RPS

Project Hydrus
Operations Building with Support Facility, AWE Aldermaston, Reading

Energy Resources Statement

For

Atomic Weapons Establishment

UNCLASSIFIED

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1.0 INTRODUCTION

RPS Health Safety & Environment (RPS) was commissioned by AWE to assess the potential for incorporating renewable and efficient energy sources into the proposed development together with energy efficient design measures. As a consequence, options for reducing energy use and carbon will be identified.

This report outlines the scheme and the planning context, assesses likely energy demands of the development and investigates the potential use of zero and low carbon technologies at the site.

AWE has an Energy Strategy, which sets out its intentions for sustainable energy management and the approach to be adopted for the design, construction and operation of existing, refurbished and new buildings and infrastructure. Furthermore, AWE has also specified that the scheme is to be assessed under DREAM (Defence Related Environmental Assessment Methodology) with the aim of achieving an 'Excellent' rating.

The following sections therefore consider the implications of these factors along with other planning policy prior to assessing the feasibility of the technology options.

2.0 METHODOLOGY

The following methodology is based upon the AWE Energy Strategy Principles and general energy best practice:

1. Use Less Energy (be lean)
2. Use Renewable Energy - Zero Carbon (be green)
3. Supply Energy Efficiently – Low Carbon (be clean)

The report will therefore examine the planning policy and other requirements relevant to the development before assessing the likely energy demands. A review of the scheme features and options applicable to meeting the above Principles will then be undertaken and preferred options will be presented in the context of their carbon savings and economic implications.

3.0 SCHEME OVERVIEW

AWE proposes to develop part of a site in Aldermaston, Berkshire. The proposed scheme comprises an Operations Building and Support Facility and is considered necessary to service the continuing work of AWE. The proposed scheme is identified as references 9 and 10 within the AWE Site Development Context Plan 2008.

4.0 PLANNING POLICY CONTEXT

The relevant authority for this site is West Berkshire Council (WBC). The key planning policy framework applicable to the development is outlined below:

4.1 West Berkshire Council

The *Berkshire Structure Plan 2001-2016* was replaced by the South East Plan in May 2009 (see below), and is no longer part of the development plan. The former energy requirements of this document have therefore been superseded.

A number of 'Saved Policies' are listed under the *West Berkshire District Local Plan 1991-2006*. These policies were saved from expiry following an application to Central Government for an extension. They are still valid in making planning decisions. 'Saved' Policy OVS.9 *Renewable Energy* permits proposals for renewable energy schemes, as long as landscaping, open countryside and sites of nature conservation interest are protected, there is no environmental nuisance or pollution, and that access, road safety, public footpaths / rights of way and residential amenity are respected.

'Saved' Policy OVS.10 *Energy Efficiency* seeks for new development to maximise solar (or natural) heating, lighting and ventilation through siting, form, orientation and layout; use soft landscaping to increase shading and reduce heat loss in winter; and use energy efficient technology for heating, power and lighting.

West Berkshire's *Supplementary Planning Document – Quality Design, Part 4, Sustainable Design Techniques* indicates that, in order to comply with Local Plan Policy OVS.10, developers will be expected to demonstrate how the development has regard for energy and resource efficiency. Any new major development should be accompanied by an Energy and Resource Impact Statement, explaining these principles. For smaller proposals aspects of this statement should be addressed in the supporting statement submitted with the planning application.

Furthermore, the *Supplementary Planning Document* also requires non-residential buildings to be built to the BREEAM 'Excellent' standard (or equivalent).

4.2 South East of England Regional Assembly

The Regional Spatial Strategy (RSS) for the South East of England (known as the *South East Plan*) sets out the planning strategy for the region for the years 2006-2026; key policies relevant to the use of low and zero carbon technologies are detailed below.

Policy CC2: *Climate Change* requires local authorities to include policies and proposals in their plans, strategies and investment programmes to help reduce the region's carbon dioxide emissions by at least 20% below 1990 levels by 2010, by at least 25% below 1990 levels by 2015 and by 80% by 2050. Mitigation of greenhouse gases is to be achieved through a variety of mechanisms including improvements to energy efficiency and carbon performance of new buildings and encouraging the development and use of renewable energy.

Policy CC4: *Sustainable Design and Construction* includes a requirement for building design to increase the use of natural lighting, heat and ventilation, and for a proportion of the energy supply to be secured from decentralized and renewable or low carbon sources.

Policy NRM11: *Development Design for Energy Efficiency and Renewable Energy* states that local authorities should promote and secure greater use of decentralized and renewable or low-carbon energy in new development to be required to come from such sources. In advance of local targets being set in development plan documents, new developments of more than 1,000m^2 of non-residential floor space should secure at least 10% of their energy from decentralized and renewable or low-carbon sources unless, having regard to the type of development involved and its design, this is not feasible or viable.

Policy NRM 12 *Combined Heat and Power* suggests that Local Development Documents and other policies should encourage the integration of combined heat and power (CHP), in all developments and district heating infrastructure in large scale developments in mixed use. The use of biomass fuel should be investigated and promoted where possible.

5.0 OTHER REQUIREMENTS

The site is also subject to a number of other requirements in addition to the planning policy described above.

5.1 Ministry of Defence (MoD) Sustainability Handbook

The following policies from the MoD Sustainability Handbook are also considered pertinent to this study:

- To achieve major long term cuts in greenhouse gas emissions;
- To improve the quality of air by minimising air pollution by gases and particulate matter;
- To improve energy efficiency;
- To promote development and use of renewable energy;
- To ensure the prolonged availability of finite fossil fuels; and
- To explore secure, diverse supplies of energy at competitive prices and generated in environmentally acceptable ways.

5.2 AWE Energy Strategy

The Energy Strategy document was prepared by AWE to set out its intentions for sustainable energy management and the approach to be adopted for the design, construction and operation of existing, refurbished and new buildings and infrastructure. The Strategy was developed in consideration of AWE's stakeholder expectations including the MoD, regulators and other policy drivers. The underlying principles are to use less energy, use energy efficiently and use renewable energy, with the aim of reducing resource use and carbon dioxide emissions.

5.3 DREAM Aspirations

In addition to the above planning requirements, the proposed development is to be assessed under DREAM (Defence Related Environmental Assessment Methodology) with the aim of achieving an 'Excellent' rating. This Energy Resources Statement and the recommendations contained herein will form a part of the DREAM assessment process.

6.0 PREDICTED ENERGY DEMAND

Before consideration can be given to energy saving measures and low / zero carbon technologies, the expected energy demand should be assessed so that the solution can be suitably tailored to the specific needs of the proposed development.

The proposed buildings are intended for research and development activities and the actual energy demand will be dependent upon the specific plant installed and its frequency of operation. For the purposes of this energy resources statement, the predicted energy demand of the development has been assessed by RPS using the Simplified Building Energy Model (SBEM). SBEM is a computer programme that provides an analysis of a building's energy consumption. It calculates monthly energy usage and carbon dioxide emissions based upon a given description of the building geometry, construction, use, heating ventilation air conditioning (HVAC) and lighting.

The purpose of the tool is to provide a consistent methodology and reliable evaluation of energy use in non-domestic buildings for Part L Building Regulation compliance.

6.1 Baseline Demand Operations Building

The following has been calculated on the basis of the indicative SBEM assessment:

Energy Use	% of Demand	CO_2/yr (kg)	Energy/yr (kWh)
Heating	0.9	14,003	33,182
Cooling	3.0	46,676	110,606
Auxiliary	1.5	23,338	55,303
Hot Water	0.6	9,335	22,121
Lighting	23.7	368,737	873,785
Equipment	70.3	1,093,765	2,591,860
Total	**100.0**	**1,555,853**	**3,686,856**

It has been assumed that Heating Ventilation and Air Conditioning (HVAC) is only used to condition the personnel and laboratory spaces. For the purposes of the baseline assessment, the fuel source for all energy systems is assumed to be electricity due to the likely cooling requirements and relatively low hot water demand. No gas is assumed for the baseline on the basis that the nearest gas main to the site is located approximately 800m to the south and any gas-fired systems at the site would need to be housed in a separate buildings and located >45m from the proposed buildings for safety reasons.

Assumptions relating to the building fabric are detailed in Section 7 below.

6.2 Baseline Demand Support Facility

The following has been calculated on the basis of the indicative SBEM assessment:

Energy Use	**% of Demand**	**CO_2/yr (kg)**	**Energy/yr (kWh)**
Heating	25.0	29,193	69,179
Cooling	6.0	7,006	16,603
Auxiliary	3.0	3,503	8,301
Hot Water	2.0	2,335	5,534
Lighting	35.0	41,455	98,234
Equipment	28.5	33,280	78,864
Total	**100.0**	**116,774**	**276,715**

HVAC has been assumed for the office area. For the purposes of the baseline assessment, the fuel source for all energy systems is assumed to be electricity due to the likely cooling requirements and relatively low hot water demand. No gas has been assumed for reasons discussed above.

Assumptions relating to the building fabric are detailed in Section 7 below.

6.3 Energy & Carbon Dioxide

The relationship between energy and carbon dioxide emissions is usually calculated on the basis of the 'carbon conversion factor' associated with a particular energy source (e.g. electricity 0.422kgCO_2/kWh; or gas 0.194kgCO_2/kWh). Therefore, replacement of grid energy demand with on-site use of renewable technology does not necessarily correspond with a *proportional* reduction in carbon dioxide emissions. This is because the amount of carbon saved will depend upon the fuel type being replaced and its carbon dioxide emission factor.

However, for this proposed scheme, the baseline assessment has assumed a single source of energy (i.e. electricity). In this instance, therefore, reductions in grid energy usage will be proportional to reductions in carbon dioxide.

7.0 BUILDING FABRIC

Typically, specifics relating to building fabric performance are considered in greater detail during the latter stages of the scheme design. However, early consideration has been given to building fabric in this instance in order to reduce the likely energy demand prior to the consideration of the supply. This is in line with the first principle of the AWE Energy Strategy, *to use less energy (be lean)*.

Whilst the project will evolve throughout its design, at this stage, the following fabric elements are proposed:

7.1 Building Materials

All building elements will be compliant with Part L of the Building Regulations.

- *Exterior walls* will be predominantly metal cladding with insulated breeze block in the lower part.
- *Internal walls* will be predominantly breeze block.
- *Roofs* will be predominantly metal standing seam, non-reflective self finish cladding. An area of green roof is proposed for the support facility.

7.2 Heating Ventilation & Air Conditioning (HVAC)

Low and Zero Carbon HVAC options will be in line with the findings of this study, however, the following is also proposed.

- A *Variable Refrigerant Flow (VRF)* system will be use in the Support building to move heat around by extracting it from one area that requires cooling and releasing it in another which requires heating.
- During the winter months, fresh air entering the Operations Building will be directed via the IVA Halls and *pre-heated*. The pre-heating process takes advantage of the waste heat dissipated from the IVA machines, which will reduce the heating demand on the conventional HVAC and therefore reduce energy consumption and carbon emissions.
- Air Handling Units (AHU) within the Operations Building will be designed to allow *recirculation* of air. This will significantly reduce heat losses associated with ventilation.
- Ventilation systems within the Support Building will use run-around coils / cross-flow *heat exchangers* where practicable. This will significantly reduce heat losses.
- *Control systems* will be provided to allow the flexibility of controlling individual ventilation processes.
- Spaces will be *sub-metered* to ensure close monitoring and control of energy use.

7.3 Lighting

The following efficient design will be applied to the lighting systems:

- It is proposed that both buildings will have zoned lighting fitted with an *intelligent control system*. Areas adjacent to window and doors will be zoned separately.
- WCs and other appropriate spaces will be installed with *infra-red occupancy sensors*.
- Internal and External Luminaires will be *efficient* and will exceed the standards specified within Part L of the Building Regulations with the exception of the IVA Halls where non electronic lamps will be used due to safety requirements. .

7.4 Hot Water

The following system will be applied to Domestic Hot Water (DHW):

- Instantaneous ‘point of use’ heaters will be used. These types of water heaters will only generate hot water when it is required and typically have an efficiency of >85%.

8.0 RENEWABLE TECHNOLOGY OPTIONS

Renewable technologies are those that take their energy from sources, which are considered to be inexhaustible (e.g. sunlight, wind, and wave). Renewable technologies are generally considered to be 'green' as the carbon dioxide emissions associated with the production of energy are typically negligible. The expression 'zero carbon technologies' is often used in reference to renewables.

The consideration of renewables is consistent with the second Principle of the AWE Energy Strategy; *to use renewable technology (be green)*.

The feasibility of the following technologies has been considered as part of this assessment:

- Air Source Heat Pumps (ASHP)
- Biomass
- Ground Source Heat Pumps (GSHP)
- Photovoltaic (PV)
- Solar Thermal
- Wind Turbines

Feasibility is assessed by considering the relative energy and carbon savings in the context of the financial and physical restrictions associated with the proposed scheme. In addition, activities at the AWE site are potentially sensitive and are subject to security considerations; this is also taken into account.

Technologies are not necessarily compatible on the basis that they may be designed to satisfy the same energy demand (e.g. ASHP and GSHP which typically would satisfy space heating) or there is conflict with the physical space requirements (e.g. roof space requirements for photovoltaic and solar thermal).

All technologies have their advantages and disadvantages and the relative costs and benefits for this scheme are considered below.

8.1 Air Source Heat Pumps

8.1.1 Technology Overview

Air Source Heat Pumps (ASHP) draw thermal energy from the air and turn it into usable domestic heating. The system comprises a compressor, condenser and refrigerant system to absorb heat from the external environment and release it internally.

Electricity is required to power the circulation of refrigerant and system fans; and typical co-efficients of performance (CoP) are in the order of 2.5 to 4 (i.e. for each unit of electrical energy required to operate the system, between 2.5 and 4 units of thermal energy are generated). Air Source Heat Pumps are, however, generally considered as renewable (despite the electrical input) because the source for the heat is the ambient air temperature in the exterior environment.

There are two types of ASHP systems: air-to-air systems provide warm air, which is circulated to heat the building; and air-to-water systems heat water to provide heating to a building through radiators or an underfloor system.

The ASHP typically appears as a 'box' and would not look too dissimilar to a traditional air conditioning system. Furthermore, it is possible to operate the system in reverse as a cooling system, however, this operation is not considered renewable as it does not take advantage of the heat source in the natural environment.

8.1.2 Site Features

There are no space restrictions which would prohibit the inclusion of an ASHP system. Thermal energy demand is, however, comparatively low for the Operations Building; more heating would be required for the Support Facility.

8.1.3 Assessment

By replacing the assumed baseline systems with ASHPs, there is potential to significantly reduce the electrical demand required for space heating.

Assuming a CoP of 3.0, this technology would be able to satisfy approximately 0.9% of the energy demand for the Operations Building and approximately 25% of the energy demand for the Support Facility. For the proposed scheme as a whole, this would equate to approximately 2.6% of the energy demand.

System requirements would be approximately 170kW and 55kW for the Operations and Support buildings respectively. For budgetary purposes, it is expected that the system, with installation, would be in the order of £155K.

This system represents a feasible technology.

Summary Table – Air Source Heat Pump

Generated Energy	83,000 kWh/yr
Demand Type	Space Heating
Cost	£155,000
Building Demand Satisfied (Operations)	0.9%
Building Demand Satisfied (Support)	25%
Site Demand Satisfied	2.6%
Investment Cost per % renewable energy	£60,000

Whilst Air Source Heat Pumps could satisfy space heating demand across the site and contribute significantly to the energy requirements of the Support Building, the maximum potential contribution from this technology is limited (in percentage terms). This is due to the anticipated demand requirements, which are dominated by the equipment energy use in the Operations Building.

8.2 Biomass

8.2.1 Technology Overview

Biomass is a term used to describe all plant and animal material. A range of biomass material can be burnt to generate energy including wood, straw, poultry litter and energy crops such as willow or poplar.

Biomass material is considered carbon neutral if the fuel comes from a sustainably managed source. For example, if a crop is used as a fuel source, then new crops must be replanted to replace those taken. This is in contrast to fossil fuels, which cannot be replaced when burnt.

The use of biomass as an environmentally friendly fuel source is not without criticism on the basis that the fuel is bulky and must be physically transported (which has its own associated fuel requirements). Furthermore, critics argue that fuel crops displace (or replace) food crops, which can affect the price and / or availability of this commodity. This issue is generally more pertinent in countries with a greater dependence on homegrown produce.

The fuel is bulky and the development would require a storage area and access for delivery vehicles. In addition, a flue would need to be specifically designed into the building to allow sufficient air movement. Capital costs associated with installation are usually significantly more than traditional boiler systems due to the complicated fuel feeding mechanisms.

8.2.2 Site Features

The site is located in West Berkshire, a rural location which, on consultation with the Biomass Energy Centre, potentially has a number of fuel suppliers in the area.

Whilst the proposed scheme has sufficient space to store material, the site is a secure facility and regular bulk deliveries would need to be suitably managed.

8.2.3 Assessment

Whilst this technology is deemed potentially feasible and relatively cost effective, its desirability is reduced due to the ongoing management considerations associated with fuel supply.

Summary Table – Biomass

Generated Energy	83,000 kWh/yr
Demand Type	Space Heating
Cost	£70,000
Building Demand Satisfied (Operations)	0.9%
Building Demand Satisfied (Support)	25%
Site Demand Satisfied	2.6%
Investment Cost per % renewable energy	£28,000

8.3 Ground Source Heat Pumps

8.3.1 Technology Overview

Ground Source Heat Pumps (GSHPs) utilise the natural heat energy of the earth and turn it into usable domestic heating. The system is similar to the ASHP system in functionality and is also best applied as space heating.

GSHPs require an input of energy to pump the fluid around the heat exchange circuit. However, the technology can produce much more energy than it uses - typical Co-efficients of Performance (CoP) are in the order of 3-4.

Two main types of heat-exchanger system are available, a closed-loop system and an open-loop system. The closed-loop system pumps fluid through a network of underground pipes. As the liquid moves around the system, it gradually absorbs heat. With the open-loop system, the pump extracts the ground heat through pumping out groundwater and disposing of the groundwater once the heat has been extracted.

Heat pumps can be installed in a horizontal or vertical manner, the former generally requiring a significant area (~100m^2 for a small load such as a single house) for excavation and positioning of the pipework; the latter being more suitable for space restricted developments (but costing more to install). Whilst a ground source heat pump is not a wholly renewable energy source, as it requires electricity to run, the renewable component is considered to be the heat extracted from the ground.

The technology works optimally when used in conjunction with under-floor heating as this utilises the energy at the temperature at which it is generally supplied.

8.3.2 Site Features

There are no space restrictions which would prohibit the inclusion of a GSHP system; however, vertical boreholes may be required in preference to the horizontal system to avoid the need for space beyond the building footprint.

Thermal energy demand is comparatively low for the Operations Building; more heating would be required for the Support Facility.

8.3.3 Assessment

Performance will be dependent upon the thermal properties of the ground beneath the proposed buildings; however, it is expected to be similar to that of the ASHP (detailed above).

Therefore, as with the ASHP, the technology would be able to satisfy approximately 0.9% of the energy demand for the Operations Building and approximately 25% of the energy demand for the Support Facility. For the proposed scheme as a whole, this would equate to approximately 2.6% of the energy demand.

System requirements would be approximately 170kW and 55kW for the Operations and Support buildings respectively. For budgetary purposes, it is expected that the system, with installation, would be in the order of £180K.

This system represents a feasible technology.

Summary Table – Ground Source Heat Pump

Generated Energy	83,000 kWh/yr
Demand Type	Space Heating
Cost	£180,000
Building Demand Satisfied (Operations)	0.9%
Building Demand Satisfied (Support)	25%
Site Demand Satisfied	2.6%
Investment Cost per % renewable energy	£69,000

8.4 Photovoltaic

8.4.1 Technology Overview

Photovoltaic (PV) systems convert energy from the sun into electricity though semi-conductor cells. There are three main types of photovoltaic system; crystalline silicon (15% efficiency), poly-crystalline silicon (8-12%) and amorphous crystalline silicon (4-6%).

The output of the systems is measured in kilowatt peak potential (kWp), which is an indication of how much electricity the system could generate at peak or optimum conditions. The Department of Trade and Industry estimates that a typical 1kWp system in the UK would produce 700-750kWh per year of electricity and high-performance systems could produce around 850kWh.

To optimise performance of PV systems, they should be mounted on a south-facing roof, although south-east / south-west will also function successfully. Ideally, the panels should be elevated to between 30 and 40 degrees to maximise the received solar energy. As with the solar thermal technology (discussed later), roof-space requirements vary significantly according to the type of system used (typically areas requirements are $8m^2$-$20m^2$ per kWp).

Cleaning will also be required on a periodic basis and birds should be discouraged, as droppings will affect the performance. Roof-mounted PV cells are generally not compatible with solar thermal or green roofs due to the space requirements. The durability of the systems varies according to the module type, as follows: mono-crystalline 25-30 years; poly-crystalline 20-25 years; and amorphous 15-20 years.

8.4.2 Site Features

A significant extent of roof space is potentially available to this technology, particularly on the Operations Building. A green roof is proposed for the Support Building.

Both buildings employ a Lighting Protection System (LPS). The Operations Building requires a number of independent systems due to the potential consequences of a strike. One system proposed for the Operations Building is the Catenary system which is designed to intercept and conduct any lighting strikes from the building to the ground. This system relies upon the mechanical properties of the calzip roof structure to function. The Support Building will use a mesh / finial system.

8.4.3 Assessment

Photovoltaic is not considered appropriate for the Operations Building principally because of its potential to affect the mechanical properties of the roof and consequently affect the functionality of the Catenary LPS.

The mesh / finial LPS proposed for the Support Building potentially allows for the position of PV in the protected zones, however, this building will have a green roof which is incompatible with the technology.

On the basis of the presence of the LPS and the green roof, PV is not considered feasible for this proposed development.

8.5 Solar Thermal

8.5.1 Technology Overview

Solar heating systems convert energy from the sun into thermal energy – usually for hot water heating. There are two main types of solar panels: flat plate collectors and evacuated tube collectors. Both systems require a prominent position on the building to maximise exposure to sunlight; usually this is on a south-facing roof surface although wall-mounted systems can operate (albeit with a lower efficiency due to the reduced angle of sunlight). For optimum performance, the panels should be mounted on a south-facing roof at an angle of between 10 and 60 degrees. Variations, such as external wall mountings or building orientation, will reduce the potential performance.

Roof-space requirements will vary according to the selected technology (e.g. flat plate or evacuated tube systems) on the basis that these technologies have varying performance characteristics.

The panels are generally very low maintenance, but should have an annual check. Birds, however, should be deterred from the rooftop as droppings have the potential to affect the performance. Solar hot water heating systems are frequently not compatible with photovoltaic systems or green roofs owing to the roof space requirements. The lifespan of the panels is generally considered to be up to 25 years.

Both systems require a small amount of energy to power a circulation pump.

8.5.2 Site Features

Relevant site features are consistent with those discussed in Section 8.4.2 above.

8.5.3 Assessment

This technology is not considered appropriate in conjuncture with the lighting protection system and green roof.

8.6 Wind Turbines

8.6.1 Technology Overview

Wind energy is harnessed in turbines to produce electricity. The turbines can be freestanding or roof-mounted and come in a range of sizes. The British Wind Energy Association (BWEA) states that a modern wind turbine produces electricity 70-85% of the time, but it generates different outputs dependent on wind speed. Over the course of a year, turbines typically generate about 30% of the theoretical maximum output.

Wind turbines generally require average wind speeds in excess of 4.5m/s at hub height in order to be economically viable, and speeds in excess of 6m/s are recommended for larger systems. Energy production is seasonable and generally peaks during the winter months, which is likely to correspond with increased energy requirements within a development.

Obstacles will create turbulence and affect the functionality of the turbine. Large open areas are therefore preferred locations to optimise power generation. Planning permission will likely be required as turbines can alter the aesthetics of an area. Maintenance requirements are generally low and turbines can last for 20–25 years without the need for replacement.

There may be some issues with structural-borne vibration if roof-mounted and noise issues (associated with the rotation) should also be considered. Turbines produce noise and this may prove to be an issue with regards to roof-mounted systems.

8.6.2 Site Features

The London Renewables Toolkit indicates that most freestanding wind turbines require a wind speed of at least 6m/s to operate economically (although it is acknowledge that very small roof-mounted turbines can operate at speeds of as low as 3.5m/s). The BWEA wind speed database has indicated the following wind speeds in the vicinity of the site: 4.4m/s at 10m above ground level (agl) and 5.1m/s at 25m agl.

As discussed above, the proposed site would operate a lightning protection system.

8.6.3 Assessment

On the basis that average wind speeds in the area are only marginally above the recommended minimum threshold and that the turbines potentially could interfere with the lighting protection system, this technology is not considered feasible.

9.0 EFFICIENT TECHNOLOGY OPTIONS

Efficient technologies are those which, whilst not defined as renewable, produce energy at a far higher efficiency than conventional systems. The expression 'low carbon technologies' is often used in reference to these systems.

The consideration of low carbon technologies is consistent with the third Principle of the AWE Energy Strategy; *to supply energy efficiently (be clean)*.

The feasibility of the following technology has been considered as part of this assessment:

- Combined Heat and Power (CHP)

9.1 Combined Heat & Power (CHP)

9.1.1 Technology Overview

Combined Heat and Power (CHP) systems can simultaneously generate thermal and electrical energy. They are typically generally gas-powered, but they can also be run off alternative fuels (e.g. biomass - although the current availability and performance of this technology at this scale need improvement).

CHP can provide significant carbon savings when compared to conventional systems as the excess heat from the electricity generation process is directly used on site.

Designing the CHP according to the base load ensures that it will be running most efficiently, and any peak loads can be met by additional power sources - possibly comprising traditional energy efficient and low emission gas boilers.

9.1.2 Site Features

The site has a relatively modest thermal demand. There is no gas provision for the proposed scheme and the nearest gas main is located 800m to the south. Any CHP unit would need to be located at least 45m from the Operation and Support Buildings for safety reasons.

9.1.3 Assessment

Technically, it is feasible to extend the gas supply to the subject site, locate a CHP external to the proposed buildings and transfer heat as steam for the purposes of space heating and domestic hot water. However, this is not considered a pragmatic or desirable solution for the proposed scheme for a number of reasons.

CHP typically requires a relatively constant thermal base load for optimum performance. It is expected that space heating requirements in the office areas will fluctuate on a daily basis in line with the occupancy of the building. Furthermore, heating requirements for domestic hot water are relatively insignificant. Any suitably sized CHP system would therefore need to be sized to meet the constant thermal load through the day (likely to be a fraction of the overall heating requirements) and installed in conjunction with traditional gas-fired boilers in order to satisfy the peak demand requirements.

The expense associated with connection to the gas main, siting of the CHP and transfer of heat is considered significant (>£300,000).

Whilst an efficient technology, CHP is not considered to be a renewable technology because the primary fuel source is gas. The use of CHP would therefore not satisfy the planning policy requirement for the inclusion of renewable technologies in new developments.

On the basis of the limited potential for this technology, its expense and that it would not be considered as renewable by the local authority, CHP is not deemed to be a viable option for this proposed scheme.

10.0 GRANTS & OTHER INCENTIVES

There are a number of incentives and grant schemes available to developers, which could reduce the capital expenditure associated with renewable energy technologies.

10.1 Low Carbon Building Programme (DTI)

This scheme replaced the former Clear Skies Scheme and provides funding to businesses and public sector organisations for the installation of renewable technologies into new buildings. Between 30 and 50% of the installation cost of PV, wind turbines, solar hot water systems, ground source heat pumps and wood-fuelled stoves and boilers can be obtained, using a combination of up to three technologies. The equipment must be purchased from a list of approved suppliers and the system must remain unchanged for at least 5 years. The funding is based on the carbon savings that would be provided and can range up to £1 million.

10.2 Energy Technology Product List

The Energy Technology List details products that meet the Government's energy efficiency criteria, and is deigned for organisations wishing to procure energy efficient equipment. The list is expanded on a continuous basis, the latest version of which can be found at www.eca.gov.uk.

11.0 SUMMARY

The site is located in the area falling under the authority of West Berkshire Council, which has policies encouraging the adoption of renewable and efficient technologies in new developments. Furthermore, the Government Office for the South East has a regional policy requiring new non-residential developments >1,000m^2 to secure at least 10% of their energy from decentralized and renewable or low-carbon sources, unless this is not feasible or viable.

Two buildings are proposed for development at the site; an Operations Building and Support Facility. Anticipated demand for these units is expected to be entirely electrical and dominated by the lighting and equipment requirements.

The proposed scheme was assessed considering the planning requirements and following the principles of the AWE Energy Strategy (be lean, be green, be clean). On the basis of this assessment, it is concluded that whilst there is potential to reduce energy consumption through the use of improved building fabric (e.g. lighting controls, heat recovery etc), the scope for inclusion of renewable technologies is considered limited.

The principal reason for this is because the demand associated with the cooling, auxiliary, lighting and equipment is significant (in the order of 96.7% of the overall site demand) and of an electrical nature. The two potential renewable technologies capable of generating electricity (PV and wind turbines) are not deemed to be feasible at any meaningful scale on the basis of their potential to interfere with the function of the lightning protection system and, in the case of PV, their incompatibility with the green roof.

Renewable technology solutions are therefore limited to addressing the thermal demand requirements (i.e. domestic hot water and space heating), which account for approximately 3.3% of the overall energy demand. Three technologies are therefore considered feasible for addressing the space heating demand, air source heat pump (ASHP), ground source heat pump (GSHP) and biomass.

On the basis of the analysis, it is proposed to include ASHP for the purposes of space heating. This technology is considered preferential to GSHP due to its performance relative to investment expense; and preferential to biomass due to its reduced requirement for ongoing management of fuel supply.

ASHP will therefore supply 25% of the energy demand for the Support Building and 0.9% of the energy demand for the Operations Building. On a site wide basis this accounts for 2.6% of the overall demand (due to a larger proportion of energy being required by the Operations Building). Domestic hot water will be supplied by instantaneous hot water heaters which, whilst not renewable, are considered to be a very efficient means of providing this energy.

The above approach is considered compliant with policy requirements and consistent with the principles of the AWE Energy Strategy.

APPPENDICES

SBEM Main Calculation Output Document

Fri Sep 04 11:40:44 2009

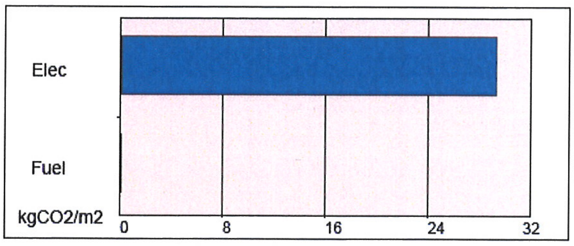
Building name

Operations (Indicative)

Building type: Office

SBEM is an energy calculation tool for the purpose of assessing and demonstrating compliance with Building Regulations (Part L for England and Wales, Section 6 for Scotland, Part F for Northern Ireland, Part L for Republic of Ireland and Building Bye-laws Jersey Part 11) and to produce Energy Performance Certificates and Building Energy Ratings. Although the data produced by the tool may be of use in the design process, **SBEM is not intended as a building design tool.**

Building Energy Performance and CO2 emissions

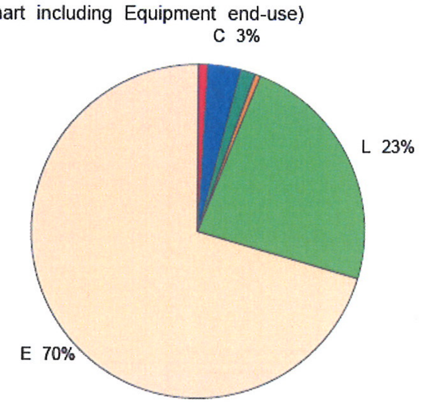


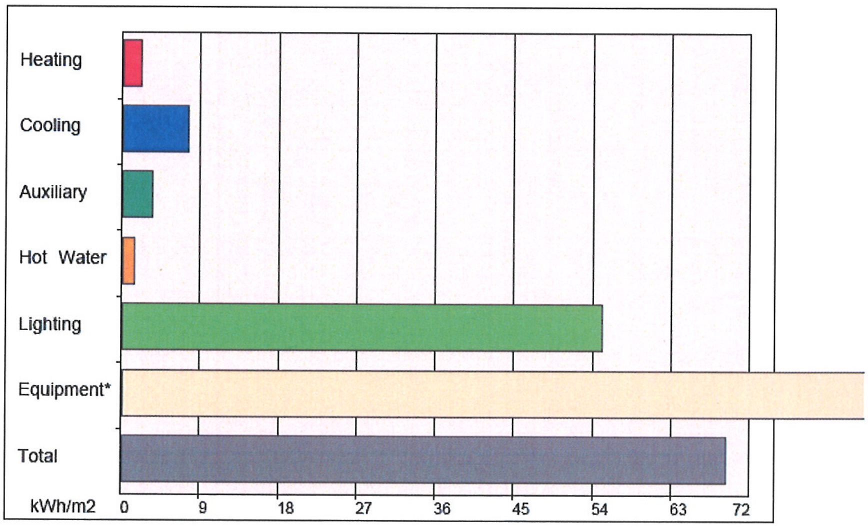
0 kgCO2/m2 displaced by the use of renewable sources.

Building area is 15903.1m2

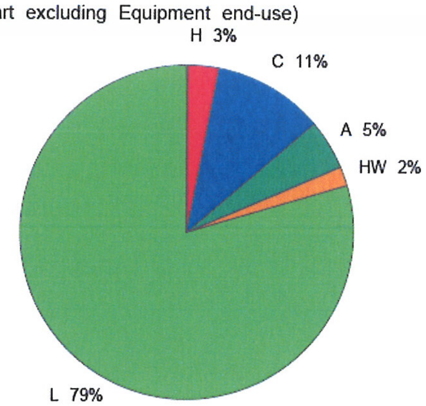
Annual Energy Consumption

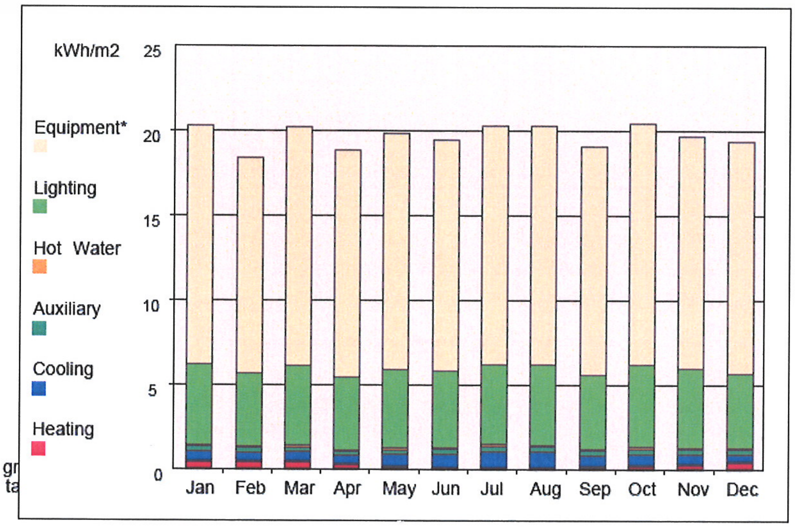
(Pie chart including Equipment end-use)





(Pie chart excluding Equipment end-use)





(*) Although energy consumption by equipment is shown in the gr
the CO2 emissions associated with this end-use have not been ta
into account when producing the rating.

SBEM Main Calculation Output Document

Fri Sep 04 14:20:44 2009

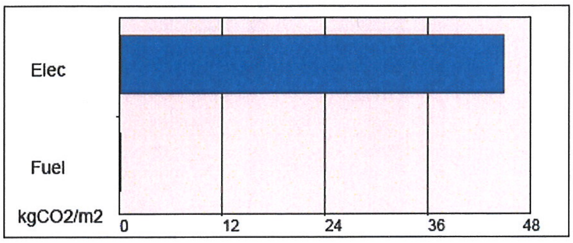
Building name

Support (Indicative)

Building type: Office

SBEM is an energy calculation tool for the purpose of assessing and demonstrating compliance with Building Regulations (Part L for England and Wales, Section 6 for Scotland, Part F for Northern Ireland, Part L for Republic of Ireland and Building Bye-laws Jersey Part 11) and to produce Energy Performance Certificates and Building Energy Ratings. Although the data produced by the tool may be of use in the design process, **SBEM is not intended as a building design tool.**

Building Energy Performance and CO2 emissions

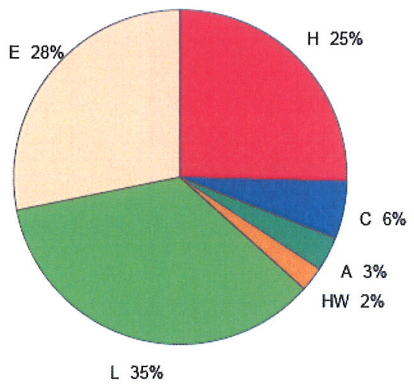


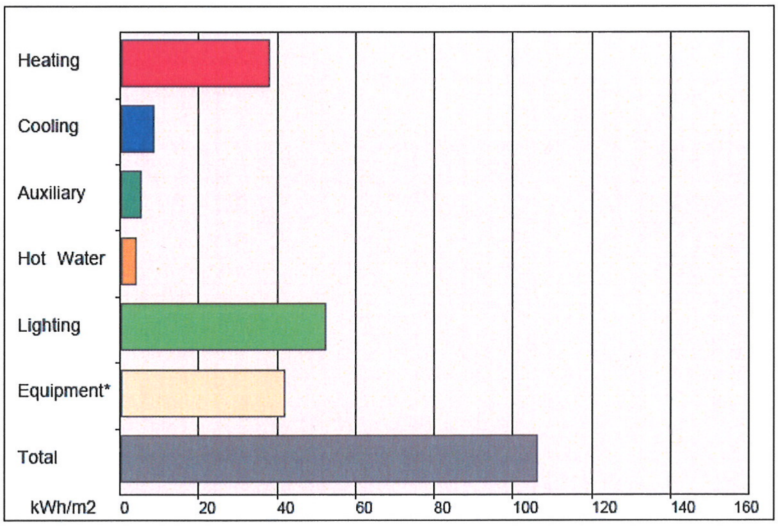
0 kgCO2/m2 displaced by the use of renewable sources.

Building area is 2214.3m2

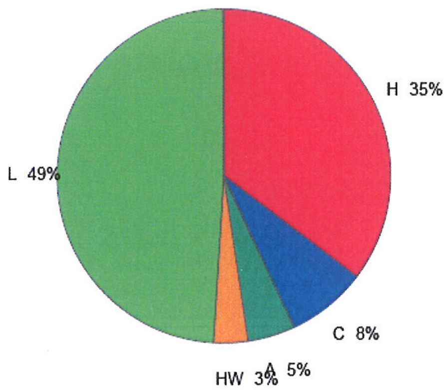
Annual Energy Consumption

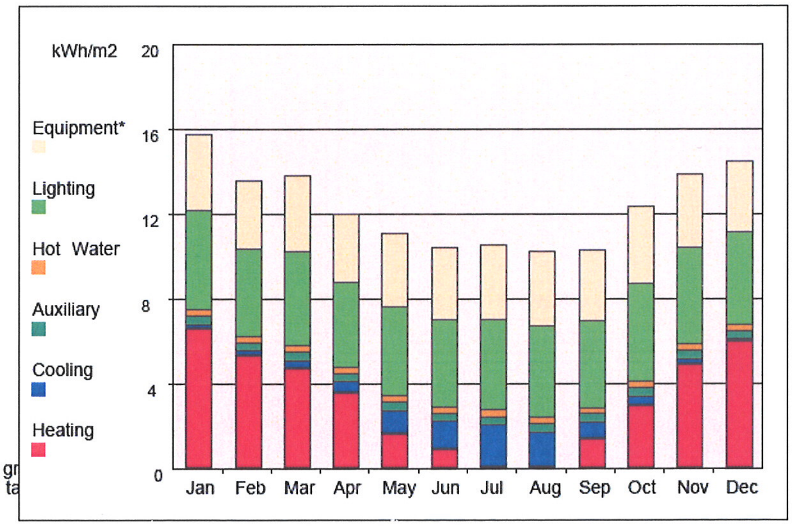
(Pie chart including Equipment end-use)





(Pie chart excluding Equipment end-use)





(*) Although energy consumption by equipment is shown in the gr
the CO2 emissions associated with this end-use have not been ta
into account when producing the rating.