The environmental and health impacts of Energy from Waste, the myths and the truth?

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SUMMARY: The UK produces large quantities of solid waste and has a range of technologies available for the processing and disposal of wastes at numerous facilities around the country.

The UK Government is actively encouraging the diversion of waste from landfill through the diversification of waste management by local waste authorities. However, concerns have been raised that the operation of certain facilities, particularly incineration, may be associated with adverse impacts on health and the environment. Some of these concerns are deliberately exaggerated to support wider opposition agendas, whereas others have a sounder scientific basis.

This paper seeks to set out a balanced objective view of the current state of knowledge with respect to health and environmental impacts of incineration compared with other forms of waste management activities and other sources of health risks in modern life. The paper concludes that, on the balance of evidence, the health risks of various waste treatment solutions and particularly incineration are minor compared to other everyday health risks.

1. INTRODUCTION

In the UK about 430 million tonnes of waste a year is produced. Of this, about 7% (29 million tonnes) is municipal solid waste. In recent times this has been growing at rates of between 1% and 3% per annum. There are now signs that in some areas overall growth in waste is being checked. However, due to the complexities associated with measuring different waste streams as collection and treatment regimes change it is too early to generate any long term confidence in any declining trend in overall waste arisings.

‘‘Municipal solid waste’’ means the waste materials generated in the home, and by schools, shops, and small businesses. As such the nature of municipal solid waste reflects the nature of the modern consumer culture and therefore contains a wide variety of materials, reflecting the variety of things that we buy, use and then dispose. Figure 1 shows the types of waste in the UK, and the materials that municipal solid waste is made up from.

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Textiles and shoes
Nappies
Other paper and card
Demolition and construction, 19%
Quarry, 27%
Agricultural, 20%
Commercial/industrial, 19%
Municipal, 7%
Other glass

Aluminium
Wood
Plastic bottles
Other metals
Recyclable paper
Garden waste
Other plastics
Compostable food waste
Unclassified fines
Card, paper, packaging
Non-compostable organics
Glass bottles/jars
Dredged material
Steel cans

Figure 1: Waste in the UK (source: Defra, 2004)

Waste is an inevitable by-product of our use of natural resources. The amount and make-up of waste in any given area depends on factors such as the local population density, economic prosperity, time of year, type of housing and whether there are local waste minimization initiatives such as home composting or source separated waste collections.

The UK public is now familiar with the concept of separating out recyclables and separate doorstep collections. A high media profile and a "drip, drip" flow of information from government at all levels has helped bring about a gradual change in householder behaviour.

Some of this change process is unpopular, for example as householders are forced to accept fortnightly collection of residual wastes. Despite some local reticence, changes are taking effect and this is being reflected in ever increasing recycling rates in local authorities around the Country. Some authorities are now approaching the previously unheard of 50% recycling rate although the national average is somewhere between 25% and 30%.

The slow cultural shift in attitudes towards recycling has not been mirrored in the public acceptance of new waste facilities on their door steps and in their 'back yard'. It is estimated that many thousands of new waste facilities will be required across the UK in the next 10 years including many more new EfW plants. These will need to be located in many new back yards.

The British public remain to be persuaded that the health and environmental fears are unfounded: this is where the battle lines are drawn.

2. DISPOSING OF MUNICIPAL SOLID WASTE

Until very recently the UK disposed of two-thirds of its municipal solid waste directly to landfill.

If the UK meets its Landfill Directive targets then the biodegradable element sent to landfill is set to reduce significantly. This is happening in stages up to 2020, by which time only 35% of the

1995 totals of biodegradable wastes will be permitted to be landfilled. Of the total amount of municipal waste it is anticipated that the proportion landfilled will reduce from the 60-70% of recent times to 15% in 2020.

The remaining mix of disposal destinations include 25% recycling and composting, which is rising dramatically, and 9% incineration which is also likely to rise. A small but growing percentage is pre-treated using a variety of new or specialist methods, such as mechanical biological treatment, anaerobic digestion and gasification/pyrolysis.

Considerable emphasis has been placed on the role of a range of so called ‘new technologies’ in achieving the step change that is required to meet the Landfill Directive targets. The term waste disposal, as in the title of this chapter is a misnomer, when applied to many of these new technologies. The new approaches to waste management are often seeking to recover value from
the waste by changing the form of the materials through biological, mechanical and thermo/chemical processes. Landfill and incineration remain the only real final disposal solutions with other proportions of the original waste stream being diverted for a variety of uses.

This is at odds with the definition of disposal in the European Waste Framework Directive (Annex IIA). This lists disposal operations in 15 categories ranging from storage and transfer through to incineration. The Environmental Impact Assessment Directive as applied to wastes operations in the UK has also applied this broad definition to ‘‘disposal’’.

The term ‘‘new technologies’’ is also misleading. Many of the processing techniques are applying well-established materials handling and thermal treatment approaches to municipal waste streams where they have previously been used in other industries handling different materials.

Mechanical sorting techniques have been applied for some time in the waste industry but greater fiscal incentives to separate and recover value materials for reprocessing and re-use has permitted more sophisticated and expensive approaches to be adopted. We can now successfully separate glass, plastics and metals from mixed inputs, resulting in high quality low contamination outputs for re-sale. Methods such as air knives and infra-red scanners are used to differentiate between the various physical and chemical properties of the materials.

This paper concentrates on issues associated with Energy from Waste (EfW) facilities. EfW includes a range of thermal treatment processes and in its broadest sense can also be applied to the use of gas from biological processes such as anaerobic digestion and even landfill.

The Waste Strategy for England 2007 lists the following as the principal EfW technologies:
- ♦ Anaerobic digestion
- ♦ Direct Combustion (incineration)
- ♦ Secondary recovered fuel (an output form MBT processes)

♦ Pyrolysis
♦ Gasification
♦ Plasma arc heating

Most of the well documented concerns relating to public fears and health have been associated with the thermal treatment (burning) processes described below.
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Definitions of the thermal treatment processes considered in this report
Pyrolysis is a process whereby the waste is firstly heated in an oxygen-free atmosphere in order to reduce organic compounds to simple gases and also produce char containing carbon and metals. The off-gases can be burnt to generate electricity, reducing the need to use other fuels.

Gasification: This term can describe the process of mixing the char from a pyrolysis process with air and steam to produce hydrogen and carbon monoxide. The gases are burnt to produce electricity. The term can also be used to describe the combustion of waste in a reduced oxygen environment. The remaining ash can be re-used or sent to landfill.

Incineration involves the burning of waste to reduce the volume of solids (typically by 70%) and generate heat and/or electricity. Typically this process is undertaken using reciprocating grate systems and boilers and also fluidised bed systems. The resulting ash can again be re-used or sent to landfill. The residue from air pollution control systems used at waste incineration processes is a fine ash, typically about 4% of the weight of waste processed. This is a hazardous material and normally needs to be disposed of at a landfill licensed to accept this kind of waste.

3. THE MYTHS!

Throughout the UK a number of national and locally-formed pressure groups are campaigning against local authority and private sector plans to implement new waste incineration facilities in their approach to achieve sustainable waste management. Generally, these pressure groups justify their arguments on the basis that waste incineration facilities present a number of health hazards and will only contribute to the much publicised problems of global warming. They advocate that local authorities should instead be promoting a green-recycling and zero-waste approach. However, the question that needs to be asked is, are these arguments based on myths or are they actually based on hard scientific evidence?

3.1 Contribution of CO2 emissions to Global Warming

Global Warming is a much publicised and well-documented yet highly contentious issue amongst environmentalists and academics alike. A local Surrey-based group, Capel Action Group, is against incineration anywhere due to the belief that mass burn waste incinerators produce huge quantities of carbon dioxide which is thought to be largely responsible for Global Warming. They argue that *''approximately 50% of the weight of household waste going into an* *incinerator will emerge as Carbon Dioxide and get dumped into the atmosphere"* [Capel Action Group website: http://www.capelaction.org.uk/].

Similarly, the People Against Incinerators (PAIN) group which is currently campaigning against proposals to build an incinerator in Rainworth, Nottinghamshire advocate that if it was to go ahead, it would cause a huge increase in greenhouse gases. Not only does this now *"fly in the face of international agreements"* but the project also *"breaches the recent STERN report (30/10/2006) on global warming to radically reduce CO2 emissions"* [PAIN website http://www.p-a-in.co.uk].

Additionally, the long-established Friends of the Earth (FoE) group disagree with claims that

Figure 2: FoE campaigners at a Zero Waste parliamentary meeting for the global day of action against waste incineration [www.foe.co.uk].

Figure 3: A NAIL protest against the proposed expansion of the Eastcroft Incinerator.

incineration is a form of *'green'* recycling. In a press release dated May 3 2006, Dr Michael Warhurst, a Senior Waste Campaigner for FoE states that:
"The Government and waste industry must stop peddling the myth that waste incineration is green energy. Incinerators can generate electricity, but they produce more climate emissions than a gas-fired power station'" [http://www.foe.co.uk].

3.2 Poisonous and cancerous dioxins

Another well-documented argument against waste incineration results from the belief that incineration plants, whilst quickly disposing of waste, release numerous harmful pollutants into our atmosphere which present a serious health hazard.

Greenpeace, a long-running campaigner against waste incineration argue that "*Incineration may put the waste problem out of our sight, but it does not put it out of our minds, our lungs, our environment or our food chain. Incineration causes more problems than it professes to remedy. It is a multi-billion dollar pollutant"* [http://www.cank.org.uk/Greenpeace.html].

The Guildford Anti-Incineration Network (GAIN) which in principle opposes plans to build a waste incineration plant in Surrey, argues that taking this approach would mean destroying precious natural resources and creating a hazardous environment for us to live in. They stand by Dr Paul Connett's quote that *"when you build an incinerator in your community you are advertising to the world that you were not clever enough, either politically or technically, to recover your discarded resources in a manner which is responsible to your local community or future generations"* [www.no-incinerator.org.uk]. Instead, they encourage local authorities to improve on existing recycling rates.

A pressure group opposed to incineration in Nottingham, Nottingham Against Incineration and Landfill (NAIL), argue that the proposed expansion of the incineration plant at Eastcroft, is unnecessary, highly polluting and poorly regulated. They believe that we have the right to breathe in clean air which is
not contaminated with highly poisonous and cancerous dioxins. They state that *"incinerators do NOT destroy waste, it is one of the fundamental principles of science that matter can never be destroyed; it can only ever be transformed.*
Incinerators basically turn rubbish into ash, gases and particulate matter. These gases and the poisons are spewed into the atmosphere, to the air, which we
breathe" [http://www.indymedia.org.uk].

3.3 Ultra fine particulate matter

In recent years, the release of ultra fine particulate matter has become a central focus of research and anti-incineration campaigners. Ultra fine particulate matter (e.g. PM2.5 and PM1) is small enough in size to avoid capture at the filtration stage enabling it to be released and penetrate into *Sardinia 2007, Eleventh International Waste Management and Landfill Symposium*

Figure 4: Members of YRAIN and Green Party with a smoking model incinerator during a protest outside Mansion House in April 2007. our lungs. It can therefore contribute to a number of health problems including cardiovascular disease, pulmonary disease and cancer.

A number of articles posted on the UK Health Research website address this issue and provide evidence for its validity. One such article published in Norwich Evening News 24 on 27 March 2006 entitled *"Incinerator and birth defects are linked"* suggests how to support this antiincineration campaign. Adrian Ramsay, leader of Norwich City Council's Green Group, used evidence compiled by scientist Michael Ryan, to argue that *"families living near to incinerators*
had suffered disproportionately high levels of birth defects". In one piece of evidence, it was shown that *"one in every 16 babies born in rural mid Devon in 2002, an area with an incinerator, had at least one defect. This compared with fewer than one in 630 babies born in London's traffic-clogged Islington during the same year"*. Claims about the potential health implications of ultra fine particulate material are also made in more serious *'academic publications'* such as the British Society for Ecological Medicine (2006) 4th Report: *The Health Effects of Waste Incinerators.* The executive summary of this report claims:
"Two large cohort studies in America have shown that fine (PM2.5) particulate air pollution causes increases in all-cause mortality, cardiac mortality and mortality from lung cancer, after adjustment for other factors. Fine particulates are primarily produced by combustion processes and are produced in large quantities by incinerators."

Enviros prepared a response to the findings of this work and this is discussed in section 4 below.

Similarly, according to NAIL, ultra fine particulate matter is part of the common cocktail emitted from waste incineration plants, the other ingredients being heavy metals such as lead, cadmium and mercury; dioxins, benzene and PCBs. They argue that *"many of these substances accumulate in the environment and body fat of people and wildlife"* [www.nail2.co.uk].

Greenpeace has also published a report entitled *"Incineration and Human Health"* [www.greenpeace.org.uk] which establishes that current air pollution control devices on incinerators do not prevent ultra fine particulate matter from being released into the atmosphere.

The report states that "*it is these respirable particles….which can reach the deepest regions of the lungs, and which are thought to be responsible for causing adverse impacts on human health. Incinerators therefore contribute to the type of particulate air pollution that is the most dangerous for human health*".

3.4 In search of "zero waste" and "greedy burner" issues

Big choices have to be made by local authorities when deciding on new waste infrastructure. Many groups opposed to incineration will argue that such investment needs to be made firstly in achieving the highest possible rates of re-use and recycling before long term commitments to large capacity burners are made.

A local pressure group who are opposed to incineration in York, (York Residents Against Incineration (YRAIN)), is currently campaigning against the plans of local councils to gain PFI funding *Sardinia 2007, Eleventh International Waste Management and Landfill Symposium* for a new incineration plant in York believe that recycling is the better option and it is not possible to do both. Their solution is that we need to aim for zero waste and as their slogan says *"No burner, no brainer!"* .

This theme of the 'greedy' incinerator is reiterated by Shrewsbury Friends of the Earth who in there campaign are branding incinerators as *"greedy beasts"* meaning *"their constant desire for feeding means recycling becomes more unlikely"*. Whilst local pressure group Cheshire Against Incinerators Network (CHAIN) tackle recycling feasibility alongside zero waste intentions by stating, *"It is still uneconomical to recycle a lot of material, but councils are investing in recycling to save paying for higher landfill taxes and to avoid building costly waste treatment plants. The best local authorities in the world are recycling/composting 80% of their municipal waste"*.

Director of Zero Waste Alliance UK, Ralf Ryder explains the objective of a Parliamentary lobby session to present the Zero Waste Charter;

"Any politician who ignores the groundswell of public support for waste elimination initiatives should be reminded that Parliamentary seats are being lost on the issue of incineration, and councils changed control in Sheffield, Hull and Kidderminster as voters reject this polluting technology. Anti-incineration protests could very well make the road protests look like a dress rehearsal, as the ongoing occupation of the Basingstoke site shows".

3.5 Dealing with the myths

Clearly proving negatives is a challenging exercise for all scientists not least in the field of health impacts and long term congenital effects. However, there does need to be a balanced view of the available evidence and the state of science today. It is also necessary to accept that public concern whether based on good science or not is a valid planning consideration. It is also the case that with respect to some issues a robust scientific case may not be enough. We seek to present this balance in the remainder of this paper.

4. THE TRUTH!

How much scientific evidence is required before you reach 'the truth' is a matter for conjecture.

A considerable body of separate research has now been undertaken over many years which has investigated whether waste management operations might cause health effects. The various threads of evidence were reviewed in a report prepared by Enviros with the University of Birmingham, and published by Defra in May 2004 (Defra 2004). The overall conclusion of this review was that effects on the health of people living near waste management facilities were either generally not apparent, or the evidence was not consistent or convincing.

The Defra study looked at a wide range of waste management activities. We focus here on the findings from this and subsequent work with respect to thermal treatment plants and we provide a general overview of health issues associated with other waste activities.

4.1 Incineration and pyrolysis/gasification Contribution of CO2 emissions to Global Warming

A considerable body of scientific work is currently being conducted into the various anthropogenic causes of greenhouse gases and humans' contribution to the widely accepted theories associated with global warming. Our management of waste and the treatment, handling and disposal methods have not escaped this scrutiny and have been subjected to their own carbon footprint assessments. One such study was recently commissioned by Defra and undertaken by consultants ERM (Defra, 2006). This study looked at various types of waste management systems where a combination of activities are undertaken as part of the steps from collection to final destination.

The baseline in this study and in Figure 5 below represents the UK capacity for recycling, composting and EfW in 2003/04 and assumes all additional waste arisings over the period 2004- 2020 will be landfilled. A number of different strategies for achieving the Landfill Directive targets for 2020 with an emphasis on different treatment techniques were then evaluated, as summarised in Figure 4. All scenarios show a significant reduction in CO_2 compared with the baseline. There is surprisingly little difference between the approaches taken. The mixed scenario suggests the best performance. This is influenced mainly by the larger amount of recycling assumed in this scenario compared with other scenarios. The high EfW scenario also performs well, and this careful, strategic analysis dispels the various lobby groups' claims of poor performance in relation to global warming impacts.

The outcome of this type of research is greatly influenced by assumptions over energy consumption and transport modes operated. For example, a significant improvement in the overall carbon footprint of a given waste management system would be achieved if all treatment operation were undertaken on a single site, avoiding multiple handling and transport of waste materials and residues.

Figure 5: Impact of Energy from Waste and Recycling Policy on UK Greenhouse Gas Emissions, (based on Defra, 2006)

-12000
-10000
-8000
-6000
-4000
-2000
0

1.Baseline
2.High EfW
3.High paper recycle
4.High AD
5.High composting
6.High MBT/stabilise
7.High MBT/RDF
8.High gasification
9.Mixed

1000 T CO2 equivalent *Sardinia 2007, Eleventh International Waste Management and Landfill Symposium* The key finding from the Defra report with respect to the CO_2 contribution from incineration is summed up by this extract from the executive summary:

''Waste management makes a significant contribution to UK emissions of greenhouse gases, in particular methane from landfills. Other forms of waste management (e.g. recycling or incineration with energy recovery) can result in net reductions of emissions of greenhouse gases through energy recovery or materials recycling.''

Emissions of poisonous and cancerous dioxins

There is a considerable body of evidence on the health effects of waste incineration facilities. There are no specific studies of the health effects of pyrolysis, gasification or combined pyrolysis/ gasification processes, but consideration of the emissions from these processes suggests that any health effects are likely to be similar to those from incineration facilities.

The Defra review did not find a link between the current generation of municipal solid waste incinerators and health effects, including cancers, respiratory diseases and birth defects. Adverse health effects have been observed in populations living around older, more polluting incinerators and industrial areas. However, the current generation of waste incinerators results in much lower levels of exposure to pollutants.

Proposals for incineration on the Isle of Man in the early 1990's were received with the now common place levels of opposition and concern. Unusually a planning condition was imposed to restrict the visibility of the stack plume, although this photograph suggests that the flume heating system required to achieve this may not be working as well as it should! This measure was purely a matter of addressing concerns over the link between a visible plume and harmful emissions. In reality the plume is largely composed of water vapour.

There is no consistent evidence of a link between exposure to emissions from incinerators and an increased rate of cancer, including cancers of the stomach, colon, liver, lung, blood and larynx, and non-Hodgkins lymphoma. In some studies, apparently significant effects have been observed. These are often in relation to incinerators close to other sources of potentially hazardous emissions, which make it much harder to pin down the source of any effect. Socioeconomic conditions can also increase cancer incidence, for example a significant association was initially found between the incidence of cancer and residence close to waste to energy facilities (Elliott *et al.* 1996). Subsequent revisions to the analysis did not convincingly demonstrate an excess of cancers once socio-economic confounding was fully taken into account (Elliott *et al.* 2000).

The Waste Strategy for England 2007 reinforces the point about the lack of evidence to support cancer claims.

Figure 6: Waste to energy facility, Isle of Man

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"Research carried out to date shows no credible evidence of adverse health outcomes for those living near incinerators. The relevant health effects – primary cancers – have long incubation times, but the available research demonstrates an absence of symptoms relating to exposures twenty or more years ago, when emission from incinerators were much greater than they are now." [p.77, para 22, Waste Strategy for England 2007]

The Government's expert advisory Committee on the Carcinogenicity of Chemicals in Food, Consumer Products and the Environment concluded that "*any potential risk of cancer due to residency (for periods in excess of ten years) near to municipal solid waste incinerators was exceedingly low and probably not measurable by the most modern techniques.*" (Committee on Carcinogenicity, 2000). A recent study has investigated the incidence of birth defects in populations living close to incinerators in Cumbria between 1956 and 1993 (Dummer *et al.* 2003). The authors found a significantly increased risk of spina bifida and heart defects in relation to the proximity of incinerators, but not of stillbirth or neonatal death. Again, this information relates to an older generation of incineration plant, and may be influenced by changes in reporting patterns and other sources of emissions.

Looking at the weight of evidence for adverse health effects from waste incineration facilities, it seems plausible that incineration plants may in the past have given rise to detectable increases in the incidence of cancers and possibly birth defects.

Since 1990, emissions of dioxins and furans and metals from incineration of MSW are estimated to have reduced by over 98%. This analysis supports the view that emissions from incinerators have been reduced to levels at which harmful effects are most unlikely to be significant.

Emissions of ultra fine particulate matter

Enviros concluded in their review of the British Society for Ecological Medicine (BSEM) 4th Report: that, with respect to ultra fine particulate matter, no discernible benefit would be gained by any policy change relating to waste incineration, because the source is simply too small to be significant. Although challenged by BSEM this claim is based on sound evidence associated with the total volumes of small particulate matter emitted by incinerators. Emissions of PM_{10} from MSW incineration are approximately 100 tonnes per year, compared to 22,000 tonnes per year from electricity generation. Although not routinely measured, emissions of finer particles (e.g. $PM_{2.5}$ and PM_1) and secondary particles would be expected to be in a similar proportion. If it is right to be concerned about fine particulate matter, then attention needs to be paid to controlling emissions from electricity generation, road transport, agriculture and domestic sources. The position is similar for the other substances referred to by the BSEM – dioxins and furans, volatile organic compounds and metals.

It is a fact that waste incinerators make a very small contribution to primary or secondary emissions of $PM_{2.5}$. Even in the near vicinity of a waste incinerator, the process contribution to annual mean levels of $PM_{2.5}$ is likely to be 1% or less of the background levels due to emissions from other sources. Under the very worst-case weather conditions, our experience is that the process contribution to $PM_{2.5}$ could approach 5% to 10% of background levels in the immediate vicinity of a waste incinerator. As mentioned by the BSEM report, these are the conditions under which dispersion models perform least satisfactorily. For this reason, there is always a considerable "margin for error" factored into the modelling of emissions from waste incinerator facilities. This is not an unusual situation for an individual source of pollutants, and many industrial facilities will make a more significant contribution to levels of $PM_{2.5}$ and other pollutants.

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In our view, there would be some value in confirming these views by carrying out a research study based on measured emissions of $PM_{2.5}$ and PM_1 from waste incinerators.

In search of "zero waste" and "greedy burner" issues

An approach to strategic waste management which has as an ultimate goal, an aspiration of zero waste cannot be questioned. However, in the immortal words of Winston Churchill the challenges have only just begun "…***this is not the end. It is not even the beginning of the end.***

But it is, perhaps, the end of the beginning." We are all engaged on a journey towards truly sustainable resource management and we have so far achieved only a small step along the way.

Zero waste which is indeed a valid and laudable objective can become a distraction when seeking to achieve challenging steps from a landfill dominated industry towards something better.

Whether incineration can be justified when set against other forms of waste management activities further up the hierarchy, is not a debate where you can apply broad generalisations. It is important when making such comparisons to ensure that in terms of functionality and the nature of inputs and outputs that fair and balanced comparisons are made. For example an incineration plant is not seeking to achieve the same objective as a composting facility or MBT plant. It is however a well proven method for obtaining value from an input material which would otherwise not be realised. Incineration is now being presented as the penultimate stage in a series of process steps prior to landfill. The more materials that are re-used, recycled and biologically treated prior to incineration the better. Provided the overall energy and carbon footprint profile is better than a thermal recovery option. Waste management systems need to be considered in the round and not in isolation. Adaptation to future needs is also a major consideration.

Waste Strategy for England 2007 for England strongly refutes the claim that incineration frustrates recycling efforts:
"Evidence from neighbouring countries, where very high rates of recycling and energy from waste are able to coexist, demonstrates that a vigorous energy from waste policy is compatible with high recycling rates." [p.78, para 23, Waste Strategy for England 2007]
It also emphasises that it is not a good thing to be tied to a technology requiring fixed amounts of feed stock that might soon become obsolete. Flexibility seems to be the key but how practicable
is this in the context of long term waste treatment contracts?

When the infrastructure associated with waste management is in a state of flux sizing of facilities is not an easy task. Economies of scale do apply equally to incineration plants as they do to other forms of development. At a time when there is a short fall in waste recovery capacity in the UK and a growing mountain of 'stabilised waste' requiring an alternative to landfill, incineration is the obvious choice.

4.2 Other waste management activities

Composting - Studies have found no increase in cancer or asthma in opulations close to composting facilities. However, even a well-run open windrow facility can give rise to emissions of micro-organisms and dusts. These could in theory affect the health of people living in close proximity to the facility. Further research in this area based on field monitoring or health surveillance data would be useful.

Waste Transfer Stations - There is evidence that workers in such facilities can experience acute
symptoms such as asthma or flu-like symptoms. There have not been any studies of the health effects in local populations.

Landfill – Landfills have been the subject of a significant body of research. No convincing causal link has been made to incidents of cancers or congenital birth defects. Emissions from landfill sites could occasionally have minor and short term health impacts such as increased incidence of asthma attacks, lethargy and respiratory problems. The best way to deal with these symptoms is effective control of landfill site emissions, and particularly landfill gas.

Other technologies: No long term studies of the health effects of anaerobic digestion, autoclave
or MBT facilities have yet been carried out. Depending on the nature of an individual facility, the health effects of MBT and anaerobic digestion facilities might be expected to be comparable to those of composting facilities.

5. CONTEXT

Table 1 below provides an indication of the inventory of emissions from incineration of MSW in the UK, compared with emissions from other important sources. Table 2 provides an indication of comparable sources of pollutants to a typical UK MSW incinerator (Enviros and Waste Recycling Group 2006).

Table 1: Emissions to air from waste management and other sources in the UK

Substance
UK total
emissions
Landfill as
percentage of UK
total
EfW as
percentage of
UK total
Other important sources
Power generation: 29%
Carbon dioxide 147,500,000 t/year 0.8% 1.6% Road Transport:21%
Domestic: 16%
Methane 2,427,000 t/year 27% 0.002% Agriculture: 40%
Power generation: 13%
Road Transport: 15%
Fine particles
(PM_{10})
172,000 t/year 0.06% 0.05%
Domestic: 16%
Oxides of Power generation: 24%
nitrogen
1,512,000 t/year 0.4% 0.3%
Road Transport: 42%
Sulphur dioxide 1,165,000 t/year 0.16% 0.01% Power generation: 71%
Dioxins and Fireworks: 14%
furans
360 g/year 0.53% 0.27%
Accidental fires: 16%
PCBs 1706 kg/year Not known 0.01% Old electric equipment: 70%
Arsenic 34.6 t/year 0.025% 0.035% Domestic: 21%
Cadmium 5.2 t/year 10% 0.23% Metals manufacture: 44%

When seeking to communicate the potential environmental impacts of waste facilities and particularly incinerators to a non scientific lay audience the authors have found it helpful to compare the key target emissions from incineration with the same emissions resulting from more commonly experienced activities. This allows members of the public to appreciate the likely significance of these emissions, in a context with which they are likely to be more familiar. The
table below shows the equivalent annual emissions to air from more commonly encountered sources.

Table 2: Emissions from a typical EfW plant

It is a scientific fact that emissions from incineration in the UK are a relatively minor source of air pollution, including substances of significant concern such as dioxins and furans, metals and fine particulate matter.

6. CONCLUSIONS

There are many who would seek to exaggerate the negative impacts of incineration motivated by various local and wider political agendas. The authors strongly contend that the continually growing body of scientific evidence does not support the high level of concern relating to air pollution and health effects which are used by local and national groups to block specific incineration proposals, resulting in restrictions on any increase in MSW incineration in the UK.

There is always room for more and better monitoring and research but the level of concern **Substance Annual emissions to air from typical** (230,000
tonnes per year) **EfW facility Approximately equivalent to**
Carbon monoxide 70,000 kg A 1 km stretch of a typical motorway
Volatile organic
compounds
1800 kg A 0.3 km stretch of a typical motorway
Oxides of nitrogen 370,000 kg A 7 km stretch of a typical motorway
Fine particles (PM_{10}) 8,000 kg A 5 km stretch of a typical motorway
Carbon dioxide 220,000 tonnes A 28 km stretch of a typical motorway
Methane 4630 kg A herd of 100 cows
Sulphur dioxide 9,000 kg 100 homes using coal fires for heating
Dioxins and furans 0.18 grams
Accidental fires in a town the size of
Milton Keynes
Arsenic 1.2 kg
Less than a fiftieth of the emissions from a
medium sized UK coal-fired power station
Cadmium 1.2 kg

Less than a twentieth of the emissions from a medium sized UK coal-fired
power station

directed at incineration is clearly disproportionate to the level of measured impact. The waste industry and the emission standards applied to incineration under legislation such as the Waste Incineration Directive are in many ways far more stringent than many other industries and might be said to be one of the heavily environmentally regulated industries in the UK.

The health effects of some emissions from waste disposal in the UK can be partially quantified, as shown in Table 3 below. The health impacts associated with MSW landfill and incineration are minor compared with other comparable risks to health.

Table 3: Health effects of waste management in context
Number per year Health in the UK due to
Impact
MSW
landfill / incineration Lung cancer due to passive smoking
Accidents in the home
Accidents in the workplace
Pedestrian traffic accidents

Natural/ environmental causes Choking on food Injury from fireworks
Deaths brought forward 0.5 4300 One per small town
736 One per large town
671 One per large town
191 One per large town
246 One per large town
Hospital admissions
5 168,300 One per street or village
500,000 (approx) One per street
34,881 One per village
1017 One per small town
Cancers 0.0018 Several hundred
One per large town
Data
Pedigree
Poor Poor Good Good/
moderate
Very good Good Good Good

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