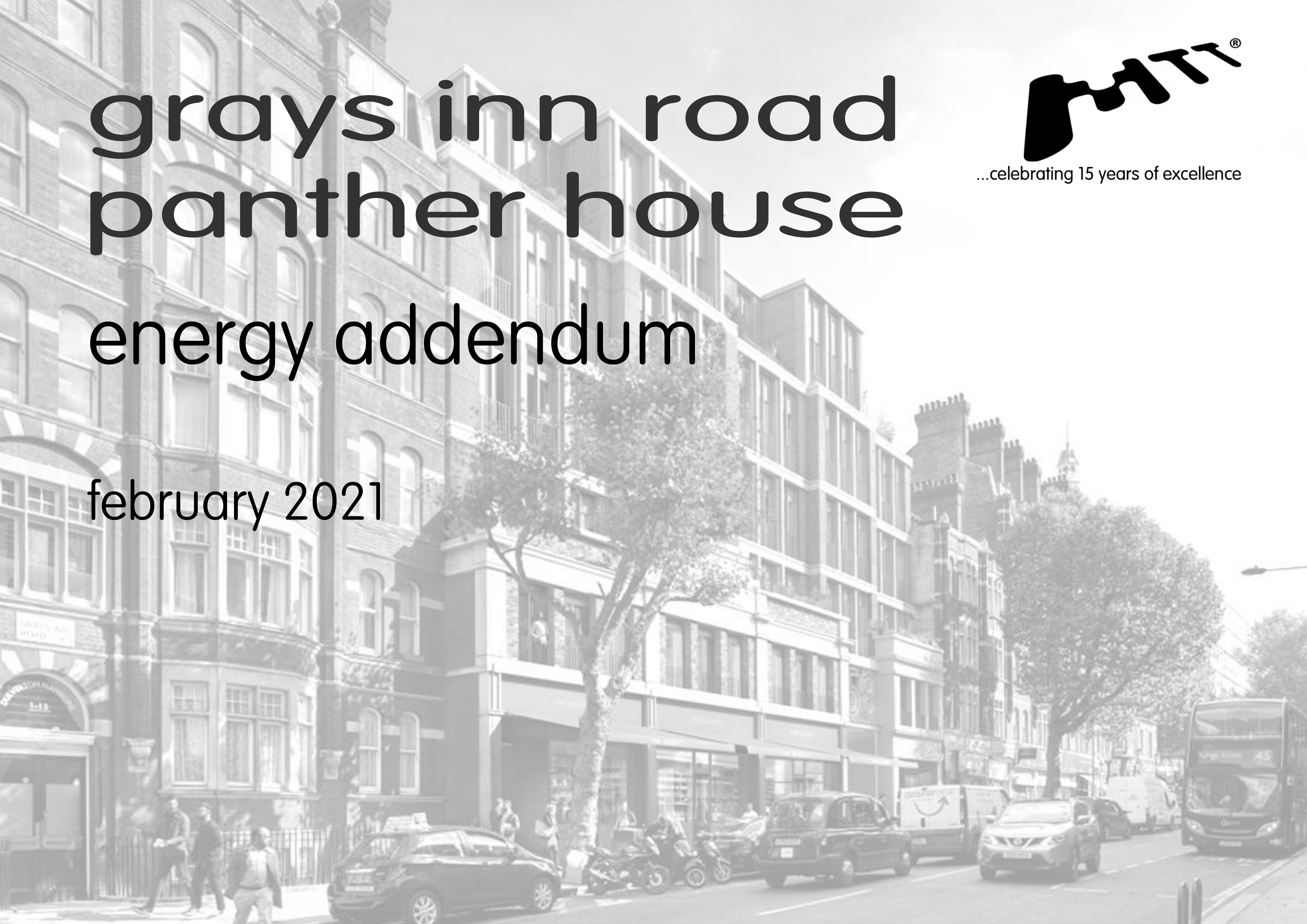
grays inn road panther house

energy addendum

february 2021

...celebrating 15 years of excellence



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ISSUE DETAILS

DATE OF ISSUE	DETAILS OF ISSUE	AUTHOR	CHECKED
19TH FEBRUARY 2021	ISSUE ONE	CLL	LN/MML/LA

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OVERVIEW

The consented application for the redevelopment of 156-164 Gray's Inn Road, known as Panther House, was submitted in December 2015, with amendments agreed and permitted in early 2017.

The energy strategy approved as part of the consented scheme utilised gas boilers to provide heating and hot water to the residential element of the scheme. Since then, there has been a shift in the regulatory and policy backgrounds which discourage the use of combustible fossil fuels on site for heat (namely gas boilers in this case).

This document has been produced to summarise the changes to local and regional planning policy (particularly the London Plan), emerging policy (Future Homes Standard) and forthcoming regulatory change (Building Regulations Part L 2021), with a view to changing the use of gas boilers in favour of air source heat pumps for the residential units.

In light of these changes and consideration of updates to the carbon intensity of fuels, particularly the decrease in grid electricity reported to be included in the forthcoming update to SAP and adopted by the GLA, it is considered that the energy strategy should be revised to remove gas boilers in favour of heat pumps for the residential units.

No changes are proposed for the non-residential element of the consented scheme in terms of the energy strategy, although proposed minor architectural alterations to the commercial building (Panther House) have been reviewed and are considered to not have a significant impact on the consented scheme's energy model.

This addendum to the energy strategy aims to demonstrate that the revised residential energy strategy is an improvement on the consented scheme for the following key reasons:

- Utilising heat pumps rather than gas boilers accords with the current and emerging policy and anticipated future regulatory background
- Using heat pumps rather than gas boilers achieves a lower overall tonnage of CO_2 emissions, reducing the carbon footprint of the scheme and lowering the associated Carbon Offset Payment, when adopting SAP 10
- The revised energy strategy replaces gas-fired boilers with heat pumps that use electricity, meaning the scheme's CO_2 emissions will continue to decrease as grid electricity continues to decarbonise
- Replacing boilers with heat pumps eliminates gas being burned for heat, meaning lower impact on local air quality compared to the consented strategy.

The revised CO_2 emissions for the development have been estimated as **194.5 TCO_2** per year, with a total saving of **56.8 TCO_2** (a **22.6% reduction** against the Part L baseline). This is an improvement on the consented scheme's energy strategy, which had higher estimated CO_2 emissions of **199.7 TCO_2** per year and a lower saving of **50.1 TCO_2** (a **20.0% reduction** against the Part L baseline).

The Carbon Offset Payment reduces from £100,710 to £84,240.

EMERGING NATIONAL POLICY

The government has committed to cutting greenhouse gas emissions to almost zero by 2050. The National Planning Policy Framework (NPPF) sets out the Government's planning policies on the delivery of sustainable development through the planning system in England and indicates how these are expected to be applied, informing Local Councils and communities with regards to local plans and planning applications.

The Future Homes Standard, launched by the Government in the 2019 Spring Statement proposed that by 2025 all new homes will incorporate world-leading levels of energy efficiency, with low-carbon heating. It indicated that, by 2025, new housing should not be fuelled by gas.

The Future Homes Standard consultation document was released on 1st October 2019, on changes to Building Regulations Part L (and Part F), including either a 20% reduction in CO_2 emissions against current Part L 2013 from energy efficiency measures, or a 31% reduction using energy efficiency and renewable technologies until 2025. Government responses on this consultation were released on 27th January 2021. After 2025, the Future Homes Standard is expected to require a 75-80% CO_2 emissions reduction.

BUILDING REGULATIONS

The element of the Building Regulations which governs energy consumption and CO_2 emissions from the operation of new buildings is Part L. For new builds, this is split into Part L1A (conservation of fuel and power in new dwellings) and Part L2A (conservation of fuel in power in new buildings other than dwellings). Part L only considers 'regulated' energy, i.e. that necessary for heating, cooling, hot water, ventilation and lighting. Therefore, small power and plug-in equipment is not included.

The current version of Building Regulations Part L is the 2013 edition incorporating 2016 amendments. Each time the Building Regulations is updated, there is a public consultation period, then a transition period ahead of full implementation. The next Building Regulations Part L update was previously anticipated in 2020 but is now most likely to be released in 2021.

Transitional arrangements were set out within the January 2021 Government responses on the Future Homes Standard. This proposed that where a residential building, or block in a phased masterplan has an initial notice in place by June 2022 and commences by June 2023, the existing Part L standards can be applied. After this, the new Part L standards apply.

SAP 10

The Standard Assessment Procedure (SAP) is the approved calculation methodology for demonstrating compliance with Building Regulations Part L1A. The non-residential equivalent is the Standard Building Energy Model (SBEM) methodology, which must be used for Part L2A.

An update to SAP is usually released as part of the public consultation period, which precedes implementation of a Building Regulations Part L update. The latest update, known as SAP 10, is intended to replace SAP 2012. The latest version of SAP 2012 for use in the existing Building Regulations Part L1A is v9.92, dated October 2013. SAP 2012 is still the only version of the methodology that it is acceptable to use for Building Regulations Part L compliance until full implementation of the superseding Regulations.

The changes to SAP are often the precursor to changes in approaches for all buildings. The first version of SAP 10 was released on 24/07/18, with some important details likely to lead to a transition away from site-based fossil fuels and towards electricity. The key change identified by the industry has been to the carbon emission factors associated with fuels for different uses.

On 10/10/19, SAP 10 was updated to SAP 10.1 (still a consultation document, not adopted by GLA), with further amendments to carbon emission factors.

THE LONDON PLAN

The Mayor of London has declared a climate emergency and has set an ambition for London to be net zero-carbon. The new London Plan is currently in draft and is a material consideration in new planning decisions. As part of the draft new London Plan, Greater London Authority (GLA) have released the draft version of the Energy Assessment Guidance 2020, also a material consideration in new applications, which includes requirements for the latest structure, approach and contents of energy assessments for new buildings.

The GLA require all referable planning applications to be submitted with an Energy Assessment, to demonstrate how the London Plan CO_2 emissions reduction targets have been met in line with the Energy Hierarchy.

Energy Assessment Guidance

The Energy Hierarchy is presented in the GLA's Energy Assessment Guidance documentation and sets out expectations for how CO_2 emissions reductions should be achieved (following defined steps as follows: Use Less Energy - 'Be Lean', Supply Energy Efficiently - 'Be Clean' and Use Renewable Energy - 'Be Green').

The Energy Assessment Guidance documentation was updated in October 2018, following the release of SAP 10. This new guidance document was issued alongside the announcement that, from January 2019, the GLA's expectation was for SAP 10 carbon emission factors to be implemented. A calculation tool was developed to allow conversion of CO_2 emissions, at each stage of the Energy Hierarchy, from current SAP 2012 emission factors to SAP 10, for all major residential and non-residential applications.

In 2020 the Energy Assessment Guidance was further updated to restructure the Energy Hierarchy slightly, insomuch as there is a decoupling of district heating as a principle and CHP as the de facto technology. Whilst district heating is still favoured by the GLA, the use of CHP should now be considered as part of a wider feasibility study of all types of heat source and must be fully justified if selected. It is still necessary to offset remaining CO_2 emissions via a Carbon Offset Payment, after implementation of the Energy Hierarchy.

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Camden planning guidance

Camden's Local Plan 2017 aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable energy technologies. Green Action for Change: Camden's environmental sustainability plan (2011-2020) commits Camden to a 27% borough wide CO_2 reduction by 2017 and a 40% borough wide CO_2 reduction by 2020 (London carbon reduction target). This is delivered, among others, by policy CC1: Climate Change Mitigation, which promotes zero carbon development by following the London Plan's Energy Hierarchy and the associated targets for CO_2 emissions reductions.

Camden's 'Energy efficiency and adaptation' CPG January 2021 supports Local Plan Policy CC1 (and other relevant policies) and replaced CPG3 Sustainability (July 2015).

Policy relevant at the time of submission in December 2015 required Code for Sustainable Homes Level 4, with a target of 35% reduction in CO_2 emissions for major residential and non-residential schemes. Where the target was demonstrated to not be achievable, Carbon Offsetting was implemented at a price of £90 per tonne of CO_2 shortfall over 30 years (i.e. £2,700 per tonne CO_2).

The Code for Sustainable Homes was withdrawn by the Government in April 2015, with an allowance for any Local Authority with this as an existing policy requirement to implement a 19% reduction in CO_2 emissions, equivalent to Code Level 4. This was adopted as an absolute minimum by Camden Council, as confirmed during the planning submission process, with the 35% CO_2 emissions reduction maintained as an aspirational target.

CARBON EMISSION FACTORS

Electricity

Carbon emissions factors allow the conversion of energy used in a building (in kWh) from a given fuel, to the equivalent CO_2 emissions. Amongst the two primary fuel sources in the UK, gas has a relatively constant CO_2 intensity; electricity, however, has more variation due to the mix of energy generation sources that constitute the grid.

The emission factor for grid electricity in SAP 2012 is 0.519 $kgCO_2/kWh$, i.e. roughly half a kilogram of carbon dioxide emissions for every kWh of regulated energy used in the building. Under SAP 10, this is due to reduce to 0.233 $kgCO_2/kWh$, i.e. less than half the previous CO_2 emissions for the same amount of energy used. This is to reflect the decarbonisation of grid electricity, by the phasing out of coal and gas, with a higher proportion of nuclear and renewable sources in the mix, as shown in Figure 1 below.

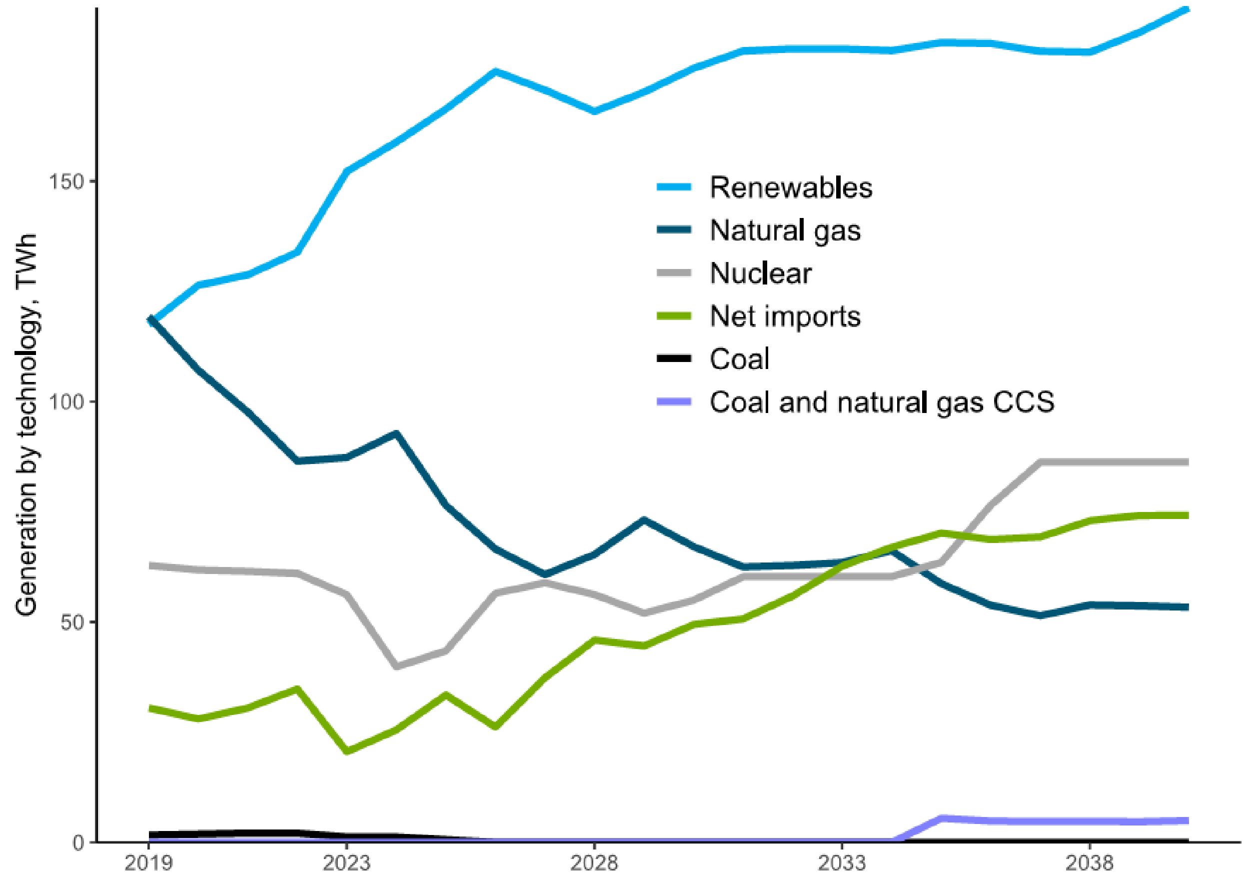

Figure 1 – Projected Electricity Generation by Fuel Source from 2019 Onwards (BEIS October 2020)

This change will be a major factor in the selection of energy strategies for new and existing buildings.

In SAP 10.1, the emission factor for grid electricity is 0.136 $kgCO_2/kWh$. This is a further step-change, which would appear to extend beyond the level of decarbonisation currently being achieved for grid electricity. At the time of writing, it is uncertain where the electricity carbon emission factor will lie in the official Building Regulations update.

The graph in Figure 2 shows the carbon intensity trajectory for two Energy & Emissions Projections (EEP), which differ based on the rate of uptake of renewables.

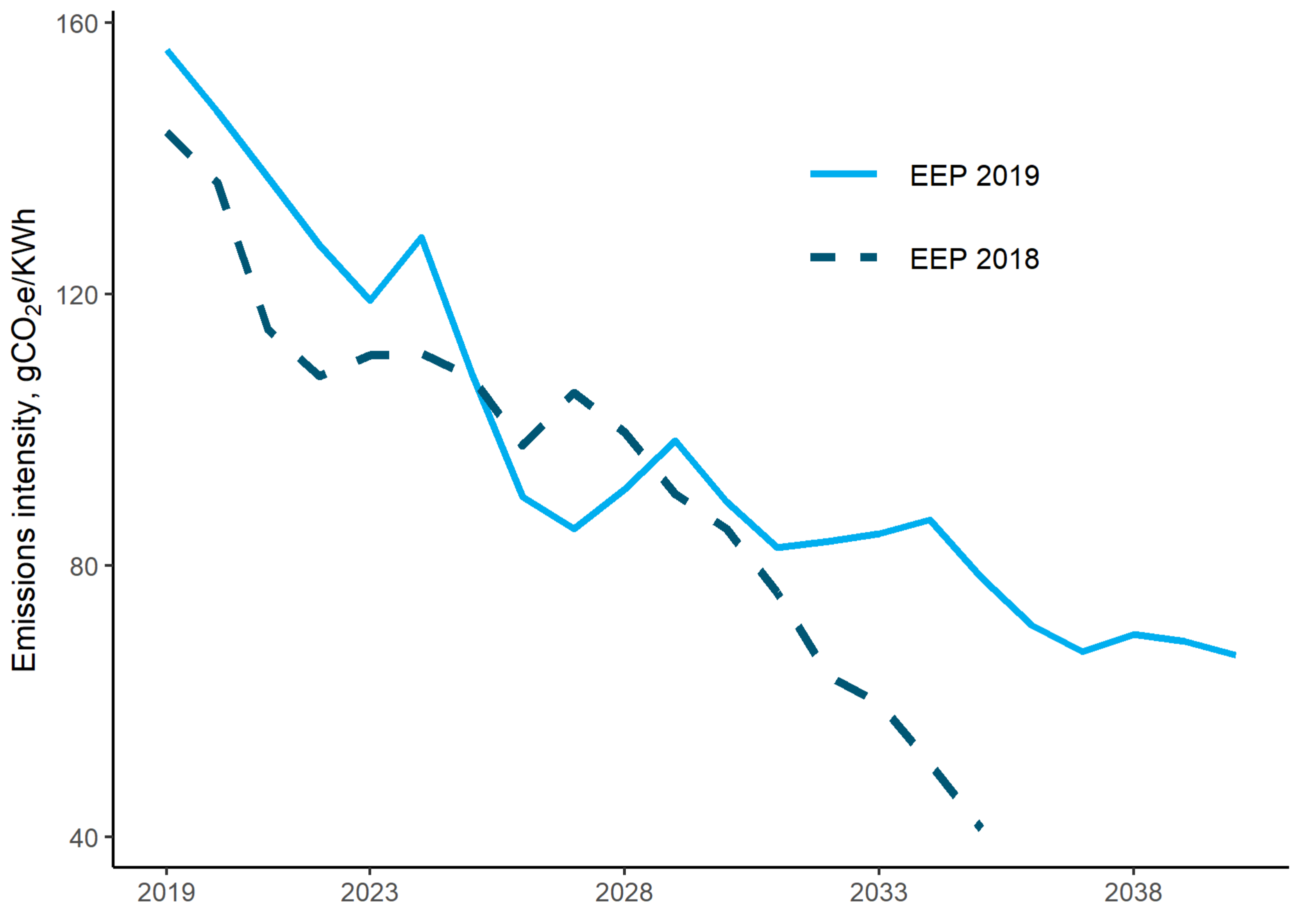

Figure 2 – CO_2 Emissions Intensity of Grid Electricity from 2019 Onwards (BEIS October 2020)

Gas

Mains gas has also reduced from 0.216 in SAP 2012 to 0.210 in SAP 10, also reflecting decarbonisation, albeit less pronounced, due to the integration of green gas with natural gas in the network.

Green gas, biogas or biomethane, is generated from anaerobic digestion of organic material and can be added to natural gas in the network. Green gas is more sustainable than natural gas, given that it is not a fossil fuel and is generated from a renewable source: organic plant or animal material. Some biogas is made from plant material, green waste, food waste or agricultural waste that would have been thrown away anyway. Even animal waste and sewage can be used. The leftover organic material is nutrient rich and can be used as a substitute for chemical fertilisers. Biogas can therefore contribute to the circular economy.

Although burning green gas still emits greenhouse gases, it is considered to achieve a carbon balance because some of the organic matter used to harvest the green gas would have decomposed and released CO_2 anyway and the new organic matter being regrown to replenish the anaerobic digesters is absorbing CO_2 as it grows.

Issues with biogas include the current scale and reliability of supply (although this is improving), it requires refinement to extract impurities before it is suitable for inclusion into the network, the system for producing biogas is inefficient and the effectiveness of a generation plant can depend on weather, supply of organic materials and space.

Given the technology and availability of biogas is developing, its most effective application is seen as part of the UK's energy mix in the future, to supplement and decarbonise the network for the legacy of the UK's domestic gas reliance. Decarbonised electricity is the current preference of the Government for future applications.

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CONSENTED STRATEGY

Policy Requirements

At the time of submission, Part L 2013 was still the current version of the Building Regulations. The prevailing version of the London Plan was the March 2015 edition, which was supported by the April 2015 version of the 'Energy Planning: Greater London Authority guidance on preparing energy assessments' document (these have since been superseded by the 2018 and 2020 revisions).

This is a mixed-use development with significant elements of existing and retained building fabric, particularly for the commercial elements within the scheme. For residential units, the Code for Sustainable Homes was withdrawn in April 2015, before submission of the planning application. The Government had stated that where Local Authorities has Code for Sustainable Homes requirements within their policies, they could require a 19% reduction in CO_2 emissions, equivalent to Code Level 4 performance.

This approach was adopted by Camden Council, whereby a 19% CO_2 emissions reduction was the minimum requirement, with a 35% CO_2 emissions reduction as the target within London Plan policy 5.2, Camden Local Plan policy CC1 and Camden's CPG1 Sustainability July 2015. Where it was not possible to achieve a 35% reduction in CO_2 emissions, carbon offsetting was applied up to this target.

The 2015 version of the policy required compliance with the following:

- 35% reduction in CO_2 emissions against Part L 2013, as an aspirational target with an absolute minimum of 19% for residential properties
- Carbon offset payment for all remaining residential CO_2 emissions, up to 35%, at £1,800 per tonne of CO_2 shortfall
- 35% reduction in CO_2 emissions against Part L 2013, as an aspirational target for commercial spaces
- Carbon offset payment for any commercial CO_2 emissions, up to the 35% target, at £1,800 per tonne of CO_2 shortfall
- Energy Hierarchy - Part L compliance via Be Lean measures only
- Energy Hierarchy – maximise renewable technologies including rooftop PV.

Consented Energy Strategy

Planning consent was granted for the residential properties based on gas boilers for heating and hot water, mechanical ventilation with heat recovery (MVHR), cooling and PV. For the commercial elements of the scheme, consent was granted based on high efficiency VRF (refrigerant-based system using electricity) heating and cooling, with heat recovery ventilation and high efficiency lighting.

The use of gas boilers in residential properties provides user familiarity and a consistent efficiency (as opposed to heat pumps whose efficiency, although normally far higher, varies with external climatic temperatures). However, this technology is considered to have reached its peak in terms of performance and is being eclipsed by technologies that offer equivalent outputs with cleaner fuels, higher efficiencies, lower CO_2 emissions and opportunities for further carbon reductions as time goes on.

REVISED STRATEGY

The policy changes and other drivers identified earlier in this document lead the design away from the used of gas and strongly towards electricity for the provision of heat, and hence the replacement of gas boilers with heat pump technology. Heat pumps essentially upgrade the ambient heat within atmospheric air, watercourses or the ground to a higher temperature for use as space heating or hot water, using refrigerant. Electricity is used to fuel this process; the heat generated is considered low carbon because one kilowatt of electricity can be converted into many kilowatts of heat. (Note: conventional heat pumps can achieve 3 to 5 or more kilowatts of heat for every 1kW of electricity used; this multiplier is known as the Coefficient of Performance, or COP)

The emergence of the consultation on note on SAP 10 and the subsequent adoption of the carbon intensity factors therein (which, as described previously, is more reflective of today's reality), means that the GLA's conversion spreadsheet has been used as a key tool in analysing the benefits of the revised strategy.

Revising the energy strategy as described in this document is considered a positive change and an improvement to the overall scheme. Given the changing policy background described earlier in this document, it is hoped that the move away from the consented strategy towards a strategy which replaces boilers with heat pumps will be viewed favourably.

The feasibility work undertaken has been centred around how to best incorporate heat pumps into the design, given the capabilities and constraints of the technology and the availability of appropriate products on the market.

Conventional heat pumps are excellent at producing low-temperature hot water, up to approximately 55°C, when the ambient temperature, i.e. local weather conditions, are mild. This is particularly the case for individual domestic-scale heat pumps providing space heating in a long-lag system, which can achieve a COP of up to 3.5-4.5. As the ambient temperature decreases, say to 0°C or below, the efficiency of the heat generation can decrease. Similarly, when producing heat at above 55°C, which is needed to deliver domestic hot water, the efficiency decreases, and it is usually necessary to utilise other means to deliver temperatures above 60°C. This can be in the form of electric emersion heaters in cylinders or via other means.

Residential Element – Gray's Inn Road

The options for how to integrate heat pumps have been reviewed and the most appropriate has been identified. Three communal air source, or air-to-water heat pumps are proposed on the roof of the residential properties within the Gray's Inn Road building, which will provide heating and hot water to all residential units.

Commercial Element – Panther House and Brain Yard

No changes are proposed to the energy strategy for the commercial element of the scheme.

The proposed architectural changes to the massing and façades of the commercial buildings are considered to be minor. They have been reviewed in the context of the energy modelling and our examination of the changes has concluded that alterations would have minimal impact on the overall energy calculations compared to our original calculations.

There has been a minor update to the floor area of the commercial element of the scheme and this has been reflected in the results on a pro rata basis.

ANALYSIS UNDERTAKEN

In order to assess the impact of changing the scheme's energy strategy, the SAP calculations used to calculate CO_2 emissions and establish Carbon Offset Payments have been revised. The results have been combined with the previous results from the non-residential element of the consented scheme for comparison of the previous and proposed residential energy strategies.

Consented Scheme Results

The carbon offset payment included in the Section 106 agreement is £100,710, which was calculated by multiplying Camden's price per tonne of carbon (£2,700 – derived from £90 per tonne over 30 years), by the project's carbon shortfall up to the 35% CO_2 emissions reduction target.

It was necessary to demonstrate that the residential element of the scheme met Camden's requirement for a minimum 19% reduction in residential CO_2 emissions. Offsetting was required for the remaining CO_2 emissions up to 35%.

Table 1 Gray's Inn Road Residential CO_2 emissions After each stage of the energy hierarchy	Carbon dioxide emissions (Tonnes CO_2 per annum) SAP2012		
	Regulated	Unregulated	Total
Part L 2013 compliant building	17.7	20.3	38.1
Be Lean	17.3	20.3	37.6
Be Clean	17.3	20.3	37.6
Be Green	13.9	20.3	34.2

Table 2 Gray's Inn Road Residential CO_2 emissions Savings at each stage of the energy hierarchy		Carbon dioxide savings SAP2012			
		(Tonnes CO_2 per annum)		%	
		Regulated	Total	Regulated	Total
Be Lean	Savings from demand reduction	0.5	0.5	2.8%	1.3%
Be Clean	Savings from decentralised energy	0.0	0.0	0.0%	0.0%
Be Green	Savings from renewable energy	3.4	3.4	18.9%	8.8%
	Total cumulative savings	3.9	3.9	21.7%	10.1%

Tables 1 and 2 above show the total tonnage of CO_2 and savings at each stage of the Energy Hierarchy, respectively. The residential units achieved a 21.7% reduction in CO_2 emissions, in compliance with Camden's policy.

Given that the target CO_2 emissions reduction of 35% was the same for residential and non-residential in Camden, the combined results were used to calculate the necessary offset payment. Table 3 below shows the overall site-wide tonnage of CO_2 at each stage of the Energy Hierarchy for the previously consented scheme.

Table 3 Gray's Inn Road & Panther House Combined Residential &Non-Residential CO_2 After each stage of the energy hierarchy	Carbon dioxide emissions (Tonnes CO_2 per annum) SAP2012		
	Regulated	Unregulated	Total
Part L 2013 compliant development	249.7	98.7	348.4
Be Lean	203.0	98.7	301.8
Be Clean	203.0	98.7	301.8
Be Green	199.7	98.7	298.4

Table 4 below shows the overall site-wide CO_2 savings in tonnes and as a percentage for each stage of the energy hierarchy. The site-wide CO_2 emissions saving was 20%, which is short of the 35% target, meaning an offset payment was required.

Table 4 Gray's Inn Road & Panther House Combined Residential & Non-Residential CO_2 Savings at each stage of the energy hierarchy		Carbon dioxide savings SAP2012			
		(Tonnes CO_2 per annum)		%	
		Regulated	Total	Regulated	Total
Be Lean	Savings from demand reduction	46.7	46.7	18.7%	13.4%
Be Clean	Savings from CHP	0.0	0.0	0.0%	0.0%
Be Green	Savings from renewable energy	3.4	3.4	1.3%	1.0%
	Total cumulative savings	**50.1**	**50.1**	**20.0%**	**14.4%**

Table 5 below shows the CO_2 emissions savings, the shortfall to the 35% target and the associated offset payment figure.

Total Target Savings (35%)	87.4 TCO_2
Savings Achieved	50.1 TCO_2
Shortfall	37.3 TCO_2
Offset (Shortfall x £90 x 30 years)	£100,710

Table 5: Carbon Offset Calculation for Consented Scheme's Energy Strategy

Revised Strategy Results

The latest iteration of the GLA's energy policy (April 2020) indicates that the results should be presented and any associated offsetting, in the event of a shortfall in CO_2 emissions to the relevant targets, should be set against SAP 10. Given it is proposed to change the only gas-based heating within the scheme, previously used for the residential units, to heat pumps to comply with emerging and future policy more closely, it is proposed to use SAP 10 results to assess CO_2 emissions for residential only.

Table 6 below shows that the overall CO_2 emissions for the residential units will be 8.7 tonnes per year using SAP 10. This is a reduction from the 13.9 tonnes CO_2 from the consented scheme's energy strategy under SAP 2012 of 5.2 tonnes CO_2.

Table 6 Gray's Inn Road Residential CO_2 emissions After each stage of the energy hierarchy	**Carbon dioxide emissions (Tonnes CO_2 per annum) SAP10**		
	Regulated	**Unregulated**	**Total**
Part L compliant building	19.3	20.3	39.6
Be Lean	18.2	20.3	38.5
Be Clean	18.2	20.3	38.5
Be Green	8.7	20.3	29.0

Table 7 below shows that the revised heat pump strategy achieves a 54.8% reduction in CO_2 emissions under SAP10, which exceeds the 35% target.

Table 7 Gray's Inn Road Residential CO_2 emissions Savings at each stage of the energy hierarchy		**Carbon dioxide savings SAP10**			
		(Tonnes CO_2 per annum)		**%**	
		Regulated	**Total**	**Regulated**	**Total**
Be Lean	**Savings from demand reduction**	1.1	1.1	5.8%	2.8%
Be Clean	**Savings from decentralised energy**	0.0	0.0	0.0%	0.0%
Be Green	**Savings from renewable energy**	9.5	9.5	49.0%	23.9%
	Total cumulative savings	10.6	10.6	54.8%	26.7%

When combined with the non-residential element of the scheme, the site-wide results are also 5.2 TCO_2 lower than the consented scheme's strategy. The results in Table 8 below are a combination of the updated residential emissions using the heat pump strategy under SAP 10 and the previous unchanged strategy as consented for the non-residential element of the scheme under SAP 2012.

Table 8 Gray's Inn Road & Panther House Combined Residential &Non-Residential CO_2 After each stage of the energy hierarchy	**Carbon dioxide emissions (Tonnes CO_2 per annum) SAP10 & SAP2012**		
	Regulated	**Unregulated**	**Total**
Part L 2013 compliant development	251.3	98.7	350.0
Be Lean	203.9	98.7	302.7
Be Clean	203.9	98.7	302.7
Be Green	194.5	98.7	293.2

The overall site-wide CO_2 savings in tonnes and as a percentage for each stage of the energy hierarchy combined for the revised residential heat pump strategy under SAP 10 and the consented scheme's unchanged non-residential energy strategy under SAP 2012, are presented in Table 9.

This shows that the total cumulative CO_2 emissions savings are 56.8 tonnes, which is a 22.6% reduction.

The site-wide CO_2 emissions saving is short of the 35% target, meaning an offset payment is still required.

Table 9 Gray's Inn Road & Panther House Combined Residential & Non-Residential CO_2 Savings at each stage of the energy hierarchy		**Carbon dioxide savings SAP 10 & SAP2012**			
		(Tonnes CO_2 per annum)		**%**	
		Regulated	**Total**	**Regulated**	**Total**
Be Lean	**Savings from demand reduction**	47.3	47.3	18.8%	13.5%
Be Clean	**Savings from CHP**	0.0	0.0	0.0%	0.0%
Be Green	**Savings from renewable energy**	9.5	9.5	3.8%	2.7%
	Total cumulative savings	**56.8**	**56.8**	**22.6%**	**16.2%**

Table 10 below shows the CO_2 emissions savings, the shortfall to the 35% target and the associated offset payment figure for the development with the revised residential energy strategy.

Total Target Savings (35%)	87.9 TCO_2
Savings Achieved	56.8 TCO_2
Shortfall	31.2 TCO_2
Offset (Shortfall x £90 x 30 years)	£84,240

Table 10: Carbon Offset Calculation for Revised Residential Energy Strategy

CONCLUSION

The proposed revision to the energy strategy is an improvement on the consented scheme. The CO_2 emissions from the development will be lower and the use of heat pumps also benefits the scheme as the emissions will continue to decrease as grid electricity continues to decarbonise.

Although a robust and reliable source of heat, gas boilers are viewed less and less favourably due to concerns regarding air quality (from local combustion of gas and expulsion via flues), limitations with respect to efficiency and lower opportunities for decarbonisation due to the use of mains gas. The replacement of boilers with heat pumps helps the scheme's transition to net zero by taking advantage of the current and projected decarbonisation of grid electricity, providing all of the heat demand from highly efficient low-carbon plant.

Although a relatively minor change from gas boilers to heat pumps for the residential properties, the proposed energy strategy aligns more closely with the emerging Building Regulations and planning policies and could help to future proof the scheme against the Government's Future Homes Standards.

Results Comparison

The final table 11 below is a summary of the consented scheme's results compared with the revised residential strategy results.

Table 11 Simple comparison between the Consented Scheme and the Revised Strategy	**Consented Scheme**		**Revised Strategy**	
	Regulated (Tonnes CO_2 per annum)	**%**	**Regulated (Tonnes CO_2 per annum)**	**%**
Residential CO_2 emissions Savings after all stages of the energy hierarchy	3.9	21.7%	10.6	54.8%
Combined Residential & Non-Residential CO_2 Savings after all stages of the energy hierarchy	50.1	20%	56.1	22.6%
Shortfall	37.3	-	31.2	-
Offset (Shortfall x £90 x 30 years)	£100,710	-	£84,240	-

Table 11: Simple comparison between the Consented Scheme and the Revised Strategy

appendix a...

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Apt 12	Issued on Date	15/02/2021
Assessment Reference	012	Prop Type Ref	
Property	12		

SAP Rating	83 B	DER	14.48	TER	25.61
Environmental	90 B	% DER<TER	43.46		
CO_2 Emissions (t/year)	0.71	DFEE	42.82	TFEE	43.02
General Requirements Compliance	Pass	% DFEE<TFEE	0.47		

Assessor Details	Mrs. Caroline Kerss, Caroline Kerss, Tel: 020778361133, ckerss@mtt-limited.com	Assessor ID	T282-0001
Client			

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 59 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 (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 25.61 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.48 kgCO□/m²OK
--------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)43.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.8 kWh/m²/yrOK
--------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.20 (max. 0.30)        0.25 (max. 0.70)          OK
Floor           (no floor)
Roof            0.12 (max. 0.20)        0.12 (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:                    Community heating scheme            -

Secondary heating system:               Room heaters - electric

Panel, convector or radiant heaters
--------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 1.18 kWh/day
Permitted by DBSCG 1.85                           OK
Primary pipework insulated:             Yes (assumed)                       OK
--------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Charging system linked to use of community heating, TRVsOK


Hot water controls:                     Cylinderstat                        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:                     0.50
Maximum                                 1.5                                 OK
MVHR efficiency:                        90%
Minimum:                                70%                                 OK
--------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Medium                              OK
Based on:
Overshading:                            Average
Windows facing West:                    18.00 m², No overhang
Air change rate:                        4.00 ach
Blinds/curtains:                        Dark-coloured curtain or roller blind, closed 0% of daylight hours
--------------------------------------------------------------------------------
10 Key features
Roof U-value                            0.12 W/m²K
Air permeability                        3.0 m³/m²h
Secondary heating (electricity)
Photovoltaic array                      0.09 kW



--------------------------------------------------------------------------------
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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
--------------------------------------------------------------------------------------------
--------------------------------------------------------------------------------------------

--------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
--------------------------------------------------------------------------------------------
                                                                        Area          Storey height              Volume
                                                                        (m2)                   (m)                 (m3)
Ground floor                                                         59.0000 (1b)     x      2.7000 (2b)    =    159.3000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          59.0000                                                  (4)
Dwelling volume                                                            (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    159.3000 (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                                                                                               3 (19)

Shelter factor                                                                    (20) = 1  -  [0.075 x (19)]  =      0.7750 (20)
Infiltration rate adjusted to include shelter factor                                     (21) = (18) x (20)  =      0.1163 (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
               0.1482    0.1453    0.1424    0.1279    0.1250    0.1104    0.1104    0.1075    0.1163    0.1250    0.1308    0.1366 (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) =                      76.5000 (23c)

Effective ac   0.2657    0.2628    0.2599    0.2454    0.2425    0.2279    0.2279    0.2250    0.2338    0.2425    0.2483    0.2541 (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)                                           18.0000      1.2357     22.2433                          (27)
Spandrel                                                              1.4400      1.3000      1.8720                          (26)
External Wall 1                             39.4200      19.4400     19.9800      0.1500      2.9970                          (29a)
Lift                                        18.3600                  18.3600      0.2500      4.5900                          (29a)
External Roof 1                             12.6000                  12.6000      0.1200      1.5120                          (30)
Total net area of external elements Aum(A, m2)                       70.3800                                                  (31)
Fabric heat loss, W/K = Sum (A x U)                                      (26)...(30) + (32) =     33.2143                     (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                               250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area)                                                       10.5570 (36)
Total fabric heat loss                                                                          (33) + (36) =    43.7713 (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         13.9686   13.8158   13.6630   12.8991   12.7463   11.9824   11.9824   11.8297   12.2880   12.7463   13.0519   13.3575 (38)
Heat transfer coeff
              57.7399   57.5871   57.4344   56.6705   56.5177   55.7538   55.7538   55.6010   56.0593   56.5177   56.8232   57.1288 (39)
Average = Sum(39)m / 12 =                                                                                         56.6323 (39)

                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            0.9786    0.9761    0.9735    0.9605    0.9579    0.9450    0.9450    0.9424    0.9502    0.9579    0.9631    0.9683 (40)
HLP (average)                                                                                                      0.9599 (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                                                                                                  1.9532 (42)
Average daily hot water use (litres/day)                                                                          80.5891 (43)

                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
              88.6480   85.4244   82.2008   78.9773   75.7537   72.5301   72.5301   75.7537   78.9773   82.2008   85.4244   88.6480 (44)
Energy conte 131.4624  114.9778  118.6468  103.4392   99.2523   85.6472   79.3647   91.0722   92.1599  107.4035  117.2393  127.3143 (45)
Energy content (annual)                                                                        Total = Sum(45)m =   1267.9796 (45)
Distribution loss  (46)m = 0.15 x (45)m
              19.7194   17.2467   17.7970   15.5159   14.8879   12.8471   11.9047   13.6608   13.8240   16.1105   17.5859   19.0971 (46)
Water storage loss:
```


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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Store volume                                                                                                    145.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                     1.1800 (48)
  Temperature factor from Table 2b                                                                                0.6000 (49)
Enter (49) or (54) in (55)                                                                                        0.7080 (55)
Total storage loss
              21.9480   19.8240   21.9480   21.2400   21.9480   21.2400   21.9480   21.9480   21.2400   21.9480   21.2400   21.9480 (56)
If cylinder contains dedicated solar storage
              21.9480   19.8240   21.9480   21.2400   21.9480   21.2400   21.9480   21.9480   21.2400   21.9480   21.2400   21.9480 (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
             176.6728  155.8130  163.8572  147.1912  144.4627  129.3992  124.5751  136.2826  135.9119  152.6139  160.9913  172.5247 (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
             176.6728  155.8130  163.8572  147.1912  144.4627  129.3992  124.5751  136.2826  135.9119  152.6139  160.9913  172.5247 (64)
                                                                         Total per year (kWh/year) = Sum(64)m =   1800.2956 (64)
Heat gains from water heating, kWh/month
              79.8796   70.8983   75.6184   69.3951   69.1697   63.4793   62.5571   66.4498   65.6448   71.8800   73.9837   78.5003 (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         97.6612   97.6612   97.6612   97.6612   97.6612   97.6612   97.6612   97.6612   97.6612   97.6612   97.6612   97.6612 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              15.1929   13.4942   10.9742    8.3082    6.2105    5.2431    5.6654    7.3641    9.8841   12.5501   14.6478   15.6151 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             170.4180  172.1864  167.7301  158.2431  146.2675  135.0121  127.4928  125.7244  130.1807  139.6677  151.6433  162.8987 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              32.7661   32.7661   32.7661   32.7661   32.7661   32.7661   32.7661   32.7661   32.7661   32.7661   32.7661   32.7661 (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)
             -78.1289  -78.1289  -78.1289  -78.1289  -78.1289  -78.1289  -78.1289  -78.1289  -78.1289  -78.1289  -78.1289  -78.1289 (71)
Water heating gains (Table 5)
             107.3650  105.5034  101.6376   96.3821   92.9701   88.1657   84.0821   89.3143   91.1733   96.6129  102.7551  105.5112 (72)
Total internal gains
             345.2743  343.4824  332.6403  315.2318  297.7464  280.7193  269.5387  274.7011  283.5364  301.1290  321.3446  336.3234 (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
--------------------------------------------------------------------------------------------
West                                18.0000         19.6403          0.5400          1.0000        0.7700       132.2960 (80)
--------------------------------------------------------------------------------------------

Solar gains   132.2960  258.7991  426.2053  621.5950  761.7880  779.8255  742.4257  637.7327  495.6944  307.0869  164.9576  108.7938 (83)
Total gains   477.5703  602.2815  758.8456  936.8267 1059.5343 1060.5448 1011.9644  912.4338  779.2308  608.2160  486.3022  445.1172 (84)

--------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
--------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           70.9600   71.1482   71.3375   72.2991   72.4945   73.4878   73.4878   73.6897   73.0872   72.4945   72.1047   71.7190
alpha          5.7307    5.7432    5.7558    5.8199    5.8330    5.8992    5.8992    5.9126    5.8725    5.8330    5.8070    5.7813
util living area
               0.9909    0.9689    0.8885    0.6957    0.4919    0.3361    0.2424    0.2802    0.4923    0.8387    0.9761    0.9937 (86)

MIT           20.1932   20.4351   20.7393   20.9440   20.9926   20.9994   20.9999   20.9998   20.9947   20.8719   20.4807   20.1481 (87)
Th 2          20.1012   20.1033   20.1055   20.1164   20.1185   20.1294   20.1294   20.1316   20.1251   20.1185   20.1142   20.1098 (88)
util rest of house
               0.9882    0.9604    0.8642    0.6539    0.4467    0.2905    0.1944    0.2274    0.4316    0.7965    0.9681    0.9917 (89)
MIT 2         19.0413   19.3881   19.8028   20.0608   20.1126   20.1291   20.1294   20.1316   20.1216   19.9893   19.4657   18.9826 (90)
Living area fraction                                                                  fLA = Living area / (4) =      0.4763 (91)
MIT           19.5899   19.8868   20.2488   20.4815   20.5317   20.5436   20.5440   20.5451   20.5375   20.4096   19.9491   19.5377 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  19.5899   19.8868   20.2488   20.4815   20.5317   20.5436   20.5440   20.5451   20.5375   20.4096   19.9491   19.5377 (93)

--------------------------------------------------------------------------------------------
8. Space heating requirement
--------------------------------------------------------------------------------------------
                  Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9862    0.9580    0.8684    0.6716    0.4680    0.3122    0.2173    0.2525    0.4604    0.8114    0.9663    0.9901 (94)
Useful gains 470.9830  576.9927  658.9712  629.1534  495.8564  331.1380  219.8726  230.4209  358.7600  493.4841  469.9373  440.7081 (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
             882.8373  863.0446  789.6550  656.3267  499.1482  331.3765  219.8937  230.4714  360.8795  554.4179  730.1265  876.2249 (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
             306.4197  192.2269   97.2287   19.5648    2.4491    0.0000    0.0000    0.0000    0.0000   45.3347  187.3362  324.0245 (98)
Space heating                                                                                                  1174.5846 (98)
Space heating per m2                                                                             (98) / (4) =    19.9082 (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  524.0856  412.5781  422.5677    0.0000    0.0000    0.0000    0.0000 (100)
Utilisation      0.0000    0.0000    0.0000    0.0000    0.0000    0.9972    0.9990    0.9981    0.0000    0.0000    0.0000    0.0000 (101)
Useful loss      0.0000    0.0000    0.0000    0.0000    0.0000  522.6231  412.1678  421.7729    0.0000    0.0000    0.0000    0.0000 (102)
Total gains      0.0000    0.0000    0.0000    0.0000    0.0000 1302.0056 1244.0407 1128.5118    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  561.1554  618.9135  525.8137    0.0000    0.0000    0.0000    0.0000 (104)
Space cooling                                                                                                              1705.8826 (104)
Cooled fraction                                                                                   fC = cooled area / (4) =    0.7627 (105)
Intermittency factor (Table 10b)
                 0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.0000    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                 0.0000    0.0000    0.0000    0.0000    0.0000  107.0000    0.0000  100.2611    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                               207.2611 (107)
Space cooling per m2                                                                                                          3.5129 (108)



-----------------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                        0.1000 (301)
Fraction of space heat from community system                                                                 0.9000 (302)
Fraction of heat from community Heat pump                                                                    1.0000 (303a)
Fraction of total space heat from community Heat pump                                                        0.9000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating                             1.0000 (305)
Factor for control and charging method (Table 4c(3)) for community water heating                             1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                            1.1000 (306)
Space heating:
Annual space heating requirement                                                                          1174.5846 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10                                                     1162.8387 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                    100.0000 (308)
Space heating fuel for secondary/supplementary system                                                      117.4585 (309)

Water heating
Annual water heating requirement                                                                          1800.2956 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10                                                     1980.3252 (310a)
Electricity used for heat distribution                                                                      31.4316 (313)
Cooling System Energy Efficiency Ratio                                                                       4.4250 (314)
Space cooling (if there is a fixed cooling system, if not enter 0)                                          46.8387 (315)
Annual totals kWh/year

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)
   mechanical ventilation fans (SFP =       0.6250)                                                        121.4663 (330a)
Total electricity for the above, kWh/year                                                                  121.4663 (331)
Electricity for lighting (calculated in Appendix L)                                                        268.3112 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.09 * 1080 * 0.80) =                                                  -62.1806          -62.1806 (333)
Total delivered energy for all uses                                                                       3635.0579 (338)



-----------------------------------------------------------------------------------------------------
12b. Carbon dioxide emissions - Community heating scheme
-----------------------------------------------------------------------------------------------------
                                                                        Energy      Emission factor         Emissions
                                                                      kWh/year          kg CO2/kWh       kg CO2/year
Efficiency of heat source Heat pump                                                                        280.0000 (367a)
Space heating from Heat pump                                         1122.5585              0.5190          582.6079 (367)
Electrical energy for heat distribution                                31.4316              0.5190           16.3130 (372)
Total CO2 associated with community systems                                                                598.9209 (373)
 (negative value allowed since DFEE <= TFEE)
Space heating - secondary                                             117.4585              0.5190           60.9609 (374)
Space and water heating                                                                                    659.8818 (376)
Space cooling                                                          46.8387              0.5190           24.3093 (377)
Pumps and fans                                                        121.4663              0.5190           63.0410 (378)
Energy for lighting                                                   268.3112              0.5190          139.2535 (379)

 Energy saving/generation technologies
PV Unit                                                               -62.1806              0.5190          -32.2717 (380)
Total CO2, kg/year                                                                                         854.2139 (383)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                 14.4800 (384)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                         14.4800 ZC1
Total Floor Area                                                                                    TFA     59.0000
Assumed number of occupants                                                                           N      1.9532
CO2 emission factor in Table 12 for electricity displaced from grid                                  EF      0.5190
CO2 emissions from appliances, equation (L14)                                                               17.1163 ZC2
CO2 emissions from cooking, equation (L16)                                                                   2.8115 ZC3
Total CO2 emissions                                                                                         34.4078 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                                                                                           34.4078 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

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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                                                          59.0000 (1b)    x     2.7000 (2b)   =   159.3000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)          59.0000                                                 (4)
Dwelling volume                                                           (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   159.3000 (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                                                                                    2 * 10 =    20.0000 (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) =                            20.0000 / (5) =     0.1255 (8)
Pressure test                                                                                                                 Yes
Measured/design AP50                                                                                                       5.0000
Infiltration rate                                                                                                          0.3755 (18)
Number of sides sheltered                                                                                                       3 (19)

Shelter factor                                                                       (20) = 1  -  [0.075 x (19)]  =        0.7750 (20)
Infiltration rate adjusted to include shelter factor                                        (21) = (18) x (20)   =        0.2911 (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
                 0.3711    0.3638    0.3565    0.3202    0.3129    0.2765    0.2765    0.2692    0.2911    0.3129    0.3274    0.3420 (22b)
Effective ac     0.5689    0.5662    0.5636    0.5512    0.5489    0.5382    0.5382    0.5362    0.5424    0.5489    0.5536    0.5585 (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 Opaque door                                                       1.4400        1.0000        1.4400                              (26)
TER Opening Type (Uw = 1.40)                                         13.3100        1.3258       17.6458                              (27)
External Wall 1                          39.4200       14.7500       24.6700        0.1800        4.4406                              (29a)
Lift                                     18.3600                     18.3600        0.1800        3.3048                              (29a)
External Roof 1                          12.6000                     12.6000        0.1300        1.6380                              (30)
Total net area of external elements Aum(A, m2)                       70.3800                                                          (31)
Fabric heat loss, W/K = Sum (A x U)                                     (26)...(30) + (32) =     28.4692                              (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                          250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)                                                               3.5190 (36)
Total fabric heat loss                                                                                   (33) + (36) =      31.9882 (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          29.9041   29.7635   29.6258   28.9787   28.8576   28.2940   28.2940   28.1896   28.5111   28.8576   29.1025   29.3586 (38)
Heat transfer coeff
               61.8923   61.7518   61.6140   60.9669   60.8458   60.2822   60.2822   60.1778   60.4993   60.8458   61.0907   61.3468 (39)
Average = Sum(39)m / 12 =                                                                                                   60.9663 (39)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP              1.0490    1.0466    1.0443    1.0333    1.0313    1.0217    1.0217    1.0200    1.0254    1.0313    1.0354    1.0398 (40)
HLP (average)                                                                                                                1.0333 (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                                                                                                            1.9532 (42)
Average daily hot water use (litres/day)                                                                                    80.5891 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
               88.6480   85.4244   82.2008   78.9773   75.7537   72.5301   72.5301   75.7537   78.9773   82.2008   85.4244   88.6480 (44)
Energy conte  131.4624  114.9778  118.6468  103.4392   99.2523   85.6472   79.3647   91.0722   92.1599  107.4035  117.2393  127.3143 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =  1267.9796 (45)
Distribution loss  (46)m = 0.15 x (45)m
               19.7194   17.2467   17.7970   15.5159   14.8879   12.8471   11.9047   13.6608   13.8240   16.1105   17.5859   19.0971 (46)
Water storage loss:
Store volume                                                                                                               145.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                1.3665 (48)
  Temperature factor from Table 2b                                                                                           0.5400 (49)
Enter (49) or (54) in (55)                                                                                                   0.7379 (55)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Total storage loss
               22.8747    20.6610    22.8747    22.1368    22.8747    22.1368    22.8747    22.8747    22.1368    22.8747    22.1368    22.8747 (56)
If cylinder contains dedicated solar storage
               22.8747    20.6610    22.8747    22.1368    22.8747    22.1368    22.8747    22.8747    22.1368    22.8747    22.1368    22.8747 (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
              177.5994   156.6500   164.7839   148.0879   145.3894   130.2960   125.5018   137.2093   136.8087   153.5405   161.8881   173.4514 (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
              177.5994   156.6500   164.7839   148.0879   145.3894   130.2960   125.5018   137.2093   136.8087   153.5405   161.8881   173.4514 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =      1811.2065 (64)
Heat gains from water heating, kWh/month
               80.6209    71.5679    76.3597    70.1125    69.9111    64.1967    63.2984    67.1912    66.3622    72.6213    74.7011    79.2417 (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          97.6612    97.6612    97.6612    97.6612    97.6612    97.6612    97.6612    97.6612    97.6612    97.6612    97.6612    97.6612 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               15.1904    13.4919    10.9724     8.3068     6.2094     5.2423     5.6644     7.3629     9.8824    12.5480    14.6454    15.6125 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              170.4180   172.1864   167.7301   158.2431   146.2675   135.0121   127.4928   125.7244   130.1807   139.6677   151.6433   162.8987 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               32.7661    32.7661    32.7661    32.7661    32.7661    32.7661    32.7661    32.7661    32.7661    32.7661    32.7661    32.7661 (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)
              -78.1289   -78.1289   -78.1289   -78.1289   -78.1289   -78.1289   -78.1289   -78.1289   -78.1289   -78.1289   -78.1289   -78.1289 (71)
Water heating gains (Table 5)
              108.3614   106.4998   102.6340    97.3785    93.9665    89.1621    85.0785    90.3107    92.1697    97.6093   103.7515   106.5076 (72)
Total internal gains
              349.2682   347.4766   336.6349   319.2268   301.7418   284.7148   273.5342   278.6963   287.5312   305.1234   325.3386   340.3172 (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
-----------------------------------------------------------------------------------------------------
West                                     13.3100           19.6403           0.6300           0.7000             0.7700            79.8909 (80)
-----------------------------------------------------------------------------------------------------

Solar gains     79.8909   156.2835   257.3767   375.3685   460.0282   470.9208   448.3358   385.1138   299.3397   185.4435    99.6145    65.6984 (83)
Total gains    429.1590   503.7601   594.0116   694.5953   761.7700   755.6356   721.8699   663.8101   586.8709   490.5669   424.9531   406.0156 (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            66.1992    66.3499    66.4983    67.2041    67.3378    67.9673    67.9673    68.0852    67.7235    67.3378    67.0678    66.7879
alpha           5.4133     5.4233     5.4332     5.4803     5.4892     5.5312     5.5312     5.5390     5.5149     5.4892     5.4712     5.4525
util living area
                0.9950     0.9875     0.9607     0.8700     0.6991     0.5044     0.3665     0.4151     0.6761     0.9313     0.9886     0.9962 (86)

MIT            20.0163    20.1941    20.4762    20.7830    20.9458    20.9924    20.9989    20.9979    20.9664    20.7137    20.3024    19.9829 (87)
Th 2           20.0427    20.0446    20.0466    20.0556    20.0573    20.0653    20.0653    20.0667    20.0622    20.0573    20.0539    20.0503 (88)
util rest of house
                0.9934     0.9836     0.9488     0.8366     0.6415     0.4335     0.2892     0.3319     0.5978     0.9048     0.9843     0.9950 (89)
MIT 2          18.7410    18.9998    19.4023    19.8198    20.0101    20.0607    20.0649    20.0659    20.0386    19.7438    19.1656    18.6980 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.4763 (91)
MIT            19.3484    19.5686    19.9137    20.2786    20.4558    20.5045    20.5097    20.5098    20.4805    20.2057    19.7070    19.3100 (92)
Temperature adjustment                                                                                                             0.0000
adjusted MIT   19.3484    19.5686    19.9137    20.2786    20.4558    20.5045    20.5097    20.5098    20.4805    20.2057    19.7070    19.3100 (93)


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

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9918     0.9811     0.9469     0.8451     0.6666     0.4671     0.3260     0.3716     0.6339     0.9095     0.9823     0.9937 (94)
Useful gains  425.6451   494.2613   562.4713   587.0366   507.8048   352.9866   235.3628   246.6646   371.9888   446.1882   417.4318   403.4712 (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
              931.3807   905.8132   826.4732   693.7155   532.7512   355.9353   235.6880   247.3199   386.0128   584.4684   770.1725   926.9484 (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
              376.2673   276.5629   196.4175    76.8088    18.5601     0.0000     0.0000     0.0000     0.0000   102.8804   253.9733   389.4670 (98)
Space heating                                                                                                                   1690.9373 (98)
Space heating per m2                                                                                          (98) / (4) =       28.6600 (99)


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


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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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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 %)                                                                              93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                                        0.0000 (208)
Space heating requirement                                                                                                   1808.4891 (211)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
              376.2673   276.5629   196.4175    76.8088    18.5601     0.0000     0.0000     0.0000     0.0000   102.8804   253.9733   389.4670 (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)
              402.4250   295.7892   210.0722    82.1485    19.8504     0.0000     0.0000     0.0000     0.0000   110.0326   271.6291   416.5423 (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
              177.5994   156.6500   164.7839   148.0879   145.3894   130.2960   125.5018   137.2093   136.8087   153.5405   161.8881   173.4514 (64)
Efficiency of water heater                                                                                                    79.8000 (216)
(217)m         86.7694    86.3150    85.2831    83.1579    80.8826    79.8000    79.8000    79.8000    79.8000    83.7740    86.0105    86.9093 (217)
Fuel for water heating, kWh/month
              204.6799   181.4865   193.2198   178.0805   179.7537   163.2782   157.2704   171.9415   171.4394   183.2796   188.2190   199.5774 (219)
Water heating fuel used                                                                                                     2172.2258 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                            1808.4891 (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)                                                                          268.2664 (232)
Total delivered energy for all uses                                                                                         4323.9813 (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                                                            1808.4891              0.2160            390.6337 (261)
Space heating - secondary                                                                   0.0000              0.0000              0.0000 (263)
Water heating (other fuel)                                                               2172.2258              0.2160            469.2008 (264)
Space and water heating                                                                                                          859.8344 (265)
Pumps and fans                                                                             75.0000              0.5190             38.9250 (267)
Energy for lighting                                                                       268.2664              0.5190            139.2302 (268)
Total CO2, kg/m2/year                                                                                                           1037.9897 (272)
Emissions per m2 for space and water heating                                                                                      14.5735 (272a)
Fuel factor (electricity)                                                                                                          1.5500
Emissions per m2 for lighting                                                                                                      2.3598 (272b)
Emissions per m2 for pumps and fans                                                                                                0.6597 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.5735 * 1.55) + 2.3598 + 0.6597, rounded to 2 d.p.                                 25.6100 (273)
```

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

Design SAP
elmhurst energy

Property Reference	Apt 13	Issued on Date	17/02/2021
Assessment Reference	013	Prop Type Ref	
Property	13		

SAP Rating	84 B	DER	13.52	TER	23.27
Environmental	89 B	% DER<TER	41.90		
CO_2 Emissions (t/year)	1.03	DFEE	43.23	TFEE	45.40
General Requirements Compliance	Pass	% DFEE<TFEE	4.78		

Assessor Details	Mrs. Caroline Kerss, Caroline Kerss, Tel: 020778361133, ckerss@mtt-limited.com	Assessor ID	T282-0001
Client			

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

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 95 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 (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 23.27 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.52 kgCO□/m²OK
-------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)45.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.2 kWh/m²/yrOK
-------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average               Highest
External wall   0.15 (max. 0.30)      0.15 (max. 0.70)          OK
Floor           (no floor)
Roof            0.12 (max. 0.20)      0.12 (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:                  Community heating scheme                -

Secondary heating system:             Room heaters - electric

Panel, convector or radiant heaters
-------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                     Measured cylinder loss: 1.69 kWh/day
Permitted by DBSCG 2.86                       OK
Primary pipework insulated:           Yes (assumed)                           OK
-------------------------------------------------------------------------------------
6 Controls
Space heating controls:               Charging system linked to use of community heating, TRVsOK


Hot water controls:                   Cylinderstat                            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:                   0.60
Maximum                               1.5                                     OK
MVHR efficiency:                      89%
Minimum:                              70%                                     OK
-------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):     Medium                                  OK
Based on:
Overshading:                          Average
Windows facing East:                  22.00 m², No overhang
Windows facing West:                  9.00 m², No overhang
Air change rate:                      4.00 ach
Blinds/curtains:                      Dark-coloured curtain or roller blind, closed 0% of daylight hours
-------------------------------------------------------------------------------------
10 Key features
Roof U-value                          0.12 W/m²K
Air permeability                      3.0 m³/m²h
Secondary heating (electricity)
Photovoltaic array                    0.15 kW



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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
-------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------



-------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------
                                                                    Area          Storey height              Volume
                                                                    (m2)                (m)                   (m3)
Ground floor                                                     95.0000 (1b)     x     2.7000 (2b)     =    256.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)             95.0000                                             (4)
Dwelling volume                                                       (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    256.5000 (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                                                                                                       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) =                              75.6500 (23c)

Effective ac    0.2843      0.2811      0.2779      0.2620      0.2588      0.2429      0.2429      0.2397      0.2493      0.2588      0.2652      0.2716 (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)                                                31.0000         1.2357        38.3080                                (27)
Spandrel                                                                   2.2800         1.3000         2.9640                                (26)
External Wall 1                             91.8000         33.2800        58.5200         0.1500         8.7780                                (29a)
External Roof 1                             22.4000                        22.4000         0.1200         2.6880                                (30)
Total net area of external elements Aum(A, m2)                            114.2000                                                            (31)
Fabric heat loss, W/K = Sum (A x U)                                 (26)...(30) + (32) =      52.7380                                         (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                          250.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area)                                                                  17.1300 (36)
Total fabric heat loss                                                                                     (33) + (36) =    69.8680 (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         24.0656     23.7958     23.5260     22.1770     21.9072     20.5582     20.5582     20.2883     21.0978     21.9072     22.4468     22.9864 (38)
Heat transfer coeff
              93.9336     93.6638     93.3940     92.0450     91.7752     90.4261     90.4261     90.1563     90.9658     91.7752     92.3148     92.8544 (39)
Average = Sum(39)m / 12 =                                                                                                  91.9775 (39)

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
HLP            0.9888      0.9859      0.9831      0.9689      0.9661      0.9519      0.9519      0.9490      0.9575      0.9661      0.9717      0.9774 (40)
HLP (average)                                                                                                               0.9682 (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                                                                                                           2.6882 (42)
Average daily hot water use (litres/day)                                                                                   98.0440 (43)

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Daily hot water use
             107.8484    103.9267    100.0049     96.0831     92.1614     88.2396     88.2396     92.1614     96.0831    100.0049    103.9267    107.8484 (44)
Energy conte 159.9361    139.8811    144.3448    125.8433    120.7496    104.1977     96.5545    110.7977    112.1210    130.6662    142.6324    154.8896 (45)
Energy content (annual)                                                                            Total = Sum(45)m =   1542.6141 (45)
Distribution loss  (46)m = 0.15 x (45)m
              23.9904     20.9822     21.6517     18.8765     18.1124     15.6297     14.4832     16.6197     16.8182     19.5999     21.3949     23.2334 (46)
Water storage loss:
Store volume                                                                                                              300.0000 (47)
```


CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014


```
a) If  manufacturer declared loss factor is known  (kWh/day):                                                               1.6900 (48)
  Temperature factor from Table 2b                                                                                          0.6000 (49)
Enter (49) or (54) in (55)                                                                                                  1.0140 (55)
Total storage loss
              31.4340     28.3920     31.4340     30.4200     31.4340     30.4200     31.4340     31.4340     30.4200     31.4340     30.4200     31.4340 (56)
If cylinder contains dedicated solar storage
              31.4340     28.3920     31.4340     30.4200     31.4340     30.4200     31.4340     31.4340     30.4200     31.4340     30.4200     31.4340 (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
             214.6325    189.2843    199.0412    178.7753    175.4460    157.1297    151.2509    165.4941    165.0530    185.3626    195.5644    209.5860 (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
             214.6325    189.2843    199.0412    178.7753    175.4460    157.1297    151.2509    165.4941    165.0530    185.3626    195.5644    209.5860 (64)
                                                                                     Total per year (kWh/year) = Sum(64)m =   2186.6201 (64)
Heat gains from water heating, kWh/month
              96.9359     86.0330     91.7518     84.1885     83.9064     76.9914     75.8615     80.5974     79.6258     87.2036     89.7709     95.2579 (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        134.4085    134.4085    134.4085    134.4085    134.4085    134.4085    134.4085    134.4085    134.4085    134.4085    134.4085    134.4085 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              22.1078     19.6359     15.9690     12.0896      9.0371      7.6295      8.2439     10.7158     14.3827     18.2621     21.3146     22.7222 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             247.9820    250.5553    244.0707    230.2658    212.8396    196.4615    185.5198    182.9466    189.4311    203.2360    220.6622    237.0404 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              36.4408     36.4408     36.4408     36.4408     36.4408     36.4408     36.4408     36.4408     36.4408     36.4408     36.4408     36.4408 (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)
            -107.5268   -107.5268   -107.5268   -107.5268   -107.5268   -107.5268   -107.5268   -107.5268   -107.5268   -107.5268   -107.5268   -107.5268 (71)
Water heating gains (Table 5)
             130.2901    128.0253    123.3223    116.9285    112.7774    106.9324    101.9644    108.3298    110.5914    117.2092    124.6818    128.0348 (72)
Total internal gains
             463.7025    461.5391    446.6845    422.6064    397.9766    374.3459    359.0507    365.3147    377.7278    402.0299    429.9812    451.1200 (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
-------------------------------------------------------------------------------------------------
East                                        22.0000           19.6403          0.5400           1.0000          0.7700        161.6951 (76)
West                                         9.0000           19.6403          0.5400           1.0000          0.7700         66.1480 (80)
-------------------------------------------------------------------------------------------------

Solar gains    227.8432    445.7096    734.0202   1070.5246   1311.9681   1343.0329   1278.6220   1098.3174    853.6958    528.8719    284.0936    187.3671 (83)
Total gains    691.5457    907.2487   1180.7047   1493.1311   1709.9448   1717.3788   1637.6727   1463.6321   1231.4236    930.9019    714.0748    638.4871 (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           70.2328     70.4351     70.6386     71.6739     71.8846     72.9570     72.9570     73.1754     72.5242     71.8846     71.4644     71.0491
alpha          5.6822      5.6957      5.7092      5.7783      5.7923      5.8638      5.8638      5.8784      5.8349      5.7923      5.7643      5.7366
util living area
               0.9947      0.9772      0.9026      0.7055      0.4946      0.3366      0.2429      0.2832      0.5048      0.8632      0.9846      0.9965 (86)

MIT           20.1029     20.3667     20.7059     20.9384     20.9921     20.9993     20.9999     20.9998     20.9938     20.8457     20.4073     20.0572 (87)
Th 2          20.0927     20.0951     20.0974     20.1093     20.1117     20.1236     20.1236     20.1260     20.1189     20.1117     20.1070     20.1022 (88)
util rest of house
               0.9930      0.9707      0.8801      0.6635      0.4490      0.2907      0.1946      0.2295      0.4424      0.8240      0.9791      0.9954 (89)
MIT 2         18.9041     19.2852     19.7528     20.0479     20.1054     20.1233     20.1236     20.1260     20.1148     19.9531     19.3563     18.8449 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.3232 (91)
MIT           19.2915     19.6347     20.0608     20.3357     20.3919     20.4064     20.4068     20.4084     20.3989     20.2416     19.6960     19.2366 (92)
Temperature adjustment                                                                                                      0.0000
adjusted MIT  19.2915     19.6347     20.0608     20.3357     20.3919     20.4064     20.4068     20.4084     20.3989     20.2416     19.6960     19.2366 (93)



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

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation    0.9910      0.9666      0.8791      0.6745      0.4635      0.3055      0.2102      0.2469      0.4624      0.8303      0.9759      0.9939 (94)
Useful gains 685.3037    876.9192   1037.9482   1007.1573    792.5338    524.6981    344.2057    361.3060    569.4339    772.9248    696.8590    634.5729 (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
            1408.2056   1380.1105   1266.4976   1052.5963    797.7022    525.0480    344.2347    361.3791    572.9806    884.8552   1162.7926   1396.2177 (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
             537.8390    338.1445    170.0408     32.7160      3.8452      0.0000      0.0000      0.0000      0.0000     83.2762    335.4721    566.6637 (98)
Space heating                                                                                                            2067.9977 (98)
Space heating per m2                                                                                     (98) / (4) =     21.7684 (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	850.0057	669.1534	685.1881	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9970	0.9989	0.9979	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	847.4626	668.4310	683.7320	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2096.5915	2001.5434	1799.5020	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	899.3728	991.8356	830.1329	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2721.3413	(104)
Cooled fraction									fC = cooled area / (4) =			0.7895	(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	177.5078	195.7570	163.8420	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												537.1068	(107)
Space cooling per m2												5.6538	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)		0.1000	(301)
Fraction of space heat from community system		0.9000	(302)
Fraction of heat from community Heat pump		1.0000	(303a)
Fraction of total space heat from community Heat pump		0.9000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating		1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system		1.1000	(306)
Space heating:			
Annual space heating requirement		2067.9977	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10		2047.3177	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		100.0000	(308)
Space heating fuel for secondary/supplementary system		206.7998	(309)
Water heating			
Annual water heating requirement		2186.6201	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10		2405.2821	(310a)
Electricity used for heat distribution		44.5260	(313)
Cooling System Energy Efficiency Ratio		4.7790	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)		112.3890	(315)
Annual totals kWh/year			
Electricity for pumps and fans:			
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)			
mechanical ventilation fans (SFP = 0.7500)		234.6975	(330a)
Total electricity for the above, kWh/year		234.6975	(331)
Electricity for lighting (calculated in Appendix L)		390.4303	(332)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 0.15 * 1080 * 0.80) =	-103.6344	-103.6344	(333)
Total delivered energy for all uses		5293.2820	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			280.0000	(367a)
Space heating from Heat pump	1590.2142	0.5190	825.3212	(367)
Electrical energy for heat distribution	44.5260	0.5190	23.1090	(372)
Total CO2 associated with community systems			848.4302	(373)
(negative value allowed since DFEE <= TFEE)				
Space heating - secondary	206.7998	0.5190	107.3291	(374)
Space and water heating			955.7593	(376)
Space cooling	112.3890	0.5190	58.3299	(377)
Pumps and fans	234.6975	0.5190	121.8080	(378)
Energy for lighting	390.4303	0.5190	202.6333	(379)
Energy saving/generation technologies				
PV Unit	-103.6344	0.5190	-53.7862	(380)
Total CO2, kg/year			1284.7442	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			13.5200	(384)

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

DER		13.5200	ZC1
Total Floor Area	TFA	95.0000	
Assumed number of occupants	N	2.6882	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4683	ZC2
CO2 emissions from cooking, equation (L16)		1.9317	ZC3
Total CO2 emissions		30.9201	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		30.9201	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

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1. Overall dwelling dimensions

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	95.0000	(1b)	x	2.7000	(2b)	=	256.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 95.0000								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	256.5000	(5)

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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) =	0.1170	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3670	(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) =	0.3119	(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	0.3977	0.3899	0.3821	0.3431	0.3353	0.2963	0.2963	0.2885	0.3119	0.3353	0.3509	0.3665	(22b)
Effective ac	0.5791	0.5760	0.5730	0.5589	0.5562	0.5439	0.5439	0.5416	0.5486	0.5562	0.5616	0.5672	(25)

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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 Opaque door			2.2800	1.0000	2.2800			(26)
TER Opening Type (Uw = 1.40)			21.4700	1.3258	28.4640			(27)
External Wall 1	91.8000	23.7500	68.0500	0.1800	12.2490			(29a)
External Roof 1	22.4000		22.4000	0.1300	2.9120			(30)
Total net area of external elements Aum(A, m2)			114.2000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.9050			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)		5.7100	(36)
Total fabric heat loss	(33) + (36) =	51.6150	(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	49.0162	48.7563	48.5015	47.3048	47.0809	46.0386	46.0386	45.8456	46.4401	47.0809	47.5338	48.0074	(38)
Heat transfer coeff	100.6312	100.3713	100.1165	98.9198	98.6959	97.6537	97.6537	97.4606	98.0551	98.6959	99.1489	99.6224	(39)
Average = Sum(39)m / 12 =												98.9187	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0593	1.0565	1.0539	1.0413	1.0389	1.0279	1.0279	1.0259	1.0322	1.0389	1.0437	1.0487	(40)
HLP (average)												1.0412	(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	2.6882	(42)
Average daily hot water use (litres/day)	98.0440	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.8484	103.9267	100.0049	96.0831	92.1614	88.2396	88.2396	92.1614	96.0831	100.0049	103.9267	107.8484	(44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896	(45)
Energy content (annual)										Total = Sum(45)m =		1542.6141	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9904	20.9822	21.6517	18.8765	18.1124	15.6297	14.4832	16.6197	16.8182	19.5999	21.3949	23.2334	(46)

Water storage loss:		
Store volume	300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.1127	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.1409	(55)
Total storage loss		

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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                 35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (56)
If cylinder contains dedicated solar storage
                 35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (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
                218.5649   192.8362   202.9736   182.5808   179.3784   160.9353   155.1833   169.4265   168.8586   189.2950   199.3700   213.5184 (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
                218.5649   192.8362   202.9736   182.5808   179.3784   160.9353   155.1833   169.4265   168.8586   189.2950   199.3700   213.5184 (64)
                                                                                     Total per year (kWh/year) = Sum(64)m =      2232.9211 (64)
Heat gains from water heating, kWh/month
                100.0818    88.8745    94.8977    87.2329    87.0523    80.0358    79.0074    83.7433    82.6703    90.3496    92.8153    98.4038 (65)
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-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m           134.4085   134.4085   134.4085   134.4085   134.4085   134.4085   134.4085   134.4085   134.4085   134.4085   134.4085   134.4085 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 22.1038    19.6324    15.9661    12.0874     9.0355     7.6281     8.2424    10.7138    14.3801    18.2588    21.3108    22.7181 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                247.9820   250.5553   244.0707   230.2658   212.8396   196.4615   185.5198   182.9466   189.4311   203.2360   220.6622   237.0404 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 36.4408    36.4408    36.4408    36.4408    36.4408    36.4408    36.4408    36.4408    36.4408    36.4408    36.4408    36.4408 (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)
               -107.5268  -107.5268  -107.5268  -107.5268  -107.5268  -107.5268  -107.5268  -107.5268  -107.5268  -107.5268  -107.5268  -107.5268 (71)
Water heating gains (Table 5)
                134.5185   132.2537   127.5507   121.1569   117.0058   111.1608   106.1928   112.5582   114.8198   121.4376   128.9102   132.2632 (72)
Total internal gains
                470.9269   468.7640   453.9101   429.8326   405.2034   381.5729   366.2776   372.5411   384.9536   409.2550   437.2057   458.3443 (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
-----------------------------------------------------------------------------------------------------
East                                    15.2400           19.6403           0.6300           0.7000           0.7700           91.4754 (76)
West                                     6.2300           19.6403           0.6300           0.7000           0.7700           37.3945 (80)
-----------------------------------------------------------------------------------------------------

Solar gains     128.8698   252.0967   415.1673   605.4968   742.0591   759.6295   723.1982   621.2166   482.8568   299.1340   160.6855   105.9763 (83)
Total gains     599.7967   720.8607   869.0774  1035.3294  1147.2625  1141.2024  1089.4759   993.7577   867.8104   708.3890   597.8912   564.3205 (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              65.5584    65.7282    65.8955    66.6926    66.8439    67.5574    67.5574    67.6911    67.2808    66.8439    66.5386    66.2223
alpha             5.3706     5.3819     5.3930     5.4462     5.4563     5.5038     5.5038     5.5127     5.4854     5.4563     5.4359     5.4148
util living area
                  0.9975     0.9928     0.9738     0.8991     0.7380     0.5385     0.3930     0.4480     0.7249     0.9549     0.9939     0.9982 (86)

MIT              19.9121    20.0945    20.3908    20.7317    20.9282    20.9894    20.9984    20.9969    20.9520    20.6469    20.2097    19.8817 (87)
Th 2             20.0342    20.0365    20.0387    20.0491    20.0510    20.0601    20.0601    20.0618    20.0566    20.0510    20.0471    20.0430 (88)
util rest of house
                  0.9966     0.9904     0.9653     0.8703     0.6807     0.4634     0.3098     0.3583     0.6459     0.9355     0.9915     0.9975 (89)
MIT 2            18.5832    18.8502    19.2775    19.7509    19.9870    20.0537    20.0596    20.0606    20.0217    19.6519    19.0270    18.5451 (90)
Living area fraction                                                                              fLA = Living area / (4) =      0.3232 (91)
MIT              19.0126    19.2523    19.6373    20.0679    20.2912    20.3561    20.3630    20.3632    20.3224    19.9734    19.4092    18.9770 (92)
Temperature adjustment                                                                                                           0.0000
adjusted MIT     19.0126    19.2523    19.6373    20.0679    20.2912    20.3561    20.3630    20.3632    20.3224    19.9734    19.4092    18.9770 (93)
```

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

                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation       0.9953     0.9878     0.9609     0.8709     0.6959     0.4874     0.3367     0.3874     0.6694     0.9335     0.9893     0.9966 (94)
Useful gains    597.0022   712.0803   835.1210   901.6789   798.3791   556.2550   366.8524   384.9605   580.9305   661.3079   591.5213   562.3811 (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
               1480.5498  1440.5628  1315.2591  1104.7223   847.9124   562.1013   367.4677   386.2534   610.1344   925.1185  1220.4462  1472.1238 (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
                657.3594   489.5402   357.2228   146.1913    36.8527     0.0000     0.0000     0.0000     0.0000   196.2751   452.8259   676.8485 (98)
Space heating                                                                                                                 3013.1160 (98)
Space heating per m2                                                                                      (98) / (4) =      31.7170 (99)
```

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


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

Design SAP
elmhurst energy

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                                                                                                   3222.5840 (211)

                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
                657.3594   489.5402   357.2228   146.1913    36.8527     0.0000     0.0000     0.0000     0.0000   196.2751   452.8259   676.8485 (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)
                703.0582   523.5724   382.0565   156.3543    39.4147     0.0000     0.0000     0.0000     0.0000   209.9199   484.3058   723.9022 (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
                218.5649   192.8362   202.9736   182.5808   179.3784   160.9353   155.1833   169.4265   168.8586   189.2950   199.3700   213.5184 (64)
Efficiency of water heater                                                                                                    79.8000 (216)
(217)m           87.5701    87.1960    86.3070    84.2281    81.4411    79.8000    79.8000    79.8000    79.8000    84.9104    86.9366    87.6806 (217)
Fuel for water heating, kWh/month
                249.5885   221.1526   235.1763   216.7695   220.2555   201.6733   194.4653   212.3140   211.6022   222.9350   229.3280   243.5183 (219)
Water heating fuel used                                                                                                     2658.7784 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                            3222.5840 (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)                                                                          390.3596 (232)
Total delivered energy for all uses                                                                                         6346.7220 (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                                         3222.5840               0.2160             696.0781 (261)
Space heating - secondary                                                0.0000               0.0000               0.0000 (263)
Water heating (other fuel)                                            2658.7784               0.2160             574.2961 (264)
Space and water heating                                                                                         1270.3743 (265)
Pumps and fans                                                          75.0000               0.5190              38.9250 (267)
Energy for lighting                                                    390.3596               0.5190             202.5966 (268)
Total CO2, kg/m2/year                                                                                           1511.8959 (272)
Emissions per m2 for space and water heating                                                                      13.3724 (272a)
Fuel factor (electricity)                                                                                          1.5500
Emissions per m2 for lighting                                                                                      2.1326 (272b)
Emissions per m2 for pumps and fans                                                                                0.4097 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.3724 * 1.55) + 2.1326 + 0.4097, rounded to 2 d.p.                 23.2700 (273)
```

…sustainable building services solutions

appendix b...

GLA Carbon Emission Reporting Spreadsheet

BACKGROUND AND PURPOSE

The GLA has decided that from **January 2019** and until central Government updates Part L with the latest carbon emission factors, planning applicants are encouraged to use the SAP 10.0 emission factors for **referable applications** when estimating CO_2 emission performance against London Plan policies. This is a new approach being taken by the GLA to reflect the decarbonisation of the electricity grid, which is not currently taken into account by Part L of Building Regulations. This approach will remain in place until Government adopts new Building Regulations with updated emission factors.

This GLA Carbon Emission Reporting Spreadsheet facilitates the use of the SAP 10.0 emission factors and ensures a consistent and transparent process for updating Part L 2013 CO_2 emission performance. In particular, the approach has been developed to ensure that SAP 10.0 results can still be validated against supporting Part L 2013 BRUKL and SAP outputs.

From **January 2019** all GLA referable applications (including refurbishments) are expected to use this spreadsheet to report the anticipated carbon performance of a development. This includes planning applicants who are continuing to use SAP 2012 emission factors; although doing so will need to be supported by sufficient justification in line with the Energy Assessment Guidance. Applicants are required to submit this spreadsheet to the GLA alongside the energy assessment. It should be used for both domestic and non-domestic uses. The GLA will not accept the use of alternative methodologies or tools. This is to ensure consistency and to minimise the need for clarifications during the determination period.

Planning applicants should use Part L 2013 BRUKL and SAP outputs to fill in this spreadsheet which serves as a the final step in reporting the carbon emission performance of the proposed energy strategy. **It is solely for the purpose of reporting to the GLA and does not replace Part L calculations submitted for Building Regulations approval.**

The spreadsheet has been developed to fit as wide a range of policy compliant approaches for referable schemes as possible. Any planning applicants with a policy compliant approach that the spreadsheet does not serve should contact the GLA at: **environment@london.gov.uk.** Applicants must not amend or alter the spreadsheet to suit non-policy compliant strategies. Any unauthorised amendment to the spreadsheet will invalidate the CO_2 emission calculations.

Applicants should note that we will update the spreadsheet from time to time to ensure it remains fit for purpose. Applicants are expected to use the latest version at the time of the planning submission.

Any feedback on this spreadsheet should be sent to: environment@london.gov.uk.

METHODOLOGY

Applicants are required to complete all light blue input cells in the applicable tabs ('Carbon Factors', 'Baseline', 'Be Lean', 'Be Clean', 'Be Green' and 'GLA Summary Tables').

Input Data

For all applications, the input data required includes:
• Bespoke Carbon Factors (if applicable)
• Type of units modelled
• Area of units modelled (m²)
• Number of units modelled
• Total area represented by model (m²)
• Regulated energy consumption by end use (kWh p.a. for residential and kWh/m^2 p.a. for non-residential)
• Regulated energy consumption by fuel type (kWh/m^2 p.a. for non-residential)
• TER, DER and BER figures (kgCO_2/m² p.a.)
• TFEE and DFEE figures for residential (kWh//m² p.a.)
• Unregulated figures (tCO_2 p.a.) **[In the 'GLA Summary tables' tab only]**
• Actual and notional building cooling demand (MJ/m²) **[In the 'GLA Summary tables' tab only]**
• Distribution loss factor (if applicable) **[In the 'Development information' tab, Table 4]**

Applicants should update the highlighted cells with the type, area and number of modelled units. The consumption figures (kWh p.a. for domestic and kWh/m^2 p.a. for non-domestic) from the Part L modelling output reports should be reported and used to estimate the CO_2 emissions for each stage of the Energy Hierarchy. The TER, DER and BER figures from the Part L 2013 modelling output sheets should also be reported for cross-reference purposes. The applicant should ensure that the manually calculated TER, DER and BER figures are equal to the figures reported within the output sheets. TFEE and DFEE information should also be provided as well as unregulated uses consumption figures and cooling demand performance.

The total carbon emissions figures in the 'GLA Summary tables' tab are now calculated based on the area input for 'Total area represented by model (m²)'. This input requirement has been added to ensure that the carbon emission figures align with the development area schedule (included within the DAS) rather than the number of representative models.

Required Part L Outputs for the GLA spreadsheet

Domestic Part L Outputs:

For the domestic conversion applicants are required to use the outputs from the SAP TER and DER worksheets. To assist in the conversion process the required SAP worksheet rows have been referenced in each input cell. For Space Heating and Hot Water applicants will be required to manually convert the SAP energy requirements to energy consumption by fuel type, the appropriate SAP rows for this calculation have also been listed. **Note.** The SAP worksheet rows are based on a communal heating system, which is an expectation for GLA referrable schemes. Applicants proposing individual systems must first seek confirmation from the GLA as to whether the approach will be acceptable.

Non-domestic Part L Outputs:

The required Part L outputs from non-domestic modelling will be energy consumption by **fuel type** (e.g. grid electricity, natural gas).The energy consumption by end use (e.g. heating, hot water, cooling etc.) included in the BRUKL documents are no longer used to estimate the CO_2 emission performance with SAP 10.0 emission factors in this spreadsheet. This decision has been taken as the consumption figures provided in the BRUKL may include a mixture of fuel types, for instance heating may include energy consumption from gas boilers and electrically driven heat pumps. The required data can be found in:
• SBEM software: the required data is included in the output file ending "*sim.csv"
• Government approved software (such as IES and TAS): the required data is included in the output file ending in "*BRUKL.inp"

The above output files should be appended to the energy assessment document.

Regarding the non-domestic uses, the applicant can determine whether each individual unit will be modelled independently and apportioned to the entire scheme or whether a single model will be generated for the entire development. The applicant should, however, include the results from all BRUKL outputs generated for the proposed development under the "NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS" sections. Applicants are generally encouraged to model each individual typology independently.

Note: GLA are aware that the Part L outputs for grid supplied electricity consumption does not account for power factor correction. Where power factor correction is present applicants may be required to amend the electricity consumption by the appropriate adjustment factor. The power factor correction is found in Table 1 of the Government's Approved Document L2A (ADL2A). Applicants should note in the appropriate cells where power factor correction has been applied.

Carbon Factors

The carbon factors for SAP 2012 and SAP 10.0 scenarios have been provided in the 'Development Information' tab. The table has been pre-populated with grid electricity and gas factors. Additional space has been included for alternative fuel factors that are included in Table 12 of the SAP 2012 and SAP 10.0 methodology documents. For applications with non-domestic buildings connecting to external heat networks a bespoke carbon factor needs to be introduced, the applicant should provide the full calculation behind the introduced bespoke carbon factor.

Validation Check

A validation check is required for each model entered to ensure that the conversion is robust. Applicants must ensure that the calculated TER/DER/BER in this spreadsheet matches the actual values from the Part L 2013 BRUKL and SAP worksheets.

The applicant should complete all the light blue cells including information on the modelled units, the area per unit, the number of units, the baseline energy consumption figures, the TER and the TFEE.	SAP 2012 CO_2 PERFORMANCE	SAP 10.0 CO_2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

DEMAND

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 (kgCO$_2$ / m^2)	TER Worksheet TER 2012 (kgCO$_2$ / m^2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	REGULATED CO_2 EMISSIONS PER UNIT (kgCO$_2$ p.a.): Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO_2 emissions (kgCO$_2$ p.a.)	REGULATED CO_2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP 10.0 CO_2 emissions (kgCO$_2$ p.a.)	Calculated TER SAP 10.0 (kgCO$_2$ / m^2)	Fabric Energy Efficiency (FEE): Target Fabric Energy Efficiency (TFEE) (kWh/m²)
	TER Worksheet (Row 4)				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A														
1	50	1	50	23.5	23.5	2794.0296	Natural Gas	1904.9632	Natural Gas	232.1581	75		604	411	120	39		1,174	587	400	54	17		1,058	21.2	
2	55	1	55	20.6	20.6	2444.7719	Natural Gas	2002.537	Natural Gas	253.5485	75		528	433	132	39		1,131	513	421	59	17		1,010	18.4	
3	58	1	58	19.3	19.3	2301.3669	Natural Gas	2059.8532	Natural Gas	268.5646	75		497	445	139	39		1,120	483	433	63	17		996	17.2	
4	51	1	51	21.0	21.0	2287.1546	Natural Gas	1932.1419	Natural Gas	236.0002	75		494	417	122	39		1,073	480	406	55	17		959	18.8	
11	93	3	279	16.5	16.5	3518.6262	Natural Gas	2492.5383	Natural Gas	385.1222	75		760	538	200	39		1,537	739	523	90	17		1,370	14.7	
12	59	3	177	17.8	17.8	1949.955	Natural Gas	2086.8303	Natural Gas	268.2664	75		421	451	139	39		1,050	409	438	63	17		928	15.7	
13	95	3	285	16.0	16.0	3417.2672	Natural Gas	2507.969	Natural Gas	390.3596	75		738	542	203	39		1,521	718	527	91	17		1,353	14.2	
14	131	1	131	17.0	17.0	6423.1027	Natural Gas	2588.0963	Natural Gas	470.6313	75		1,387	559	244	39		2,230	1,349	544	110	17		2,019	15.4	
15	158	1	158	16.1	16.1	7743.6515	Natural Gas	2605.3947	Natural Gas	518.1402	75		1,673	563	269	39		2,543	1,626	547	121	17		2,312	14.6	
Sum	1,244	15	1,244	17.4	-	50,652	N/A	34,355	N/A	5,110	1,125	0	10,941	7,421	2,652	584	0	21,598	10,637	7,215	1,191	262	0	19,304	15.5	0.00

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 (kgCO$_2$ / m^2)	BRUKL TER 2012 (kgCO$_2$ / m^2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) TER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) TER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Equipment			2012 CO_2 emissions (kgCO$_2$ p.a.)	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) - TER BRUKL: Natural Gas	Grid Electricity	Unregulated Grid Electricity			REGULATED CO_2 EMISSIONS: SAP10.0 CO_2 emissions (kgCO$_2$ p.a.)	BRUKL TER SAP10.0 (kgCO$_2$ / m^2)
													0.216 kgCO$_2$/kWh	0.519 kgCO$_2$/kWh	0.519 kgCO$_2$/kWh				0.210 kgCO$_2$/kWh	0.233 kgCO$_2$/kWh	0.233 kgCO$_2$/kWh				
Sum	0	0	0	0.0	-	0	N/A	0	N/A	0	0	0	0	0	0	N/A	N/A	0	0	0	0	N/A	N/A	0	0.0

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated TER 2012 (kgCO$_2$ / m^2)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	REGULATED CO_2 EMISSIONS: 2012 CO_2 emissions (kgCO$_2$ p.a.)	REGULATED CO_2 EMISSIONS PER UNIT: SAP 10.0 CO_2 emissions (kgCO$_2$ p.a.)	Calculated TER SAP 10.0 (kgCO$_2$ / m^2)
Sum	1,244	17.4	-	50,652		34,355		5,110	1,125	0	21,598	19,304	15.5

The applicant should complete all the light blue cells including information on the 'be lean' energy consumption figures, the 'be lean' DER, the DFEE and the regulated energy demand of the 'be lean' scenario.

SAP 2012 CO_2 PERFORMANCE | SAP 10.0 CO_2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

				VALIDATION CHECK		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET									
Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	Calculated DER 2012 ($kgCO_2 / m^2$)	DER Worksheet DER 2012 ($kgCO_2 / m^2$)	Space Heating	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Secondary Heating system	Fuel type Space Heating	Lighting	Auxiliary	Cooling	
					DER Sheet (Row 384)	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 309]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315	
1	50	1	50	23.1	23.1	2451.8501	Natural Gas	1913.5756	Natural Gas	0	Natural Gas	231.8095	177.9375	0	
2	55	1	55	20.0	20.0	2014.5548	Natural Gas	2012.122	Natural Gas	0	Natural Gas	252.201	188.2312	0	
3	58	1	58	18.0	18.0	1651.9532	Natural Gas	2076.6454	Natural Gas	0	Natural Gas	264.3093	194.4075	0	
4	51	1	51	20.9	20.9	1986.1943	Natural Gas	1942.5564	Natural Gas	0	Natural Gas	235.8981	179.9962	0	
11	93	3	279	15.4	15.5	2539.5143	Natural Gas	2518.7417	Natural Gas	0	Natural Gas	384.9323	277.9516	0	
12	59	3	177	16.8	16.8	1355.1279	Natural Gas	2106.8794	Natural Gas	0	Natural Gas	268.3112	196.4662	0	
13	95	3	285	14.9	14.9	2340.0168	Natural Gas	2535.3101	Natural Gas	0	Natural Gas	390.4303	309.6975	0	
14	131	1	131	19.3	19.3	6795.2273	Natural Gas	2587.7282	Natural Gas	0	Natural Gas	470.6313	428.2022	70.7008	
15	158	1	158	18.6	18.6	8186.2161	Natural Gas	2605.4919	Natural Gas	0	Natural Gas	518.1402	569.9113	76.9967	
Sum	1,244	15	1,244	17.2	-	41,790	N/A	34,621	N/A	0	N/A	5,104	4,091	148	N/A

	REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.)						REGULATED CO_2 EMISSIONS PER UNIT							
Unit identifier	Space Heating CO_2 emissions ($kgCO_2$ p.a.)	Domestic Hot Water CO_2 emissions ($kgCO_2$ p.a.)	Lighting CO_2 emissions ($kgCO_2$ p.a.)	Auxiliary CO_2 emissions ($kgCO_2$ p.a.)	Cooling CO_2 emissions ($kgCO_2$ p.a.)	2012 CO_2 emissions ($kgCO_2$ p.a.)	Space Heating CO_2 emissions ($kgCO_2$ p.a.)	Domestic Hot Water CO_2 emissions ($kgCO_2$ p.a.)	Lighting CO_2 emissions ($kgCO_2$ p.a.)	Auxiliary CO_2 emissions ($kgCO_2$ p.a.)	Cooling CO_2 emissions ($kgCO_2$ p.a.)	Unregulated ($kgCO_2$ p.a.)	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2 / m^2$)
1	530	413	120	92	0	1,156	515	402	54	41	0	429	1,012	20.2
2	435	435	131	98	0	1,098	423	423	59	44	0	465	948	17.2
3	357	449	137	101	0	1,043	347	436	62	45	0	485	890	15.3
4	429	420	122	93	0	1,064	417	408	55	42	0	436	922	18.1
11	549	544	200	144	0	1,437	533	529	90	65	0	694	1,217	13.1
12	293	455	139	102	0	989	285	442	63	46	0	492	835	14.2
13	505	548	203	161	0	1,416	491	532	91	72	0	703	1,187	12.5
14	1,468	559	244	222	37	2,530	1,427	543	110	100	16	840	2,196	16.8
15	1,768	563	269	296	40	2,936	1,719	547	121	133	18	920	2,538	16.1
Sum	9,027	7,478	2,649	2,123	77	21,354	8,776	7,270	1,189	953	34	9,243	*18,223*	14.6

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

				VALIDATION CHECK		REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT								
Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	Calculated BER 2012 ($kgCO_2 / m^2$)	BRUKL BER 2012 ($kgCO_2 / m^2$)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water			Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
Sum	0	0	0	0.0	-	0	N/A	0	N/A	N/A	N/A	0	0	0

	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE							REGULATED CO_2 EMISSIONS PER UNIT					
Building Use	Natural Gas	Grid Electricity	Equipment				2012 CO_2 emissions ($kgCO_2$ p.a.)	Natural Gas	Grid Electricity	Equipment		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	BRUKL BER SAP 10.0 ($kgCO_2 / m^2$)
	0.216 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh					0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh			
Sum	0	0	0	N/A	N/A	N/A	*0*	0	0	0		*0*	0.0

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

				REGULATED ENERGY CONSUMPTION									REGULATED CO_2 EMISSIONS	REGULATED CO_2 EMISSIONS	
Use	Total Area (m²)	Calculated BER 2012 ($kgCO_2 / m^2$)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Secondary Heating System (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	2012 CO_2 emissions ($kgCO_2$ p.a.)	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated BER SAP 10.0 ($kgCO_2 / m^2$)
Sum	1,244	17.2	-	41,790		34,621		0		5,104	4,091	148	*21,354*	*18,223*	14.6

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

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Validation check and regulated energy consumption per unit (kWh p.a.) - 'BE CLEAN' SAP DER WORKSHEET

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 ($kgCO_2/m^2$)	VALIDATION CHECK: DER Worksheet DER 2012 ($kgCO_2/m^2$)	Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP (if applicable)	Fuel type CHP (if applicable)	Total Electricity generated by CHP (-) (if applicable)	Secondary Heating system	Fuel type Secondary Heating	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet [Row 309]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1	50	1	50	23.1	23.1	2451.8501	Natural Gas	1913.5756	Natural Gas						231.8095	177.9375	0
2	55	1	55	20.0	20.0	2014.5548	Natural Gas	2012.122	Natural Gas						252.201	188.2312	0
3	58	1	58	18.0	18.0	1651.9532	Natural Gas	2076.6454	Natural Gas						264.3093	194.4075	0
4	51	1	51	20.9	20.9	1986.1943	Natural Gas	1942.5564	Natural Gas						235.8981	179.9962	0
11	93	3	279	15.4	15.5	2539.5143	Natural Gas	2518.7417	Natural Gas						384.9323	277.9516	0
12	59	3	177	16.8	16.8	1355.1279	Natural Gas	2106.8794	Natural Gas						268.3112	196.4662	0
13	95	3	285	14.9	14.9	2340.0168	Natural Gas	2535.3101	Natural Gas						390.4303	309.6975	0
14	131	1	131	19.3	19.3	6795.2273	Natural Gas	2587.7282	Natural Gas						470.6313	428.2022	70.7008
15	158	1	158	18.6	18.6	8186.2161	Natural Gas	2605.4919	Natural Gas						518.1402	569.9113	76.9967
Sum	1,244	15	1,244	17.2	-	41,790	N/A	34,621	N/A	0	N/A	0	0	N/A	5,104	4,091	148

SAP 2012 CO_2 PERFORMANCE — REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.)

Unit identifier	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP (if applicable)	Electricity generated by CHP (if applicable)	Lighting	Auxiliary	Cooling	2012 CO_2 emissions ($kgCO_2$ p.a.)
1	530	413			120	92	0	1,156
2	435	435			131	98	0	1,098
3	357	449			137	101	0	1,043
4	429	420			122	93	0	1,064
11	549	544			200	144	0	1,437
12	293	455			139	102	0	989
13	505	548			203	161	0	1,416
14	1,468	559			244	222	37	2,530
15	1,768	563			269	296	40	2,936
Sum	9,027	7,478	0	0	2,649	2,123	77	21,354

SAP 10.0 CO_2 PERFORMANCE — REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.)

Unit identifier	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP (if applicable)	Electricity generated by CHP (if applicable)	Lighting	Auxiliary	Cooling	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2/m^2$)
1	515	402			54	41	0	1,012	20.2
2	423	423			59	44	0	948	17.2
3	347	436			62	45	0	890	15.3
4	417	408			55	42	0	922	18.1
11	533	529			90	65	0	1,217	13.1
12	285	442			63	46	0	835	14.2
13	491	532			91	72	0	1,187	12.5
14	1,427	543			110	100	16	2,196	16.8
15	1,719	547			121	133	18	2,538	16.1
Sum	8,776	7,270	0	0	1,189	953	34	18,223	14.6

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

VALIDATION CHECK / REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL OUTPUT

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	Calculated BER 2012 ($kgCO_2/m^2$)	BRUKL BER 2012 ($kgCO_2/m^2$)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water			Electricity generated by CHP (-) (if applicable)			Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
										N/A	N/A		N/A	N/A			
Sum	0	0	0	0.0	-	0	N/A	0	N/A			0			0	0	0

REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE

Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) (if applicable)	Equipment			2012 CO_2 emissions ($kgCO_2$ p.a.)
0.216 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	N/A	N/A	
0	0	0	0	0			0

REGULATED CO_2 EMISSIONS PER UNIT

Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Equipment		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	BRUKL BER SAP10.0 ($kgCO_2/m^2$)
0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh			
0	0	0	0	0		0	0.0

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

REGULATED ENERGY CONSUMPTION

Use	Total Area (m²)	Calculated BER 2012 ($kgCO_2/m^2$)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Secondary Heating System (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	REGULATED CO_2 EMISSIONS: 2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED CO_2 EMISSIONS PER UNIT: SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED CO_2 EMISSIONS PER UNIT: Calculated BER SAP 10.0 ($kgCO_2/m^2$)
Sum	1,244	17.2	-	41,790		34,621		0		0	0		5,104	4,091	148	21,354	18,223	14.6

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

DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 ($kgCO_2/m^2$)	VALIDATION CHECK: DER Worksheet DER 2012 ($kgCO_2/m^2$)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type
1	50	1	50	21.0	21.0	770.2627143	Grid Electricity	668.6318571	Grid Electricity
2	55	1	55	17.6	17.6	623.4516786	Grid Electricity	690.2498571	Grid Electricity
3	58	1	58	15.6	15.6	505.8226786	Grid Electricity	703.0509643	Grid Electricity
4	51	1	51	18.9	18.9	620.0055	Grid Electricity	672.9581429	Grid Electricity
11	93	3	279	14.1	14.1	803.5553571	Grid Electricity	832.3392857	Grid Electricity
12	59	3	177	14.5	14.5	415.2995357	Grid Electricity	707.259	Grid Electricity
13	95	3	285	13.5	13.5	731.1848929	Grid Electricity	859.0293214	Grid Electricity
14	131	1	131	18.0	18.0	2190.949429	Grid Electricity	889.765	Grid Electricity
15	158	1	158	17.4	17.4	2649.365964	Grid Electricity	896.8908571	Grid Electricity
Sum	1,244	15	1,244	15.5	-	13,210	N/A	11,717	N/A

Unit identifier	Space Heating (Heat source 2)	Fuel type Space Heating	Domestic Hot Water (Heat source 2)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP	Fuel type CHP	Total Electricity generated by CHP (-)	Secondary Heating system	Fuel type Secondary Heating	Electricity generated by renewable (-)	Lighting	Auxiliary	Cooling
	if applicable		if applicable		if applicable	if applicable	if applicable			if applicable			
	DER Sheet [Row 307c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [Row 310c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 309	Select fuel type	DER Sheet Row 333	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1								217.8521	Grid Electricity	-55.2717	231.8095	143.2265	47.9818
2								176.3298	Grid Electricity	-62.1806	252.201	150.0148	31.795
3								143.061	Grid Electricity	-62.1806	264.3093	153.256	35.4933
4								175.3551	Grid Electricity	-55.2717	235.8981	141.1992	63.3053
11								227.2682	Grid Electricity	-103.6344	384.9323	248.7566	131.0295
12								117.4585	Grid Electricity	-62.1806	268.3112	152.8978	46.8387
13								206.7998	Grid Electricity	-103.6344	390.4303	279.2235	112.389
14								619.6625	Grid Electricity	-145.0881	470.6313	439.4622	66.9339
15								749.3156	Grid Electricity	-172.7239	518.1402	594.2065	67.0341
Sum	0	N/A	0	N/A	0	N/A	0	3,736	N/A	-1,361	5,104	3,664	1,183

SAP 2012 CO_2 PERFORMANCE

Unit identifier	REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP	Electricity generated by CHP	Electricity generated by renewable	Lighting	Auxiliary	Cooling		2012 CO_2 emissions ($kgCO_2$ p.a.)
			if applicable	if applicable	if applicable					
1	513	347			-29	120	74	25		1,051
2	415	358			-32	131	78	17		966
3	337	365			-32	137	80	18		905
4	413	349			-29	122	73	33		962
11	535	432			-54	200	129	68		1,310
12	277	367			-32	139	79	24		854
13	487	446			-54	203	145	58		1,285
14	1.459	462			-75	244	228	35		2,352
15	1.764	465			-90	269	308	35		2,752
Sum	8,795	6,081	0	0	-706	2,649	1,902	614	NA	19,335

SAP 10.0 CO_2 PERFORMANCE

Unit identifier	REGULATED CO_2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Space Heating and DHW from CHP	Electricity generated by CHP	Electricity generated by renewable	Lighting	Auxiliary	Cooling		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2/m^2$)
			if applicable	if applicable	if applicable						
1	230	156			-13	54	33	11		472	9.4
2	186	161			-14	59	35	7		434	7.9
3	151	164			-14	62	36	8		406	7.0
4	185	157			-13	55	33	15		432	8.5
11	240	194			-24	90	58	31		588	6.3
12	124	165			-14	63	36	11		383	6.5
13	219	200			-24	91	65	26		577	6.1
14	655	207			-34	110	102	16		1,056	8.1
15	792	209			-40	121	138	16		1,235	7.8
Sum	3,948	2,730	0	0	-317	1,189	854	276	NA	8,680	7.0

NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 ($kgCO_2/m^2$)	VALIDATION CHECK: BRUKL BER 2012 ($kgCO_2/m^2$)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water							Electricity generated by CHP (-)			Electricity generated by renewable technology (-)	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
																if applicable			if applicable			
										N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A				
Sum	0	0	0	0.0	-	0	N/A	0	N/A							0			0	0	0	0

REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-)	Electricity generated by renewable technology (-)	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	Equipment	2012 CO_2 emissions ($kgCO_2$ p.a.)
			if applicable	if applicable					
0.216 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	
0	0	0	0	0	0	0	0	0	0

REGULATED CO_2 EMISSIONS PER UNIT: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-)	Electricity generated by renewable technology (-)	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	Equipment	SAP 10.0 CO_2 emissions	BRUKL BER SAP 10.0 ($kgCO_2/m^2$)
			if applicable	if applicable						
0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh		
0	0	0	0	0	0	0	0	0	0	0.0

SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 ($kgCO_2/m^2$)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space Heating (Heat source 2) (kWh p.a.)	N/A	Domestic Hot Water (Heat source 2) (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Secondary Heating system (kWh p.a.)	N/A	Electricity generated by renewable (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	REGULATED CO_2 EMISSIONS: 2012 CO_2 emissions	N/A	REGULATED CO_2 EMISSIONS: SAP 10.0 CO_2 emissions	Calculated BER SAP 10.0 ($kgCO_2/m^2$)
Sum	1,244	15.5	-	13,210		11,717		0		0		0		0	3,736		-1,361	5,104	3,664	1,183	19,335		8,680	7.0

SAP 2012 Performance | SAP 10.0 Performance

Domestic

SAP 2012 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	21.6	
After energy demand reduction (be lean)	21.4	
After heat network connection (be clean)	21.4	
After renewable energy (be green)	19.3	

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)	(%)
Be lean: savings from energy demand reduction	0.2	1%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	2.0	9%
Cumulative on site savings	**2.3**	**10%**
Annual savings from off-set payment	19.3	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**580**	-
Cash in-lieu contribution (£)	**0**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

SAP 10.0 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	19.3	
After energy demand reduction (be lean)	18.2	
After heat network connection (be clean)	18.2	
After renewable energy (be green)	8.7	

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)	(%)
Be lean: Savings from energy demand reduction	1.1	6%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	9.5	49%
Cumulative on site savings	**10.6**	**55%**
Annual savings from off-set payment	8.7	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**260**	-
Cash in-lieu contribution (£)	**0**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Non-domestic

SAP 2012 Performance

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	0.0	
After energy demand reduction (be lean)	0.0	
After heat network connection (be clean)	0.0	
After renewable energy (be green)	0.0	

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)	(%)
Be lean: savings from energy demand reduction	0.0	0%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.0	0%
Total Cumulative Savings	**0.0**	**0%**
Annual savings from off-set payment	0.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**0**	-
Cash in-lieu contribution (£)	**0**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

SAP 10.0 Performance

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	0.0	
After energy demand reduction (be lean)	0.0	
After heat network connection (be clean)	0.0	
After renewable energy (be green)	0.0	

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)	(%)
Be lean: savings from energy demand reduction	0.0	0%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.0	0%
Total Cumulative Savings	**0.0**	**0%**
Annual savings from off-set payment	0.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**0**	-
Cash in-lieu contribution (£)*	**0**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

SITE-WIDE

SAP 2012 Performance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	21.6		
Be lean	21.4	0.2	1%
Be clean	21.4	0.0	0%
Be green	19.3	2.0	9%
Total Savings	-	2.3	10%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**580.0**	-

SAP 10.0 Performance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	19.3		
Be lean	18.2	1.1	6%
Be clean	18.2	0.0	0%
Be green	8.7	9.5	49%
Total Savings	-	10.6	55%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**260.4**	-

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	0.00	0.00	

	Area weighted non-domestic cooling demand (MJ/m²)	Total area weighted non-domestic cooling demand (MJ/year)
Actual		
Notional