

## The Municipal Solid Waste Resource in England

This report:

- Provides a summary of the national policy/strategy on waste management and energy from waste
- Summarises the data on the historical arisings and management of MSW
- Assesses the potential for increasing the amount of energy which is recovered from MSW in England.

### National Policy/Strategy

The European Union has been the major source of environmental legislation and guidance in relation to the management of waste in the UK and current policy initiatives for both waste management and supply of energy are placing more emphasis on reducing greenhouse gas emissions, improving the energy efficiency of energy recovery and applying life-cycle type analysis in developing waste policy.

### Waste policy

The main area of European legislation that UK waste policy has to meet is the Landfill Directive. This aims to prevent, or minimise, the negative effects on both the environment and human health caused by landfilling of wastes. It requires that the amount of biodegradable municipal solid waste sent to landfill in the UK to be reduced:

- to 75% of 1995 levels by 2010 (the UK has a four year derogation),
- to 50% of 1995 levels by 2013, and
- to 35% of 1995 levels by 2020.

In 2009 the UK redefined the meaning of municipal solid waste (MSW) to include local authority collected waste (LACW) and waste from the commercial and industrial (C&I) sector which was of a similar nature to LACW. Table 1 shows the landfill Directive targets (tonnes of biodegradable waste) for the UK based on the revised definition of MSW.

**Table 1: Maximum tonnages of biodegradable municipal waste (BMW) that can be land filled**

	<b>2010</b>	<b>2013</b>	<b>2020</b>
UK	13,700,000	9,130,000	6,390,000
England	11,200,000	7,460,000	5,220,000
Scotland	1,320,000	880,000	620,000
Wales	710,000	470,000	330,000
Northern Ireland	470,000	320,000	220,000

The 2010 Directive targets have been met and the 2013 targets are also expected to be met although the final out turn will not be known until June 2013. It is also forecast by the Department of Environment, Food, and Rural Affairs (Defra) that England will achieve the 2020 Directive target. The tonnage of waste consigned to landfill is progressively reducing each year; in England the waste consigned to landfill in 2011/12 amounted to about 20 million tonnes or 42% of arisings. 50% was recycled and 8% was treated primarily through energy from waste (EfW) systems. The forecast for 2020 is that the recycling rate will be ~55% and treatment ~20% with the remaining 25% consigned to landfill.

**Figure 1: Management of MSW in England (Source: Niranjana Patel, Defra)**



The main economic driver for reducing landfill reliance is the Landfill Tax. Landfill Tax is a tax payable for each tonne of waste sent to landfill and was introduced by the Government in 1996 as a way of encouraging more sustainable means of waste management through recognising the hidden financial effects of the environmental impact of landfill. The landfill tax, which is currently £64/t (for active waste), increases at the rate of £8/t each year, and will continue to increase at this rate until 2014/15 when it reaches £80/t. The tax rate for inert waste is £2.50/t. This progressive increase in the cost of disposal has been one of the main driving factors in moving waste out of landfill and up the waste hierarchy.

## Waste strategy

The aim of the Waste Strategy for England<sup>1</sup> is to reduce waste by making products with fewer natural resources, breaking the link between economic growth and waste growth. Products should be re-used, their materials recycled, energy from waste recovered, and landfilling of residual waste should occur only where necessary. The key objectives are to:

- decouple waste growth (in all sectors) from economic growth and put more emphasis on waste prevention and re-use;
- meet and exceed the Landfill Directive diversion targets for biodegradable municipal waste in 2010, 2013 and 2020;
- increase diversion from landfill of non-municipal waste and secure better integration of treatment for municipal and non-municipal waste;
- secure the investment in infrastructure needed to divert waste from landfill and for the management of hazardous waste;
- Maximise the environmental benefit from that investment through increased recycling of resources and recovery of energy from residual waste using a mix of technologies.

<sup>1</sup> Waste Strategy for England 2007. Defra, May 2007

To address the 2<sup>nd</sup> bullet point (meeting Landfill Directive targets) the Defra set up the Waste Infrastructure Delivery Programme (WIDP) in 2006/7. The objective of WIDP is to ensure that sufficient waste treatment infrastructure is delivered to achieve the landfill diversion requirements for 2010, 2013 and 2020. To this end WIDP has allocated to date approximately £4bn of funding to assist local authorities in procuring the financing, construction and management of a range of waste treatment infrastructure.

Waste Strategy 2007 was reviewed in 2011 and this re-affirmed the Governments commitments, as part of a more sustainable approach to the use of materials, to:

- Prioritise efforts to manage waste in line with the waste hierarchy and reduce the carbon impact of waste;
- Develop a range of measures to encourage waste prevention and reuse, supporting greater resource efficiency;
- Develop voluntary approaches to cutting waste, increase recycling, and improve the overall quality of recycle material, working closely with business sectors and the waste and material resources industry;
- Consult on the case for higher packaging recovery targets for some key materials;
- Support energy from waste where appropriate, and for waste which cannot be recycled;
- Work to overcome the barriers to increasing the energy from waste which Anaerobic Digestion provides, as set out in the new AD strategy;
- Consult on restricting wood waste from landfill and review the case for restrictions on sending other materials to landfill.

The Government has also stated that it intends to consult on the possible introduction of further reductions in the amount of biodegradable waste that is landfilled (this could result in similar legislation to that already existing in a number of European countries, such as Germany and Sweden).

## **Renewable energy policy**

The UK Government published an updated a renewable energy (RE) strategy in 2009<sup>2</sup> followed by a RE Road Map in 2011. The RE Strategy outlined the use of renewables as a key part of the UK's strategy to tackle climate change and deploy cleaner sources of energy, setting out the legally binding target of 15% of UK energy from renewable sources by 2020, including more than 30% of electricity, 12% of heat and 10% of transport from renewables. The RE Road map is designed to show the UK's approach to unlocking its RE potential.

The main policies introduced to encourage the uptake of RE are:

- The Renewables Obligation (RO) which supports renewable electricity
- The Renewable Heat Incentive (RHI) which supports renewable heat; and
- The Renewable Transport Fuel Obligation (RTFO), which supports renewable fuel.

### **The Renewables Obligation (RO)**

Introduced in 2002, the RO is currently the main mechanism for incentivising growth in renewable electricity. Under this government subsidies (known as renewable obligation certificates (ROCs)) are paid to power generators for every unit of renewable energy produced.

The UK Government recognises that generating energy from that portion of waste that cannot be prevented, reused or recycled has both energy and waste policy benefits. It also

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<sup>2</sup> The UK Renewable Energy Strategy 2009

recognises that the biodegradable fraction of waste is a renewable resource, and that energy generated either directly from waste or through the use of a refuse-derived fuel has benefits for security of supply.

Under the RO technologies are supported in “bands”. Energy from waste is supported in a variety of ways under these bands:

- Energy from waste with CHP is rewarded at the rate of 0.5 ROCs for each MWh of electricity generated. The RO deems a value of 50% renewable content of waste. Alternatively EfW generators can provide measured values if they think their waste renewable content exceeds 50%. For other wastes (e.g. solid recovered fuel) the biogenic content of the waste must be measured.
- Energy from waste using advanced conversion technologies (ACT) is supported at the rate of 0.5 or 2 ROCs for each MWh of electricity generated. 0.5 ROC is given to standard ACT; advanced ACT is rewarded at 2 ROCs/MWh. The definitions for these are given in Box 1. Anaerobic digestion is rewarded with ROCs/MWh until March 2015 and a decreasing scale from then on.

#### Box 1 Definition of Advanced Conversion of waste to energy under the UK Renewables Obligation

##### Standard ACT

“Standard gasification” means electricity generated from a gaseous fuel which is produced from waste or biomass by means of gasification, and has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station which is at least 2 megajoules per metre cubed but is less than 4 megajoules per metre cubed.

“Standard pyrolysis” means electricity generated from a gaseous fuel which is produced from waste or biomass by means of pyrolysis, and has a gross calorific value when measured at 25degrees Celsius and 0.1 megapascals at the inlet to the generating station which is at least 2 megajoules per metre cubed but is less than 4 megajoules per metre cubed.

##### Advanced ACT

“Advanced gasification” means electricity generated from a gaseous fuel which is produced from waste or biomass by means of gasification, and has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station of at least 4 megajoules per metre cubed

“Advanced pyrolysis” means electricity generated from a liquid or gaseous fuel which is produced from waste or biomass by means of pyrolysis and

a) in the case of a gaseous fuel, has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station of at least 4 megajoules per metre cubed, and

b) in the case of a liquid fuel, has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station of at least 10 megajoules per kilogram.

The Renewables Obligation is being replaced in 2017 by the **proposed Electricity Market Reform (EMR)**.<sup>3</sup> The EMR is designed to secure long-term electricity supply and decarbonise electricity generation, while minimising costs to the consumer. It includes *inter alia* proposals for:

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<sup>3</sup> See: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48129/2176-emr-white-paper.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48129/2176-emr-white-paper.pdf)

- A carbon floor price
- Long-term Feed-in Tariffs with Contract for Difference (FiT CfD)
- An Emissions Performance Standard set at 450g CO<sub>2</sub>/kWh

As part of this market reform the Government also released a National Policy Statement for Renewable Energy Infrastructure which provides guidance on infrastructure planning.<sup>4</sup> The details for the Electricity Market Reform are still being developed, with legislation proposed for 2013/14. The Government has also established a Green Investment Bank. One of the first projects supported by the Green Investment Bank was £30.4 M for a new waste treatment, recycling and energy from waste facility near Wakefield.<sup>5</sup> However, much of the funding to date in waste has been for anaerobic digestion of organic waste rather than combustion systems.

### **The Renewable Heat Incentive (RHI)**

This was introduced in 2010 to help provide an incentive for uptake of renewable heat, in terms of a subsidy per kWh of heat. Municipal solid waste was originally included within the biomass tariff at a level of 1p/kWh (heat) for plants of >1 MW for the biomass part of the waste. In September 2012 proposals were published to support a wider range of waste feedstocks, such as commercial and industrial waste, using the same eligibility criteria as the RO. The final decision regarding this consultation is not yet available.

### **The Renewable Fuel Transport Obligation (RTFO)**

This is the UK's mechanism to implement the RED requirements for achieving a percentage of road transport fuel from renewable sources. Under the RTFO suppliers are required to supply a percentage of their fuel from renewable sources. This is based on the fuel rather than the feedstock required for the fuel; and under sustainability rules, fuels derived from organic and industrial waste are eligible and are double counted towards the target. Under proposed EC rules this would change to quadruple counting, but these rules are still under debate.

To date there are no biofuels produced in the UK from energy from waste combustion technologies.

## **Current Situation**

This section discusses the definition of MSW in the UK. It then presents historical data on the arisings and management of MSW in England, and lists (not exhaustively) residual waste facilities (primarily EfW) that are either in operation, under construction or proposed.

## **Definition of municipal waste in the UK**

The principal waste streams are:

- Household waste - includes waste from household collection rounds, dry recyclables collected through banks or kerbside collections, bulky waste collections, hazardous household waste collection, garden waste collections, and waste from services such as street sweeping, litter and civic amenity sites. The definition also covers waste from schools.

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<sup>4</sup> DECC (2011) National Policy Statement for Renewable Energy Infrastructure. Available: [https://whitehall-admin.production.alpha.gov.co.uk/government/uploads/system/uploads/attachment\\_data/file/37048/1940-nps-renewable-energy-en3.pdf](https://whitehall-admin.production.alpha.gov.co.uk/government/uploads/system/uploads/attachment_data/file/37048/1940-nps-renewable-energy-en3.pdf)

<sup>5</sup> See: <http://www.businessgreen.com/bg/news/2236533/green-investment-bank-backs-shanks-gbp750m-waste-infrastructure-project> and <http://news.bis.gov.uk/Press-Releases/Green-bank-opens-for-business-6841.d.aspx>

- Commercial waste - waste arising from wholesalers, catering establishments, shops and offices.
- Industrial waste - waste arising from factories and industrial plants. The UK definition of industrial waste does not include construction and demolition waste.
- Construction and demolition waste - waste arising from the construction, repair, maintenance and demolition of buildings and structures.

Municipal waste arisings in the UK includes all wastes under the control of local authorities or agents acting on their behalf, which means all household waste, municipal parks and garden wastes, and council office waste. It also includes any waste collected by local authorities from businesses. This waste is referred to as Local Authority Collected Waste (LACW).

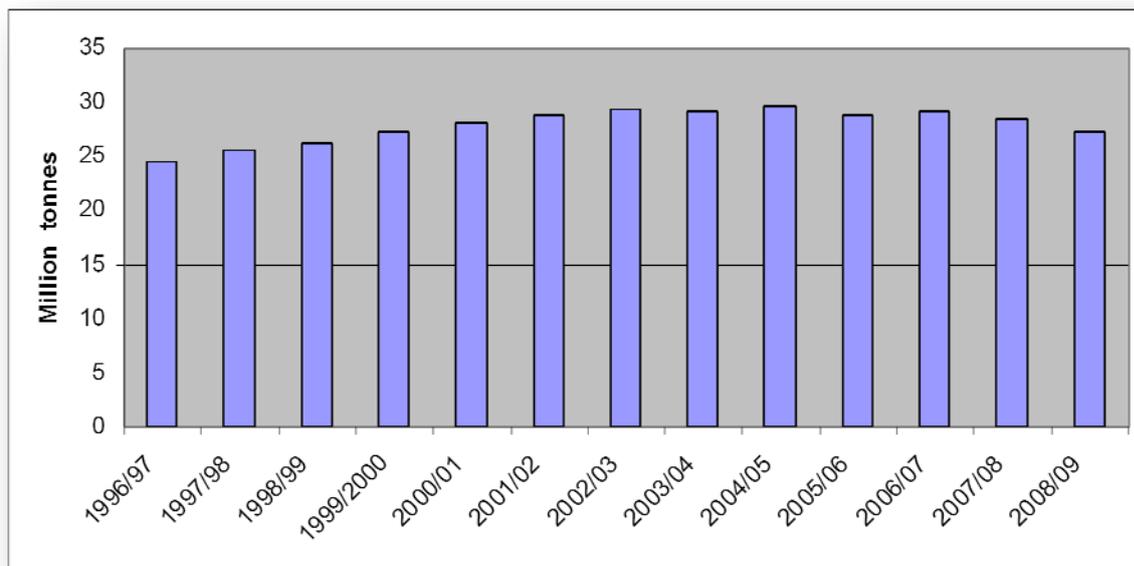
In 2010 the Government redefined Municipal Solid Waste (MSW) to include commercial and industrial waste of a similar nature to LACW; this brings the UK definition of MSW to be more aligned to that applying in other EU countries. This re-definition of MSW virtually doubled the tonnage of waste that was previously counted as MSW. However, the challenge of meeting EU landfill directive targets remained more or less the same as the target tonnages to landfill had also be revised upwards with EU agreement

Waste Collection Authorities (WCAs) are responsible for collecting household waste – either provided as an ‘in-house’ service or contracted out to the private sector. Waste Disposal Authorities (WDAs) are responsible for the treatment and disposal of waste collected by the WCAs. WDAs contract with the private sector to make such disposal arrangements. The business sector is expected to make their own arrangements with private sector waste management companies for the collection, treatment and disposal of their waste. Local authorities in the UK can compete in this sector, but only collect a small fraction of this waste, mainly from smaller shops and trading estates. Some local authorities in the UK have been reducing the amount of business waste that they collect because this additional waste can make it more difficult to meet targets for land filling of biodegradable waste. However, since the change in the in the definition of MSW mentioned above, this situation may change particularly as individual landfill targets for local authorities have now been abolished.

## **Historical MSW arisings in England**

**Error! Reference source not found.** 49 shows that the arisings of LACW in England between 1996 to 2009. This shows that over the period to 2003 the average waste growth rate was about 3% per year, which is similar to growth in GDP at the time. However, there was virtually no growth between about 2004 and 2008 and since then waste growth has been on a downward trajectory. LACW arisings between 2008 and 2012 are shown in Figure 2 .

**Figure 2: LACW arisings ('000 t) in England 1996/97 to 2008/09**



There are a number of possible reasons for the lower growth rate since 2002/03:

- The impact of Waste minimisation and prevention campaigns;
- Restrictions placed on the types of waste taken to the household waste recycling centres; and
- Impacts of the 2008 financial crisis and subsequent recession.

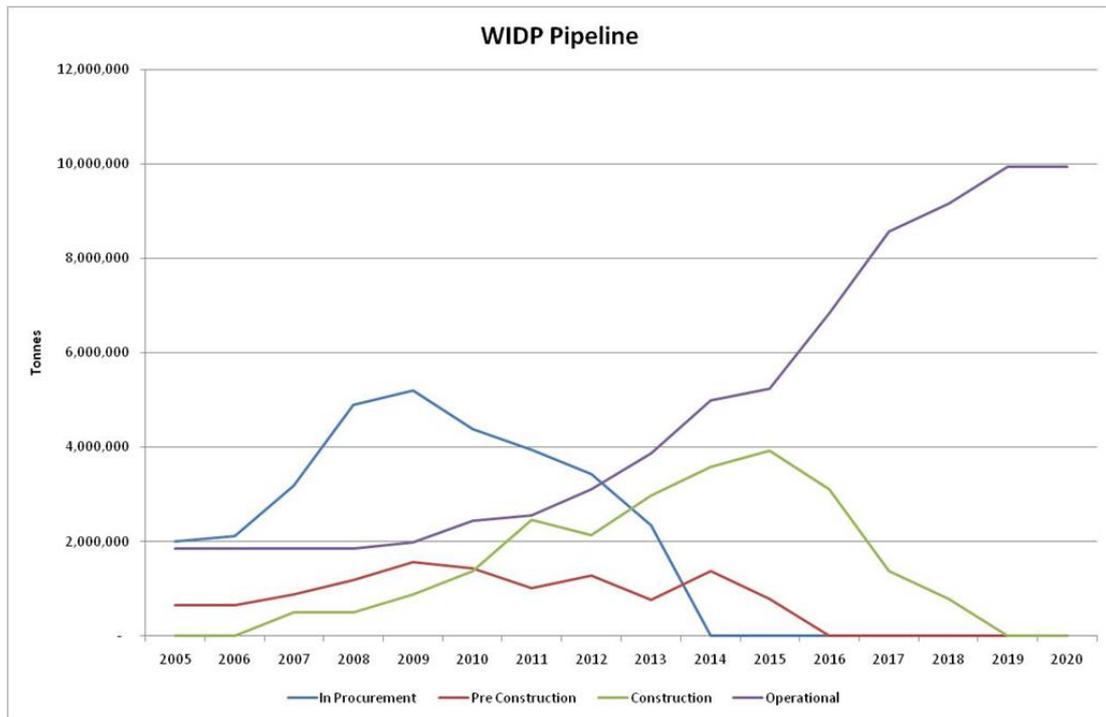
The household waste recycling rate, rather than the MSW recycling rate, is usually reported for the UK. The household waste recycling rate is based on arisings of household waste, and the materials which can be included in the tonnage of household waste which can be recycled exclude both source separated construction & demolition waste arisings at a civic amenity (public recycling and disposal) site, and any bottom ash from EfW facilities which is recycled. A compost product can only be classified as being recycled if it has a beneficial use (a low quality compost used as a soil improver is classified as recovery, but not recycling). The household waste recycling rate achieved in England in 2011/12 was 43%.

### **Residual Waste Treatment**

Residual waste is the municipal solid waste remaining after recycling and composting activities. In 2006 the Department of Environment, food and rural affairs (Defra) established a delivery unit (the Waste Infrastructure Delivery Programme – WIDP) to ensure that sufficient residual waste treatment infrastructure was deployed to achieve the 2010, 2013 and 2020 EU Landfill Directive Diversion targets for biodegradable municipal waste (BMW).

WIDP has allocated over £3bn of funding over the next 30 years to assist to local authorities responsible for waste management to procure and deliver the required treatment infrastructure. As part of this programme, and including developments outside of the programme, significant procurement and construction activity has taken place in this sector. For the projects within the WIDP programme, Figure 3 shows the pipeline (capacity vs time) profile for the key phases of development; procurement, pre-construction, construction and operational.

**Figure 3: WIDP Pipeline**



It can be noted that the procurement phase peaked in 2009 when approximately 5 million tonnes of capacity was being procured. Many projects are now in the construction phase which is due to peak in 2015 at about 4 million tonnes. When this phase is over, and assuming all projects are delivered, it can be seen that about 10 million tonnes of capacity will be operational.

Figure 4 below shows the geographical distribution of the facilities in England – these include mechanical biological treatment (MBT) plants and energy from waste (EfW) facilities – the latter are primarily grate based systems.

**Figure 4: Geographical distribution of facilities in England (Source; Niranjan Patel, Defra)**

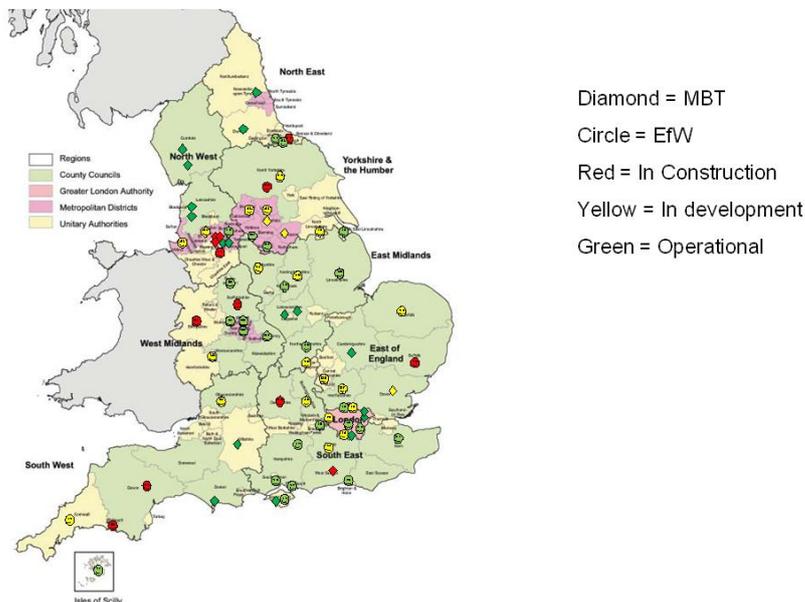
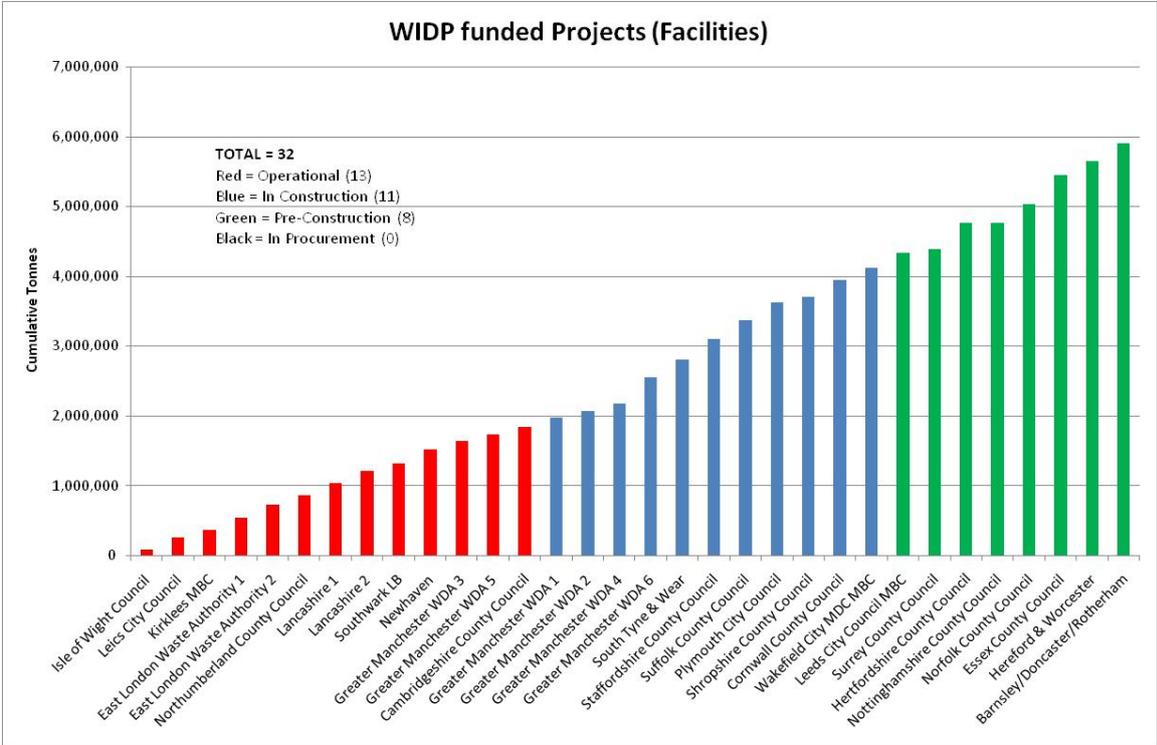


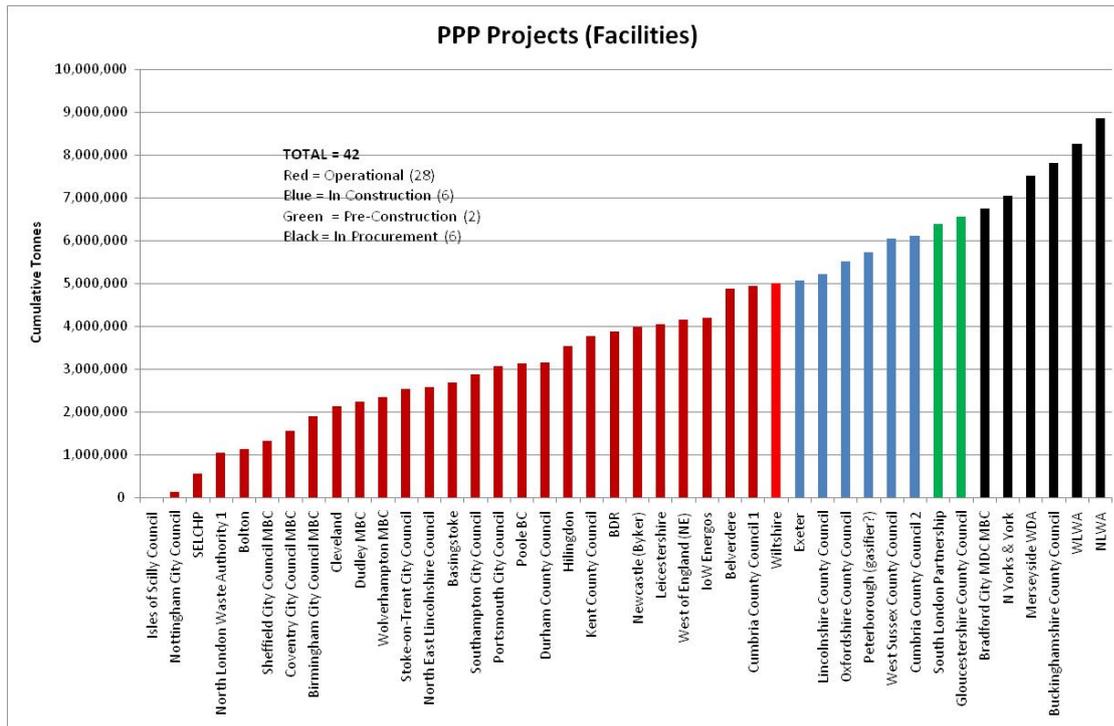
Figure 5 and Figure 6 show respectively the cumulative treatment capacity being delivered by both (WIDP) funded projects and those outside the programme. Given the difficulties in development (particularly in securing planning) it is unlikely that all of the listed facilities will actually progress to the operational phase but it does demonstrate the total additional capacity (over currently operational) that might be developed (in excess of 7 million tonnes) if all of the facilities are delivered.

In terms of energy generating capacity the operational plant equates to about 300 MWe (or assuming 50% renewable component then 150 MWe of renewable energy). There is the potential to increase this to over 1,000 MWe (500 MWe renewable) in the period up to 2020.

**Figure 5 Energy from waste capacity**



**Figure 6: PPP Projects**



**Advanced Waste Treatment in the UK**

The UK has seen huge increases in the amount of refuse-derived fuel exports in the last few years, In 2012, a total of 892,000 tonnes of RDF was exported, an increase on 272,000 tonnes the previous year. Exporting to Europe remains a cheaper option whilst the capacity in the UK continues to develop. Whilst infrastructure development in the UK includes a high quantity of traditional EfW combustion facilities, there is also a pipeline of developments of Advanced Thermal Treatment (ATT). This technology includes pyrolysis, gasification and plasma gasification. The UK is seen as an attractive market for the development of ATT facilities, due to landfill tax, robust regulatory regime and landfill diversion targets.

Table 2 summarises the current situation, including ATT plants which are currently operational and those which are at various stages of development.

**Table 2: Summary of Advanced Thermal Treatment facilities in UK**

	Operational	In Construction	Consented	Proposed
Advanced Thermal Treatment Facilities	5	3	15	12

<http://falcon.aea.com/index/map>

One example of an ATT project in the UK is the Advanced Plasma Power (APP) Gasplasma process. The APP process combines fluidised bed gasification followed by a further plasma convertor stage. A commercial scale pilot plant is already in operation at the companies Swindon headquarters. APP has recently announced a project with National Grid and Progressive Energy to develop bio-substitute natural gas. This project is intended to produce Bio-SNG from waste using the Gasplasma process and convert it to a gas suitable for injecting into the grid.

Plasma gasification is also the technology at the heart of the Air Products 49MW development at Teeside. Currently under construction, the plant is thought to be the world's largest gasification plant and is designed to process 300-350,000 tonnes of MSW and commercial and industrial waste per year.<sup>6</sup> Air Products hope to begin operation early 2014. They have recently announced plans for a second facility at Teeside (350,000t/y, 37MW) following signing of a 20 year power purchase agreement with the UK Government's Cabinet Office.<sup>7</sup>

Benefits/Advantages of the Teeside facility include;

- Advantages of the Westinghouse process:
- Ability to blend feedstocks
- Optimise gate fees by taking in wider range of wastes
- Plasma qualifies for incentives – 2x ROCS in UK
- Power in combined cycled mode – high efficiency
- Large quantities of waste can be treated – up to 1000t/d with a single gasifier
- Produces low cost syngas without the volatility of fossil fuels

A third scheme announced recently is the 13.6 MW plasma gasification plant proposed in London by Waste2Tricity.<sup>8</sup> This plant will be integrated with fuel cells. The plant will take around 100,000t/y of MSW or C&I waste. This plant and the Teeside plants will use Westinghouse Alter-NRG technology.

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<sup>6</sup> See: <http://www.airproducts.co.uk/teesvalley/>

<sup>7</sup> See: <http://www.waste-management-world.com/articles/2013/04/plasma-gasification-waste-to-energy-air-products-teesside-uk-government.html>

<sup>8</sup> <http://www.waste-management-world.com/articles/2013/04/plasma-gasification-waste-project-to-demo-fuel-cells.html>