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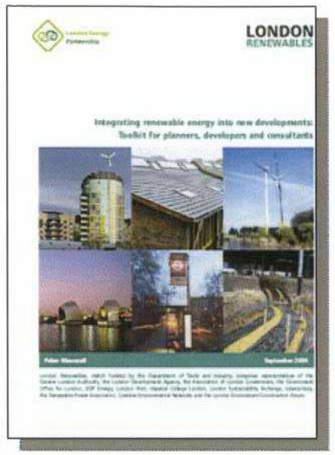
INTRODUCTION



This section of the report presents a site-wide energy assessment intended to review opportunities to provide a portion of the energy use on site by renewable means, in accordance with the London Plan Policy 4A.

In order to maintain consistency with other components of the report, this assessment has been undertaken using the methods laid out in the London Energy Partnership's 'Renewables Toolkit'.

METHODOLOGY

Background

The six renewable energy sources (wind turbines, photovoltaics, solar water heating, biomass heating, (including biomass combined heat and power) and ground source heating/cooling), are considered in this report for supplying a proportion of site energy demand.

With the exception of biomass CHP, these are proven technologies which have been commercially available for many years and are those technologies detailed with the London Energy Partnership's 'Renewables Toolkit'.

Annual Predicted Energy Demand of The Site Prior to the Application Of Renewables

Initially, a base energy demand for the development, with an associated carbon emissions figure has been established for the site. The Renewables Toolkit provides guidance on the selection and use of carbon emissions factors in this calculation.

An assessment of the baseline total delivered energy for the site, broken down into predicted energy use for (gas fired) space and water heating and electrical loads (including lighting, cooking, appliance and small power loads) has been undertaken using accredited benchmark figures and Good Practice guides.

Shortlist of Renewable Technologies to Study

Once the overall base annual carbon emissions have been calculated, the next stage is to assess those renewables that are most likely to deliver the required carbon savings. From a consideration of the site's suburban location and the types of dwellings in the proposed development, a shortlist of renewable energy technologies that will be the subject of further feasibility studies has been drawn up.

The main challenge is to match the renewables to the building's operational requirements, for instance: solar water heating is best suited to daytime hot water demands, say from a restaurant, to reduce the need to store significant quantities of hot water.

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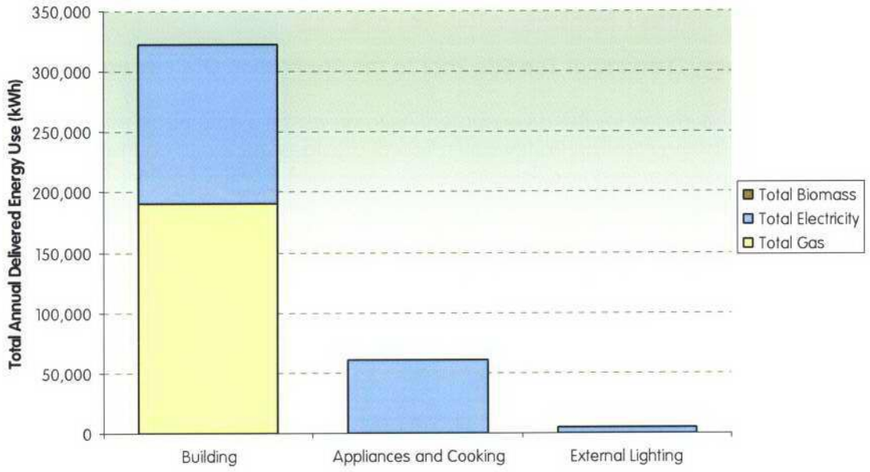
Base Annual Predicted Energy Demand of the Development

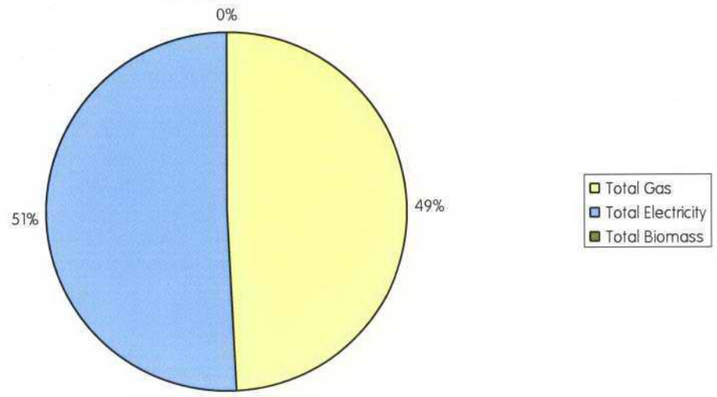
INTRODUCTION

The total annual energy consumption for the site is 387,608 kWh, made up of gas and electricity. This is equivalent to 32,763 kg of carbon per year.

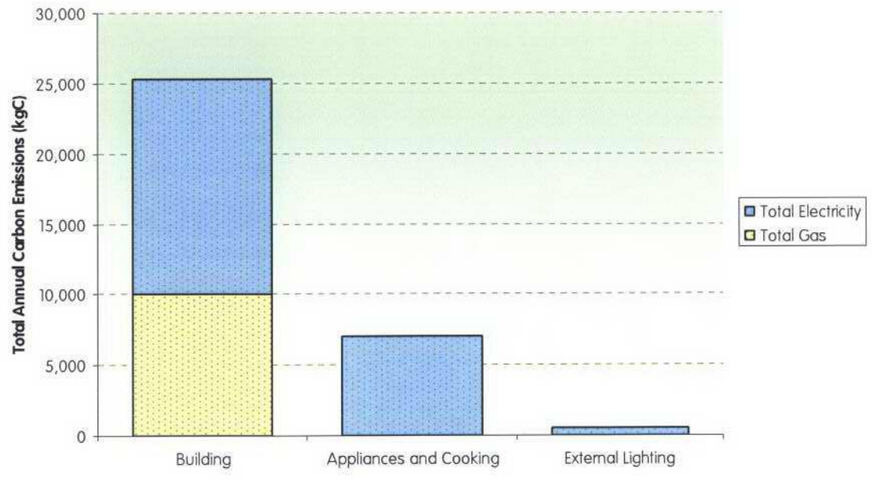
SUMMARY GRAPH – DELIVERED ENERGY BY SITE AREA AND FUEL TYPE.



SUMMARY GRAPH – DELIVERED ENERGY BY FUEL TYPE ONLY



SUMMARY GRAPH – DELIVERED ENERGY BY SITE ELEMENT



SUMMARY GRAPH - ANNUAL CARBON EMISSIONS BY SITE AREA AND FUEL TYPE

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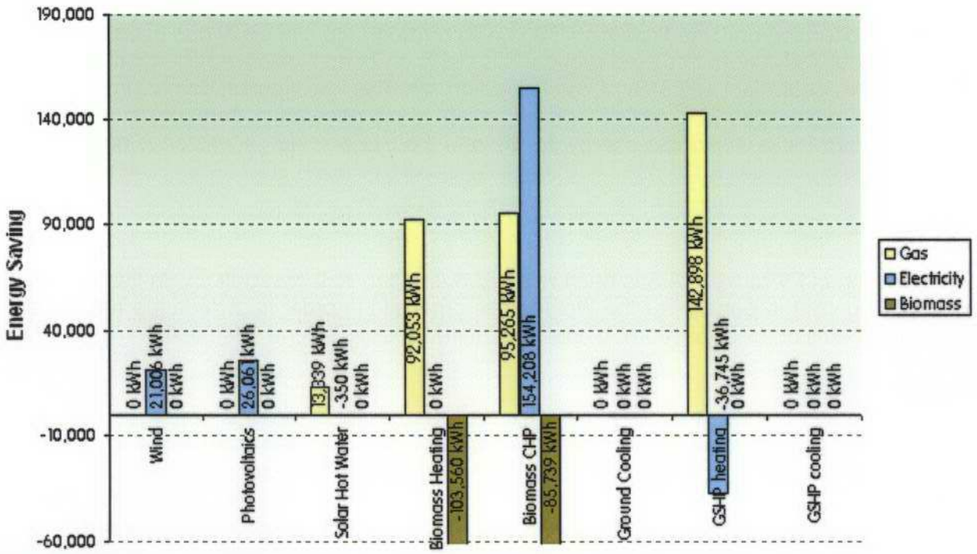
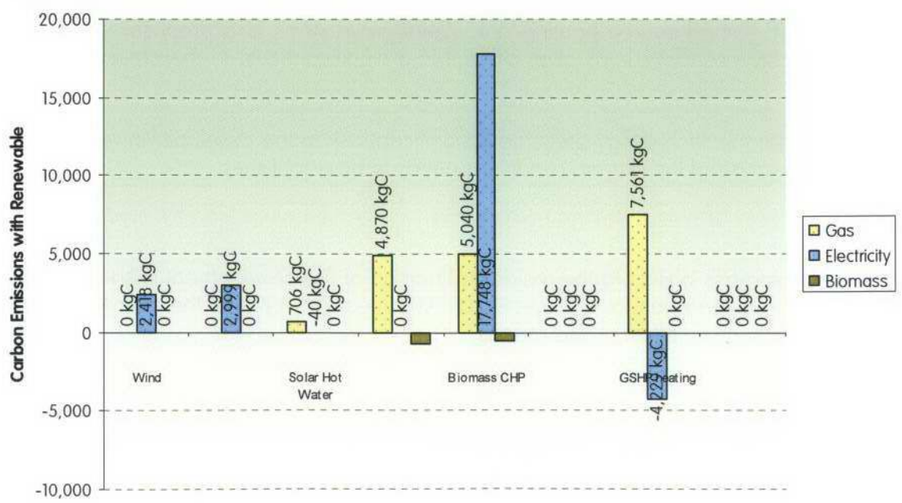
CALCULATE THE CONTRIBUTION OF EACH PROPOSED RENEWABLE ENERGY TECHNOLOGY TO REDUCING THE BASELINE CARBON EMISSIONS OF THE DEVELOPMENT

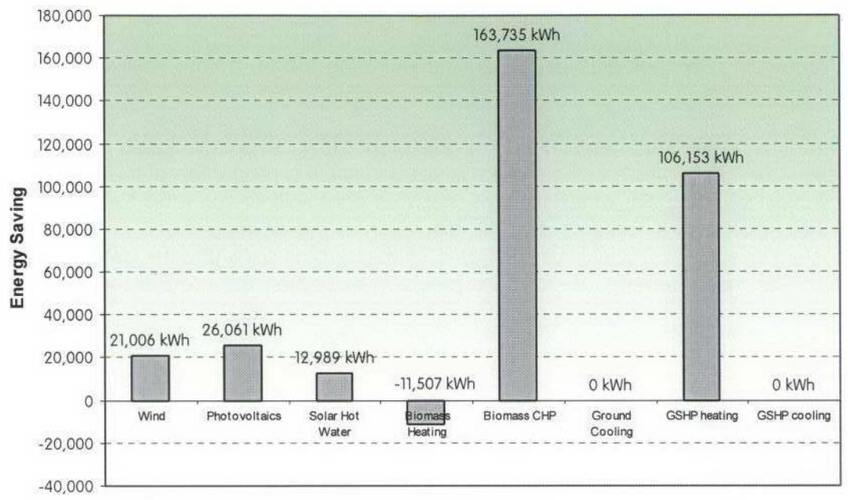
SUMMARY GRAPH – ENERGY GENERATION POTENTIAL FOR RENEWABLE ENERGY TECHNOLOGY



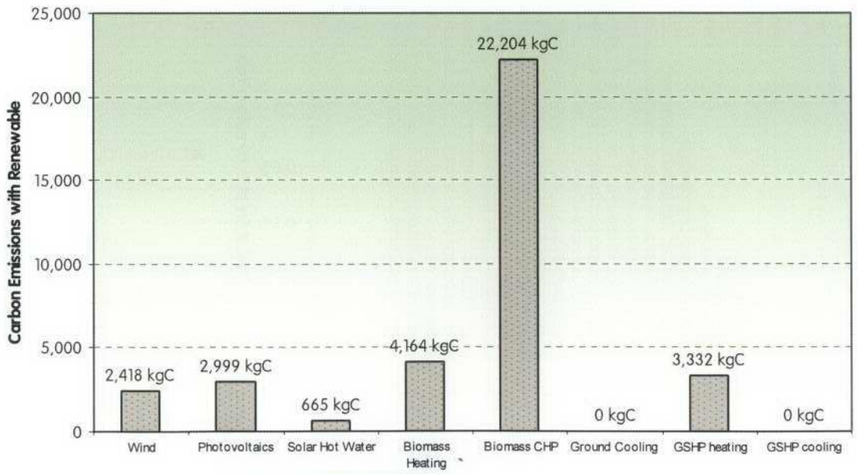
SUMMARY GRAPH – CARBON DIOXIDE EMISSION REDUCTION AGAINST BASELINE LOADS



SUMMARY GRAPH – % CARBON DIOXIDE EMISSION REDUCTION AGAINST BASELINE LOADS



SUMMARY GRAPH – TOTAL CARBON SAVINGS PER ANUAM



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CONTRIBUTION OF RENEWABLE ENERGY TECHNOLOGIES

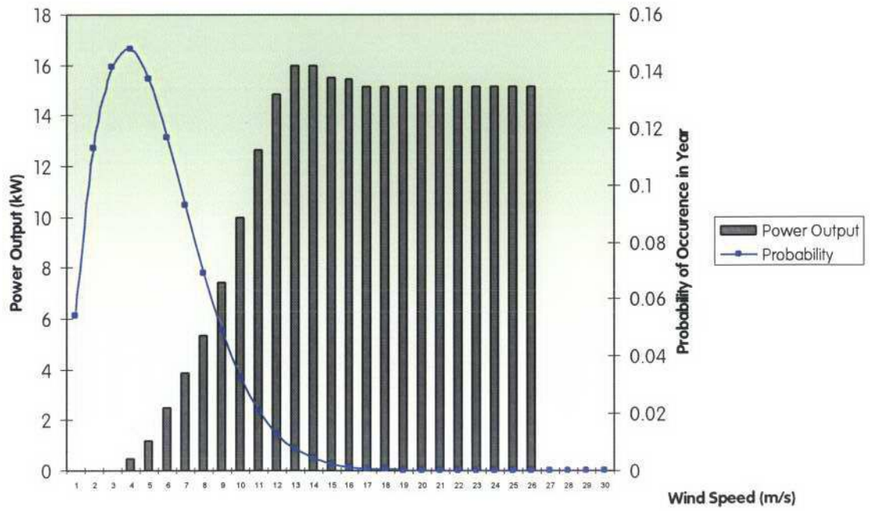
Introduction

The next stage in the methodology is to calculate the effectiveness of each proposed renewable technology under consideration in achieving the overall reduction in the energy use for the development. The Renewables Toolkit provides a method of evaluating carbon emission savings from particular renewable technologies at the outline planning stage, before specific system sizing is possible.

For certain systems, such as Solar Water Heating, the plant sizing and calculation of carbon emissions reduction are 'design-led' i.e. the system is sized to meet a proportion of the predicted demand in the subject building. For other systems, such as photovoltaics or wind turbines, the system sizing is discretionary, i.e. the size is at the discretion of the developer and is otherwise limited only by system specific characteristics such as available turbine sizes and the availability of a suitable location. For these systems, a standard provision based on the area of the site has been used.

Wind Turbine

The output of the wind turbine is dependant on wind speeds across the year and as such the simple 'average wind speed' calculation tends to misrepresent the actual energy provided by the turbine since the relationship between wind speed and power generated is not linear.



Accordingly, a short period of below-average or above average wind speed will skew the delivered energy from the turbine. A Weibull distribution has been applied to the wind speed prediction for the site to accommodate this effect. The graph on the left shows the turbine power output at different wind speeds against the probability of occurrence of the given wind speed at Waldegrave Arms.

A typical wind turbine unit, the Proven VT15000 with a rated output of 15kW has been used to verify the output likely under this wind regime. This yields an annual delivered energy of 23,340 kWh/year – the equivalent of 7.38% of energy use on site. This investigation demonstrates that the low local wind speeds identified earlier prevent wind generation from being a viable approach to providing renewable energy on site and the use of wind generation is not viable for the site.

Photovoltaics

The installation of PV at the site has been rejected due to the cost associated with the purchase and installation of the panels. For the Waldegrave arms site in order to provide the 10% on site renewable energy an array of 340m^2 would be required costing around £340,000.

Solar Water Heating

The provision of solar water heating to the residential units is limited in its scope to greatly influence the renewable energy aspect of the scheme because the water heating loads to the building not excessively high. The calculations in Appendix d indicate that only 53,356 kWh/year or 6.34% of the energy demand of the development may be offset by this means.

Ground Source Heat pumps

The application of ground source heating and Waldegrave Arms is a proposal which would require considerable economic evaluation since it is a significant cost to the project versus the construction costs.

It is considered that this technology presents a significant risk to the developer in respect of the cost and further analysis of the ground conditions needs to be established.

Biomass Boilers

The provision of biomass boilers to the residential portion of the development is shown within the calculation sheets in Appendix d shows 90,053kWh/year or 12.71% of the energy demand of the development may be offset by this means.

The introduction of community biomass heating at Waldegrave Arms is proposed to provide one hundred percent of the demand from heating and hot water. In this instance the cost of the technology would be estimated at around £24,000.

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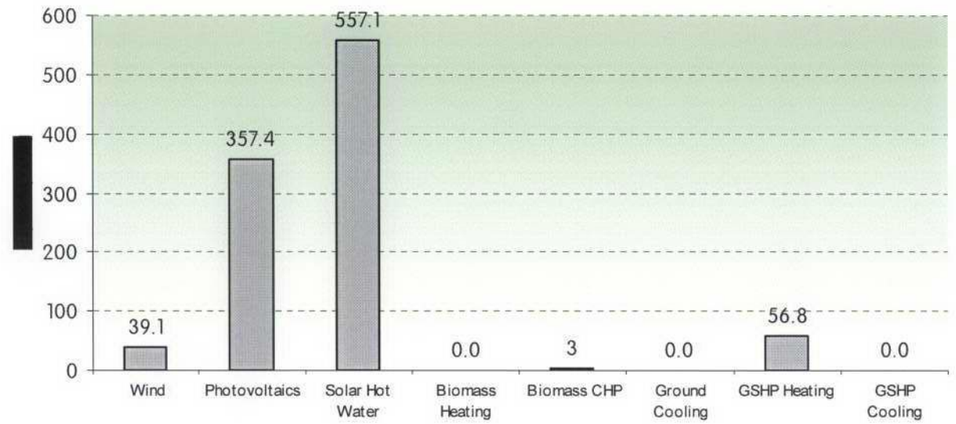
CALCULATE THE COSTS OF TECHNICALLY FEASIBLE RENEWABLE TECHNOLOGIES

Cost Summary Table

Payback Period



A payback is not achieved using the biomass heating system due to the higher fuel cost for the wood pellet fuel when compared to conventional gas heating.

Full calculation sheets can be found in Appendix d.

BENEFITS AND ISSUES OF TECHNICALLY FEASIBLE RENEWABLE TECHNOLOGIES

ISSUE	BIOMASS HEATING
Pollution	Despite Biomass being considered a carbon neutral technology – carbon emissions are reabsorbed by the trees that later will be used as fuel, the pollution associated to the transport of fuel, as well as NOx emissions, should be taken into account.
Space Allowance	The biomass boiler needs to be 45kW. The boiler could be located in the existing basement below the pub. Storage volume necessary for pellets has been estimated as $2m^3$, assuming a delivery every month
Installation Works	Since the boiler is going to be installed in the basement most of the requirements forthe boiler room ventilation will be met. However a pellets storage room is required Because of the different combustion characteristics between condensing boiler and biomass boiler, a separate (additional) flue will be required.
Risks and Reliability	Biomass reliability depends on the fuel delivery reliability. Currently it is possible obtain long term contracts with fuel distributors that guarantee the supply.
Management and Maintenance	DELIVERIES: one delivery a month is needed. Despite the central location of the development, the suppliers consulted -The Renewable Fuel Company- assures the delivery viable. It could also be executed following a schedule that minimizes impact on local traffic.

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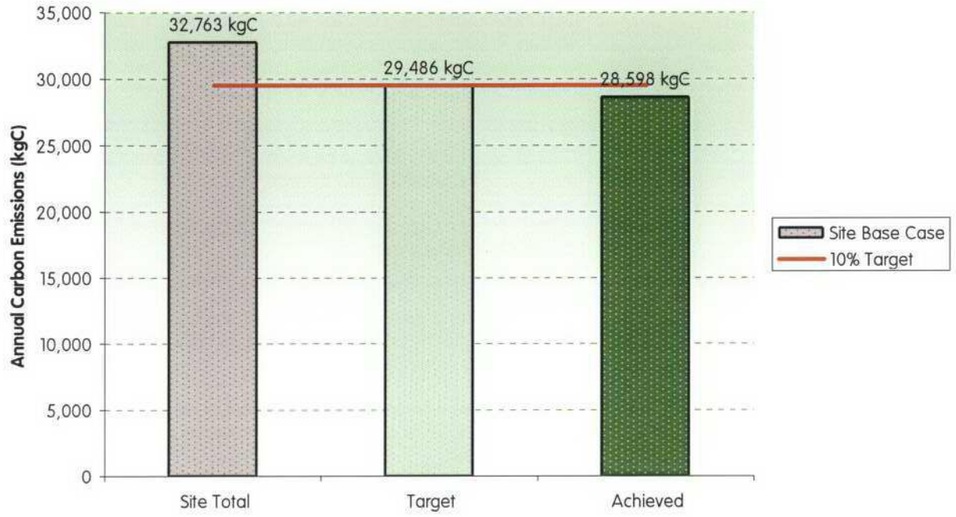
CONCLUSION

Total Carbon Savings



As shown in the graph above, the biomass heating system matching the loads present at the Waldegrave Arms site will result in Carbon emission savings of 12.71% against the baseline emissions calculated using benchmark figures.

This is in excess of the minimum requirement of the London Borough of Richmond upon Thames Sustainability Construction Checklist.