PROPOSED RESIDENTIAL DEVELOPMENT
at
38 Heath Drive, London

Energy Statement

Prepared by Bespoke Builder Services Ltd
on behalf of Status Design Associates for ZEN Developments
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Assessment type: Clear planning condition 4.7 & Unilateral Undertaking 2.13

1. Introduction

This Energy Statement has been prepared for Status Design Associates by BBS Environmental, a construction consultancy specialising in sustainability, energy conservation and the application of renewable energy technologies. It has been prepared to clear Planning Condition 4.7 and Unilateral Undertaking condition 2.13 for the proposed residential development at 38 Heath Drive to be constructed by ZEN Developments.

This Energy Statement sets out the methodology and results, in ordered for the scheme element to meet the energy conservation target required to meet Code for Sustainable[1] Homes level 4, and meeting the 20% carbon dioxide reduction by the installation of low and zero carbon technologies.

It contains an energy demand assessment for regulated energy based on SAP2012 as used for Part L1A: 2013 of the Building Regulations and estimates for the energy demand for unregulated energy, i.e. appliances and cooking, using the Bredem-12 methodology as used in the Code for Sustainable Homes (CSH).

It details the energy efficiency measures being incorporated within the development and shows that these will ensure that the dwellings will meet the requirements of the Building Regulations using these measures alone. It also includes an overview of distributed energy networks and renewable energy technologies and identifies the technologies most suitable for this development and reasons why other technologies have had to be excluded. Finally, it shows that the selected technologies will result in a reduction in Dwelling Emissions Rate (DER) of 20% compared to Part L1A: 2013, exceeding the level 4 energy mandatory required within the CSH assessment.

In presenting this information this Energy Statement demonstrates that the proposed development will fully satisfy the applicable planning policies relating to energy conservation, distributed energy networks and renewable energy.

1. Code for Sustainable Homes Technical Guide Addendum (2014) England

2. Executive Summary

2.1 Introduction

This summary sets out the key measures and carbon dioxide emissions targets proposed for the development in the three stages, an energy hierarchy. The concept of the hierarchy is that in the first instance passive energy efficiency measures, such as building topology and orientation, and improved insulation, together with certain active measures such as using plant with higher efficiency, or heat recovery ventilation systems, should be employed to reduce the energy demand as far as is feasible. If possible, this approach should be used to meet or exceed the regulatory requirements. The energy hierarchy then requires that the potential for decentralised energy systems and combined heat and power (CHP) is considered.

The CSH sets targets for and requires evaluations of *regulated energy use* – i.e. energy related to building services such as heating and lighting. Other energy use is classed as *unregulated* and covers energy used by the building occupants, for in the case of dwellings, cooking, domestic appliances and entertainment systems. This energy cannot be influenced by a developer.

2.2 Key results

Carbon dioxide emissions at each stage of the energy hierarchy – whole site

Stage	*Carbon dioxide emissions (Tonnes CO_2/yr)*	
	Regulated	*Unregulated*
Building Regulation compliant	***30.56***	***34.12***
After efficiency measures	***30.56***	***34.12***
After CHP	***23.35***	***34.12***

In this case no reductions in unregulated energy can be presumed.

Regulated emissions savings at each stage of the energy hierarchy – whole site

Stage	*Regulated emissions savings*	
	(Tonnes CO_2/yr)	*Percentage*
Savings from efficiency measures (be lean)	***0.0***	***0.0%***
Savings from CHP (be clean)	***0.0***	***0.0%***
Total cumulative savings	***7.2***	***23.6%***

Note: the percentage cumulative saving is expressed as a percentage of the baseline emissions, and is not therefore equal to the sum of the percentage savings at each stage.

2.3 Key energy efficient design measures

The development proposals include the provision of the following energy efficiency measures:

- Enhanced insulation in, in particular, walls, floors and roofs and windows (triple glazing); reduced air leakage at just $3.5m^3/hm^2$, well below the regulatory limit; and careful design to reduce the effect of no repeating thermal bridges.
- All residential lighting will use lamps with a luminous efficacy of at least 40 Lumens/watt (equivalent to an “A” rating).
- Where provided, white goods will be supplied (fridges, freezers, washer dryers and dishwashers) that are “best practice” for energy consumption.
- Communal space will have automatic lighting controls and display lighting with lamp efficacy of at least 30 lumens/watt.
- Metering of Low Carbon technologies to enable monitoring of energy and carbon emission savings.
- Incorporation of Building management System (BMS) to monitor plant and operational hours.
- Facilitate the future connection to a local energy network.

These measures will enable the dwellings to achieve compliance with the current Building Regulations, Part L1A: 2013 prior to the addition of low and zero carbon technologies.

2.4 Summary of proposed heating and cooling systems

Residential units will be heated from a communal plant room comprising of a condensing gas boiler and Combined Heat and Power (CHP) plant. All heat load for space & water heating will be delivered to each unit via a Heat interface Unit (HIU). Energy consumption will be monitored for each apartment (via the HIU) and billed accordingly.

2.5 Choice and impact of energy technologies

The installation of the CHP plant (a low carbon technology) has been selected to maximise the schemes carbon dioxide emissions. Locally generated electricity will be consumed on site, both within the apartments & communal spaces. Excess electrical energy will be exported to the national grid.

The system will be designed so that future connection to a district heat main will be possible.

The proposed low carbon technology will therefore have no material noise or visual impact on the proposed development

3. Calculation methodology

This Energy Statement follows the detailed methodology set out the GLA guidance in order to give an indication of the total emissions. It uses SAP2012 to estimate the regulated energy demand for each dwelling, and the latest version of Bredem-12[2] to estimate the unregulated energy demand. The final totals for the whole development were derived from the individual calculated results by combining the results and scaling to represent the total number of dwellings and total floor area of the development.

The SAP2012 compliance calculations were completed with software which implements SAP version 9.92 (Oct 2013). SAP is a complex method, and it is important, when comparing results, to ensure that comparisons are valid and that anomalies do not arise. An example is the case where a dwelling with an individual boiler is compared to a dwelling with community heating. The different systems have different allowances for boiler fan and pump electricity which, although small, should not be allowed to obscure the results.

The baseline "compliant" case for emissions was determined by using the Target Emissions Rates (TER) from the compliance calculations. These figures provide only an emissions rate, and hence a figure for total regulated emissions from a dwelling. The emissions saving from efficiency measures ("Be Lean") was determined by comparing the total emissions based on the TER figures with the predicted emissions based on the actual proposed specification as defined in the Dwelling Emissions Rate (DER) also from the compliance calculations.

Note 2: *SAP2009 version 9.90, Appendix L*, DECC (March 2010)

4. Energy demand and efficiency

4.1 Baseline emissions

The total regulated residential energy demand has been calculated taking full account of energy demands for space heating and hot water, and electricity for pumps, fans, and lighting. A separate calculation has been completed for the unregulated energy demand. The baseline emissions were established by reference to the TER figures for each dwelling. The TER is the maximum permitted emissions rate for a building, and is expressed in $kgCO_2/m^2$. Thus the total emissions for a building/dwelling are the product of the TER and the total floor area.

Total baseline emissions for all dwellings:	30,567 $kgCO_2$/yr
Total baseline regulated emissions	**30,567 $kgCO_2$/yr**

The results for energy demand for each dwelling are summarised in Appendix 4.

4.2 Energy efficiency measures (“Be Lean”)

During the design process the team have explored a range of energy efficiency measures including enhanced U-values, specific construction details to reduce the effect of non-repeating thermal bridges, and advanced heating controls. The specific target for the dwellings was to meet the requirements of Part L1A: 2013 using these measures alone. A range of options was evaluated, and those presented below represent one way of delivering the required result: they are not finalised, but there is a commitment to achieve the resulting level of emissions, by this or another combination of specifications. The proposed specifications (indicative) for the building fabric are as follows:

Heat loss floors (including exposed upper floors etc.):	0.11 W/m^2K
External walls:	0.15 W/m^2K
Roofs:	0.14 W/m^2K
Doors:	1.0 W/m^2K
Windows:	0.8 W/m^2K
Air leakage rate:	3.5 $m^3/hr/m^2$

In addition to the above a variety of improvements are proposed to the building services and fit-out specifications. These include:

Lighting: 100% of light fittings to have “A” rated (or equivalent) lamps
Detail design analysis to minimise non-repeatable thermal bridging
Communal lighting: luminous efficacy of 30 lumens/watt minimum
Heating controls: full zone control with delayed start to be installed in all flats.
Ventilation: all to be natural ventilated.

In addition, efforts are being made to reduce the unregulated emissions by providing “best in class” (“A” rated or equivalent) white goods and energy display devices that show electricity use to encourage resident to save energy. The benefits are not included in any results.

These measures interact to some degree (e.g. more low energy lighting reduces the ancillary heat gains from lighting, so increases the space heating demand) so comparisons of individual results can produce apparent anomalies and are not provided.

As noted above the building fabric and services equipment specifications for the residential units have been developed to achieve an emissions performance that meets the requirements of Part L1A: 2013 prior to the application of low carbon technologies.

The final results for the development with all the identified efficiency measures are:

Total emissions with savings:	30,567 kgCO_2/yr
Emissions savings at this stage:	0 kgCO_2/yr
Percentage savings compared to baseline:	**0.0%**

4.3 Fabric energy efficiency performance

The ongoing transformation of the UK specifications for housing over the past 5 years, in both building fabric specifications and plant efficiency, and the switch to a “carbon” based performance measure and the introduction of new low-carbon energy sources has highlighted the need to ensure that new dwellings have the lowest possible energy demand as well as using low carbon energy: without this, and if a low carbon heat source is available, good results for emissions could be achieved without high performance fabric, and this would be very undesirable. This issue has been discussed extensively both by Regulators and Industry and the CLG-sponsored Zero Carbon Hub (ZCH) report: *Carbon Compliance - Setting an appropriate limit for zero carbon new homes - Findings and Recommendations (February 2011)* considers this issue in great depth, and makes recommendations for national targets for efficiency measures going forwards to 2016 and beyond. The recommendation is that a separate building fabric performance measure should be used alongside the TER/DER measure. The recommendation for the standard, known as the *Fabric Energy Efficiency (FEE)* standard, has been accepted by Government and the methodology has been incorporated into SAP2012. The methodology eliminates the distorting effects of all non-fabric influences such as heat recovery through ventilation, and lighting and hot water system losses (and gains) and thus allows a true comparison of the fabric performance to be made. This is important since unlike the building services the fabric is intrinsic to the building and it is generally very difficult to implement further improvements once a building is complete. The FEE standard is expressed as a performance metric (kWh/m^2/year) that varies with building topology.

The FEE calculations carried as part of the SAP2012 calculation procedure for the scheme resulted in a predicted area weighted FEE value of 35.6 kWh/m^2/year for the development as currently specified. This performance level exceeds the value of 39 kWh/m^2/yr for flats that is being considered for inclusion as a mandatory requirement for zero carbon homes.

5. Summer overheating

The Building Regulations Approved Document Part L1A (Conservation of fuel and power in new dwellings) – both the 2010 and 2013 editions – have as one of the five criterion for compliance a requirement that adequate measures are implemented to ensure that summer solar gains are limited and that a dwelling does not overheat in the summer. The Approved Document cites a methodology contained in SAP Appendix P which determines overheating risk for a dwelling as one of four classes: “not significant”, “slight”, “medium” and “high”, and requires that using this methodology a dwelling should be shown to have a risk of overheating no worse than “medium”. The methodology takes account of the differing solar irradiation levels and average temperatures through each month of the summer and all other relevant factors including window size, orientation, shading, g-value, ventilation rate, thermal capacity, fabric insulation and the mean summer temperature of the dwelling location. It has been developed in a “compliance” context and has the major advantage that the principle parameters used are fully defined, and not, as with the alternative methods, subject to many areas of adjustment and interpretation.

The results from the Appendix P assessment show that none of the dwellings present an unacceptable risk of summer overheating. The assessment found a “low” or “not significant” risk of overheating which is acceptable under SAP2012 guidelines.

6. CHP and decentralised energy

6.1 Overview of decentralised energy

Part L1 2013 clearly sets out a requirement that new developments must connect to any existing district heating network if one is available. This was duly considered but a review of existing schemes using the London Heat Map revealed that there are none within a reasonable distance of the site.

In the absence of a district heating scheme, the policy requires that larger developments utilise community heating networks and where possible incorporate CHP units unless it can be shown that this is not technically feasible. Community heating networks are being promoted because it is envisaged that they provide “future proofing” through the ability in the future to be connected to “low carbon” and “renewable” district heating schemes. They also allow a variety of other technologies to be utilised that might not otherwise be practicable. Community heating is also essential if CHP or CCHP systems are to be used.

Community heating systems typically have a single “energy centre” which houses central plant that will include boilers, and may include CHP and cooling units. Heat is distributed across the development using “heat mains” that connect to each block or core, and from there distribute heat to each dwelling, office, retail unit etc. Within each unit there is a heat exchanger and metering system that allows heat to be transferred into a local heating system that serves the unit, and the amount of heat energy taken by the occupant to be measured so that they can be billed accordingly. The local heating system will provide space heating and hot water and can incorporate a hot water storage cylinder. The energy centre plant is generally designed with a substantial degree of redundancy – for example there will typically be at least three boilers, and any two will be able to supply the whole heat load. Similarly there will be redundant pumps and other equipment to allow the system to continue to operate in the event that an item of equipment fails or has to be taken off-line for maintenance.

However it should be noted that community heating systems provide no intrinsic reduction in energy demand or carbon dioxide emissions, and indeed, due to the need to distribute hot water over substantial distances they can incur significant system losses and circulation pump energy requirements. To achieve any benefit (other than “future proofing”) they must incorporate low carbon heat sources.

6.2 Combined heat and power systems

Combined Heat and Power (CHP) systems are recognised as a very desirable way of reducing energy wastage and resulting carbon dioxide emissions. While generally operating on fossil fuel, mainly natural gas, and using reciprocating engines (or, on large scale units, gas turbines) to drive electrical generators, their advantage is that the waste heat produced by the engine (the reason for the familiar “cooling towers” at power stations) is collected and put to good use providing space heating and hot water. This means that the overall fuel efficiency can be increased significantly – typically to above 80% compared to 30 – 40% for grid electricity. It is important to note that the carbon dioxide emissions reduction is due to the utilisation of the waste heat, and that the use to which the electricity is put is not significant, and is not included in any of the assessment calculations. Furthermore, the overall “energy efficiency” of the CHP units (the total useful energy produced as the sum of the heat and electricity) is lower than that of a boiler. So any direct comparison of total *energy efficiency* will produce a meaningless result. It is for this reason that all calculations involving CHP always use a carbon emissions basis alone.

However, CHP, although highly desirable, does have practical limitations. The principle requirement is that to be effective, all of the energy produced must be utilised. This means that all the electricity must be used in a financially sound manner and all the waste heat must be put to good use – preferably to meet a heat demand – and not dumped. This means that a workable operating strategy must be developed taking full account of the electrical and heat loads.

6.3 Heating Infrastructure (“Be clean”)

Space and water heating is to be provided from an onsite energy centre, comprising for a CHP plant and back up gas condensing boilers.

The heat load splits between set between plant to match the residents requirements and maximises carbon savings.

6.4 Emissions savings from CHP ("Be Clean")

Heat Splits	CHP - 60% Gas boilers - 40%
CHP plant	Heat efficiency - 63.5% Electrical efficiency – 29.5%
Gas Boiler	Efficiency – 95%

Total regulated emissions with energy centre (CHP): 23,359 kgCO_2/yr

Percentage savings from renewables: 23.6%

7. Renewable energy options

7.1 Overview of renewable energy

Renewable energy is defined as energy derived from energy flows that occur naturally and repeatedly in the environment. It may be contrasted with energy sources that can be depleted such as fossil fuels or uranium-238-based nuclear power. It therefore follows that the commonly used phrase "equipment to generate renewable energy" is an oxymoron since renewable energy cannot be "generated" – instead the technology *harnesses* a natural energy flow. Renewable energy technologies, with a couple of exceptions, all utilise energy from the sun – either directly or indirectly, the exceptions being true geothermal[4], which uses heat from the earth's mantle, and tidal / marine current electricity generation which uses the gravitational forces between the earth and the moon, (although some marine currents are also greatly affected by solar energy). Insofar as this study is only concerned with practical options for *on-site* renewable energy, these options are not considered further. The remaining range of "solar" technologies are however vast, and some would not even appear to be solar on superficial inspection. They can be summarised as follows:

- Solar thermal – direct heating of water for space heating or domestic hot water;
- Photovoltaic – direct generation of electricity from sunlight;
- Hydroelectricity – electricity generation by solar (water cycle) driven[5] water flows;
- Wind turbines – use of solar driven air movement to generate electricity;
- Heat pumps – extraction of solar heat from the earth, atmosphere or water bodies;
- Bio-fuels – combustion of solid or liquid bio-fuels to produce heat or electricity;

The technologies, and their potential application to this site are discussed in more detail the following sections (appendix 2).

Note 4: Ground source heat pumps are sometimes described as "geothermal", however most simply extract solar energy stored near the Earth's surface. True geothermal heat is heat from deep in the earth, which is believed to arise mainly from the decay of radioactive isotopes in the earth's mantle.

Note 5: This may be compared with "pumped storage" systems such as Dinorwig in North Wales where water is pumped to an upper storage lake during periods of low electricity demand and released to generate electricity when needed during times of peak demand.

7.2 Renewable energy proposals

Taking account of the foregoing section of this report, it is apparent that additional renewable technology is not required to advance the schemes carbon dioxide savings. The proposed energy centre delivers over the required carbon savings for both the Code for Sustainable Homes and to meet the planning requirements. Therefore no additional renewable are required.

8. Conclusions

The foregoing projected results show that this development proposal meets the applicable planning policies that relate to energy conservation, decentralised energy networks and renewable energy systems so far as this is technically feasible.

In developing these proposals the Design Team has taken account of the nature of the site and its location. In this regard, matters of physical appearance were considered significant and the nature of the technologies selected was guided by the need to ensure that any visual and noise impacts were acceptable. A key outcome is that the choice of a energy centre, incorporating a CHP plant, to deliver all the space and hot water demands for the scheme. Incorporating a heat network meets the future proofing requirement for any future connection to a district heat main, thereby satisfying all the applicable planning policies without any unacceptable impacts.

In terms of results for energy and emissions savings, and compared to the “compliant case” baseline referenced to the current Building Regulations the development proposals including energy efficiency measures will meet building regulations.

Then, using this figure as a reference the CHP plant was reviewed to further reduce the emissions by 23.6%.

The development proposals therefore fully meets the carbon dioxide savings requirement in order to secure CSH level 4 and planning condition 2.13.

Appendix 1

Carbon dioxide emission factors

These factors are taken from SAP2012 version 9.90, Table 12 and are used in Part L1A: 2013 of the Building Regulations. They have superseded the factors used in Part L1A: 2010, and due to significant differences, can result in different level of emissions reduction, particularly with CHP systems and PV panels where grid displaced electricity is taken into account.

Fuel	**CO_2 emission factor $kgCO_2/kWh$**
Natural gas	0.216
LPG	0.241
Heating oil	0.298
House coal	0.394
Anthracite	0.394
Smokeless fuel (inc. coke)	0.433
Dual fuel appliances (mineral + wood)	0.226
Wood logs	0.019
Wood chips	0.016
Wood pellets	0.039
Grid supplied electricity	0.519
Grid displaced electricity[6]	0.519

Note 6: Grid displaced electricity comprises all electricity generated in or on the building premises by, for instance, PV panels, wind-powered generators, combined heat and power (CHP) etc. The associated CO_2 emissions are deducted from the total CO_2 emissions for the building to determine the building emissions. CO_2 emissions arising from fuels used by the building's power generation system (e.g. to power the CHP engine) must be included in the building's CO_2 emissions calculations.

Appendix 2

Background information on renewable energy systems

The following sections contain a summary of each alternative possibly-applicable technology, a comparison of the advantages and disadvantages of technologies relevant to this development, and the reasons it was not proposed.

A2.1 Solar thermal panels

A typical solar thermal (hot water) panel can provide 400 kWh of *useable* hot water per year for every square metre of panel. Under normal circumstances this energy will replace gas, and because the emissions factor for gas is only 0.216 $kgCO_2/kWh$, the reduction in carbon dioxide emissions, allowing for the boiler efficiency, is modest.

A2.2 Wind turbines

Micro wind turbines produce electricity and can be grid-connected in the same way as photovoltaic panels. There are two main concerns with wind turbines – aesthetic considerations, and the limited output in an urban environment. It was considered that in this location the visual impact of even a modest-sized unit would be unacceptable, and the tall buildings nearby would create unsatisfactory wind conditions, so this technology was not considered further.

A2.3 Bio-fuels

In the UK at present the commercial bio-fuels that can be used in the context of emissions reduction in the built environment are confined to either wood pellets or wood chips (biomass) or in special cases glycerine for CHP. Bio-diesel is not an acceptable fuel as it is easily replaced by petro-diesel so does not qualify under the applicable regulations. A small 50 kW automated pellet boiler could have been installed in the plant room to provide additional low carbon winter heat. However it would have greatly increased the emissions of NO_x and have resulted in significant emissions of particulates which were judged to be unacceptable in this location. It has not therefore been proposed. Glycerine CHP is an emerging technology which has very low emissions and uses the fuel that is a waste product from the bio-diesel manufacturing process. However the commercial availability is very limited (there is a single small-scale supplier) and it was unclear whether plant of a suitable type and size would be available for this development. It has not therefore been proposed.

A2.4 Heat pumps

Heat pumps collect low temperature heat from renewable sources and “concentrate” it to a usable temperature. Fossil fuel based (grid) electricity is generally required to operate the pumps and the renewable component of the output is therefore by convention taken as the difference between the output energy and the input energy. A typical heat pump will deliver 3 kWh of useful energy for every 1 kWh of input energy. A heat pump operating in this way would therefore be deemed to have delivered 2 kWh of renewable energy.

There are two common types of heat pump – ground source and air source. In urban locations ground source heat pumps collect heat from boreholes. These are typically up to 100m deep and have to be spaced at least 6m apart to avoid over-cooling the ground. A typical borehole can deliver a maximum output of 4kW of heat. Air source heat pumps collect heat from the ambient air using air-heat-exchanger units.

With commercial heating systems the heat pump is used to supply heat for space heating, but can only be used to pre-heat the domestic hot water. This is because the heat pump will not operate effectively at the temperatures needed for domestic hot water. As a result the heat pump is confined to meeting only a proportion of the heat demand and this limits its ability to deliver a reduction in carbon dioxide emissions.

Appendix 3 – SAP results

Block Compliance WorkSheet: Scheme SAP2012 compliance report

User Details

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP **Software Version:** Version: 1.0.1.21

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Flat C1	12.52	16.49	37.1	44.4	94.67
Flat C2	11.83	15.63	38.3	45.1	99.29
Flat C3	12.83	16.27	46	47.7	126.56
Flat C4	11.87	15.29	42.9	52.1	137.06
Flat C5	11.13	14.94	34.3	41.7	98.98
Flat C6	14.31	19.13	44.2	48.6	58.59
Flat C7	12.08	16.43	33.9	43.9	81.04
Flat C8	14.63	18.98	49.4	51.3	67.97
Flat C9	9.65	12.52	29.3	39.5	137.18
Flat 10	10.34	14.54	23.9	32.3	76.19
Flat 11	12.03	16.87	34.1	41.8	89.95
Flat 12	11	15.29	31.5	39	96.62
Flat 13	11.83	16.48	32.5	40.3	72.88
Flat 14	9.7	12.76	29.4	38.7	137.18
Flat 15	10.74	14.98	26.8	34.1	76.19
Flat 16	12.34	17.14	32.6	37.4	58.17
Flat 17	12.57	15.72	41.7	45.7	108.5
Flat 18	12.39	16.38	39.9	42.8	94.85
Flat 19	9.95	12.76	28.3	34.8	126.28
Flat 20	11.02	14.96	23.6	28.3	67.98
Flat 21	12.16	13.7	42.8	45.1	155.68

Stroma FSAP 2012 Version: 1.0.1.21 (SAP 9.92) - http://www.stroma.com Page 1 of 2

Block Compliance WorkSheet: Scheme SAP2012 compliance r

Calculation Summary

Total Floor Area	2016.01
Average TER	15.16
Average DER	11.59
Average DFEE	35.68
Average TFEE	42.03
Compliance	Pass
% Improvement DER|TER	23.55
% Improvement DFEE|TFEE	15.11