



## Energy from waste and incineration

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Incineration is the burning of waste to reduce its volume, so that the remaining ash is easier to dispose of. Energy from waste (EfW) takes this process further by recovering some of the energy contained in the waste. There are a variety of incineration and EfW technologies, such as gasification. Together these technologies are called ‘thermal treatment’.

Local opposition to thermal treatment technologies can be fierce. Concerns are often raised about the health implications and the wider environmental impacts of burning waste. However, Government agencies and many professional groups argue that the evidence shows that the thermal treatment of waste is safe. Many also argue that it can play an important role in sustainable waste management—although the degree to which a plant may be considered ‘sustainable’ is dependent upon a number of factors.

It is likely that these technologies will play an increasing role in UK waste management as it becomes more expensive to landfill waste. These technologies may also become increasingly important in the move towards a low carbon economy. However, some analysts have indicated that we might be nearing maximum capacity for thermal treatment in the UK, depending on the number of plants that gain consent and the waste policies introduced.

The Government’s Waste Review stated that it would continue to “support the role of energy recovery from waste within the waste hierarchy and aim to improve understanding of this role”.

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## **1 What is incineration, energy from waste, combined heat and power and thermal treatment?**

Incineration is the burning of waste to reduce its volume, so that the remaining ash is easier to dispose of. Energy from waste (EfW) takes this process further by recovering some of the energy contained in the waste. If both electricity and heat is recovered from the waste, the plant is known as combined heat and power (CHP).<sup>1</sup>

There are a variety of incineration and EfW technologies, such as gasification. Together these technologies are called ‘thermal treatment’. Background technical information on thermal treatment technologies can be found in the Defra documents [Incineration of Municipal Solid Waste](#) and [Advanced Thermal Treatment of Municipal Solid Waste](#).<sup>2</sup>

## **2 Legislation**

Thermal treatment of waste is covered by the EU Waste Incineration Directive 2000/76/EC. The Directive aims to prevent or limit “as far as practicable” pollution through the setting of specific conditions, technical requirements and emission limit values.<sup>3</sup> The regime operates on the principle that installations must operate using the best available technologies for reducing pollution, as set out [in guidance](#).

In addition, the revised Waste Framework Directive 2008/98/EC states that a thermal treatment plant can be considered a ‘recovery’ option rather than a ‘disposal’ option if the plant exceeds a certain efficiency level of energy recovery. This distinction is intended to

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<sup>1</sup> Sustainable Development Commission Scotland, [A burning issue; Energy from Waste in Scotland](#), 17 December 2007

<sup>2</sup> [New waste technologies: Supporter programme publications](#), Defra, 27 August 2008

<sup>3</sup> [Environmental Permitting Guidance; The Waste Incineration Directive, For the Environmental Permitting \(England and Wales\) Regulations 2010](#), Defra, March 2010

incentivise more efficient plant over less efficient plant and landfill options. The efficiency is calculated using the R1 formula found in Annex II of the Directive.<sup>4</sup>

## 2.1 Regulating thermal treatment—the environmental permitting process

The Waste Incineration Directive has been transposed in England and Wales through the *Environmental Permitting (England and Wales) Regulations 2007*. These regulations mean that thermal plant must have a permit from the Environment Agency to operate. More information can be found on the [Environment Agency website](#).

The Environment Agency will only grant a permit for a plant to operate if it is “sure that the plant will be designed, constructed and operated in a way that will not significantly pollute the environment or harm human health”.<sup>5</sup> Specifically, the following conditions have to be met:

- the applicant has demonstrated that the proposed facility meets the requirements of the Environmental Permitting Regulations and uses Best Available Techniques in its design and operation. It must also meet criteria set out in other relevant Directives on Air Quality, Urban Waste Water and Dangerous Substance;
- the standards proposed for the design, construction and operation of the facility meet or exceed our guidance, national legislation and relevant Directives;
- the comments received from the public and statutory consultees have been taken into account;
- as far as practicable, the energy generated by the EfW plant will be recovered for use;
- the amount of residues and their harmfulness will be minimised and recycled where appropriate; and
- proposed measurement techniques for emissions are in line with those specified in national legislation and relevant Directives.<sup>6</sup>

## 2.2 Monitoring and enforcement

The Environment Agency will issue a permit if it is satisfied that the criteria set out in guidance are met in an application. Permits contain a series of legally binding conditions such as:

- Staff training, awareness of permit conditions and providing written operating instructions.
- Receiving, handling and storing waste and raw materials.
- Categories of waste that can be incinerated.
- Plant operating conditions, for example residence time, temperature, ash burn out.
- Energy efficiency, accident prevention, noise and vibration control.

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<sup>4</sup> *Waste to Energy Focus: Achieving R1 Status*, Waste Management World, viewed 13 May 2011

<sup>5</sup> *Energy from waste – regulation*, Environment Agency, viewed 13 May 2011

<sup>6</sup> *ibid*

- Emission limit values for air, water, land, sewer and ground water protection (where appropriate).
- Monitoring – techniques, equipment, standards, sampling etc. The permit specifies the frequency of monitoring and reporting. All EfW plants must have continuous monitors for gaseous pollutants and dust. Heavy metals and dioxins are monitored periodically but at a defined frequency.
- Record keeping, reporting and notifications, for example all exceedances of emission limits must be notified to the Environment Agency within 24 hours.

The Environment Agency monitors plant throughout their operation to ensure compliance with the permit. It said:

- Operators must monitor emissions at given times and report the results to us.
- We regularly inspect installations, review monitoring techniques and assess monitoring results to measure the performance of the plant.
- We carry out independent routine monitoring of emissions (once a year for all EfW plants) or undertake auditing of operator monitoring, as well as making spot checks.
- Operators must inform us within 24 hours of any breach of the emissions limits, followed by a fuller report of the size of the release, its impact and how they propose to avoid this happening in the future.
- Operators' monitoring results are placed on the public registers.

The Environment Agency will take enforcement action against those who fail to meet the requirements of their permit. The Agency explained that enforcement can include:

- enforcement notices and works notices (where contravention can be prevented or needs to be remedied);
- prohibition notices (where there is an imminent risk of serious environmental damage);
- suspension or revocation of environmental permits and licences;
- variation of permit conditions;
- injunctions;
- carrying out remedial works (where we carry out remedial works, we will seek to recover the full costs incurred from those responsible);
- criminal sanctions, including prosecution;
- civil sanctions, including financial penalties.<sup>7</sup>

The Environment Agency's [Enforcement and Prosecution Policy](#) provides further information.

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<sup>7</sup> [Enforcement](#), Environment Agency, viewed 13 May 2011

### 3 Local impacts of thermal treatment—planning

In addition to an environmental permit from the Environment Agency, thermal treatment plants require planning permission. Even if a permit is granted, planning permission may not. The planning system will enable the consideration of a range of positive and negative impacts on local communities. The potential negative impacts of thermal treatment plant can be mitigated by the planning system.

Positive impacts may include the reduction of greenhouse gas emissions where thermal treatment fits within a sustainable waste management strategy and the creation of jobs. Thermal treatment may also help communities to manage their waste in a more cost effective manner in certain circumstances.

Negative local impacts may include increased road congestion in the area, visual intrusion and noise nuisance. Thermal treatment may also not be the best environmental option in all circumstances.

The Coalition Government has indicated that it will introduce major reforms to the planning system. Please consult Library Standard Note [Planning for Constituency Cases](#) for further information. In August 2010 commentators indicated that Coalition Government proposals for the planning system may lead to more applications for new thermal treatment plant being rejected.<sup>8</sup>

### 4 Are the emissions dangerous?

Concerns about the safety of thermal treatment emissions are common. This is because the emissions can contain low levels of a number of pollutants including dioxins and particulates.

However, because the concentrations of these substances are low, the evidence suggests that the emissions have no detectable impact on human health. An Environment Agency [factsheet](#) provided more information. The Health Protection Agency said:

While it is not possible to rule out adverse health effects from modern, well regulated municipal waste incinerators with complete certainty, any potential damage to the health of those living close-by is likely to be very small, if detectable...

[M]odern and well managed municipal waste incinerators make only a very small contribution to local concentrations of air pollutants...

[A]ny potential risk of cancer due to residency near to municipal waste incinerators is exceedingly low and probably not measurable by the most modern techniques. Since any possible health effects are likely to be very small, if detectable, studies of public health around modern, well managed municipal waste incinerators are not recommended.<sup>9</sup>

While thermal treatment contributes to air pollution, any additional pollution it causes tends to be very small in comparison to other sources, such as traffic. For example, in 2006 particulate matter pollution (PM10) from incineration was “0.03% of the total compared with 27% and 25% for traffic and industry respectively”. The Health Protection Agency went on that “this low proportion is also found at a local level... one incinerator modelling study...

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<sup>8</sup> *Fears for efforts on low carbon energy*, Financial Times, 17 August 2010

<sup>9</sup> *The Impact on Health of Emissions to Air from Municipal Waste Incinerators*, Health Protection Agency, September 2009

found a modelled ground level increment in PM10 of 0.0005 µg/m<sup>3</sup> as an annual average”.<sup>10</sup> The World Health Organisation guideline values for particulate matter, which “represent an acceptable and achievable objective to minimize health effects”, state that PM10 should not exceed 20 µg/m<sup>3</sup> as an annual average.<sup>11</sup>

Nevertheless, thermal treatment emissions should be considered in the context of overall air pollution. Air pollution can have serious health implications.<sup>12 13</sup>

## 5 Is the burning of waste sustainable?

Whether thermal treatment can be considered a sustainable solution to waste management is a complex issue. The answer depends on the individual characteristics of the thermal treatment process involved and the wider management of waste.

A process known as lifecycle analysis can help to assess whether a specific waste management proposal is sustainable. [An example of such an assessment](#) was conducted by the Environment Agency Wales on the South West Wales Regional Waste Plan. In that case the highest sustainability appraisal rating was given to a waste management option involving high recycling and composting rates with the thermal treatment of residual waste.<sup>14</sup>

In a major study for the Scottish Government, the Sustainable Development Commission (SDC) found that thermal treatment of waste can be a sustainable option if [a number of principles](#) are followed including:

1. **No easily recyclable material is burnt.** As recycling normally leads to lower overall emissions than thermal treatment with energy recovery, it is best to recycle waste rather than recover energy from it. However, the SDC recognised that a fraction of waste cannot easily be recycled—the ‘residual waste’. The SDC considered that it was better to recover energy from the residual waste than to landfill it.
2. **The plant is efficient at recovering energy from the waste.** The SDC recommended that no new EfW plants should be constructed with an efficiency of less than 60%. Few UK EfW plants have efficiencies of over 60%.<sup>15</sup> The normal efficiency of energy from waste plants producing electricity is about 25%.<sup>16</sup> In order for EfW to achieve efficiencies of over 60%, it is likely that the heat produced by the process would also need to be used—i.e. they would need to be combined heat and power (CHP).<sup>17</sup>

## 6 Is thermal treatment compatible with high recycling rates?

Some argue that thermal treatment is incompatible with high recycling rates. Friends of the Earth argue that because plants require a through-put of material, recyclable material may be

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<sup>10</sup> *ibid*

<sup>11</sup> [Air quality and health](#), World Health Organisation, August 2008

<sup>12</sup> *ibid*

<sup>13</sup> *ibid*

<sup>14</sup> [Sustainability Appraisal and Life Cycle Analysis of Strategic Waste Management Options](#), Environment Agency, viewed 13 May 2011

<sup>15</sup> [Revision of the Waste Framework Directive – agreement reached](#), Local Government Association, viewed 13 May 2011

<sup>16</sup> [Waste incineration – questions and answers](#), Environment Agency, viewed 13 May 2011

<sup>17</sup> Sustainable Development Commission Scotland, [A burning issue; Energy from Waste in Scotland](#), 17 December 2007

burned if there is not enough residual waste. In addition it argued that incinerators create an incentive to maintain waste levels in order to fuel the plant.<sup>18</sup>

However, while it is true that thermal treatment can create perverse incentives that may undermine recycling and waste minimisation objectives, these can be avoided with effective planning. To avoid these problems the Audit Commission recommended that authorities should use challenging recycling and waste minimisation forecasts when deciding what size of thermal treatment plant is required.<sup>19</sup> The need to prevent thermal treatment from crowding out recycling was acknowledged in the Labour Government's Waste Strategy documents.<sup>20</sup>

## 7 Will there be too many thermal treatment plants?

Dr Dominic Hogg of the consultancy Eunomia recently cautioned about over-capacity in the sector, which may have implications for thermal treatment's relationship with recycling (see previous section).<sup>21</sup> He indicated that within the next few years the UK may not have enough residual waste to run the number of planned thermal treatment plants.<sup>22</sup>

Over-capacity could happen if all the plants currently seeking planning consent are successful and if residual waste production reduced.<sup>23</sup> Residual waste could be reduced by greater recycling, improved recyclability of products and waste minimisation. However, it is unlikely that all planned plants will get consent. Dr Hogg called for an assessment of residual waste treatment capacity:

"If the government says it wants a zero-waste nation, we need to understand how much residual waste treatment capacity that will require. And if more is done to enhance recyclability of materials, there will be even less residual waste treatment capacity needed. We have to ask the question 'When will we have too much?', because we might get there soon with what we're planning."<sup>24</sup>

The Coalition Government [Waste Review](#) will therefore have important consequences for the relationship between thermal treatment and recycling.

## 8 Labour Government policy

It has been claimed that the Labour Government was reticent about supporting thermal treatment due to its controversial nature.<sup>25</sup>

The Labour Government set out its Waste Strategy for England in 2007. It said that it wanted to "maximise energy recovered from unavoidable residual waste (that would otherwise go to landfill) so as to make the greatest contribution to energy policy".<sup>26</sup> It stated that while there was no specific target for EfW, meeting other waste targets would probably translate to "an increase in energy recovery to about 25% of municipal waste in 2020 compared to around 10% today". Energy recovery in this case included anaerobic digestion. The landfill tax was the primary driver used by the last Government to divert waste from landfill to other disposal

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<sup>18</sup> [Up in smoke: Why Friends of the Earth opposes incineration](#), Friends of the Earth, September 2007

<sup>19</sup> [Well disposed: Responding to the waste challenge](#), Audit Commission, 25 September 2008

<sup>20</sup> [Up in smoke: Why Friends of the Earth opposes incineration](#), Friends of the Earth, September 2007

<sup>21</sup> [UK close to waste treatment overcapacity](#), ENDS Report 426, July 2010, p. 20

<sup>22</sup> *ibid*

<sup>23</sup> *ibid*

<sup>24</sup> *ibid*

<sup>25</sup> [Government to clarify policy on energy-from-waste](#), Letsrecycle.com, 17 February 2010

<sup>26</sup> [Energy from waste and anaerobic digestion](#), Defra, viewed 13 May 2011



methods, including EfW. The last Government also sought to support the development of waste infrastructure:

The Government has continued to support development of waste infrastructure through PFI credits with £2.48 billion of PFI credits committed to 37 projects. There are additional projects in the application process, for which it is expected a further £0.8 billion PFI credits will be awarded. Other support has been in the form of the demonstration of new technologies (New Technology Demonstrator Scheme), and the Waste Infrastructure Capital Grant (£185m 2008/09 – 2010/11) to Local Authorities in recognition of the need to get front-end waste infrastructure such as recycling and composting facilities on the ground. The recent rise in the landfill tax escalator is also expected to trigger greater investment from the private sector in merchant facilities for municipal and nonmunicipal waste.<sup>27</sup>

[The Renewables Obligation](#), a scheme designed to incentivise renewable energy generation, was also changed to support EfW. The biomass fraction of waste was eligible for Renewable Obligation Certificates (ROCs) provided an advanced thermal technology such as gasification or pyrolysis was used.<sup>28</sup>

## 9 Coalition Government Policy—the Waste Review

On 15 June 2010 Caroline Spelman MP, Secretary of State for Environment, announced a major Waste Review. This would “look at what policies are needed to reduce the amount of waste generated and to maximise reuse and recycling, while also considering how waste policies affect local communities, individual households and businesses”.<sup>29</sup> The review considered the thermal treatment of waste:

Energy recovery is about extracting, through various technologies, Energy from Waste. Energy from waste (EfW) processes include direct combustion (incineration), gasification, pyrolysis, anaerobic digestion and others. EfW can be an effective waste management option. It avoids methane emissions from waste that would otherwise rot in landfill and using waste as a fuel can replace fossil fuels such as oil, coal or gas – both of these factors deliver climate change benefits. The technology used choice depends on the type of waste available, local circumstances and finance. The Government has therefore not made recommendations on technology type, but has supported the provision of infrastructure through the Waste Infrastructure Delivery Programme.

The exception is Anaerobic Digestion which, in England, has been encouraged for separately collected food waste because it meets a number of environmental objectives, such as: reducing greenhouse gas emissions; producing renewable energy for heat, power and transport fuel; recycling nutrients back to land; and reducing air and diffuse water pollution). The Coalition has committed to a huge increase in energy from waste through Anaerobic Digestion. Energy from waste has a key role in the government’s commitment to working towards a zero waste society and being the greenest government to date.

A separate cross-Government Energy from Waste project is underway with the intention of reporting later in 2010. As well as inputting into the Review of Waste

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<sup>27</sup> [Waste Strategy Annual Progress Report 2008/09](#), Defra, October 2009

<sup>28</sup> [Eligible renewable sources and banding levels](#), DECC, viewed 13 May 2011

<sup>29</sup> [Waste Review](#), Defra, viewed 13 May 2011



Policies, this will from a technical perspective consider what technologies are best deployed in relation to available feedstocks.<sup>30</sup>

The Waste Review was published in June 2011. The Government stated that it supported energy from waste where it fit within the waste hierarchy. It set out how it would support the technology:

The role of government is to facilitate informed decisions by communities, local authorities and businesses about how they recover value from their residual waste. To do this we will:

- Support the role of energy recovery from waste within the waste hierarchy and aim to improve understanding of this role.
- Provide a clear position on the health implications of the recovery of energy from waste, based on the best available evidence, to support a reasoned, evidence based evaluation of risks and benefits.
- Work with all involved to identify commercially viable routes by which communities can realise benefits from hosting recovery infrastructure;
- Work to identify and communicate the full range of recovery technologies available and their relative merits – right fuel, right place and right time. As part of this we will publish a guide on energy from waste to help all involved make decisions best suited to their specific requirements.
- Not ‘pick winners’ but we will provide the necessary framework to address market failures and deliver the most sustainable solutions.
- Ensure the correct blend of incentives are in place to support the development of recovery infrastructure as a renewable energy source that can make an effective contribution to renewable energy targets and carbon reduction commitments.
- Work with industry and delivery partners to develop effective fuel monitoring and sampling systems which allow the renewable content of mixed wastes and waste derived energy to be accurately measured to help facilitate an effective market.
- Ensure that waste management legislation and regulation provides a safe well monitored sector but does not have unintended consequences on development of energy recovery industry through unnecessary barriers or burdens.<sup>31</sup>

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<sup>30</sup> [Waste Review Background](#), Defra, viewed 13 May 2011

<sup>31</sup> [Government Review of Waste Policy in England 2011](#), Defra, 14 June 2011