

**London Wind & Biomass Study Summary Report:
Feasibility of the Potential for Stand Alone Wind and Biomass
Plants in London**



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Foreword

London faces unique challenges in generating a high proportion of renewable energy, due to its predominantly high density, urban area. However, to meet London's challenging short and long-term carbon dioxide reduction targets it is clear that we need to install significant renewable energy capacity.

This study commissioned by the London Energy Partnership evaluates the feasibility of large-scale wind and biomass plant, the main non-building integrated renewable energy technologies relevant to London. Biomass is not perhaps a renewable energy source typically associated with London, yet it is one of the renewable technologies closest to commercial viability for the urban environment, and in appropriate locations and at the right scale, wind energy is currently one of the most economic and rapid ways of reducing carbon dioxide emissions of energy supply.

Tackling climate change and reducing carbon emissions is an imperative and this feasibility study is a valuable and timely investigation into the potential biomass and wind resource available within the Greater London area. The study represents the first publicly available assessment of potential wind locations in London, and provides guidance and recommendations for local authorities, developers and others taking these and other large and small developments forward.

There are locations identified in this report that could offer the potential for landmark renewable energy developments, hosting both wind and biomass plant. Current and forthcoming large-scale development and regeneration in London, such as the Thames Gateway, represent an unparalleled opportunity for maximising renewable energy and combined heat and power and community heating options. In conjunction with energy efficiency, this can make a significant contribution to reducing carbon dioxide emissions whilst putting London on the path to becoming a sustainable world city. This report represents a crucial step in illustrating the potential role for wind and biomass in realising this vision.



Ken Livingstone
Mayor of London

A handwritten signature in black ink that reads "Ken Livingstone".



David Green
Chair, London Energy
Partnership
Chief Executive, UK
Business Council for
Sustainable Energy

A handwritten signature in black ink that reads "David Green".

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Executive Summary

This summary document is part of the London Energy Partnership's feasibility study into the potential for non-building integrated wind energy and biomass plants. A separate piece of work on the deployment of photovoltaics (PV) on roadside noise barriers in London was also carried out in conjunction with the feasibility of wind energy and biomass plants. This work is not reported in this summary but for further detail on all of the work carried out, the reader is referred to the main reports, which are available to download from the London Energy Partnership's website, www.lep.org.uk. The feasibility study has been divided into the following reports:

1. Wind Study Phase 1: Assessment of Constraints and Opportunities
2. Wind Study Phase 2: Location Assessments and Guidance
3. Wind Study: Guidance Notes for Wind Turbine Location Suitability
4. Biomass Report
5. Deployment of Photovoltaics on London's Roadside Noise Barriers
6. GIS (Geographical Information System) Guidance Notes.

This document provides a summary of the key findings of the first four reports.

Wind turbines

The maximum estimated installed (non-building integrated) wind energy capacity identified through this study for the Greater London area is predicted to be 50.34MW, generating 144.5GWh of electricity annually, able to supply approximately 116,015 households and saving 147,015 tonnes of CO₂ each year (equations used are shown in Appendix A of the main report).

The wind feasibility study looked at the potential for installing commercial-scale non-building integrated wind turbines in the urban environment of the Greater London area. The key objectives of the study were to:

- Identify locations across London that are suitable for commercial-sized (medium to large, >100kW rated capacity) wind turbines, illustrated on GIS maps, and outline how to take them forward
- Produce of a set of guidelines detailing what renders a location suitable for installing a wind turbine (large/medium-scale and small-scale (<100kW rated capacity) stand-alone).

In appropriate locations and at the right scale, wind energy is currently one of the most economic and rapid ways of reducing CO₂ emissions. By maximising on-site energy generation in all available localities, micro-generation has the potential to make a significant cumulative contribution to government targets. In combination with improved energy efficiency this will go a long way towards cutting CO₂ emissions and reducing the overall demand for energy. All of these are required to meet the government's 2050 targets of cutting CO₂ emissions by 60 per cent (%) and the Mayor's target of a 20% reduction by 2020. Small-scale projects will also be an indispensable factor in creating sustainable communities and will be an effective method in aiding communities in generating their own electricity.

The wind study was carried out in two phases.

Phase one

The Phase one report provides a general assessment of the constraints, development options and opportunities in the Greater London area and explores the current development situation, policy requirements and local targets. GIS assessment, wind resource modelling and other technical expertise were used to identify a number of potential development locations. A range of potentially feasible development opportunities and deployment scenarios were presented and appropriately prioritised for more detailed assessment as part of Phase two of the study.

Phase two

Phase 2 of the study involved detailed assessments of the locations identified in Phase 1 for larger-scale wind turbines, including financial modelling and identification of partners to be involved in potential projects. The study focused on urban/industrial/brownfield sites, open land and farmland within the designated boundaries of Greater London and within a 5km wide corridor along the M25, which may be able to accommodate large-scale wind turbines.

An extended range of site-specific constraints, including aeronautical impacts, noise and residential amenity, landscape and visual impact, ecological considerations, planning policy considerations, and topple distance were addressed within the Phase 2 report. Where possible, specific location assessments include economic forecasts and indicative layouts.

The Phase 2 report provides advice on the development of small-scale wind energy schemes, relating specifically to turbines ranging in size from 1.0kW to 100kW. This advice concerns such issues as location, grid connection, site design, turbine specification, planning permission, funding, and community projects. Information is designed to be used as a general guide for use by the London boroughs and other organisations when undertaking specific or strategic assessments of small-scale wind opportunities.

Given the rigorous tests and scrutiny that large-scale wind energy schemes undergo, it is not possible to provide an exhaustive assessment in each specific case at this stage. Therefore, any developers, landowners or stakeholders interested in pursuing such schemes must understand that a series of further assessments and investigations, including the submission of a planning application, will be required before any official consent to develop is forthcoming.

Together the reports provide a portfolio of locations suitable for general wind energy opportunities, landmark sites, and innovative locations for utilising new technologies such as low wind speed turbines. Recommendations are made on the most suitable methods of progressing such projects.

If commissioned, the projects proposed here could represent a significant contribution towards achieving the Mayor's target of generating at least 665GWh of electricity from renewable schemes by 2010.

Biomass Plant

The biomass feasibility study provides an overview of the current total biomass resource in and around London along with specific proposals for utilising the resource as a fuel. Biomass is one of the renewable technologies closest to commercial viability for the urban environment, particularly where waste sources can be utilised. It is also relatively flexible with the ability to transform it into a solid, liquid or gas and, in contrast to wind and solar, the ability to store it and use when required.

For the purposes of the study, the broadest definition of biomass was used. This is also the definition adopted by the UK Biomass Task Force:

“literally, any biological mass derived from plant or animal matter. This includes material from forests, crop-derived biomass including timber crops, short rotation forestry, straw, chicken litter and waste material.”

If all biomass that is currently not recycled or already used for energy recovery is used in combined heat and power (CHP) plant, the potential would be to displace around 10% of conventional energy sources, saving around 3.5 million tonnes of CO₂ a year. This would constitute a total of approximately 540-660MW_e of installed biomass generating capacity¹ and generate around 3.6-4.3TWh of electricity and 7.2-8TWh of heat.

Assessment has been made of the quality of the resource in terms of likely moisture content or impurities/contamination. Moisture content also impacts greatly on the choice of technology used to convert the various biomass streams to energy, with wetter material more suitable for anaerobic digestion rather than combustion or gasification technologies.

The economics of biomass energy in London appear attractive but two issues compromise the ability to maximise the carbon savings achieved by its use.

Firstly, the study takes as a fundamental starting point for assessing the potential for biomass that it will be used in CHP plant. However, the cost of developing a heat network to utilise the waste heat produced generally reduces the economic viability of such a plant. The framework in the UK does still not sufficiently encourage the development of CHP.

Secondly, the optimal use of the material is compromised by the rules of the Renewables Obligation² in relation to co-firing. An Avedøre²-style combined cycle CHP plant, though the most efficient biomass plant currently in operation with the lowest cost per kW of capacity,

¹ Depending on run hours and technology.

² The Avedøre is a multi-fuel CHP plant using wood straw and natural gas, located south of Copenhagen. It provides electrical power to the local network in Eastern Denmark as well as heat to a district heating scheme in Copenhagen.

would not qualify for the central mechanism for supporting renewable energy, the Renewables Obligation, after 2009. This is because such a plant deliberately sets out to co-fire biomass and fossil fuel in order to achieve the highest electrical conversion efficiency.

A range of proposals for biomass plants have been produced for this report. Conceivably every building in London could house some form of biomass plant, but the view was taken to concentrate on sites for medium to large-scale CHP applications. The locations listed are not an exhaustive list of locations in London but were strategically selected to serve the aims of the brief in terms of Energy Action Areas³, the London Thames Gateway Development, Regeneration and Opportunity Areas⁴ and the Olympics. A scoring system that took into account the key factors in selection of the locations has been developed which could be used to select further biomass development locations.

Potential Wind and Biomass Combined Locations

During the course of the work, a number of locations were identified which could offer potential for both wind and biomass development, if not at the exact same location, in adjacent or close-by areas. These locations could offer increased potential for landmark renewable energy developments, where both wind turbines and biomass options could be developed as a joint project, and include the Barking Riverside/Thames Gateway development area and the Stratford area.

³ An Energy Action Area is an area selected by the London Energy Partnership as a showcase low carbon community. Four pilot areas were selected for London in July 2005.

⁴ Opportunity Areas are defined in the London Plan as being able to “typically accommodate at least 5,000 jobs or 2,500 homes or a mix of the two, together with appropriate provision for other uses such as shops, leisure facilities and schools.”

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Abbreviations

AONB	Area of Outstanding Natural Beauty
CAA	Civil Aviation Authority
CHP	Combined Heat and Power
DTI	Department for Trade and Industry
EIA	Environmental Impact Assessment
ESA	Environmentally Sensitive Area
GIS	Geographical Information Systems
IBA	Important Bird Area
MBT	Mechanical Biological Treatment
MOD	Ministry of Defence
NATS	National Air Traffic Service
PV	Photovoltaics
RDF	Refuse Derived Fuel
SAC	Special Areas of Conservation
SPA	Special Protected Area
SRF	Solid Recovered Fuel
SSR	Secondary Surveillance Radar
SSSI	Site of Special Scientific Interest
UCO	Used Cooking Oil
UDP	Unitary Development Plan

1 Introduction

This report is part of the London Energy Partnership's feasibility study into the potential for non-building integrated wind, biomass plants and PV deployment on roadside noise barriers in London. The study was undertaken between September and December 2005.

The main series of reports comprises:

- Wind Study Phase 1: Assessment of Constraints and Opportunities
- Wind Study Phase 2: Location Assessments and Guidance
- Wind Study: Guidance Notes for Wind Turbine Location Suitability
- Biomass Report
- Deployment of Photovoltaics on London's Roadside Noise Barriers
- GIS (Geographical Information System) Guidance Notes.

These reports are available in full to download from the London Energy Partnership's website, www.lep.org.uk.

This summary document provides an overview of the reports on the potential of wind energy and biomass in London. The additional reports on the deployment of PV and the GIS Guidance Notes are not summarised here.

1.1 Why Wind and Biomass?

As a predominantly high density, urban area, London faces unique challenges and limitations in generating a high proportion of its energy use from renewables, particularly in the short term. London has a highly concentrated energy demand, which means that it needs to install significantly more renewable energy capacity in a much smaller area to meet the same target as an equivalent area elsewhere in the UK. Urban renewables such as biomass-fuelled CHP and biomass boilers are considered particularly appropriate for London's buildings and some locations in London may be suitable to host installations such as large wind turbines.

The London Energy Partnership proposed this study because whilst work has previously been carried out to promote renewable energy in London, this has focused on building integrated systems, eg solar thermal, photovoltaics, etc. rather than non-building integrated renewables.

The main non-building integrated renewable energy technologies that are relevant to London are large-scale wind turbines and biomass. Given the high density and urban characteristics of London, there is no significant potential for harnessing wave, tidal or hydropower, to meet London's energy demands in the short to medium term, and as a result, this study focuses on wind and biomass potential which is a more viable and available energy resource.

1.2 Funding

The study has been delivered by the London Energy Partnership with funding from the London Development Agency, the Greater London Authority and the Department of Trade and Industry.

The purpose of the work was:

- To identify the potential for wind energy and biomass in London, through assessing suitable locations for wind turbines and identifying the resource of biomass and potential for setting up and securing a supply chain.

- To engage relevant organisations and stakeholders in the process, in particular how the supply chains can be set up for biomass, which will allow the recommendations to be made for future activity by the London Energy Partnership in this area.
- To identify potential locations for wind and biomass plants, on suitable GIS maps, to enable the London Energy Partnership to work with relevant partners to facilitate an increased number of wind turbines and a supply chain for biomass.
- To assess the potential for photovoltaic arrays on noise barriers on roads in London and on surrounding motorways.

The report is not intended to provide any specific guidance or policy proposals on behalf of the London Energy Partnership or any funders or partners. The study has identified potential for increased sustainable energy measures. Further detailed technical and economical feasibility will be required for taking forward the findings of the report.

2 Key Highlights of the Wind Feasibility Study

2.1 Overview

The wind feasibility study looked at the potential for installing commercial-scale non-building integrated wind turbines in urban environments of the Greater London area.

The key objectives of the study were to:

- Identify locations across London that are suitable for commercial-sized (medium to large, >100kW rated capacity) wind turbines, illustrate these on GIS maps, and outline how to take them forward
- Produce of a set of guidelines detailing what renders a location suitable for installing a wind turbine (large/medium-scale and small-scale (<100kW rated capacity) stand-alone).

2.2 Key Findings

Locations identified across London, which could possibly accommodate commercial sized wind turbines (above 100kW rated capacity), could together represent a significant contribution (22.73%) towards achieving the Mayor's target of generating at least 665GWh of electricity from renewables energy schemes by 2010.

The projects could together provide a maximum estimated installed wind energy capacity for the Greater London area of **50.34MW**, generating **144.5GWh** of electricity annually, able to supply approximately **116,015 households** and saving **147,015 tonnes of CO₂** each year, depending on specific turbine layouts and sizes.

Initially, 25 locations were identified across London with the potential to accommodate commercial sized wind turbines (above 100kW rated capacity), from an initial location-finding exercise. This examined constraints upon wind development existing within the Greater London area, including:

- Residential areas (plus 400m buffer)
- All trunk roads (plus 100m buffer)
- All railway lines (plus 100m buffer)
- All pylons and substations (plus 100m buffer)
- All areas of low wind speed (less than 5.5 m/s)
- Ecological and cultural designations: (Areas of Outstanding Natural Beauty (AONB), Community Forest, Environmentally Sensitive Areas (ESA), Important Bird Areas (IBA), Local Nature Reserves, National Nature Reserves, National Parks, Ramsar Sites, Registered Battlefields, Registered Parks and Gardens, RSPB Reserves, Scheduled Monuments, Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protected Areas (SPA), World Heritage Sites)
- Planning policy constraints - any constraints identified within Unitary Development Plan (UDP) Proposals Maps further to those mentioned above (eg areas outlined for future housing development)
- Aeronautical constraints.

These 25 locations can be broken down into the following categories:

- Seven large strategic areas within the London area with potential for medium to large scale wind development
- Eight smaller areas within the London area with potential for small to medium scale wind development

- 10 large strategic green belt areas on the outskirts of the London area, within the M25 Corridor, with the potential for medium to large scale wind development (some of which are in fact outside the boundaries of the London boroughs).



The list of locations was further examined and prioritised into a portfolio of 11 locations of varying sizes and significance, offering the best opportunities for wind turbine development. One location offers potential for the development of a medium-sized wind farm.

The choice of priority locations was influenced by consultations with the London Energy Partnership and their task group members, including representatives from the Greater London Authority, Government Office for London, London Development Agency and the British Wind Energy Association.

Following the identification of the key development areas, three clear categories of location emerged:

Figure 1: 1.75 kW Community Turbine on Greenfield land, Pantperthog⁵

a) Locations of considerable strategic potential

A number of key regeneration locations have been identified around the Thames Gateway. Whilst generally in the early master planning stages of development, these locations have been identified as having strategic wind energy potential, possibly offering high profile or iconic development opportunities. They therefore present clear opportunities to integrate wind energy into future development proposals. Given the high proportion and density of residential development generally planned at these locations, it is likely that renewable energy targets would be best achieved by integrating smaller scale (<100kW) turbine(s) within these developments.

The strategic locations identified are:

- Stratford Olympic site
- Greenwich Peninsula mixed use area
- Barking Riverside.

b) Locations potentially capable of accommodating larger turbines

A number of other locations have been identified as being potentially capable of supporting larger scale wind turbines (500kW - 3MW) and which, in contrast to the strategic locations, present an opportunity for wind energy development achievable in the short-term.

The large-scale wind turbine locations identified are:

- New Charlton Meridian
- East Beckton
- Dagenham Docks
- Jenningtree Point

⁵ Source: www.cat.org.uk/gallery/cwtphotodiary.tmpl?startat=41&endat=44&subdir=gallery

- The Lee Valley
- East Rainham.

c) Locations potentially capable of accommodating medium-sized turbines

Other locations have been identified as being potentially capable of supporting smaller to medium-scale wind turbines (250kW - 500kW). These also present an opportunity for wind energy development achievable in the short-term.

The medium-sized wind turbine locations identified are:

- Fairview Industrial Area
- Northwick Hospital.

See Section 2.8 for further detail on all these locations.

Individual locations were visited to assess viability and were assessed in further detail, including:

- Background to the location
- Key location specific issues
- Assessment of location wind resource (modelled using the industry standard pan-European wind atlas⁶, more accurate in the absence of true measured data than the UK Windspeed Database (NOABL)⁷)
- Layout options (where possible a range of indicative potential wind turbine layout options were illustrated)
- Financial information (indicative capital cost and income based on indicative layouts)
- Development/Partnership scenarios
- Recommendations (the location assessments are not exhaustive and it will be necessary in each case for future developers to engage in further dialogue with statutory consultees, stakeholders etc and commission any appropriate detailed location specific assessments, such as ornithological surveys).

A significant part of the process has been consultation with the following key stakeholders on the potential for wind energy development at all of the locations identified for further investigation:

- Civil Aviation Authority
- Port of London Authority
- Greater London Authority - Strategic Planning, Planning Decisions Unit, Architecture and Urbanism Unit, Energy, Biodiversity, Noise, and Air Quality.

To date, no landowners have been contacted regarding development on their locations. It is believed that such contact should be made following endorsement from the London Energy Partnership.

It should be noted that each assessment is simply an early indicative representation of a location's potential. This can only be realised through rigorous consultation and further detailed site-specific assessment, including site surveys where appropriate. The majority of the strategic locations are at the very early master planning stages. It is therefore difficult to gauge the extent to which these locations will be developed, the specific type of development and often the specific area, which will be developed. Thus, at the current time it is not possible to illustrate specific layout opportunities for the integration of wind turbines into these developments.

⁶ Troen, I. and Petersen, E.L., (1989). European Wind Atlas. Risø National Laboratory, Roskilde, Denmark, pp. 656

⁷ www.britishwindenergy.co.uk/noabl/index.html

2.3 Energy Potential of Identified Wind Locations

If commissioned, these projects could represent a significant contribution towards achieving the Mayor's target of generating at least 665GWh of electricity from renewable schemes by 2010.

It must be noted that the possible installed capacity at each location is an early indicative representation of a location's potential for wind energy production. The values are dependent upon further assessments and overcoming the constraints associated with each location. Therefore, two total values have been presented, a higher optimistic value based on the upper output layouts of locations identified, and a lower pessimistic value based on the lower output layouts of locations identified and the removal of East Rainham large-scale wind farm due to its Green Belt designation.

The maximum estimated installed non-building integrated wind energy capacity for the Greater London area is predicted to be **50.34MW**, generating **144.5GWh** of electricity annually, able to supply approximately **116,015 households** and saving **147,015 tonnes of CO₂ each year** (equations used are shown in Appendix A of the main report).

Taking the lower estimate, installed non-building integrated wind energy capacity for the Greater London area is predicted to be **16.8MW**, generating **41.9GWh** of electricity annually, able to supply approximately **9,393 households** and saving **37,969 tonnes of CO₂ each year**.

Using the higher estimate, wind energy production would contribute **22.73%** towards the Mayor's target for electricity from renewable schemes by 2010. Using the lower estimate, wind energy production would contribute **6.13%** towards the Mayor's target for electricity from renewable schemes by 2010.

2.4 Guidelines for Selection of Location for Large Wind Turbines

This section summarises a set of guidance notes (in the main report) that set out the general principles of location suitability for larger wind turbines (>100kW rated capacity).

As with all forms of development, wind energy proposals face a variety of constraints, which may either be reasonably surmounted or, conversely, severely limit the number of localities suitable for such a proposal. Such constraints should be addressed in the early stages of site selection to ensure the exclusion of less feasible locations for wind development and increase the possibility of achieving planning permission. The requirements for siting a large-scale wind turbine in the London area are fairly constrained due to the lack of space available and the heavily urbanised environment.

Wind energy development is classed as Schedule II development under the provisions of the Town and Country Planning (Environmental Impact Assessment) Regulations 1999, to which it is the duty of the local planning authority to consider whether a formal planning application for the development would need to be supported by an Environmental Impact Assessment (EIA). The EIA procedure ensures that the likely significant environmental effects of development projects and their mitigation measures are identified and taken into account within the planning process. If a full EIA is not required, a Scoping Report produced by the local planning authority will indicate the constraints recommended for address within the planning application.

The key factors that need to be addressed by wind energy are summarised below.

2.4.1 Wind resource

Wind speeds of 5.5m/s or above at turbine hub height are required (wind speeds in the Greater London area average between 5.0 and 6.0m/s at 45m above ground level).

2.4.2 Access to grid connection

The distance to the connection point should be minimised and a connection requiring significant infrastructure could be financially prohibitive.



2.4.3 Landscape and visual impact

Landscape designation areas such as Areas of Outstanding Natural Beauty and World Heritage Sites would need careful assessment. Landscape and visual impact is considered one of the main environmental issues in determining wind farm applications. Planning Policy Statement 22 includes that planning permission should not be granted for renewable energy developments in designated areas unless there are strong overriding considerations and no alternative locations. It is unlikely that large-scale commercial wind development would be permitted in such areas.

Figure 2: 2.75MW wind turbine on brownfield site at Ness Point, Lowestoft⁸

2.4.4 Ecological impact

Wind developers undertake an EIA to identify any possible impact on protected species (eg bats, badgers, great crested newts) and birds, and developments seek to avoid or mitigate any impacts. Consultation is undertaken with RSPB and English Nature. Areas with ecological designations are likely to constrain potential for wind development.

2.4.5 Archaeological constraints

Surveys to determine any constraints are carried out as part of EIA to ensure any important archaeological remains or their settings are preserved.

2.4.6 Noise

Concerns over noise are generally related to perception rather than actual experience and wind turbine technology has advanced significantly to reduce noise outputs. Wind turbine noise is assessed for the EIA and generally in site development a distance of about 400m is retained between turbines and residential areas. Most urban environments will have a relatively high background noise level caused by traffic, people, railways, commercial and industrial activity, which will usually mask any noise from turbines. Please refer to the main report for further detail/guidance on noise.

⁸ Source: www.bbc.co.uk/suffolk/content/image_galleries/turbine_lowestoft_gallery.shtml

2.4.7 Shadow flicker

The effects of sunlight being interrupted by the passing of turbine blades can be a problem in specific light and wind directions when it appears through a window or door. This is also assessed in the EIA and can be easily mitigated.

2.4.8 Telecommunications

Wind turbines can interfere with radio signals and affect TV reception and telecommunications systems. Solutions to mitigate any negative effects include the installation of digital television or a local community re-broadcast facility. Interference of fixed radio links can be more difficult to resolve, early identification of such issues is important.

2.4.9 Aeronautical concerns

Aviation and radar issues are considered major constraints to wind development in the UK. It is suggested that the UK has some of the strictest policies on aviation and radar.

- Early consultation with statutory consultees (the Civil Aviation Authority (CAA), Ministry of Defence (MOD) and the National Air Traffic Service (NATS)) is important and in general many aeronautical and radar issues can be resolved by site scoping and through technical solutions.
- The MOD requests consultation on projects within 67km of their airfields, where these are radar equipped. There are also statutory consultation requirements for any wind project within 10km of any Secondary Surveillance Radar (SSR)⁹.
- There are a number of officially safeguarded aerodromes in and around London. These include Heathrow, Gatwick, Luton, London City, Stansted and Biggin Hill. All of these sites operate radar systems with the exception of Biggin Hill and London City. The radar systems at Heathrow, Gatwick and Stansted, supplemented by NATS radar at Debden near to Saffron Walden, together provide the 'Thames' radar service, used by London City and Biggin Hill. In addition, a radar system is operated by RAF Northolt, and a meteorological radar is located at Chenies, west of Watford. Please refer to the main report for further detail on these constraints.

2.5 Main Barriers to the Development of Large-/Medium-Scale Wind Locations

The main barriers to development of large-scale and medium-scale wind turbines are effectively the factors laid out below in the guidelines for location selection. The spatial requirements of wind turbines will be a constraining factor in any urban environment and will limit the number of options available for development.

2.6 Guidelines for Selection of Location for Small Wind Turbines

This section summarises a set of guidance notes (in the main report) that set out the general principles of location suitability for smaller wind turbines (1-100 kW) within an urban environment. No attempt has been made to identify specific locations where smaller wind turbines could be deployed, as these are too numerous across London, however the guidance notes identify the type of location suitable.

⁹ Secondary Surveillance Radar (SSR) communicate directly with transponder equipped aircraft. Where turbines lie within 10km of a SSR, it is possible that rotating turbines could affect the communication between SSRs and aircraft, leading to the incorrect identification of the position of the latter. This, however, is not considered to be a problem at distances greater than 10km from a SSR.



Figure 3: Small scale wind turbine in Wandsworth

The requirements for siting a small wind turbine are fairly easily met due to the range and sizes of turbines currently available. However, they will be particularly dependent upon:

- Good wind speeds >4.5m/s
- The presence of an open space between approximately 80-2025 m² in extent
- Lack of physical obstructions to the wind
- The requirement for on-site electricity.

Small scale wind projects might therefore be suitable for development within small open areas in the following contexts:

- Schools, colleges and universities
- Small industrial sites and estates
- Supermarkets and superstores
- Hospitals
- Households (depending on space)
- Council buildings and depots
- Community areas and schemes
- Car parks
- Sports grounds and stadiums
- Recreation areas such as playing fields, leisure centres and environment centres.

Following the decision to install renewable energy on an urban/brownfield site, it is necessary to identify whether the location is actually suitable for a wind turbine, and if so, selecting the best location for it.

The key points to consider are:

Initial location selection

- Wind speed above 4.5m/s
- Land availability
- Distance from housing, preferably about 100-200m, unless a very small unit is being considered (<50kW)
- Relatively high on-site demand for electricity (turbines can be stand-alone or grid connected systems)
- Avoidance of important environmental or landscape designations (depending on size of turbine)
- Lack of national/regional/local planning policies that could constrain development (depending on size of turbine being considered)
- Distance from local airfields - unlikely to be of significance for small wind turbines

More detailed site selection factors

- No obstructions to wind flow (eg buildings, trees etc) in the direction of the prevailing wind, and the highest ground is preferable
- Safe location (>3m between moving parts and any point where people or livestock may have access)
- Topple distance (full turbine height) plus 10% from electricity grid lines, railways, local roads, highways, footpaths and bridle-ways (even though there is a minimal risk of turbine tower failure), and also buildings (at the discretion of a private owner)
- Minimal presence of telecommunication links and avoiding TV links
- Close to a grid connection point to reduce cabling costs
- Ground conditions avoiding very soft ground or solid rock
- Easy access to the site for installation, maintenance and decommissioning
- Local support.

2.7 Barriers to the Widespread Deployment of Small-Scale Wind Turbines

Even though the first commercial wind turbines in the UK were erected in 1991, small-scale wind turbines and other micro-renewables are still at an early stage in their evolution. Consequently, the market, strategies and mechanisms to support its widespread deployment are not yet effectively in place. Hence, a number of constraints or barriers often act to prevent the widespread uptake of small-scale wind installations. These are outlined below.

- **Information constraints:** Inadequate promotion and provision of information to potential customers; lack of information on how to set about installing a turbine; lack of a widely understood accreditation system for products and installers, and consequently a lack of local installers.
- **Costs:** Costs are often prohibitive to small companies and especially households.
- **Technical constraints:** The lack of a comprehensive approach to dealing with the issues surrounding the connection of micro-generators to the grid network reduces the uptake of micro-generators.
- **Grid connection issues:** Electricity export to the grid improves the economics of a project. However, compliance with technical standards (designed for generators of up to 5MW in size) is costly and is also likely to require feasibility studies.
- **Electricity export payment:** Until recently it has been relatively difficult for micro-generators to access Renewables Obligation Certificates¹⁰ which enable them to sell back excess electricity to the grid in exchange for income. However, the Renewables Obligation was revised in 2004 so that any generators with a declared net capacity of 50kW or less can now claim Renewables Obligation Certificates on an annual or monthly basis.
- **Funding:** Funding for the purchase and installation of small-scale renewables has historically come from the DTI grant funded scheme Clear Skies¹¹. This was replaced by the Low Carbon Buildings Programme in April 2006.

¹⁰ ROCs are certificates issued to electricity generators for each MWh of renewable energy generated. These certificates can then be presented by electricity suppliers to prove compliance with the Renewable Obligation.

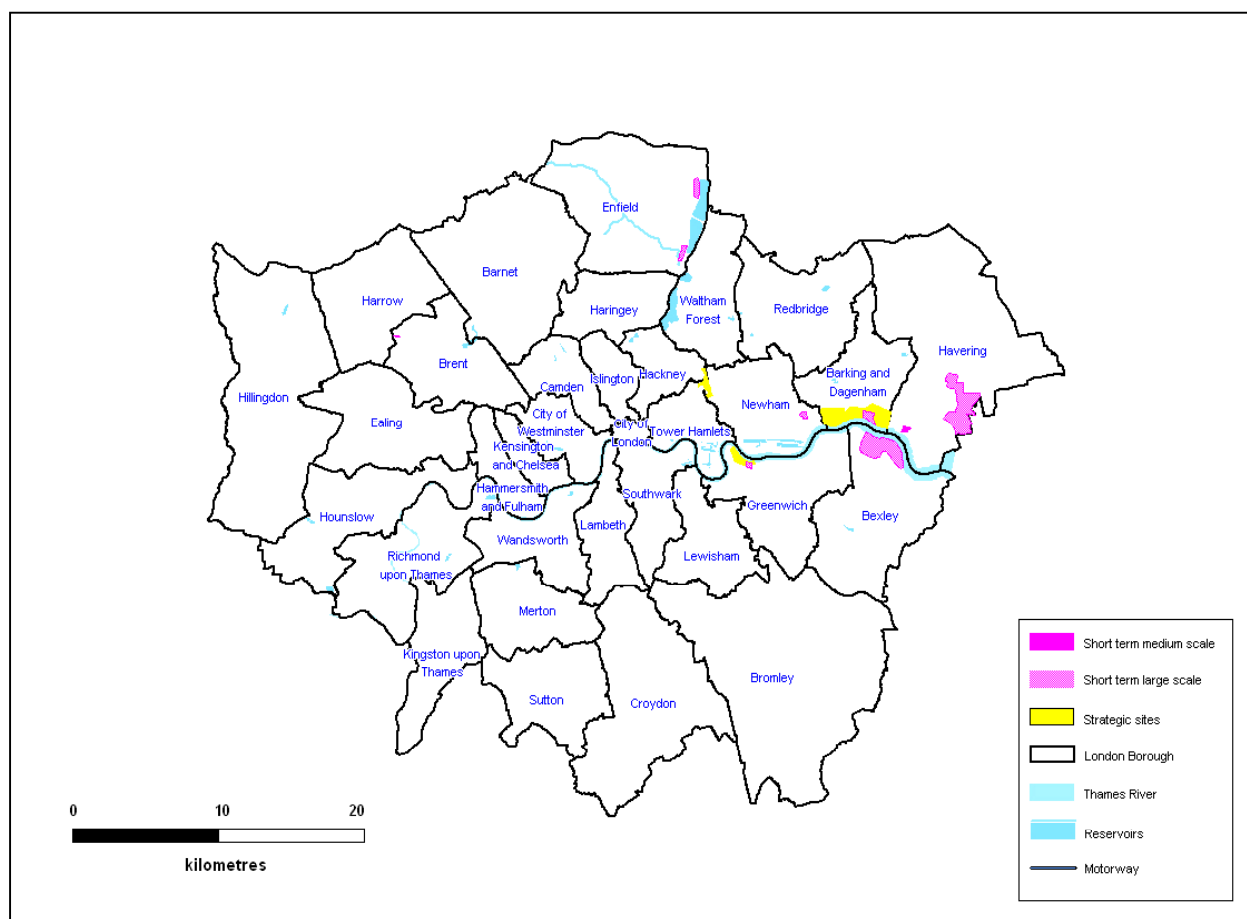
¹¹ Clear Skies is national government grant designed to support the installation of community renewable energy installations including, wind, solar thermal, biomass and ground source heat pumps.

2.8 List of Locations Identified

The locations identified are categorised as locations of considerable strategic potential, short-term/large-scale locations, and those which have medium-sized turbine capacity.

It is important to recognise that this study is not intended to include the level of detailed assessment of each location required for full wind development. Therefore, issues such as the requirement to upgrade infrastructure networks, or securing of environmental benefits from wind energy development through Section 106 Agreements and Planning Obligations, will be more fully considered at the development stage. In addition, a detailed assessment of the effect of turbine locations on the marketability of sites for housing or industry, particularly on those sites within or adjacent to areas of strategic redevelopment potential, will be required in order to justify use of land for wind energy production. Furthermore, as locations are developed, detailed survey work may reveal additional constraints to wind energy development in that location.

Figure 4: Potential wind development locations identified across London



2.8.1 Locations of considerable strategic potential

2.8.1.1 Stratford Olympic site

In considering the location of wind turbines, the needs of the users of the site are paramount - no noise or shadow flicker effects should affect the training, performance and recreation of the athletes and officials who will attend the Games, and those who will live in the area after the Games have finished.

Turbine characteristics	Notes
<ul style="list-style-type: none"> • Installed capacity: Mainly small-scale integrated turbines (4 x 250kW = 1 MW)* • Annual generation potential (% of Mayor's target): Depends on number of schemes (2.5GWh (0.37%))* • CO₂ savings: 2,260 tonnes • No. of households supplied: 559 	<p>Advantages: Extremely high profile site for London 2012 Olympic Games. Renewable energy already highlighted within initial planning documents.</p>

2.8.1.2 Greenwich Peninsula mixed use area

The development is being put forward as a 'sustainable living' proposal, with provisions for sustainable transport measures and energy efficient design. In addition, it is expected that the Greater London Authority and local planning authority will be requesting that the scheme incorporates at least the 10% renewables obligation¹².

Turbine characteristics	Notes
<ul style="list-style-type: none"> • Installed capacity: Mainly small-scale integrated turbines (2 x 600kW = 1.2MW) • Annual generation potential (% of Mayor's target): Depends on number of schemes (3.0GWh (0.44%)) • CO₂ savings: 2,712 tonnes • No. of households supplied: 670 	<p>Advantages: High profile site near to the Greenwich Millennium Dome, development plans promote 'sustainable living', small scale renewables already within the area.</p> <p>Main constraints: Capacity to be included within development at this stage.</p>

2.8.1.3 Barking Riverside

As one of the largest development sites in London, Barking Riverside aims to create a best practice model for sustainable living in the 21st century. The development includes building over 10,000 new homes, new transport links and a new community school.

Turbine characteristics:	Notes:
<ul style="list-style-type: none"> • Installed capacity: Mainly small-scale integrated turbines (2 x 600kW = 1.2MW) • Annual generation potential (% of Mayor's target): Depends on number of schemes (3.0GWh (0.44%)) • CO₂ savings: 2,712 tonnes • No. of households supplied: 670 	<p>Advantages: High profile site in Thames Gateway where sustainability will be key part of new development.</p>

* Figures are based on approximate estimations as to the scale and number of turbines possible on these sites.

¹² This relates to current GLA Planning policy as per April 2006, please refer to <http://www.london.gov.uk/mayor/strategies/sds/review.jsp> for more information on the review of the London Plan.

2.8.2 Short-term/Large-scale locations

2.8.2.1 New Charlton Meridian

As part of the Greenwich peninsula development, this location will need to consider the effect of turbines on residential areas, although the level of industrial/commercial background noise will reduce the effect of the turbines. Turbines could possibly be tolerated up to 300m from housing without any adverse impacts.

Turbine characteristics	Notes
Option 1: One large 1.65MW turbine with a tower height of 100m and a rotor radius of 41m:	Advantages: Potential location is owned by energy intensive industry (Lafarge). Main constraints: Future residential amenity, Port of London Authority, Radar (although an existing large stack on the site will reduce the impact).
<ul style="list-style-type: none"> • Installed capacity: 1.65MW • Annual generation potential (% of Mayor's target): 4.1GWh (0.6%) • CO₂ savings: 3,729 tonnes • No. of households supplied: 922 • Approximate development cost: £1.3 million 	
Option 2: Two medium 500 kW turbines with a tower height of 65m and a rotor radius of 20m:	
<ul style="list-style-type: none"> • Installed capacity: 1MW • Annual generation potential (% of Mayor's target): 2.5GWh (0.4%) • CO₂ savings: 2,260 tonnes • No. of households supplied: 559 • Approximate development cost: £0.8 million 	

2.8.2.2 East Beckton

This assessment focuses on potential opportunities within the proposed industrial park in Beckton Meadows and Gallions Reach Retail Park situated in the north-eastern corner of this area.

Beckton Meadows

Turbine characteristics	Notes
Option 1: Two large 1.65MW turbines with a tower height of 100m and a rotor blade radius of 41m:	Advantages: Fits within development plans for the area. Main constraints: Aeronautical, pylons and overhead lines, ground conditions.
<ul style="list-style-type: none"> • Installed capacity: 3.3MW • Annual generation potential (% of Mayor's target): 8.2GWh (1.2%) • CO₂ savings: 7,458 tonnes • No. of households supplied: 1845 • Approximate development cost: £2.5 million 	
Option 2: One large 1.65MW turbines with a tower height of 100m and a rotor blade radius of 41m:	

<ul style="list-style-type: none"> • Installed capacity: 1.65MW • Annual generation potential (% of Mayor's target): 4.1GWh (0.6%) • CO₂ savings: 3,729 tonnes • No. of households supplied: 922 	
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Gallions Reach Retail Park

Gallions Reach Retail Park is being developed immediately to the south of the Beckton Meadows site.

Turbine characteristics	Notes
<ul style="list-style-type: none"> • Installed capacity: Small/medium-scale turbines 1 x 600kW* • Annual generation potential (% of Mayor's target): Depends on number of schemes 1.5GWh (0.22%) • CO₂ savings: 1,356 tonnes • No. of households supplied: 355 • Approximate development cost: £0.5 million 	<p>Advantages: Site owners have expressed initial interest in installing a wind turbine of some 30m in height.</p>

2.8.2.3 Dagenham Docks

As part of the development planning for London Riverside regeneration, the London Borough of Barking and Dagenham, in partnership with the London Development Agency, has developed a vision for Dagenham Dock as a Sustainable Industrial Park. The goal for Dagenham Dock is the creation of a modern, sustainable industrial park and this report considers that the installation of on-site renewable energy technologies would compliment these wider objectives and vision.

Turbine characteristics	Notes
<p>Option 1: One 3MW wind turbine, with a tower height of 120m and rotor blade radius of 45m:</p> <ul style="list-style-type: none"> • Installed capacity: 3MW • Annual generation potential (% of Mayor's target): 7.5GWh (1.1%) • CO₂ savings : 6,780 tonnes • No. of households supplied: 1,677 	<p>Advantages: Existing large wind turbines within the area.</p> <p>Main constraints: Ecological (ornithological)</p>
<p>Option 2: Three 3MW wind turbine, with a tower height of 120m and rotor blade radius of 45m:</p> <ul style="list-style-type: none"> • Installed capacity: 9MW • Annual generation potential (% of Mayor's target): 22.5GWh (3.4%) • CO₂ savings: 20,340 tonnes • No. of households supplied: 5031 • Approximate development cost: £6.8 million 	

2.8.2.4 *Jenningtree*

This location consists of the Belvedere Industrial Park and Crossness Sewage, with the potential for a single landmark turbine as part of the Bronze Age Park development or a cluster of turbines as part of the industrial park.

Belvedere Industrial Park

Turbine characteristics	Notes
Option 1: One large 3MW turbine: <ul style="list-style-type: none"> • Installed capacity: 3MW • Annual generation potential (% of Mayor's target): 7.5GWh (1.1%) • CO₂ savings: 6,780 tonnes • No. of households supplied: 1,677 • Approximate development cost: £2.3 million 	Advantages: Potential locations owned by energy intensive industry; potential for an iconic landmark to replace the Pirelli Tower. Main constraints: Ecological (ornithological); radio-communications
Option 2: Cluster of turbines - up to five 3MW turbines: <ul style="list-style-type: none"> • Installed capacity: 15MW • Annual generation potential (% of Mayor's target): 37.4GWh (5.6%) • CO₂ savings: 33,901 tonnes • No. of households supplied: 8385 	

Crossness Sewage Treatment Works

Turbine characteristics	Notes:
Option 1: One large 1.65MW turbine: <ul style="list-style-type: none"> • Installed capacity: 1.65MW • Annual Generation Potential (% of Mayor's target): 4.1GWh (0.6%) • CO₂ savings: 3,729 tonnes • No. of households supplied: 922 	Main constraints: Ecological (ornithological); radio-communications
Option 2: Three small 250kW turbines: <ul style="list-style-type: none"> • Installed capacity: 500KW • Annual Generation Potential (% of Mayor's target): 1.2GWh (0.2%) • CO₂ savings: 1,130 tonnes • No. of households supplied: 279 	

2.8.2.5 *Lee Valley*

The proposed locations are industrial/sewage works, with the reservoirs designated as IBAs, ESAs and SSSIs. The area is also the subject of an Opportunity Area and Planning Framework. Wind turbine developments would therefore have to take account of any potential plans for residential units within 400m of the proposed location.

Picketts Lock or Brimsdown Locations - three medium 500kW turbines

Turbine characteristics	Notes
<ul style="list-style-type: none"> Installed capacity: 1.5MW Annual generation potential (% of Mayor's target): 3.7GWh (0.6%) CO₂ savings: 3,390 tonnes No. of households supplied: 838 Approximate development cost: £1.3 million 	<p>Advantages: High profile industrial occupants such as Coca Cola; opportunity to add industrial landmark; could provide public viewing platform to link with Greater London Authority objectives to promote access to the reservoir.</p> <p>Main constraints: Pylons and overhead lines; ecological (ornithological); future development plans</p>

2.8.2.6 East Rainham

The location is allocated as Green Belt and therefore, poses a wider planning policy debate than the brownfield sites discussed earlier in this report.

Turbine characteristics	Notes
<ul style="list-style-type: none"> Installed capacity: 24MW Annual generation potential (% of Mayor's target): 59.9GWh (9.0%) CO₂ savings: 54,241 tonnes No. of households supplied: 13,416 Approximate development cost: £18 million 	<p>Advantages: Only location identified for a potential large-scale wind development in London.</p> <p>Main constraints: Green Belt designation; ecological (ornithological)</p>

2.8.3 Locations potentially capable of accommodating medium-sized turbines*2.8.3.1 Fairview Industrial Area*

Turbine characteristics	Notes
<ul style="list-style-type: none"> Installed capacity: 1MW (2 x 500kW turbines) Annual Generation Potential (% of Mayor's target): 2.6GWh (0.4%) CO₂ savings: 2,260 tonnes No. of households supplied: 559 Approximate Development Cost: £0.8 million 	<p>Advantages: Industrial users; existing turbines within the area.</p> <p>Main constraints: Ecological (ornithological)</p>

2.8.3.2 Northwick Hospital

Turbine characteristics	Notes
<ul style="list-style-type: none"> Installed capacity: 500kW Annual generation potential (% of Mayor's target): 0.6GWh (0.1%) CO₂ savings: 565 tonnes No. of households supplied: 139 Approximate development cost: £0.4 million 	<p>Advantages: Existing stacks on the hospital site will reduce visual impact; potential as a landmark for the research centre.</p> <p>Main constraints: Aeronautical; future development plans</p>

3 Key Highlights of Biomass Feasibility Study

3.1 Overview

The biomass feasibility study report evaluates the total biomass resource in and around London and presents specific proposals for utilising the resource as a fuel.

3.2 Key Findings

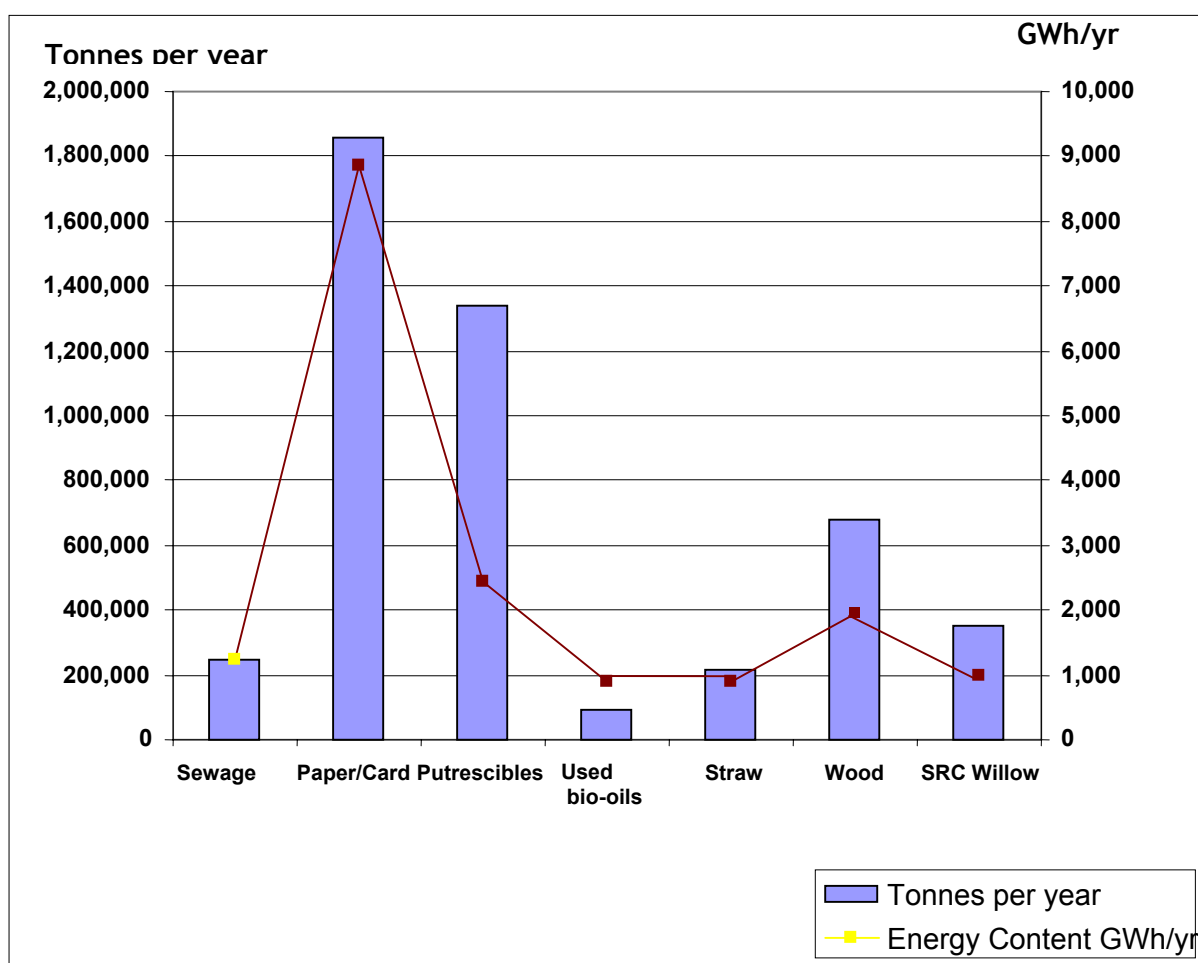
3.2.1 Defining, mapping and quantifying the resource

For the purposes of this study, the broadest definition of biomass has been used. This is also the definition adopted by the UK Biomass Task Force:

“literally, any biological mass derived from plant or animal matter. This includes material from forests, crop-derived biomass including timber crops, short rotation forestry, straw, chicken litter and waste material.”

Biomass arises from a wide range of different sources, such as energy crops grown specifically for the purpose of energy generation, and is present in the waste stream.

Figure 5: Total Biomass Arisings in London and within 40km by tonnage and energy content



The biological part of the waste stream holds the largest potential for biomass power generation in London. Combined with energy crops, agricultural and forestry residues, this study estimates that the resource constitutes some five million tonnes per year. The breakdown can be seen in Figure 5 above. The energy content of this material would equate to some 12% of London's total energy demand (including transport). As total utilisation of this resource for energy generation would go against the whole thrust of both UK and London waste policy, it is only the residual elements of these waste streams that should be made available for energy generation.

Potential biomass sources in London include:

- **Waste:** Waste incorporates many different elements and these are identified separately below. The worst performing area in terms of recycling is municipal waste with 73% going to landfill. 81% of construction waste on the other hand is recycled. Most of London's municipal waste is taken by road rail or barge to landfill sites outside of London in the surrounding counties. Transfer stations could be converted to energy facilities in the future, as practices move away from collection and transfer for disposal at landfill to local recovery facilities.
- **Paper/Card:** Constitutes the largest single resource of biomass energy in London. However, following the waste hierarchy would suggest that this resource should not primarily be utilised for energy production. However some of this material, where it forms the residual element of the waste stream, will become available as solid recovered fuel as described below. This will then form part of the available resource.
- **Putrescibles:**¹³ Represents a significant resource in London whether from commercial or household sources (kitchen and garden waste). An increasing amount of this waste is being composted but very little is being used for energy generation. It has a much lower calorific value but as a wet section of the resource stream it is most suited to anaerobic digestion technology.
- **Refuse Derived Fuel (RDF) & Solid Recovered Fuel (SRF):** The Draft Alterations to the London Plan¹⁴ indicate that 20 Mechanical Biological Treatment (MBT) facilities will be needed in London by 2020. MBT plants produce a dry residue called RDF or SRF, which can be used as a fuel source. SRF has a higher calorific value than mixed municipal waste. Where this material is treated by gasification or pyrolysis or in CHP plant, the electricity generated from the biomass proportion (estimated to be 62%) will qualify for Renewables Obligation Certificates.
- **Oils and Fats:** Vegetable oils or animal fats can either be burnt as they are or converted into biodiesel. The calorific value of vegetable oil is similar to that of conventional diesel. London Remade and London Community Recycling Network have recently commissioned a survey¹⁵ to quantify this resource, which estimated that 37,000 tonnes of used cooking oil, mainly vegetable or nut based, is available in London - of which only 15,000 tonnes is actually collected. A further 53,000 tonnes of animal fats is estimated to be available. As the most recent and comprehensive figures, these have been used for this study.

¹³ Putrescible waste is solid waste that contains organic matter capable of being decomposed by micro-organisms.

¹⁴ Draft Alterations to the London Plan, October 2005, GLA

¹⁵ The Market for Biodiesel Production from Used Cooking Oils in London, J Stephen Burnett

- **Sewage:** The UK Biomass Taskforce¹⁶ estimates that there is around 1.8TWh of energy available from sewage in the UK using combined heat and power (CHP) technology. This would constitute 0.2% of total UK heat and power demand. Currently there is 100% utilisation of sewage sludge in London - no sewage is landfilled or disposed of at sea. Much of the resource (32%) is burnt at the two sewage sludge incinerators at Beckton and Crossness. At Mogden in Hounslow and Beddington in Sutton, anaerobic digestion is still used to process sewage and according to the Mayor's Energy and Municipal Waste Strategies there is potential to expand this at those sites. They state that altogether the potential exists to deal with a further 600,000 tonnes of biodegradable materials at these sites.
- **Agricultural Residues:** There is approximately 97km² of arable farmland within Greater London, which is 5.6% of London's land area and already produces some materials that could be used for energy production, namely straw and vegetable/cereal residues. According to the Biomass Task Force, straw is a major potential resource for biomass, able to deliver around 1.3% of total UK heat and power demand if used in CHP plant. 3,000,000 tonnes of straw is available, mainly in East Anglia, for energy production.
- **Energy Crops:** A large area of land is required to produce significant quantities of fuel, which is in competition with growing food. One answer to this is that set aside land should be used to grow fuel. These crops also require a long-term commitment - farmers will need to feel it is a secure choice before changing their crops. Energy crop choices include: willow and poplar, miscanthus and oil bearing crops.¹⁷
- **Woodfuel:** Wood is present in all three of the main waste stream classifications: municipal, commercial/industrial and construction/demolition. It is also the main constituent of arboricultural waste from tree surgery operations in London. A recent study conducted by Bioregional and the London Tree Officers Association¹⁸ has been used for the purposes of this study and gives a total of 127,000 tonnes per year. The potential for woodfuel from forestry operations around London has been taken from the Future Energy Solutions 2002 study and puts the forestry operations potential at 2,195 oven dried tonnes per year within London (from 6,700 ha of woodland), and at 63,441 oven dried tonnes per year around London (40km radius).

There are a range of possible biomass materials available to London and the size of the resource is dependent on how far afield they should be sourced. Of those identified above the most concentrated, cheap and easily available resource will be SRF produced by MBT treatment facilities. The Draft Alterations to the London Plan indicate that around 2.5 million tonnes of MBT capacity will be required by 2020, producing around 1.2 million tonnes of SRF per year.

A further resource is wood in a variety of forms in the waste stream. Some of this material will be contaminated and thus require a Waste Incineration Directive compliant

¹⁶ The UK Biomass Taskforce was set up in October 2004 to undertake a study to help the Government and Industry develop biomass energy in the support of renewable energy targets and sustainable farming and forestry and rural objectives.

¹⁷ The potential for utilising this resource in London was undertaken by Future Energy Solutions (FES) in 2002. FES estimated that only 120 oven dried tonnes (odt) of short rotation coppicing willow could be produced in London, although including a 40km radius around London would give 174,900 odt.

¹⁸ Tree Surgery Waste, Bioregional and LTOA, November 2005

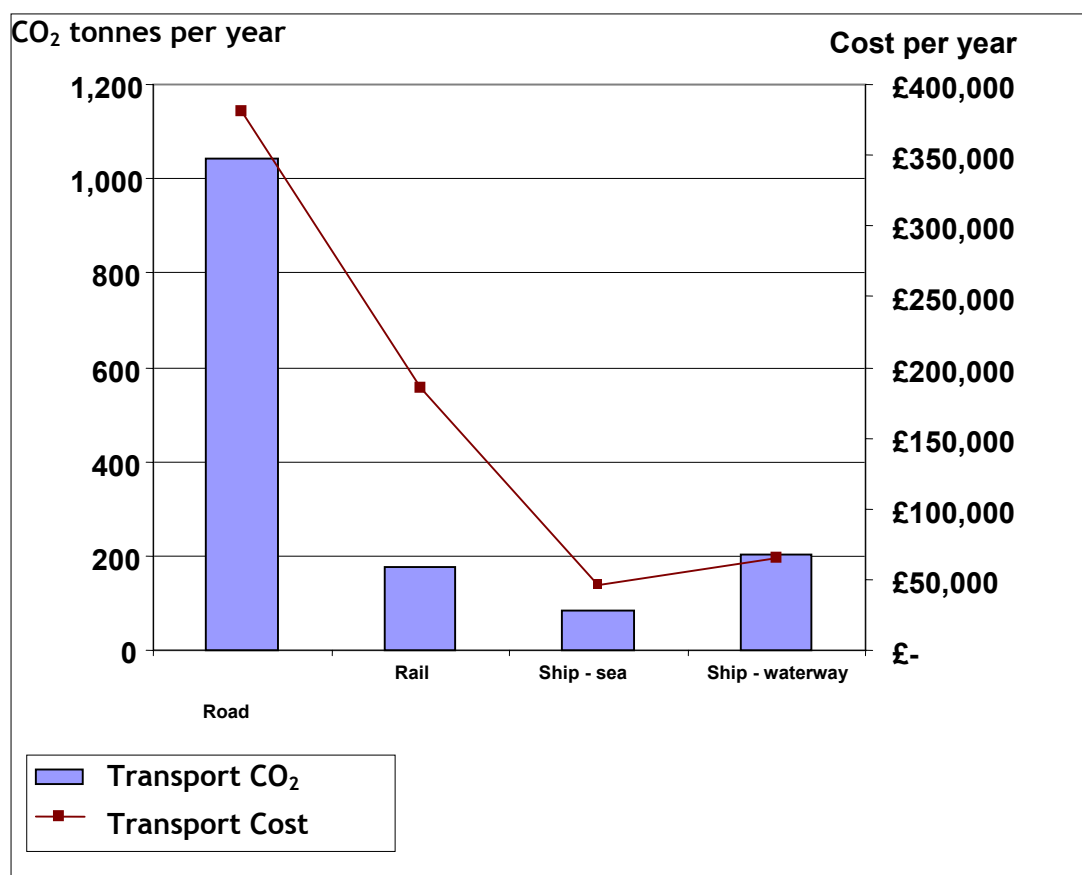
plant. Around 490,000 tonnes of wood are estimated to be present in the waste stream. A further 978,000 tonnes of woody material from woodland management and energy crops could become available if land within a 40km radius around the edge of the London is included in the analysis.

More sewage could be used for energy generation in London, though the relative carbon benefit of diverting this from use as a fertiliser is unclear. Agricultural residues are surprisingly large in London and the counties around London have the highest density of straw production in the UK. In the following section the carbon impacts of transporting biomass are examined. Bringing biomass from outside this 40km boundary would increase the available resource considerably but attention will need to be paid to both the transport mode and the sustainability of the source of this material.

3.2.2 Transportation and other carbon impacts of biomass

The use of biomass as a fuel provides significant potential to reduce London's carbon burden arising from conventional fossil fuel electricity and heat. There are, however, associated carbon impacts in terms of the production, processing and transportation of biomass. If strategically developed with sustainably sourced biomass and the material is produced locally and/or transported by rail or water, these impacts should be minimal when compared to the carbon reductions achieved through renewable heat and power generation. This is illustrated in Figure 6 below showing the transportation carbon impacts of a 20MWe woodchip CHP plant. Assuming the worst case mode and an average transportation distance of 40km, the transport carbon emissions represent less than 1% of the savings from the operation of the plant.

Figure 6: Transport CO₂ and cost for different modes for an average 40km transportation distance to supply at 20MWe woodchip CHP Plant¹⁹



3.3 Energy potential of identified biomass locations

Biomass CHP provides one of the most attractive methods of providing low or zero carbon developments in London. All of the pilot Energy Action Areas have considered the use of biomass CHP as one of the ways of meeting carbon reduction targets, but have yet to commit to it until they have a guaranteed supply. Slough Heat and Power plant is a converted coal fired power station, which by May 2004 was 90% fuelled by biomass (wood chips and non-recyclable packaging materials), in part provided by Croydon Tree Station²⁰.

Biomass CHP could displace 15% of London's conventional energy needs for buildings, excluding transport, and reduce CO₂ emissions by just over 5 million tonnes per year. However this would involve using all available biomass whatever its current fate. Assuming that all biomass that is currently not recycled or already used for energy recovery is used, the potential would be to displace around 10% of conventional sources, saving around 3.5 million tonnes per year of CO₂. All of these figures assume that CHP is utilised. If instead, electricity only systems were used, these would provide only 5% (all biomass) and 3% (residual biomass) respectively.

¹⁹ Figures are based on the Royal Commission on Environmental Pollution Biomass Report

²⁰ In calculating the potential for biomass, this feasibility study makes the assumption that biomass will be used in CHP plant. Other possible future uses for waste include waste to hydrogen technologies. See 'The Potential for Hydrogen Production from Waste in London', London Hydrogen Partnership, October 2006.

Table 1: Potential CO₂ displaced by residual biomass

Sector	Material	CO ₂ Displaced 1000s tonnes per year		
		Combustion ²¹ (C)	Gasification (G)	Digestion (D)
Sewage	Sludge	0	0	0
Municipal Solid Waste	Paper/Card	1,190	1,261	0
	Putrescibles	352	374	234
	Misc Combustible	203	215	0
	Wood	117	124	0
Commercial & Industrial Waste	Paper/Card	617	654	0
	Putrescibles	188	199	126
	Wood	16	17	0
	Used cooking oil	96	90	0
	Animal fats	137	129	0
Construction Waste	Wood	26	27	0
Aboricultural	Wood	44	46	0
Woodland	Wood	3	3	0
Farms in GL	Straw	0	0	0
	Vegetable/Cereal Residue	10	10	6
	Manure	0	0	0
SRC Potential in London	Willow	6	6	0
SRC Potential in 40km Radius	Willow	235	249	0
Forestry in 40km radius	Wood	96	90	0
Total		3,335	3,496	366

Using conventional CHP technologies, if all the available residual materials were used this would constitute a total of approximately 500MW_e of installed biomass generating capacity.

²¹ Under this category we have assumed the most appropriate conventional combustion technology for each material. For most materials steam turbine plant has been assumed, but for fats and oils a diesel engine.

Table 2: Potential electrical and thermal generation from Residual biomass

Sector	Material	Potential electrical energy yield (GWh)			Potential thermal energy yield (GWh)		
		C	G	D	C	G	D
Sewage	Sludge	0	0	0	0	0	-
Municipal Solid Waste	Paper/card	1,231	1,576	0	2,955	2,610	-
	Putrescibles	365	467	344	875	773	387
	Misc combustible	210	269	0	504	445	-
	Wood	121	156	0	292	258	-
Commercial & industrial waste	Paper/card	638	817	0	1,532	1,354	-
	Putrescibles	194	249	185	466	412	208
	Wood	17	21	0	40	35	-
	Used cooking oil	141	112	0	158	186	-
	Animal fats	201	161	0	227	267	-
Construction waste	Wood	27	34	0	64	57	-
Arboricultural	Wood	45	58	0	108	96	-
Woodland	Wood	3	4	0	7	6	-
Farms in GL	Straw	0	0	0	0	0	-
	Vegetable/cereal residue	10	13	9	24	21	10
	Manure	0	0	0	0	0	-
SRC potential in London	Willow	6	8	0	14	12	-
SRC potential in 40km radius	Willow	243	311	0	583	515	-
Forestry in 40km radius	Wood	113	113	0	211	187	-
Total		3,566	4,368	537	8,062	7,235	605

Using conventional CHP technologies if all the available residual materials were used this would constitute a maximum electrical yield of 3.5TWh and a thermal yield of 8TWh.

3.4 Barriers

The UK Biomass Task Force has produced a report on the barriers and possible solutions to biomass use in the UK. Five of the major barriers affecting London have been assessed for this report and are outlined below.

- **The heat barrier:** CHP clearly provides the best route for the utilisation of biomass in London, yet the development of electricity only schemes such as the Novera plant in East London, is still the norm. The economic analysis conducted in the main report shows that there is a heavy economic burden in developing a heat network and, depending on the assumptions in terms of cost of connection, this can adversely effect the viability of a scheme.
- **The Renewables Obligation and co-firing:** The Renewables Obligation is the main mechanism by which biomass power generation receives support and could add as much as 4.5p to the sale price of electricity from biomass. However, the rules around biomass and waste materials do not necessarily encourage efficient use, as they discriminate against co-firing.
- **Lack of sites for collection of clean wood waste:** Arboricultural waste and other wood waste are an important energy resource that could be captured if suitable sites existed for collection.

- **Classification of energy recovery in the waste hierarchy:** The energy hierarchy serves a very important purpose but can lead to a lack of flexibility. Arguably, in carbon terms, it would be better to use the wood resource for energy recovery.
- **Lack of energy crop producer groups:** There is currently a lack of energy crop producers in the environs of London.

3.5 Guidelines

There are a range of different factors to be taken into account in selecting the size, type and location of plant:

- Land area required and land value
- Proximity to fuel supply and/or ease of sustainable transport supply
- Transportation distances and modes - proximity to rail/waterways avoiding road transportation
- Proximity to heat loads
- Proximity to community heating networks - costs of interconnection of heat networks where larger loads are required
- Proximity to Priority Areas: Energy Action Areas, Olympics, Thames Gateway
- Proximity to regeneration sites
- Cost of electricity network connection
- Economies of scale at large sizes
- Heat to power ratios at different sizes of CHP plant
- Interest from or agreement of site owner
- Local environmental impact.

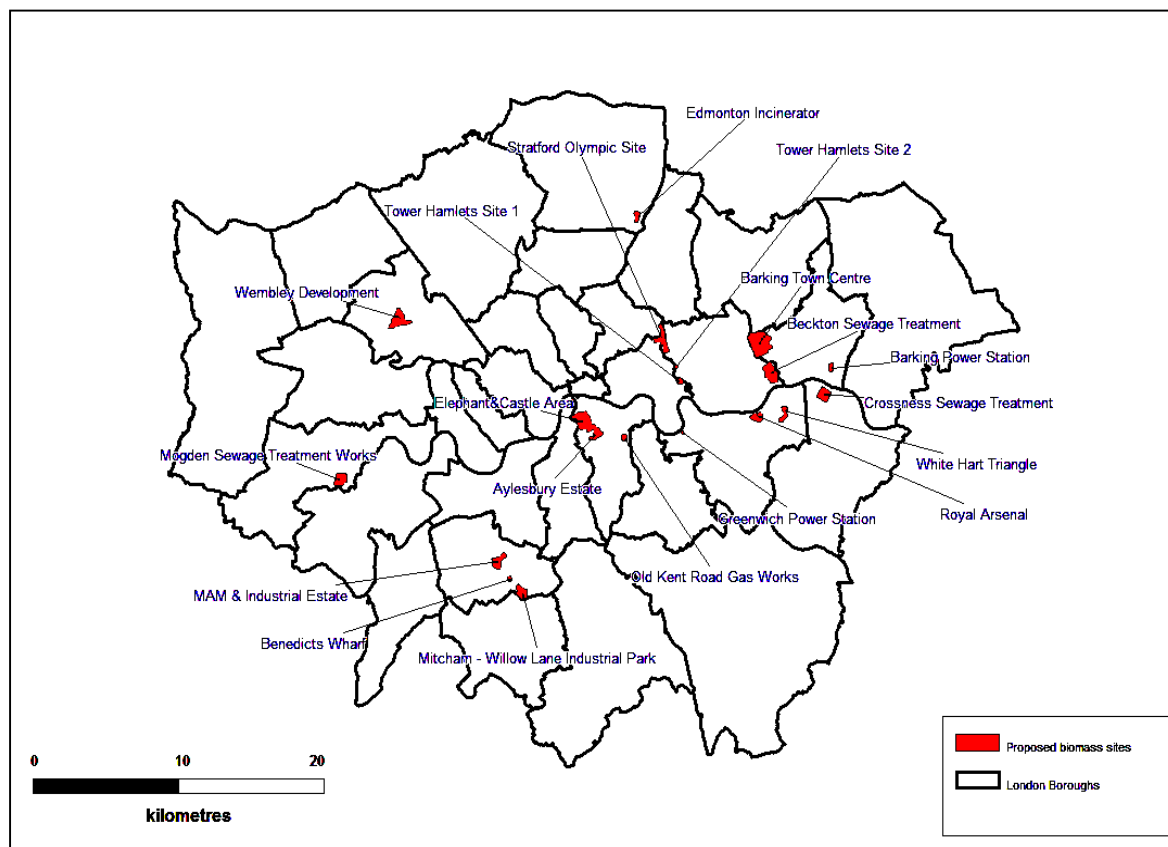
The criteria above have been used to generate a scoring system for the siting of biomass CHP plant. This is shown in Table 2 below.

Table 2: Criteria for site selection

Criterion	Least potential → Greatest potential				
	1	2	3	4	5
Land area available	0.3-0.7ha	0.7-1	1-3	3-5	>5
Proximity to fuel supply	International	National	Within 40km	Subregional	Local
Sustainability of transport supply	Road only	Mix	Direct rail	Waterway	Waterway and suitable wharf
Proximity to heat loads	>3km	1-3km	1-0.5	0.5-0.1	0.1-0
Proximity to existing community heating networks	>3km	1-3km	1-0.5	0.5-0.1	0.1-0
Proximity to Priority Areas: Energy Action Areas, Olympics, Thames Gateway	>3km	1-3km	1-0.5	0.5-0.1	0.1-0
Proximity to regeneration sites	>3km	1-3km	1-0.5	0.5-0.1	0.1-0
Cost of electricity network connection	Unknown at this stage				
Opportunities to piggyback on existing power, waste or related development	None whatsoever	Site reusable	Some integration /reuse	Can integrate with new development	Can reuse existing facilities
Appropriate Industrial site	Inappropriate				Industrial
Interest from or agreement of site owner	Hostile	Ambivalent	Neutral	Interested	Enthusiastic

3.6 List of Locations Identified

Eleven possible biomass schemes have been identified in London together with appropriate heat loads. The locations identified are by no means exhaustive, and there are undoubtedly many more opportunities in London, but these are considered to provide a range of different technologies, utilising a range of different materials that



complement the Mayor’s strategic framework for both waste and energy.

Further information on each potential scheme is outlined below divided by subregion.

Figure 7: Overview of biomass locations

3.6.1 Subregion East

3.6.1.1 Barking Power Station Extension

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Avedøre-style combined cycle co-firing • Fuel: Gas, straw, wood • Power: 100MW_e biomass (400MW_e including gas) • Heat serving: Barking town centre • Land available for extension: 3 hectares 	<p>Barking power station is planning an expansion in the near future. The location is also part of a larger site which has been designated a green business district and a biomass element would complement this project.</p>

3.6.1.2 Tower Hamlets/Newham Plant

Plant characteristics:	Notes:
<ul style="list-style-type: none"> • Technology: Steam turbine • Fuel: Wood - waste and SRC willow • Power: 20MW_e • Heat: 30MW_{th} • Heat serving: Tower Hamlets Community Heating 	Two locations have been identified in this area (by the London Heat Study) and both have good transport links and could provide heat to the Olympic site.

3.6.1.3 Beckton Thames Water Site

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Anaerobic digestion or gasification • Fuel: Kitchen waste or sewage sludge • Power: 2.5MW_e or above • Heat serving: Barking Town Centre Pilot Energy Action Area²² 	There is the possibility of river transportation for both feedstock and digestate and a waste transfer station next to Battersea power station that could serve as a biomass fuel supplier.

3.6.1.4 Crossness

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Anaerobic digestion • Fuel: Source separated kitchen waste • Power: 10MW_e • Heat serving: Woolwich and Thamesmead regeneration schemes 	The main asset of Crossness is the space available and there seems to be genuine interest from the site owner.

3.6.1.5 White Hart Triangle / Woolwich Arsenal

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Steam turbine/gasifier • Fuel: Waste wood from Civic Amenity Site/ Material Recycling Facility and short rotation coppiced willow from Kent • Transport: River access - 1km direct • Power: 20MW_e • Heat: 30MW_{th} • Heat serving: Woolwich Arsenal Redevelopment and Thamesmead sites, Woolwich Dockyard and other Estates, White Hart Triangle Industrial Estate, Woolwich Town Centre Redevelopment, Belmarsh Prison 	A gas fired combined cycle CHP is currently proposed but there is some interest in biomass, both from the owner Tilfen Land, and Greenwich Council.

²² An Energy Action Area is an area selected by the London Energy Partnership as a showcase low carbon community. Four pilot areas were selected for London in July 2005.

3.6.1.6 Greenwich Power Station

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Currently gas turbine - proposed steam turbine • Fuel: Vegetable oils or biomass wood chip brought in by river • Power: 20MW_e (currently 117MW_e gas) • Heat: 30MW_{th} • Heat serving: Greenwich University, museums, developments on Greenwich Hospital site, social housing, • Land available 1.5 hectares 	<p>Greenwich power station is a prime development site, but also a useful location for developing a sustainable energy scheme. This represents a conflict in terms of development, but could also represent a good opportunity to bring the power plant back to full operation. An existing pier at the site offers the opportunity for river transportation of biomass fuel.</p>

3.6.2 Subregion South

There are three potential locations that could be used for developing a biomass plant and they could also be linked to each other: Merton Abbey Mills Industrial Estate, and Mitcham and Benedict Wharf locations on Willow Lane Industrial Estates.

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Gasification or pyrolysis • Fuel: Solid recovered fuel (SRF15,000 tonnes/yr) • Power: 5MW_e • Heat serving: Industrial Estate and Merton Abbey Mills, Mitcham Town Centre (which is also one of the Mayor's Pilot Energy Action Areas) and Willow Lane Industrial Park 	<p>Merton Council is very interested in developing a biomass energy plant and biomass fuel can be supplied locally. Mitcham town centre also represents a good heat load for a biomass CHP scheme.</p>

3.6.3 Subregion West

3.6.3.1 Mogden

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Anaerobic digestion - Co-digestion • Fuel: Sewage and municipal solid waste putrescibles • Power: Unknown at this stage. • Heat serving: There are several residential areas that could be potentially connected to the location. 	<p>This location currently digests sewage sludge, with spare capacity for the addition of other feedstocks. Thames Water advises that the road access is poor although there is a railway station (Hounslow) near the location that might be used for biomass deliveries.</p>

3.6.3.2 Wembley Pilot Energy Action Area

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Gasification • Fuel: SRF or local tree waste • Power: Unknown at this stage • Heat serving: New developments around the Wembley area. 	A major urban regeneration mixed use project, located adjacent to the New National Stadium, is under development. Biomass is not currently envisaged as a major contributor to the heat and power needs of the development but CHP and community heating are planned. MBT derived SRF or local waste wood sources could provide a contribution to this network.

3.6.4 Subregion Central

3.6.4.1 Elephant and Castle and Old Kent Road Gas Works

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Gasification • Fuel: Clean wood from Civic Amenity and arboriculture waste, SRF from Southwark MBT plant • Power: 9MW_e • Heat serving: Elephant and Castle Redevelopment and the Aylesbury Estate (a pilot Energy Action Area) 	45-50,000 tonnes/yr of SRF would be available from the planned MBT plant at the Old Kent Road Gas works, which could feed into a heat network supplying the regeneration areas and Southwark estates.

3.6.4.2 SELCHP - Utilisation of Existing Biomass Heat

SELCHP and Edmonton currently produce power only. The heat produced is simply dumped into the atmosphere. Connecting these to community heating would increase the biomass energy input into London's energy demand. PB Power has already carried out a study of connecting SELCHP to estates in Southwark.

3.6.5 Subregion North

3.6.5.1 Edmonton

Plant characteristics	Notes
<ul style="list-style-type: none"> • Technology: Steam turbine • Fuel: Energy Crops • Power: 5.5 MW_e • Heat: 14 MW_{th} • Heat serving: Public sector buildings and council housing 	A Thames Energy Ltd study concluded that a biomass CHP development should be viable and economically attractive, with potential for further network development. The study estimated that some 55,000 tonnes of CO ₂ would be saved per year.

4 Combined Wind and Biomass Development Locations

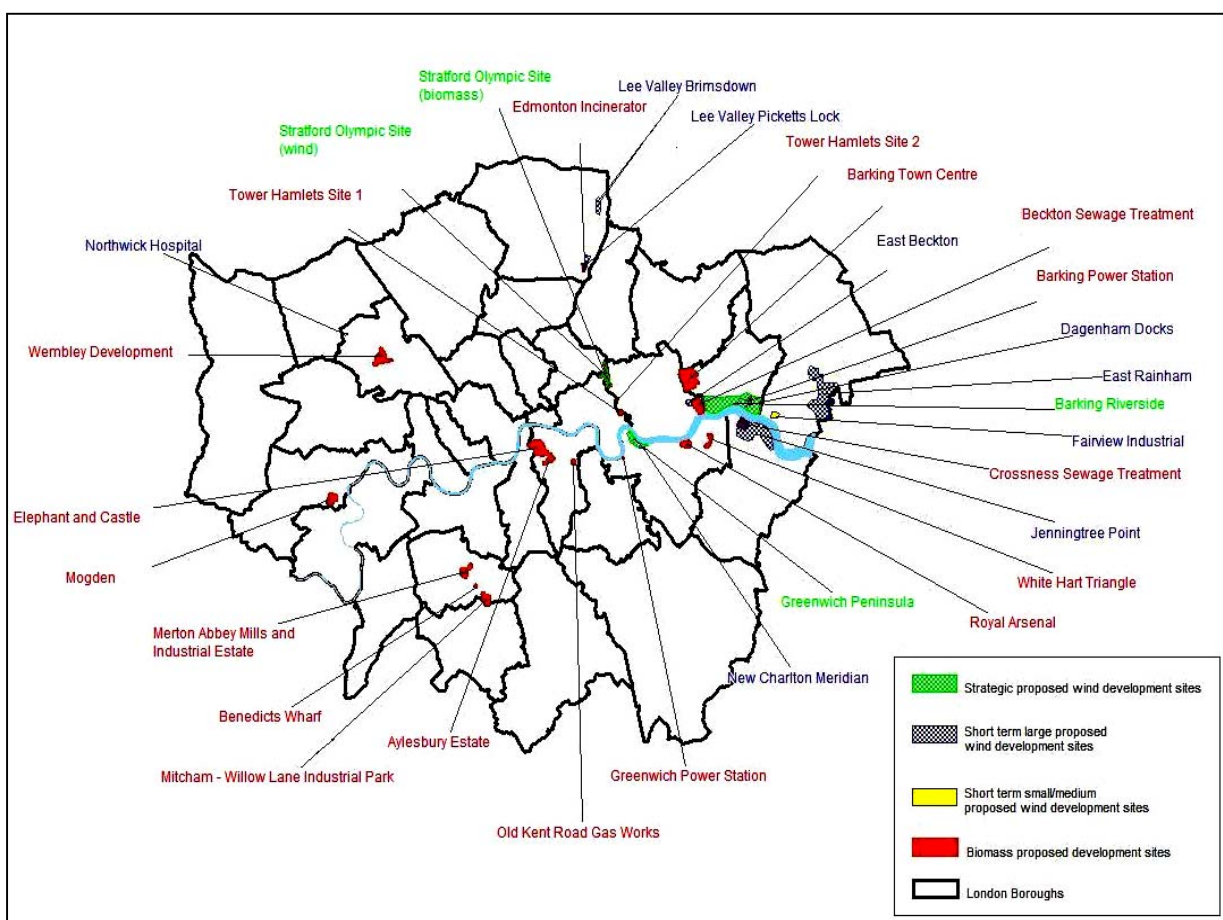
During the course of the work a number of locations were identified which could offer potential for both wind and biomass development, if not on the exact same location, then in adjacent or nearby areas. These locations could offer increased potential for landmark renewable energy developments, where both wind turbines and biomass options could be developed as a joint project.

Figure 8 below shows all the various potential wind and biomass development locations identified as part of the study, and shows the proximity of some of the locations.

The following locations have been identified as potential areas for a combined wind and biomass development:

1. Stratford Olympic Site/Tower Hamlets (up to 1MW wind and 20MW_e/30MW_{th} biomass)
2. Barking Riverside (up to 9MW wind and up to 100MW_e biomass)
3. Beckton (up to 3.3MW wind and 5MW_e biomass)
4. Crossness/Jenningtree Point (up to 15MW wind and 10MW_e biomass)
5. Lee Valley (up to 3MW wind and 5.5MW_e/14MW_{th} biomass)

Figure 8: The potential for combined wind and biomass development locations as identified through both studies



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Working as an independent body, the London Energy Partnership uses the power of partnership to enable London to respond to the challenges of climate change, security of energy supply and fuel poverty. The London Energy Partnership steering group members and observers include representatives from Argent Group Plc, Business Councils for Sustainable Energy UK, Carbon Trust, EDF Energy, Energy Saving Trust, RBC Capital Markets, Greater London Authority, Government Office for London, London Borough's Energy Group, London Climate Change Agency, London Development Agency, London Sustainability Exchange, Renewable Energy Association, London South Bank University and Thames Gateway London Partnership.