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From trash to cash: The enticing economics of energy from waste

November 2020

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From trash to cash: The enticing economics of energy from waste

As the UK grapples with its mounting waste problem and increasingly urgent emissions reduction targets, Fieldfisher's EfW experts consider the opportunities to expand the role of energy from waste.

What is waste?

The UK's definition of waste has been in use for four decades. It is embedded in the EU's 2008 Waste Framework Directive (Directive 2008/98/EC) Article 3(1), which defines waste as:

"…any substance or object which the holder discards or intends or is required to discard…"

This means that almost anything can become waste, once it has been discarded and/or reached the end of its useful life.

Waste as fuel

The terms "energy recovery (from waste)", or simply "energy from waste" (EfW) can be used interchangeably and cover a range of different processes and technologies (see below).

Burning waste to generate energy has been around for more than a century. While early forms of the technology relied on basic incineration techniques, the last 30 years has seen the development of far more sophisticated EfW processes, including combustion, gasification, pyrolysis and anaerobic digestion (AD).

In the UK, the introduction of landfill diversion targets in the mid-1990s (see below) helped drive a new generation of EfW plants, designed to meet strict emissions standards, and provide valuable low-carbon, partially renewable* energy.

The energy generation capacity of waste depends on calorific value (CV), which is measured by how much energy is available per tonne of waste. Different waste components have different calorific values – for example, food waste tends to have a relatively low CV due to its high water content, while the CV of plastic, which is generally made from hydrocarbons, is much higher.

The main EfW technologies—an overview

Combustion

Combustion (or incineration) is considered when the CV of the input feed is at least 7MJ/Kg. Combustion is where waste is burned to produce heat. Conversion of thermal energy from incineration can be used to drive a steam turbine for electricity.

Combustion produces emissions – 250-600 kg CO2/tonne of waste processed – but this is offset by the fact that fossil fuels do not need to burned. Other pollutants are emitted as flue gas, however various technologies have been developed and deployed to clean the flue gas so that emissions fall within regulated limits.

Gasification

Rather than driving turbines directly, gasification produces gas from waste. The waste is combined with oxygen and/or steam at very high temperature to produce 'syngas' – synthesised gas which can be used to make products including transport fuels or fertilisers, or turned into electricity. Gasification is often followed by combustion, resulting in the same emissions issues.

Pyrolysis

Pyrolysis of waste takes place at high temperature, but without oxygen, or in an atmosphere of inert gases. This means the process requires lower temperatures than combustion, and has lower emissions of some air pollutants.

**Friends of the Earth does not consider the energy generated through either gasification or pyrolysis as truly 'renewable' because they release CO2 from fossil fuel origins such as plastics and synthetic textiles as well as biological materials.*

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Anaerobic digestion

Anaerobic digestion (AD) synthesises waste that has higher water content (such as agricultural waste and food waste) through a series of microbial processes to generate biogas.

The waste is broken down in an oxygen-free tank to produce biogas and fertiliser.

Source: Adapted from the Energy Saving Trust

The economics of EfW

In the UK, all waste comes with a liability attached. This means that whoever generates the waste will need to pay to get rid of it.

Household waste collection by local authorities is paid for through council tax. Local authorities that pick up waste then have to pay an offtaker a "gate fee" to process it. The waste processor will then pay another offtaker a gate fee to handle the resulting waste stream and so on, until it eventually arrives at an EfW facility in a form suitable for conversion to energy.

The economics of waste rely on offtakers paying less to get rid of waste than they were paid to accept it. This creates an economic supply chain.

For offtakers, there is a financial incentive to clean out the waste stream to remove certain categories of material that carry a resale value, such as metals, plastics and paper.

When as many as possible of these valuable components have been removed, what remains is known as residual waste – non-hazardous waste material that cannot be (practically or economically) re-used or recycled.

In the absence of EfW as a waste diversion option, this residual waste would only be fit for landfill. Once earmarked for EfW, this residual waste is generally referred to as refuse-derived fuel (RDF) or solid recovered fuel (SRF).

Landfill tax

Since 1996, successive governments have taken steps to deter landfilling waste by gradually ramping up Landfill Tax.

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Landfill Tax is charged on material disposed of at landfill sites and is intended to encourage use of non-landfill options, such as recycling, composting and recovery (i.e., EfW).

Under current government policy, the Landfill Tax standard rate increases annually line with the RPI rate of inflation.

Section 42 of the Finance Act 1996 (as amended by the Finance Bill 2020) specifies the rates of Landfill Tax which, as of 1 April 2020, stand at £94.15/tonne for standard rated waste, up from £7/tonne in 1996; and £3.00/tonne for lower rated waste (less polluting 'qualifying materials' listed in the Schedule to the Landfill Tax (Qualifying Material) Order 1996), up from £2/tonne in 1996.

Economic challenges of diverting waste from landfill

While the cost of landfilling waste has become increasingly prohibitive, other waste management options come with their own economic and practical challenges.

Transport

There is a significant cost to transporting waste, and fine margins can be eroded by these costs. This means waste offtakers will usually look for the closest available option for offloading waste.

The location of EfW plants is therefore highly significant, as their distance from where waste is generated can make the difference between profit and loss for suppliers.

A consequence of high transport costs is that it is often cheaper to export waste overseas than to truck it around the UK, creating a market for UK RDF in other countries (mainly in northern Europe) where companies are paid to accept UK waste.

Since early 2020, however, the imposition of taxes on waste imports by some European countries has made exporting RDF a less attractive option for UK suppliers (*see below*).

Storage

Storing waste legally in the UK requires a permit.

In 2019, there were around 14,000 waste storage permit holders in the UK covering everything from end of life vehicles to waste wood. These storage facilities are subject to extremely strict regulations including rules on the height, width and spacing of waste stacks, which vary depending on the type of waste, associated fire risk, air quality impacts and other environmental factors.

Regulations and permits are controlled and enforced by the Environment Agency (EA), which determines and approves where and how waste can be stored in line with UK planning laws (see below).

Restrictions on the amount of waste that can be stored in a particular location are exacerbated by the seasonality of waste flows in the UK, as more waste tends to be produced in summer (driven largely by construction and DIY activity) when energy demand is lower, putting more pressure on storage facilities.

The EA prosecutes waste storage facilities for holding more waste than their permits allow, or for storing waste in areas not covered by permits. Breaching permits can result in facilities being fined or even shut down.

Because EfW plants are typically supplied by large numbers of small waste sites, which have usually been selected for the quality and reliability of their waste supply, if any get closed down, this can severely impact fuel availability.

Equally, if an EfW plant goes offline temporarily for maintenance, this can cause problems for suppliers who risk exceeding storage capacity.

The nature and volume of UK waste

Efforts to change the composition and amount of waste generated in the UK have been a mixed bag for the EfW industry.

Better sorting techniques, such as the requirement by some local authorities to separate food waste and recyclable materials, is improving the quality and consistency of waste streams, particularly for EfW facilities that rely on biodegradable waste.

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However, the increasing use of bioplastics and the removal of recyclable material from waste streams decreases the CV of waste, while a government-backed drive to reduce the overall amount of waste produced by households could also starve some EfW facilities of fuel supply.

Overview of key legislation affecting waste management in the UK

Local authorities regulate most small (less than 1 tonne/hour waste) incinerators. The Environment Agency regulates all incinerators that burn hazardous waste and incinerators that burn non-hazardous waste at a rate of more than 1 tonne/hour. The EA also regulates all EfW plants burning municipal waste to monitor emissions. A full set of guides on the production, transport, storage, treatment, disposal and recovery of waste is available on the UK government website.

The Environmental Permitting (England and Wales) Regulations 2016 (EPR)

The EPR requires operators of "regulated facilities" to obtain a permit or to register some activities, which would otherwise require permits, as "exempt facilities".

Regulated facilities include:

- Waste operations
- Mobile waste plants
- Small waste incineration plants
- Medium combustion plants; and
- Specified generators

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The Waste (England and Wales) Regulations 2011 (EPR)

These regulations implement the revised EU Waste Framework Directive 2008/98, which sets requirements for the collection, transport, recovery and disposal of waste.

They require businesses to confirm they have applied the waste management hierarchy when transferring waste.

The regulations apply to businesses that:

- Produce waste
- Import or export waste
- Carry or transport waste
- Keep or store waste
- Treat waste
- Dispose of waste
- Operate as waste brokers or dealers

The hierarchy sets out, in order of priority, the waste management options that should be considered:

- Prevention
- Preparing for re-use
- Recycling
- Recovery, e.g. energy recovery
- Disposal

The Hazardous Waste (England and Wales) Regulations 2005 (amended 2016)

These regulations are intended to reduce pollution caused by hazardous waste and specify how such waste should be disposed of.

Hazardous wastes are defined, listed and coded in the European Waste Catalogue; these codes are transposed into UK law through The List of Wastes (LOW) Regulations.

EfW in the UK

Despite its various practical, regulatory and economic challenges, the UK has the potential to be an excellent market for EfW projects.

Following the introduction of new waste management policies in the mid-1990s, the UK waste industry only really commenced the transition from landfill to treatment and recovery of residual waste more than a decade later in the late-2000s.

This shift was chiefly driven by the need to comply with EU's 2008 Waste Framework Directive and successive EU environmental policies, and was underpinned by the introduction of the Landfill Tax escalator, the UK government's private finance initiatives (PFIs) and public private partnerships (PPPs).

During their heyday the mid-to-late 2000s, PFIs and PPPs were seen as the main routes to developing EfW projects, and numerous operators participated in lengthy and competitive tenders to secure local authority contracts.

After 2009, when enthusiasm for PFIs and PPPs began to ebb and austerity measures following the global financial crash slashed local authority budgets, many contracts awarded under these schemes were cancelled, some at very late stages. This somewhat tarnished the UK's reputation as a promising market for EfW.

However, in the last five years, the market has revived, thanks partly to renewed emphasis on finding sustainable long-term solutions to waste management and to meeting climate change objectives (including the UK's binding Net Zero emissions by 2050 target) laid out in the 2015 Paris Agreement and ratified by the UK in 2016, requiring greater reliance on renewable energy.

Regional differences

While there is a clear need for alternatives to landfilling residual waste in the UK as a whole, regional variations exist in terms of remaining landfill capacity, waste arisings and the ability to obtain planning consent for waste storage and EfW facilities.

The Midlands and North of England have significant remaining landfill capacity, however the South of England, where largest volumes of waste arisings exist, is now almost completely depleted in terms of landfill capacity.

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Identifying appropriate sites and obtaining planning permission for waste disposal and treatment facilities is more problematic in the South than in the rest of the country, meaning that even waste disposal solutions like EfW projects have difficulties securing approval.

Contrast with the US

New entrants to the UK EfW market helped set the pace for developing domestic EfW projects in the mid-2000s.

Many of these new entrants had already established successful EfW portfolios in other markets such as the US. By partnering with local players to understand specific UK market drivers, they were able to adapt their business models to drive growth in UK EfW capacity.

Those with track records of developing and running EfW plants in other countries were able to reassure UK authorities about the feasibility, longevity and safety of properly managed projects.

The UK's waste disposal context made it particularly attractive to US EfW developers, many of which were facing stagnation in their home market.

Landfill opportunities in the US remain plentiful and low cost, recycling is patchy, and low fuel prices make it financially viable to move waste vast distances from populous coastal regions to landfills in sparsely populated inland areas. Consequently, around 92% of residual waste in the US is currently sent to landfill.

Factors shaping UK's EfW opportunity

Diversified revenue stream

The main attraction of EfW, particularly in the context of decreasing energy prices, is the additional revenue streams offered by this method of processing waste.

Income is received from the sale of energy, but also from gate fees (payments received per tonne of waste accepted and processed) which is attractive to waste collectors as the alternative disposal route is heavily taxed landfill (see above).

The requirement to dispose of waste responsibly is not directly connected to the energy market, which means gate fees do not materially correlate with, and can move independently from, energy prices.

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For funds with large exposure to energy prices, which is not uncommon in the renewables space, EfW offers an opportunity for revenue diversification.

Gate fees

The outlook for gate fees in the UK EfW market is encouraging for developers, as the UK, which is currently a net waste exporter, is running out of places to send its residual waste.

EA statistics indicate that England exported more than 2.7 million tonnes of RDF in 2019, 13% less than the previous year, with the decline partly attributed to countries including the Netherlands and Sweden, which have historically been major destinations for UK waste shipments, signalling their intention to tax waste imports from 2020.

The weakness of the British pound (which has been its de facto status since the UK Brexit referendum in 2016) is also likely to have restrained waste exports, as the attractiveness of UK waste gate fees to European EfW plants is lower when GBP is weaker.

In the near-to-medium term, policy intervention could force higher rates of recycling of plastic and separation of food waste, a favourable Brexit deal could reboot the value of the pound, and an increase in domestic EfW capacity could all reduce the UK's RDF overhang, which would undermine EfWs' leverage on gate fees.

However, as matters stand, operators look likely to be in a strong position to set gate fees for the foreseeable future.

Demand for baseload

With increasing levels of intermittent generation (mainly wind and solar) being added to the UK energy mix, the importance of baseload generation (the minimum amount of electric power needed to be supplied to the electrical grid at any given time) provided by EfW will grow as coal generation is phased out (even with power-to-gas back-up and battery storage helping to achieve grid balancing).

Public, political and economic pressure

Increasing demand (social and economic) for the UK to build enough processing capacity to deal with its own waste by means other than landfill or exporting to overseas EfW plants, is likely to prove a strong push factor for expanding domestic EfW capacity.

Politicians and pressure groups are also scrutinising the government's efforts to meet its Net Zero emissions by 2050 target, which could favour EfW as an alternative to fossil fuel-based energy generation technology.

However, the government will be anxious to avoid saturating the domestic EfW market to a point where the UK is forced to import waste to feed its plants.

Factors to consider for prospective EfW projects

Risk profile

UK EfW plants with steady track records and established feedstock supply chains remain attractive assets for investors.

However, the relatively low risk profile of operational EfW projects means these are usually marketed competitively and vendors are likely to push for premiums on sale.

The space is dominated by the large waste and energy utility companies and acquisition opportunities, particularly for larger scale projects, can be hotly contested.

Greenfield development projects and underperforming assets where the incumbent owner is struggling to resolve construction or operational challenges are particularly popular with investors seeking returns. However, such opportunities clearly come with a commensurate increase in risk.

To manage these risks, it is important to fully understand the additional complexity and develop appropriate contracts, strategies and business models to mitigate any potential downside.

Working with experienced advisers, investment teams and developers is therefore recommended.

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Plant location

When assessing potential greenfield projects, finding developers who understand what makes the right site location for an EfW plant is crucial.

Access to road and other transport infrastructure and proximity to waste supply are key aspects, but these on their own do not make optimal locations.

Locations where it is easiest to get planning permission for EfW plants – usually in industrial/post-industrial areas – often host existing energy recovery projects and other competitors for waste supply.

Competition for waste is typically less intense and haulage costs are lower in areas where securing planning consents is most challenging, although this increases the risk profile for project developers

Trucking waste long distances by road is very carbon-intensive, but due to the difficulty in getting planning consents close to cities and densely populated parts of the Southern England where the majority of waste is generated, it is sometimes unavoidable.

Where possible, it makes sense to build moderately sized EfW plants close to populated cities/conurbations to reduce 'waste miles' and take advantage of localised markets for the energy produced from waste.

However, the lack of a fully co-ordinated UK waste strategy and the effect of 'nimby-ism' (not in my back yard) and 'banana-ism' (build absolutely nothing anywhere near anyone) on planning decisions means that efficient theory is rarely translated into practice.

Identifying and developing sites that balance the above aspects successfully takes experience and a deep understanding of the UK and regional waste markets and planning regulations.

Energy distribution

Most EfW plants in the UK are built onsite (co-located) at an offtaker's premises specifically to supply their operations.

Distributing power to the grid (for example, any excess power from a co-located EfW) plant is more complicated than serving a single nearby offtaker. While many sites may be relatively straightforward to connect to the electricity grid, a plant aiming to convert and upgrade syngas to biomethane and link up with the gas network may have a more limited choice of sites.

If heat is a major output from the EfW facility, it is essential that customers for the heat are relatively close by, as heat pipeworks are very costly to install. Heat offtake is not common in the UK, unlike many other European countries such as the Nordics, where EfW plants are often sited in urban areas connected directly to the local heat grid.

Shifting subsidies

One shift in the private equity-funded EfW market in the last five years relates to subsidies.

The Renewable Obligation Certificate (ROC) subsidy scheme was closed in March 2017 and replaced with the UK electricity market reform (EMR) contract for differences (CfD) auction regime, which effectively provides a 15-year inflation-linked fixed price to renewable energy generators that are successful at auction.

The potential for revenue stability this can offer is attractive to investors. However, EfW plants need to meet the advanced conversion technology (ACT) criteria and compete in increasingly competitive auctions, with other technologies that have relatively lower levelised costs per MWh, such as offshore wind, to secure CfD tariffs.

Project developers and contractors are increasingly opting for standard combustion plant designs, which also offer (relatively) lower technological complexity and a broader pool of EPC and O&M contractors.

Like the rest of the sustainable energy world, the medium to long-term future for EfW looks almost certain to be unsubsidised. With lower levels of contracted cash flows, developers will have to work harder, manage more merchant exposure and partner with investors who understand the market dynamics to raise funding to put new projects successfully into construction.

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Feedstock and contractor markets

Long-term waste supply contracts with investment-grade counterparties are increasingly scarce.

Most councils have secured long-term offtake solutions for their municipal solid waste (MSW) arisings by running PFI and PPP initiatives, mainly with contracts awarded to large utility companies following rigorous and costly tender processes.

Building a Commercial and Industrial (C&I) feedstock supply contracting strategy with a range of terms and blend of cornerstone and merchant suppliers to secure RDF for EfW is therefore key.

Understanding the properties/specification of the available waste and how much processing is required to make it ready for conversion into energy within the capabilities of a plant's design is technically complex.

Deciding exactly how to pre-process the waste and whether the plant should do it on site or rely on suppliers to do it is not always straightforward.

Successful greenfield projects also require carefully put together and negotiated construction and operational contracts to wrap around and deliver the overall strategy.

A smarter future

Subsidised operational assets with a good track record (particularly wind and solar) are in short supply and high demand.

Aggregation strategies led by unlisted YieldCos and listed funds are already fully established and overseas capital is flowing into European renewables.

The assets remain attractive, but returns are relatively compressed as a result.

The cost of locking-in to medium-long term fixed price power purchase agreements (PPAs) in an unsubsidised world is high and drives investors and managers increasingly towards merchant power offtake strategies and low (or no) debt, at least for construction assets.

Subsidised projects with a merchant power element (e.g., ROCs projects), particularly those with high gearing levels, are feeling the impact of the recent reduction in actual and forecast energy prices.

Brexit

Exporting waste to continental Europe continues but is declining, and is expected to fall significantly post-Brexit.

This drop is predicted to be exacerbated by foreign exchange risk and potentially complex customs arrangements after the UK leaves the EU, plus the introduction of taxes on imported waste in the Netherlands and Sweden, and the possibility of further carbon taxes, creating the need for more treatment capacity within the UK.

Conclusion

In the context of the above, UK EfW assets with revenue diversification from gate fees and a favourable waste market outlook, are increasingly attractive to investors.

However, the relatively higher risk profile and complexity of these projects, particularly for greenfield EfW, should not be overlooked and experience will be required if the apparent return premiums are to be realised.

New policies are required in the UK to further encourage the use of heat generated by EfW by energy consumers.

EfW developments are limited in the UK, with only eight of the 45 plants currently in operation delivering both heat and power, although all are successfully diverting waste from landfill.

Public opinion clearly identifies the environment as a priority for policy to address and EfW has a role to play in reducing the negative impact of waste.

Acknowledgements

With thanks to Foresight and Wheelabrator Technologies for their contributions to this paper.

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