for natural ventilation during the summer months, including dwellings that have mechanical supply and extract ventilation with heat recovery, are to be assessed utilising the adaptive method based on CIBSE TM52, as detailed in the subsequent Section 2.03.01.

Dwellings that are predominately mechanically ventilated due to natural ventilation being unfeasible, because of acoustic or air quality issues, are assessed for overheating using the fixed temperature method based on the 2015 edition of CIBSE Guide A as described in Section 2.03.02

For clarity, CIBSE TM59 supercedes TM52 for the assessment of overheating risk in dwellings. TM52 can be used to assess any type and use of building, whereas TM59 has been tailored to specifically assess the risk of overheating in dwellings. The CIBSE TM59 methodology has been derived and developed from the earlier CIBSE TM52 and as such reference to TM52 is made throughout this report.

2.02 Software Utilised

The modelling software used to carry out this analysis is a product of Environmental Design Solutions Ltd (EDSL) called TAS, version 9.5. This is a dynamic simulation software which is constructed in accordance with CIBSE AM11. TAS can provide a full dynamic thermal analysis for simple or complex building HVAC systems. Using this software it will be illustrated how the 247 Tottenham Court Road development performs against the overheating / thermal comfort parameters, as set out in CIBSE TM59 and the 2015 edition of the CIBSE Guide A.

2.03 Overheating Risk Criteria

2.03.01 Predominantly Naturally Ventilated Homes

The TM59 overheating compliance criteria for a naturally ventilated building to be regarded as not overheating is that both of the two criteria, set out below need to be met.

The pass / fail limits for the two criteria are summarised below:

Criterion (a)	Hours of Exceedance (H_e)	For living rooms, kitchens and bedrooms: the number of hours during which ΔT is greater than or equal to one degree (K) during the non-heating season shall not be more than 3% of occupied hours (CIBSE TM52 Criterion 1).
Criterion (b)	Night Time Comfort	For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26˚C for more than 1% of annual hours (1% of annual hours between 22:00 and 7:00 equates to 32 hours).

Where the following, in the above table are defined as:

Operative temperature (T_{op})	The resultant hourly room air temperature calculated by the dynamic simulation software
Non-heating season	1st May to 30th September
Delta T (ΔT)	This is a simple equation where $\Delta T = T_{op} - T_{max}$

2.03.02 Predominantly Mechanically Ventilated Homes

For homes with restricted window openings, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26˚C for more than 3% of the annual occupied hours (CIBSE Guide A (2015a)).

The above criteria for predominantly mechanically ventilated homes, is not applicable to the Tottenham Court Road development.

2.04 Design Summer Year (DSY)

Technical memorandum document TM59 requires a climate change CIBSE TM49 DSY to be simulated. Developments are required to pass the simulation using the DSY1 file for the 2020s, high emissions, 50% percentile scenario.

For developments of particular concern (e.g. vulnerable occupants are present) the more extreme DSY2 and DSY3 weather files, as well as the 2050 and 2080 files, can be used to further test the design. These are, however, not mandatory.

Also, to take account of the urban heat island effect appropriate for the Proposed Development each the DSY data is available for three different locations as set out below:

- *The Greater London Authority Central Activity Zone (CAZ) and other high density urban areas (e.g. Canary Wharf): London Weather Centre data.*
- *Lower density urban and suburban areas: London Heathrow airport data.*
- *Rural and peri-urban areas around the edge of London: Gatwick Airport data.*

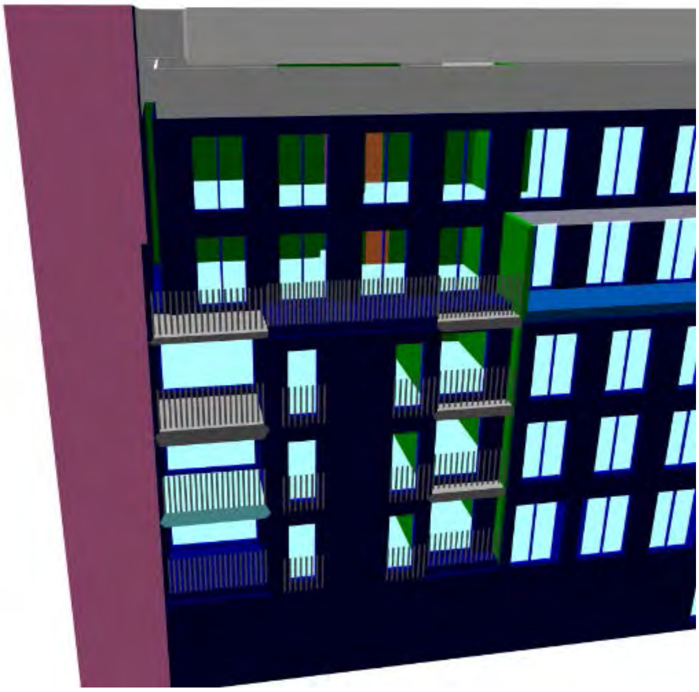
The location applicable to the Tottenham Court Road Development is London Weather Centre.

The Proposed Development is not considered to be of particular concern and as such the use of more extreme weather files is not necessary.

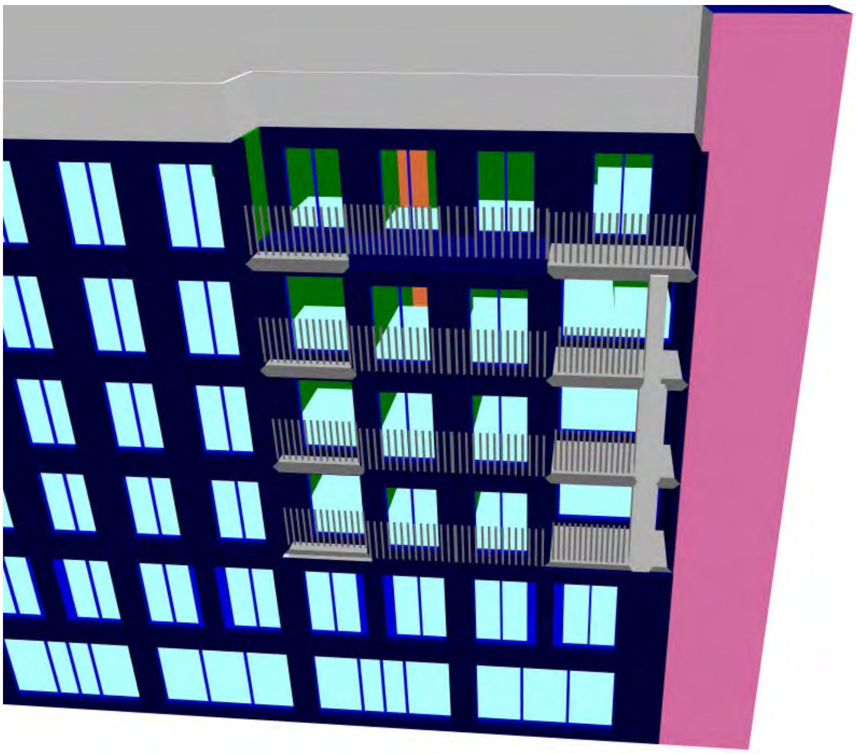
3.00 THERMAL MODEL

3.01 Site Location and Sample Apartments

The proposed development is located at 247 Tottenham Court Road, London, (Easting: 524668, Northing: 182263). The below images display the thermal model as well as floor layouts displaying the orientation of the development (the angle to north is approximately 57 degrees).

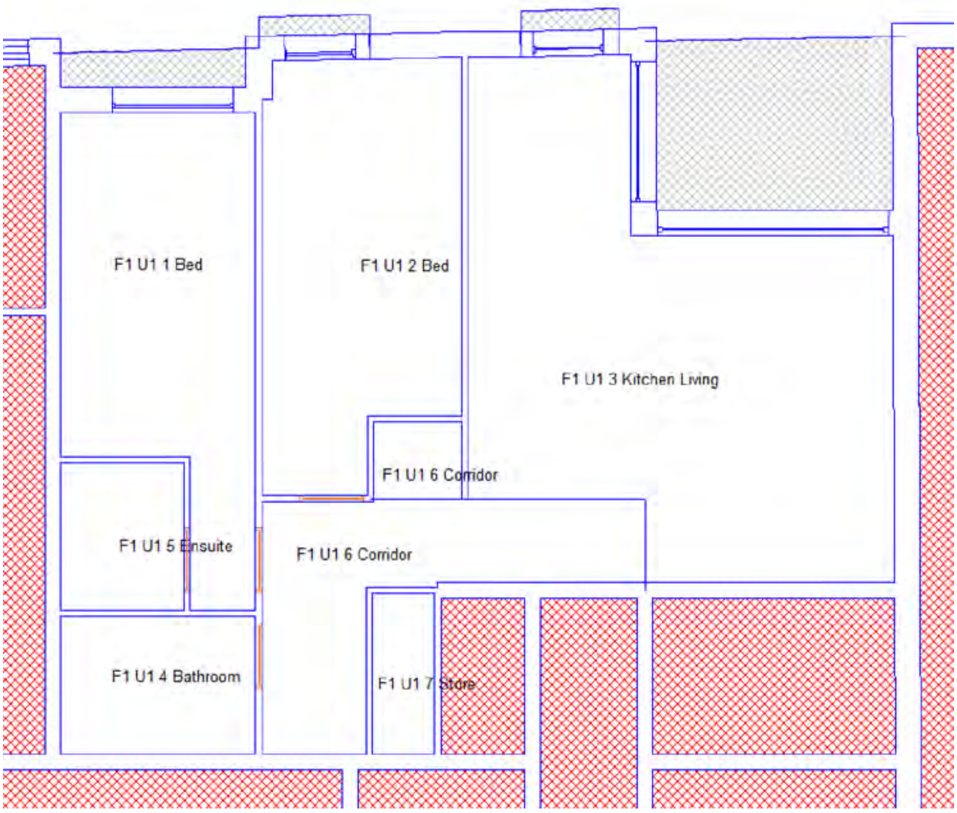


East Elevation

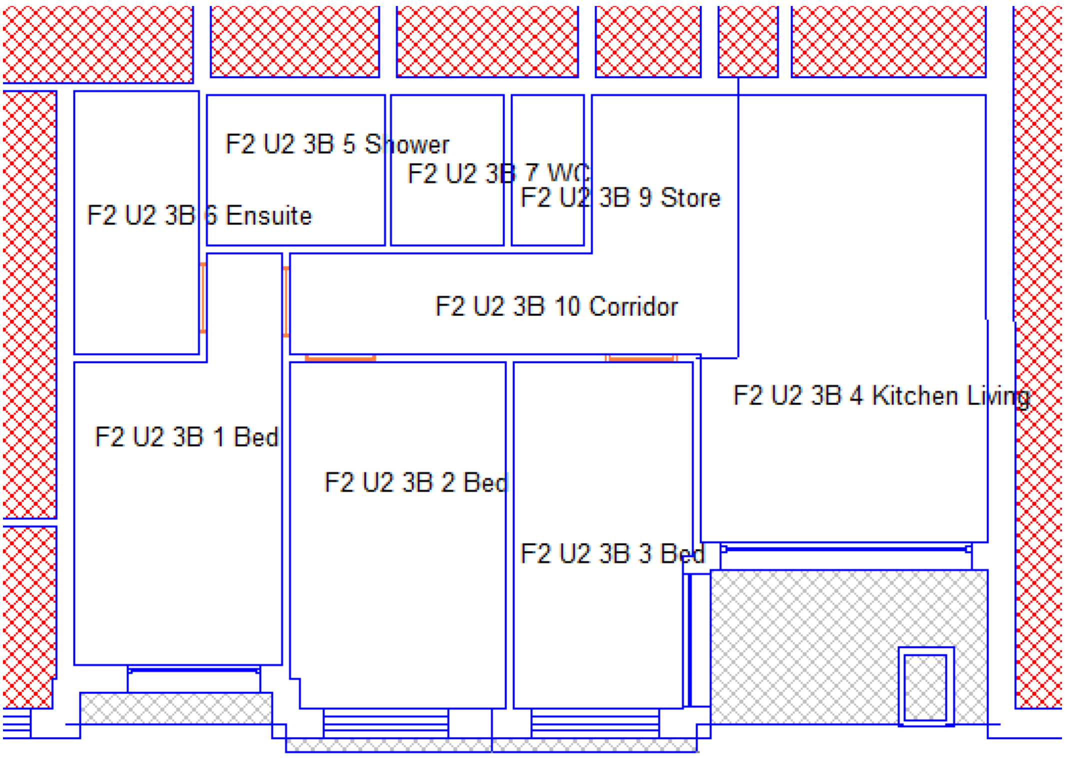


West Elevation

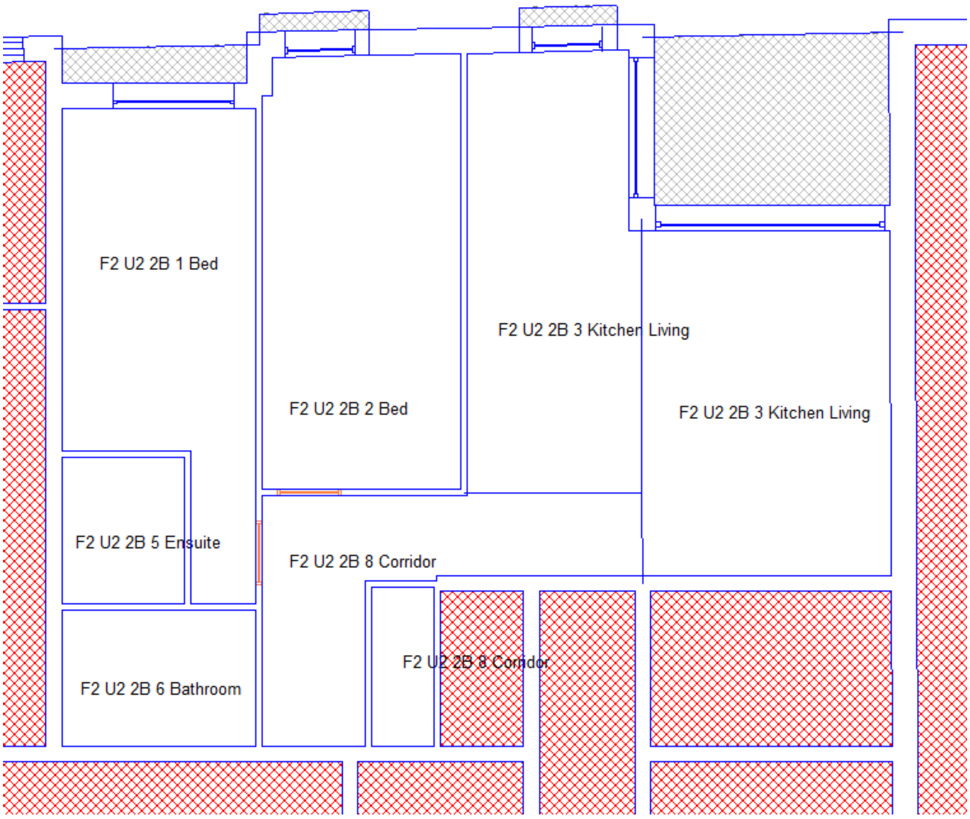
As the development features a relatively small number of apartments, all seven dwellings were assessed against the TM59 overheating criteria. Images displaying the apartment layouts on all floors are shown below.



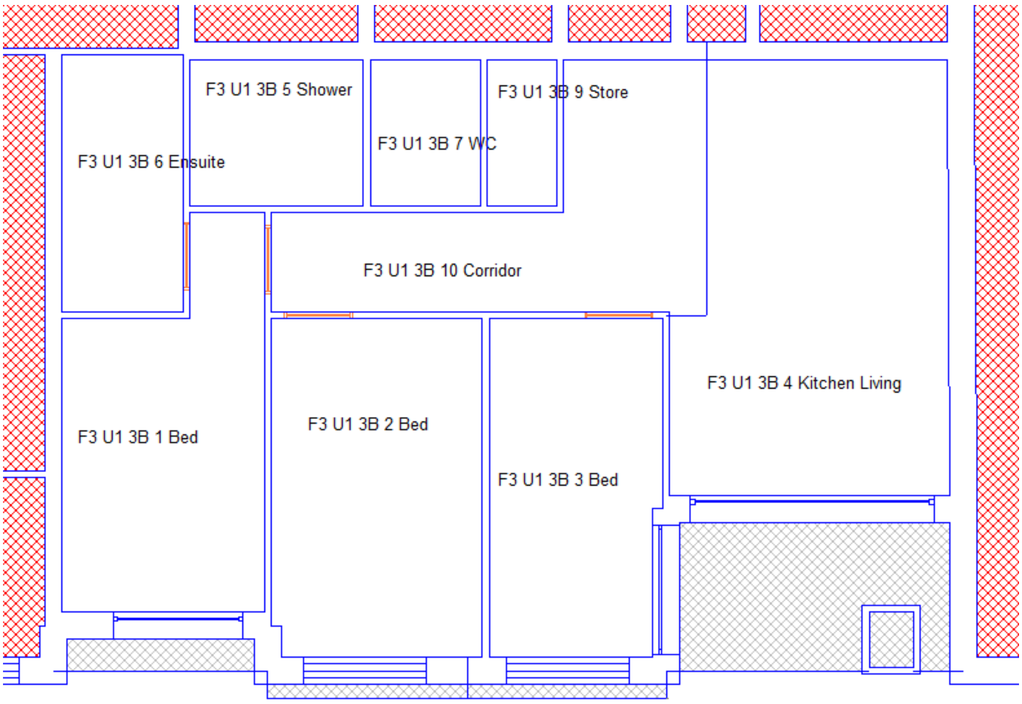
1st floor



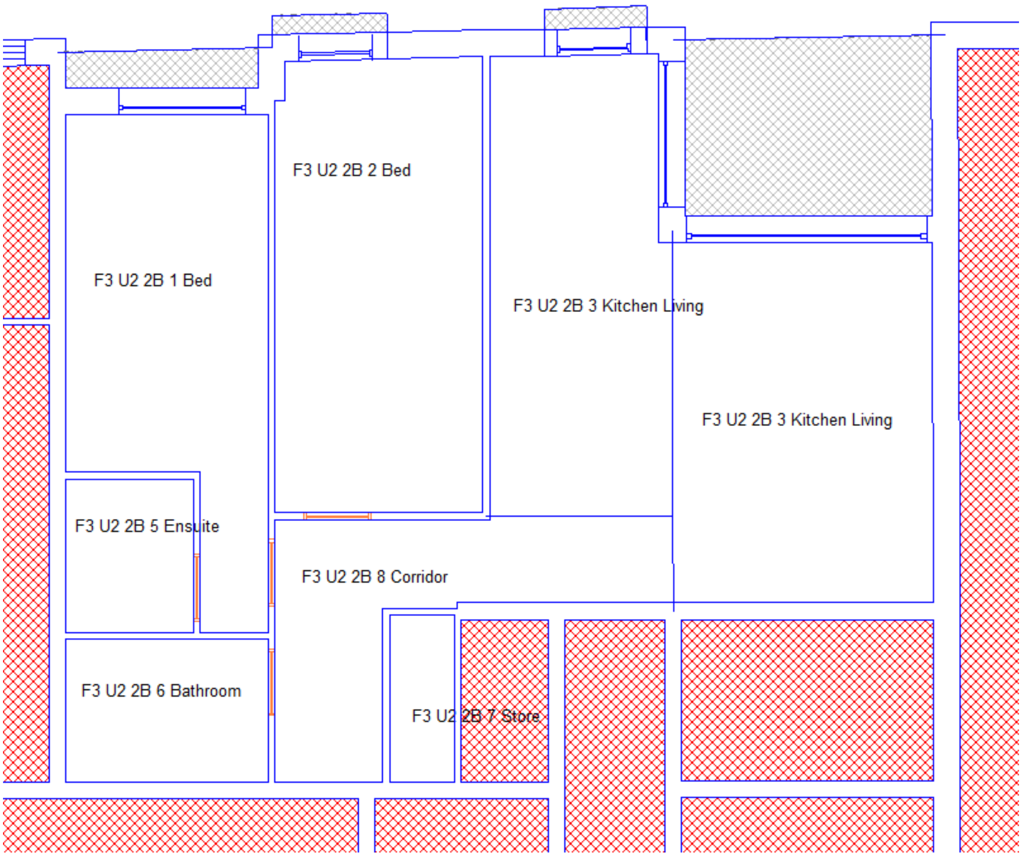
2nd floor West unit



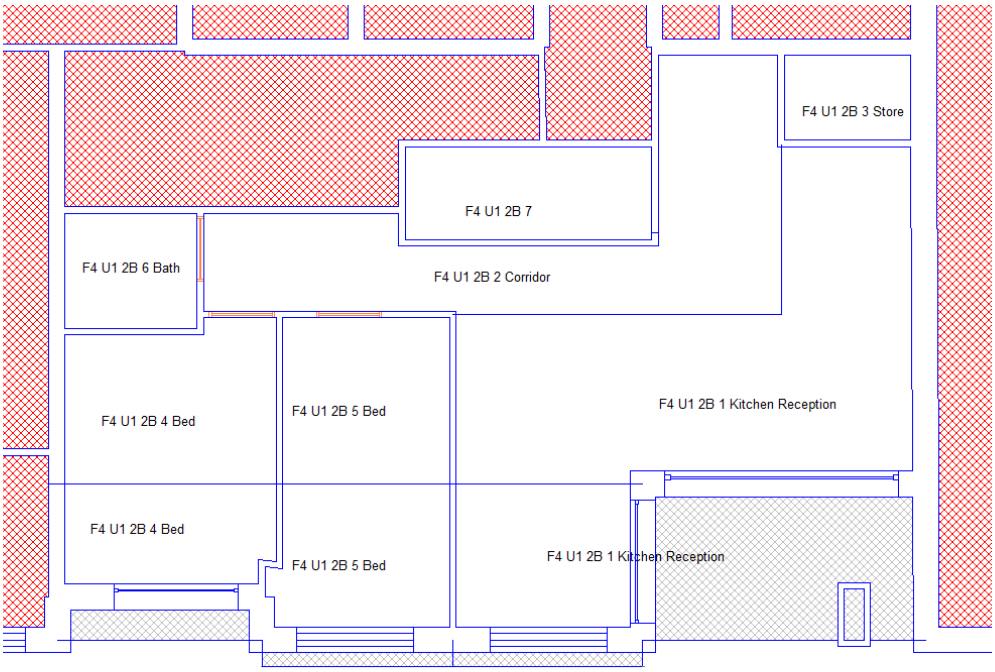
2nd floor east unit



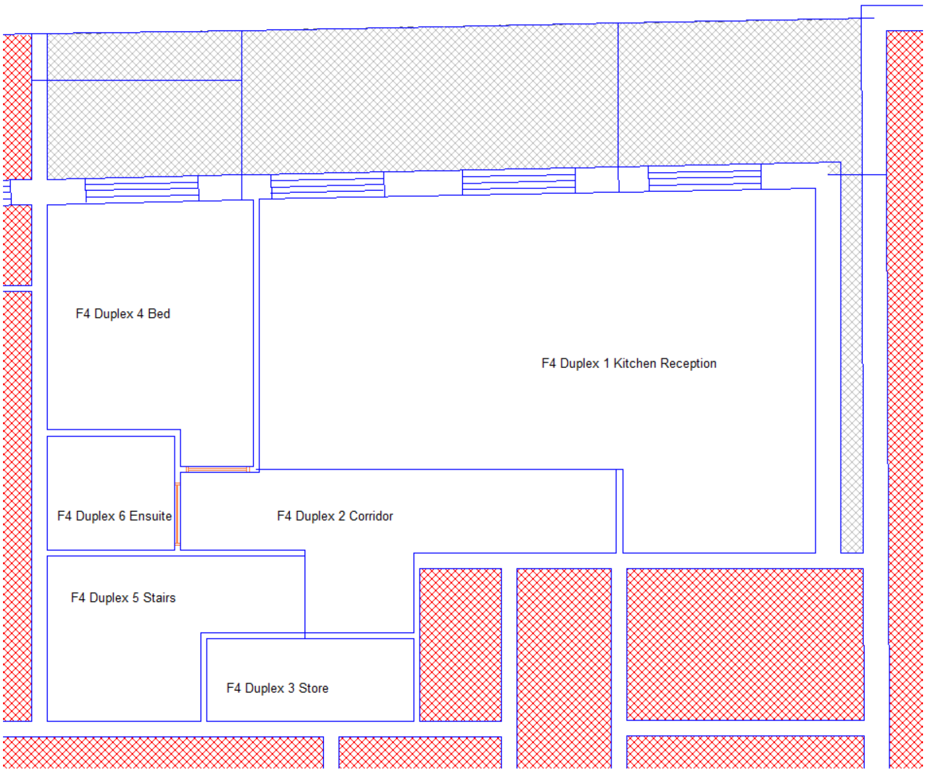
3rd floor West unit



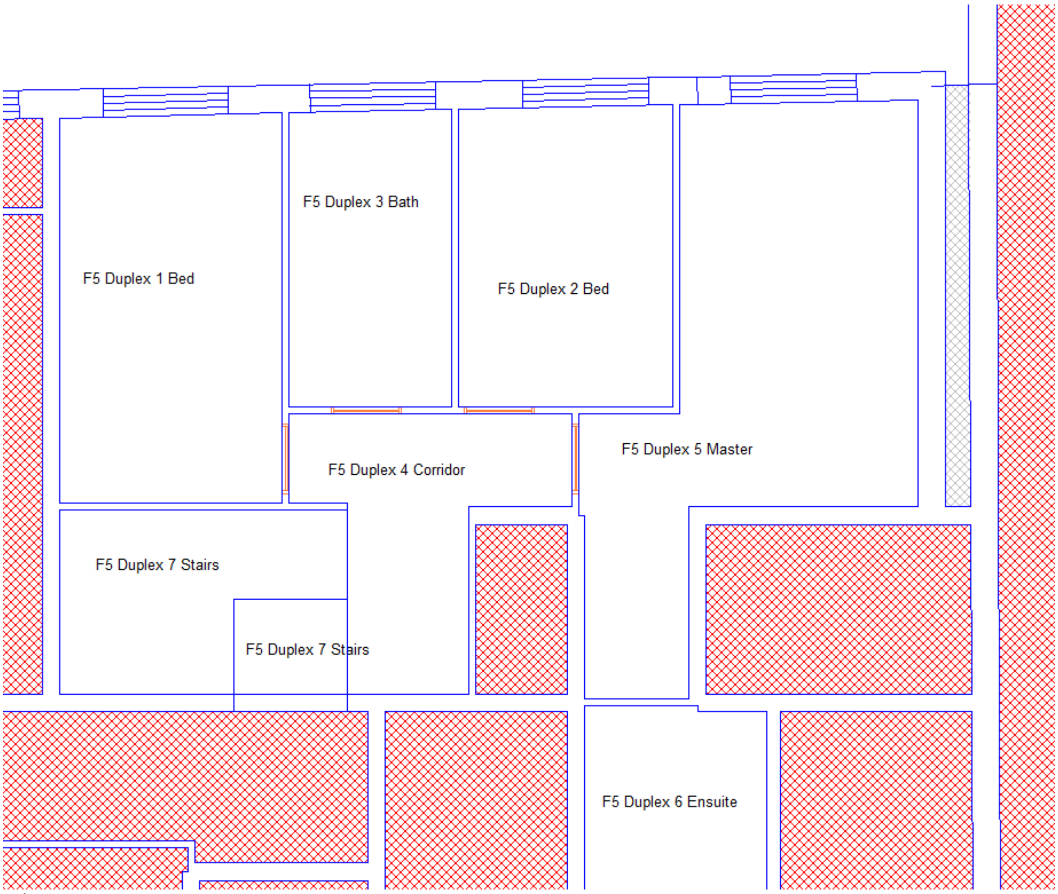
3rd floor East unit



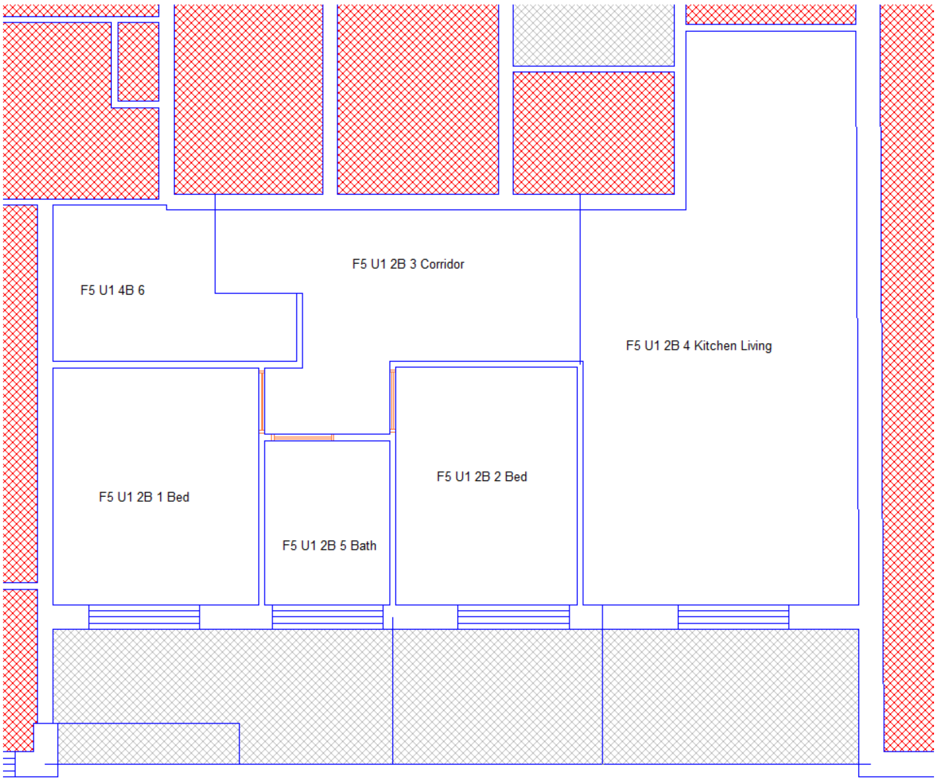
4th floor West unit



Duplex unit East lower floor



5th floor East unit



5th floor West unit

3.02 Thermal Construction Elements

The thermal performance of the construction elements utilised within the model are largely dictated and constrained by the SAP analysis and the mandatory requirements of ADL1A, namely the Fabric Energy Efficiency (FEE). The thermal properties of the construction elements have been discussed and agreed with the Architect and are tabulated below:

Fabric Element	Area Weighted U Values W/m².K
External walls	0.13
Party walls	0.00
Roof	0.11
Exposed floor slab	N/A
Side lit glazing elements	1.3 (G Value of 0.58)

The thermal model does not incorporate the use of internal or external blinds as part of the overheating risk analysis, although it is expected that internal blinds will be utilised in the final construction.

3.03 Ventilation Strategy

The residential dwellings will all feature mechanical ventilation with heat recovery (MVHR), therefore the overheating analysis has been undertaken based on a principally naturally ventilated scenario but with background mechanical air supply. Natural ventilation is achieved via a combination of openable terrace and balcony doors. The areas of the openable elements exceed the minimum requirements of Building Regulations Approved Document F for each habitable room of the development.

All variations of openings are of the side hung variety. It has been agreed with the Architect that these will all be openable to 100% of their area. The opening angle to achieve an openable area of 100% is ultimately dependent on the dimensions of the aperture in question, namely the ratio of the width to the height known as the aspect ratio. For side hung doors an opening angle of 30 degrees or greater achieves a 100% openable area for aspect ratios of 0.58 or less.

A total of two varieties of openable balcony doors have been used throughout the development, the dimensions of which can be viewed in the tables below.

Door Dimensions W x H (mm)	Aspect Ratio
1000 x 2400	0.42
1200 x 2400	0.50

The external doors were modelled to be controlled separately for each habitable room and opened when the internal dry bulb temperature exceeded 22˚C and the room was occupied, in line with the recommendations of TM59.

As none of the dwellings are located at ground floor level and there are no concerns over security, the bedroom openings were simulated to remain open during night time hours when required for comfort.

To allow cross ventilation were feasible, internal doors were incorporated into the thermal model to permit airflow between rooms. The internal doors were closed during night time hours.

The infiltration rate used in the simulation was based on an air permeability of $3m^3/hr.m^2$ equating to 0.15 air changes per hour (ACH).

3.04 Additional Information

The weather file used for the simulation was the London Heathrow DSY1, 2020s, high emissions, 50% percentile data. No additional weather files were utilised.

The applicable occupation use internal heat gains and schedules, as outlined in TM59, have been used in this overheating analysis.

Each dwelling will be served with a LTHW system to meet all heating and domestic hot water loads. As there is no communal heating system, the shared corridors have not been included as part of the analysis.

The thermal comfort category based on CIBSE TM52 used in the analysis was category II.

4.00 OVERHEATING RISK ANALYSIS

4.01 Predominantly Naturally Ventilated Analysis

The naturally ventilated analysis has been dynamically simulated and the subsequent associated results calculated for the residential accommodation for the climate change TM49 DSY in accordance with the recommendations of TM59. The results are summarised in the following sub sections of this report.

Using the dynamic software the resultant room air temperature has been calculated for each occupied hour in each room / zone for the relevant TM49 design summer year. The software does not calculate the operative temperature however TM52, and thus TM59, accepts that simulated room air temperatures from dynamic modelling software are acceptable for use in place of the operative temperature.

4.01.01 Predominantly Naturally Ventilated Analysis

To be regarded as not at risk from overheating both of the two TM59 naturally ventilated criteria, i.e. criterion (a) and criterion (b) must be met.

4.01.02 Predominantly Naturally Ventilated Analysis – Criterion (a)

A summary of the dynamic simulation results is as follows:

Zone Name	Room Use	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Result
F1 U1 1 Bed	Bedroom	3672	110	7	Pass
F1 U1 2 Bed	Bedroom	3672	110	9	Pass
F1 U1 3 Kitchen Living	Living Room / Kitchen	1989	59	5	Pass
F2 U2 2B 1 Bed	Bedroom	3672	110	11	Pass
F2 U2 2B 2 Bed	Bedroom	3672	110	9	Pass
F2 U2 2B 3 Kitchen Living	Living Room / Kitchen	1989	59	4	Pass
F2 U2 3B 1 Bed	Bedroom	3672	110	172	Fail
F2 U2 3B 2 Bed	Bedroom	3672	110	229	Fail
F2 U2 3B 3 Bed	Bedroom	3672	110	264	Fail
F2 U2 3B 4 Kitchen Living	Living Room / Kitchen	1989	59	37	Pass
F3 U1 3B 1 Bed	Bedroom	3672	110	181	Fail
F3 U1 3B 2 Bed	Bedroom	3672	110	237	Fail
F3 U1 3B 3 Bed	Bedroom	3672	110	272	Fail
F3 U1 3B 4 Kitchen Living	Living Room / Kitchen	1989	59	39	Pass
F3 U2 2B 1 Bed	Bedroom	3672	110	12	Pass
F3 U2 2B 2 Bed	Bedroom	3672	110	12	Pass
F3 U2 2B 3 Kitchen Living	Living Room / Kitchen	1989	59	7	Pass
F4 Duplex 1 Kitchen Reception	Living Room / Kitchen	1989	59	12	Pass
F4 Duplex 4 Bed	Bedroom	3672	110	18	Pass
F4 U1 2B 1 Kitchen Reception	Living Room / Kitchen	1989	59	128	Fail
F4 U1 2B 4 Bed	Bedroom	3672	110	265	Fail

Zone Name	Room Use	Occupied Summer Hours	Max. Exceedable Hours	Criterion 1: #Hours Exceeding Comfort Range	Result
F4 U1 2B 5 Bed	Bedroom	3672	110	259	Fail
F5 Duplex 1 Bed	Bedroom	3672	110	20	Pass
F5 Duplex 2 Bed	Bedroom	3672	110	28	Pass
F5 Duplex 5 Master	Bedroom	3672	110	6	Pass
F5 U1 2B 1 Bed	Bedroom	3672	110	145	Fail
F5 U1 2B 2 Bed	Bedroom	3672	110	196	Fail
F5 U1 2B 4 Kitchen Living	Living Room / Kitchen	1989	59	23	Pass

The above analysis shows that, for TM59 criteria (a), the bedroom accommodation across the Proposed Development does not satisfy the requirements on average with 118 hours exceeding the comfort criteria (the maximum allowed hours of exceedance, for bedrooms, is equal to 110 hours), equating to 3.2% of the summer occupied hours (maximum allowed percentage of exceedance = 3%).

Bedrooms of a smaller plan exhibit a slightly higher risk of overheating as the solar and fabric heat gains are distributed over a smaller volume of air, thus further raising internal temperatures relative to larger plan bedrooms. The above is exacerbated by the fact that the smaller plan bedrooms feature the same sized glazing elements as their larger plan counterparts.

In terms of the living room and kitchen accommodation across the Proposed Development, the overheating risk analysis has identified that every west-facing apartment exhibits a risk of overheating during the summer months. The average hours in which the internal temperature exceeds the comfort temperature across all apartments is 31.8 (the maximum allowed hours of exceedance for living/kitchen areas is equal to 59 hours) equating to 1.6% of summer occupied hours (maximum allowed percentage of exceedance = 3%).

The overheating performance of the living room and kitchen accommodation can be attributed to multiple factors. Firstly, living room and kitchen areas are inherently harder to achieve compliance with TM59 due to the higher occupancy and small power internal heat gains. Furthermore, for apartments which incorporate west facing glazed elements, peak solar gains coincide with peak living room/kitchen internal gains.

Given the building form, a number of measures have been incorporated into the design to help mitigate the risk of overheating. The thermal performance of the external constructions was improved as far as possible (from an overheating prospective) without failing the Fabric Energy Efficiency (FEE) which is a statutory requirement of Building Regulations. The most logical further step to improve the overheating performance of the development would be to reduce the G-value of the glazed elements, however any reduction from the simulated valve of 0.58 leads to a risk of failure on the developments Fabric Energy Efficiency.

Although some living room/kitchen areas and a number of bedrooms fail to meet the requirements of TM59 criterion (a) on an individual basis, when the figures are looked at as an average across the Proposed Development, the numbers are relatively low percentages. Additionally, as previously discussed, the dynamic thermal simulation software employed for the analysis simulates air temperature opposed to operative temperature and as such the effect of air movement on occupant comfort has not been accounted for (this would have a positive effect on the overheating performance).

	Percentage of Summer Occupied Hours Below or Equal to The Comfort Temperature Limit	
Criterion (a)	**TM59 Compliance**	**Development**
Bedrooms	3%	3.2%
Living/Kitchen Areas	3%	1.6%

4.01.02 Predominantly Naturally Ventilated Analysis – Criterion (b)

A summary of the dynamic simulation results is as follows:

Zone Name	Room Use	Annual Night Occupied Hours for Bedroom	Max Exceedable Night Hours	Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms.
F1 U1 1 Bed	Bedroom	3285	32	8
F1 U1 2 Bed	Bedroom	3285	32	7
F2 U2 2B 1 Bed	Bedroom	3285	32	9
F2 U2 2B 2 Bed	Bedroom	3285	32	7
F2 U2 3B 1 Bed	Bedroom	3285	32	16
F2 U2 3B 2 Bed	Bedroom	3285	32	13
F2 U2 3B 3 Bed	Bedroom	3285	32	12
F3 U1 3B 1 Bed	Bedroom	3285	32	16
F3 U1 3B 2 Bed	Bedroom	3285	32	13
F3 U1 3B 3 Bed	Bedroom	3285	32	12
F3 U2 2B 1 Bed	Bedroom	3285	32	9
F3 U2 2B 2 Bed	Bedroom	3285	32	8
F4 Duplex 4 Bed	Bedroom	3285	32	7
F4 U1 2B 4 Bed	Bedroom	3285	32	15
F4 U1 2B 5 Bed	Bedroom	3285	32	12
F5 Duplex 1 Bed	Bedroom	3285	32	7
F5 Duplex 2 Bed	Bedroom	3285	32	7
F5 Duplex 5 Master	Bedroom	3285	32	5
F5 U1 2B 1 Bed	Bedroom	3285	32	11
F5 U1 2B 2 Bed	Bedroom	3285	32	11

The above analysis displays that all bedrooms of the Proposed Development comply with the TM59 criterion (b). When the figures are taken as an average over the development the annual hours in which the temperature exceeds 26˚C is 10.2 (the maximum number of allowable hours is 32) which equates to 0.31% of the annual occupied hours (the maximum allowable percentage for criterion (b) is 1%).

	Percentage of Annual Occupied Night Time Hours Below 26 °C	
Criterion (b)	**TM59 Compliance**	**Development**
Bedrooms	3285	3274

A contributing factor to the relative improved performance of the bedroom accommodation is owing to the lack of security concerns during sleeping hours which allows the apertures to remain openable through the occupied night time period. However this may not always be acceptable to the occupants in this location.

Criterion (b) is arguably the most important indicator of occupant health and wellbeing as sleep deprivation can have a profound detrimental effect on an occupants psychological and physical health.

5.00 OVERHEATING / THERMAL COMFORT STRATEGY

The TM59 predominantly naturally ventilated overheating results for the residential accommodation for the TM49 climate change design summer year are summarised below:

- The bedroom accommodation across the development does not completely comply with TM59 criterion (a).
- All west-facing living room/kitchen areas exhibit a risk of overheating when assessed against criterion (a). West facing zones are most at risk of overheating as the periods of occupancy coincide with peak solar gain.
- None of the bedroom accommodation achieves compliance with TM59 criterion (b) on an individual basis.

The modelled scheme incorporates the following passive measures to help mitigate the risk of overheating:

- High performance glazing that has an area weighted U-value of 1.3 W/m²K and a G-value of 0.58.
- High performance low U-value external construction elements.
- Large openable apertures within every habitable room, openable to at least 50% of their area.
- Shading from balconies and recessed glazing to restrict some solar gain.
- Internal doors, openable during daytime hours to permit cross ventilation where possible.
- Apertures openable during the sleeping period within the bedroom accommodation.

6.00 CONCLUSION

The residential accommodation has been analysed for the overheating risk against the criteria for predominantly naturally ventilated homes in accordance with the requirements of CIBSE TM59.

The results of the analysis indicate that the bedrooms across the Proposed Development display a risk of overheating during both the occupied hours throughout the non-heating season (criterion (a)) and the annual night time occupied hours (criterion (b)). This is especially significant for west-facing rooms which will be impacted by the evening sun.

The living room/kitchen areas exhibit a risk of overheating when assessed against TM59 criterion (a).

Not one apartment type satisfies both criterion (a) and (b) for all habitable rooms.

The modelled scheme incorporates the passive measures appropriate to the development to reduce the risk of overheating. The measures include multiple fully openable apertures to each habitable room, openable internal doors to allow cross ventilation and balcony shading devices. In addition to the above the thermal properties of the glazing and external fabric have been improved as far as is possible without failing the Fabric Energy Efficiency (FEE), which is a statutory Building Regulations requirement.

Therefore, a predominantly naturally ventilated scheme is not appropriate for the development. Some mechanical cooling will be necessary to mitigate the significant risks of overheating in all areas.

This report accounts for all relevant design features and includes for the anticipated building usage. Should the final design and/or use of the building differ from the described, or should the actual weather differ from the accredited weather files, then 'out of range' temperature may occur beyond that predicted.

Appendix 8 – LZC Assessment Document

LZC ASSESSMENT DOCUMENT

1.00 Introduction

This document outlines the renewable energy sources that were considered but were deemed to be not suitable for the Proposed Development.

2.00 LZC Assessment

2.01 General

The following renewable energy technology has been considered for the Proposed Development and are not considered viable:

- Biomass
- Ground source heating and cooling
- Fuel cell

2.02 Biomass

Biomass is considered to be a renewable fuel source as the CO_2 absorbed during the growth period is assessed as being approximately equal to the CO_2 emitted during combustion and hence deemed "carbon neutral". Biomass for boilers is typically wood either in chip or pellet form.

Biomass boilers require fuel storage together with associated transportation and delivery to the store location. Biomass boilers also increase the NOx emissions when compared to gas fired boilers.

Commercial area

There is no realistic space within the Proposed Development for the following plant rooms and fuel storage that are required to accommodate a biomass boiler installation:

- Biomass fuel store

- Boiler room with space for gas fired boiler back-up
- The associated low temperature hot water heating pump room.

The Proposed Development heating and hot water strategy does not currently require these rooms and hence the proposed basement would need to considerably increased in size.

Commercial biomass boiler installations require regular fuel deliveries with direct access from the street to the fuel store. For the Proposed Development the deliveries would be from would be Morwell Street. The additional delivery vehicle traffic movements in the constraints of Morwell Street are not appropriate.

In addition, as set out in Policy 7.14 of the current London Plan, development proposals should be at least 'air quality neutral' and not lead to further deterioration of the existing poor air quality which biomass boilers will likely lead to.

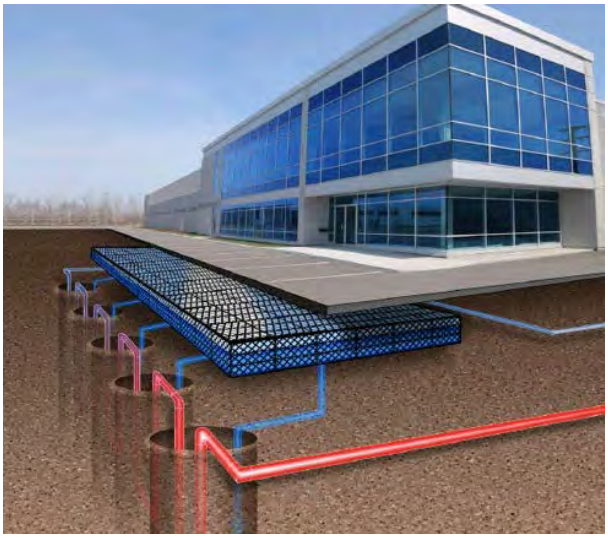
Residential Area

The reasoning stated for the commercial areas applies to the residential area.

For the reasons detailed above biomass are not considered viable for the proposed development.

2.03 Ground Source Heating and Cooling

Ground source heating and cooling systems utilise the principle during heating mode of upgrading heat from the ground to a usable temperature and during cooling mode of rejecting heat from the building into the ground. There are two primary methods utilising either open or closed loop systems.



The open loop system extracts water, typically from the chalk aquifer, and uses this water in either the heating or cooling process before rejecting this heat back to the aquifer in a separate borehole. The open loop system requires licence approval from the Environment Agency that typically has a 10 year duration.

The closed loop system dissipates heat to or extracts heat from the ground via pipework circuits that are typically inserted into vertical boreholes. These generally do not require Environment Agency licences as no extraction of water from the aquifer takes place.

Generally, for both the open and closed loop options, heat pumps are used in order to generate the heating and cooling water temperatures needed within a building.

Commercial Area

GSHPs are technically not feasible for this development for a number of reasons:

- For closed loop systems the ground source heat pump is coupled to an extensive ground loop pipework network. The ground loop solution is constrained for this development at it is a city centre site, i.e. the site footprint area is limited to the foot print size of the building. A ground loop solution is better suited to an out of town business park development where there is likely to be a larger site area made up of external car parking and landscaping areas that can accommodate the ground loop pipework.
- For open loop systems whilst the excavations of the boreholes may theoretically be technically feasible the logistics and expense make the incorporation of the scheme economically not viable. Furthermore, the London Basin Chalk Aquifer which open loop GSHPs utilise is becoming increasingly unstable for certain areas around London including in Camden where the Proposed Development is located. This is due to users not having a balanced input and output, so the aquifer varies greatly at different times of the year resulting in damaging environmental impacts.
- Studies have also shown that a lack of knowledge in the operation of ground source heat pump systems result in them not being used correctly and often switched off as a result.

For the reasons defined above the use of ground source heating and cooling is not considered feasible for the Proposed Development.

Residential Area

The reasoning stated for the commercial areas applies to the residential area.

For the reasons detailed above GSHPs are not considered viable for the proposed development.

2.04 Fuel Cell

The fuel cell technology essentially converts chemical energy into both electrical and heat energy. The cell needs to be continually supplied with hydrogen (derived from either a piped or storage source) and oxygen (derived from air) which are combined, and the chemical reaction produces electrical energy, heat energy and water vapour.

The fuel cell requires a hydrogen fuel source that can either be from a piped source (not currently available) or from stored gas. However, the more usual approach currently in the UK is to use natural gas in order to generate the hydrogen required to operate the fuel cell. This is not a sustainable solution and generates emissions that will worsen the already poor air quality of London. As previously stated, the Mayor insists on development proposals to be ‘air quality neutral’ so until a sustainable method of generating hydrogen is undertaken, this is not a feasible renewable option.

It is noted that there are initiatives to create a green gas supply network i.e. gas goes green however, due to the planning policy of being ‘air quality neutral’ the use of natural gas boiler plant connected to a low temperature hot water system, that could be converted to run on green gas in the future, has not been considered.

Fuel cells have various commercial and technical limitations. There is a high initial capital cost together with there being few established suppliers and a very limited specialist design, installation and maintenance capabilities. Certain fuel cell elements require regular replacement imposing a significant on-going cost implication. The fuel cells themselves are generally large, heavy and require fresh air ventilation.

Commercial Area

Due to the initial capital cost, space requirements and on-going maintenance costs fuel cells are not considered feasible for this development.

Residential Area

The reasoning stated for the commercial areas applies to the residential area.

For the reasons detailed above fuel cells are not considered viable for the proposed development.

Appendix 9 – GLA SAP 10 Spreadsheet

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	13	27
After energy demand reduction	13	26
After heat network / CHP	13	26
After renewable energy	9	24

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	1	5%
Savings from heat network / CHP	0	0%
Savings from renewable energy	3	24%
Cumulative on site savings	**4**	**29%**
Annual savings from off-set payment	9	-
	(Tonnes CO2)	
Cumulative savings for off-set payment	**282**	-
Cash in-lieu contribution (£)	**16,892**	

SAP10 PERFORMANCE

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	12	18
After energy demand reduction	10	16
After heat network / CHP	10	16
After renewable energy	4	11

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	2	13%
Savings from heat network / CHP	0	0%
Savings from renewable energy	6	51%
Cumulative on site savings	**8**	**64%**
Annual savings from off-set payment	4	-
	(Tonnes CO2)	
Cumulative savings for off-set payment	**126**	-
Cash in-lieu contribution (£)	**7,583**	

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	227	238
After energy demand reduction	184	238
After heat network / CHP	184	238
After renewable energy	126	238

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	43	19%
Savings from heat network / CHP	0	0%
Savings from renewable energy	58	26%
Total Cumulative Savings	**101**	**45%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**79**	-
Shortfall	-22	-653
Cash in-lieu contribution (£)	**-39,180**	-

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	111	107
After energy demand reduction	92	107
After heat network / CHP	92	107
After renewable energy	56	107

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	18	17%
Savings from heat network / CHP	0	0%
Savings from renewable energy	36	32%
Total Cumulative Savings	**54**	**49%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	39	-
Shortfall	-16	-467
Cash in-lieu contribution (£)	**-28,000**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	240		
Be lean	196	44	18%
Be clean	196	0	0%
Be green	135	61	26%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**-371**	-

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	122		
Be lean	103	20	16%
Be clean	103	0	0%
Be green	61	42	34%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**-340**	-

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxilary	Cooling	Unregulated electricity	Unregulated gas
Domestic	17	18	2	11	2	27.3	0
Non-domestic	17	61	130	107	296	381.24	0

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	43.96	38.81	12%

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	115.5480344	1062348.628
Notional	164.7152206	1514391.738

Appendix 10 – Energy Strategy Parameters

ENERGY STRATEGY PARAMETERS

1.00 Introduction

This document outlines the parameters used for the energy modelling of the Proposed Development for use with the Planning thermal models.

2.00 Thermal Model Parameters

General

- Retail unit to be modelled as shell and core

Commercial Area

Area weighted U & G values

- Roof = 0.16 W/m^{2}K
- Ground floor (basement space) U = 0.22 W/m^{2}K
- External Façade
  - Glazing-office
    U = 1.5 W/m^{2}K
    G = 0.28
    VLT = 0.6
  - Glazing-Display (Retail)
    U = 5.68 W/m^{2}K
    G = 0.82
    VLT = 0.88
  - Walls Elevation & Basement
    U = 0.23 W/m^{2}K

Air Permeability at 50 Pa - 3 m^3/hr.m^2

Lighting

- 120 lu/W efficacy in office areas
- 60 lu/W efficacy in retail space (shell only limiting value)
- 80 lu/W efficacy in other areas
- No PIR Control – (manual on / manual off) in plantrooms and reception spaces
- PIR control – auto on / auto off in circulation, office, toilet areas
- Photocell dimming in all daylit external office zones

Mechanical Ventilation

- Office Supply & Extract AHU (Heat & cool)
  - SFP: 1.9 W/l/s (1.6 + 0.3 Thermal Wheel HR)
  - HR efficiency: 75%
- Central WC Extract Fan
  - SFP: 0.5 W/l/s
  - 10 air changes per hour
- FCU Terminal Fans
  - SFP: 0.3 W/l/s

Heading

Heating

- LTHW Gas Boiler (Lean scheme only for comparison)
    - Efficiency: 91%
- Air Source Heat Pump system (Green scheme)
    - SCOP: 4.00
- No heating in central toilets and circulation areas as they are 'landlocked' with no external walls
- Electric heating in perimeter toilets and circulation

Cooling

- CHW Chiller only (Lean scheme)
    - SEER: 3.3
- Chillers & Reversible Air Source Heat Pump system (Green scheme)
    - SEER: 5.8

DHW

- LTHW Gas Boiler (Lean scheme only for comparison)
    - Efficiency: 91%
- Centralised LTHW DHW circuit (85% Air Source Heat Pump with electric top-up to 60°C (All including Basement facilities)
    - ASHP SCOP: 2.55

District Heating

The scheme currently does not assume connection to the any network.

PV

- Panel area 180m^2
- Efficiency 20%
- Orientation - Flat

Residential Area

Area weighted U & G values

- Roof = 0.11 W/m^{2}K
- Ground floor (basement space) U = 0.22 W/m^{2}K
- External Façade
    - Glazing
      U = 1.3 W/m^{2}K
      G = 0.60
    - Walls Elevation
      U = 0.13 W/m^{2}K
    - Party Walls Elevation
      U = 0.00 W/m^{2}K

Air Permeability at 50 Pa - 3 m^3/hr.m^2

Lighting

- Low energy lighting (LED)

Mechanical Ventilation

- Whole House Ventilation Unit
  - SFP: 0.66 W/l/s
  - HR efficiency: 85%

Heating

- LTHW Gas Boiler (Lean scheme only for comparison)
  - Efficiency: 90.4%
  - Emitter - Radiators
- Air Source Heat Pump system (Green scheme)
  - COP: 1.99
  - Emitter – Fan coil units

Cooling

- Split or Multi Split Unit (Lean scheme)
  - Energy Class A from SAP Defaults
  - Emitter – Fam coil units
- Air Source Heat Pump system (Green scheme)
  - EER: 3.0
  - Emitter – Fan coil units

DHW

- LTHW Gas Boiler (Lean scheme only for comparison)
  - Efficiency: 90.4%
- Centralised LTHW DHW circuit (95% Air Source Heat Pump up to 55°C
  - COP: 1.99

District Heating

The scheme currently does not assume connection to the any network.

PV

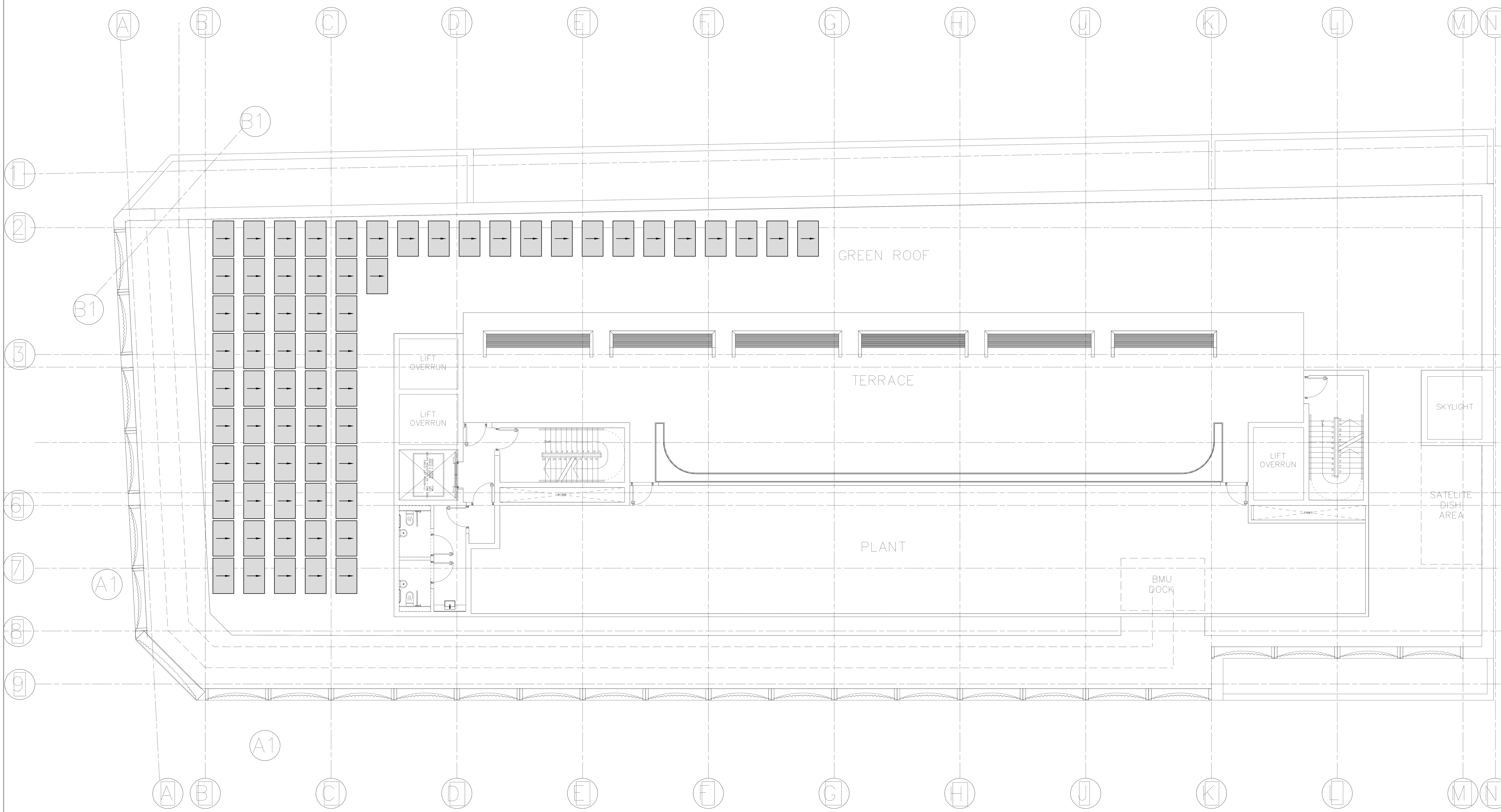
- Panel area 24m^2
- Efficiency 20%
- Orientation - Flat

3.00 Glazing Percentage

Figures below is the glazing percentage of the building, expressed as the glazed area divided by the façade area.

Office area (B1) = 43.9%
Residential area = 41.4%
D1/B1 type area = 62%
Retail area (A1) = 59.9%

Appendix 11 – PV Layout Drawing



NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE SPECIFICATION AND LEGEND DRAWING.
2. DO NOT SCALE FROM THIS DRAWING.
3. LANDLORD TARGET – 180m² OF PV / 107 No. PV PANELS
4. RESIDENTIAL TARGET – 24 No. PV PANELS
5. STANDARD PV PANEL SIZE = 1689mm x 998mm
6. FLAT ROOF MOUNTING ANGLE – 5 DEGREES
7. GREEN ROOF MOUNTING ANGLE – 15 DEGREES

Ref.	Revision	Date

PRELIMINARY

watkins payne
designed ▮ engineered ▮ focused
Watkins Payne Partnership
7/8 Conduit Street, London, W1S 2XF
51 Staines Road West, Sunbury-on-Thames, Middlesex, TW16 7AH
T: 0207 6293322 / 01932 781641
E: wpp@wppgroup.co.uk W: watkinspayne.co.uk

Client
CO-RE

Project
247 TOTTENHAM COURT ROAD

Title
PROPOSED LOW LEVEL ROOF PV LAYOUT

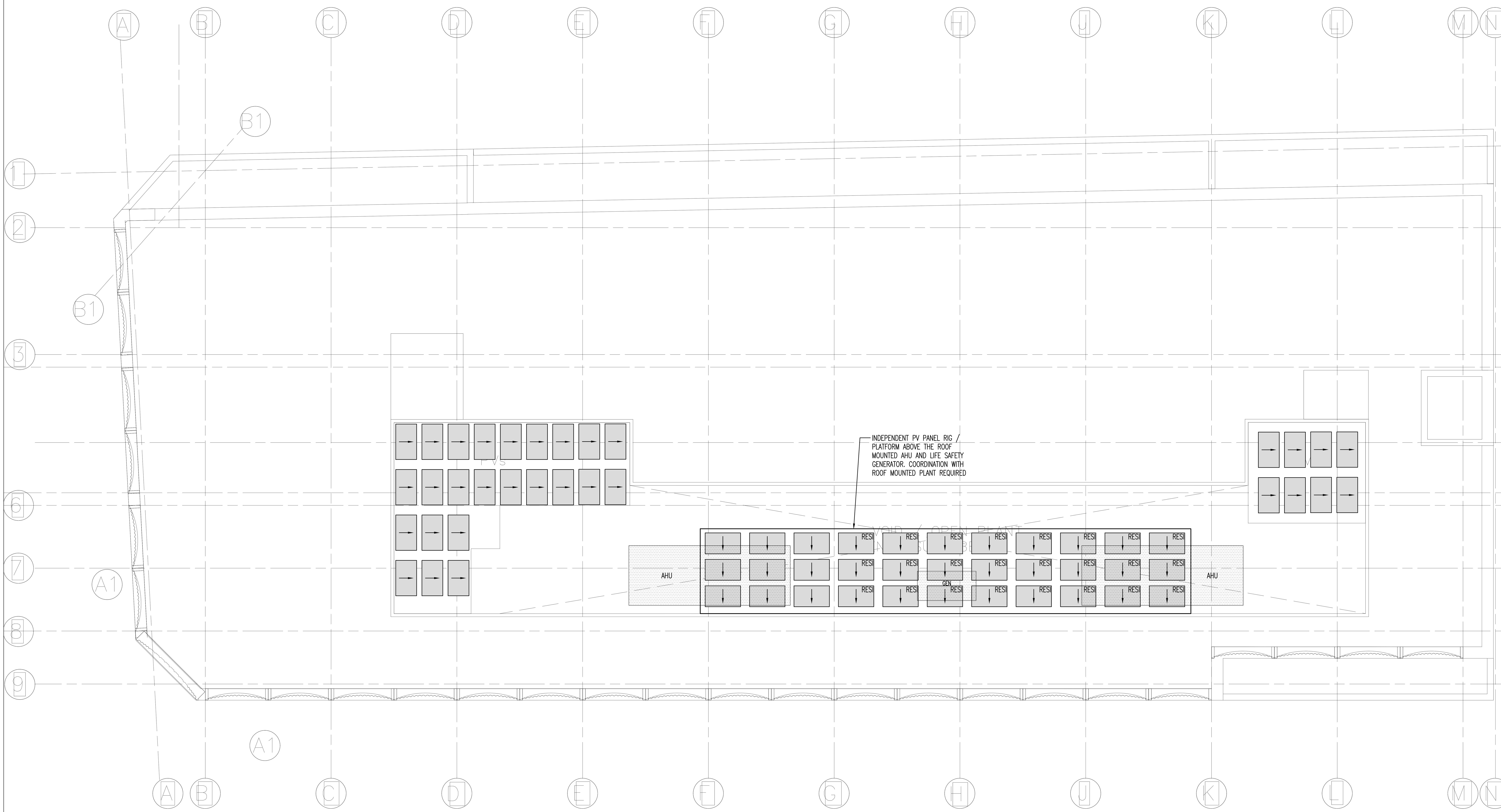
Date	JULY 2020	Scale at A1	1:100
Drawn By	JB	Validated	
Checked			

Drawing Number
4650/M/406

Revision
P1

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE SPECIFICATION AND LEGEND DRAWING.
2. DO NOT SCALE FROM THIS DRAWING.
3. LANDLORD TARGET – $180m^2$ OF PV / 107 No. PV PANELS
4. RESIDENTIAL TARGET – 24 No. PV PANELS
5. STANDARD PV PANEL SIZE = 1689mm x 998mm
6. FLAT ROOF MOUNTING ANGLE – 5 DEGREES
7. GREEN ROOF MOUNTING ANGLE – 15 DEGREES



Ref.	Revision	Date

PRELIMINARY

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Project
247 TOTTENHAM COURT ROAD

Title
PROPOSED HIGH LEVEL ROOF PV LAYOUT

Date	JULY 2020	Scale at A1	1:100
Drawn By	JB	Validated	
Checked			

Drawing Number: 4650/M/407
Revision: P1