

The purpose of this study

Read the conclusions on page 7

Tackling climate change is the major environmental challenge of our times. Friends of the Earth believes that all government policies should be examined for their climate change impacts, from transport policy to waste policy.

At the same time, other environmental challenges must not be ignored – climate change may be the most immediate environmental crisis, but we should not ignore the possibility of others following on from it. For example, in the case of waste policy, it is vital that we also focus on maximising resource efficiency and on minimising pollution.

Waste and climate change

Waste policy has important climate change impacts, from, at one end, the emission savings by waste prevention or from recycling, to at the other end, the problem of methane emissions from landfill.

Waste prevention is the most beneficial option from a climate point of view, followed by reuse and recycling; landfill and incineration are worse options.

Research is clear that waste prevention is the most beneficial option, followed by reuse and recycling

The UK Government is currently reviewing England's waste policy, and is proposing to process 25% through energy from waste.

But what is energy from waste? In reality this catch-all term refers to a wide range of technologies, with a whole range of impacts on climate change. In order to better understand the impacts of these technologies, Friends of the Earth commissioned Eunomia Research and Consulting Ltd to examine the climate impacts of the different options.

In addition, in order to improve understanding of the climate impacts of different methods of dealing with residual waste (what is left after reuse, recycling and composting), we also asked Eunomia to examine this complex issue.

This summary report takes the results of the Eunomia research and puts them in context. The full report, *A changing climate for energy from waste?* is available at Friends of the Earth's web site:

http://www.foe.co.uk/resource/reports/changing_climate.pdf

Glossary

Anaerobic digestion (AD) is a method of processing biological wastes, generating methane which can be used to generate power and heat, and a soil improver. If the wastes are source separated, eg, separately collected kitchen waste, then the soil improver should be usable as a compost.

A **combined heat and power** or **CHP** power station generates both electricity and heat (eg, hot water). The heat can then be used to heat homes or businesses, as long as there is a demand. With extra equipment it can be used to cool buildings.

Energy from waste is a wide term that encompasses a range of technologies that directly generate energy from waste. It does not cover waste management techniques that save energy, such as recycling or waste prevention.

Fossil fuel CO₂ is carbon dioxide which is produced by burning carbon sourced from fossil fuels such as coal, oil or gas. Fossil fuel-derived CO₂ is the main cause of climate change.

An **incinerator** is a plant that combusts waste in a controlled environment, some electricity and/or heat may be generated. Most municipal waste incinerators either built or proposed to be built in the UK generate only electricity.

Mechanical-Biological Treatment or **MBT** is a range of technologies that are used to treat residual waste – eg, a milling process with separation of remaining recyclables, then an aerobic composting or anaerobic digestion process to break down organic components. The final output may then be landfilled or burnt as **Refuse Derived Fuel (RDF)**.

Renewable or Biogenic CO₂ is carbon dioxide which is produced by burning carbon sourced from natural renewable materials such as food waste or paper. Biogenic CO₂ is usually treated as having no impact on climate change, as it is part of the natural carbon cycle.

Residual waste is the waste that remains after reuse, recycling and composting.

CO₂ from energy from waste

Q. How does energy from waste incineration compare, in terms of emissions of greenhouse gases per unit of energy generated, with other technologies for generating energy in the UK?

A. Waste incinerators generate either electricity only, electricity and heat or heat only. In the UK there are 19 waste incinerators of which only four are considered to produce both heat and electricity. The remainder produce only electricity. There are no waste incinerators in the UK that produce heat only, though plants exist in countries such as Sweden.

Graph 1 shows how energy from waste incineration fares against fossil fuel generation, in terms of the amount of fossil fuel-derived CO₂ released per unit energy produced. The details of the calculations, results and assumptions made can be found in the full report. Two key points:

- the report only examines direct emissions, so doesn't cover emissions from transport, mining etc.
- the graph does not include the biologically-derived (biogenic) CO₂ that will be produced by the incinerators, if it

did then emissions would be much higher. See the full report for this data and a discussion of the importance of biogenic CO₂.

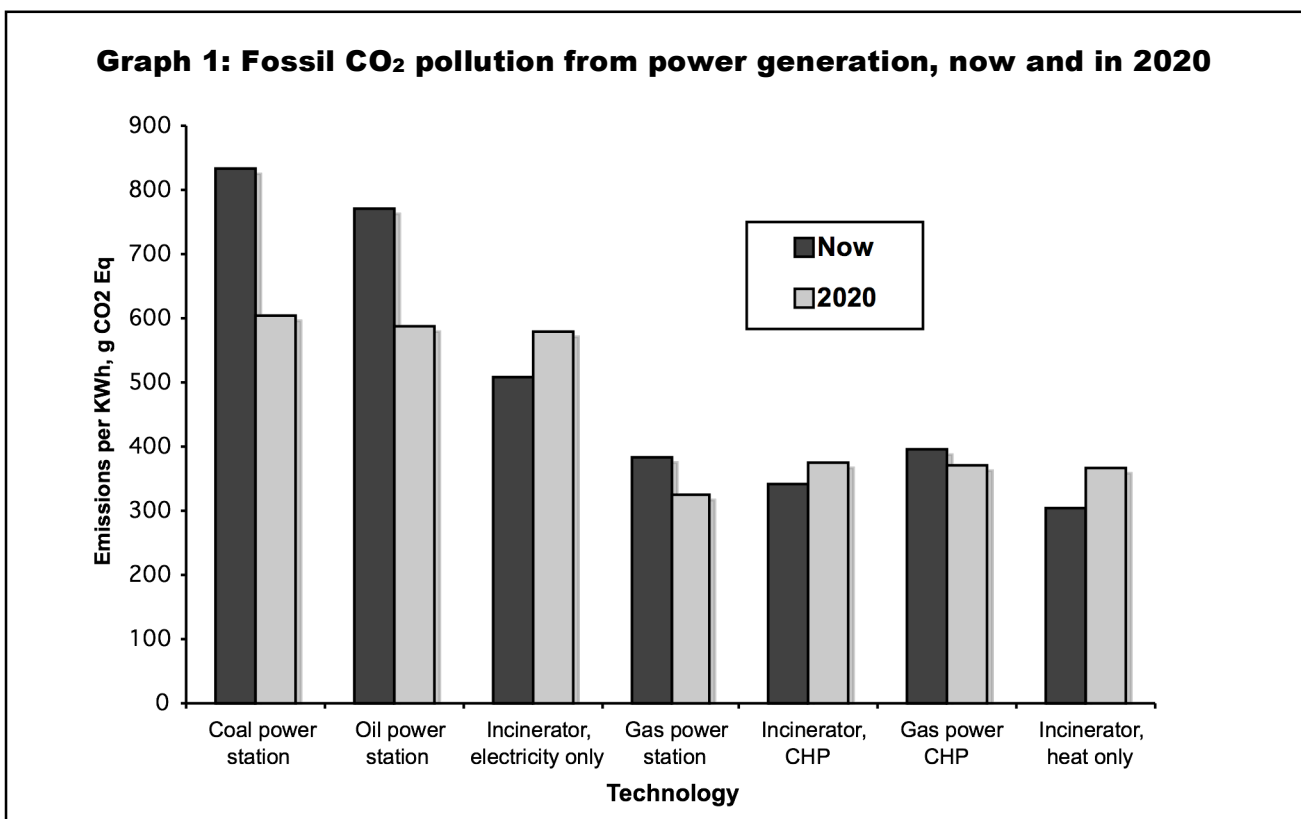
The analysis is done based on current technology, and on an analysis of what is likely to be possible in 2020 (though not including any carbon capture technologies).

Some key conclusions are:

- Electricity-only incinerators emit 33 per cent more fossil CO₂ than gas power stations, but 40 per cent less than a coal power station.
- In 2020, the situation will have changed:
 - There will be improvements in technology, particularly for fossil-fuel power stations (including re-fitting of existing coal power stations with more efficient equipment).
 - Assuming the Government's proposed recycling rate of 50 per cent, it is expected that fossil-fuel derived plastics will make up a higher percentage of residual waste.
- In 2020 it is predicted that electricity-only incinerators will emit 78 per cent more fossil CO₂ than gas power stations, and only around 5 per cent less than a coal power station.

Electricity-only incinerators emit 33 per cent more fossil CO₂ than gas fired power stations

In 2020 such incinerators will emit 78 per cent more fossil CO₂ than gas fired power stations and only around 5 per cent less than coal-fired power stations



Energy from waste technologies

Energy from waste technologies emitting fossil fuel-derived CO₂:

- Incineration of residual waste with electricity and/or heat generation.
- Production of refuse derived fuel (RDF) from a mechanical and biological treatment (MBT) process; this RDF is then burnt elsewhere.
- Gasification and/or pyrolysis of residual waste.

Energy from waste technologies which emit no fossil fuel-derived CO₂:

- Anaerobic digestion of source-separated organic waste (ie, kitchen scraps and garden waste). This technology also produces a useful compost.
- Anaerobic digestion of residual mixed waste (what is left after recycling and composting household waste).
- Gasification and/or pyrolysis of source separated organic waste.
- Incineration of source separated organic waste in a dedicated biomass plant.

1.45 TWh of renewable power (around 0.36 per cent of UK electricity demand) could be generated by anaerobic digestion of source-separated household waste. Even more could be generated if commercial waste was added

The picture is slightly different if the incinerator is used for heating, with or without power generation. In this case, the incinerators perform slightly better than gas-fired combined heat and power plants.

However, these results will only be valid if this heat is *really* used. NB: The calculations use a conversion factor of 0.4, to allow for some inefficiency of heat use (see full report for more explanation).

Note that the report did not analyse the CO₂ emissions of gasification and/or pyrolysis plants, another waste disposal technology. This was because this is a new technology, and it is too early to make general comments on its performance. However, gasification/pyrolysis of residual household waste will inevitably emit fossil-fuel derived CO₂ – unlike the technologies in the following section.

Energy from waste – with no fossil fuel-derived CO₂

Given the importance of the debate on climate change, it is surprising that most discussion on energy from waste focuses on technologies which emit fossil-fuel derived CO₂.

In reality, a whole range of technologies exist that produce energy only from biodegradable, biologically-derived, materials (see table above).

The most interesting technology is anaerobic digestion of separately collected organic waste (eg, kitchen waste). This

technology is very resource efficient, generating both methane that can be used to generate power, and a soil improver which can be used to fertilise land (which also brings climate benefits through storing up some carbon in the soil – the report does not calculate these benefits).

The Eunomia report estimates that at least 1.45 TWh of power (around 0.36 per cent of UK electricity generation) could be generated in the UK by anaerobic digestion (AD) of source-separated household waste. Even more could be generated with non-household waste streams, such as food waste from restaurants, caf teria and retailers.

In addition, it is worth noting that the methane from an AD plant can be burnt in a CHP plant, generating renewable-only heating. Such AD/CHP plants would be well suited for use in distributed generation schemes, where power and heat are generated more locally than in our current electricity supply system.

Given the benefits of this well-established technology, it is surprising that it is not even mentioned in the UK Government's consultation document on a revision to the English Waste Strategy [1].

1. "Review of England's Waste Strategy: A consultation Document", UK Government, February 2006.
<http://www.defra.gov.uk/corporate/consult/wastestratereview/review-consult.pdf>

Climate impacts of residual waste

Residual waste is the waste left over after you have reused, recycled and composted some of the waste. The amount of residual waste will depend on how much effort goes into making these non-residual treatments as effective as possible, combined with the extent to which certain waste types are difficult to reuse, recycle or compost.

The best thing to do with residual waste from an environmental point of view is to phase it out. Prevention, reuse and recycling are all more environmentally beneficial than residual waste treatment, as shown by the analysis accompanying the Government's England waste strategy consultation [2], so Friends of the Earth believes that:

- Planning for residual waste should assume that its volume will reduce over time.
- Policies should be put in place to increase the amount of residual waste that is recyclable or compostable, for example by ensuring that all plastic packaging is easy to recycle or, in some cases, compost.

However, given that residual waste will continue to exist for some time, the question is – what are the climate impacts of the different options for residual waste?

Climate impacts of residual waste options

The Eunomia report undertakes a detailed analysis of the climate impacts of different residual waste technologies. The analysis is complex, in particular because it considers:

- **The impact of time of CO₂ release** – some technologies release CO₂ rapidly (eg, incineration), others slowly (eg, landfill)
- **Biogenic carbon dioxide**, in order to incorporate the impact of whether this is

stored (reducing atmospheric CO₂) or released.

As a very brief summary of the results of the analysis, this is an approximate ranking of technologies, with the most climate-damaging first:

- **Landfill, with low capture of methane** (25 per cent or 50 per cent)
- **Aerobic Mechanical Biological Treatment (MBT) followed by fluidised bed incineration** (this form of incineration generates NO₂, a potent greenhouse gas).
- **Landfill with 75 per cent capture of methane** – though the report disputes how possible this performance is.
- **Electricity-only incineration**, with extraction of steel and aluminium for recycling.
- **Aerobic MBT with metal extraction and stabilised residue to landfill**
- **Anaerobic MBT with metal extraction and stabilised residue to landfill**
- **Heat-only incineration with metal extraction.**
- **Aerobic MBT, metal extraction and refuse derived fuel to a cement kiln – but only if this fuel replaces coal.** The displacement of coal is why this approach scores highly – if another energy source is displaced, the results will be different.
- **Anaerobic MBT, extracting both metals and plastics for recycling, with residual waste to landfill.** Techniques for separating waste are advancing all the time, with automated methods being developed for separating different types of plastics.

The final two options are very close together in the analysis; the report states “*the differentials are small and a clear decision as to whether one is ‘better’ or ‘worse’ is likely to be difficult to make in any hard and fast manner*”. In Friends of the Earth's view, the latter option is better as it also maximises resource recovery.

The best thing to do with residual waste is to phase it out

2. “*Impact of energy from waste and recycling policy on UK Greenhouse gas emissions*”, ERM <http://www.defra.gov.uk/ENVIRONMENT/was/strategy/pdf/ermreport.pdf>

Energy from waste confusion

“Recovering energy from residual wastes also contributes to our renewable energy and climate change targets”
Ben Bradshaw,
Minister for Local Environment, DEFRA

Given the results on the previous pages, are the waste industry, the Government and local councils making clear the climate problems of incinerators?

From Government literature to brochures from incineration companies, the spin is that energy from waste is part of the solution to climate change. However, as we have discussed, the term energy from waste covers a wide range of different technologies and although some of these technologies do bring benefits in terms of climate change, not all of them do.

In fact incineration with electricity generation only – which is the main form of energy from waste in the UK at the moment – performs worse in terms of greenhouse gas emissions than a gas fired power station. However, this has not stopped both the industry and the Government trying to sell this technology as “green” to the public.

An industry line

Waste Recycling Group, which is planning to build a waste incinerator (generating electricity only) in Hull, has claimed in its literature that “*Waste which is not recycled will be converted into Green Energy*” [3]. But how can this plant be producing green electricity when it produces more CO₂ emissions than a gas fired powered station?

The Government line

The Government is currently reviewing its waste strategy [4], with one of the core principles of the strategy being to “*reduce the impact of waste on climate change.*”

The Minister in charge, Ben Bradshaw, has said that “*recovering energy from residual wastes also contributes to our renewable energy and climate change targets*” [5].

3 “*Waste Management News Salt End Planning Information Issue 2*”, WRG, 2005.

4. “*Review of England’s Waste Strategy: A consultation Document*”, UK Government, February 2006.

<http://www.defra.gov.uk/corporate/consult/wastestratereview/review-consult.pdf>

5 Letter to Diane Abbott MP, 12th April 2006.

The consultation document discusses incineration as one of these energy from waste technologies, but nowhere does the Government discuss the negative climate impacts of waste incineration when it only generates electricity.

The consultation does mention that waste incineration can recover heat which can be provided to local users, but does not point out that these schemes are rare and in fact not all of the ones that have been planned have been followed through. For example the ‘South East London Combined Heat and Power’ plant opened in 1994, yet still (despite its name) does not produce any heat for heating, as providing district heating proved too expensive.

It is time that both the industry and the Government stops peddling the myth that waste incineration is good in terms of climate change.

One key test is what decision the Government reaches in the Belvedere case (see below).

The Belvedere story

For 14 years the community in Belvedere, East London, has been fighting against various proposals to build a huge incinerator.

The current proposal, from Energy Power Resources Limited and Cory Environmental, is for a plant that will handle 585,000-850,000 tonnes of rubbish every year. If built, the incinerator will generate enough electricity for it to be classed as a power station.

However, as this research has established, this power generation will be at the cost of huge emissions of fossil-fuel derived CO₂, far more than would be produced by a gas fired power station producing the same amount of energy.

The DTI is currently deciding whether the Belvedere plant should go ahead. The plant is also opposed by the Greater London Assembly and the local council.

Conclusions

- **Recycling is better than incineration in terms of climate change.**
- **Waste incinerators are being sold to the public and local authorities as a source of green electricity, yet the fact that they produce fossil fuel derived greenhouse gases is rarely mentioned.**
- **This research shows that, currently, electricity-only incinerators produce 33 per cent more fossil fuel derived CO₂ per unit energy generated than a gas fired power station.** By 2020, with increases in recycling and improved technology, these incinerators will be almost as polluting in terms of CO₂ emissions as new or refitted coal fired power stations, and 78 per cent worse than new gas power stations.
- **It makes no sense to promote this type of technology when there are better waste management options available.** Incinerators that generate heat have similar efficiency to gas-fired plants – but only if the heat is really used.
- **Anaerobic digestion, an alternative energy from waste technology, generates power exclusively from the biomass portion of waste, so is truly renewable.** It could generate at least 1.45 TWh from source-separated household biodegradable waste, and more if commercial wastes were added.
- **The best option in terms of climate and resources is to phase out residual waste, ensuring that all waste is reusable, recyclable or compostable.**
- **However, residual waste will continue to exist for some time, so must be dealt with.** This research shows that one of the best options from a climate point of view is an MBT process that extracts both the metals and plastics with the stabilised residual going to landfill.

Anaerobic digestion generates power exclusively from the biomass portion of waste, so is truly renewable

Important note

This report only considers climate impacts of these technologies, eg,

- it does not analyse other negative environmental impacts of incineration, such as the production of toxic ash and air pollution, or the negative impact on recycling rates. See “*Up in Smoke*” for more on this: http://www.foe.co.uk/resource/briefings/up_in_smoke.pdf
- it does not analyse the soil improvement benefits from the compost produced by source-separated anaerobic digestion.

Recommendations

Friends of the Earth proposes the following recommendations:

- 1) **The government should promote the development of totally renewable energy from waste technologies**, in particular anaerobic digestion, using both household and commercial/industrial waste streams.
- 2) **Government policy should be focused on phasing-out residual waste**, through waste prevention, recycling and composting/digestion. This must include measures to ensure that products and packaging are designed to be reusable, recyclable or compostable. They should also assist in developing effective recycling of plastics in residual waste.
- 3) **The government must dispel the myth that incinerators which only generate electricity produce green energy.**
- 4) **The government should give clear criteria to local authorities in order for them to rank the performance of residual waste technologies.**
- 5) **The government must ensure that the economic framework encourages the most environmentally-friendly methods of residual waste disposal**, eg,
 - A tax of at least £12 a tonne for waste burnt in an electricity-only incinerator.
 - A reduced rate of landfill tax for waste that has been adequately stabilised through an MBT process.

Government must dispel the myth that incinerators which only generate electricity produce green energy – they don't

For more information on Friends of the Earth's work on waste or climate change:

<http://www.foe.co.uk/campaigns/waste/>

<http://www.foe.co.uk/campaigns/climate/>

Friends of the Earth inspires solutions to environmental problems, which make life better for people

Friends of the Earth is:

- the UK's most influential national environmental campaigning organisation
- the most extensive environmental network in the world, with around 1 million supporters across five continents, and more than 70 national organisations worldwide
- a unique network of campaigning local groups, working in more than 200 communities throughout England, Wales and Northern Ireland
- dependent on individuals for over 90 per cent of its income.

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May 2006