

ENERGY STATEMENT



**175a Nightingale Lane
London
N8 7LJ**

March 2022

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Appendix 1 – Be Lean SAP Worksheets

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1.0 EXECUTIVE SUMMARY

1.1 UK Building Compliance have been appointed to undertake an Energy Statement on a proposed development in the London Borough of Haringey.

1.2 The scheme comprises of a proposed single two-storey dwelling. The proposed site is to consist of residential use (Use Class C3) to provide one end of terrace house.

1.3 This document has been produced to satisfy:

- Policy SI2 of the 2021 London Plan by providing at least a 10% improvement in regulated CO₂ over Part L of the Building Regulations 2013 through on-site measures & by following the energy hierarchy.
- Policy 5.6 of the 2020 GLA Energy Assessment Guidance by converting the above figures using the updated SAP 10 carbon emission factors.
- Policy SP4 'Working towards a Low Carbon Haringey' of the London Borough of Haringey's 2013 Spatial Strategy by providing a 25% improvement in regulated CO₂ over Part L of the Building Regulations 2013 through on-site measures.

1.4 This document details how the targets are met via:

- Passive Design Measures
- Low U-Values
- Low Air Permeability
- Air Source Heat Pump

1.5 This document has been written in adherence to the GLA Guide to Energy Statements.

2.0 POLICY FRAMEWORK

2.1 The following section outlines the relevant policy frameworks at national, regional and local level.

NATIONAL POLICIES

2.2 In March 2016, the Government confirmed its policy to limit local energy requirements and continue to support low carbon infrastructure. The Mayor has considered the Government's intentions regarding energy performance standards and its support for energy infrastructure and considers his energy targets within his energy hierarchy to be in line with this approach. It encourages developers to make carbon savings on-site, firstly through demand reduction. The remaining energy savings are met through low carbon infrastructure, either on-site or off-site.

REGIONAL POLICIES

2.3 The London Plan was updated in March 2021. A link to the new version can be found here: https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf

Policy SI2 Minimising greenhouse gas emissions;

A) Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) **be lean**: use less energy and manage demand during operation

2) **be clean**: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly

3) **be green**: maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site

4) **be seen**: monitor, verify and report on energy performance

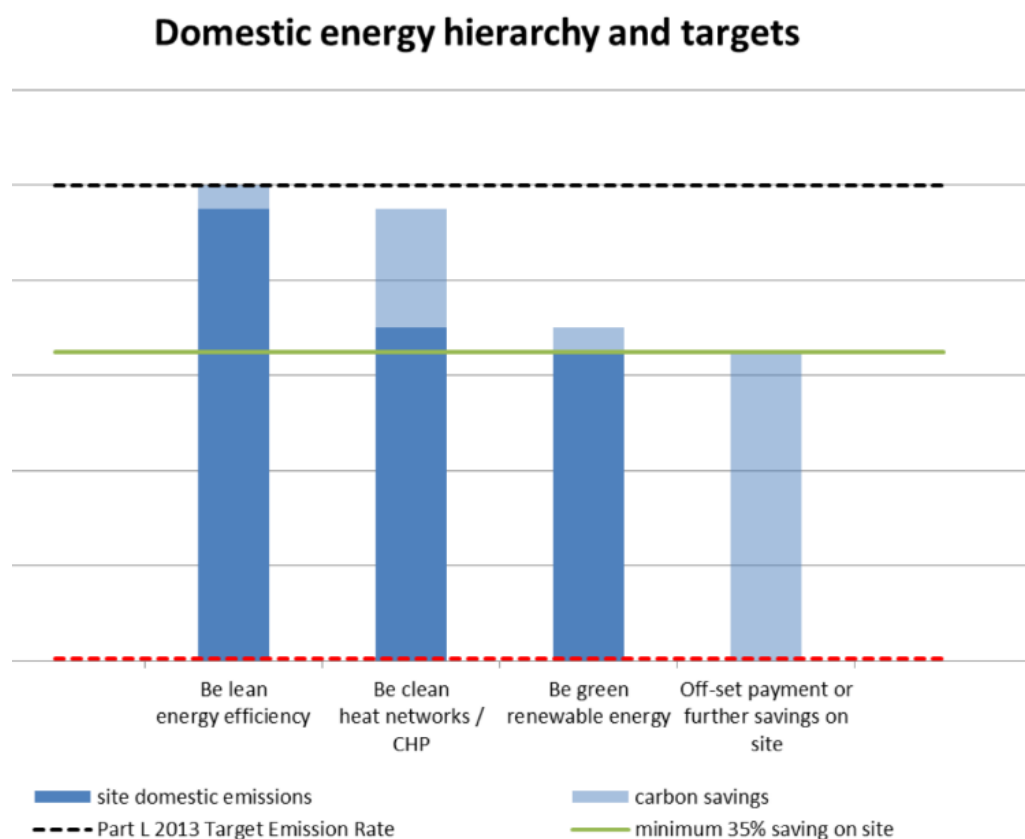
B) Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C) A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

- 1) through a cash in lieu contribution to the borough's carbon offset fund, or
 - 2) off-site provided that an alternative proposal is identified, and delivery is certain.
- D) Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.
 - E) Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.
 - F) Development proposals referable to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

2.6 To meet the zero-carbon target, an on-site reduction of at least 35 per cent beyond the baseline of Part L of the current Building Regulations is required. The minimum improvement over the Target Emission Rate (TER) will increase over a period of time in order to achieve the zero-carbon London ambition and reflect the costs of more efficient construction methods. This will be reflected in future updates to the London Plan

2.7 A visual representation of the GLA Target in relation to Building Regulations where feasible is:



2.8 GLA guidance on preparing energy assessments has been altered to request that

“Planning applicants are encouraged to use updated (SAP 10) carbon emission factors to assess the expected carbon performance of a new development. Applicants should continue to use the current Building Regulations methodology for estimating energy performance against Part L 2013 requirements (as outlined in Section 6) but with the outputs manually converted for the SAP 10 emission factors. A spreadsheet (version 1.1) has been developed for this purpose which should be submitted alongside an energy assessment. It should be noted that the use of the SAP 10 emission factors in this context is for demonstrating performance against planning policy targets and, as such, is separate to Building Regulation compliance. Applications should therefore ensure that compliance with Building Regulations is maintained.”

Source: GLA. 2020. Energy Planning - GLA Guidance on preparing energy assessments. [ONLINE] Available at: https://www.london.gov.uk/sites/default/files/gla_energy_assessment_guidance_april_2020.pdf [Accessed November 2021].

LOCAL POLICIES

2.9 Policy SP4 ‘Working towards a Low Carbon Haringey’ of the London Borough of Haringey’s 2013 Spatial Strategy states that:

Development in Haringey should be designed to ensure that it is as sustainable as possible, including taking account of:

1. In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction, and occupation, by incorporating the following measures:
 - a. From 2011 onwards, all new residential development will achieve a minimum 25% reduction in total (regulated) CO₂ emissions in line with Code for Sustainable Homes Level 4 energy standards, and should aim to achieve Level 6. All new residential development shall be zero carbon from 2016 onwards; and
 - b. From 2011 onwards all new non-residential development shall be built to at least BREEAM “very good” standard and should aim to achieve BREEAM “excellent” or the current nationally agreed standard. All new non-residential development shall be zero carbon from 2019.
2. The Council will promote low- and zero-carbon energy generation through the following measures:
 - a. Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;

- b. Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;
- c. Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks including the potential in the Upper Lee Valley Opportunity Area; and
- d. All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from onsite renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.

The London Plan targets will be followed on this development.

The Code for Sustainable Homes is no longer required for new developments.

3.0 BASELINE

3.1 SAP Calculations have been carried out on a representative sample using the Stroma FSAP Software Version 1.0.5.50 to gain the regulated emissions for the site.

Regulated Emissions are the CO₂ emissions covered under Part L of the Building Regulations and comprise of:

- a) Space Heating and Cooling
- b) Hot Water
- c) Lighting
- d) Pumps and Fans

A licensed and OCDEA accredited SAP Assessor has carried out the calculations.

Development emissions at this stage of the hierarchy are as follows:

	Regulated CO ₂ Emissions – kg of CO ₂ per m ²	SAP 10 Conversion Factor Adjusted Figures	% Improvement on TER
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	21.13	18.9	
After energy demand reduction <i>'Be Lean'</i>			
After CHP <i>'Be Clean'</i>			
After renewable energy <i>'Be Green'</i>			

4.0 BE LEAN

4.1 High energy efficiency standards are demonstrated in the table below. Construction Details have been selected to ensure that all fabric U-Values exceed the requirements of Part L of the Building Regulations (2013) and all Heating, Hot Water and Ventilation elements are in compliance with the Domestic Building Services Compliance Guide (2013). The proposed construction details for the residential units are as follows:

Elements	U Value	Development Notes
Basement/Ground Floor	0.11 w/m ² /k	e.g. 150mm Celotex
Main External Walls	0.17 w/m ² /k	e.g. 90mm Kingspan 108
Basement Walls	0.21 w/m ² /k	e.g. 100mm Dritherm 32
Flat Roof	0.14 w/m ² /k	e.g. 150mm Celotex
Windows	1.20 w/m ² /k	Argon filled 16mm
External Doors	1.00 w/m ² /k	Solid
Air Permeability	4.5m ³ /hm ² @50Pa	
Ventilation	Natural Ventilation	
Heating	Combi Gas Condensing Boilers	92.5% Efficiency
Heating Controls	Time & Temperature Zone Control	
Emitters	Radiators	
Secondary Heating	No	
Thermal Bridging	Constructive Details	
Lighting	100%	

A full sample SAP Input Data Sheet and SAP L1A Checklist can be found in Appendix 1 to verify the above inputs.

Following SAP Calculations, CO2 emissions at this stage of the hierarchy are as follows:

	Regulated CO2 Emissions – kg of CO2 per m ²	SAP 10 Conversion Factor: Adjusted Figures	% Improvement on SAP 10 adjusted TER
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	21.13	18.9	
After energy demand reduction <i>'Be Lean'</i>	21.08	18.9	0%
After CHP <i>'Be Clean'</i>			
After renewable energy <i>'Be Green'</i>			

5.0 BE CLEAN

5.1 Policy SI3 of the London Plan advises the following:

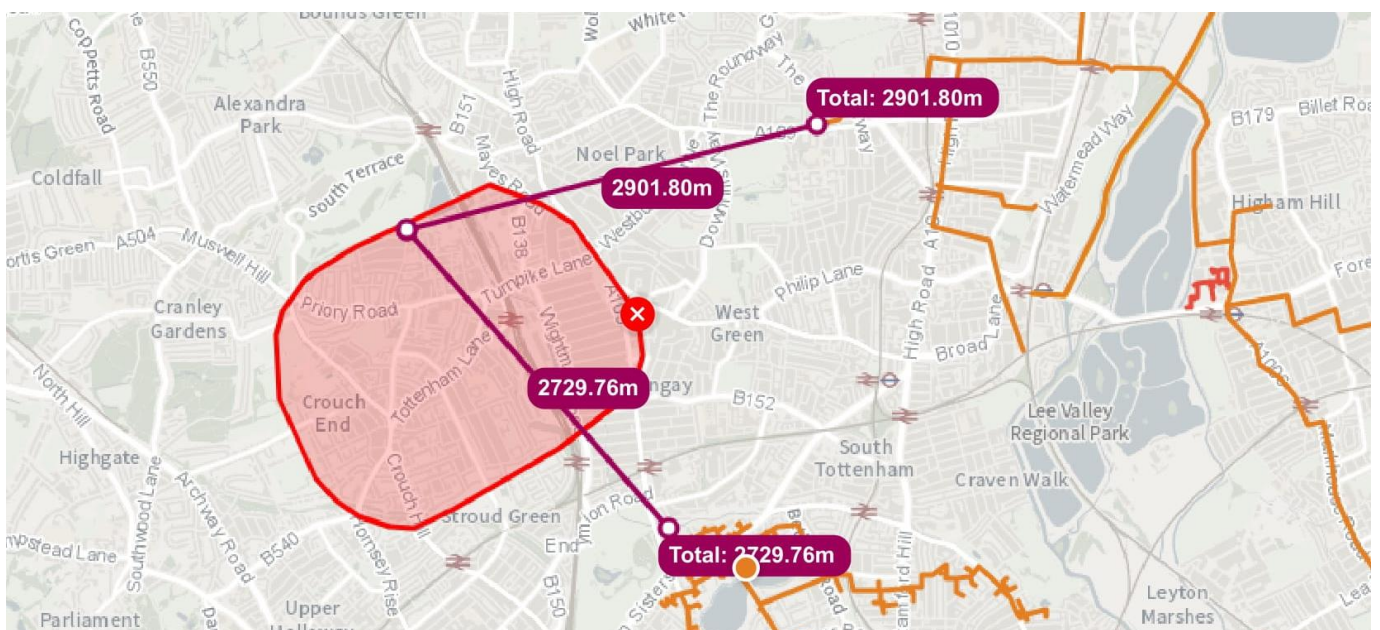
Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks;
2. Site wide CHP network;
3. Communal heating and cooling.

(Source: Mayor of London. 2021. *The London Plan March 2021*. [ONLINE] Available at: https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf)
[Accessed November 2021].

HEAT MAP

The site lies outside of any existing decentralised energy networks. There is a proposed heat network 2729m away from the site.



CONNECTION TO AREA WIDE LOW CARBON HEAT DISTRIBUTION NETWORKS

EXISTING NETWORKS

5.2 There are no existing heat networks within the site of the development. The possibility of utilising an existing area wide connection is therefore unfeasible.

PLANNED NETWORKS

5.3 There is no potential heat network within 2km of the development

5.4 It is therefore proposed that the 'Be Clean' stage of the hierarchy is bypassed due to the lack of feasible and realistic options. The remaining required reduction will therefore be met during the 'Be Green' stage of the hierarchy.

5.5 Development emissions at this stage of the hierarchy remain as follows:

	Regulated CO2 Emissions – kg of CO2 per m ²	SAP 10 Conversion Factor Adjusted Figures	% Improvement on SAP 10 adjusted TER
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	21.13	18.9	
After energy demand reduction <i>'Be Lean'</i>	21.08	18.9	0%
After CHP <i>'Be Clean'</i>	21.08	18.9	0%
After renewable energy <i>'Be Green'</i>			

Appendix 1 shows the full breakdown of:

- floor area of each dwelling and respective emission rate.
- the Target Emission Rate (TER) and Dwelling Emission Rate (DER) in terms of kg/m²/year.
- the percentage reduction of the DER over the TER.
- the CO2 saved through the proposed use of energy efficient measures.

5.7 Reductions are shown in the table below.

Elements	U Value	Development Notes
Basement/Ground Floor	0.11 w/m2/k	e.g. 150mm Celotex
Main External Walls	0.17 w/m2/k	e.g. 90mm Kingspan 108
Basement Walls	0.21 w/m2/k	e.g. 100mm Dritherm 32
Flat Roof	0.14 w/m2/k	e.g. 150mm Celotex
Windows	1.20 w/m2/k	Argon filled 16mm
External Doors	1.00 w/m2/k	Solid

Air Permeability	4.5m ³ /hm ² @50Pa	
Ventilation	Natural Ventilation	
Heating	Combi Gas Condensing Boilers	92.5% Efficiency
Heating Controls	Time & Temperature Zone Control	
Emitters	Radiators	
Secondary Heating	No	
Thermal Bridging	Constructive Details	
Lighting	100%	

5.0 BE GREEN

6.1 The potential renewable energy applicable to this development and its feasibility is investigated below:

Renewable	Advantages	Disadvantages	Feasibility
Photovoltaic Panels	Can have significant impact on carbon by offsetting electricity which has a high carbon footprint. Low maintenance. No noise issues associated with PV. No additional land use from the installation of PV panels.	High capital investment required. Needs unobstructed space on roof. Solar PV has a reduced carbon reduction effect when incorporating the new SAP 10 emission factors than it did previously.	The development incorporates a flat roof which is potentially suited to PV. There is sufficient space for a reasonable PV system. However, the roof of the neighbouring property means that the south orientation would face considerable overshadowing. The PV would therefore need to be installed on an East or West facing roof – decreasing its effectiveness.
Solar Thermal Collectors	No additional land use from the installation of solar thermal collectors. Low maintenance and easy to manage. Low capital cost. No noise issues associated with Solar thermal collectors.	Limited CO2 offset No Grants or Tariffs for new build installations.	Solar thermal collectors are feasible for the development, although it is not possible to meet the required carbon saving as the maximum demand that solar thermal collectors can be designed to meet can be no greater than 50% of the hot water demand.
Biomass Heating	Potential to reduce large component of the total CO2. A biomass boiler would replace a standard gas heating system so some of the cost may be offset through money saved on a traditional boiler.	Regular maintenance will be required. Reliability of fuel may become a problem, therefore limited cost saving for residents. A plant room and fuel store will be required which may take additional land from the proposed development or surroundings. The fuel will need to be delivered, which can cause issues with access etc.	This is a small tight site in a dense urban area. Biomass is not considered feasible for such a development due to the need for space to accommodate fuel storages, access for delivery vehicles and local NOX emissions.

Ground Source Heat Pumps	Low maintenance and easy to manage Optimum efficiency with under- floor heating systems. As heat pumps would replace standard heating systems, some of the cost may offset through money saved on a traditional boiler.	The heat pump has a noise level around 45- 60dB so some attenuation may be required and it should be sensibly located. Relatively high capital cost. Requires electricity to run the pump, therefore limited carbon savings in most cases. For communal systems plant room required which may take additional land from the proposed development/ surroundings. High payback.	Limited Space on site and large communal infrastructure needed would remove and reduce amenity space.
Air Source Heat Pumps	ASHP systems are cheaper than ground source as there is no requirement for long lengths of buried piping. Low maintenance and easy to manage. Optimum efficiency with under-floor heating systems. As heat pumps would replace standard heating systems, some of the cost may offset through money saved on a traditional boiler.	The heat pump has a noise level around 50- 60dB so some attenuation may be required, and it should be sensibly located. The potential noise from the external unit may mean there is local opposition to their installation. Requires electricity to run the pump, therefore limited carbon savings in most cases. For communal systems, plant room is required which may take additional land from the proposed development/surroundings Potential noise issues.	This option is deemed the most appropriate. There would be space for the outdoor wall units to be fitted. This option previously did not meet a 25% reduction alone, but under the new SAP 10 figures – it becomes more favourable. This is due to the significant carbon emission reduction associated with the updated national grid figures.

6.2 The 25% offset has not been achieved without the need for the above renewable technologies.

6.3 The required reduction is to be achieved with the provision of an Air Source Heat Pump. Reductions are shown in the table below.

Elements	U Value	Development Notes
Basement/Ground Floor	0.11 w/m2/k	e.g. 150mm Celotex
Main External Walls	0.17 w/m2/k	e.g. 90mm Kingspan 108
Basement Walls	0.21 w/m2/k	e.g. 100mm Dritherm 32
Flat Roof	0.14 w/m2/k	e.g. 150mm Celotex
Windows	1.20 w/m2/k	Argon filled 16mm

External Doors	1.00 w/m2/k	Solid
Air Permeability	4.5m ³ /hm ² @50Pa	
Ventilation	Natural Ventilation	
Space Heating/Water Heating	Air Source Heat Pump	
Heating Controls	Time & Temperature Zone Control	
Emitters	Radiators	
Secondary Heating	No	
Thermal Bridging	Constructive Details	
Lighting	100%	

6.3 Development emissions at this stage of the hierarchy are as follows:

	Regulated CO2 Emissions – kg of CO2 per m ²	SAP 10 Conversion Factor: Adjusted Figures	% Improvement on SAP 10 adjusted TER
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	21.13	18.09	
After energy demand reduction <i>'Be Lean'</i>	21.08	18.9	0%
After CHP <i>'Be Clean'</i>	21.08	18.9	0%
After renewable energy <i>'Be Green'</i>	25.63	11.5	39.15%

Appendix 2 shows the full breakdown of:

- floor area of each dwelling and respective emission rate.
- the Dwelling Emission Rate (DER) in terms of kg/m²/year.
- the CO2 saved through the proposed use of energy efficient measures.

7.0 COOLING AND OVERHEATING

THE COOLING HIERARCHY

7.1 Pursuant with Policy 5.9 of the London Plan the following measures have been investigated:

Cooling Hierarchy	Measures Undertaken
1. Minimising internal heat generation through energy efficient design	Individual heating means the associated heat loss associated with communal heat pipes will not apply to this project.
2. Reducing the amount of heat entering the building in summer	Carefully designed shading measures have been considered, including: Specification of blinds.
3. Use of thermal mass and high ceilings to manage the heat within the building	Level of exposed thermal mass has been maximised to help to absorb excess heat within the building.
4. Passive Ventilation	The use of: Openable windows, Dual aspect units, Designing in the 'stack effect.
5. Mechanical Ventilation	N/A

OVERHEATING RISK ANALYSIS

7.2 Criterion 3 of Part L 2013 of the Building Regulations relates to limiting the effects of heat gains in summer - this is implemented for new dwellings as set out in Appendix P of SAP 2012.

The project passes this criterion.

However, the Building Regulations recognises that Criterion 3 does not cover all factors influencing overheating and that there is no guarantee that buildings will not overheat.

7.3 CIBSE Guide A – Environmental Design (2015) is the reference standard for overheating in the GLA SPG on Sustainability and the current industry standard amongst other CIBSE guides such as CIBSE TM52 “The Limits of Thermal Comfort: Avoiding Overheating in European Buildings” (2013). These set out guidelines on the number of hours a dwelling should not exceed a certain temperature.

7.4 The risk of summertime overheating has been assessed as ‘slight’.

8.0 CARBON OFFSETTING

8.1 For schemes submitted from 1 October 2016, policy SI2 of the London Plan requires proposals to achieve Zero Carbon for residential development. The on-site target remains at 25% carbon improvement with the remaining improvement through to zero to be met via a contribution to the local Borough's carbon offset fund.

8.2 The scheme achieves a CO2 reduction of 39.15% through on-site measures.

8.3 Based on the Mayor's Sustainable Design and Construction SPG, the London Borough of Haringey have adopted the suggested carbon offset payment set at £95 per tonne, per year – to be calculated across a 30-year time period.

8.4 The offset payment is calculated to be £2,018. This is outlined on the GLA Carbon Emission Reporting Spreadsheet in Appendix 3.

(Source: Haringey Borough Council, *Haringey's 10th Annual Carbon Report 2020*. [ONLINE] Available at:

https://www.haringey.gov.uk/sites/haringeygovuk/files/10th_annual_carbon_report_2020.pdf [Accessed November 2021].

9.0 CONCLUSION

9.1 This document is written in accordance with the guidelines and requirements of:

- Policy SI2 of the 2021 London Plan
- Policy 5.6 of the 2020 GLA Energy Assessment Guidance
- Policy SP4 'Working towards a Low Carbon Haringey' of the London Borough of Haringey's 2013 Spatial Strategy

9.2 The development has CO₂ baseline emissions that are Part L compliant via passive energy efficiency measures alone as highlighted in Section 4.

9.3 In addition to the passive measures and high energy efficiency standards, an efficient Air Source Heat Pump will be incorporated in order to achieve the required reduction in CO₂ emissions.

9.4 The remaining carbon emissions will require an offset payment of £2,018.

Appendix 1

Be Lean SAP Worksheets

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Thomas Holland **Stroma Number:** STRO032196
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Plot 1 - Be Lean

Address : 175a Nightingale Lane, LONDON, N8 7LJ

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Basement	31.24 (1a) x	2.55 (2a) =	79.66 (3a)
Ground floor	30.28 (1b) x	3 (2b) =	90.84 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	170.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 x 40 =	0 (6a)
Number of open flues	0	0	0	0 x 20 =	0 (6b)
Number of intermittent fans				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.4 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.43	0.43	0.42	0.37	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.59 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.57 0.58 (24d)

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

(25)m= 0.59 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.57 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.7	x 1.4	= 2.38		(26)
Windows Type 1			1.1	x1/[1/(1.2)+ 0.04] =	1.26		(27)
Windows Type 2			1.29	x1/[1/(1.2)+ 0.04] =	1.48		(27)
Windows Type 3			2.68	x1/[1/(1.2)+ 0.04] =	3.07		(27)
Rooflights			2.17	x1/[1/(1.3) + 0.04] =	2.821		(27b)
Floor			31.24	x 0.11	= 3.4364		(28)
Walls Type1	33.81	0	33.81	x 0.21	= 7.1		(29)
Walls Type2	57.86	6.77	51.09	x 0.17	= 8.69		(29)
Roof	31.24	2.17	29.07	x 0.14	= 4.07		(30)
Total area of elements, m²			154.15				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 34.16 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.99 (36)

DER WorkSheet: New dwelling design stage

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 43.15 (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=	33.44	33.24	33.04	32.09	31.91	31.08	31.08	30.93	31.4	31.91	32.27	32.64	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	76.59	76.39	76.18	75.23	75.06	74.23	74.23	74.08	74.55	75.06	75.42	75.79	
Average = Sum(39) _{1...12} /12=												75.23	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.24	1.24	1.24	1.22	1.22	1.21	1.21	1.2	1.21	1.22	1.23	1.23	
Average = Sum(40) _{1...12} /12=												1.22	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.02 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)²)] + 0.0013 x (TFA -13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.28 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	90.5	87.21	83.92	80.63	77.34	74.05	74.05	77.34	80.63	83.92	87.21	90.5	
Total = Sum(44) _{1...12} =												987.32	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	134.21	117.39	121.13	105.6	101.33	87.44	81.03	92.98	94.09	109.65	119.69	129.98	
Total = Sum(45) _{1...12} =												1294.53	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.13	17.61	18.17	15.84	15.2	13.12	12.15	13.95	14.11	16.45	17.95	19.5	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

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Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (57)

Primary circuit loss (annual) from Table 3

0

 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=

46.12	40.14	42.77	39.76	39.41	36.52	37.73	39.41	39.76	42.77	43.01	46.12
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

180.33	157.53	163.9	145.37	140.74	123.96	118.76	132.39	133.85	152.42	162.7	176.1
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

180.33	157.53	163.9	145.37	140.74	123.96	118.76	132.39	133.85	152.42	162.7	176.1
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------

Output from water heater (annual) _{1...12}	1788.05
---	---------

 (64)

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

(65)m=

56.16	49.07	50.97	45.05	43.55	38.2	36.37	40.77	41.23	47.15	50.55	54.75
-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21

 (66)

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

(67)m=

16.6	14.74	11.99	9.08	6.79	5.73	6.19	8.05	10.8	13.71	16	17.06
------	-------	-------	------	------	------	------	------	------	-------	----	-------

 (67)

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

(68)m=

176.76	178.6	173.98	164.14	151.71	140.04	132.24	130.41	135.03	144.87	157.29	168.96
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

75.48	73.01	68.5	62.58	58.53	53.06	48.89	54.8	57.26	63.37	70.21	73.59
-------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	-------

 (72)

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

(73)m=

325.21	322.72	310.83	292.15	273.39	255.19	243.69	249.61	259.45	278.32	299.87	315.98
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.68	x	10.63	x	0.63	x	0.7	=	8.71 (74)
North	0.9x	0.77	x	2.68	x	20.32	x	0.63	x	0.7	=	16.64 (74)
North	0.9x	0.77	x	2.68	x	34.53	x	0.63	x	0.7	=	28.28 (74)
North	0.9x	0.77	x	2.68	x	55.46	x	0.63	x	0.7	=	45.43 (74)
North	0.9x	0.77	x	2.68	x	74.72	x	0.63	x	0.7	=	61.2 (74)
North	0.9x	0.77	x	2.68	x	79.99	x	0.63	x	0.7	=	65.51 (74)
North	0.9x	0.77	x	2.68	x	74.68	x	0.63	x	0.7	=	61.16 (74)
North	0.9x	0.77	x	2.68	x	59.25	x	0.63	x	0.7	=	48.53 (74)
North	0.9x	0.77	x	2.68	x	41.52	x	0.63	x	0.7	=	34 (74)
North	0.9x	0.77	x	2.68	x	24.19	x	0.63	x	0.7	=	19.81 (74)
North	0.9x	0.77	x	2.68	x	13.12	x	0.63	x	0.7	=	10.74 (74)
North	0.9x	0.77	x	2.68	x	8.86	x	0.63	x	0.7	=	7.26 (74)
East	0.9x	0.77	x	1.1	x	19.64	x	0.63	x	0.7	=	6.6 (76)
East	0.9x	0.77	x	1.1	x	38.42	x	0.63	x	0.7	=	12.92 (76)
East	0.9x	0.77	x	1.1	x	63.27	x	0.63	x	0.7	=	21.27 (76)
East	0.9x	0.77	x	1.1	x	92.28	x	0.63	x	0.7	=	31.02 (76)
East	0.9x	0.77	x	1.1	x	113.09	x	0.63	x	0.7	=	38.02 (76)
East	0.9x	0.77	x	1.1	x	115.77	x	0.63	x	0.7	=	38.92 (76)
East	0.9x	0.77	x	1.1	x	110.22	x	0.63	x	0.7	=	37.05 (76)
East	0.9x	0.77	x	1.1	x	94.68	x	0.63	x	0.7	=	31.83 (76)
East	0.9x	0.77	x	1.1	x	73.59	x	0.63	x	0.7	=	24.74 (76)
East	0.9x	0.77	x	1.1	x	45.59	x	0.63	x	0.7	=	15.33 (76)
East	0.9x	0.77	x	1.1	x	24.49	x	0.63	x	0.7	=	8.23 (76)
East	0.9x	0.77	x	1.1	x	16.15	x	0.63	x	0.7	=	5.43 (76)
West	0.9x	0.77	x	1.29	x	19.64	x	0.63	x	0.7	=	7.74 (80)
West	0.9x	0.77	x	1.29	x	38.42	x	0.63	x	0.7	=	15.15 (80)
West	0.9x	0.77	x	1.29	x	63.27	x	0.63	x	0.7	=	24.94 (80)
West	0.9x	0.77	x	1.29	x	92.28	x	0.63	x	0.7	=	36.38 (80)
West	0.9x	0.77	x	1.29	x	113.09	x	0.63	x	0.7	=	44.59 (80)
West	0.9x	0.77	x	1.29	x	115.77	x	0.63	x	0.7	=	45.64 (80)
West	0.9x	0.77	x	1.29	x	110.22	x	0.63	x	0.7	=	43.45 (80)
West	0.9x	0.77	x	1.29	x	94.68	x	0.63	x	0.7	=	37.33 (80)
West	0.9x	0.77	x	1.29	x	73.59	x	0.63	x	0.7	=	29.01 (80)
West	0.9x	0.77	x	1.29	x	45.59	x	0.63	x	0.7	=	17.97 (80)
West	0.9x	0.77	x	1.29	x	24.49	x	0.63	x	0.7	=	9.65 (80)
West	0.9x	0.77	x	1.29	x	16.15	x	0.63	x	0.7	=	6.37 (80)
Rooflights	0.9x	1	x	2.17	x	26	x	0.63	x	0.7	=	22.39 (82)
Rooflights	0.9x	1	x	2.17	x	54	x	0.63	x	0.7	=	46.51 (82)
Rooflights	0.9x	1	x	2.17	x	96	x	0.63	x	0.7	=	82.68 (82)

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Rooflights 0.9x	1	x	2.17	x	150	x	0.63	x	0.7	=	129.19	(82)
Rooflights 0.9x	1	x	2.17	x	192	x	0.63	x	0.7	=	165.36	(82)
Rooflights 0.9x	1	x	2.17	x	200	x	0.63	x	0.7	=	172.25	(82)
Rooflights 0.9x	1	x	2.17	x	189	x	0.63	x	0.7	=	162.78	(82)
Rooflights 0.9x	1	x	2.17	x	157	x	0.63	x	0.7	=	135.22	(82)
Rooflights 0.9x	1	x	2.17	x	115	x	0.63	x	0.7	=	99.05	(82)
Rooflights 0.9x	1	x	2.17	x	66	x	0.63	x	0.7	=	56.84	(82)
Rooflights 0.9x	1	x	2.17	x	33	x	0.63	x	0.7	=	28.42	(82)
Rooflights 0.9x	1	x	2.17	x	21	x	0.63	x	0.7	=	18.09	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	45.45	91.22	157.18	242.02	309.16	322.33	304.45	252.9	186.8	109.96	57.05	37.14	(83)
--------	-------	-------	--------	--------	--------	--------	--------	-------	-------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	370.65	413.94	468.01	534.17	582.56	577.52	548.13	502.51	446.25	388.27	356.92	353.12	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.74	0.58	0.64	0.88	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.92	20.02	20.22	20.5	20.74	20.89	20.93	20.92	20.81	20.49	20.16	19.9	(87)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.92	19.91	19.9	19.9	19.89	(88)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	------	------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.85	0.64	0.44	0.51	0.82	0.97	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	18.44	18.59	18.88	19.29	19.62	19.8	19.83	19.83	19.71	19.29	18.81	18.43	(90)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.03	19.17	19.42	19.78	20.07	20.23	20.27	20.27	20.15	19.77	19.35	19.02	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.88	19.02	19.27	19.63	19.92	20.08	20.12	20.12	20	19.62	19.2	18.87	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.95	0.85	0.66	0.47	0.53	0.82	0.97	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	369.29	411.17	460.32	506.56	495.36	381.68	257.48	268.33	366.95	376.29	354.46	352.09	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

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

(97)m=	1117.07	1078.34	972.88	806.91	617.04	407.12	261.33	275.28	439.99	677.19	912.54	1111.89	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	556.35	448.34	381.35	216.26	90.53	0	0	0	0	223.87	401.82	565.29	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													2883.8 (98)

Space heating requirement in kWh/m ² /year	46.88 (99)
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9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1 (204)
Efficiency of main space heating system 1		93.3 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

556.35	448.34	381.35	216.26	90.53	0	0	0	0	223.87	401.82	565.29
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

596.3	480.54	408.73	231.79	97.03	0	0	0	0	239.95	430.68	605.88	
Total (kWh/year) = Sum(211) _{1...5,10...12} =												3090.89 (211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) = Sum(215) _{1...5,10...12} =												0 (215)

Water heating

Output from water heater (calculated above)

180.33	157.53	163.9	145.37	140.74	123.96	118.76	132.39	133.85	152.42	162.7	176.1
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Efficiency of water heater 84 (216)

(217)m=	90.84	90.69	90.29	89.32	87.41	84	84	84	84	89.3	90.41	90.91	(217)
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Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	198.52	173.7	181.51	162.74	161.01	147.57	141.38	157.61	159.35	170.69	179.95	193.71		
Total = Sum(219a) _{1...12} =													2027.75	(219)

Annual totals

Space heating fuel used, main system 1 kWh/year kWh/year 3090.89

Water heating fuel used kWh/year 2027.75

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 75 (231)

Electricity for lighting 293.16 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 5486.8 (338)

12a. CO2 emissions – Individual heating systems including micro-CHP

DER WorkSheet: New dwelling design stage

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	667.63 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	437.99 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1105.63 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	152.15 (268)
Total CO2, kg/year	sum of (265)...(271) =			1296.7 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			21.08 (273)
El rating (section 14)				84 (274)

Appendix 2

Be Green SAP Worksheets

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Thomas Holland **Stroma Number:** STRO032196
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: Plot 1 - Be Green

Address : 175a Nightingale Lane, LONDON, N8 7LJ

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Basement	31.24 (1a) x	2.55 (2a) =	79.66 (3a)
Ground floor	30.28 (1b) x	3 (2b) =	90.84 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.52 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	170.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 x 40 =	0 (6a)
Number of open flues	0	0	0	0 x 20 =	0 (6b)
Number of intermittent fans				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.4 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.43	0.43	0.42	0.37	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.59 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.57 0.58 (24d)

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

(25)m= 0.59 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.57 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.7	x 1.4	= 2.38		(26)
Windows Type 1			1.1	x1/[1/(1.2)+0.04]	= 1.26		(27)
Windows Type 2			1.29	x1/[1/(1.2)+0.04]	= 1.48		(27)
Windows Type 3			2.68	x1/[1/(1.2)+0.04]	= 3.07		(27)
Rooflights			2.17	x1/[1/(1.3)+0.04]	= 2.821		(27b)
Floor			31.24	x 0.11	= 3.4364		(28)
Walls Type1	33.81	0	33.81	x 0.21	= 7.1		(29)
Walls Type2	57.86	6.77	51.09	x 0.17	= 8.69		(29)
Roof	31.24	2.17	29.07	x 0.14	= 4.07		(30)
Total area of elements, m²			154.15				(31)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 34.16 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.99 (36)

DER WorkSheet: New dwelling design stage

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 43.15 (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=	33.44	33.24	33.04	32.09	31.91	31.08	31.08	30.93	31.4	31.91	32.27	32.64	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	76.59	76.39	76.18	75.23	75.06	74.23	74.23	74.08	74.55	75.06	75.42	75.79	
Average = Sum(39) _{1...12} / 12 =												75.23	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.24	1.24	1.24	1.22	1.22	1.21	1.21	1.2	1.21	1.22	1.23	1.23	
Average = Sum(40) _{1...12} / 12 =												1.22	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.02 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.28 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	90.5	87.21	83.92	80.63	77.34	74.05	74.05	77.34	80.63	83.92	87.21	90.5	
Total = Sum(44) _{1...12} =												987.32	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	134.21	117.39	121.13	105.6	101.33	87.44	81.03	92.98	94.09	109.65	119.69	129.98	
Total = Sum(45) _{1...12} =												1294.53	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	20.13	17.61	18.17	15.84	15.2	13.12	12.15	13.95	14.11	16.45	17.95	19.5	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.27 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.69 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.69 (55)

DER WorkSheet: New dwelling design stage

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

21.26	19.2	21.26	20.57	21.26	20.57	21.26	21.26	20.57	21.26	20.57	21.26
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 (56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=

21.26	19.2	21.26	20.57	21.26	20.57	21.26	21.26	20.57	21.26	20.57	21.26
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 (57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

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

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

178.74	157.6	165.65	148.69	145.85	130.53	125.55	137.5	137.18	154.17	162.78	174.5
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 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m=

178.74	157.6	165.65	148.69	145.85	130.53	125.55	137.5	137.18	154.17	162.78	174.5
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$$\text{Output from water heater (annual)}_{1..12} = 1818.74$$
 (64)

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

(65)m=

80.24	71.2	75.89	69.58	69.31	63.54	62.56	66.53	65.75	72.08	74.27	78.84
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 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21	101.21

 (66)

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

(67)m=

16.6	14.74	11.99	9.08	6.79	5.73	6.19	8.05	10.8	13.71	16	17.06
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 (67)

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

(68)m=

176.76	178.6	173.98	164.14	151.71	140.04	132.24	130.41	135.03	144.87	157.29	168.96
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 (68)

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

(69)m=

33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12	33.12
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 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
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 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97	-80.97
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

107.86	105.95	102.01	96.64	93.16	88.25	84.08	89.43	91.32	96.88	103.15	105.96
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 (72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=

357.58	355.66	344.34	326.22	308.02	290.39	278.88	284.24	293.52	311.82	332.81	348.35
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 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.68	x	10.63	x	0.63	x	0.7	=	8.71 (74)
North	0.9x	0.77	x	2.68	x	20.32	x	0.63	x	0.7	=	16.64 (74)
North	0.9x	0.77	x	2.68	x	34.53	x	0.63	x	0.7	=	28.28 (74)
North	0.9x	0.77	x	2.68	x	55.46	x	0.63	x	0.7	=	45.43 (74)
North	0.9x	0.77	x	2.68	x	74.72	x	0.63	x	0.7	=	61.2 (74)
North	0.9x	0.77	x	2.68	x	79.99	x	0.63	x	0.7	=	65.51 (74)
North	0.9x	0.77	x	2.68	x	74.68	x	0.63	x	0.7	=	61.16 (74)
North	0.9x	0.77	x	2.68	x	59.25	x	0.63	x	0.7	=	48.53 (74)
North	0.9x	0.77	x	2.68	x	41.52	x	0.63	x	0.7	=	34 (74)
North	0.9x	0.77	x	2.68	x	24.19	x	0.63	x	0.7	=	19.81 (74)
North	0.9x	0.77	x	2.68	x	13.12	x	0.63	x	0.7	=	10.74 (74)
North	0.9x	0.77	x	2.68	x	8.86	x	0.63	x	0.7	=	7.26 (74)
East	0.9x	0.77	x	1.1	x	19.64	x	0.63	x	0.7	=	6.6 (76)
East	0.9x	0.77	x	1.1	x	38.42	x	0.63	x	0.7	=	12.92 (76)
East	0.9x	0.77	x	1.1	x	63.27	x	0.63	x	0.7	=	21.27 (76)
East	0.9x	0.77	x	1.1	x	92.28	x	0.63	x	0.7	=	31.02 (76)
East	0.9x	0.77	x	1.1	x	113.09	x	0.63	x	0.7	=	38.02 (76)
East	0.9x	0.77	x	1.1	x	115.77	x	0.63	x	0.7	=	38.92 (76)
East	0.9x	0.77	x	1.1	x	110.22	x	0.63	x	0.7	=	37.05 (76)
East	0.9x	0.77	x	1.1	x	94.68	x	0.63	x	0.7	=	31.83 (76)
East	0.9x	0.77	x	1.1	x	73.59	x	0.63	x	0.7	=	24.74 (76)
East	0.9x	0.77	x	1.1	x	45.59	x	0.63	x	0.7	=	15.33 (76)
East	0.9x	0.77	x	1.1	x	24.49	x	0.63	x	0.7	=	8.23 (76)
East	0.9x	0.77	x	1.1	x	16.15	x	0.63	x	0.7	=	5.43 (76)
West	0.9x	0.77	x	1.29	x	19.64	x	0.63	x	0.7	=	7.74 (80)
West	0.9x	0.77	x	1.29	x	38.42	x	0.63	x	0.7	=	15.15 (80)
West	0.9x	0.77	x	1.29	x	63.27	x	0.63	x	0.7	=	24.94 (80)
West	0.9x	0.77	x	1.29	x	92.28	x	0.63	x	0.7	=	36.38 (80)
West	0.9x	0.77	x	1.29	x	113.09	x	0.63	x	0.7	=	44.59 (80)
West	0.9x	0.77	x	1.29	x	115.77	x	0.63	x	0.7	=	45.64 (80)
West	0.9x	0.77	x	1.29	x	110.22	x	0.63	x	0.7	=	43.45 (80)
West	0.9x	0.77	x	1.29	x	94.68	x	0.63	x	0.7	=	37.33 (80)
West	0.9x	0.77	x	1.29	x	73.59	x	0.63	x	0.7	=	29.01 (80)
West	0.9x	0.77	x	1.29	x	45.59	x	0.63	x	0.7	=	17.97 (80)
West	0.9x	0.77	x	1.29	x	24.49	x	0.63	x	0.7	=	9.65 (80)
West	0.9x	0.77	x	1.29	x	16.15	x	0.63	x	0.7	=	6.37 (80)
Rooflights	0.9x	1	x	2.17	x	26	x	0.63	x	0.7	=	22.39 (82)
Rooflights	0.9x	1	x	2.17	x	54	x	0.63	x	0.7	=	46.51 (82)
Rooflights	0.9x	1	x	2.17	x	96	x	0.63	x	0.7	=	82.68 (82)

DER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	2.17	x	150	x	0.63	x	0.7	=	129.19	(82)
Rooflights 0.9x	1	x	2.17	x	192	x	0.63	x	0.7	=	165.36	(82)
Rooflights 0.9x	1	x	2.17	x	200	x	0.63	x	0.7	=	172.25	(82)
Rooflights 0.9x	1	x	2.17	x	189	x	0.63	x	0.7	=	162.78	(82)
Rooflights 0.9x	1	x	2.17	x	157	x	0.63	x	0.7	=	135.22	(82)
Rooflights 0.9x	1	x	2.17	x	115	x	0.63	x	0.7	=	99.05	(82)
Rooflights 0.9x	1	x	2.17	x	66	x	0.63	x	0.7	=	56.84	(82)
Rooflights 0.9x	1	x	2.17	x	33	x	0.63	x	0.7	=	28.42	(82)
Rooflights 0.9x	1	x	2.17	x	21	x	0.63	x	0.7	=	18.09	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	45.45	91.22	157.18	242.02	309.16	322.33	304.45	252.9	186.8	109.96	57.05	37.14	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	403.03	446.88	501.52	568.24	617.19	612.71	583.33	537.14	480.32	421.78	389.86	385.5	(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 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.87	0.71	0.54	0.61	0.86	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.06	20.26	20.53	20.76	20.9	20.93	20.93	20.83	20.53	20.2	19.94	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.92	19.91	19.9	19.9	19.89	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.83	0.61	0.42	0.48	0.78	0.96	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.49	18.65	18.94	19.33	19.65	19.8	19.83	19.83	19.73	19.34	18.86	18.48	(90)
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fLA = Living area ÷ (4) =

0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.08	19.21	19.47	19.81	20.09	20.24	20.27	20.27	20.17	19.81	19.4	19.07	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.08	19.21	19.47	19.81	20.09	20.24	20.27	20.27	20.17	19.81	19.4	19.07	(93)
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8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.46	0.52	0.8	0.96	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	401.04	443.01	491.36	534.13	515.89	395.22	268.89	280.07	385.57	405.48	386.23	383.95	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	1132.07	1093.31	987.73	821.11	630.09	418.82	272.59	286.61	452.66	691.59	927.33	1126.75	(97)
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DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	543.89	437	369.29	206.63	84.96	0	0	0	0	212.86	389.59	552.64	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													2796.87 (98)

Space heating requirement in kWh/m ² /year	45.46 (99)
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9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1 (204)
Efficiency of main space heating system 1		170 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

543.89	437	369.29	206.63	84.96	0	0	0	0	212.86	389.59	552.64
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(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

319.93	257.06	217.23	121.54	49.98	0	0	0	0	125.21	229.17	325.08		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												1645.22	(211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215) _{1...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

178.74	157.6	165.65	148.69	145.85	130.53	125.55	137.5	137.18	154.17	162.78	174.5
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Efficiency of water heater 170 (216)

(217)m=	170	170	170	170	170	170	170	170	170	170	170	
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	105.14	92.71	97.44	87.47	85.8	76.78	73.85	80.88	80.69	90.69	95.75	102.65	
Total = Sum(219a) _{1...12} =													1069.85 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year kWh/year 1645.22

Water heating fuel used kWh/year 1069.85

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 30 (231)

Electricity for lighting 293.16 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 3038.23 (338)

12a. CO2 emissions – Individual heating systems including micro-CHP

Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.519	=	853.87	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	555.25	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1409.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	152.15	(268)
Total CO2, kg/year	sum of (265)...(271) =			1576.84	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			25.63	(273)
El rating (section 14)				80	(274)