EfW Outputs and Residues

Guidance on the management of energy outputs and residues including air pollution control residues and incinerator bottom ash
1.0 ENERGY FROM WASTE OUTPUTS

The choice of technology, fuel and plant design will generate varying quantities of energy output and residual material at the end of the treatment process. Operators will need to consider and evaluate the following within the business case for their chosen EfW technology:

- electricity production;
- heat or cooling potential;
- syngas production,
- management of the outputs and waste residues; and
- current and future markets.

1.1 Electricity production

The most common output from EfW facilities will be heat to drive a steam cycle, which drives a turbine, spinning a magnet against a wire coil to produce electricity. This will most often be sold to the National Grid, although some facilities will sell their electricity output directly to industrial users. Electricity produced in this manner will qualify for ROCs payments\(^1\) for the biogenic fraction of the fuel input\(^2\).

1.2 Heat production or cooling

Industrial users may want to consider producing their own heat by utilising their own wastes to produce their own fuels. This can provide direct heat for industrial processes, thereby reducing the dependence on fossil fuels and reducing fossil carbon releases. Heat produced in this manner could be eligible for incentive payments under the RHI\(^3\).

1.3 Combined Heat and Power (CHP)

Operators may also want to consider an assessment for potential combined heat and power (CHP) where electricity is produced as in section 1.1, and then the waste heat is captured and re-used in a manner similar to section 1.2. This increases the efficiency of the thermal process significantly. Operators also have the option to consider exporting the heat to an alternative end market. For example, heat can be used to generate cooling through a heat exchange system for refrigeration processes. Heat, steam or cooling energy is relatively complex to export to off-takers and is dependent on the location and reliability of a suitable consumer. The installation and management of a network of insulated pipes can considerably increase the cost of a development.

1.4 Transport Fuels

Although markets are minimal at present, the production of transport fuels from waste is a technically feasible process garnering much interest on a global stage. Fuels from unrecyclable plastics, for instance, could help address both landfill and energy issues. Fossil based plastics, derived from oil, can be broken down into their constituent elements in order to be refined and processed into diesel fuels.

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\(^1\) See WRAP guidance on Incentives
\(^2\) See WRAP guidance on Fuel and Feedstocks
\(^3\) See WRAP guidance on Incentives

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2.0 ENERGY FROM WASTE RESIDUES

Thermal treatment processes do not destroy material. Fuel input is converted, via an exothermic chemical reaction, to break the bonds of atoms within the fuel and release certain elements and compounds (e.g. hydrogen, methane, and carbon monoxide). These chemical compounds can then be combusted to produce heat. Inevitably, there are compounds which are not usable in this manner and which will produce wastes and residues. The residues will generally be ashes, aggregates and particles within the flue gases (see section 2.1). Some of these can be recovered and recycled and others need to be disposed of in a landfill. Gasification and pyrolysis processes typically produce a syngas (see Section 2.4), an oil and a solid char residue. During the plant design process provision should be made within the site infrastructure for storage of the residues, as well as their treatment, removal, transport and disposal. Developers should consider how these will be managed either at the site or taken off site for further recovery or disposal. Operators should consider the quantities and costs of managing all the outputs and residues within a recovery plan.

2.1 Fly ash and air pollution control (APC) residues

Fly ash and APC residues are the by-products of the flue gas cleaning process and are commonly combined. These wastes can become a dust hazard and operators will need to put in place specific arrangements for their storage, handling and transportation. APC residue is typically a mixture of ash, carbon and lime. It is a hazardous waste which is currently disposed of at a hazardous waste landfill or undergoes further processing such as washing or stabilisation to send to a non-hazardous landfill. Fly ash, which is a lighter weight ash, can be recovered and used in a manufacturing process, such as cement manufacture.

2.2 Incinerator bottom ash (IBA)

Following the combustion process non-combustible ash of varying particle size is produced, often containing mineral material and metals. The ash which falls to the bottom of the process is typically dry and dusty and operators will need to ensure that it is appropriately stored in covered containers to prevent emissions to air. Operators will need to consider dust suppression, containment, transport and recovery or disposal options. An ‘Incinerator Bottom Ash Quality Protocol’ is currently being considered through the Waste Protocols project, in an attempt to define an end-of-waste point for the material, therefore allowing its further use as, for instance, an aggregate replacement.

Current waste data shows that over half a million tonnes of IBA goes to landfill each year in England and Wales. However, as recovery processes have improved this material can now be processed and recycled back into applications such as aggregate replacement for sub base road construction, bulk fill, concrete block manufacture or concrete grouting.

The IBA aggregate produced from municipal waste contains glass, brick, stone, concrete, ceramics and fused clinker. Processed IBA can comply with EN and British Standards and the aggregate product has been shown to exhibit engineering properties which are similar to natural aggregates. Across the UK established markets for IBA are now opening up which are replacing primary, virgin aggregates with processed IBA in specific civil engineering applications.

The Highways Agency has been accepting processed incinerator bottom ash (IBA) as an aggregate in bound and unbound layers in road construction where it meets aggregate requirements.

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2.3 Products and residues from thermal processes

The types of residues will be dependent on the waste fuel used, its composition and quantity. A modern municipal waste incinerator will typically produce IBA at around 25% of the input mass. There may also be rejected feedstocks and recovered waste fractions such as ferrous metals. Operators should separate these two waste streams (usually with an overband magnet) in order to recycle and recover them.

New processes are being driven by industry such as plasma arc gasification which utilises an electrically powered plasma stream to raise the temperature to 1500°C. This process releases releases a syngas and additionally vitrifies the waste remnants to provide a safe, stable by product, which can be used as an aggregate replacement.

2.4 Syngas, tars, char and ash

Advanced Conversion Technologies (ACTs) such as gasification and pyrolysis produce what is known as syngas. This typically consists of hydrogen, methane and carbon monoxide which can be combusted or turned into a fuel to run a turbine to generate electricity. Another by-product of ACTs is char, which can be recovered from the residue and used as a fuel. The tars, char and ash can also be processed for use in the petrochemical industry and in concrete or asphalt applications. The gases and oils produced by ACT can be combusted in an engine, gas turbine or boiler to produce electricity and or heat. Alternatively they can be further processed into a liquid fuel which can be stored, transported and refined.

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