Twenty16 Design

2011/1433/P.

13 St. Cross Street, EC1

Energy Statement for Planning

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Document Control

Author	Date	Signature
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BW	29.07.11	

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This report is based on limited early design information and therefore changes to the design will affect the accuracy of the predictions made. Furthermore, external factors such as climate will impact on energy and carbon saving calculations.

Introduction

This Energy Statement is produced in support of the proposed development of 8no new flats at St. Cross Street, EC1. It has been produced in accordance with the guidance in Camden's Policy Guidance document CPG1/3 and in compliance with LDF policies CS13 and DP22.

It has been commissioned to help demonstrate compliance with the Local Planning Authority (London Borough of Camden) requirement to procure 10% of operational energy from renewable technologies (information sourced from Camden Council's Website[1]) and runs alongside the Code for Sustainable Homes documents that have also been produced by others.

The Code for Sustainable Homes predicted rating for this site is Code Level 3. This requires a CO_2 reduction of 25% over the 2006 Building Regulations, but since the update to Part L in 2010, is now only the equivalent of passing Building Regulations.

However, the Code Assessor for this site (who has also undertaken the SAP calculations), has predicted a score under issue ENE1 (which awards credits based on the reduction in CO_2 emissions over the targets in Part L) of 4.2 (out of 10). To achieve this score, the development will need to improve on Part L 2010 by 38%

The report uses the London Renewables Toolkit strategy along with the preliminary SAP calculations to demonstrate how the development is meeting the emissions reduction requirements of the Local Authority.

Key Commitments:

- **All dwellings are to achieve a Code for Sustainable Homes Level 3 rating**
- **All dwellings will improve over the requirements of Part L 2010 by approximately 38%**
- **U Values will be increased and the air permeability will be considerably lower than building regulations requirements**
- **Consideration will be given in due course to linear thermal bridging details to improve the Fabric Energy Efficiency**
- **At least 10% of site wide energy demand (as calculated using SAP 2009) will come from Low or Zero Carbon technologies.**
- **All dwellings will have a calculated potable water consumption of less than 105 litres per person per day – considerably improved over Building Regulations.**
- **The level of surface water discharge will be reduced post development to be no more than at current.**
- **The ecological value of the site will be increased.**
- **A disused brownfield site will be brought back into use as much needed residential dwellings.**

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[1] - http://www.camden.gov.uk/ccm/content/environment/planning-and-built-environment/two/planning-applications/making-an-application/supporting-documentation/sustainability-statements-design-and-construction.en

The Site and Proposal

The site is currently vacant. The current proposal is to replace construct a new block containing 8no. flats. A "Street View" image of the existing site is shown at Figure 1. A Perspective sketch by the Architect is shown at Fig. 2

Figure 1: Existing Site (© Google Inc)

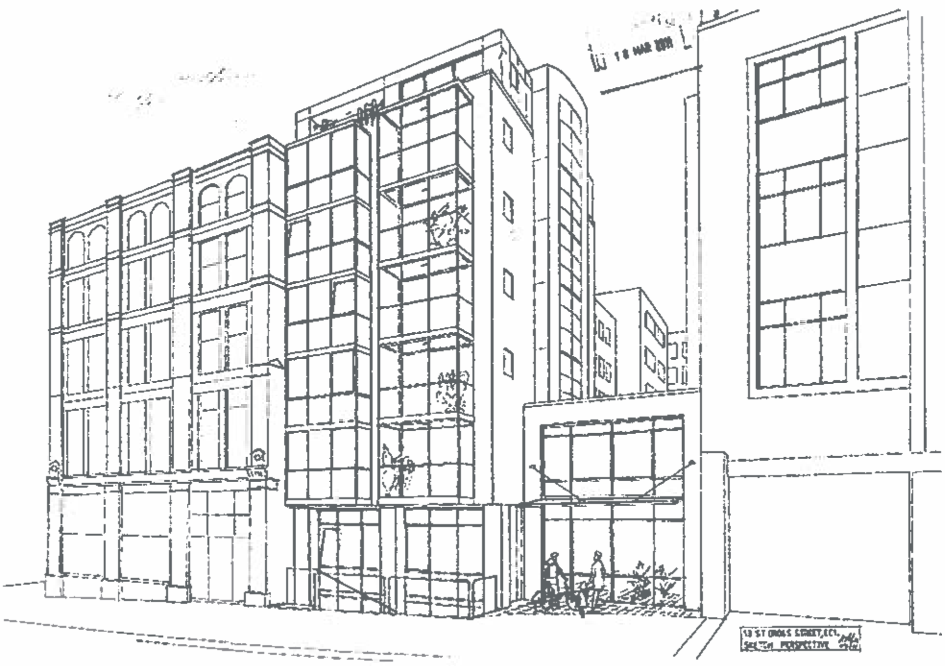

Figure 2: Proposed Sketch (© Alec Alexandrou)

"Passive" Measures Proposed

The developer for this site is adopting a "fabric first" approach to the build, which has numerous advantages.

Passive measures such as glazing, orientation, insulation, reduction of thermal bridging, biodiversity etc. are generally more cost effective ways to reduce energy use than "active" measures, such as renewable technologies.

In addition, since there is a planning requirement to reduce emissions by 10% through the use of renewables, it makes sense to reduce the baseline energy demand as far as possible using passive measures first, thus reducing the amount of more costly technologies required.

Passive measures generally have much less embodied Carbon, since on the whole they are design considerations rather than "bolt-on" extras.

Passive measures proposed for this site include:

- **Increased U Values above Building regulations backstop values**
- **The considered use of "enhanced" construction details to minimize linear thermal bridging**
- **Maximizing south facing glazing, while taking care to avoid overheating**
- **Proposing a green or brown roof, to improve the insulation value, attenuate rainwater and increase the biodiversity of the site.**
    - **Green roofs also contribute to reducing the "heat island" effect associated with cities.**
    - **They are also considered as a Sustainable Drainage System (SuDS)**
    - **It is estimated that Green Roofs can help reduce emissions by as much as 5kg/m²/yr[2]**
- **Using high quality, sustainably sourced materials with good "Green Guide" ratings**
    - **Further details of this Green Guide can be found at http://www.bre.co.uk/greenguide/**
- **Ensuring good levels of daylighting to habitable rooms.**
- **Supplying dedicated low-energy lighting inside and outside.**
- **Supplying a secure drying space to occupants to reduce the use if tumble driers.**
- **Complying with the other requirements of the Code, which can be considered "passive" energy reduction (cycle storage, home office provision etc.)**

These measures combined will reduce the energy demand considerably (although it is not possible to quantify exactly), help occupants live a more sustainable lifestyle, and comply with the Local Authorities vision for new housing in the Borough.

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[2] http://www.greenroofoffsets.co.uk/reduce.php

Calculating the Renewable Energy Requirement

In order to determine the amount and type of renewable technologies which are most appropriate for this site, we first need to calculate the amount of energy predicted to be consumed.

The most usual way to do this is with the Standard Assessment Procedure (SAP), which is the calculation methodology used to demonstrate compliance with both the Building Regulations Part L, and the Code.

Preliminary SAP calcs have already been carried out, and provided to us for use in this report. The SAP calculations we will use here are effectively "base case" SAPs, which provide for no renewables. They offer, at this stage at least a representation of the likely construction and therefore the energy demand.

The SAP calculations also give an estimated CO_2 emissions figure, based on the input fuel types. It is this figure that can be used to calculate the most suitable renewable or low-carbon system.

These figures will be checked against the baseline figures used in the London Renewables Toolkit (which is used where no SAP calculations have been done) to ensure there is some parity.

Primary Energy Demand

Using SAP

The primary energy demand has been calculated for 3 different flats, termed Flat A, D and G. We will average the energy demand for the 3 flats, and use that as a baseline.

Flat A	Annual Primary Energy Demand –	11235 kWh/yr
Flat D	Annual Primary Energy Demand –	6646 kWh/yr
Flat G	Annual Primary Energy Demand –	6646 kWh/yr
Total for all 3 flats		24527 kWh/yr
Average per flat		8176 kWh/yr
Estimated total for 8 Flats		**65405kWh/yr**

Baseline Carbon Emissions

Using SAP

The SAP calculations for the 3 types assessed at this stage give predicted emissions rates as follows:

Flat A	Annual Predicted CO_2 Emissions –	2334 kg C/yr
Flat D	Annual Predicted CO_2 Emissions –	1398 kg C/yr
Flat G	Annual Predicted CO_2 Emissions –	1398 kg C/yr
Total for all 3 flats		5130 kg C/yr
Average per flat		1710 kg C/yr
Estimated total for 8 Flats		**13680 kg C/yr**

Using London Renewables Toolkit

The London Renewables Toolkit gives benchmark figures for emissions rates, where actual Sap calculations have not yet been undertaken.

The benchmark emissions rate figure for a "Town Centre Residential Tower", which is the closest matching description, is given as

8.62 kg C/m² GIFA

Although the drawings are not sufficiently advanced to be completely accurate about the floor areas, we estimate the gross internal floor area (GIFA) to be approximately 775m²

Using the simple equation:

Floor Area of Building x Baseline Emissions for Type = Annual Baseline Emissions

We arrive at a figure of:

775m2 x 8.62kg C/m2 = **6680 kg C / yr**

Clearly the London Renewables Toolkit is considerably lower than the SAP calculations and it is the higher SAP figure that we will use in establishing the renewables input.

Carbon Reduction Target

The next stage of the calculation is also a simple equation:

Emissions Reduction Target = Carbon Reduction Target (%) x Baseline Emissions

So the emissions reduction target is:

13680 kg C/yr x 10% = **1368 kg C / Yr**

So, in order to meet the council's planning condition, the development will need to reduce its emissions by approximately **1368 kg C / Yr through** the use of renewables.

Complying with the Requirements

The mayor's energy hierarchy asks developers to consider carbon reductions in the following order:

The Mayor will expect all strategic referrals of commercial and residential schemes to demonstrate that the proposed heating and cooling systems have been selected in accordance with the following order of preference

- passive design;
- solar water heating;
- combined heat and power, for heating and cooling, preferably fuelled by renewables;
- community heating for heating and cooling;
- heat pumps;
- gas condensing boilers and gas central heating.

Opportunities on this site for passive design are limited in that the orientation of the building is more or less pre-defined. However, the developer is making the best commitment possible, by using the passive features previously discussed.

Where relevant, these measures have been incorporated already into the SAP calculations.

The next stage of the analysis is to determine the most appropriate renewable strategy for the site. Increased investment and heavier regulation have meant that a reasonably wide range of technologies is now available to help meet carbon reduction targets.

Each technology is suitable for different applications, and many can usually be discounted quite early in the process for reasons outside the control of the design team.

The following table shows the full list of potential technologies and which are discounted immediately.

Development type	**Solar PV**	**Solar Thermal**	**Small scale wind**	**Biomass**	**Biomass CHP**	**Heat pump**	**Micro Gas CHP**
Apartments	√	√	X	√	X	√	X

Key:
Appropriate technology to be considered √
Technology not appropriate (reasons given below) X

Technologies Not Considered Further

Small-scale Wind Turbine

Micro wind turbines (roof-mounted) work best in exposed locations, without turbulence caused by large obstacles such as buildings and trees. They tend not to work very well in urban situations where wind comes from several directions and there are significant obstacles in the way. Most rooftops get an average annual wind speed of no more than 2 or 3 metres per second, and as the turbines do not generate power at less than 3 or 4 m/s, it would be sitting idle for much of the time.

The proposed development is set within a dense urban site and is in very close proximity to other buildings in all directions. The adjacent buildings are high, and there is a proposal to increase the height of the building to one side. Any wind turbine installed would produce an unacceptably low output. Current research being carried out into the effectiveness of urban micro turbines is suggesting that the predicted financial and carbon ROIs are not being met.

Micro CHP – Gas fired and Biomass

Micro-CHPs are an emerging technology (described by the Biomass Energy Centre as a technology that should be regarded as "still under development" (http://tinyurl.com/375btxq).

The installation costs are still extremely high (approx £7,000 for a standard domestic sized gas CHP unit) and the range of installers and manufacturers is very small.

CHP requires a regular heating and hot water demand to be efficient in a small scale development such as this there is likely to be too much load variance for the system to operate effectively, and the carbon savings are unlikely to be worth the initial investment.

There would undoubtedly be issues regarding the commercial availability of Micro-CHP units along with difficulties with maintenance, servicing and repairs.

For these reasons, this technology will not be considered for this project.

Renewable Energy Technologies Considered

The following renewable technologies are considered potentially viable for the development and will be considered further:

Solar Thermal Collector

Figure 3: Evacuated Tube Solar Thermal Collectors (Creative Commons License)

Solar thermal collectors use radiant energy from the sun to heat water pumped through tubes mounted on the roof. They are an established technology and widely used. As a result, capital costs are comparatively lower than other solutions. There are two main types, evacuated tube (Fig.3) and flat plate (Fig 4). Evacuated tube panels are less aesthetically pleasing, but produce more heat per square metre.

Figure 4: Flat Plate Solar Thermal Collector (©http://www.inbalance-energy.co.uk)

Although the capital cost of solar thermal panels is low, there is currently uncertainty over when (and if) the Government will introduce the proposed Renewable Heat Incentive which would reward dwellings with solar thermal technology. There is also uncertainty over any level or reward that would be offered.

Thermal energy is difficult to store effectively and on this development there is little space that could be used effectively. Another main disadvantage is that solar thermal systems only work effectively in the summer months when there is significant solar radiation. This is, of course when there is lowest demand for heating, and so if the energy cannot be stored or used elsewhere, it is likely to be wasted.

A 13m² system feeding all 8 dwellings would generate approximately 1800kWh/annum and save approximately 2900 kg C/annum[3] at a cost of approximately £19k

Although solar thermal panels are often used as a renewable technology, and represent a cost-effective means of reducing emissions, they are not considered the most suitable for this site.

Photovoltaic Cells (PV)

Figure 5: Roof Mounted Photovoltaic Panels (Creative Commons License)

Photovoltaic panels convert energy from solar radiation into electricity using a semiconductor material such as silicon. There is now a huge range of panels available, divided primarily into roof-integrated (where the panel forms the roof covering) and roof-mounted (where the panel sits over the tile)

PV panels can also be classified by the type of semiconductor used. Polycrystalline panels are the cheaper option, but have reduced efficiency over the more expensive

[3] http://www.encraft.co.uk/ws/P/Standalone/SolarHotWaterBudget.php

monocrystalline. Hybrid panels which comprise a mono crystalline cell with a thin amorphous layer are now becoming more popular, but remain the most expensive option.

While PV was until recently considered much more costly than other solutions, growing demand as well as Government incentives (through the Feed-In Tariff scheme which guarantee a certain financial ROI for a period of 25 years) have meant that PV is now a much more economical solution.

Another advantage of PV over solar thermal is the versatility of panel sizes, which means the production can be sized more accurately to reflect demand.

A quick calculation using Encraft's PV sizing tool[4] gives a system that produces 4.32kWp, generating 2850kWh per year, and saves 1500 kg C/yr. This is explored further in this report.

A PV system, with gas boilers is selected as the most suitable technology for this development.

Biomass

Figure 6: District Biomass System (© Ingleton Wood LLP)

Biomass refers to a method of producing energy from the combustion of organic material, usually wood chip or pellets. Although producing warmth through combustion is an ancient technique, its use as a primary heating source in dwellings has only recently made a resurgence. Biomass boilers are now extremely efficient (more than 90%), produce very little ash and smoke, and many have self-cleaning and auto de-ash functions.

[4] http://www.encraft.co.uk/ws/P/Standalone/SAP2009SolarPV_V2.php

For any biomass based solution, the two primary obstacles are space, and supply of fuel. Biomass requires a storage area for the fuel, and this must be of sufficient size that overly frequent deliveries are not needed, particularly through the winter months. Given the severity of recent winters, with the consequent disruption to transportation, there are now concerns that should the development run dry of fuel, there could be significant implications.

There are additional reasons why biomass has now been discounted: Biomass boilers need to run at full, or near to full capacity to maintain efficiency. For dwellings such as these which are likely to be purchased by young professionals, the boiler will be under-used during the day. This means that much of the carbon savings that can be gained from biomass will be wasted.

In central London there are also issues with smoke and fumes into neighbouring properties,

For these reasons, biomass is not considered to be the appropriate solution.

Ground Source Heat Pumps

Ground source heat pumps use a buried ground loop which transfers heat from the ground into a building to provide space heating and, in some cases, to pre-heat domestic hot water. The latent warmth in the ground is then amplified using an electrically powered heat pump at a coefficient of performance (CoP) of around 3. In other words for every unit of electrical energy put into the system, around 3 are output.

There are two main methods to achieve the required length of underground pipework, vertical boreholes and horizontal coiled loop ("slinky"), shown at Fig. 7.

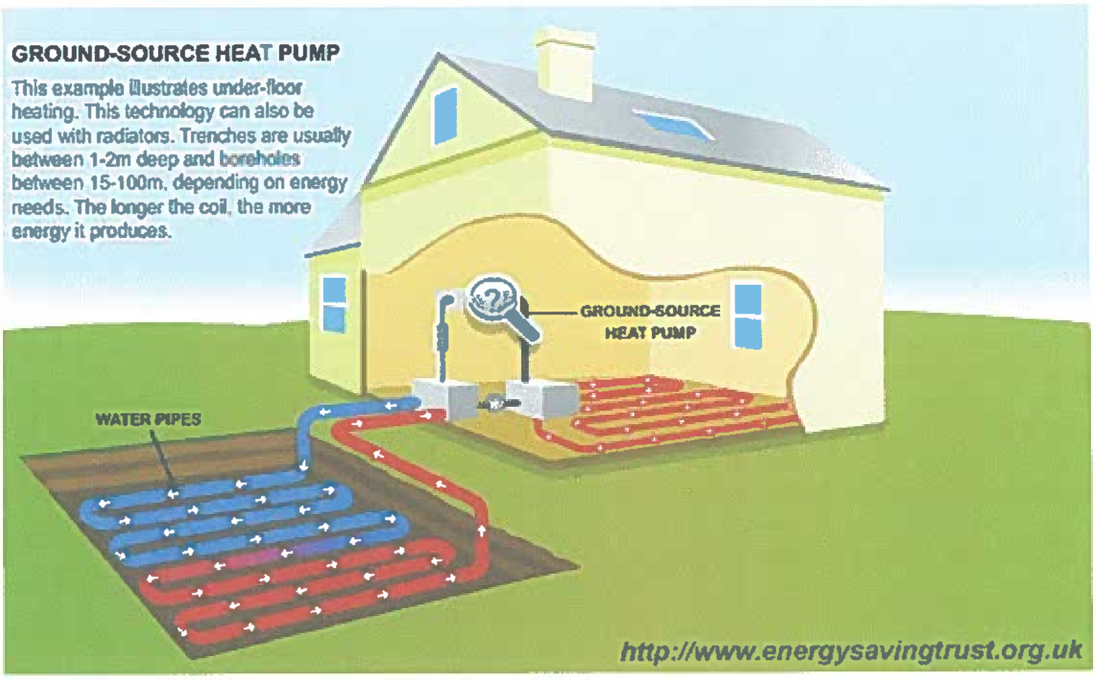

Figure 7: The basics of a Ground Source Heat Pump (Source: EST)

Boreholes require very deep piles to work effectively (between 15 and 100m) this is unlikely to be possible in central London with the myriad below ground services and ducts.

There is no space on site that is unused by the proposed building and so a horizontal coil is also not considered feasible.

Ground source heat pumps are therefore not considered suitable.

Air Source Heat Pumps

Air source heat pumps (ASHPs) operate using the same principles as the underground alternative, but draw thermal energy from the air rather than the ground. ASHPs work by extracting heat from the air and turning it into usable domestic heating. There are two main types of ASHP systems: air-to-air systems provide warm air, which is circulated to heat the building; and air-to-water systems which heat water to provide heating to a building through radiators or an underfloor system.

Air source heat pumps best suited to new build applications, with high levels of insulation, and low air leakage. They are also best suited to low-temperature applications such as underfloor heating.

The heat pump itself comprises a compressor and two heat exchangers that extract heat from ambient air.

Unlike the GSHP, the ASHP requires considerably less external space to install (and the pump is usually sited externally or can be located in the roof space. Accordingly, installation costs are kept to a minimum.

Although usually powered by electricity, the ASHP has a CoP ranging between 3 and 4, however the CoP declines with a reduction in air temperature, unlike the GSHP that has a relatively stable CoP. Air to water heat pumps produce hot water that is at a lower temperature than standard boiler systems, which makes it most efficient when supplying low temperature systems such as under floor heating. Optimising the system to generate higher temperatures reduces the CoP meaning the economic and energy benefits may be affected.

Fig 8: An Example of an external Air Source Heat Pump (Source: Internet)

External ASHP's require a box such as the one shown in Fig.8 to be mounted on the outside of the building. These are reasonably unsightly (although could be mounted to the rear), but more importantly can create significant noise.

Given the high density of the site location, and the proximity of neighbours, it is proposed that this type of heat pump is not the most suitable. In addition, these units require at least a measure of warmth in the air to work effectively. The recent extreme cold experienced in UK winters means that the dwelling occupiers may experience higher fuel bills and consequent emissions than if standard gas boilers had been used.

Air Source Heat Pumps are therefore not considered suitable for this project.

Exhaust Air Heat Pumps

A more favourable alternative is the exhaust air heat pump (EAHP), a variant on the technology described above.

These systems work essentially in the same way to an ASHP, combined with a Mechanical Ventilation and Heat Recovery system (MVHR). Warm stale air is extracted from the dwelling and any warmth in the air is extracted using a heat exchanger in the heat pump circuit. This heat energy is used to provide heating and hot water to the dwelling, while the cold air is expelled, usually at a temperature of around 0°C. Fig. 9 gives a graphical representation of this process.

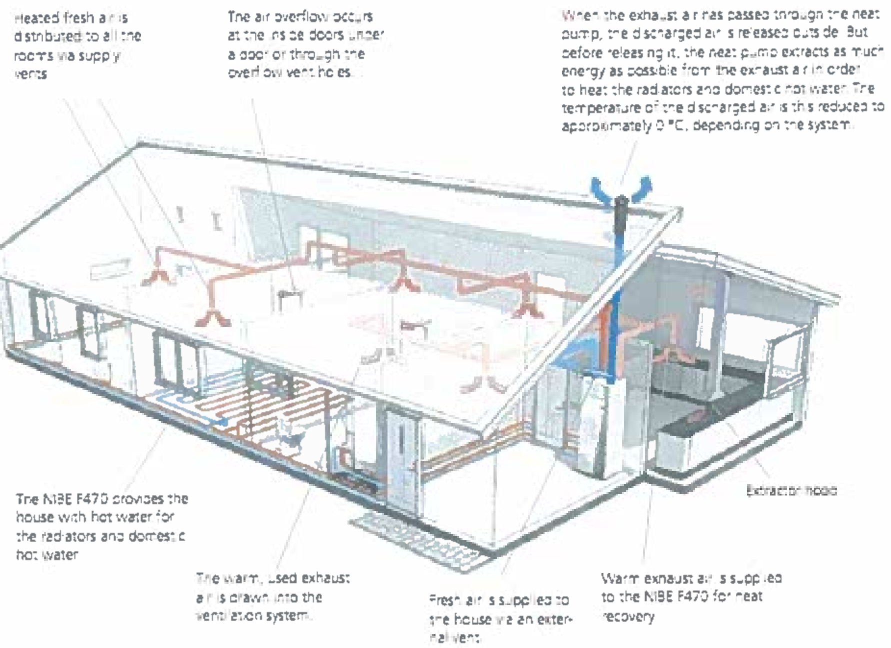

Fig 9. The Workings of an Exhaust Heat Pump System © *Nibe*

As with ASHPs, EAHPs supply low temperature water for heating (ideally in a well insulated airtight fabric with underfloor heating) and DHW. Any shortfall in the production from exhaust air is met with an electric immersion.

The advantage of an exhaust air system over a "standard" ASHP is essentially that all of the technology is contained internally, and so there is no visual or audible intrusion into neighbouring properties.

The systems are cost effective, and although they are a comparatively recent development, the research carried out so far seems to show that their performance is living up to the predictions in terms of energy reduction.

Although an EAHP system is considered suitable in most respects, the preliminary SAP calculations undertaken and provided in Appendix 1, show that the use of a heat pump will not reduce the carbon emissions by 10% on its own.

For that reason, the use of EAHPs is not considered suitable for this project.

Preferred Renewable Energy Technology

We have made our recommendation for the preferred system above, but we need to demonstrate that it can help meet the 10% requirements of the local authority.

To do this, we will refer back to the SAP calculation method, and demonstrate that the addition of PV will achieve the 10% reduction needed.

Our target for the whole development was a reduction of approximately **1368 kg C / Yr.**

Conveniently, the SAP calculations give us an overall prediction of the CO_2 emissions for each unit. As the calculations have not yet been undertaken for each unit, an average is taken to approximate the overall improvement:

Flat A	Annual Predicted CO_2 Saving through PV –	272 kg C/yr
Flat D	Annual Predicted CO_2 Saving through PV –	181 kg C/yr
Flat G	Annual Predicted CO_2 Saving through PV –	181 kg C/yr
Total for all 3 flats		634 kg C/yr
Average per flat		211kg C/yr
Estimated total for 8 Flats		**1688 kg C/yr**

Since clearly 1688 > 1368, the PV panels as proposed will reduce CO_2 emissions by **more than 10%** (in fact the figure is just over 12%)

PV panels are rated according to their peak output in Watt Peak (Wp). The CO_2 reduction figures above are based on the input figures in the SAP calculations of 0.6kWp for Flat A, and 0.4kWp for Flats D and G.

There are numerous tools available for predicting the likely output and emissions reductions for renewable technologies. The most flexible and regularly updated that we have found is the set of tools provided by Encraft.

Using their PV calculator tool to estimate the likely savings from PV, the output in Fig 10 is given. The calculations are based on using Sanyo HIT240 PV panels (which are amongst the most efficient currently available) and an overall rating for the system of 4.32kWp (18no. panels).

Fig 10. PV Benefit Calculations © *Encraft*

As can be seen, the predicted carbon savings align reasonably closely with the predictions of the SAP calculations and therefore offers some reassurance that the 10% target will be met using a system of this size.

Location and Visual Impact of Equipment

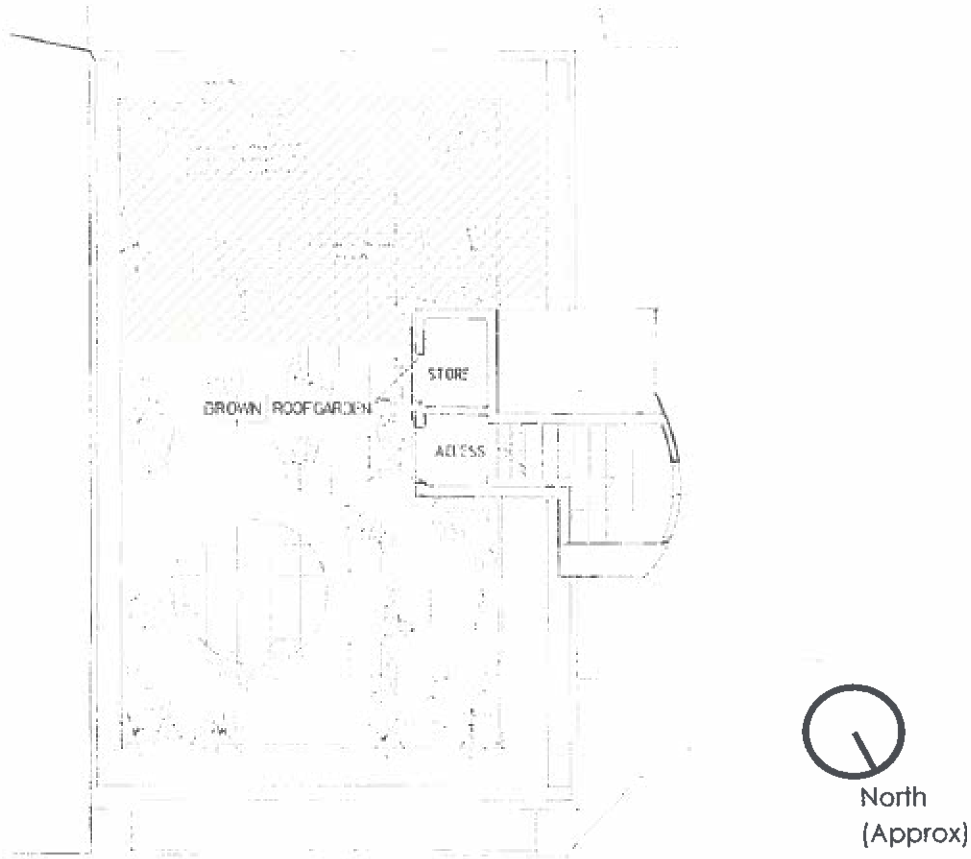

Figure 11: Proposed Roof Plan (© Alec Alexandrou)

The current roof plan is shown at Fig. 11, with the approximate area that would be needed for PV panels overlaid in green. As the proposal is for a flat roofed building, the panels would need to be raised to an angle of approximately 35-45° as shown in Fig. 12.

Figure 12: PV Angled Framework (©greensolarwales.co.uk)

The panels would therefore face approximately SSW, which would not significantly affect the predicted yield.

Grants and financing

There are a number of grant schemes and other incentive schemes available in the UK for PV. The main incentive is the Feed in Tariff, summarized below; however there may be additional grants available.

Grant / Incentive	Description	Available Financing
OFGEM Feed in Tariff (FiT)	Feed in Tariffs will be available for all installations of less than 5MW. These are available for all installations and were introduced in April 2010. The rate will be reduced by 7% per year to provide an incentive for installing sooner rather than later.	41.3 p/kWh < 4 kWp 36.1 p/kWh for PV 4 - 10 kWp 31.4 p/kWh 10 – 100 kWp

NB, other streams of capital and operational funding are available, but change regularly, so are not listed here.

Lifecycle Cost Analysis and Payback Periods

To calculate the payback period of the proposed system, it is necessary to calculate the time that it will take for a system to return the initial investment, taking into consideration the current cost of fuel, and a predicted rise in fuel costs.
For the purposes of this report, only the payback period of the recommended solution will be considered. Since the renewable energy provision from renewables is a planning obligation, and the decision on which technology to adopt is to be made on cost, efficiency and convenience factors, it is essentially an academic exercise to calculate payback periods for all of the technologies considered.

It should be noted that payback periods can be misleading as numerous factors (changing value of money, fluctuations on future energy and technology prices etc.) cannot be factored in with any degree of certainty.

For a 4.32 kWp system, Figure 13 (from Encraft PV calculation tools which use constantly updated standard industry data, including Feed in Tariff allowances) shows the estimated payback in terms of carbon and financial investment.

Appendix 1 – Sap Calculations (Front Pages Only)

elmhurst energy systems

Full SAP Calculation Printout

Users Ref: 001 - Flat A pv
EES Ref: 000069 A
Property: 13, Cross Street, London, EC1,

Issued on: 15.Mar.2011
Prop Type Ref: 00702009
DER: 16.09
TER: 17.84

SAP Rating: 85 B	**CO2 Emissions:** 1.88 t/year	**Fabric Energy:** 60.7	**Energy used:** 76 kWh/m²/year
EI Rating: 85 B	**SAP Energy Cost:** £ 403.88	**HLP:** 1.50	**Enel:** 0 **ZC:** 0.00

Surveyor: Matthew Carter, Tel: 01754-761035
Address: Marine Avenue, Skegness, Lincolnshire, PE25 3ER
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 2.03r02
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Design,

CALCULATION DETAILS for survey reference no '001 - Flat A pv' Page: 1
SAP2009 - 9.81 input data (DesignData) -

SAP2009 Input Data

FullRefNo:	001 - Flat A pv
Sap Version:	SAP 2009
Regs Region:	England & Wales
Region:	Thames Valley
Calculation Type:	New Build (As Designed)
DwellingOrientation:	North West
Property Type:	Flat, Detached
Storeys:	1
Date Built:	2011
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	51.6, 128.19, 2.8
Living Area:	22.98 m2, fraction: 17.9%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Medium
Thermal MassValue:	250
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1	96.67, 145.04, 70, , CavityWallDensePlasterAACblock, , Cavity, 0, 0.2, Calculate
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Party Ceilings	Area, Kappa, Construction, Element
Party Ceiling 1	128.19, 30, PartyFloorConcretePlank, ,
Heat Loss Floors	Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Heat Loss Floor 1	128.19, 110, GroundFloorSlabOnGround, , GroundSolid, 0, 0.15
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Door	Manufacturer, Solid Door, , , , , , ,
Windows	Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, PVC, 0.7,
Openings	Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Door	Solid Door, External Wall 1, Northwest, , , , 0, 0, 1, 1.89,
South East	Window, External Wall 1, Southeast, None, 0, , 0, 0, 1, 15.40,
N / West	Window, External Wall 1, Northwest, None, 0, , 0, 0, 1, 25.48,
N / East	Window, External Wall 1, Northeast, None, 0, , 0, 0, 1, 6.20,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	User Input, Accredited details
Y	0.08
Pressure Test:	True
Designed q50:	5
AsBuilt q50:	15
Property Tested:	False
Mechanical Ventilation	None
Chimneys MHS:	0
Chimneys SHS:	0
Chimneys Other:	0
Chimneys Total:	0
Open Flues MHS:	0
Open Flues SHS:	0
Open Flues Other:	0
Open Flues Total:	0
Intermittent Fans:	3
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	None
Light Fittings:	12
LEL Fittings:	12

Twenty16 Design

elmhurst energy systems

Full SAP Calculation Printout

Users Ref: 002 - Flat D pv
EES Ref: 000069 D
Property: 13, Cross Street, London, EC1,

Issued on: 15.Mar.2011
Prop Type Ref: 00702009
DER: 15.63
TER: 17.27

SAP Rating:	85 B	**CO2 Emissions:**	1.09 t/year	**Fabric Energy:** 47.8		**Energy used:** 73 kWh/m²/year	
EI Rating:	88 B	**SAP Energy Cost:**	£ 280.77		**HLP:** 1.25	**Enel:** 0	**ZC:** 0.00

Surveyor: Matthew Carter, Tel: 01754-761035
Address: Marine Avenue, Skegness, Lincolnshire, PE25 3ER
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 2.03r02
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Design,

CALCULATION DETAILS for survey reference no '002 - Flat D pv'
SAP2009 - 9.81 input data (DesignData) - **Page: 1**

```
----------------------------------------------------------------------
          SAP2009 Input Data
----------------------------------------------------------------------
FullRefNo:                    002 - Flat D pv
Sap Version:                  SAP 2009
Regs Region:                  England & Wales
Region:                       Thames Valley
Calculation Type:             New Build (As Designed)
DwellingOrientation:          North West
Property Type:                Flat, Detached
Storeys:                      1
Date Built:                   2011
Sheltered Sides:              2
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
     1st Storey:              45.1, 77.81, 2.4
Living Area:                  30.9 m2, fraction: 39.7%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Medium
Thermal MassValue:            250
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
     External Wall 1          67.42, 85.69, 70, , CavityWallDensePlasterAACblock, , Cavity, 0, 0.2, Calculate
     Wall to stairs           14.2, 22.55, 70, , CavityWallDensePlasterAACblock, , Cavity, 0, 0.2, Gross
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Party Ceilings                Area, Kappa, Construction, Element
     Party Ceiling 1          77.41, 30, PartyFloorConcretePlank, ,
Heat Loss Floors              Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Party Floors                  Area, Kappa, Construction, Element
     Party Floor 1            77.81, 90
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Door                     Manufacturer, Solid Door, , , , , , ,
     Windows                  Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, PVC, 0.7,
Openings                      Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     Door                     Solid Door, Wall to stairs, Northwest, , , , 0, 0, 1, 1.89,
     South East               Window, External Wall 1, Southeast, None, 0, , 0, 0, 1, 1.68,
     N / West                 Window, External Wall 1, Northwest, None, 0, , 0, 0, 1, 13.92,
     N / East                 Window, External Wall 1, Northeast, None, 0, , 0, 0, 1, 2.67,
     S / West                 Window, Wall to stairs, Southwest, None, 0, , 0, 0, 1, 6.46,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges               User Input, Accredited details
     Y                        0.08
Pressure Test:                True
Designed q50:                 5
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
Chimneys MHS:                 0
Chimneys SHS:                 0
Chimneys Other:               0
Chimneys Total:               0
Open Flues MHS:               0
Open Flues SHS:               0
Open Flues Other:             0
Open Flues Total:             0
Intermittent Fans:            3
Passive Vents:                0
Flueless Gas Fires:           0
```

Twenty16 Design

elmhurst energy systems

Full SAP Calculation Printout

Users Ref: 002 - Flat G pv
EES Ref: 000069 G
Property: 13, Cross Street, London, EC1,

Issued on: 15.Mar.2011
Prop Type Ref: 00702009
DER: 15.63
TER: 17.27

SAP Rating:	85 B	**CO2 Emissions:**	1.09 t/year	**Fabric Energy:** 47.8		**Energy used:**	73 kWh/m²/year
EI Rating:	88 B	**SAP Energy Cost:**	£ 280.77	**HLP:**1.25		**Enel:** 0	**ZC:**0.00

Surveyor: Matthew Carter, Tel: 01754-761035
Address: Marine Avenue, Skegness, Lincolnshire, PE25 3ER
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 2.03r02
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Design,

CALCULATION DETAILS for survey reference no '002 - Flat G pv'
SAP2009 - 9.81 input data (DesignData) -

Page: 1

```
SAP2009 Input Data

FullRefNo:                     002 - Flat G pv
Sap Version:                   SAP 2009
Regs Region:                   England & Wales
Region:                        Thames Valley
Calculation Type:              New Build (As Designed)
DwellingOrientation:           North West
Property Type:                 Flat, Detached
Storeys:                       1
Date Built:                    2011
Sheltered Sides:               2
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
     1st Storey:               45.1, 77.81, 2.4
Living Area:                   30.9 m2, fraction: 39.7%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           Medium
Thermal MassValue:             250
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
     External Wall 1           67.42, 85.69, 70, , CavityWallDensePlasterAACblock, , Cavity, 0, 0.2, Calculate
     Wall to stairs            14.2, 22.55, 70, , CavityWallDensePlasterAACblock, , Cavity, 5, 0.2, Gross
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Party Ceilings                 Area, Kappa, Construction, Element
     Party Ceiling 1           77.81, 30, PartyFloorConcretePlank, ,
Heat Loss Floors               Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Party Floors                   Area, Kappa, Construction, Element
     Party Floor 1             77.81, 90
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Door                      Manufacturer, Solid Door, , , , , , ,
     Windows                   Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, PVC, 0.7,
Openings                       Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     Door                      Solid Door, Wall to stairs, Northwest, , , , 0, 0, 1, 1.89,
     South East                Window, External Wall 1, Southeast, None, 0, , 0, 0, 1, 1.68,
     N / West                  Window, External Wall 1, Northwest, None, 0, , 0, 0, 1, 13.92,
     N / East                  Window, External Wall 1, Northeast, None, 0, , 0, 0, 1, 2.67,
     S / West                  Window, Wall to stairs, Southwest, None, 0, , 0, 0, 1, 6.46,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges                User Input, Accredited details
     Y                         0.08
Pressure Test:                 True
Designed q50:                  5
AsBuilt q50:                   15
Property Tested:               False
Mechanical Ventilation         None
Chimneys MHS:                  0
Chimneys SHS:                  0
Chimneys Other:                0
Chimneys Total:                0
Open Flues MHS:                0
Open Flues SHS:                0
Open Flues Other:              0
Open Flues Total:              0
Intermittent Fans:             3
Passive Vents:                 0
Flueless Gas Fires:            0
```