RUBBISH IN - RESOURCES OUT
DESIGN IDEAS FOR WASTE FACILITIES IN LONDON

GREATER LONDON AUTHORITY

Design for London

A report by

DOW JONES ARCHITECTS LLP

and ARUP

PAPER p. David Grandorge

CONTENTS

WASTE BARGE p. Alun Jones

FOREWORD

BY ANDREW RICHMOND, GLA PRINCIPAL POLICY OFFICER, WASTE

London's Spatial Development Strategy, The London Plan, was first published in 2004. Under the requirements of the Greater London Authority (GLA) Act 1999, the London Plan deals only with matters that are of strategic importance to Greater London, and also takes account of three crosscutting themes:

- The health of Londoners
- Equality of opportunity
- Its contribution to sustainable development in the UK.

The London Plan provides a unified, spatial framework for all the Mayor's strategies covering these three cross cutting themes.

The Municipal Waste Management Strategy (MWMS) for London, 'Rethinking Rubbish in London', was first published in September 2003, and sets out the vision that by 2020 municipal waste management will no longer compromise London's ability to become a sustainable world city.

In order to achieve this vision the municipal waste management strategy adopted the following waste management hierarchy, to be approached from the top down;

- Reduce
- Re-use
- Recycle & Compost
- Recovery using new and emerging advanced thermal treatment (ATT) technologies
- Conventional incineration
- Landfill.

In 2000/01, London's municipal waste recycling rate was 8%, up from 5% in 1996/97. In 2006/07, the municipal waste recycling rate in London was up to 20%, somewhat short of the targets set in the strategy but a significant improvement all the same. However, as for the rest, 57% was buried in landfill sites and 22% was burnt in incinerators.

Much of the improvement in the recycling was down to the London Recycling Fund that distributed money for recycling schemes totalling £50m over four years. This fund combined with statutory targets set by government and a London wide recycling campaign managed by the GLA focussed minds and delivered a step change in the way waste was viewed in London - a resource to be harnessed, not a problem to be rid off.

Although recycling has now gathered a momentum, education and improvement in services is still required, but above all London needs its own facilities to sort, manage and process these materials.

The next challenge that London now needs to tackle, whilst continuing to increase its recycling rates, is what to do with the waste that cannot be recycled, and where to do it. The waste hierarchy and the supporting policies and proposals both in the MWMS and the London Plan, advocate the use of new and emerging advanced thermal treatment technologies to treat non-recyclable waste, which should be carried out near to the source of production and/or collection.

The London Plan has set a self sufficiency target for managing all of London's waste of 85% by 2020. Currently we estimate that 60% of London's waste (19m tonnes) is managed inside London. The construction and demolition industry are by far the best performers managing nearly 95% in London of which 85% is recycled. It is the household, commercial and industrial waste streams that require the most facilities.

The policy is in place to achieve this with the London Plan allocating a proportion of London's waste (household, commercial and industrial) to each London Borough for which land must be allocated in their Development Plan Documents, in order to

PLASTERBOARD p. David Grandorge

achieve the 85% self sufficiency target. Based on the strategy's preferred waste management option of high recycling and the use of advanced thermal treatment technologies, it is estimated that an additional 328ha of land will be required for approximately 199 Material Recycling Facilities (MRFs), 57 composting facilities, 16 Mechanical Biological Treatment (MBT) Facilities, 25 Anaerobic Digestion (AD) facilities and 11 Advanced Thermal Treatment (ATT) facilities.

This report considers new and emerging technologies: anaerobic digestion and advanced thermal treatment technologies, which recover energy as part of the waste treatment process. It explores how these technologies can be successfully integrated into our city in order to achieve a complementary set of waste treatment facilities to meet current and future needs, and the likely impact this will have on the city.

FOREWORD
CONTINUED

Anaerobic digestion takes biodegradable waste and breaks it down in enclosed vessels, turning it into compost and a methane rich biogas. ATT technologies take the residual waste unsuitable for recycling, composting and/or anaerobic digestion, and convert it into a syngas at high temperatures, leaving ash and char which can be used, for example, in construction materials.

The biogas and syngas produced by anaerobic digestion and ATT technologies respectively can be turned into energy, providing local heat and power.

The ambition of this report is to confront traditional preconceptions of waste and waste treatment. New waste treatment processes will be brought into the city and, through thoughtful design, find an appropriate place on our streets, where waste is turned into energy for the benefit of the community.

Four design scenarios have been developed which examine different types of treatment technology, scale and location, and develop an appropriate urban proposal for each. These range from a large scale, multi-borough facility on the fringe of the city, to a small scale, local facility on a restricted inner city site. All these scenarios form part of a coherent and integrated waste strategy for the city.

BOX p. David Grandorge

CONCEPT DESIGNS
OVERVIEW

London has a history of industrial buildings in the heart of the city sitting alongside residential and commercial buildings; gasometers, small-scale industrial premises and breweries, for instance, are to be found across the city, frequently cheek by jowl with houses, pubs and offices. Many were concentrated along train lines, canals and the river to make use of transportation by rail or water, an idea once again being actively encouraged through policy in the London Plan. One of the design scenarios in this report positions a waste treatment plant on the riverbank, taking advantage of the riverside location as did its prominent forerunners of Battersea, Bankside, and Lots Road power stations.

Industrial buildings within the city have provided a strong precedent of bold, often iconic buildings. So successful is their integration into the city that many are adapted to a broad range of new uses after the demise of their original purpose - for instance, the cultural venues at the Roundhouse, at Bankside and the Menier Chocolate Factory, offices in the Leathermarket and the Oxo Tower, and flats in the Bryant and May match factory and the Bermondsey wharf warehouses, to name but a few.

This report explores how the new buildings treating London's waste could be similarly bold and visible. Waste treatment buildings have rarely been designed by architects, or built in central urban locations. It is appropriate that these buildings should demonstrate design and construction excellence, and a contextual response to site, so that they are well integrated into the build-up of the city. Through their central urban location and their prominent designs, the buildings have the ability to raise awareness of the waste treatment process and can become a means of focusing communal responsibility. The concept designs in this report are envisaged as local landmarks, so that the buildings are understood not only as a destination for a neighbourhood's waste, but also as a positive addition to the urban environment.

The concept designs in this report are strategic rather than detailed, and demonstrate a broad design approach. They have been developed to explore different scenarios for possible treatment plants, and are hypothetical in terms of site, scale and design. The intention of the concept designs is to demonstrate ways in which waste treatment plants can be successfully adapted to suit different contexts. Each scenario proposes a scale of operation in a generic part of the city, and addresses the impact the building will have in terms of scale, traffic and associated benefits. Scenario Three illustrates how the plants can be camouflaged if necessary, and concealed within another development, which might be a suitable approach in areas with sensitive planning requirements.

The designs have been developed with a common language of form and construction, adaptable to each scenario. The designs share a modular construction which is readily adapted to different sites, orientations and scales. This form of construction suggests that the buildings are clad in a sheet material, punctured with large windows giving views into the building from outside, thereby presenting themselves back to the city. These windows invite passers-by to look in, revealing the mechanics of the process to the street, again as a way of raising awareness and an understanding of the process.

Cladding materials demonstrate an appropriately low embodied energy and/or be recycled, establishing an approach of re-appraisal and re-use which is appropriate to the project. Recovered materials might include recycled aluminium or stainless steel sheet or tiles. The buildings might be partly clad in steel mesh or glass to assist visibility and lend themselves to an interesting play of light, or be painted in reflective material to be visible at night. Copper cladding would provide interesting colour as well as having an extremely low embodied energy, and being readily available as a recycled material. The material choice is endless, and to be explored during the design development; the decision would be influenced by various factors including site context and cost.

Our proposals show green roofs on all the plants, encouraging biodiversity, capturing rainfall and forming a filter for odour and dust. In the more urban contexts, where the plants are inserted into densely populated situations, these green roof spaces provide a place for communal enjoyment and promote a sense of ownership. They form a visible reminder of London as a sustainable city, where a building which processes our rubbish also creates an urban garden.

The design scenarios investigate the impact these plants will have on local businesses. For instance, the big treatment park invites other associated development such as manufacturing based on recycled materials, closing the loop. The smaller inner city plants identified with a neighbourhood will encourage community awareness and activities, as developed in the East London Community Recycling Partnership case study.

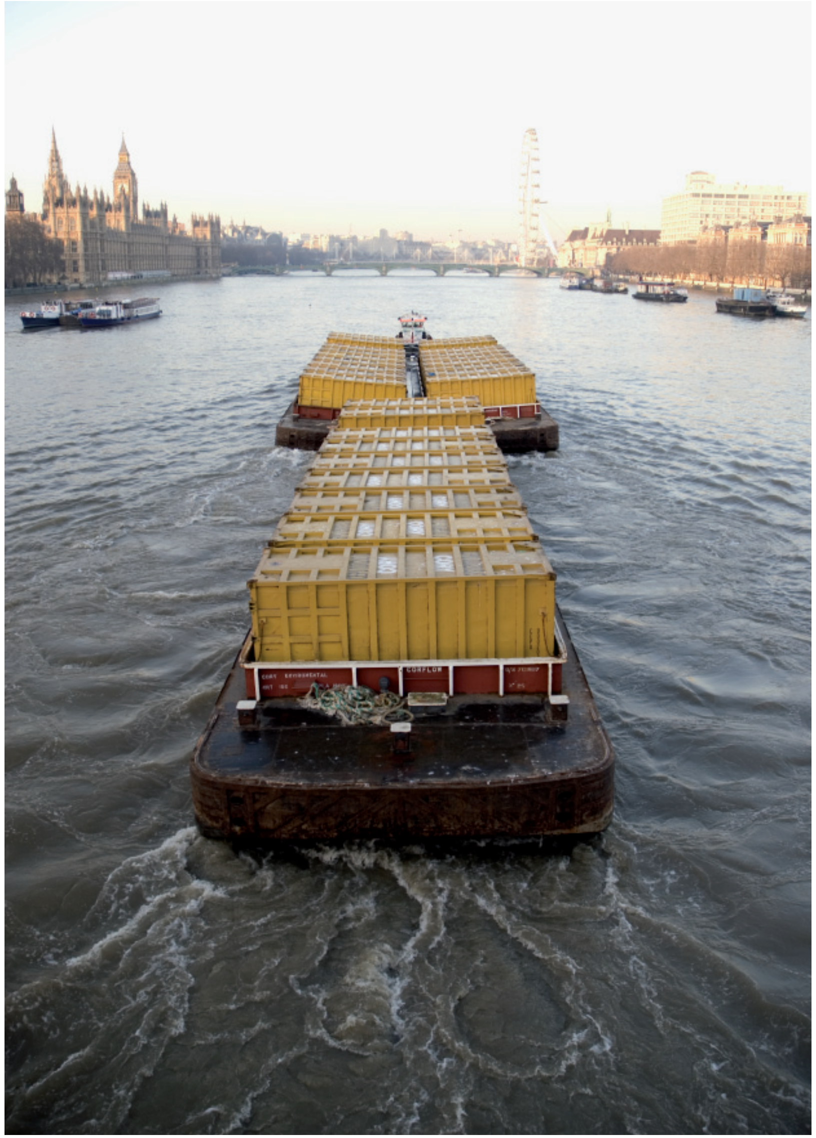
Engagement with the local community at all stages of the development life cycle is essential. Interesting design and implementation of new and emerging technologies should be used to encourage involvement of the local communities with waste issues. This can be development through an education and awareness centre at the facility and making the facilities visitor friendly by the inclusion of viewing galleries and guided tours etc.

Both anaerobic digestion and gasification have the capacity to generate heat and power. With investment in suitable heating networks and private wire electricity supply networks, these facilities can provide combined heat and power to neighbouring areas, whether residential, commercial or industrial. The potential already exists for large mixed use developments to incorporate an advanced waste treatment facility that would provide heat and power for itself. In this way, both technologies meet the requirements of the Renewables Obligation Order 2002, as well as complying with the development obligations of the London Plan to instigate decentralised energy.

The London Plan encourages the use of transportation by rail or by water, as part of the Blue Ribbon Network. Several waste transfer stations currently operate on the river, and ideally new waste treatment plants will be incorporated on sites like these, taking advantage of transportation by barge.

The proposals embody the principles of the London Plan Supplementary Planning Guidance on Sustainable Design and Construction by putting in place a sustainable approach to waste treatment, with the capacity for providing combined heat and power, on re-used and dense sites within the city. The detailed development and construction of the buildings should refer to Sustainable Design and Construction to maximise opportunities for energy efficiency.

The ambition of this report is to show that, through excellent design, waste treatment plants



Waste barge on the Thames. p. A Jones

can become a positive element of our city on a local as well as on a general scale.

BUILDING ENVIRONMENT
Looking at the city as a whole, the benefits of sustainable living are irrefutable. However, not all of London's citizens might welcome the idea of living next door to a waste treatment plant. Common preconceptions might suggest that the plants could be noisy, smelly, busy, or give off unpleasant emissions.

There are key challenges associated with all of the scenarios that must be planned and designed for appropriately. Both AD and ATT are new and emerging technologies, and particular attention will be required during the detailed design stage to ensure the plants achieve good performance on all aspects. There are a range of measures that can be implemented to control the environment in and around waste treatment plants. These range from building solutions - such as close fitting doors and high levels of acoustic insulation – to good operational management in maintaining a clean and well-organised plant.

The potential environmental effects and the control measures applied to them are identified as follows:

Odour is generally associated with the storage and movement of waste and materials within the waste management facility, and can be controlled using a combination of the following measures:
• Limiting the quantity of waste stored at any one time;
• Providing sealed doors to prevent the release of odours from the building;
• Maintaining negative air pressure inside the building;
• Cleaning and washing down areas that give rise to offensive odours, as necessary; and
• Providing a mechanical ventilation

system designed to extract air from the building and passing it through air filters (eg bio-filters or carbon filters) and/or wet scrubbers to remove any odour prior to discharge to the ambient air. Provided such control measures are implemented, odour can be managed and is likely to have no or little adverse effect on the surrounding environment.

Noise and vibration in and around waste treatment plants are likely to be generated from delivery vehicles, maintenance and cleaning activities (for instance, alarm testing), and the running of waste processing equipment and energy-converting equipment, such as gas engines. Noise and vibration can be mitigated using the following measures:

- Enclosing noisy areas and activities inside buildings;
- Insulating the building to achieve the required sound proofing assessed against any sensitive receptors;
- Reducing drop heights during loading and unloading of waste and recyclables;
- Avoiding speed humps on haul roads, and maintaining roads in good condition to minimise excessive 'rattle noise';
- Designing site layouts to minimise vehicles reversing on-site, reducing reversing alarm noise, and/or using quieter alternatives such as broadband alarms, on-vehicle video, or on-site supervisory staff;
- Installing fast closing and quietened roller shutter doors to contain noise;
- Keeping doors shut during operational hours except for vehicles entering and leaving the building;
- Carefully locating ventilation, air conditioning and cleaning equipment to avoid excessive noise propagation;
- Adequately maintaining any parts of the waste processing equipment to avoid excessive noise generation; and
- Where possible, using energy conversion technologies that do not generate noise, such as fuel cells.

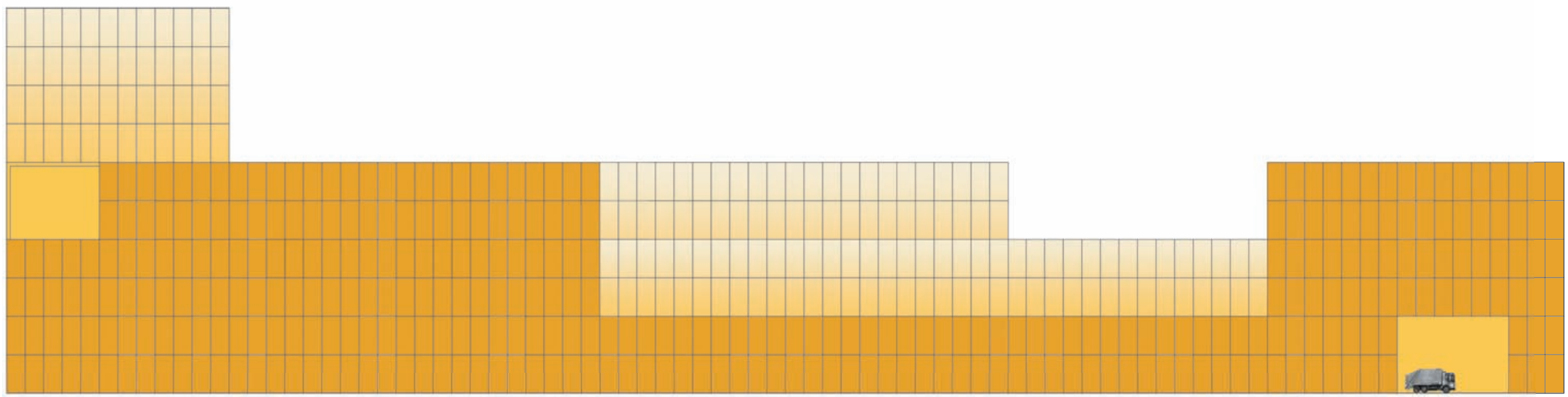

LEATHER LANE. p. D. Grandorge

Noise targets would be specified based on the existing noise climate, ensuring that the proposed development would not have an unacceptable impact on the surrounding area. A method for determining the likelihood of complaint from a new industrial development is provided in BS 4142:1997 Rating industrial noise affecting mixed residential and industrial areas (British Standards Institution, 1997). Although the title of the Standard implies a limited application to industrial situations only, the assessment methods it recommends are often used to assess noise from building services plants from commercial premises. The Standard specifies a survey method to measure 'the specific noise level' (the introduced noise) against ‘the background noise level’ (the noise existing in the absence of the specific noise level at the receiver location) to identify if the specific noise has a distinctive character, i.e. tonality or impulsivity. This is then analysed to assess the likelihood of complaints.

Air emissions such as carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbons, nitrous oxides (NO_x), particulate matter and bio-aerosols are generated from waste management operations associated with vehicles deliveries, thermal treatment of waste, conversion of energy such as biogas/syngas into electricity (eg using a gas engine) and air cleaning equipment. Air emissions from waste treatment technologies are regulated under different legislative and regulatory requirements. For example, advanced thermal treatment technologies are regulated by strict emission control standards set out in the Waste Incineration Directive. More detailed information relating to emission controls is given in the Technology Analysis section.

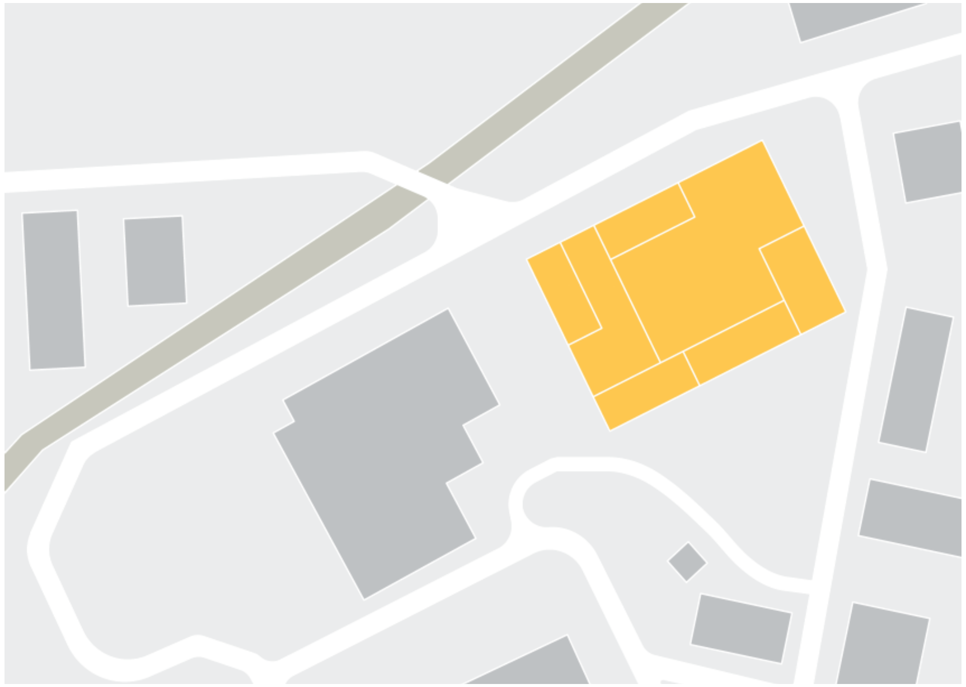
Dust in and around the site is caused mainly by vehicles using roadways and the unloading and transferring of waste and recyclables.
This can be minimised in the following way:
• Ensuring vehicles transporting waste and recyclables to and from the site are sheeted or are containerised;
• Unloading and loading of waste and recyclables inside buildings with closed doors;
• Providing a water misting system inside the waste processing building to suppress dust generation;
• Installing air curtains at the roller shutter doors to prevent the escape of dust from the building while opening and closing doors;
• Minimising the drop height of waste when loading and unloading waste materials and recyclables;
• Ensuring that roads are dampened down during prolonged dry periods;
• Providing wash pads or power spray to vehicles before leaving the site;
• Cleaning the roads regularly, and removing mud and debris using road sweepers;
• Conditioning wastes that are more likely to generate dust with water before internal transfer; and
• Restricting the speed of vehicles moving around the site to avoid excessive air turbulence and the raising of dust.
Provided that a combination of these dust control measures are incorporated in the design of a waste management facility, fugitive dust emissions are controllable and low.

Litter is likely to arise from wastes that are not stored adequately on site, and from the delivery of waste and recyclables to and from the site. Litter will reduce the cleanliness of the site, generating odour and attracting pests and can result in detriment to the local amenity. This can be avoided through good management and environmental control measures such as:
• Ensuring that vehicles are covered by sheets or held in containers to reduce the risk of waste being blown onto the site as litter;
• Unloading waste inside buildings with closed doors;
• Ensuring that all wastes are stored and processed internally, to reduce the amount of litter being blown around the site;
• Providing litter bins on site for workers;
• Regularly sweeping areas inside buildings and external areas; and
• Inspecting the site daily and picking up litter.
Provided that such control measures are implemented, litter can be controlled, and will have little impact on the local amenity. This will also reduce the risk of problems associated with pests.



CONCEPT DESIGNS

1. INTEGRATED RESOURCE RECOVERY PARK ON THE URBAN FRINGE



DATA	
TOTAL WASTE THROUGHPUT:	150,000tpa
RECYCLING:	40,000tpa
GASIFICATION:	80,000tpa
ANAEROBIC DIGESTION:	30,000tpa
SITE AREA:	4.05ha
BUILDING FOOTPRINT:	3.15ha
8t RCVS PER DAY:	73
20t LORRIES PER DAY:	14
HEAT OUTPUT PER YEAR:	165,400 MWh/annum
ELECTRICITY OUTPUT PER YEAR:	66,000 MWh/annum

SCENARIO

This proposal develops a site of 40,500m^2 (4.05ha) in outer London to create an integrated resource park, bringing together all strands of the waste stream on one site. The facility will combine a central reception and sorting area with recycling, gasification and anaerobic digestion. This proposal offers the most efficient way of dealing with the waste stream by eliminating transportation between sites and providing the maximum opportunity for resource recovery.

This scenario proposes that a plant of this scale would be able to deal with the municipal waste from a number of London boroughs. Waste would arrive at the facility in refuse collection vehicles (RCVs) directly

Concept design 1 in a London fringe industrial area from collection, and be sorted and processed within the facility.

CONTEXT

This proposal is situated on the fringes of London, where the availability of land and its relationship with transportation makes this scale of operation viable. The typology of this site is that of the industrial and retail park, familiar to the outer London boroughs. These areas are well served by the existing road network, and the potential exists for rail transport to be used to bring waste to the site and transport materials off-site.

SITE

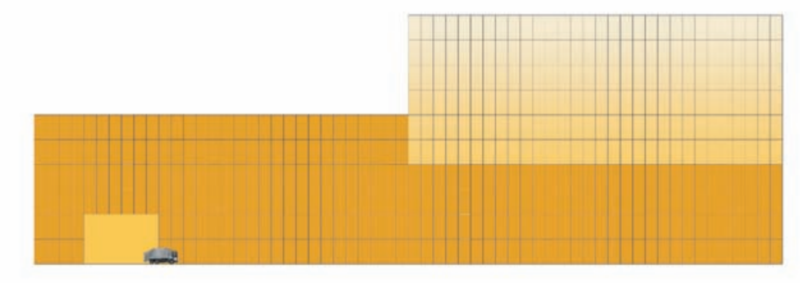
The plant is located alongside business and general industrial buildings and 'out-of-town' retail facilities. The scale of the surrounding buildings make this an appropriate location for the facility that this scenario proposes.

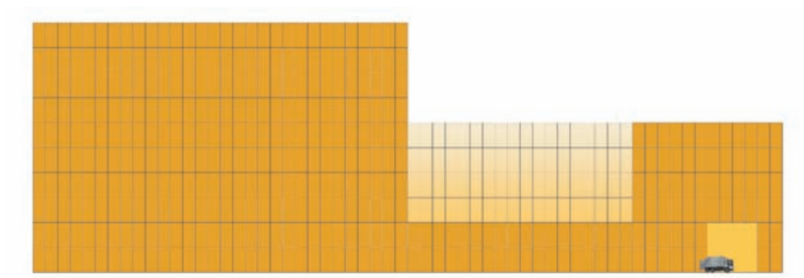
AMOUNT

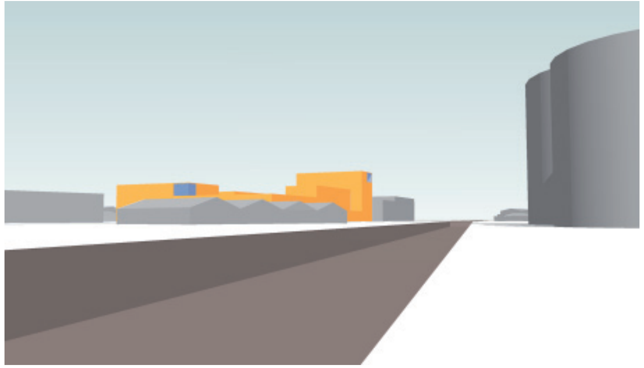
The site receives 150,000tpa (tonnes per annum) of waste, from the equivalent of 130,400 homes. This is sorted and broken down into 30,000tpa of wet food and green waste which is sent to the anaerobic digestion plant, and 40,000tpa of dry material which is processed to remove recyclables for the materials recycling facility (MRF); the remaining 80,000tpa of non-recyclable waste is sent to the gasification plant.

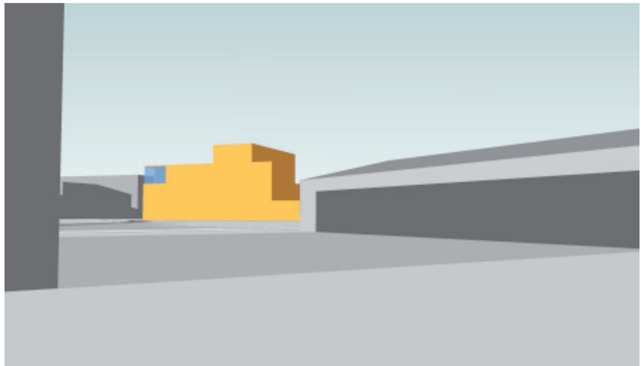
LAYOUT

The 31,500m^2 (3.15ha) facility is organised around a central









reception and sorting area. From here, waste is directed to the different treatment plants located around the perimeter.

The recycling plant is 30m tall. The anaerobic digestion plant ranges between 10m and 30m tall, containing the enclosed composting vessels where waste is broken down over a three week period. The plant produces a compost-like material which is sold. The biogas produced is converted into heat and electricity, and a small flue from the generator and a gas flare from the gas store are run to the roof level to a height of 1-5m.

The gasification plant is located in a 10m high block and a 50m high tower. The gasification process equipment has been stacked vertically to reduce the footprint but also so that the flue can be concealed within the overall volume of the building. This enables the building to avoid having a visible flue and thus overcomes the negative connotations of large flues.

APPEARANCE
The building takes its formal expression from an idea about breaking up the mass of the building into distinct zones which are dealing with the different parts of the waste stream. This strategy avoids the building becoming a monotonous block and creates a more interesting addition to the visual landscape of the area.

As the photomontages illustrate, the faceted volumetric approach to the design of the building catches light and accentuates its form whilst also appearing to reduce the overall volume of the building.

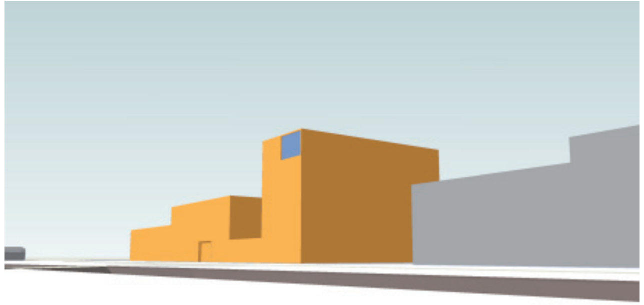
The building is illustrated as a steel frame clad in standing seam copper sheet. Copper has one of the lowest embodied energy of all cladding materials. The building will have a green roof that will provide additional environmental benefits.

TRANSPORT
Waste is transported to the site in RCVs, at a rate of 73 per day. The recycled materials, the ash and char produced by the gasification process, and the compost produced by the anaerobic digestion plant will be transported out of the site in 20-tonne lorries at the rate of 14 per day.

BENEFITS
The gasification and anaerobic digestion plant produce energy which provides enough electricity for the equivalent of 18,800 homes, and enough heat for the equivalent of 8,100 homes.

This heat can be supplied to local businesses directly or to residential developments through appropriate heat networks.

All of the by-products produced on site - the recycled materials, ash and char, and the compost-like material- can be supplied to local businesses for sale or



remanufacture, forming a closed loop industrial cycle, minimising transportation and encouraging local business development.

Indeed, the careful siting of these plants with due regard to road, rail and water transportation links would encourage the formation of symbiotic industry around the plant. The availability of heat would be an attractive proposition for industrial co-location.

CHALLENGES
The key challenge associated with this scenario relates to high landtake, required to combine complimentary waste processes and treatment technologies.

While the largest nuisance is likely to arise from the transportation of RCVs and articulated lorries transporting material to and from the site, overall this integrated resource recovery plant reduces transport by cutting out journeys between waste facilities which currently occur.

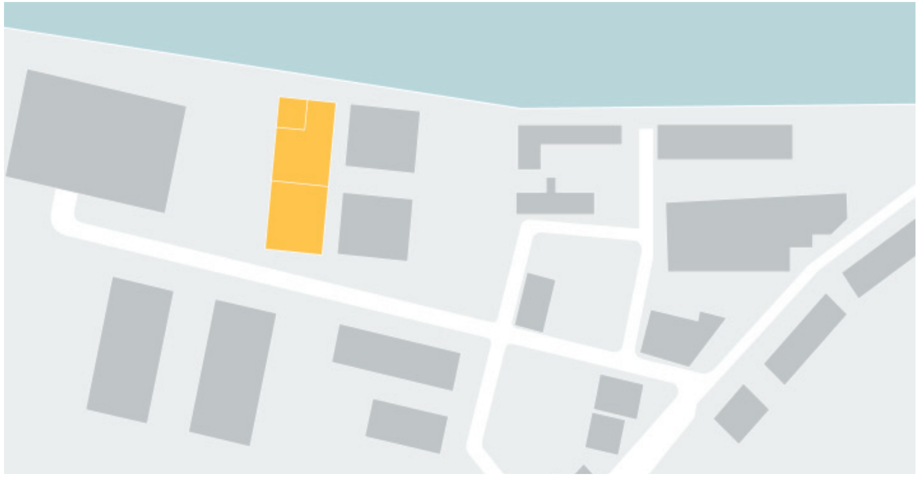
The careful siting of these plants with due regard to road, rail and water transportation links, and existing industrial and commercial users, provides the opportunity to develop industrial symbiosis links.

Thoughtful design will mitigate against its size and scale, resulting in a positive addition to the urban landscape.

Concept design 1 in a London fringe retail park

CONCEPT DESIGNS

2. GASIFICATION PLANT ON AN INDUSTRIAL RIVERSIDE SITE



DATA	
TOTAL WASTE THROUGHPUT:	80,000tpa
RECYCLING:	30,000tpa
GASIFICATION:	50,000tpa
ANAEROBIC DIGESTION:	0tpa
SITE AREA:	2.35ha
BUILDING FOOTPRINT:	0.4ha
8t RCVS PER DAY:	39
150t BARGES PER DAY:	1
HEAT OUTPUT PER YEAR:	80,000 MWh/annum
ELECTRICITY OUTPUT PER YEAR:	35,000 MWh/annum

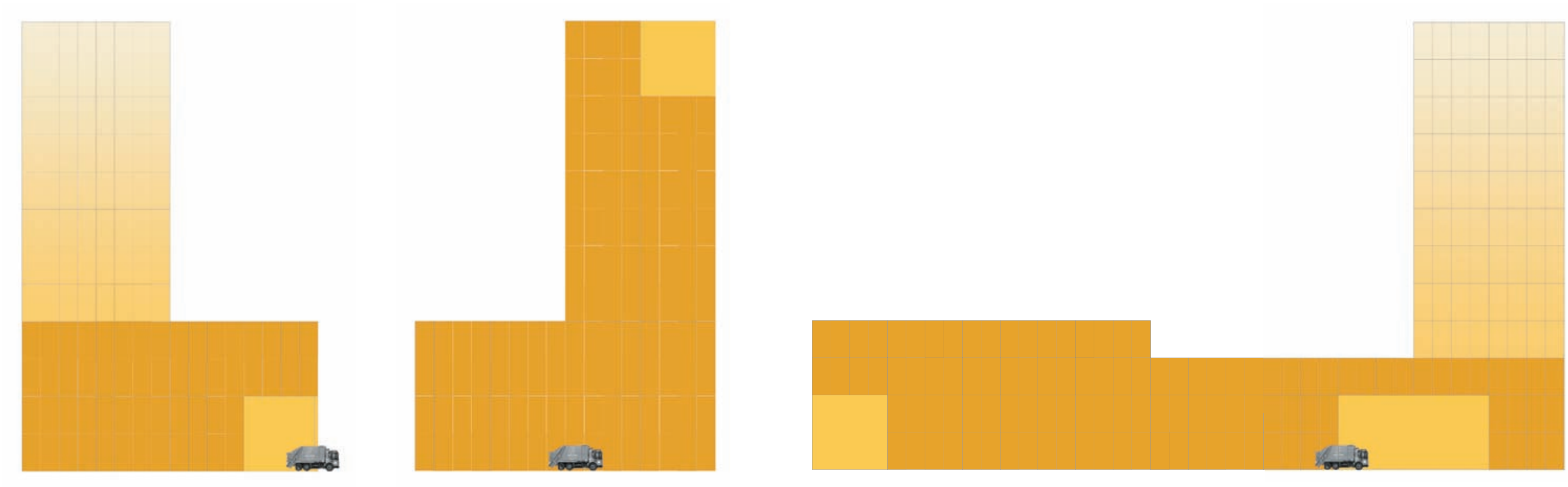
SCENARIO

This proposal is located on a hypothetical site on the banks of the Thames. It takes the idea of river transport as central to the scenario, and develops the established use of the river for the transport of waste.

This scenario takes on board the fact that there are a number of existing waste transfer stations along the river. However, unlike the current situation, this proposal makes the sites along the river a destination for waste as opposed to a staging post for landfill.

Our proposal combines a gasification/pyrolysis plant with a sorting facility. This broadens the waste stream coming into the site, and implements on-site treatment. It is envisaged that waste will arrive at this facility by refuse collection vehicles (RCVs) and by river barge, and is sorted on site with the appropriate waste stream being sent through the gasification/pyrolysis plant, with the remainder being sent for recycling.

Concept design 2 on the Thames



CONTEXT
This notional site is typical of much of the post-industrial river; it has an established historical association with industry located on the river and used as its primary transportation link. The development of road transport and the change in nature of industry in England led to the decline of riverside industry, resulting in the availability of large tracts of land in the heart of the city.

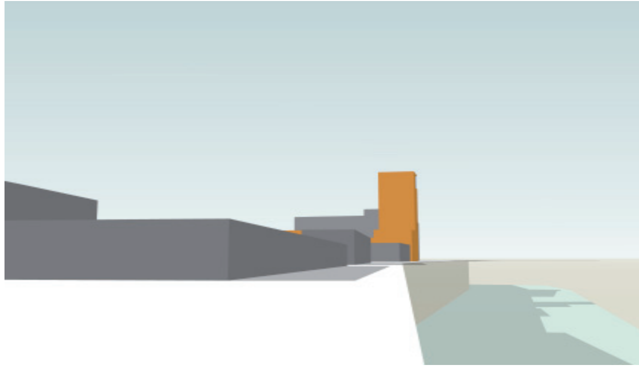
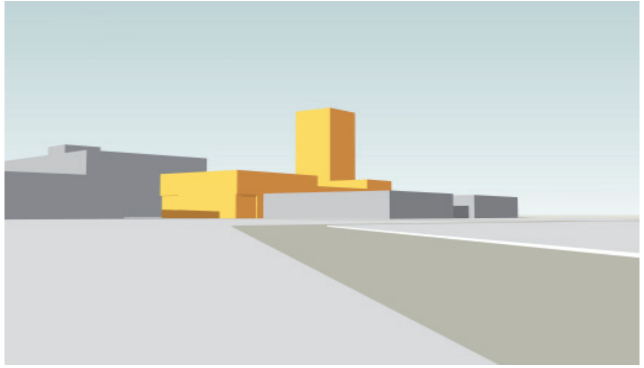
There has been a recent growth of riverside development in London, which has seen the residential development of the riverside. However, there remain large areas of undeveloped riverside and residual disused industrial sites. This proposal is located on such a brownfield site, adjacent to existing industry and new residential development.

SITE
The buildings that surround this site are typically a mix of business and general industrial buildings, a number of large retail buildings and a new residential development.

AMOUNT
The 80,000tpa plant receives municipal waste from the equivalent of 69,500 homes. This will be sorted on site into 30,000tpa for recycling, and 50,000tpa of solid recovered fuel for gasification. The ash and char produced as a by-product of gasification will be transported by barge along the river, together with the recovered recycled materials heading for re-manufacture.

LAYOUT
The gasification plant has a footprint of 4,000m^2 (0.4ha), and is organised with a central block where waste is received. The gasification process equipment is organised in the two storey block alongside and in the 60m high tower against the river edge. The tower also contains a flue for gases which will have been filtered and cleaned.

APPEARANCE
This design for this plant needs to be of a very high quality, appropriate to its prominent riverside site. The tower takes its


place comfortably alongside the industrial and residential buildings of a similar scale, and becomes a local landmark along the river frontage. The gasification/pyrolysis equipment is stacked vertically in order that the plant occupies a smaller footprint, and also so that the flue can be contained within the overall form of the building.

This facility has the capacity to form a contemporary icon for the Thames in the way that Bankside, Battersea and Lots Road power stations have done historically. The relationship between the building and its role within the life of the city is similarly explicit, and serves as a powerful reminder of the responsibility we have for our waste and the city.

The building is illustrated as a steel frame clad in mill-finished stainless steel panels. Stainless steel is manufactured from recycled steel and has an extremely long, maintenance-free life, making it a sustainable as a long-term material choice. The building can have a green roof to further enhance its environmental benefit.

TRANSPORT

Municipal waste is delivered each day by road 8-tonne RCVs, at a rate of 39 per day. The recovered materials from the recycling and the ash or char by-product from the gasification plant are transported by river, at a rate of one 150tonne barge everyday. Transport movements within the city are reduced by processing waste on site. Similarly waste could be transported to this facility by river for processing.

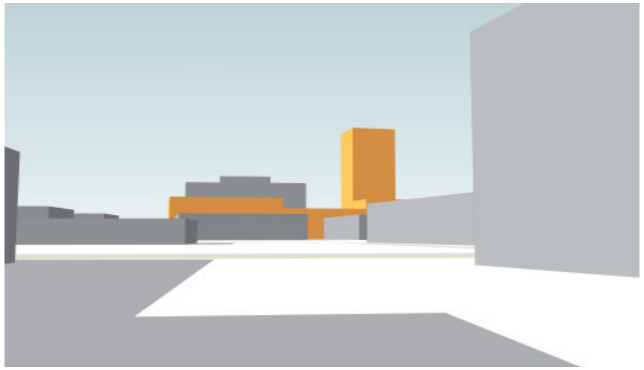
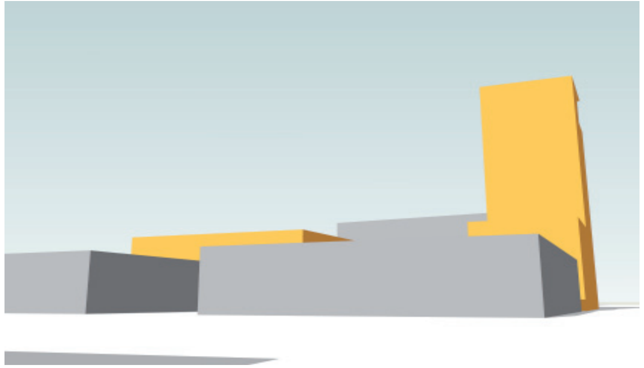
BENEFITS

This 50,000tpa gasification/ pyrolysis plant generates enough power to provide electricity to the equivalent of 10,600 homes, and enough heat for the equivalent of 3,900 homes. The plant is situated ideally to provide this either to local industry or to large-scale residential developments which are attracted to the riverside urban character of the site.

The neighbouring business and general industrial buildings provide a development opportunity for businesses using recycled materials for re-forming and re-manufacture, with a ready supply of raw materials on their doorstep.

CHALLENGES

A particular challenge addressing this riverside site is the possible risk of flooding. Development must take into account the suitablitity of land for development in a flood risk area, and a flood assessment risk must be carried out at the building planning stage. Waste treatment facilities are categorised as less vulnerable land uses, as defined by Planning Policy Statement 25 (PPS25). PPS25 identifies that the owner/developer has the primary responsibility for safeguarding land against flooding; they will be responsible for demonstrating that the proposal is consistent with PPS25 and

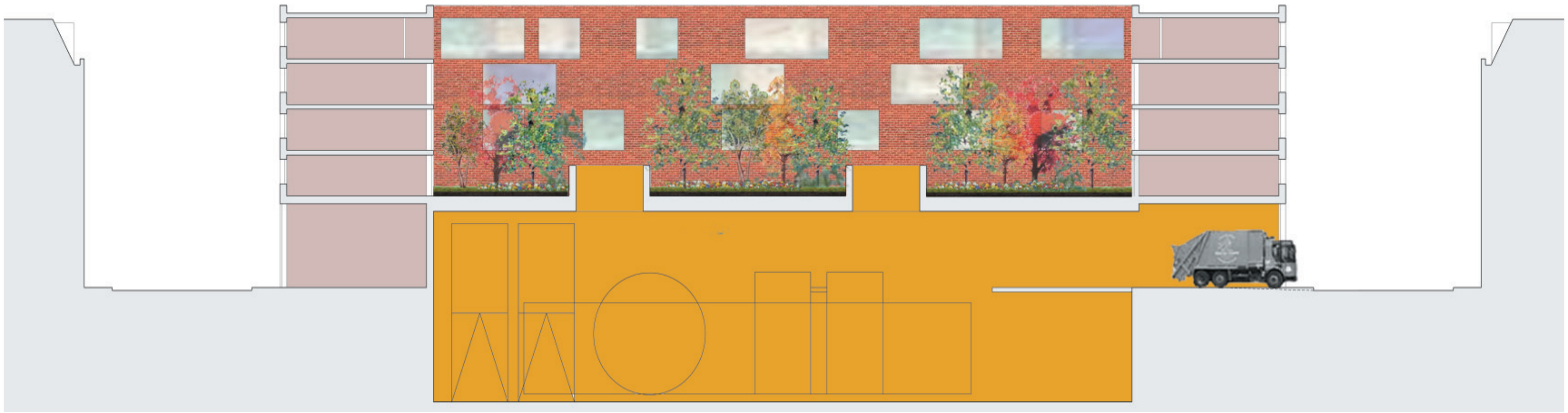




those developed by local planning authorities, such as the London Plan. They will need to provide a risk assessment for the project, and incorporate into the design flood resilience measures and alternative drainage systems, as well as to identify opportunities to reduce flood risk, enhancing biodiversity and protecting the historic environment, seeking collective solutions to managing flood risk. The London Plan identifies that a precautionary approach should be taken to flood risk, and that the design must meet high standards of sustainable design and construction. As a precautionary measure, all sensitive equipment should be installed above flood risk levels, and temporary barriers protecting the site during high risk periods must be provided.

The key challenges associated with the scenario are associated with managing the potential nuisances, such as odour, noise and dust. Such effects can be mitigated by implementing best available techniques, described in the Concept Designs Overview.

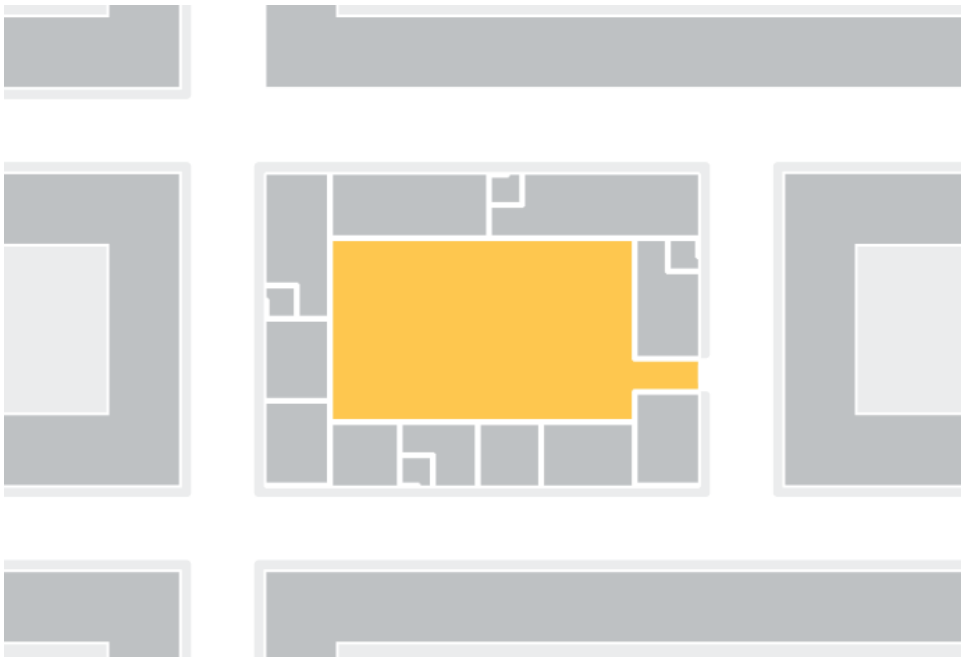
The visual intrusion of the building within the surrounding urban environment has been mitigated by incorporating the flue system into a visually iconic design, allowing it to be co-located with commercial and residential buildings. All emissions from the flue will be required to meet strict emission limits as required under the Waste Incineration Directive (WID).


Battersea power station: city industry on the river. p. A Jones



CONCEPT DESIGNS

3. ANAEROBIC DIGESTION PLANT ON A DENSE INNER CITY SITE



DATA	
TOTAL WASTE THROUGHPUT:	10,000tpa
RECYCLING:	0tpa
GASIFICATION:	0tpa
ANAEROBIC DIGESTION:	10,000tpa
SITE AREA:	0.15ha
BUILDING FOOTPRINT:	0.15ha
8t RCVS PER DAY:	5
20t LORRIES PER DAY:	1
HEAT OUTPUT PER YEAR:	1,800 MWh/annum
ELECTRICITY OUTPUT PER YEAR:	2,000 MWh/annum

SCENARIO

This proposal is for a small decentralised anaerobic digestion plant on an inner-city site, forming part of a new development of commercial and residential units. The anaerobic digestion plant is at ground and basement level in the centre of the site, located below an urban garden accessed by the residential development at first floor level. The ground floor of the development that surrounds the AD plant contains retail and commercial units.

Biodegradable waste will arrive at this facility in refuse collection vehicles (RCVs) having been pre-sorted at a remote station or seperately collected through food waste collection schemes.

Concept design 3 in a West-end urban block

Concept design 3 seen through the urban block

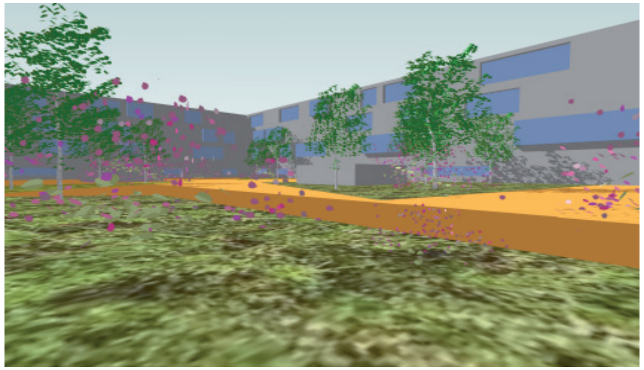
CONTEXT
The small scale of this proposal makes it suitable for inclusion in inner-city developments providing commercial and residential accommodation.

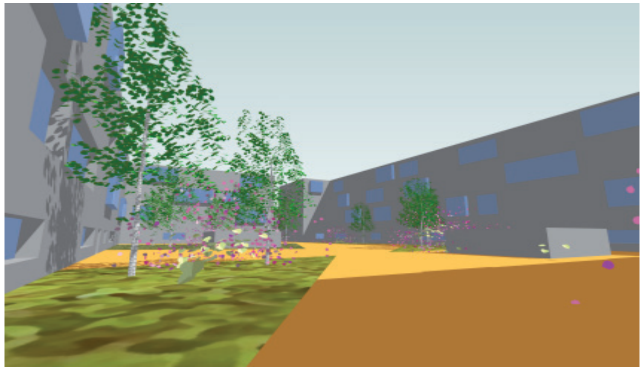
It could similarly be fitted into sites with limited access and street frontage as a stand-alone building.

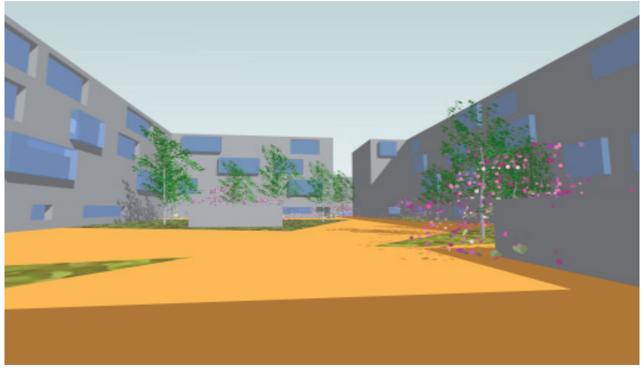
This proposal shows an anaerobic digestion plant built at ground and basement level at the core of a larger development. Around its perimeter is wrapped a building with commercial units at street level and four floors of residential units above. The height of the new building is determined by the scale of the surrounding streets.

This proposal demonstrates that it is possible to conceal a plant within a development, an approach which has advantages in areas where planning and contextual issues are more sensitive. The plant is visible on the street only through double shutter doors, and, with a modest transport flow, has a low impact on the street.

SITE
The anaerobic digestion plant has a 1,500m^2 (0.15ha) footprint and is partially sunk below ground level, at 12.5m high. The design shows a development site footprint of 3,744m^2. This provides 2,244m^2 on the ground floor for commercial units, and four storeys of 2,244m^2 for residential units above. The communal garden at first floor







level, on the roof of the anaerobic digestion plant, is 1,500m^2.

AMOUNT
The anaerobic digestion plant has a throughput of 10,000 tonnes of biodegradable waste annually, from the equivalent of 29,000 homes. The plant produces a compost-like material sold to the agricultural and horticultural market.

LAYOUT
The plant consists of a reception area where bio-degradable waste is sorted and then fed to the enclosed composting vessels. Here, the waste breaks down over a three week period, producing the compost-like material.

The biogas emitted is converted into heat and power; a small flue from the generator and a gas flare from the gas store are run to the roof level to a height of 1-5m above the roof line, depending on surrounding building heights.

APPEARANCE
This proposal has been designed to be invisible. Being located within the heart of an urban block, the only outward visual appearance will be the doors to the loading bay.

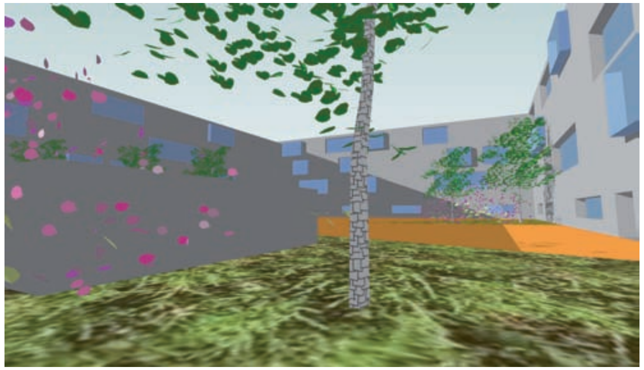
TRANSPORT
Transport in and out of the site is by road, carried in eight-tonne trucks. Five RCVs of biodegradable waste are delivered daily, and the compost produced in the plant is carried away in one truckload per day. This level of transport activity is very low and would not be recognisable over and above the traffic associated with the context of the proposal.

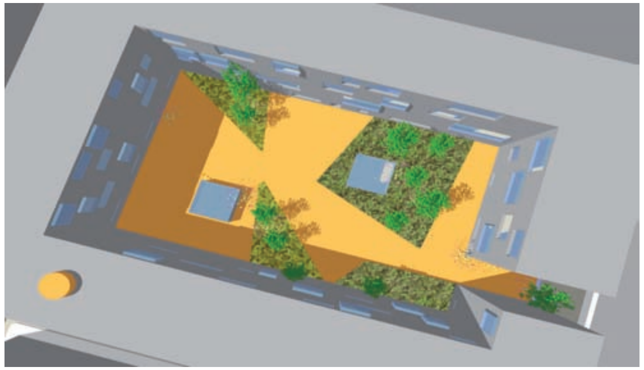
BENEFITS
The plant is ideally located to provide heat and electricity to the residential and commercial units on the same site. This 10,000tpa plant will yield enough power to provide electricity to the equivalent of 600 homes, and heat to the equivalent of 90 homes.

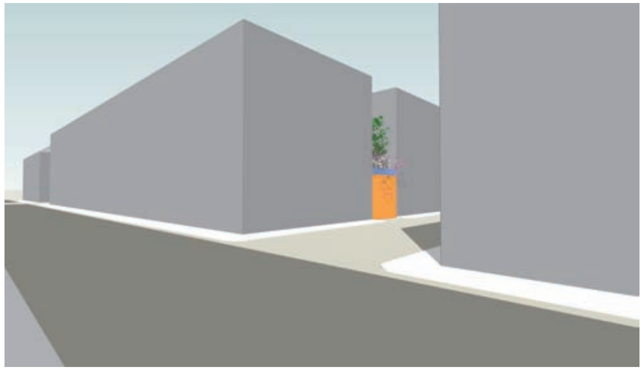
The green roof of the plant provides a garden for the residents, which is fertilised with the composting material produced in the plant below. The garden is the basis for building a community within the development.

CHALLENGES
The key challenges associated with the scenario are related to the proximity of the plant to residential and commercial buildings. The AD plant will have to facilitate the storage of biogas on site and a gas flaring system (see Technology Analysis), and must closely manage any potential hazards this may raise through planning and discussion with the Health and Safety Executive (HSE). This situation is comparable to inner-city buildings which have their own generators with fuel stores.

As the proposed scenario is located within 250m of commercial

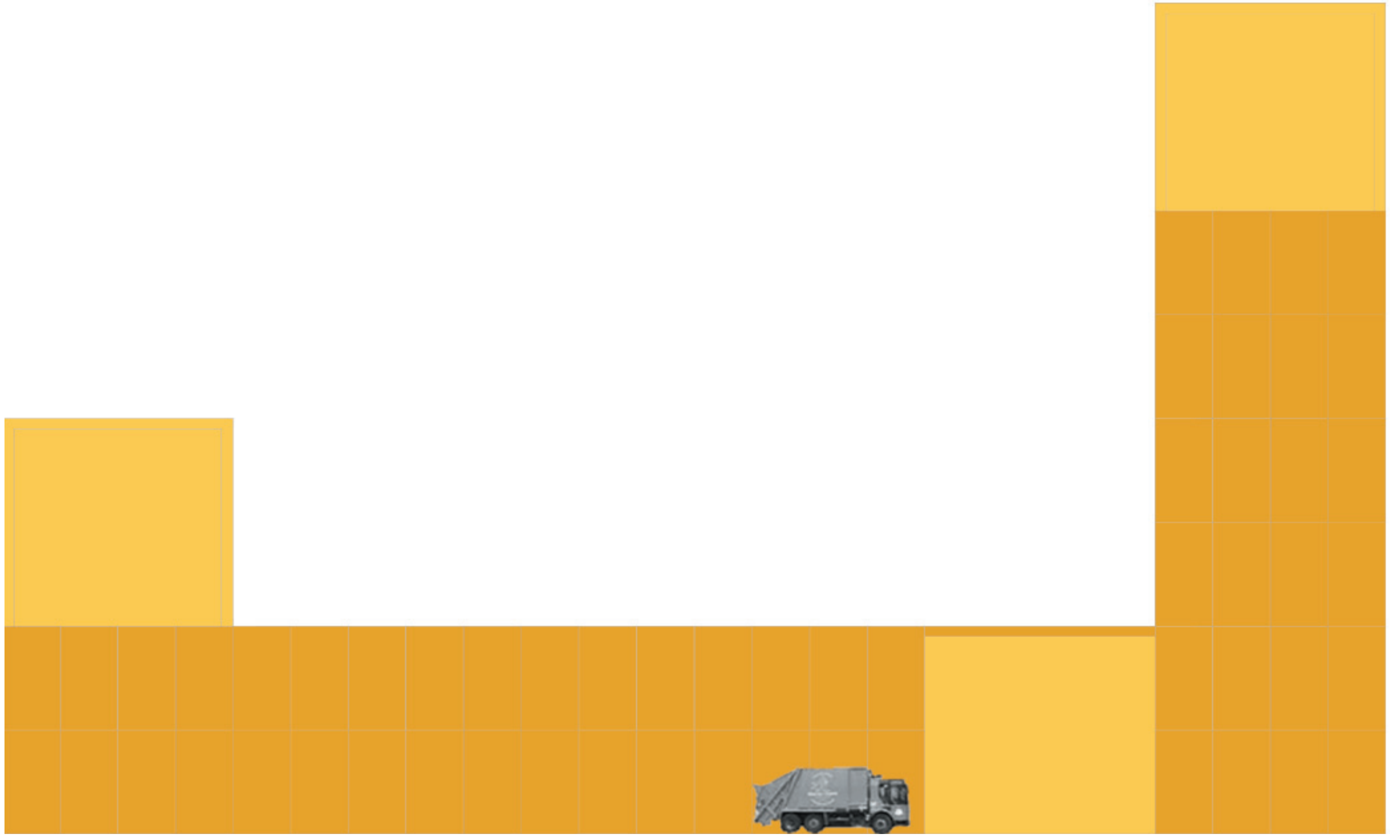






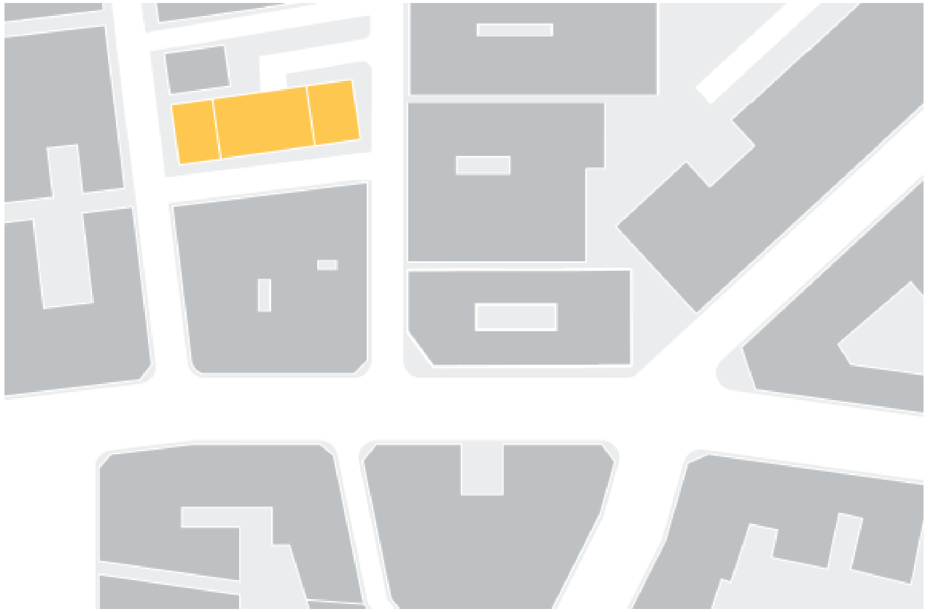
and residential buildings, an environmental risk assessment will also have to be undertaken as part of the detailed design process, to show that the AD plant poses no significant threat to human health or the environment. Perceived nuisances such as odour, noise and dust will be mitigated by implementing best available techniques as summarised previously.

Concept design 3 inner courtyard garden



CONCEPT DESIGNS

4. GASIFICATION PLANT ON A DENSE INNER CITY SITE



DATA

TOTAL WASTE THROUGHPUT:	40,000tpa
RECYCLING:	0tpa
GASIFICATION:	40,000tpa
ANAEROBIC DIGESTION:	0tpa
SITE AREA:	0.32ha
BUILDING FOOTPRINT:	0.12ha
8t RCVS PER DAY:	20
20t LORRIES PER DAY::	2
HEAT OUTPUT PER YEAR:	80,000 MWh/annum
ELECTRICITY OUTPUT PER YEAR:	28,000 MWh/annum

SCENARIO

This proposal is for a small scale gasification plant on a dense urban site. The building is prominently located within the city and consists of a small tower, bringing waste treatment to visibility.

Waste is delivered by road to the site from a remote waste transfer station where it has been sorted.

CONTEXT

The plant finds its place within the range of building types found in the hub of the city, and adds to the rich mix of contemporary London. It advertises itself as a small tower which sits comfortably within the horizon of the typical central London skyline and takes on the character of a local landmark. The small scale of the facility and its prominent location suggests

Concept design 4 on a London side street that the form and cladding of the building need close consideration.

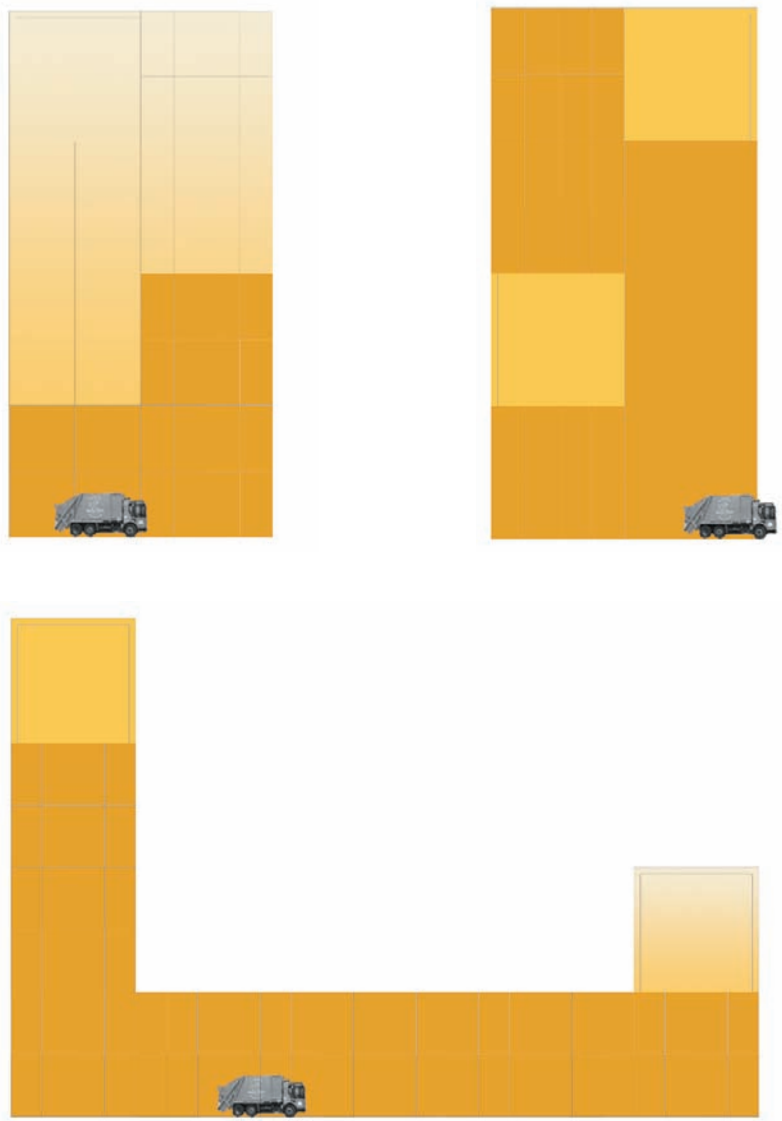
SITE
This is a stand-alone building on a fairly busy street, where the transport in and out of the site by RCVs will not be out of place. The building has a small-scale industrial nature which sits easily amongst the range of buildings found in the middle of the city, where residential, commercial and industrial buildings of a range of scales sit side by side.

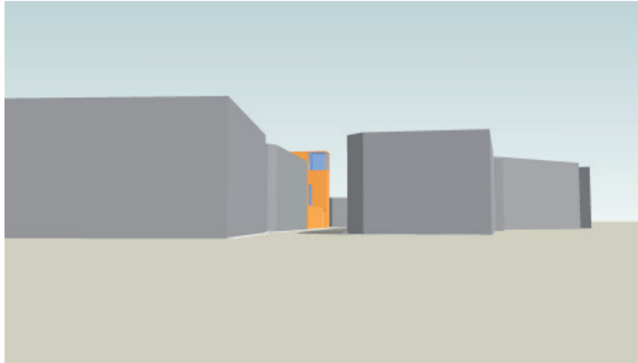
AMOUNT
The plant receives 40,000 tonnes per annum of municipal waste, from the equivalent of 35,000 homes. This will have been sorted in a waste transfer station and delivered by truck as fuel to the gasification plant.

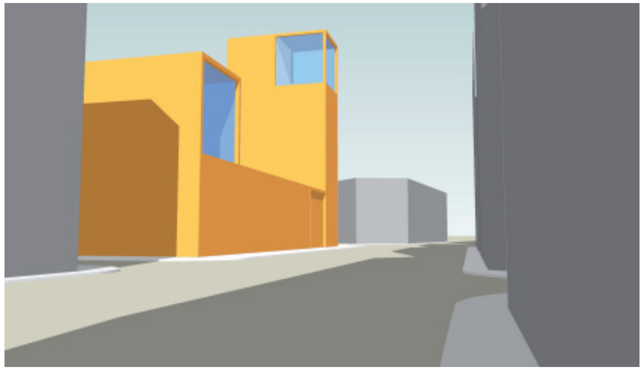
LAYOUT
The building has a footprint of 1,200m^2 (0.12ha). It is organised with a 10m high central block where waste deliveries are made, and where waste can be stored for up to two days. The plant is stacked in two taller blocks, a lower one 20m high, and a small tower 40m high. The lower block contains the craneage and reception facilities for the waste, with the administrative office accommodation above. The tower contains the process equipment, stacked vertically, and the flue, for gases which will have been filtered and cleaned.

By extruding the form of the building vertically, the flue is concealed within the overall volume of the building which removes any negative visual association of seeing a flue in the city.

APPEARANCE
The design quality of this plant is of the highest standard, ensuring its successful integration into the city centre. It shows off its contents with large glazed panels to reveal the process to passers-by. The







tower-like form of the buiding is deliberately prominent and it is intended to form a city landmark.

The iconic nature of this plant is envisaged to engender ideas of re-branding waste treatment in the city; it is a clear statement of intent to take waste treatment seriously and makes clear that the places where this takes place can be interesting.

The building is illustrated as a steel frame clad in cor-ten steel. This is a pre-oxidised sheet that is made from recycled steel and treated so that it rusts to a predetermined depth and forms a permanent protective layer to the steel below. It is maintenance-free and has a long life, making it a sustainable long-term material choice.
Being located on a main street, the building is glazed at low level to admit views of the process. The tower is articulated with upper level windows to light the processing areas of the building. These also provide articulation of the form within the city, and suggest resonances with former industrial urban archetypes.

TRANSPORT
All transport to and from the site is by 8-tonne truck, with 20 truck-loads per day of waste arriving to the plant, and 4 truck-loads of char and ash carried away daily. There is therefore a total mass reduction of 80%.

This level of transport movement within the confines of the city centre is not uncommon and should not present a nuisance to the neighbouring occupiers.

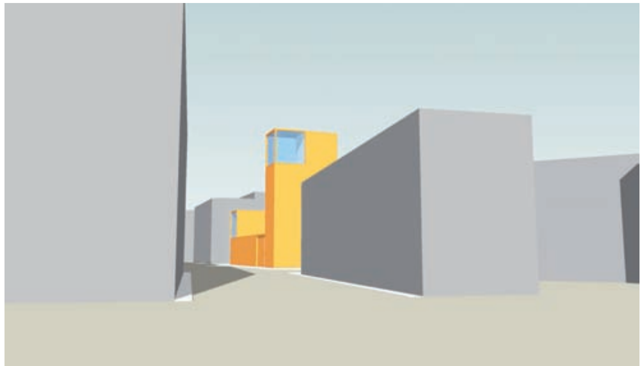
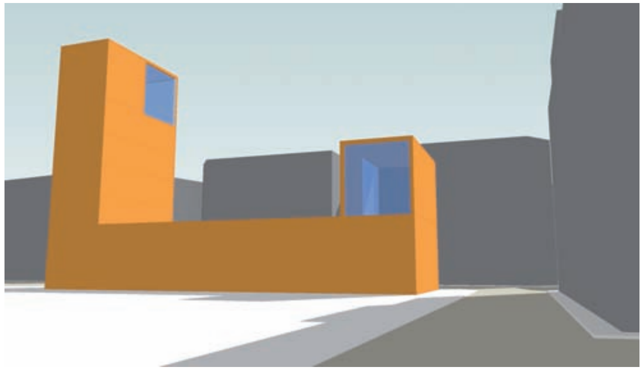
BENEFITS
This 40,000tpa plant provides electricity for the equivalent of 8,500 homes, and heat for the equivalent of 3,900 homes, which can be passed on to local users, whether residential, commercial or industrial, through appropriate networks.

The central London location of this proposal suggests that the heat produced by the plant could be used locally by office developments for either heating or, with heat exchangers, for cooling. This supports the co-location of this facility either in the heart of the city or in new commercial developments.

CHALLENGES
The key challenges associated with the scenario are associated with managing the potential nuisances, such as odour, noise and dust. Such effects can be mitigated by implementing best available techniques, as previously discussed.

A further challenge associated with this scenario is the potential visual intrusion of the building within the surrounding urban environment. This has been mitigated by designing the flue system as an iconic design. All emissions from the flue will be regulated under the WID.

The current negative perception of developing a decentralised plant should be overcome by celebrating its contribution to policies such as the proximity principle. Through

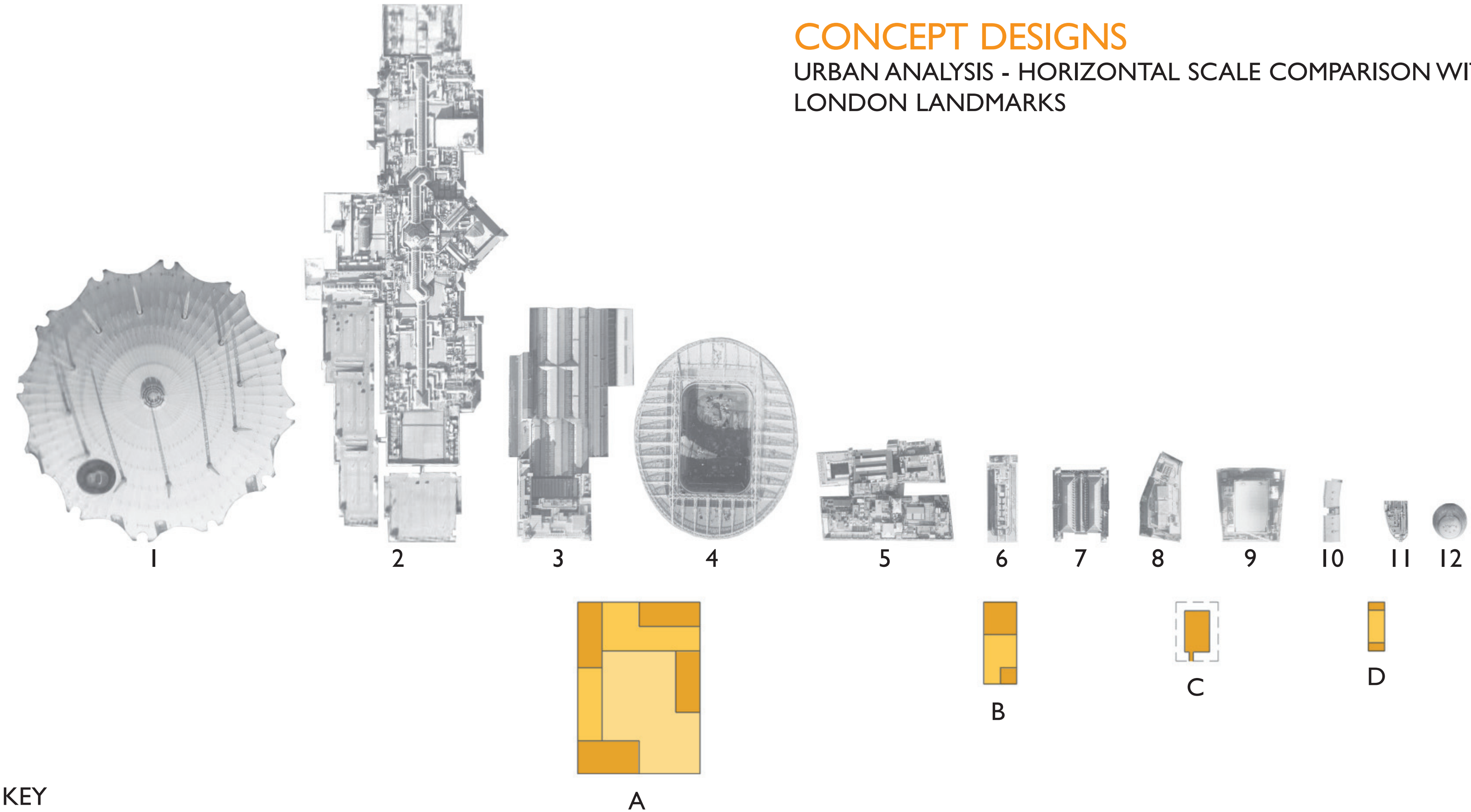
  

its interesting design, the building will engage local communities, and this can be strengthened through the development of an education and awareness centre.

Concept design 4 forming part of the urban skyline, notionally placed near Camden

CONCEPT DESIGNS

URBAN ANALYSIS - HORIZONTAL SCALE COMPARISON WITH LONDON LANDMARKS



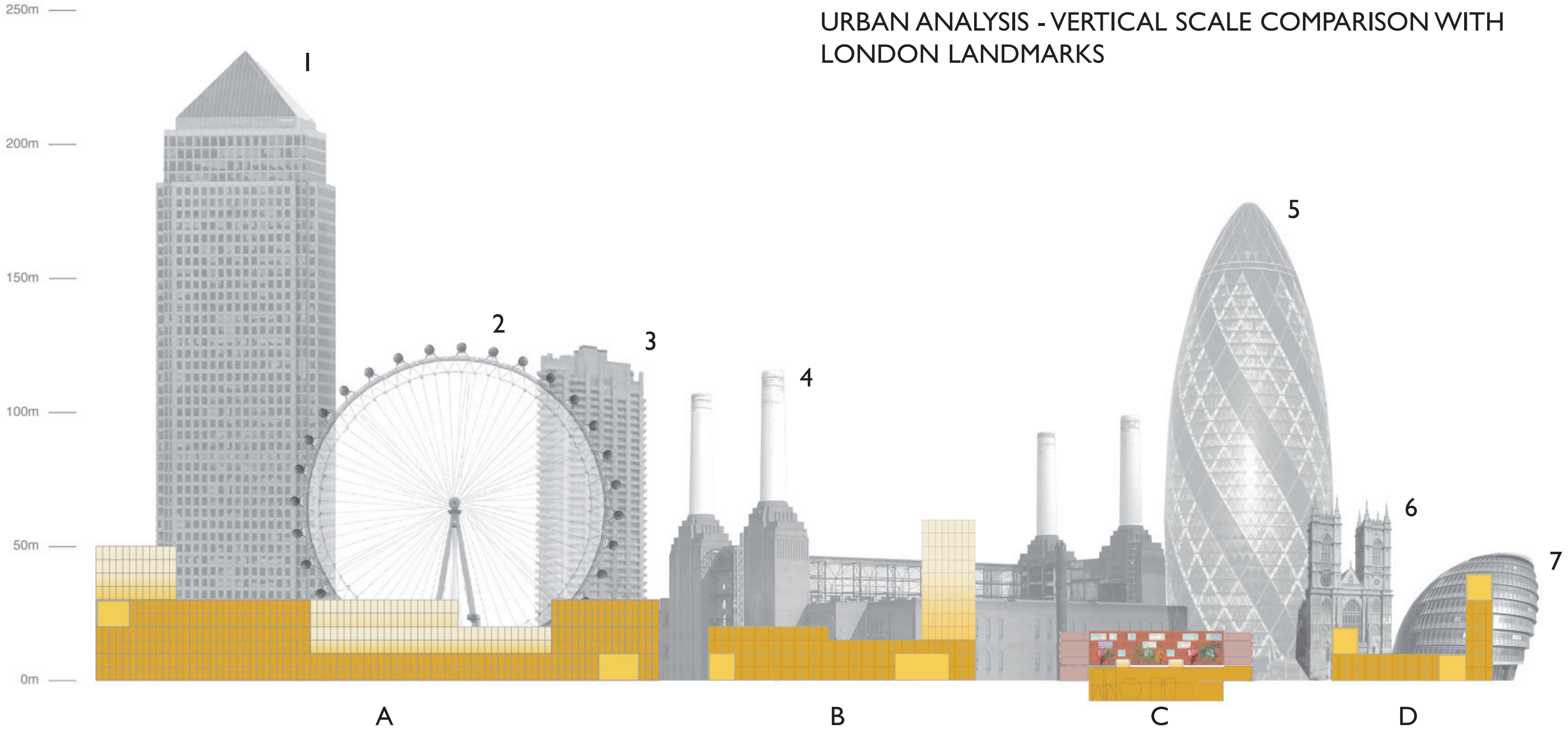
KEY

1. The Dome
2. Lakeside shopping centre
3. Paddington station
4. Wembley
5. Selfridges
6. Palestra
7. Covent garden
8. Peter Jones
9. Festival hall
10. Oxo
11. BBC
12 GLA

A. Integrated resource recovery plant
B. Gasification on an industrial riverside site
C. Anaerobic digestion on an inner city site
D. Gasification on an inner city site

CONCEPT DESIGNS

URBAN ANALYSIS - VERTICAL SCALE COMPARISON WITH LONDON LANDMARKS



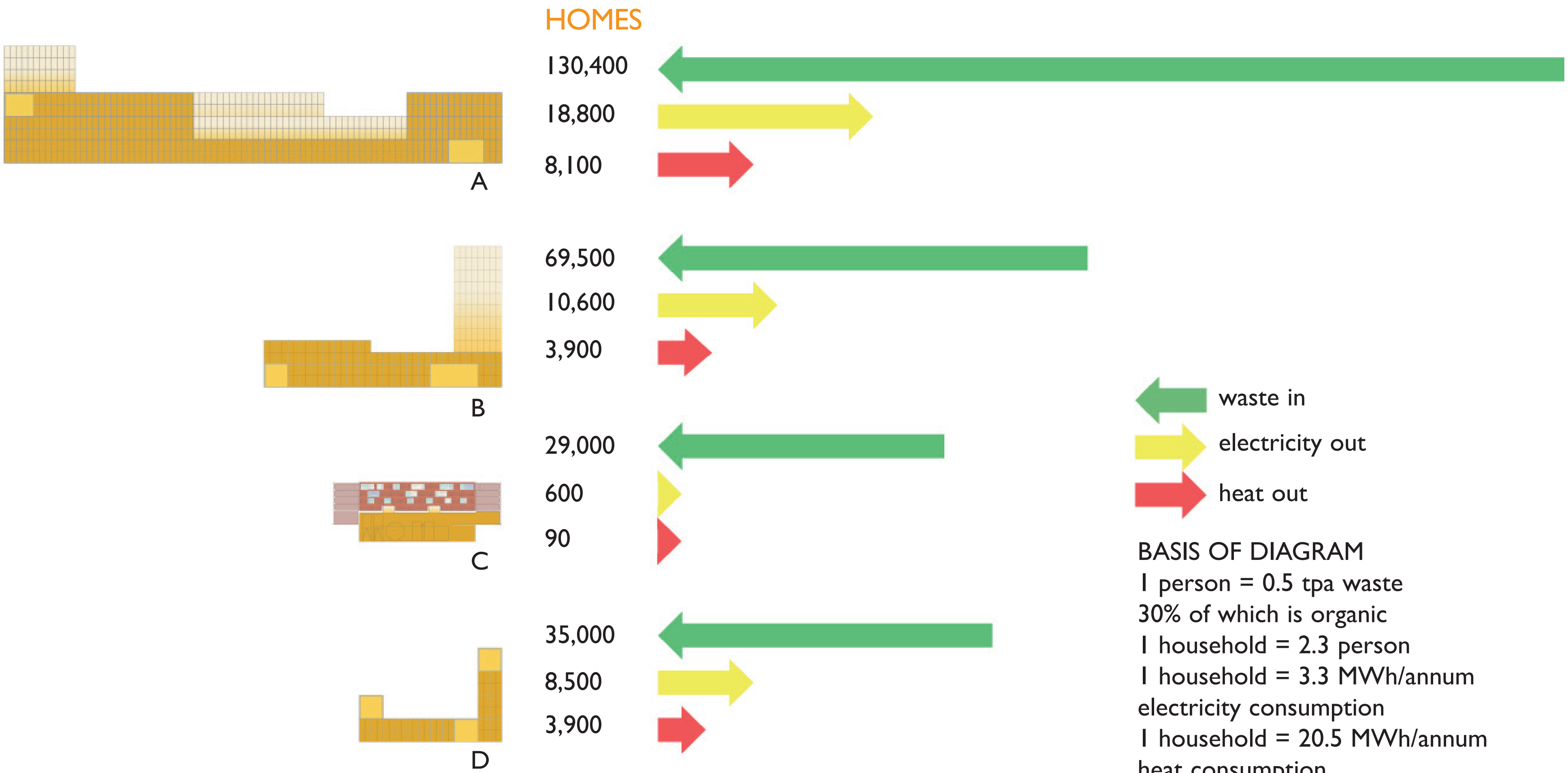
KEY

1. Canary wharf
2. London eye
3. Barbican
4. Battersea power station
5. Gherkin
6. Westminster abbey
7. GLA

A. Integrated resource recovery plant
B. Gasification on an industrial riverside site
C. Anaerobic digestion on an inner city site
D. Gasification on an inner city site

CONCEPT DESIGNS

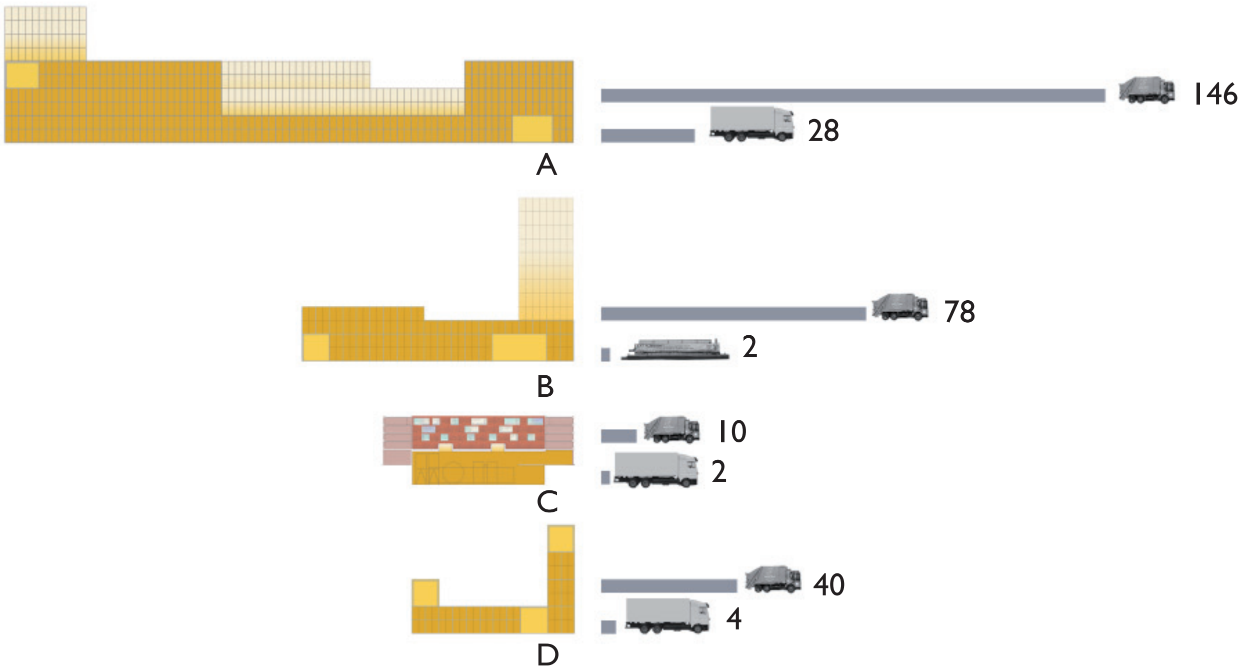
ENERGY ANALYSIS - EQUIVALENT ELECTRICITY AND HEAT PRODUCTION



BASIS OF DIAGRAM
1 person = 0.5 tpa waste
30% of which is organic
1 household = 2.3 person
1 household = 3.3 MWh/annum electricity consumption
1 household = 20.5 MWh/annum heat consumption
(ofgem factsheet 59, april 2006)

CONCEPT DESIGNS

TRANSPORT ANALYSIS - DAILY VEHICLE MOVEMENTS COMPARED WITH ESTABLISHED CITY INDUSTRY



DATA SOURCE
TRICS 2008(a) and TRAVL 8.06

LOCATIONS:
Parcel Force, Dollis Hill, London
Thwaites brewery, Blackburn
Asda, Wembley Park, London
Islington WTS, London

A. Integrated resource recovery plant
B. Gasification on an industrial riverside site
C. Anaerobic digestion on an inner city site
D. Gasification on an inner city site

BIN LORRY p. David Grandorge

WASTE TECHNOLOGY DESCRIPTION

This section provides an outline description of the new and emerging waste treatment technologies proposed in the design scenarios. The technologies described include:

- Anaerobic digestion;
- Gasification/pyrolysis; and
- Plasma gasification.

ANAEROBIC DIGESTION OVERVIEW

Anaerobic digestion is the natural decomposition (digestion) of organic waste using bacteria in an oxygen free (anaerobic) environment, under controlled conditions. The process produces a biogas (rich in methane), that can be used to power gas engines to generate electricity and heat, as well as producing a compost like residue (digestate) to be used as a compost/soil improver and a liquid fertilizer. The AD process is fully energy self-sufficient and generates a considerable energy surplus. The energy recovered from the process is carbon neutral and displaces the use of fossil fuels, contributing to the reduction of greenhouse gas (GHG) emissions. The biogas can also be used as a fuel for vehicles by reducing the carbon dioxide concentration in the biogas and therefore increasing its methane concentration to about 95%, which is equivalent to natural gas. There are different AD technology types available on the market, offering different processes, including:

- Wet (<15% dry solids) or Dry (15-40% dry solids) digestion; and
- Fully mixed (there is internal mixing in the process) or plug flow (where there is no internal mixing in process); and
- Mesophillic temperatures (20°C to 40°C) or thermophillic (50°C to 60°C); and
- Single stage (hydrolysis, acetogeneis and methanogenesis occurs in the same reactor) or multistage (hydrolysis and acetogenesis occur in different reactor to methanogenesis); and
- Batch (waste is processed in batches) or continuous (waste is continually fed into the reactor).

PROCESS DESCRIPTION

An important aspect of operating an AD plant, is maintaining a consistent 'feedstock'. The source segregation of food and green waste from other materials, such as glass, metals and plastics, is essential to ensure that the optimal performance of the digester is maintained, and the production of a high quality compost in achieved. The feedstock is placed in a sealed reactor (the digester), designed to provide the conditions necessary for biological degradation to occur, and the production of biogas. The digestion process takes about 15 to 30 days and the digester loading ranges between 10 tonnes to 3,000 tonnes. The AD process achieves a 50% to 70% reduction in weight of the input material. As the process can be continuous, the facility will have to provide for the sufficient storage of waste on site prior to its introduction to the digester. The waste facility should provide adequate storage for a minimum of three days waste storage to ensure that the process can be maintained during periods when waste is not being delivered to the facility (eg National holidays).

One tonne of organic waste generates about 110m^3 to 170m^3 of biogas.[1] Methane is normally combusted in gas engines or using fuel cells to generate electricity and heat. The digester requires an energy input to retain the material at optimum temperature in order to increase digestion. Some of the energy available from the methane generated can be recycled for this purpose, typically 20% to 40% of the total energy produced. Additional by-products of the process are digestate (nutrient rich, potential for use as a soil conditioner) and liquor (potential for use as a liquid fertiliser). If the digestate by-product is to be used as a compost/soil conditioner, it must be free of contaminants and meet defined quality criteria (eg the Compost Quality Protocol PAS 100).

COMMERCIAL VIABILITY

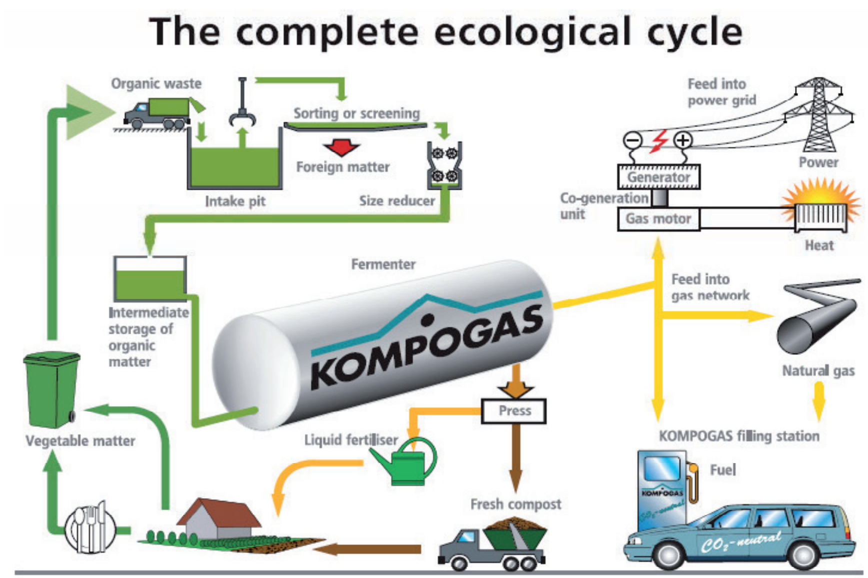
AD is a proven technology and plants are commercially available in a wide variety of process capacities generally ranging from 5,000tpa plants to greater than 100,000tpa plants.

There are many AD process suppliers with proven technology of treating source separated municipal biodegradable waste. A recent study has shown that the top 10 AD suppliers together have 117 plants with and installed capacity of 4,566,700tpa.[2] On average, the AD process generates a surplus of electricity of 0.2MWh/ tonne and a heat surplus of about 0.18MWh/tonne.

EMISSIONS AND REGULATION

The storage and handling of organic waste can result in local odour impacts, unless properly managed. Odour is also likely to be generated from ammonia and hydrogen sulphide, generated during digestion and when the digestate is temporarily stockpiled on site in a maturation hall. All the stages of the process can be enclosed, and therefore releases little odour emissions into the atmosphere, when managed correctly. Odour can be managed and mitigated, using chemical-based abatement systems, such as scrubbing, carbon adsorption, UV light and biofilters. The waste reception and temporary storage areas can also operate under negative pressure air systems, to reduce the risks of odour release (as discussed in Mitigation Options).

Bioaerosols are biological particles suspended in air, and have the potential to cause respiratory complaints if inhaled. Bioaerosols may be released from the anaerobic digestion process, mainly



source: Kompogas

from the feedstock reception and the aeration of the digestate post-treatment. To reduce this risk, it is important that each stage of the process remains enclosed.

Emissions generated from the combustion of biogas will typically be higher than emissions generated during the AD process.[3] There is EU guidance for gas emission limits for biogas combustion.[3]

The biogas will be stored in designated gas storage tanks, to ensure that human health and the environment is protected. Biogas will be generated on site that sometimes cannot be used on site eg during periods of maintenance of the gas engine. In these instances, the biogas will bypass the gas engine, and sent directly to an emergency flare. The biogas must be released through a gas flare at a minimum

source: Kompogas

temperature of 900°C, with a residence time of 0.3 seconds.[3] Therefore, gas storage and flaring in urban environments will require careful planning and early discussions with the HSE.

The EU Animal By-Products Regulation (APBR) is aimed at protecting human health and the environment, by controlling the collection, storage, handling, use and disposal of animal by-products.

The EU regulations are enforced through the national standards set by the UK that AD plants processing animal by-products must also comply with and are stated by DEFRA.[4]

PLANNING AND LICENSING

The following permits are required:

• Planning permission (will be required from the Local Planning Authority);
• Waste management license or Integrated Pollution Prevention Control (IPPC) permit;
• Animal By-Products Regulation approval (will be required from State Veterinary Service); and
• For waste treatment plants that have the potential to emit bioaerosols, the Environment Agency has adopted a precautionary approach that requires a site-specific environmental risk assessment where there is a dwelling or workplace within 250m of the site boundary.[5]

The waste planning authority decides whether a waste facility will require an Environmental Impact Assessment (EIA). Anaerobic digestion facilities fall under Schedule 2 of the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulation 1999, within the category 'installations for the disposal of waste'.[6]
EIA is required when:
• The disposal is by incineration; or
• The area of the development exceeds 0.5ha; or
• The installation is to be sited within 100m of any controlled waters.

This states that the likelihood of significant environmental effects will generally depend upon the scale of the development and the nature of the potential impact in terms of discharges, emissions or odour. For installations (including landfill sites) for the deposit, recovery and/or disposal of household, industrial and/or commercial wastes (as defined by the Controlled Waste Regulation 1992) EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per year, or to hold waste on a site of 10ha or more. Sites taking smaller quantities of these wastes (demolition, rubble etc) or civic amenity sites are unlikely to require an EIA.

ADVANCED THERMAL TREATMENT TECHNOLOGIES

Advanced thermal treatment (ATT) technologies have the potential to divert waste from landfill and mass-burn incineration, whilst providing a clean source of alternative energy generation.

GASIFICATION/PYROLYSIS GENERAL

Gasification and pyrolysis technologies are ATT technologies, recovering energy from wastes. The processes require a feedstock of high levels of carbonaceous, biodegradable waste (such as paper, cardboard, wood, food and green wastes). ATT technologies can also treat a fuel stream, including solid recovered fuel (SRF), produced from mechanical heat treatment (MHT) and mechanical biological treatment (MBT) technologies. The output of gasification and pyrolysis processes comprises a synthetic gas (hydrogen-rich gas), that can be used as a fuel for power generation, and is applicable to gas engines, fuel cells and gas–fired boilers. The synthetic gas can also be used as a feedstock for the synthesis of chemicals. By-products, such as char, ash and liquid residues may require final disposal in a hazardous landfill, if an alternative use cannot be found.

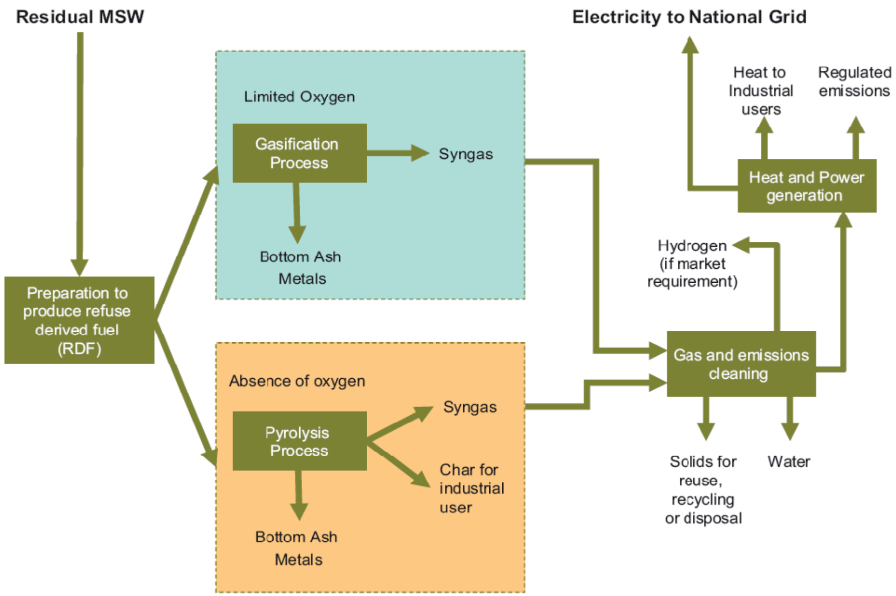
PROCESS DESCRIPTION GASIFICATION

Gasification is the partial oxidation of waste occurring at temperatures of approximately 650°C. The process can be a fluidized or fixed bed gasification process. The end products of the gasification process are:

• Synthetic gas, comprising carbon monoxide, hydrogen and methane; and
• Non-combustible solid residue (ash); and
• Liquid residue.

PYROLYSIS

Pyrolysis is the thermal breakdown of waste under anaerobic condition



source: defra 2007[7]

(no oxygen), at temperatures between 300°C to 800°C. The process can occur in a rotary kiln, a heated tube, or under surface contact. The end products of the pyrolysis process are:

• Synthetic gas (comprising carbon monoxide, hydrogen, methane and volatile organic compounds); and
• Non combustible solid residue (Char).

ATT technologies such as gasification/pyrolysis are continuous, requiring sufficient storage of waste on site to ensure both homogeneity and continuous supply. The waste facility should provide adequate storage for a minimum of three days waste storage to ensure that the process can be maintained during periods when waste is not being delivered to the facility (eg National

source: Energos

holidays). The waste requires pre-treatment, prior to processing and this usually consists of shredding or crushing to generate a homogeneous feedstock. The process reduces the material volume by approximately 70%.

COMMERCIAL VIABILITY

Commercial scale gasification and pyrolysis plants are in their early phases of development in the UK, but are more advanced in Europe, Japan and North America. Plant capacities are more flexible than mass burn incineration, typically ranging from 10,000tpa, up to 200,000tpa. On average ATT processes generate a surplus of electricity of 0.7 MWh/tonne and a heat surplus of about 2 MWh/tonne. However, this does vary between technology suppliers. The average calorific design value for plants accepting wastes also ranges between technology supplier and process type. Typical values range from 10 MJ/kg to 17 MJ/kg. Such treatment technologies generally have a low energy conversion efficiency of 30% (efficiency of incineration is approximately 20%-28%), but is approximately 70% when combined with combined heat and power (CHP).[8]

PLASMA GASIFICATION

Plasma gasification is an ATT technology where electricity is fed into a sealed vessel, converting gas into plasma creating an arc in which complete and rapid gasification of materials occur, at temperatures between 3,000°C and 10,000°C.

PROCESS DESCRIPTION

The system is capable of breaking down most materials. Synthetic gas is generated, and the process has the potential to generate approximately 1 MWh/tonne of electricity. Materials that are not converted to gas are usually melted and removed, usually consisting of a vitreous silicate slag material that can be used as a raw material, in, for example, road construction and composite products. Inorganic molten metal can be re-used as scrap metal. However, it would be preferable to remove all recyclables from the waste stream prior to treatment by plasma arc gasification.

COMMERCIAL VIABILITY

Plasma gasification is an emerging technology. Plant capacities currently range from demonstration units, processing approximately 10 tpa, up to 70,000 tpa. These plants are operational in Japan and North America. No commercial scale plants are currently reported in the UK.

EMISSIONS AND REGULATION FOR ATT TECHNOLOGIES

The storage and handling of such wastes can result in local odour impacts, and can be mitigated by operating under slightly negative air pressure and other environmental control measures (as discussed in Mitigation Options).

The 'thermal treatment' which includes combustion, gasification and pyrolysis of solids or liquids that can be defined as waste is governed by the WID.[9] The WID is designed to minimise the impact of emissions to air, soil, surface and ground water on the environment and human health, and regulates specific emission limits for the release of the following emissions to the atmosphere:

- Sulphur dioxide (SO_2);
- Nitrogen oxides (NO_x);
- Hydrogen chloride (HCl);
- Volatile organic compounds (VOCs);
- Carbon monoxide (CO);
- Particulate (fly ash); and
- Heavy metals;

Article 6(5) of the WID requires that exhaust gas stack heights are calculated in such a way that significant ground level concentrations of pollutants are avoided and that relevant community air quality standards are met. It has been indicated that, at a minimum, the stack height must be one metre above the roof height and three metres above any location, where the public has access or where there are windows (that can be opened). These are minimum requirements and the stack may need to be taller depending on atnospheric dispersion modelling.

PLANNING AND LICENSING FOR ATT TECHNOLOGIES

The following permits are required:

- Planning permission (will be required from Local Planning Authority); and
- Waste management license (the Environment Agency would require evidence of a valid planning permission for the development prior to granting a waste management licence) or IPPC permit.

For small scale plants, processing <1tonne/hour, a Prevention Pollution and Control (PPC) Permit must be obtained from the relevant local authority prior to operation of the plant and at higher throughput levels (ie >1 tonne/hour), an IPPC Permit is required from the Environment Agency.

The waste planning authority decides whether a waste facility will require an EIA. An EIA is obligatory for Schedule 1 developments, as defined under items 9 and 10 of Schedule 1 descriptions, stating:

- "Waste disposal installations for the incineration, chemical treatment or landfill of hazardous waste" or
- "Waste disposal installations for the incineration or chemical treatment of non-hazardous waste with a capacity exceeding 100 tonnes per day".

If not included under Schedule 1, an EIA will be required under Schedule 2 for the disposal of wastes:

- The disposal of waste by incineration; or
- The area exceeds 0.5ha; or
- The installation is to be sited within 100m of any controlled waters.

source: Startech

FURTHER INFORMATION
The Waste Technology Data Centre (http://www.environment-agency.gov.uk/wtd/)
DEFRA New Technologies Supporter Programme (http://www.defra.gov.uk/environment/waste/wip/newtech/supporter.htm)

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2. Esteves S, Monson K, Guwy A and Dinsdale R (2007) Anaerobic Digestion of Biodegradable Municipal Wastes – A European Perspective. 12th European Biosolids and Organic Resources Conference, Lowe P and Horan NJ (ed) Aqua Enviro, Manchester, UK.
3. Environmental Commission (2006) Integrated Pollution Prevention and Control Reference Document on Best Available Techniques for the Waste Treatments Industries
4. DEFRA (No Date) http://www.defra.gov.uk/animalh/by-prods/wastefood/compost-qanda.htm
5. Environment Agency (No Date) http://www.environment-agency.gov.uk/yourenv/eff/1190084/resources_waste/213982/152399/
6. ODPM (2004) Planning for Waste Management Facilities: A Research Study
7. DEFRA (2007) Advanced Thermal Treatment of Municipal Solid Waste. Crown Copyright 2007.
8. DEFRA (2007) The Waste Strategy for England, 2007.
9. Environmental Commission (2000) Directive 2000/76/EC of the European Parliament and of the Council of 4th December 2000 on the incineration of waste.

WHITE GOODS p. David Grandorge

CASE STUDIES
OVERVIEW

Six case studies have been selected to show how advanced waste treatment technologies have been successfully designed and incorporate the following key elements:

- Integration with surrounding residential and commercial environment;
- Provision of combined cooling, heat and power (CCHP);
- Community engagement and participation;
- Sustainable infrastructure and logistics; and
- Innovative design to create architecturally iconic buildings housing waste management and treatment processes.

The case studies are as follows:

1. Blue Tower (Der Blaue Turm) Pyrolysis Plant, Herten
The pyrolysis plant is an iconic building, designed to promote the technology process. The plant was built within Herten's Hydrogen Competence Centre, a centre of excellence for fuel cell technology and hydrogen production. A fairy tale was written about the plant for local school children to increase awareness of the project benefits.

2. Energos Gasification Plant
The gasification plant is located in an urban area, within 200m of dwellings. The plant produces thermal energy which it exports to a neighbouring paper mill, which in turn supplies part of the feedstock in the form of waste paper and cardboard, for the plant, creating a closed loop cycle and an industrial ecology link.

3. Barcelona Ecopark 3
The integrated resource park comprises a materials recycling facility, wastewater treatment plant and anaerobic digestion plant. The facility provides combined cooling, heat and power to neighbouring commercial buildings. The facility has been designed and integrated into a park, and also provides a public education and awareness centre.

4. Islington Household Re-use and Recycling Centre (RRC) and Waste Transfer Station
The site was opened in 2004 and houses a household waste RRC and waste transfer station. The facility is co-located immediately adjacent to residential and commercial properties. The site also has a successful education and awareness centre.

5. East London Community Recycling Partnership
The partnership was developed to collect and treat source separated organic wastes on the Nightingale Estate in Hackney, London. The partnership has achieved high levels of participation from the community and a closed loop system has been achieved; treating wastes on site, and using the compost on site for landscaping. By providing adequate space for the management of organic wastes on site, existing nuisances, such as vermin have been removed. The process also has provided local employment opportunities for low-skilled labourers.

6. Walbrook Wharf Waste Transfer Station
The waste transfer station has been successfully co-located with residential and commercial premises within the City of London. The site transports waste by barge, reducing the congestion on the roads.

Each design scenario has incorporated some of the key achievements from each case study, to show how such a facility can be co-located with residential and commercial buildings, using best practice achievements to provide an additional benefit to the local community.

INTRODUCTION

The Blue Tower is a pilot pyrolysis plant located in the south of Herten, an industrial area of the Ruhr Valley in Germany.

The pyrolysis process is based on a vertical 'staged reformation' technology developed by Dr Mühlen GmbH & Co KG (www.dm1-2.de). The objective of the pilot plant was to obtain operational information for optimising the new technology to be able to develop a commercial scale plant for the Herten hydrogen competence centre (H_2 Centre). The pilot plant has been operational since 2001 but is currently being deconstructed since the temporary planning consent has expired.

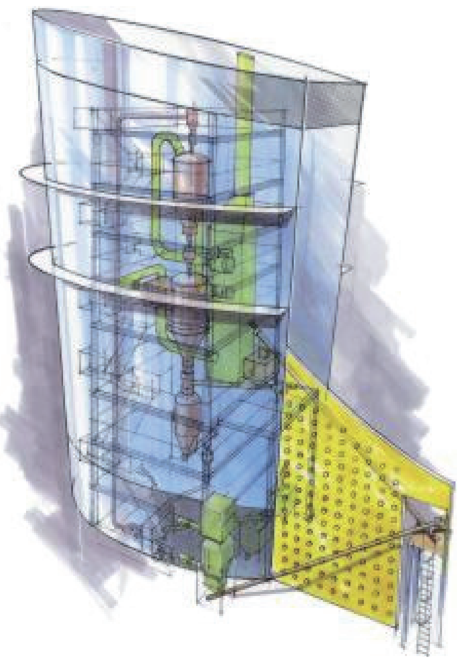
The H_2 Centre is being developed on the site of a former coal mine as part of an EU promoted initiative to create new employment. A commercial scale Blue Tower pyrolysis plant is planned on the site of the H_2 Centre by Solar Millennium AG (www.sollarmillenium.com). The H_2 Centre is being seen as a beacon project and part of North Rhine-Westphalia's aim of developing a hydrogen network and economy.

BEST PRACTICE ACHIEVEMENTS

An education and awareness programme was developed as part of the Blue Tower pilot plant project. The Blue Tower was turned into a cartoon character and fairy tale for school children.[2] The fairy tale was launched at the E-world of Energy in Essen (2002), a European energy trade fair. Over 20 pupils from a primary school in Herten were invited to a story time along with their teacher and Herten's mayor Klaus Bechtel. Two well known story tellers presented the fairy tale of Bubbes the crane, a great inventor, and the Blue Tower 'a machine that can eat almost any waste' without harming the environment and produce electricity and heat for people to use. The fairy tale was given to all schools in Herten to educate children and their parents on sustainable resource and waste management and to increase the acceptance of the technology.

The architectural design of the Blue Tower was considered by the developers in detail, and it was decided to create a transparent façade allowing the process equipment to be visible, which was achieved by constructing a steel frame around the processing plant covered by a plastic fabric. It is proposed that the new plant at the H_2 Centre will have a similar design but with a more durable façade made of a steel mesh cladding.

Planning permission for the Blue Tower pilot plant and proposed H_2 Centre pyrolysis plant was granted by the local planning authority without any major problems. The German planning system favours the development of biomass waste plants over other thermal waste



CASE STUDY

1. THE BLUE TOWER GASIFICATION PLANT, HERTEN, GERMANY[1]

treatment plants which use non-biomass feedstock.

TECHNOLOGY DESCRIPTION

The Blue Tower pilot plant is 23m high and covers a small site footprint of 1,000m^2 (0.1ha) for the whole site and 100m^2 for the Blue Tower pilot plant. The throughput of the pilot plant was about 200kg/hour.

The Blue Tower pyrolysis process converts the input material into a hydrogen rich product gas by simple reforming with steam in a pure gas phase reaction using the process heat.

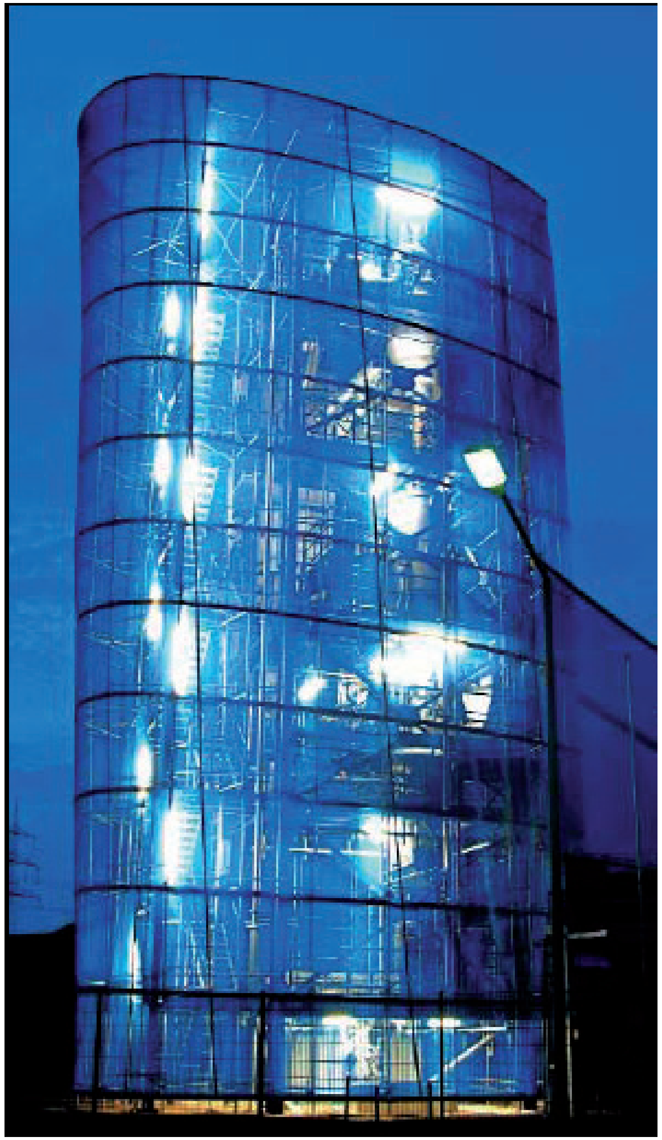
The bio-waste is being converted into a pyrolysis gas (~80% by weight) and coke (~20% by weight) by thermolysis. The coke leaves the thermolysis reactor and is transferred to a combustion chamber, while the pyrolysis gas rises up in the counter-flow reformer where it reacts with steam and is converted to a

source: D.M.2 Verfahrenstechnologien Dr Mühlen GmbH & Co KG

hydrogen rich product gas (>50% by volume). Other gases generated comprise carbon dioxide (~25% by volume), carbon monoxide (~15% by volume) and methane (5% to 8% by volume).

The reaction heat for the thermolysis and reforming is generated mainly by combustion of the remaining coke. The heat is transferred from the flue to an inert heat carrier (eg ceramic balls) inside a simple moving bed reactor. On the way through the process, the heat carrier gives off its heat first in the reformer and then in the thermolysis reactor before being re-circulated.

The plant can be operated using biomass (eg tree/hedge trimmings, grass cuttings, untreated timber, hey and straw, paper sludge and sewage sludge etc). Alternatively, the plant can be run using municipal food/green waste as well as solid recovered fuel provided, for example, by materials recycling facilities and/or mechanical biological treatment plants. The input material for the plant is being delivered to site fully pre-processed to fuel grade. The calorific value of the product gas is about 13 MJ/Nm^3 and can be used as follows:



source: www.h2herten.de

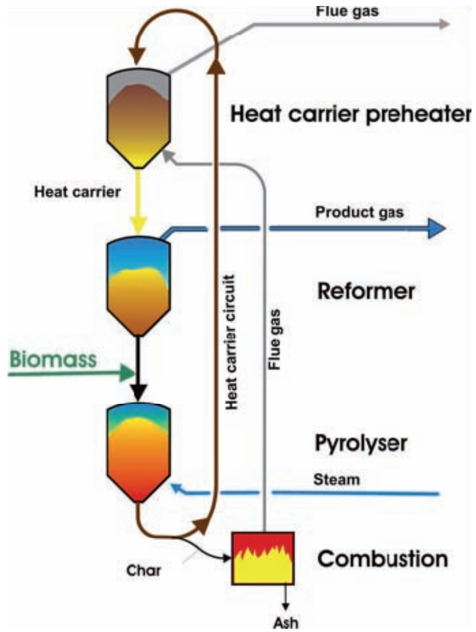
• As fuel gas to generate electricity and heat using combined heat and power and fuel cells;
• Hydrogen production; and
• As raw material for synthesis gases.

The by-product from the pyrolysis process is ash from the coke combustion, which can be vitrified, landfilled or potentially be re-used as construction aggregate.

The Blue Tower pyrolysis plant has been designed to meet strict German emission standards set out in the Bundes-Immissionsschutzgesetz (BImSchG) and the 17th BImSchV (17th Ordnance), which covers regulations regarding the incineration and co-incineration of waste and meets EU emission standards.

H_2 COMPETENCE CENTRE,
The H_2 Competence Centre is an initiative of the City of Herten to develop a centre of excellence for fuel cell technology and hydrogen production (see www.h2herten.de).

Planning permission for a pyrolysis plant at the H_2 Centre was granted by the local planning authority in May 2004. The pyrolysis plant will be about 40m high and is expected to process about 40,000 tonnes (wet weight) of biomass per year with a moisture content of about 50%. The plant is likely to have



a thermal efficiency of 37%. At a thermal input of about 13MW$_{th}$, the plant will generate about 4.5MW$_{el}$ of electricity (or 1MWh$_{el}$/tonne).

It was reported that the total capital cost of the Blue Tower including the process equipment, construction of the facility and one year of operation is approximately €18.8 million (or £12.5 million). The Blue Tower project is likely to be subsidised by €6.27 million. The bio-waste will qualify for renewables obligation certificates (ROCs) with a ROC value of about 16 cents/kWh. The Solar Millennium AG is in the process of appointing a contractor to build the Blue Tower with construction expected to start in the Summer of 2008.

NOTES
1. The information provided in this case study is based on information available on the internet and personal communication between Arup and Dr Heinz-Jürgen Mühlen.
2. Der Blaue Turm, Julia und Kathrin Kommerell Bessere Umwelt Verlag, München/Herten 2002, ISBN 3-926429-14-3.


source: www.h2herten.de

DATA	PILOT PLANT
TECHNOLOGY:	pyrolysis
SETTING:	industrial - housing within 800m
SITE AREA:	0.1ha
WASTE THROUGHPUT:	1,000tpa
CALORIFIC VALUE OF FUEL:	approx 20MJ/kg
ENERGY GENERATION:	1MW/0.35MW$_{el}$
EMISSION CONTROL STANDARD:	1,200^{0}C for 2 sec
CAPITAL COST CAPEX:	no data

DATA	H_2 CENTRE
TECHNOLOGY:	pyrolysis
SETTING:	industrial - housing within 200m
SITE AREA:	0.5ha
WASTE THROUGHPUT:	40,000tpa
CALORIFIC VALUE OF FUEL:	variable
ENERGY GENERATION:	13MW/4.5MW$_{el}$
EMISSION CONTROL STANDARD:	BImSchG
CAPITAL COST CAPEX:	no data

INTRODUCTION

The Energos gasification plant is located in Ranheim, a residential and industrial suburb of Trondheim. The plant was commissioned in 1997, and was constructed by AITOS, a wholly-owned subsidiary of ENERGOS ASA.[2] The company received grants from the Norwegian Resources and Energy Administration, the Norwegian Ministry of the Environment, the Norwegian Industrial and District Development Fund, and investment from private sources. The plant is now owned and operated by Energos. The total capital (CAPEX) and investment costs of the treatment plant were £4.6 million (50 million Norwegian Krone).

The plant has the capacity to process 10,000 tonnes of waste per annum and has a footprint of 1,500m^2 (0.15ha). The small size of the plant means that does not impinge upon the local surroundings, and the local residents did not object to the siting of the plant during the planning process or operational phase.

BEST PRACTICE ACHIEVEMENTS

The plant is located close to the sources of waste production. The feedstock for the gasification process comprises residual municipal solid waste from the neighbouring community, and residual waste paper from the local paper mill (Peterson Linerboard Ranheim). The mill specialises in manufacturing paper from recycled cardboard. The gasification plant exports all of its thermal energy (25GWh/annum) in the form of steam to the adjacent paper mill. This development of industrial ecology links have also provided further benefits by reducing the amount of residual paper and cardboard waste being sent to landfill. It also displaces approximately 7,500 tonnes of CO_2 emissions and 2.5 million litres of fuel per annum.

PROCESS DESCRIPTION

Residual waste is collected and sent directly to the gasification plant, reducing the need for a transfer station. Refuse collection vehicles enter the facility through an automated weighbridge, and waste is loaded into a bunker, using an automated crane. Ferrous metals (approximately 3% of the total waste) are removed from the waste stream via magnetic separation, using electro magnets. The residual waste is then shredded, to ensure a homogenous feedstock material, before it is used as a fuel. The waste is delivered to the fuel bunker, where additional mixing of the feedstock occurs, and is then loaded into the fuel delivery screw. Waste is fed into the gasification unit through a feed chute. The waste is distributed across the gasification grate by a conveyor and the thermal conversion process then occurs in two stages;

• Gasification occurs in the lower, primary chamber. The delivery of air is controlled to maintain the partial oxidation conditions, and to ensure the effective removal of carbon.

• The syn-gas generated in the primary chamber is transferred to a secondary chamber. The gas is oxidised under high temperature conditions, ensuring complete combustion. The combustion is controlled to minimise NO_x emissions.

source: Energos

CASE STUDY

2. RANHEIM ENERGOS GASIFICATION PLANT, NORWAY[1]

The temperature of the flue gases is approximately 150°C, and is passed through a boiler to cool. Here, it is treated by adding lime and active carbon, to remove metals and neutralise acids before it is passed through a filter, and released to the ambient air. The bunker hall is operated under negative pressure to reduce any risks of odour. The total emissions from the plant are consistently lower than those specified by the EU WID. For example, NO_x emissions are approximately 25% to 30% of the EU limit. The process also produces approximately 15% to 20% of bottom ash. This material is classified as inert, and has been used as an aggregate material in road construction. The process also produces approximately 3.5% to 5% of fly ash material that can be used as a neutralising agent in the chemical process industry, or in the gypsum manufacturing process.

source: Energos

NOTES

1. The information provided in this case study is based on information available on the internet and personal communication between Patrick McComille (Business Development Manager, Energos) and Joseph White (Sales and Contracts Support Engineer, Energos).
2. http://lib.kier.re.kr/caddet/retb/no97.pdf

DATA	RANHEIM
TECHNOLOGY:	gasification
SETTING:	residential suburbs
SITE AREA:	0.15ha
WASTE THROUGHPUT:	10,000tpa
CALORIFIC VALUE OF FUEL:	no data
ENERGY GENERATION:	25GWh/annum
EMISSION CONTROL STANDARD:	EU WID
CAPITAL COST CAPEX:	£4.6 million

INTRODUCTION

The Barcelona Ecopark 3 (Ecoparc del Mediterrani) is an example of an integrated urban resource park, comprising a combination of mechanical and biological waste treatment technologies. It is the third ecopark to be built in Barcelona. The three parks have a combined capacity of treating 60% of the total waste generated by the city, with a further 33% of waste being sent to energy recovery plants. The residual waste makes up 7% of the total waste, and is sent to controlled landfills.[2] The key objectives of the Ecoparks are to achieve a cleaner and tidier city that makes use of and benefits from its natural resources.

The integrated resource park is built in a post-industrial zone, and forms part of a public park. The area around the Ecopark is currently under development and consists of a yacht port and residential developments. The consortium Cespa, Urbaser and Emte won the commission for Ecopark 3 in 2002 and it was completed in 2006. It has the capacity to process 260,000 tonnes of municipal (black bin) waste per annum, which is equivalent to the waste generated by approximately 482,000 inhabitants (ie 15.7% of the total municipal solid waste generated in metropolitan Barcelona).[3] The total capital cost for the plant was 51 million Euros (approximately £38 million).

The process maximises materials recovery and recovers energy from processing organic material through an AD plant. The AD plant was supplied by Ros Roca, and has the capacity to treat 90,000 tonnes of organic waste per annum.

BEST PRACTICE ACHIEVEMENTS

The integrated facility is constructed on a limited plot of land (1.2 hectares), and as it is located within the city has been designed to minimise environmental impacts, such as odour, through forced air extraction that maintains the facility at negative air pressure.

The air flow is collected (approximately 100,000m^3/h) and treated in two regenerative thermal oxidation units (at approximately 750°C to 800°C).

The building has also been designed to integrate into the surrounding existing environment. The resource park provides combined cooling, heat and power (CCHP) to buildings in the area.

Approximately 22 GWh/annum of energy is generated, of which approximately half is used to meet the electricity demands of the Ecopark itself, and the remaining is exported to the grid. It is estimated that the plant will be capable of fulfilling the heating, cooling and sanitary hot water needs of the public buildings in the area and 800 housing units. For example, air conditioning, cooling and heating are provided to the Forum Building, Convention Centre, University Campus and hotels. Approximately 32,000tpa of compost is generated from the anaerobic digestion process, and is a marketed within Spain.

The facilities and construction of the plant have been designed to ensure minimal environmental impact criteria, and reduced resource consumption. Primary fuel consumption is reduced by 32% through recycling steam generated on-site.

The park blends together functional spaces and green spaces within the site. Pavements link the spaces with fish patterns to create a domestic carpet.[4] The Ecopark also has a education gallery and lecture room and provides guided tours of the plant.[5]

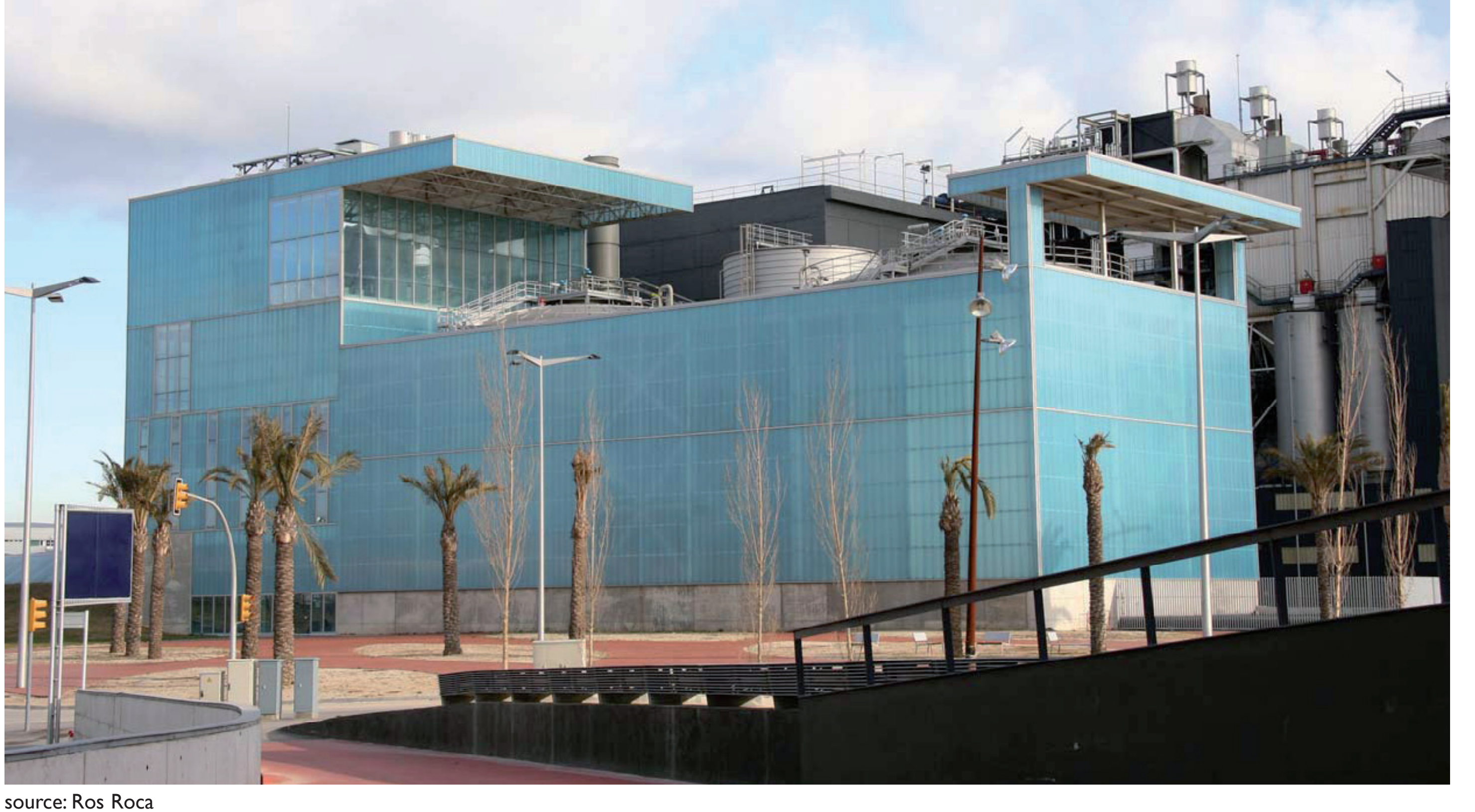
The key building elements of the facility are also made of recycled industrial material and green roofs have been incorporated into the design.

PROCESS DESCRIPTION

The Ecopark combines different technological processes. Waste is first sent to the waste reception area, with a total capacity of to store 3,000m³ of waste (equivalent to two days operation). The pit is sealed to ensure that odours are controlled. Waste is then picked up by bridge cranes, and sent to two semi-automatic selection lines. Waste is then separated using mechanical equipment, including trommel screens, ballistic separators and magnetic separators to segregate the waste into the following main fractions:

- Organic material that can be treated on-site;
- Material that cannot be treated on-site, but is deemed to have value; and
- Residual waste that is transferred to the neighbouring thermal treatment facility.

Approximately 29,000tpa of dry



source: Ros Roca

recyclable material is recovered from the sorting process, including materials, such as paper and cardboard, glass, PET, iron, non-iron, brick and film. This material is then shipped off-site for further recovery and re-processing. Approximately 141,000tpa of the total material entering the site is rejected, and sent to the local energy recovery facility.

90,000 tonnes of organic waste is processed in the anaerobic digestion plant on site. The organic waste is pulped and sent to two anaerobic digestion tanks, with the capacity to treat 5,700m^3 of material in mesophilic conditions (37°C). The average biogas generation is 10.8x10^6 Nm^3/year.

Biogas is accumulated at the top of the digesters, and is then stored in a 100m^3 low-pressure gas storage vessel that permits a regular flow for the cogeneration engines. The plant is equipped with three type JMS 420 GS-B.L biogas fuelled


source: Ros Roca

source: Ros Roca

cogeneration units, and are each powered by a Jenbacher Otto-cycle gas engine, designed to burn biogas.

Environmental odours are managed through a forced air removal system. Airtight doors have also been installed to ensure that odours are not released through the truck entry and exit doors.

NOTES

1. The information provided in this case study is based on information available on the internet and personal communication between Arup and Ian Handley (General Manager, Ros Roca). All photos are provided by Ros Roca.
2. http://w3.bcn.es/fitxers/ajuntament/informeanualangles2004.899.pdf
3. http://www.cespa.es/en/index.php?orden=61&id_noticia=5
4. http://www.geocities.com/medit1976c3/pau2.htm
5. http://www.artscampus.be/download/abalos_projecten-11925.pdf

DATA	BARCELONA ECOPARK 3
TECHNOLOGY:	MRF and AD
SETTING:	urban
SITE AREA:	1.2ha
WASTE THROUGHPUT:	260,000tpa
CALORIFIC VALUE OF FUEL:	no data
ENERGY GENERATION:	22 GWh/annum
EMISSION CONTROL STANDARD:	negative pressure within plant
CAPITAL COST CAPEX:	no data

INTRODUCTION

The new re-use and recycling centre (RRC), and waste transfer station facility was developed as a result of the Arsenal Stadium regeneration project, which saw the relocation of the North London Waste Authority (NLWA) waste transfer station and the London Borough of Islington's vehicle depot and civic amenity site.[2]

The site was opened in 2004 and is being operated by LondonWaste on behalf of the NLWA and the London Borough of Islington respectively.

BEST PRACTICE ACHIEVEMENTS

The facility is located in a dense urban environment, within a new mixed-use development comprising residential and commercial properties. As Islington is the second densest borough in the UK, there is a pressure to make maximum use of the available land. On the south side of the site the facility adjoins residential buildings, and is integrated into the development. The facility is located within the heart of the residential and retail development and consequently has very little street presence, apart from the vehicle entrances.

The design, management and maintenance of the facility have been the key factors to ensure environmental protection, whilst minimising the risk of disruption and nuisance to the local community. The building has been designed to ensure that there is no transfer of noise or vibrations to the nearby residential and commercial properties.

The new RRC has drastically increased recycling rates from previously 2% - 3% to more than 50% of the waste received from residents. The RRC also comprises an education facility, the i-recycle centre. This was established in 2005, and runs education programmes for schools and families, within London. An outreach programme is also aimed at students living in London. The education programme runs daily, and contributes towards the National Curriculum for school children. The sessions are interactive, and focus awareness on key waste, environmental and sustainability issues. There are plans to extend the education programme by providing interactive information boards within the corridors of the education facility explaining the key issues associated with waste, including noise and smell simulations.

INKJET p. D. Grandorge

4. ISLINGTON RE-USE AND RECYCLING CENTRE[1]


ADJACENCY p. D. Grandorge

PROCESS DESCRIPTION

The RRC is located within the heart of the building. Vehicles, up to 1.9m high can access the facility at the north entrance, via a ramp. For safety, traffic management systems are in place to ensure that the ramp is not open for cars when refuse collection vehicles are entering the site. The site is open to residents of any London Borough, and is used by approximately 9,000 people, depositing a combined average of 590 tonnes each month.

Approximately 80% of the total users of the site visit the facility up to four times a month. There are 13 designated car-parking bays where cars can park to unload their waste into the relevant containers. Each waste container is approximately 40m^3, and is accessed via steps. Each container is individually labelled, using Waste & Resources Action Programme (WRAP) materials labelling classifications. The signs also provide further guidance as to what materials can and cannot be put in each store. Storage is provided for a range of materials, including:

- Paper;
- Cardboard;
- Wood;
- Glass (white, green and brown);
- Plastic bottles;
- Cans;
- Green waste;
- Small appliances;
- White goods;
- Batteries;
- Plasterboard;
- Timber;
- Waste oils;
- Gas bottles;
- Fluorescent tubes;
- Fire extinguishers;
- Textiles; and
- Fridges and freezers.

There are also designated stores for reusable materials, such as furniture and books etc. All the containers are emptied as needed, by different contractors, for re-use and recycling.

An air and dust extraction system is installed above the waste containers within the RRC. Natural ventilation is also provided as well as a gas monitoring system installed within the facility that alerts drivers to turn off their car engines, if there is a build up of noxious fumes.
Pedestrians are encouraged to deposit their waste into designated bins, located outside the south and north entrance of the facility.

WASTE TRANSFER STATION
Residual wastes are delivered to the waste transfer station (WTS) by refuse collection vehicles (RCVs) from four London Boroughs including Islington, Haringey, Camden and Hackney. The WTS has a total throughput of approximately 400,000 tonnes of waste per annum, and processes up to 1,100 tonnes of waste per day. RCVs enter the facility via a weighbridge. Waste is deposited into the main tipping hall, and is then sent to the six chutes, where it is packed and compressed. Each compactor can hold up to 25 tonnes of waste. It is then collected by LondonWaste's articulated lorries, which have a


source: Arup

capacity to hold approximately 20 tonnes of waste each. The residual waste is then sent for energy recovery, or final disposal to landfill. The facility is serviced by approximately 200 vehicles per day. There is a clear traffic management system in place, comprising of traffic lights and automatic barriers. Air emissions are controlled by dust suppression and odour neutraliser sprays.

NOTES

1. The information provided in this case study is based on information available on the internet, site visits and personal communication between Arup and Matthew Homer (Recycling Manager, Islington Council) and Graham Loveland (Assistant Director (Planning), Islington Council).

2. http://www.islington.gov.uk/Council/CouncilNews/PressOffice/2004/09/813.asp

SKIPS p. D. Grandorge

DATA	ISLINGTON RRC
TECHNOLOGY:	Re-use and recycling centre
SETTING:	dense urban
SITE AREA:	2.35ha
WASTE THROUGHPUT:	400,000tpa
CALORIFIC VALUE OF FUEL:	n/a
ENERGY GENERATION:	n/a
EMISSION CONTROL STANDARD:	negative pressure within plant, odour and vibration supression
CAPITAL COST CAPEX:	n/a

source: ELCRP

source: Arup

INTRODUCTION

The East London Community Recycling Partnership (ELCRP) is a community composting project located on the Nightingale Estate in Hackney, London. It has been in operation since 2001 and serves six residential towers, with 1,000 residential units.[2]

ELCRP consists of three 'Rocket' type in-vessel composting units, administration offices and meeting rooms, and employs 35 staff including managers and labourers.

ELCRP provide the following services:

- Dry recycling collection, including paper, glass and cans;
- Food waste collection for composting; and
- Green waste collection for composting.

BEST PRACTICE ACHIEVEMENTS

The ELCRP food waste composting service is a closed loop recycling system. Biodegradable food waste is collected from the residents on the Nightingale Estate, and processed using the Rocket in-vessel composting system; the compost is returned to the local community for use on the grounds within the estate, contributing to the waste self-sufficiency principle. The Rocket compost is free of charge for residents to use in window boxes and gardens, as well as communal flower beds etc.

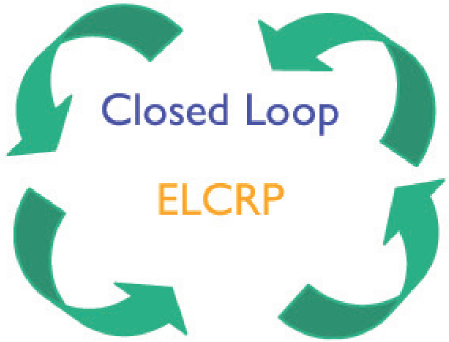
The project also encompasses the proximity principle as the waste is being processed as close to its source of production as possible. This reduces time, energy and the expense of transport. The proximity principle also alerts the waste producers and the general public to factors concerning quantity and disposal, which in turn encourages waste reduction. Raising awareness is an important part of the success of the work of ELCRP and the most effective implementation was found to be the 'door-knock' strategy. Another

CASE STUDY

5. EAST LONDON COMMUNITY RECYCLING PARTNERSHIP[1]

Residents sort their recycling waste and place it in containers and compost bags

The soil is given back to residents for use in garden areas



Waste is collected by ELCRP team (door to door service)

The waste is processed by the rocket

source: Arup

means of raising awareness was to provide pictorial leaflets to show residents exactly how to recycle, what type of materials should be put into the recycling containers and when they are collected and returned. The ELCRP success rate is 90% coverage of the Nightingale Estate, receiving approximately 80% of residents' participation. With this success, ELCRP has grown their business to cover more estates within the borough and have also started to deal with local business food waste collections.

In addition, the collection of source separated food waste has solved an existing problem on the estate with the presence of vermin and rats in waste storage rooms.

PROCESS DESCRIPTION

Residents on the Nightingale Estate place source separated food waste in 25 litre containers provided by the Council, which includes a cellulose plastic bag that is also biodegradable. ELCRP also supply residents with compost starter (EM Bokashi), which is added to the food waste to assist the breakdown of the waste and to prevent odours and vermin.

The Rocket in-vessel composting system is a simple but continues process with an operating temperature of 60°C. The collected food waste is loaded into the Rockets via a hopper. The waste is mixed and transported through the Rocket using a rotating screw mechanism located inside the Rocket. It takes approximately two weeks from the waste entering the Rocket to produce a compost/soil improver. The three Rockets on the Nightingale Estate have a combined capacity of 11 tonnes at any one time (or about 0.79 tonnes/day)[3] with the material eventually breaking down to about 5% of its original volume. The Rocket process is compliant with the Animal By-Products Regulations 2005 (ABPR) and can accept cooked meat and fish waste.

source: Arup


source: Arup

The set up costs are as follows:
- Approximately £25,000 is required for each Rocket dependant on size.
- £2,000 is needed for residents' plastic boxes.
- Additional costs include the EM Bokashi and biodegradable bin bags, plus rent for the site and wages for a waste collector.

Dry recyclables (aluminium cans, cardboard, paper, plastic and glass) are also collected by the ELCRP team, and are stored in wheelie bins, that are collected by Hackney Council. The paper is placed into wormeries located on site.

ELCRP is no longer receiving funding to carry out door to door collections of dry recyclables and food waste on estates, and is currently operating at a lower capacity within the development.

NOTES

1. The information provided in this case study is based on information available on the internet and personal communication between Arup and Sonia Chimoindes at ELCRP in February 2008.
2. www.elcrp-recycling.com
3. Based on 11 tonnes divided by 14 days processing time.

DATA	ELCRP
TECHNOLOGY:	In vessel composting
SETTING:	dense urban
SITE AREA:	0.015ha
WASTE THROUGHPUT:	200tpa
CALORIFIC VALUE OF FUEL:	n/a
ENERGY GENERATION:	none
EMISSION CONTROL STANDARD:	EM Bokashi odour prevention ABPR 2005 compliant
CAPITAL COST CAPEX:	n/a

INTRODUCTION

Walbrook Wharf waste transfer station is located in the City of London alongside the River Thames. It receives the majority of the waste from both residential and commercial premises within the City of London.[2] The transfer station has the capacity to receive, and compact approximately 85,000 tonnes of waste per annum.[3] Cory Environmental Ltd operates the waste transfer station under a 20 year contract (from 1995) with the Corporation of London Environmental Services Department. The site was originally opened in 1963, but has since been redeveloped to update the existing office accommodation, and renew the depot building services.[4] The total capital costs of the redevelopment were estimated to be approximately £22 million.[5] The total footprint of the site is approximately 6,000m^2 (0.6 ha).

source: City of London

BEST PRACTICE ACHIEVEMENTS

Walbrook Wharf is a viable and versatile river based operation, and has safeguarded wharf status.[6] Waste is compacted into containers which are loaded on to barges to be towed down the Thames by a tug for disposal at landfill sites. This use of the river enables a single tug to carry out the work of dozens of road vehicles without having any impact on other London boroughs' road systems or residents.[7] Each barge saves approximately 10,000 vehicle movements per annum. The waste transfer station operates a 24 hours a day, 7 days a week service. Although the facility is located in the heart of the city, its operations take place virtually unnoticed.[8]

PROCESS DESCRIPTION

Waste is transported to the waste transfer station in RCVs. The vehicles are weighed and the types and quantities of waste being received by the transfer station is recorded. The RCVs drive into the transfer hall and the waste is directed into hoppers. The waste is compacted, before it is transferred into an ISO container. The containers are then picked up by a gantry crane, and loaded onto the barges. The barges are then tugged down the river, once per weekday, transporting the waste for final disposal at Mucking Landfill in Essex. The waste could also be sent to a treatment plant, located alongside the River Thames.[9]

NOTES

1. The information provided in this case study is based on information available on the internet and from personal communication with Colin Russell Assistant Cleansing Director, City of London.
2. http://publications.environment-agency.gov.uk/pdf/GEHO0207BMWI-e-e.pdf?lang=_e
3. http://www.ltgdc.org.uk/uploaded/documents/wharvesreport.pdf
4. http://www.london.gov.uk/mayor/planning_decisions/strategic_dev/2003/sep2303/walbrook_wharf_report.pdf
5. http://www.cityoflondon.gov.uk/nr/rdonlyres/3850ac9f-be9f-4318-8cd7-6478118c1e4b/0/mc_sp_corpfinances_05.pdf
6. http://mayor.london.gov.uk/mayor/planning_decisions/strategic_dev/2003/sep2303/walbrook_wharf_report.rtf
7. www.cityoflondon.gov.uk
8. http://www.communities.gov.uk/documents/planningandbuilding/pdf/148385
9. http://213.86.34.248/NR/rdonlyres/2EFD94C3-88F7-47A9-9D4D-0C6CA6C62C18/0/DP_PL_udp08.pdf

CASE STUDY

6. WALBROOK WHARF WASTE TRANSFER STATION[1]

source: City of London

DATA	WALBROOK WHARF
TECHNOLOGY:	Waste transfer station
SETTING:	dense urban
SITE AREA:	0.6ha
WASTE THROUGHPUT:	50,000tpa
CALORIFIC VALUE OF FUEL:	n/a
ENERGY GENERATION:	n/a
EMISSION CONTROL STANDARD:	waste is containerised to reduce odour
CAPITAL COST CAPEX:	n/a

TVS & MONITOR p. David Grandorge

ENDWORD

This report demonstrates that new and emerging waste treatment technologies can be successfully integrated into London as a way of treating our waste sustainably.

There are currently few examples worldwide of waste treatment facilities co-located within urban developments. To successfully achieve this in London, a new and creative design approach must be taken, combining a respect for the city with an understanding of the technologies.

The key urban issue is the relationship between the type of technology being proposed, the scale of operation and the site context. The appropriateness and quality of the architectural response to this equation will determine the success of the project.

Four waste management scenarios have been developed to demonstrate how these new and emerging waste technologies can be co-located and successfully integrated into the city. Plant sizes have been selected to treat different capacities of waste, from 10,000tpa receiving wastes from local residential and commercial properties, up to 150,000tpa, where the facility can process waste generated from more than one Borough.

The scenarios have been designed to be iconic, engaging with the public and forming local landmarks, or alternatively 'hidden' within the city to reduce their visual impact in sensitive urban sites.

Where possible, more sustainable modes of transport have been proposed, such as waste barges on the Thames, and comparisons to other land uses requiring the movement of goods and materials in the city show that transport movements in the scenarios will have little impact on current flow.

Through careful and thoughtful design, the plants can mitigate against the impact, both actual and perceived, of the potential environmental nuisances associated with waste treatment facilities.

The scenarios have also shown that waste treatment technologies can provide benefits to the community through CCHP. The technologies are also eligible for ROCs, and new developments can therefore support the growth of renewable technologies.

Each scenario provides the opportunity for local authorities and developers to realise the possibility of achieving 85% self-sufficiency with respect to waste management in London.

By processing waste in the city, there is the opportunity to engage with the residents of London and to increase waste awareness. This may in turn reduce waste production.

The scenarios and the supporting information establish the means by which the ambition of the London Plan for waste self-sufficiency can be achieved.

ARRIVAL p. David Grandorge

ANAEROBIC DIGESTION

Abfallwirtschaftsbetrieb
Landkreis Boblingen
Parkstrabe 16
71034 Boblingen
Germany
Tel: +49 (0) 7031 663-1551
Email: abfallwirtschaft@lrabb.de
Number of Operating Plants: 1

Biffa Leicester
Customer Service Centre
'B' Block, New Walk Centre
Welford Place
Leicester, LE1 6ZG
UK
Tel: +44 (0116) 252 7002
www.biffaleicester.co.uk
Number of Operating Plants: 1

Biogen (UK) Ltd
Milton Parc
Milton Ernest
Bedfordshire, MK44 1YU
UK
Tel: +44 (0) 1234 827 249
E-mail: info@biogen.co.uk
www.biogen.co.uk
Number of Operating Plants: 1

CAMBI
Solbraavelen 10
N-1383, Asker
Norway
Tel: +47 66 77 98 00
Email: www.cambi.com
Number of Operating Plants: 2

CiTec
Riverside Business Centre
River Lawn Road
Tonbridge
Kent, TN9 16P
UK
Tel: +35 863240700
Number of Operating Plants: 1

Clarke Haase Ltd
Power House,
Senator Point,
South Boundary Road,
Knowsley Industrial Park,
Liverpool, L33 7RR
UK
Tel: + 44 (0) 151 546 4446
Email: salesuk@clarke-energy.com
Number of Operating Plants: 1

Dranco/Organic Waste Systems
OWS nv
Dok Noord 4
B-9000 Ghent
Belgium
Tel: +32 (0)9 233 02 04
Email: mail@ows.be
www.ows.be
Number of Operating Plants: 13

Enpure
Enpure House,
Birmingham Road
Kidderminster
Worcestershire, DY10 2SH
UK
Tel: +44 (0) 1562 820010
www.enpure.co.uk
Number of Operating Plants: 7

Greenfinch Ltd
The Business Park, Coder Road
Ludlow, Shropshire, ST8 1XE
UK
Tel: +44 (0) 1584 877687
www.greenfinch.co.uk,
biogas@greenfinch.co.uk
Number of Operating Plants: 1
(demonstration plant)

Kompogas/Active Compost Ltd
Scaur O'Doon
25 Scaur O'Doon Road
Doonfoot
Ayr, KA7 4EP
UK
Tel: +44 (0) 1292 442306
Email: info@activecompost.com,
www.kompogas.ch/en
www.activecompost.com
Number of Operating Plants: 27

Linde-KCA-Dresden GmBh
Bodenbacher Strasse 80
01277 Dresden
Germany
Tel: +49 (0)3 51250 30
www.linde-kca.com
Number of Operating Plants: 17

Oaktech Environmental (ArrowBio)
The Flint Glass Works
64 Jersey Street
Manchester, M4 6JW
UK
Tel: +44 (0) 1616050806,
www.oaktech-environmental.com
mail@oaktech-environmental.com
Number of Operating Plants: 2

Ros Roca
Ros Roca Internacional S.L.
Felix-Wankel Straße 17
D-73760 Ostfildern-Nellingen
Germany
Tel.: +49 (0) 711 310 599 70
Email: kontakt@rosroca.de
Net: www.rosroca.de
Number of Operating Plants: 11

RTS Reliant Technical Services Ltd
Brampton Business Centre
10 Queen Street
Newcastle-under-Lyme
Staffordshire, ST5 1ED
UK
Tel: +44 (0)1782 667596
Email: info@rts-ad.co.uk
www.rts-ad.co.uk
Number of Operating Plants: 2

Valorga
1140 avenue Albert Einstein - BP 51
F 34935 Montpellier Cedex 09
France
Tel: +33 (0)4 67 99 41 00
E-mail: contact@valorgainternational.fr
www.valorgainternational.fr
Number of Operating Plants: 14

GASIFICATION/PYROLYSIS

Advanced Plasma Power
Mercury House
Triton Court
14 Finsbury Square
London, EC2A 1BR
United Kingdom
Tel: +44 (0)20 7374 6335
E: info@advancedplasmapower.com
Number of Operating Plants: 1 (demonstration plant)

Brightstar Environmental
17 St. Ann's Road
Harrow
Middlesex, HA1 1JU
UK
Tel: +44 (0) 208 515 2211
www.brightstarenvironmental.com
Number of Operating Plants: 2

D.M.2 Verwertungstechnologien
Tel: 02011721675
Fax: 02011721023
www.dm1-2.de
Number of Operating Plants: 0

Ecogastek Oy
Oy Ekogastek Ltd
Laserkatu 6
FIN-53850 Lappeenranta
Finland
Tel. +358-5-624 3888
E-mail: ekogastek@kareltek.fi
wwnet.fi/ekogastek/
Number of Operating Plants: 1

Energos
ENER.G PLC
Daniel Adamson Road
Manchester, M50 1DT
UK
Tel: +44 (0)161 745 7450
Email: info@energ.co.uk
www.energ.co.uk
Number of Operating Plants: 9

First London Group
Shakespeare House
Wyke Road
London, E3 2PL
Tel: +44(0) 8458 123 112
info@firstlondon.com
Number of Operating Plants: 1 (demonstration plant)

Mitsui Babcock Energy Ltd
Porterfield Road
Renfrew, PA4 8DJ
UK
Tel: +44 (0) 1293 584887
www.doosanbabcock.com
Number of Operating Plants: 2

Novera
30 Bedford Street
London, WC2E 9ED
UK
Tel: +44 (0) 20 7845 9720
Fax: +44 (0) 20 7845 9721
www.noveraenergy.com
Number of Operating Plants: 1

TechTrade/WasteGen
Wolvey
Hinckley
Lesicestershire, LE10 3JF
UK
Tel: +44 (0) 1455222760
www.wastegen.com
Number of Operating Plants: 2

Thermoselect
Piazza Pedrazzini 11
CH 6600 Locarno
Switzerland
Tel: +41 91 7562525
E-mail: info@thermoselect.ch,
www.thermoselect.com
Number of Operating Plants: 8

Yorwaste
Mount View
Standard Way
Northallerton, DL6 2YD
UK
Tel: +44 (0) 1609 774400
Email: info@yorwaste.co.uk
www.yorwaste.co.uk
Number of Operating Plants: 1

PLASMA GASIFICATION

Geoplasma
171 17th Street NW
Suite 1550
Atlanta, GA 30363
USA
Tel: +1 678538 4321
www.geoplasma.com
Number of Operating Plants: 0

PEAT
555 Skokie Blvd.
Northbrook, IL 60062
USA
Tel: +1 847 559 8567
Number of Operating Plants: 4
(demonstration plants)

Plasco Energy Group
1145 Innovation Drive
Suite 100
Ottawa, ON K2K 3G8
Canada
Tel: +1 613 591 9438
www.plascoenergygroup.com
Number of Operating Plants: 2

ScanArc Plasma Technologies AB
P.O. Box 41
S-813 21, HOFORS
SWEDEN
Tel: +46 (0)290 76 78 00
E-mail: mail@scanarc.se
www.scanarc.se
Number of Operating Plants: 1
(demonstration plant)

Startech
88 Danbury Road
Wilton, CT. 06897
USA
Tel: (203) 762-2499
starmail@startech.net
Number of Operating Plants: 1
(demonstration plant)

Westinghouse
P.O. Box 410
Madison, PA 15663
USA
Tel: 724-722-7052
http://www.westinghouse-plasma.com/
Number of Operating Plants: 2

CELL p. David Grandorge

Advanced Waste Technologies
These are technologies such as anaerobic digestion, gasification and pyrolysis. Such technologies may require pre-treatment technologies such as Mechanical Biological Treatment (MBT) to prepare the waste. In the Climate Change Action Plan they are referred to as non- incineration technologies.

Anaerobic Digestion
This is the biological degradation of organics in the absence of oxygen, producing biogas (typical composition of 65% methane and 35% carbon dioxide) and residue (digestate) suitable for use as a soil improver.

Biomass
Biomass is the total dry organic matter or stored energy of plant matter. As a fuel it includes energy crops and sewage as well as forestry and agricultural residues.

Brownfield Land
This includes both land and premises, and refers to a site that has previously been used or developed and is not currently fully in use, although it may be partially occupied or utilised. It may also be vacant, derelict or contaminated. It excludes open spaces and land where the remains of previous use have blended into the landscape, or have been overtaken by nature conservation value or amenity use and cannot be regarded as requiring development.

Business Waste
Busines waste refers to commercial, industrial, construction, demolition, excavation and hazardous waste.

Buy Recycled Collecting
Sorting materials for recycling is only the first step in the recycling process. Once the material has been collected, sorted and sent to reprocessors, it is then recycled into new products. Making a conscious effort to seek out and buy products made from recycled materials is essential. The future of recycling ultimately depends on there being a market for the materials collected.

Carbon Dioxide
This is a naturally occurring gas comprising 0.04% of the atmosphere. The burning of fossil fuels releases carbon dioxide fixed by plants many millions of years ago, and this has increased its concentration in the atmosphere by some 12% over the past century. It contributes about 60% of the potential global warming effect of man-made emissions of greenhouse gases.

Char
Char is the product of partially burned biomass. Its modern source is from a process called pyrolysis. In this process, biomass is heated to the point where volatile gases and liquids are driven off and condensed into a product call bio-oil. What remains is almost pure carbon called char, with a varying ash content that depends on the type of biomass used.

Closed-Loop Recycling
This is when a material is recycled and returned to a similar state and use as when it was first consumed, for example, when container glass is collected, sorted, reprocessed back into cullet and manufactured back into container glass.

Combined Cooling, Heat and Power (CCHP)
This refers to the combined production of electricity and usable heat. Steam or hot water, otherwise rejected when electricity alone is produced, is used for space or process heating.

Co-mingled
This refers to recycled materials that are collected together and are recycled following further sorting.

Commercial Waste
This is waste arising from premises which are wholly or mainly for trade, business, sport, recreation

or entertainment as defined in Schedule 4 of the Controlled Waste Regulations 1992.

Composting

This is the biological degradation of organic materials, such as green garden and organic kitchen waste, in the presence of oxygen producing gas and residue suitable for use as a soil improver (see anaerobic digestion, central composting and home composting).

Conventional Incineration

This is the controlled burning of waste in the presence of sufficient air to achieve complete combustion. The heat is used to produce electricity and sometimes provide district heating. Unsorted waste is fed onto a, usually inclined, grate and burnt as it moves through the furnace. Plants are generally large-scale, having an annual capacity of 100,000 tonnes or more. Electricity generated in conventional incineration plant is not eligible for Renewables Obligation Certificates (ROCs). The term 'conventional incineration' is used in this document to refer specifically to this type of process as distinct from other thermal treatment processes such as pyrolysis or gasification processes.

Energy Efficiency

This is about making the best or most efficient use of energy in order to achieve a given output of goods or services, and of comfort and convenience. This does not necessitate the use of less energy, in which respect it differs from the concept of energy conservation. Environmental Management System (EMS) help organisations control and minimise the impact that their products, services have on the environment and provide a practical framework within which environmental issues can be managed.

EU Directive

This is a type of law that is issued by the European Union - all EU countries then have to put this into their own legal system.

Fuel Cell

A fuel cell acts like a constantly recharging battery, electrochemically combining hydrogen and oxygen to generate power. For hydrogen fuel cells, water and heat are the only by-products and there are no direct air pollution or noise emissions. They are suitable for a range of applications, including vehicles and buildings.

GLA Group

The Mayor has responsibility for appointing members to, and setting budgets for, four organisations: Transport for London (TfL), the London Development Agency (LDA), the London Fire and Emergency Planning Authority (LFEPA), and the Metropolitan Police Authority (MPA).

Gasification

Gasification is defined in the Renewables Obligation Order 2002 as meaning the substoichiometric oxidation or steam reformation of a substance to produce a gaseous mixture containing two or all of the following: oxides of carbon, methane and hydrogen.

Industrial Symbiosis

This brings together companies from all business sectors with the aim of improving cross industry resource productivity by the physical exchange of materials, energy and water and sharing assets, logistics and expertise.

Industrial Waste

This is waste from any factory and premises occupied by industry (excluding mines and quarries), defined in Schedule 3, Controlled Waste Regulations 1992.

Integrated Pollution Prevention and Control

This Directive (96/61/EC Directive), as implemented in the Pollution Prevention and Control

Regulations 2000, is designated to prevent or, where that is not possible, to reduce pollution from a range of industrial and other installations, including some waste management facilities, by means of integrated permitting processes based on the application of best available techniques.

Landfill Sites
Landfill sites are where local authorities and industry can take waste to be buried. The Environment Agency licenses and regulates landfill sites to ensure that their impact on the environment is minimised. Landfill sites are often located in disused quarries or mines. In areas where there are limited, or no ready-made voids, the practice of landraising is sometimes carried out, where some or all of the waste is deposited above ground, and the landscape is contoured. Designated landfill sites are managed to receive waste for final underground disposal under the provisions of the Waste Management Licensing Regulations 1996 as amended.

Mechanical Biological Treatment Systems
These consist of a mechanical stage, where recyclables and rejects (batteries, tyres etc.) are separated to leave an organic fraction. This fraction is then sent, in the biological stage, for treatment using composting and digestion techniques. These systems provide a new generation of integrated waste management technology able to reduce landfill and mass burn incineration and to increase recycling and composting.

Mixed-use Development
This is a development for a variety of activities on single sites or across wider areas such as town centres.

Municipal Solid Waste
This includes all waste under the control of local authorities or agents acting on their behalf. It includes all household waste, street litter, waste delivered to local authority recycling points, municipal parks and gardens wastes, council office waste, civic amenity waste, and some commercial waste from shops and smaller trading estates where local authorities have waste collection agreements in place. It can also include industrial waste collected by a waste collection authority with authorisation of the waste disposal authority.

Proximity Principle
The proximity principle deals with waste as near as practicable to its place of production.

Putrescible Waste
This is material readily able to be decomposed by bacterial action.

Pyrolysis
Pyrolysis is defined in the Renewables Obligation Order 2002 as meaning the thermal degradation of a substance in the absence of any oxidising agent (other than that which forms part of the substance itself) to produce char and one or both of gas and liquid.

Recycled Materials
These are waste materials which have been transformed into new products through reprocessing or remanufacturing.

Recycling
Recycling involves the reprocessing of waste, either into the same product or a different one.

Renewable Energy
This is energy derived from a source that is continually replenished, such as wind, wave, solar, hydroelectric and energy from plant material such as organic waste, but not fossil fuels or nuclear energy.

Reprocessing
This is the treatment of recycled materials or compostable materials, after collection and processing,

to prepare a secondary material that meets market specifications. For example, composting, the production of recycled plastic pellets, recycled paper or clean glass cullet.

Residual Waste
This is that portion of the waste stream that is not reused, recycled or composted and remains to be treated through the recovery of energy and/or materials or through disposal to landfill.

Resource Productivity
This makes the most productive and efficient use of resources.

Re-use
This means putting materials to another use after they have fulfilled their original function. The processes contribute to sustainable development and can save raw materials, energy and transport costs.

Re-use and Recycling Centres
These are sites operated by local authorities where residents and local businesses can take their waste for reuse, recycling and disposal.

Safeguarded Wharves
These are sites that have been safeguarded for cargo handling uses such as intraport or transhipment movements and freight-related purposes. A list of those sites that are currently protected and those proposed for protection is available in 'Safeguarded Wharves on the River Thames', GLA, 2003.

Secondary Materials
See recycled materials.

Secondary Materials Economy
This is the term for the chain of economic activity based on recycled materials being used more cheaply than primary production/ excavation.

Separate Collection
This is a recycling collection scheme from businesses where materials collected for recycling are kept apart. This avoids the need to mechanically sort materials at a Materials Reclamation Facility and sustains material quality.

Soil Improver
This product is ideal for improving all soil types, for mulching and also for planting trees and shrubs. The naturally fertile formula is rich in nutrients and organic matter, improving soil structure for better drainage and root establishment.

Spatial Development Strategy
This strategy is prepared by the Mayor, replacing the strategic planning guidance for London (RPG3). The Mayor has chosen to call the Spatial Development Strategy the London Plan.

Statutory Recycling Targets
All London boroughs have been set statutory targets by the government for the recycling of household waste. Statutory targets for recycling and composting were set for local authorities in England for 2003/04, 2005/06 and have been set for 2007/08. Adding together the results for Best Value Indicators 82(a) (recycling) and 82(b) (composting) measures performance against these targets.

Sustainable Development
This is development which can meet the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable Waste Management
This means using material resources productively, to cut down on the amount of waste we produce. Where waste is generated, it is dealt with it in a way that actively contributes to the economic, social and environmental goals of sustainable development.

Treatment
Treatment involves the chemical or biological processing of certain types of waste for the purposes of

rendering them harmless, reducing volumes before landfilling, or recycling certain wastes.

Waste
The strict legal definition of waste is extremely complex but it encompasses most unwanted material which has fallen out of the commercial cycle or chain of utility, which the holder discards, or intends to, or is required to discard.

Waste Arising
This is the amount of waste generated in a given locality over a given period of time.

Waste Authorities
This is the authority responsible for arranging for the collection and/or disposal of waste in their area. In London, all London boroughs (33) are responsible for waste collection. Twelve boroughs act as unitary authorities, responsible for both waste collection and disposal. The remaining 21 London boroughs carry out their disposal functions through four Statutory Joint Waste Disposal Authorities created by the Waste Regulation and Disposal (Authorities) Order 1985.

Waste Disposal
This is defined by the list of operations that constitute disposal (for under Part III of Schedule 4 of the Waste Management Licensing Regulations). This includes landfill, land raising, incineration, permanent storage etc.

Waste Hierarchy
This sets out the priority for waste management options, based on their environmental impact. In making waste management decisions, the waste heirarchy should be applied in sequence from the top down.

Waste Management Industry
This refers to the businesses in the public, private and third sector involved in the collection, management and disposal of waste.

Waste Management Licence
This is operated and enforced by the Environment Agency, and authorises the treatment, keeping or disposal of waste. These are separate but complimentary to the Land Use Planning System.

Waste Neutral
This is where the value of materials wasted is matched by the value of additional reused and recycled content materials bought.

ACRONYMS
ABPR Animal by-products Regulations
AD Anaerobic Digestion
ATT Advanced Thermal Treatment
CCHP Combined Cooling, Heat and Power
CHP Combined Heat and Power
CO_2 Carbon dioxide
DEFRA Department for the Environment, Food and Rural Affairs
EIA Environmental Impact Assessment
ELCRP East London Community Recycling Partnership
EMS Environmental Management System
GLA Greater London Authority
HDPE High Density Polyethylene
IPPC Integrated Pollution Prevention and Control
LATS Landfill Allowance Trading Scheme
LDA London Development Agency
MBT Mechanical Biological Treatment
MMWMS Mayor's Municipal Waste Management Strategy
MRF Materials Recycling Facility
PET Polyethylene Teraphthalate (recycled PET (rPET))
PPC Prevention Pollution and Control
RCV Refuse Collection Vehicle
ROCs Renewables Obligation Certificates
RRC Re-use and Recycling Centre
WEEE Waste Electrical and Electronic Equipment
WID Waste Incineration Directive
WRAP Waste & Resources Action Programme
WTS Waste Transfer Station

INFORMATION

PHOTOGRAPHY

David Grandorge is a teacher of architecture and photographer living and working in London.

For this report, he took photographs which comment on current attitudes towards waste in the city.

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INFORMATION

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Vietnamese
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Greek
Αν θέλετε να αποκτήσετε αντίγραφο του παρόντος εγγράφου στη δική σας γλώσσα, παρακαλείστε να επικοινωνήσετε τηλεφωνικά στον αριθμό αυτό ή ταχυδρομικά στην παρακάτω διεύθυνση.

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Punjabi
ਜੇ ਤੁਹਾਨੂੰ ਇਸ ਦਸਤਾਵੇਜ਼ ਦੀ ਕਾਪੀ ਤੁਹਾਡੀ ਆਪਣੀ ਭਾਸ਼ਾ ਵਿਚ ਚਾਹੀਦੀ ਹੈ, ਤਾਂ ਹੇਠ ਲਿਖੇ ਨੰਬਰ 'ਤੇ ਫ਼ੋਨ ਕਰੋ ਜਾਂ ਹੇਠ ਲਿਖੇ ਪਤੇ 'ਤੇ ਰਾਬਤਾ ਕਰੋ:

Hindi
यदि आप इस दस्तावेज की प्रति अपनी भाषा में चाहते हैं, तो कृपया निम्नलिखित नंबर पर फोन करें अथवा नीचे दिये गये पते पर संपर्क करें

Bengali
আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি (কপি) চান, তা হলে নীচের ফোন্ নম্বরে বা ঠিকানায় অনুগ্রহ করে যোগাযোগ করুন।

Urdu
اگر آپ اِس دستاویز کی نقل اپنی زبان میں چاھتے ھیں، تو براہ کرم نیچے دئے گئے نمبر پر فون کریں یا دیئے گئے پتے پر رابطہ کریں

Arabic
إذا أردت نسخة من هذه الوثيقة بلغتك، يرجى الاتصال برقم الهاتف أو مراسلة العنوان أدناه

Gujurati
જો તમને આ દસ્તાવેજની નકલ તમારી ભાષામાં જોઈતી હોય તો, કૃપા કરી આપેલ નંબર ઉપર ફોન કરો અથવા નીચેના સરનામે સંપર્ક સાધો.