BLACK BAG: Kicking the landfill habit

The UK consigns millions of tonnes of waste to sprawling landfills, but the search is on for an alternative.

There can be no greater shrine to human waste than landfill sites. The UK buries more than 18.8 million tonnes of household waste every year - two million tonnes more than any other EU country - only Greece, Spain and Ireland top it on a per capita basis. Although the UK has reduced the amount of waste that is sent to landfill sites - now 43.4 per cent from 79 per cent ten years ago - it still consigns 57 millions of tonnes of rubbish for burial each year - this comprises household waste along with that from industry and construction.

But the era of burying waste is coming to an end. Estimates from the Department of Environment, Food and Rural Affairs (Defra) point to only 650 million cubic metres of capacity left in the ground - three times the volume of Lake Windermere - which means that the UK will reach its limit by 2018.

So what is the solution? Greater recycling can ease the burden on landfills, organic material can be diverted to alternative waste streams, but there will still be the remaining waste. The answer could lie in incineration, although that has its own environmental concerns, and further in the future there is the possibility of gas plasma technology.

'In the past decade, household recycling has increased from 12 to 39 per cent, diverting millions of tonnes of waste from landfill,' Cllr Gary Porter, then the Local Government Association environment board chairman, said in response to Defra's waste review earlier this year. 'The environmental benefit has been enormous and the effort has helped council taxpayers avoid hundreds of millions of pounds in landfill tax. We recognise that even more needs to be done to achieve the zero-waste economy.'

Porter pointed to the fines that the UK could face under the EU Landfill Directive as an added incentive to further reduce landfills. If landfill is not below 50 per cent of the 1995 level by 2013 and 35 per cent by 2018, it will cost the UK £1m a day. 'The spectre of millions of pounds in possible EU fines looms large in 2013 and again in 2020 if we fail to meet challenging targets to reduce the amount of waste being put in the ground,' he said. 'The incentive for councils to continue and improve on already successful approaches to waste collection is clear.

'Boosting recycling is only addressing half the problem. Retailers, manufacturers and caterers must do more to bring down the 23 million tonnes of waste generated each year. The volume of packaging has not changed in the last five years and every year we throw out more than five million tonnes of edible food. We are pleased to see measures announced in the review to tackle waste at its source. We look forward to working with industry to help it address this significant problem.

He continues: 'If recycling becomes contaminated, it has to be sent to landfill. Allowing councils to identify and work with people who misunderstand or make mistakes when sorting their rubbish is important. As a last resort, councils also need effective, proportionate powers to take action against households or businesses which persistently or wilfully damage the local environment. We will work with Defra to ensure that adequate deterrents are in place to tackle the small number of people who undermine the good work of the rest of us.'

So why not landfill? In short, the biodegradable waste sent to landfill rots releasing methane and carbon dioxide, which in the UK accounts for 3 per cent of all climate change emissions. With this and possible financial sanctions in mind, the search is on for alternatives. Increasing the amount we recycle is one option but that can only take you so far.

One tonne of biodegradable waste produces between 200 and 400 cubic metres of landfill gas. Also during landfill site operation, a liquid known as 'leachate' is produced. This is a mixture of organic degradation products, liquid waste and rain water. Leachate is extremely variable in composition depending on the nature of waste in the landfill and the landfill design, but typically has high organic-carbon content, high concentrations of nitrogen, and is usually slightly acidic.

Landfills are designed and operated to seal waste as much as possible from the surrounding environment. Central to this protection is avoiding groundwater contamination.

But how does the rest of Europe fare. Italy dumps about 19 million tonnes of household waste in the ground, Spain 15 million, and France 12 million. But by far the best performer is Germany, which sends just 7 per cent of its waste to landfill thanks to high levels of recycling and incinerating 35 per cent of its waste.

Burning problem

Despite the success in Germany, the UK has only dipped its toes into the controversial water of incinerators. There are currently 27 waste incinerators in operation in the UK, with two more under construction.

The main concern surrounds pollutants found in the ash left in the incinerator and emitted from the chimney such as dioxins, acid gases, nitrogen oxide, heavy metals and particulates.

However, the introduction of tighter EU and UK regulations such as the Waste Incineration Directive has seen many of the older incinerators close down because they could not meet the stricter standards, driving a new breed of incinerators to the fore. One such incinerator is the Riverside Resource Recovery (RRR) facility at Belvedere. It will be one of the UK's most efficient energy recovery plants, processing waste from households and businesses in central London, as well as an important strategic waste management

facility. It will be capable of managing an average of 585,000t of residual waste each year, over its life, with an annual throughput of up to 670,000t.

London currently landfills 53 per cent of its municipal solid waste and due to the lack of waste treatment facilities in the capital most of this is exported to the Home Counties and beyond.

Operation of the plant started in 2011 with cold and hot commissioning. The facility will use conventional moving grate combustion technology, with a thermal efficiency of around 27 per cent. This places it at the forefront of UK and European EfW technology for electricity generation.

All but 85,000t of waste will be delivered in containers to the plant via the River Thames and off-loaded at the new jetty. It will be loaded onto the barges at Cory's existing river-served transfer stations at Walbrook Wharf in the City of London, Cringle Dock in Battersea, and Smugglers Way in Wandsworth.

Container-handling cranes will offload these containers and place them onto specialist container vehicles, which will transport them to a fully enclosed waste reception hall in the main building. Road-borne waste deliveries will access the waste reception hall by ramp.

Once inside, all vehicles will discharge their loads into the waste storage bunker. Air from the reception hall and bunker area will be drawn into the waste combustion units, creating a slight negative pressure to prevent the escape of odours, dust or litter.

The waste combustion process will be carefully and continuously monitored to ensure, for example, that minimum combustion temperatures exceed 850 degree C. Heat energy will be recovered from the flue gases through specialist, high-efficiency boilers. A turbine has the capability to supply up to 30MW of steam/heat and up to 72MW of electricity. Approximately 6MW of this will be used in the plant with the remainder generating at 11kV and transforming on site up to 132kV for export to the grid.

Exhaust steam from the turbine will be condensed by a bank of air-cooled condensers. The plant is designed with the capability of providing waste heat for nearby homes. Consultants PB Power have undertaken research to find an outlet for the heat. So far, however, they have found that the density of heat consumers in the local area is substantially lower than is typical for district heating schemes in the UK and they question whether it would be viable.

The principal residue from the process will be bottom ash with approximately 180,000t, including metals, being produced each year. This will be collected in the ash bunker and loaded into covered containers, which will then be loaded onto barges and sent on the River Thames for metal recovery and recycling into road building and construction aggregates.

Plasma future

Plasma technology is seen as the perfect answer to the environmental concerns of more traditional incinerators. Unlike incineration, plasma technology superheats waste in an oxygen-deprived environment.

Advanced Plasma Power (APP), leading exponents of plasma technology, have developed a flexible energy from waste technology called Gasplasma. A full Gasplasma plant comes in four main sections: a waste reception hall and Materials Recycling Facility (MRF); the core Gasplasma technology consisting of the fluidised bed gasifier and plasma convertor; gas cleaning equipment to cool, clean and condition the synthesis gas (syngas); and a power island to generate renewable power and recover residual heat.

The waste reception hall typically accepts 150,000t of residual Municipal Solid Waste or Commercial and Industrial waste a year. The waste is first sifted to remove any oversized objects and grit. The remainder is then put through the MRF to recover any metal, glass and hard plastics. The residue, which would normally go to landfill, is finally shredded and dried to make around 90,000t of Refuse Derived Fuel (RDF) a year.

The core technology is a two-stage Advanced Conversion Technology, which combines two long-standing and well-proven technologies to convert waste into a very clean, hydrogen-rich syngas.

The first stage is a Fluidised Bed Gasifier, which transforms the organic materials in the RDF into a crude syngas containing tars and chars. It does this by heating the RDF to around 800 degree C, in a highly controlled reduced oxygen environment. The crude syngas is then passed into a separate, secondary Plasma Converter. The intense heat from the plasma arc - in excess of 8,000 degree C - and the strong ultraviolet light of the plasma 'cracks' the crude syngas. The cracking creates a clean syngas, while the bottom ash from the gasifier is vitrified into a product called Plasmarok.

The syngas is then cooled, cleaned and conditioned through wet and dry scrubbers before being used directly in a Power Island to generate renewable energy on a highly efficient basis. Residual heat is also recovered from the process to be used in CHP mode within the process itself, as well as for other users in the vicinity.

Landfill mining

Despite the environmental concerns surrounding landfill sites, they, or more accurately the gas they contain, can be a vital source of energy. 'Greater use of biogas from landfill sites and anaerobic digestion processes, together with methane from coal mines, is already leading to substantial reductions in greenhouse gases,' Ian Cooper, business development manager at ENER-G Natural Power, explains.

Biogas technologies are an environmentalist's dream. Knowing that methane, for example, is 21 times more damaging to the ozone and subsequent climate changes than CO_2, it is destroyed by using the fuel to generate electricity and therefore doubling the environmental benefit.

ENER-G builds, owns, operates and maintains a number of landfills and mines gas-use schemes in the UK and Europe. To date, the company has installed over 150MWs of generating capacity.

The process of exploitation involves installing a network of deep wells into the waste mass and abstracting the gas using a pump and blower unit, which directs it through a surface-laid system of connection pipework to a generation compound. In the compound, state-of-the-art spark ignition reciprocating engines use the fuel to generate green electricity, which is subsequently sold to the National Grid network operator.

The process sounds simple. However, should oxygen greater than 5 per cent v/v enter the system, it can have the catastrophic effect of destroying the generator units in an instant.

Among UK schemes to come into operation is Locharmoss Waste Disposal site near Dumfries, Scotland, which will generate enough

green electricity to power 800 homes and cut annual carbon emissions by the equivalent of approximately 20,000t. *

http://eandt.theiet.org/magazine/2011/12/demise-of-landfill.cfm?utm_source=Adestra&utm_campaign=E%26T%20News%3A%2011%20January%202012%20-%20members&utm_medium=Newsletters&utm_term=marketing_email&utm_content=E%26T%20News%20-%20Members