WASTE:

- **REDUCE**
- **REUSE**
- **RECYCLE**
- **RETHINK**

SUBMISSION BY THE

DON'T INCINERATE STEERING COMMITTEE (DISC)

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LANDFILL RESTRICTIONS CONSULTATION

RESPONSE BY DISC

Introduction

DISC is a North Yorkshire pressure group opposed to incineration of waste for economic, environmental and health reasons. We believe that it is essential to formulate an environmentally sound strategy for waste management and that any such strategy will reduce the amount of waste produced and maximize re-use and recycling of wastes and that this strategy has environmental benefits including the reduction of pollution. However, we also believe that processes further down the waste management hierarchy should be carried out in an environmentally responsible manner and have regard to the adverse health risks associated with some technologies. In this, where there is reasonable doubt, the precautionary principle should be applied.

This Submission is in response to the Review announced in Caroline Spelman's speech at Futuresource, Excel Centre entitled "*Waste – new thinking for a new economy*" on 15th June 2010.

Background

Chapter 7 of the UK Government Sustainable Development Strategy (Cm 6467) states that "*The overall objective of government policy on waste is to protect human health and the environment by producing less waste and by using it as a resource wherever possible. Through more sustainable waste management – reduction, re-use, recycling, composting and using waste as a source of energy – the Government aims to break the link between economic growth and the environmental impact of waste.*"

Achieving the Coalition's ambition of being "*the greenest government ever*" and "*working towards a zero waste economy, encouraging paying people to recycle and working to reduce littering*" means action at all stages of the waste hierarchy to achieve optimal waste management which reduces waste, ensures maximum re-use and recycling and deals with the residual wastes in an environmentally responsible manner that takes full and proper account of health risks. It also means taking full account of the UK's obligations in respect of greenhouse gas (GHG) emissions and the Stockholm Convention on persistent organic pollutants.

The Problem

Currently, there are a wide range of approaches taken by producers of waste and by local authorities and others managing waste. There are undoubtedly examples of good practice among these, but also plenty of examples of poor or mediocre practice. This will produce some "good news" stories but does not mean that progress towards the Coalition's objectives will be sufficiently rapid. Moreover, there is significant risk that a number of local authorities will take retrograde measures that are contrary to achieving good waste management. Some of these will risk damage to both the environment and health.

A piecemeal approach will not produce good results and can create confusion, especially over recycling practices. What is needed is a coherent strategy and commitment to it from all parties. This must include suitable measures right across the waste management hierarchy as well as steps that only Government can take.

The Solution

The first three elements of moving towards a "zero waste" economy (in the sense of a society where resources are fully valued – financially and environmentally – throughout the economy) are to reduce the amount of waste produced and to reuse and recycle as much as possible of that waste. All sectors of society can act to achieve these first three steps and evidence from around the world suggests that re-use and recycling can account for over 50% of waste; indeed 50-70% are realistic targets.

Government can take a number of steps both in the short and medium term to produce a fresh, and greener, waste management strategy and to ensure it actually gets implemented. These include:

- Creating and gaining agreement on a strategy and promoting it at all levels.
- Economic incentives – the opposite of a bin tax. These could be used to encourage householders, commercial undertakings and local authorities to adopt good practice.
- Regulation; for example:
    - introducing further restrictions on the landfill of biodegradable and recyclable wastes, on which DEFRA are currently consulting;
    - ensuring standardization of the plastics used in food packaging to ensure that recycling is maximized;
    - banning waste management technologies that damage health and/or the environment. In our view this should mean an immediate ban on new incineration plant and phasing out all incineration (except for a few specialist categories like medical waste) over a reasonably short period (say five years).
- Remove perverse incentives:
    - Changes to the Landfill tax to ensure a level playing field for different waste management technologies: this means charging the standard rate for incinerator bottom ash, not a very reduced rate (as now);
    - Renewable Obligation Certificates (ROCs) are intended to subsidize electricity producing renewable electricity sources to help reduce greenhouse gas emissions. It is therefore anomalous to subsidize electricity from incineration in this way as it has the highest greenhouse gas emissions from waste management technology.

The next sections discuss waste management strategy followed by sections discussing reduction, re-use and recycling of waste. Finally, a section entitled "rethink" looks at what to do with the residual waste and suggests approaches in this controversial area.

Waste Management Strategy

We believe that any solution to disposal of municipal solid waste (MSW) and, indeed, commercial wastes should meet a number of principles or policy objectives. These include:

1. Minimizing the amount of waste going to landfill;
2. Reducing the amount of waste produced
3. Maximizing recycling
4. Minimizing greenhouse gas emissions
5. Minimizing environmental impacts
6. Minimizing pollution, including to the food chain
7. Eliminating as far as possible risks to human health, including that of vulnerable groups such as children and other vulnerable groups.

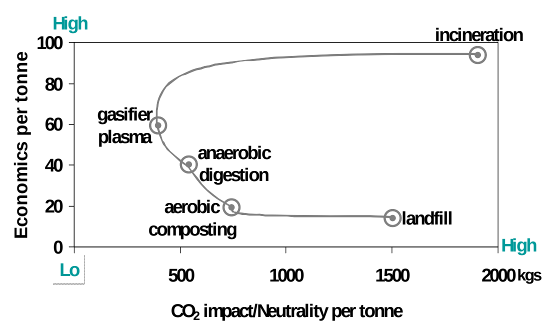
The first three of these points are widely accepted and consistent with the Sustainable Development Strategy. The question is therefore how best to achieve these goals. DISC believes that there is no single "correct" solution and that a range of measures need to be adopted. For example, recycling needs to be maximized through both optimal separation and collection of recyclable material at source (to give relatively pure waste streams) and through mechanical separation (e.g. in a Mechanical/Biological Treatment (MBT) facility).

We suggest that it is wrong, and counter-productive to look at any one part of the waste management chain in isolation. In particular, it is important to consider what happens lower down the waste management hierarchy. For example:

- No technology avoids GHG emissions altogether *but landfill and incineration are the worst technologies for greenhouse gas emissions*. By contrast Anaerobic Digestion (AD) also helps reduce GHG emissions by displacing industrially-produced chemical fertilizers and, where smaller, local facilities are used by reducing vehicle movements and by reducing electrical grid transportation losses. As Peter Jones[1] has said "*All incineration processes will raise CO_2 emissions and should therefore be minimized as part of any successful strategy in managing the waste resource*".
- Figure 1 (from a recent presentation by Peter Jones) shows the relationship between cost and CO_2 emissions for a number of waste management technologies.

Figure 1

Relationship between cost and CO_2 emissions



- Minimizing pollution, environmental impacts and health risks depends strongly on what alternative to landfill is chosen. Thus AD can be beneficial but incineration is particularly bad due to the greater number and toxicity of pollutants, including creation of new ones not present in the original waste.

[1] Peter Jones OBE is a former BIFFA Technical Director and is an Independent Advisor to Boris Johnson on the London Waste Board.

Combustion, especially high temperature combustion as in an incinerator, leads to emissions that risk health, making it prudent to choose technologies other than incineration. Moreover, their economics rely on a high load factor and this tends to discourage reuse and recycling. By contrast, technologies such as AD reduce the pollution load and produce useful products.

We therefore recommend that you take a holistic approach to waste management, taking full account of environmental and health risks. This approach points to a strategy that combines maximal waste reduction, reuse and recycling with technologies such as MBT/AD.

This approach is consistent with the aspirations announced in Secretary of State's presentation to the *Futuresource* conference on 15th June 2010 and the measures suggested in DEFRA's recent consultation document[2]. They could form part of a holistic approach to waste management which could move substantially towards reducing landfill as close to zero as possible. However, they would be more beneficial if combined with a number of other measures to facilitate reduction, re-use and re-cycling coupled with fiscal and regulatory changes which properly reflect the balance of environmental and health risk.

Less Waste Produced

Producing less waste is the obvious first step in reducing waste management problems but addressing this is not easy since it is the direct responsibility of both commercial producers and retailers and everyone who throws anything away. However, there are a number of ways that could help reduce it. For example:

- Reducing waste by individuals:
    - Composting waste in the garden is ecologically sound and using an enclosed composter would reduce the risk of rats. Some councils (e.g. Eastleigh) subsidize or give composters (e.g. Lancashire, using the Landfill Tax Credits through the Lancashire Environmental Fund to help pay for them[i]). By contrast other councils collect green waste which discourages home composting but may maximize overall composting rates. A combination of these approaches is probably the optimum.
    - Overbuying food that then goes to waste[3]. In the UK we throw away roughly ⅓ of everything we buy; over 80% is avoidable waste but is thrown away whole, untouched or unopened – some 340,000 tonnes is still in date and some 1.2 million tonnes is simply left on our plates[ii]. Much of this currently goes to landfill. While this may support the case for a ban on landfill of food, other actions are desirable. For example, selling via "*buy one, get one free*" and similar selling techniques encourages waste. Similarly, the relative difficulty of buying some things in small quantities suitable for single people probably encourages waste.
- Waste induced by commerce (including all DEFRA target categories, and more):

[2] This DEFRA's consultation (closing in June 2010) concerned introducing further restrictions on the landfill of biodegradable and recyclable wastes and whether this would make an effective contribution to meeting their key twin objectives of reducing greenhouse gas (GHG) emissions and increasing resource efficiency

[3] According to the Waste and Resources Action Programme (WRAP) the amount of food we throw away increases by 80% around Christmas – partly because we are cooking for more people than usual and cannot judge the portions correctly and partly because we simply overbuy at the supermarket.
Source: http://www.telegraph.co.uk/finance/personalfinance/consumertips/3472948/Cut-your-festive-food-bills.html

- Junk mail

  People mostly throw this out or burn it but there is a price to be paid in resource terms. Taxation and fines for those who contravene the wishes of people as expressed through the mail preference service (and an easy route for complaining) could help address this problem, as could an overall levy on distribution of such mail through commercial providers.

- Excessive packaging and non-recyclable packaging

  Excessive food packaging used by supermarkets is undermining householders' efforts to recycle more and is adding to council tax bills. The Local Government Association's third survey of food packaging found that in a typical basket of shopping almost 40% of supermarket food packaging cannot be easily recycled. A survey by the British Market Research Bureau (BMRB) looked at eight supermarkets and the weight of food packaging they use in a typical shopping basket found considerable variation between supermarkets [iii] While supermarkets are beginning to address this issue in response to consumers[iv], any official action that encourages this would be welcome. Perhaps this could build on the voluntary Courtauld Commitment under the aegis of the government-funded Waste & Resources Action Program (WRAP).

- Free plastic bags

  Plastic bags can do significant environmental damage. Some 9.9 billion were distributed in the UK in 2008, about 18% of total plastic waste or 3.24% of domestic rubbish[v]. Despite campaigns in the media (e.g. the *Daily Mail*) most supermarkets have not gone beyond offering re-usable bags for sale, sometimes with modest incentives such as Tesco club card points. Only a few no longer issue free bags. Compulsory charging combined with taxation (e.g. 5 pence per bag) could address this problem while reducing the amount of plastic going to landfill. In Ireland the Government put a 15 cent tax on plastic shopping bags and reduced use by 92% in one just year[vi].

➢ Waste by Industry; industry could cut waste by better design

- Products and packaging should be designed to minimize consumption of materials, energy and water (to an extent this already happens through the drive to reduce costs and improve efficiency) and maximize recyclability. The latter may involve some standardization to increase the use of recyclable materials (e.g. non-recyclable plastics should not be used where recyclable alternatives exist).

- Electrical goods could be designed to last longer with low-cost maintenance and repairability offsetting higher initial cost. However, this may require changes in attitudes and tighter regulations[4]. Nevertheless, it has the potential to reduce WEEE and fiscal measures that encourage longer guarantees (if such could be designed) could offer a way forward.

These measures would help facilitate reductions in some of the target waste streams in the recent DEFRA consultation document, making bans or major reductions easier to implement.

[4] A company that sells you an item of electronic equipment is now (2009) legally bound to take your old one in return. This should reduce the amount of illegal dumping of fridges etc. However, this does nothing to deter built-in obsolescence or the wasteful demands of changing fashion and there is little incentive for manufacturers to do this as it reduces sales opportunities to enforce repairability and ensure longer guarantees (say 10 years in place of the current maximum of around 3 years).

Potential Actions to Encourage Re-use and Recycling

There is a lot of good practice around but it is patchy so there is a need to identify best practice and encourage all parties to adopt it. While bans on certain waste types going to landfill have a role to play, there are other measures that we think the government should consider. These include:

- Setting national standards for the collection and processing of household waste, pointing out that the collection of clean and sorted household waste is the only way to ensure quality and value. The presumption here is that Government would set sufficiently high standards and that these would encourage/ensure that best practice would be widely adopted.
- Introducing fiscal incentives for manufacturers to use secondary rather than virgin materials
- Setting national targets to encourage reuse and recycling through tax incentives and penalties (but aimed at organizations, not individual householders).
- Considering perverse incentives prior to any charging. For example, charging for disposal of household appliances less than 10 years old might encourage illegal dumping.
- Use of Extended Product Responsibility (EPR) where firms take physical and financial responsibility for products even after they are sold, collecting their products and packaging after use. This encourages firms not to produce non-recyclable and non-reusable products. It has been applied to packaging, tyres, and electronics[vii].
- Taxing non-recyclable items to discourage their production.
- Some would argue that reuse of returnable bottles (a deposit on the bottle is hardly a new idea!) and jars would be better than recycling (especially if CO_2 is the bottom line) rather as was done prior to the 1950s. In Ontario (Canada) the beer industry has used refillable glass bottles for 50 years and achieve 98% recovered so each bottle reused 18 times, saving the company money and creating jobs in collection and cleaning [vi].

These examples illustrate significant scope to reduce waste. Not everyone will adopt best practice for a whole variety of reasons but media pressure, public opinion and local and national government action could all influence towards less waste. That said, the targets need to be well thought through if they are not to be counter-productive[5]; for example reducing the weight of packaging may not always be the best option. [6]

Recycling

DEFRA has admitted that "*In terms of recycling, England is still very much the poor relation among its European partners, with countries like Austria and Belgium recycling more than 50% of their waste*"[viii]. As the British Society of Ecological Medicine (BSEM) points out, about 46% of municipal waste consists of paper, cardboard,

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[5] For example, packing bananas in modified-atmosphere bags extends shelf life and reduces the number discarded by retailers after customers have broken up bunches Other examples are potatoes, grapes and salad leaves, while wrapping extends cucumber shelf life beyond the three days to 14 days. - Sunday Times Magazine, 0/2/09.

[6] Similarly, the Industry Council for Packaging and the Environment believe that reducing weight of packaging may not always be the best option and that manufacturing and retailers may have the knowledge to best minimize expenditure of resources (e.g. recycled paper packaging is weaker so needs to be thicker and heavier).

fabrics, glass and metals, all of which could be recycled [vi]. However, for recycling programs to work successfully, it is important to have systems in place that are easy to use .

Many materials are recyclable, though not necessarily indefinitely, while others can present difficulties. Thus:

- Glass – infinitely recyclable
- Metals including aluminium – infinitely recyclable
- Paper – can go back through the recycling system several times until fibres are too short to pulp and then can be anaerobically digested
- Textiles – recycled like paper from second hand shops then to carpet underlay and car acoustic materials. Polyester cannot be anaerobically digested but this should not be a problem with viscose, cotton or wool (cellulosics and natural materials)
- Plastics can be difficult – cleaning issues in particular for food packaging. In addition, not all plastics are recyclable and many are chlorinated[7]. Standardizing the use of plastics could help. For example, some 14 different plastics are used in different combinations simply because people are used to the look and feel of things and sorting and recovery would be easier if this were reduced. This would also help reduce public confusion over which plastics can be recycled. Arguably confusion deters people from recycling while banning non-recyclable plastics from certain uses (e.g. foodstuffs, drinks containers) would reduce the risk of contamination of waste streams.
- Mixed materials such as laminated drinks cartons are expensive to recycle and should be phased out.

A key in implementing any or all of these policies is to adopt best practice nationally so that all councils adopt a national high standard for re-use and recycling. Currently there is wide variation between councils; some sort between recyclable and non-recyclable waste, others sort into five waste streams with the laggards just making a single unsorted collection. Some collect glass, some don't. Some are equipped to handle the full range of theoretically recyclable plastics while many don't even try. Then there are problems with contamination by other rubbish so plastics and glass fail to get recycled. Councils standardizing the colours of their collection boxes would help but the mixture of plastic types adds another dimension to the problem. Such issues need addressing because they show the missed opportunities for re-use and recycling that currently exist. If taxation and/or bans on landfill can achieve this they should be implemented. However, they should be supported by Codes of Good Practice in reuse and recycling and consideration given to imposing fines on councils who fail to comply.

Food waste is a particular problem because of the relative unpopularity of separate collections for food waste. This means that food waste collection is a long way down the priority list for most local authorities. Even with the increasing uptake of relatively cheap home compost units in some areas, it is probably true that home

[7] BSEM argue that incineration is a poor answer to these issues as many plastics are organochlorines and form toxic products, notably dioxins, when burnt. In addition an important resource is wasted. We use about 3-4% of our oil to produce these plastics and it makes no sense to simply burn them. BSEM suggest that the best solution would be to stop making chlorinated plastics in the first place in view of their persistence and toxicity. Instead we could make biodegradable plastics (but note these will break down to form the powerful greenhouse gas methane).

composting does not, and will not in the future, make a large impact on the amount of food waste thrown out. In consequence it seems probable that food waste will remain a significant component of municipal waste.

Rethink – How to Deal with the Residual Waste

The measures outlined above should mean that waste arisings are reduced and that re-use and recycling is maximized. Ultimately, there are only three alternatives for dealing with such residual wastes: dump it in the sea, put it into landfill or put it into the air (e.g. via incineration). The issue here is to select a management strategy and set of technologies which ensures least risk to the environment and human health and minimizes the amount of waste going to landfill. In addition, economic and employment benefits are desirable.

While collection at source for a range of household waste materials ensures good quality waste, there will always be some of these potentially recyclable wastes put into general waste streams. These wastes are recoverable using, for example, Mechanical Biological Treatment (MBT) – a combination of mechanical sorting systems and Anaerobic Digestion) to process residual mixed municipal waste. MBT is being used by some local authorities but by no means all. Using MBT or a technology equally well able to sort waste all (i.e. the best available technology) should be the norm within a few years and no Councils waste strategy should be acceptable without it. MBT could be introduced over a period of several years to give local authorities the chance to comply. Whatever incentives are used to ensure compliance (perhaps through the block grant to local authorities), it is essential that the use of technologies such as MBT become the norm.

The Option of Choice – MBT/AD

We favour MBT/AD of residual wastes (preferably after an MBT stage) because it reduces the amount of waste going to landfill and offers environmental benefits:

- Using the methane and power produced in AD facilities can replace energy derived from fossil fuels, thereby reducing GHG emissions - the carbon in biodegradable material is part of the natural carbon cycle so CO_2 released to the atmosphere from AD has been removed by plants in order for them to grow in the recent past. In particular food plants are re-grown, so that part of the system is carbon neutral. Indeed MBT/AD is one of the best options for low GHG emissions.
- Digester liquor can be used as a fertilizer supplying vital nutrients to soils, replacing chemical fertilizers which require large amounts of energy to produce and transport. The solid, fibrous component of the digested material can be used as a soil conditioner to increase the organic content of soils.

The Must Avoid Option - Incineration

By contrast, processes relying on high temperature combustion (incinerators, also known as Energy from Waste and other euphemisms) present a range of environmental and health problems and offer no environmental benefits. Annex A outlines the range of harmful emissions while Annex B looks at health risks which pollution control reduces but does not eliminate. In summary, any incinerator is currently able to legally emit dioxins and furans in the PM_4 range and below (for which under the Stockholm Convention there is no acceptable minimum threshold) and will within a normal cleaning cycle emit far in excess of the accepted legal tolerances for up to PM_{10} leaving the population locally exposed to an accumulation of highly toxic dust which is likely to be ingested through milk and dairy products. Councils and planning authorities consider these levels low in the scale of all emissions generally over a very wide area and therefore deaths arising are considered acceptable. We understand that the government has recently received a written warning on its failure to generally reduce air emissions to acceptable EU levels and that a £300m fine is being imposed to get the authorities to pay attention to overall emissions in the UK. This means that incineration is a poor policy for the UK while any community in the region of an incinerator will be specifically vulnerable to emissions which will never or only very slowly decay and remain in the local environment and the food chain long after the 25 year term of the typical waste contract associated with incineration.

We deeply regret that official advice has taken a very sanguine approach and appears not to have taken full account of evidence from overseas which have shown adverse health effects from incineration using a proper epidemiological approach. In our view, this has led local authorities to be unaware of the extent of potential problems with incineration.

We believe that monitoring of pollution from incinerators is open to criticism. Annex A sets out our concerns. These include the quality and nature of monitoring covering the way that it is done (too infrequently, as with dioxins and heavy metals, no checking of start-ups and shut-downs, no unannounced checks), the compounds monitored (again too few and some of the most serious hazards such as ultrafine particles not measured at all), the levels deemed acceptable (failure to recognize that some health risks have no lower threshold or low dose toxicity and failure to apply the precautionary principle), lack of monitoring of body burdens in the local population or the build-up of pollutants in the locality. We believe that environmental regulation setting out a proper monitoring regime needs to be introduced as a matter of urgency to ensure that emissions from incinerators are properly monitored in order to protect the public and the environment. They should include unannounced visits (see Annex A).

Incinerators not only produce harmful emissions to atmosphere, they also produce ashes that are difficult to deal with. **Ash** comprises **Incinerator Bottom Ash** (**IBA**, collected from the grate - some 20-30% of the weight of the feedstock), **Grate siftings** (the finer particles of the grate ash), **Boiler ash** (from the energy recovery boiler), **Fly ash** (the ash removed prior to the pollution abatement system) and **Air pollution control residues** (containing unspent reagent and the entrained pollutants or reaction products). The collection of these ashes is controlled by the design of the incineration plant; often bottom ash, grate siftings and boiler ash are collected together as are fly ash and APC residues.

Fly ash (10-20% of total ash) is more of a potential health hazard than IBA because it often contains high concentrations of heavy metals such as lead, cadmium, copper and zinc as well as small amounts of dioxins and furans. In the UK it is disposed of in special waste landfills due to its lime content and the concentrations of heavy metals. Its safe disposal usually involves additional waste miles and the need for specialist toxic waste landfill elsewhere.

There is some controversy over whether IBA represents an environmental hazard since pollutants such as heavy metals in the original waste do not burn and are therefore concentrated. Even so, its use in road construction is widespread despite public concern associated with incinerators and their releases. Since it is less hazardous than Fly Ash, it may go to ordinary landfill sites after appropriate testing. Despite the generally positive views of only a few years ago, incinerator operators could have to treat IBA as hazardous waste because of doubts over its ecotoxicity and this could significantly increase costs. This depends on whether or not IBA is seen as ecotoxic; this depends on the view on the difficult to identify zinc and lead compounds and around 40% of IBA could become ecotoxic. However, it can be difficult to determine whether ash exceeded ecotoxicity thresholds and operators are likely to carry on consigning ash as non-hazardous. **We therefore recommend a much more stringent testing regime with the operators paying for independent inspectors through a levy**.

Leaching of Hazardous and/or toxic materials could take place either from waste prior to it going into the incinerator or from any IBA left out for weathering. Leaching could include hazardous and/or toxic materials present in the rubbish and leachate could enter the local land and groundwater and hence affect people, crops and animals. If IBA is weathered on-site then leaching of chemicals and metals into the environment could take place

There is less incentive to recycle in local authorities where waste management relies on incineration due to the economic need for incinerators to run at high load factors. This may produce market distortions. For example, the Environment Agency has recently approved a shipment of 40,000 tons of RDF (Refuse-Derived Fuel) by the East London Waste Authority to Amsterdam for use in incinerators. Successful recycling in Holland and Germany has led to a shortage of fuel for incinerators[ix].

In addition, incineration is the worst option for GHG emissions other than landfill. Therefore **Government should take steps to ensure that those authorities using incineration adopt best practice for reuse and recycling.** This should include both primary sorting and the use of secondary sorting technology such as MBT.

Even if this is done, IBA may still contain materials which are banned from landfill following DEFRA's expected full consultation. A policy response to this possibility will be needed – perhaps an additional charge made to local authorities or the firms they employ to meet the cost of the additional landfill. This should be set at a level markedly higher than the cost of removing the banned materials prior to incineration would have been.

Changing the Financial Picture

We believe that the influence of health and environmental factors should be aligned with financial drivers and that it is important to avoid perverse incentives. Anomalies in the way landfill tax is applied to IBA and the availability of ROCs for incineration should both be corrected. In addition, more stringent monitoring of emissions from incineration and assessment of IBA for ecotoxic pollutants is needed and the cost of these measures should be charged to the incinerator operator.

Towards a Level Playing Field - Taxation

Landfill tax is a tax on the disposal of waste and applies to all waste disposed of at landfills. It was introduced to encourage waste producers to produce less waste and recover more value from waste, thus encouraging waste producers and the waste management industry to switch to more sustainable alternatives.

The tax has two rates with qualifying materials, as set out in Schedule 2 of the Landfill Tax (Qualifying Material) Order 1996, paying a reduced rate of £2.50 per tonne compared with the standard rate that had reached £40 per tonne by April 2009 and is set to continue to increase by £8 per tonne per year at least up until 2010/11.

The qualifying materials were intended to be inert wastes – that is relatively harmless. The inclusion of ash in this category is a serious distortion of the waste management market inasmuch as it includes Incinerator Bottom Ash (IBA). Reasons for removing this market distortion by taxing IBA at the standard rate include:

- IBA represents a potential environmental hazard since pollutants such as heavy metals even asbestos or small quantities of radioactivity from smoke alarms in the original waste do not burn and are therefore concentrated. Since the make-up of domestic waste is unknown, IBA is likely to contain toxic and other dangerous pollutants, at least much of the time. There are currently concerns over its ecotoxicity; this depends on the view taken on the difficult to identify zinc and lead compounds. Classifying it as inert (a qualifying substance) is therefore illogical.

- Reliance on incineration tends to reduce the incentive to reuse and recycle waste and block out the development and introduction of other emerging technologies due to the high capital intensity and front-end-loading of incineration plant and the concomitant long-term contracts.

- The IBA contains the non-combustible materials present in the original waste so that the intention of any ban or tax on any of the non-combustible target materials in the Consultation document would be circumvented unless the full standard Landfill tax and any taxes due on these materials is applied.

These arguments show that at the very least, IBA should face the same standard landfill tax as other municipal waste. Where IBA is found to be ecotoxic, it should be treated as hazardous waste and charged accordingly.

Renewables Obligation – and avoiding encouraging GHG Emissions

As we understand it, the **Renewables Obligation** (RO) is designed to incentivize electricity generation from eligible renewable sources and was introduced in England and Wales in April 2002 An RO places an obligation on licensed electricity suppliers in the UK to source an increasing proportion of electricity from renewable sources. Suppliers get a Renewables Obligation Certificate (ROC) for eligible plant. The cost of ROCs is effectively paid by all electricity consumers, since electricity suppliers pass this cost on as a small increase in the tariff for the electricity they sell.

Drivers for increased generation from renewable include high oil prices and climate change. However, ROCs have an important influence on the economics of options for dealing with residual waste such as AD and incineration. We believe that the ROCs available to competing energy from waste technologies should properly reflect concern over greenhouse gas emissions and the GHG emissions of the various technologies.

In particular, it is anomalous that the worst offender from a GHG gas standpoint – incineration – should get any ROC. It is surely wrong to encourage the technology which contributes most to climate change throug a mechanism intended to do the opposite. **We therefore recommend that no incineration plant (under whatever name) should be eligible for an ROC.**

Paying for Monitoring of Pollution

We believe that more stringent monitoring of emissions from incineration and assessment of IBA for ecotoxic pollutants is needed (see above and Annex A). This should be carried out by organizations independent of the incinerator operator.

On the “polluter pays” principle, the costs of this monitoring should be met by the incinerator operator. Moreover, they should pay for any necessary remediation for existing pollution.

ANNEX A – The Environmental Case against Incineration

Municipal Solid Waste (MSW) incinerators are fed by a variable and uncertain mix of materials so emissions are not constant but include varying quantities of substances harmful to man, wildlife or the environment. Emissions include chemicals and substances found in the waste; those created from materials in the waste or produced during its decomposition (e.g. volatile organic compounds, VOCs) and combustion products (e.g. oxides of nitrogen (NO_x) and SO_2). Some substances can arise from both kinds of source – e.g. dioxins, furans and particulate matter. The distribution of these emissions will depend on how the plume is dispersed, dependent on chimney height and local meteorological conditions.

Pollution control is costly but reduces emissions markedly. The dangerous nature of some of these emissions means that incinerators use a range of anti-pollution devices, including acid-gas scrubbers, particle filtration, fabric filters and electrostatic precipitators. Either catalytic reduction or selective non-catalytic reduction removes NO_x while heavy metals are often adsorbed on injected active carbon powder (collected by the particle filtration). While incinerators burn the waste at sufficiently high temperatures to encourage complete combustion breaking down many complex chemicals into simpler, less harmful compounds, these may form as the flue gases cool.

Dioxins, Furans and related harmful emissions - In practice incinerators burn hazardous chemicals or precursors to them so that emissions are likely to include dioxins and furans (many are carcinogenic or endocrine disruptors) and related compounds such as PCBs, (many are endocrine disrupters), PBDEs and PBBs. While PCBs, PBBs and PBDEs can be present in waste, dioxins are not normally present in waste, but are formed when chlorine-containing organic substances (e.g. PVC) are burned. The use of gas cleaning technologies means modern incinerators are less hazardous than earlier generations of plant.

Dioxins and furans released into the air during combustion can be carried long distances before settling to the earth's surface so are found almost everywhere at low levels. They tend to bind tightly to vegetation and soil, leading to people being exposed through eating meat and dairy products and accumulating dioxins and furans in the fatty tissues of our own bodies.

Dioxin emission levels from incinerators are only measured once or twice a year by external assessors and where continuous measurements are made the total dioxin emissions are found to be very much higher than those calculated from biannual measurements. While some organizations, including Local Authorities believe that dioxin levels are low or even negligible, this is not always the case and dioxins remain an issue:

Incinerators do not always run under optimal conditions and dioxin emissions can vary accordingly. Also, the post-combustion re-synthesis of dioxins can mean dioxin levels at the waste heat boiler outlets being 11–14 times higher than at the furnace outlets. This significantly increases dioxin levels in the flue gases prior to treatment, making reduction of dioxin levels more difficult. Also, incinerators have to be shut down on occasion, for routine maintenance and due to operating problems. During shutdown and start-up levels of dioxins and other pollutants can be much higher than under optimal operation

Thus levels of pollutants emitted from incinerators can vary greatly, and can exceed the statutory limits placed upon their emission. Applying the precautionary principle in the face of the harmful nature of many dioxins, it is not appropriate to emit such chemicals in a rural and agricultural environment and close to habitation.

Polycyclic Aromatic Hydrocarbons (PAHs) - PAHs are chemical compounds that consist of fused aromatic rings and are one of the most widespread organic pollutants. Different types of combustion yield different distributions of PAHs in both relative amounts of individual PAHs and isomers are produced. Thus coal burning, for example, produces a different mixture than motor-fuel combustion or a forest fire. Some PAHs are known or suspected carcinogens and PAHs may be mutagenic or teratogenic (able to disturb the growth and development of an embryo or foetus). The toxicity of PAHs is very structurally dependent, with isomers varying from being non-toxic to being extremely toxic.

Humans can come into contact with PAHs in several ways including several which are relevant to incineration:

- Breathing air containing PAHs in the workplace including in incineration facilities.
- Breathing air containing PAHs from smoke
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.

The nature of MSW implies emissions will include various PAHs. The combination of these various routes to humans and the health implications makes it inappropriate to emit such chemicals in a rural and agricultural environment and close to habitation.

Particulates also called particulate matter (PM) are tiny particles of solid or liquid suspended in a gas or liquid. They are emitted from a wide range of man-made sources including many forms of combustion. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer. The size of particles is related to their health implications so particulates are commonly classified by their size, often expressed in terms of their aerodynamic diameter; e.g. PM_{10} describes particles of 10 micrometers or less. The smallest are the most dangerous and $PM_{2.5}$ have been repeatedly correlated spatially to infant mortality. In June 2008 several European doctors associations wrote a keynote statement directly to the European Parliament citing widespread concerns on incinerator particle emissions and the absence of specific fine and ultra-fine particle size monitoring or in depth industry/government epidemiological studies. (Under the European Waste Incineration Directive there is no requirement to monitor stack top or downwind incinerator $PM_{2.5}$ levels). Yet it is only particles smaller than PM_3 that enter lungs; some 90% of PM_1 being retained in lungs.

Modern particle filtering of flue gases is efficient. Although more than 99% of the particulate mass is removed, virtually all particulates not removed are very tiny (i.e. the most dangerous) and behave aerodynamically as gases, so these particulates are widely dispersed in the environment.

SO2 and NOx - Emissions include harmful oxides of nitrogen (NOx) and, depending on the content of the waste, SO2. Both are precursors to acid rain and contributors to the development of photochemical smog, and are directly toxic to vegetation. Children, people with lung diseases such as asthma, and people who work or exercise outside are susceptible to adverse effects of smog such as damage to lung tissue and reduction in lung function. NOx reacts with VOCs in the presence of heat and sunlight to form ozone which can damage lung tissue and reduce lung function mostly in susceptible populations (children, elderly and asthmatics). NOx also readily react with common organic chemicals, and even ozone, to form a wide variety of toxic products: nitroarenes, nitrosamines and the nitrate radical**.** Even moderate concentrations of SO_2 may result in a decrease in lung function in asthmatics

Heavy metals - Incinerators emit varying levels of heavy metals such as vanadium, manganese, chromium, nickel, arsenic, mercury, lead, and cadmium, which can be toxic at very minute levels. Many of these end up in the ash, with high concentrations in the Fly Ash but also the air pollution control (APC) system residues. While small amounts of these elements are common in our environment and diet, large amounts of any of them may cause acute or chronic toxicity which can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs. Long-term exposure may result in slowly progressing physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, and multiple sclerosis. The symptoms of toxic heavy metal poisoning and the symptoms of autism, PDD, Aspergers, and ADD/ ADHD are very similar. Toxic metals could be the cause of those symptoms: Allergies are not uncommon and repeated long-term contact with some metals or their compounds may even cause cancer.

Monitoring

Monitoring of pollution from incinerators is open to criticism. Serious concerns include the quality and nature of monitoring covering the way that it is done (too infrequently, as with dioxins and heavy metals, no checking of start-ups and shut-downs, no unannounced checks), the compounds monitored (again too few and some of the most serious hazards such as ultrafine particles not measured at all), the levels deemed acceptable (failure to recognize that some health risks have no lower threshold or low dose toxicity and failure to apply the precautionary principle), lack of monitoring of body burdens in the local population or the build-up of pollutants in the locality. This enables operators to say they are meeting statutory requirements and give the illusion of safety.

Only a tiny fraction of the hundreds of chemicals released from an incinerator are measured. On current data, the three most important pollutants released by incinerators are dioxins, heavy metals and $PM_{2.5}$ particulates but these are virtually unmonitored. Only half a dozen pollutants are measured continuously in the stack and about another half dozen are measured occasionally (usually 6 monthly for the first year and then yearly) by spot monitoring – these include heavy metals and dioxins. Not only is this unsatisfactory but waste operators are warned in advance of a visit and so have opportunity to change to burning cleaner waste that is unrepresentative of the toxic risk. Arguably, this renders the exercise largely pointless.

Accidental by-passing of pollution control devices by incinerators put people living in the vicinity of incinerators at risk and this danger is compounded by the near absence of monitoring of dioxins. For example BSEM cite a modern state of the art incinerator in Rotterdam that was found to be bypassing its pollution control devices 10% of the time emitting dioxins equivalent to 5 times the national limit over the city.

Start-ups and shut downs of incinerators give rise to further risks. Wang *et al*[x] found that a single incinerator start-up would, on average, generate, *over a 48 hour period*, 60% of the total *annual* dioxin emissions produced during steady state conditions – in other words 7 months worth of dioxin release within 2 days of a typical start-up. They also found that the levels of dioxins produced by start-ups at some of the incinerators they studied could be twice the annual dioxin emissions under steady state conditions (equivalent to 24 months of dioxin release within 2 days). High levels of dioxins can also be produced during shut-downs and during commissioning (when they are not monitored).

Infrequent Monitoring - Dioxins are only monitored at 3-12 month intervals and then only for a few hours so they are not monitored 99% of the time. It could be many months before high levels of dioxin emissions were detected perhaps allowing enough dioxin to be released to threaten the health of a whole community and render farms in the vicinity unfit for growing vegetables or rearing livestock. Indeed, the operator and the public might never find out and then steps would never be taken to deal with the consequences[5]. Spot monitoring is unrepresentative and underestimates dioxin levels by 30-50 times[xi]. Heavy metals are also unmonitored for 99% of the time. BSEM *(op cit)* judge that continuous dioxin monitoring is essential and that without it incinerators must be regarded as a hazard to anyone living in the area. Continuous dioxin monitoring should be mandatory, as is the case in some other European countries.

Conclusion - Currently, monitoring of the three most important and dangerous pollutants, namely dioxins, heavy metals and $PM_{2.5}$ particulates is far too infrequent to be meaningful in the UK. In the case of $PM_{2.5}$ particulates they are not monitored at all – only the far less relevant PM_{10} particulates. **This needs to be** corrected through environmental legislation.

We also believe that **monitoring on the ground is inadequate**. While, there is a requirement to monitor pollutants in the surrounding air (normally done by the local council with monitors at ground level), we believe that the number of monitors around incinerators today (typically 3) is unsatisfactory. For instance to monitor for safe levels of particulates would require at least 24 monitors placed at strategic points around an incinerator (assuming the wind is distributed evenly) to achieve a 25% sampling rate, an acceptable minimum. Measurement of heavy metals in the surrounding air, with the exception of lead, is not even required despite the associated health risks.

We believe that there should be monitoring of pollutants which have accumulated in the neighbourhood of incinerators. Measuring concentration of pollutants released in the stack tells you nothing about the levels of toxic material that have accumulated in the vicinity. Accumulation occurs when the rate of discharge of pollutants into the environment exceeds the ability of the ecosystems to break them down (and many do not break down for centuries). The excretion rates of many pollutants from the human body are also very poor and many pollutants, being fat soluble, will bio-accumulate in living matter at far higher concentrations than in the ambient air. Regular monitoring of dioxins in cattle and other farm animals is therefore essential but is not being done. Checks for pollutants in dust, vegetation and in the bodies of local inhabitants are also necessary.

Finally, unannounced visits are necessary. Levels of emissions achieved under test conditions or when inspections occur by prior arrangements are likely to be far lower than under real life conditions. This was demonstrated in the United States in 1990 when the EPA and Occupational Safety and Health Administration conducted 62 unannounced visits and no less than 69% of inspections led to summons for violations of regulations[xii]. (In the UK inspections are by prior arrangement). This makes a strong case for making all visits unannounced.

ANNEX B – The Health Case against Incineration

Despite emission control measures, there remain carcinogenic, mutagenic and/or teratogenic emissions (eg Dioxins Furans, PAHs) and endocrine disruptors (e.g. dioxins, PCBs, PBDEs) together with the possibility that their effect is enhanced by their presence on particulates (these can act synergistically with PAHs which can deposit on particulates, providing a path for longer term deposition in the body). Some particulates are sufficiently small to enter the sensitive lung tissue and damage it, causing premature death in extreme cases. Further, there are acid gas emissions; NO_x reacts with ammonia, moisture, and other compounds to form nitric acid vapour and related particles, inhalation of which may cause or worsen respiratory diseases such as emphysema, bronchitis and/or aggravate existing heart disease.

Ozone arises from incinerators as a result of NO_x reacting with volatile organic compounds in the presence of heat and sunlight. It can damage lung tissue and reduce lung function, mostly in susceptible populations (children, elderly, and asthmatics). Ozone can be transported by wind currents and cause health impacts far from the original sources. NOx also readily reacts to form a wide variety of toxic products: nitroarenes8 (suspected human carcinogensxiii), nitrosamines (carcinogenic in a wide variety of animal species, suggesting carcinogenicity in humans9.xiv,xv) and also the nitrate radical some of which may cause biological mutations.

Endocrine disrupting compounds include industrial by-products and pollutants. Some are pervasive and widely dispersed in the environment. Some are persistent organic pollutants (POPs)[10] while others are rapidly degraded in the environment or human body or may be present for only short periods of time[xvi]. Health effects attributed to endocrine disrupting compounds include a range of reproductive problems (reduced fertility, male and female reproductive tract abnormalities, and skewed male/female sex ratios, loss of fetus, menstrual problems[xvii], changes in hormone levels; early puberty; brain and behaviour problems; impaired immune functions; and various cancers[xviii].

Specifically, there are a number of health effects arising from acute exposure (not relevant to incinerators) to PCBs[11] and PCB use was banned worldwide in 1977. Recent studies show the endocrine interference of certain PCB congeners is toxic to the liver and thyroid[xix], increases childhood obesity in children exposed prenatally[xx] and may increase the risk of developing diabetes.[xxi,xxii]

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[8] The nitroarenes comprise a large class of structurally related chemicals normally found in particulate emissions from many combustion sources, notably diesel exhausts. Carcinogenicity results with experimental animals typically show tumour formation both at the site of injection and at sites away from it. The chemicals also show genotoxic activity in a variety of *in vitro* and *in vivo* assays, and metabolic pathways for the creation of reaction products with the ability to cause gene mutations or changes in the structure of DNA in tissues from animals as well as humans. Although adequate human studies of the relationship between exposure to these chemicals and human cancer have not been reported, they are *reasonably anticipated to be a human carcinogen*.

[9] About 300 Nitrosamines and N-nitroso compounds have been tested, with 90% found to be carcinogenic in a wide variety of experimental animals. Most nitrosamines are mutagens and a number are transplacental carcinogens. Most are organ specific. For instance, dimethylnitrosamine causes liver cancer in experimental animals, whereas some of the tobacco specific nitrosamines cause lung cancer. Since nitrosamines are metabolized the same in human and animal tissues, it seems highly likely that humans are susceptible to the carcinogenic properties of nitrosamines.

[10] POPs are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes and thus can persist in the environment, be capable of long-range transport, accumulate in human and animal tissue and hence in food chains.

[11] These include chloracne (a severe acne-like condition resulting from skin contact) and increased risk of skin cancer, liver cancer, and brain cancer

PBDEs have the potential to disrupt thyroid hormone balance and contribute to a variety of neurological and developmental deficits, including low intelligence and learning disabilities[xxiii,xxiv]. Many of the most common PBDE's were banned in the European Union in 2006[xxv].Studies with rodents have suggested that even brief exposure to PBDEs can cause developmental and behaviour problems in juveniles[xxvi,xxvii]and exposure interferes with proper thyroid hormone regulation. Research has correlated halogenated hydrocarbons, such as PCBs, with neurotoxicity[xxviii]. PBDEs are similar in chemical structure to PCBs and it has been suggested that PBDEs act by the same mechanism as PCBs[xxix].

There are some caveats to the effects described above since doses will be low and some of the data is inferred from animal experiments, However, there is no safe dose for cancers and some of the above materials are cumulative. Bearing in mind such caveats, it is reasonable to ascribe the following health risks to incinerator emissions:

- **Cancers:** leukaemias, non-Hodgkin's lymphoma, brain, breast, colon, lung, bladder, kidney, liver and stomach. This includes some childhood cancers.
- **Birth defects** - terminations, live defects, miscarriages.
- **Premature deaths** of babies, infants and adults including stillbirths
- **Asthma, COPD[12]**, making one a degree more prone to viral and other respiratory or other infections
- **Coronary artery disease**, heart attacks, arteriosclerosis, strokes, SADS (Cardiac arrhythmia[13], also known as "Sudden Adult Death Syndrome" and "Sudden Arrhythmia Death Syndrome") This may be in the form of aggravating existing problems
- **Multiple chemical sensitivity** with allergies and arthritis
- **Endocrine system problems such as**
    - **Hypothyroidism** (part of obesity problem) - endocrine glands
    - **Endometriosis** & other hormones disrupted.
    - **Diabetes 2** (and sometimes diabetes 1) through effect on endocrine glands
- **Lower IQ and educational achievement,** heavy metals produce symptoms such as memory loss, poor concentration and poor sleep as well as behavioral problems that could account for this
- **Behavioral problems such as Attention Deficit Disorder,** noting the similarities between heavy metal poisoning and conditions such as autism and ADD/ADHD. (see above)

This list suggests a range of problems, depending on the dose/response relationship of individuals and the actual doses.

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[12] Chronic obstructive pulmonary disease (**COPD**) refers to chronic bronchitis and emphysema, a pair of two commonly co-existing diseases of the lungs in which the airways become narrowed

[13] A large and heterogeneous group of conditions in which there is abnormal electrical activity in the heart The heart beat may be too fast or too slow, and may be regular or irregular.

The Vulnerable Groups

The Foetus

The unborn child (foetus) is uniquely susceptible to toxic damage and early exposures can have life changing consequences for two main reasons(Source: British Society for Ecological Medicine (BSEM) [xxx]):

1. Most of these chemicals are fat soluble and the foetus has virtually no protective fat stores until very late pregnancy so the chemicals are stored in the only fatty tissues it has, namely its own nervous system and particularly the brain.
2. Many pollutants are actively transported across the placenta from the mother to the foetus. This occurs with heavy metals which the body mistakes for essential minerals. This is particularly critical for mercury where one tenth of women already have body stores of mercury which can lead to neurodevelopmental problems in the newborn[xxxi].

Other factors that increase foetal susceptibility are higher rates of cell proliferation, lower immunological competence and decreased capacity to detoxify carcinogens and repair DNA[xxxii].

Safety limits currently do not take into account this increased risk to the foetus[5]; during a narrow window of time, in the first 12 weeks in utero, the foetus's body is affected by miniscule amounts of hormone measured in parts per trillion. Tiny amounts of chemicals can upset this delicate balance and chemicals that are not toxic to an adult can have devastating effects on the newborn. The BSEM review cites evidence that chemicals such as dioxins and PCBs, at doses that are not normally regarded as toxic, can affect thyroid hormones and neurological development and that a single exposure is enough and timing is critical.

Small doses of oestrogenic[14] chemicals (hormone disrupting chemicals) can alter sexual development of the brain and the endocrine system and that exposure to oestrogenic chemicals affects immunity, reduces the immune response to vaccines, and is associated with a high incidence of middle ear and recurrent respiratory infections[xxxiii]. The amount of chemical that the baby takes in relates to the total persistent contaminants that have built up in the mother's fat over her lifetime. This will increase in areas around incinerators. Exposure to fine particulate pollution during pregnancy can have an adverse effect on the developing foetus and lead to impaired foetal growth.

The BSEM review five reports of increases in congenital abnormalities around incinerators:

- Multiple birth defects at Sint Niklaas to leeward of the incinerator.
- Orofacial defects and other midline defects more than doubled near an incinerator in Zeeburg, Amsterdam. Most of these deformed babies were born in an area corresponding to wind-flow from the incinerator and other defects included hypospadius and spina bifida.

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[14] **oestrogens** or **œstrogens**) are a group of steroid compounds, named for their importance in the estrous cycle, and functioning as the primary female sex hormone. Oestrogenic is the adjective. It can mean promoting estrus or of, relating to, caused by, or being an estrogen.

Oestrogenic chemicals are hormone disrupting chemicals and include chemicals emitted by incinerators such as dioxins and PCBs. PCBs are very persistent in the environment while dioxins are persistent and bio-accumulative.

- In the Neerland area, Belgium, there was a 26% increase in congenital anomalies in an area situated between two incinerators.
- A study of incinerators in France has shown chromosomal defects and other major anomalies (facial clefts, megacolon, and renal dysplasias).
- A recent British study looked at births in Cumbria between 1956 and 1993 reported significantly increased lethal birth defects around incinerators after adjusting for year of birth, social class, birth order, and multiple births. The odds ratio for spina bifida was 1.17 and that for heart defects 1.12. There was also an increased risk of stillbirth and anencephalus around crematoriums[xxxiv]. The study pointed out that the figures for birth defects are likely to be substantial underestimates since they do not include spontaneous or therapeutic abortions, both increased by foetal anomalies.

Children

Children face a higher health risk from incinerator emissions than adults. Two main reasons for this are:

- Children have a relatively faster metabolism than adults and, for example, breathe more rapidly. Thus they take in a greater pollution load relative to body weight than do adults
- Children's tissues are developing and are therefore more affected by the same pollutant load than the "static" tissues of adults. Developing systems are very delicate and in many instances are not able to repair damage done by environmental toxicants[xxxv] and there is an age-related difference in neurotoxicity for many substances including heavy metals[xxxvi].

Children and especially babies are growing rapidly (e.g. a baby doubles its weight in roughly the first four months of life). If cumulative toxins such as heavy metals and dioxins are present, they will be incorporated in the child's body. Breast fed babies take on dioxins and other toxic chemicals through the mother's milk. Indeed, scientists wanting to know absorption of Persistent Organic Pollutants (POPs) in fatty tissues (most POPs are fat-soluble) look at the fat in breast milk[xxxvii]. Breast milk carries in it the "body burden" of chemicals a mother has been exposed to and has stored over her lifetime; including pollutants and dioxins which are known to disrupt the endocrine (hormone) system. Six months of breast feeding will transfer 20% of the mother's lifetime accumulation of organochlorines to the child[xxxviii]

Breast milk also contains PCBs which along with dioxins affect the nervous, endocrine (hormone) and reproductive systems of animals, and may be carcinogenic. They are found in many food sources, particularly fatty foods such as meat and milk. Also, babies are exposed to their mothers' toxins *in utero*, i.e. through the placenta. Recent research found that this prenatal exposure to PCBs has a subtle negative effect on the neurological and cognitive development of children right up to school age.

Breastfeeding can counteract any adverse developmental effects caused in the womb, despite current PCB levels in breast milk. That is because breast milk contains antioxidants, which seem to compensate for the toxic effects of the environment. Breast milk also helps babies develop stronger immune systems. So the most harmful effects of toxins are from exposure in the womb, not breastfeeding, and government bodies such as the Ministry of Agriculture, Food and Fisheries conclude that breastfeeding should continue to be promoted and supported. Their view is that "*The potential risk as a result of residual contaminants is far, far outweighed by the clear and proven nutritional, health and other benefits of breastfeeding*"[xxxix]

Particulates carry various chemicals including PAHs into the human body. Perera from the Columbia Center for Children's Environmental Health has found that the foetus is 10 times more vulnerable to damage by these substances[xl]. Also, PM2.5 particulates have an adverse effect on the developing foetus with significant reductions in weight, length and head circumference and reiterated the importance of reducing ambient fine particulate concentrations[xli]. In addition further studies have shown an adverse effect on foetal development at levels currently found in cities today, such as New York[xlii]. Studies of air pollution in mice have found that it causes irreversible genetic mutations whereas if the mice breathed air which had been freed of particulates by filtration they developed only background levels of genetic mutations, confirming that particulates were causative[5]. At the fourth Ministerial Conference of Environment and Health in June 2004, the WHO announced that between 1.8 and 6.4% of deaths in the age group from 0 to 4 could be attributed to air pollution[xliii].

A number of studies show that toxic and carcinogenic exposures in early life, including prenatal exposures, are more likely to lead to cancer than similar exposures later[5] At the First International Scientific Conference of Childhood Leukaemia (Sept 2004), Professor Alan Preece suggested that pollutants crossing the placenta, were damaging the immune system and could be linked with soaring rates of leukaemia, which were being initiated in utero[5]. Knox's recent study[xliv] found that children born in "pollution hotspots" were two to four times more likely to die from childhood cancer. The "hotspots" included sites of industrial combustion, and sites with higher levels of particulates, VOCs, nitrogen dioxides, dioxins and benz(a)pyrenes – just what would be found around incinerators. In most cases, the mother had inhaled these toxic substances and they were then passed on to the foetus through the placenta.

BSEM cite recent studies that found associations between the body burden of mercury and the risk of autism and point out that the study of the Sint Niklaas incinerator found a multitude of problems in children, including learning defects, hyperactivity, autism, mental retardation and allergies and that this is exactly what would be anticipated from the above and research already done on the health effects of heavy metals, PCBs and dioxins on children.

Lead can cause decreases in intelligence and alteration of behaviour in the absence of clinically visible signs of toxicity. This is also true of PCBs and methyl mercury. These effects are all the more likely when children are exposed to multiple pollutants, notably the heavy metals, which will be found in the cocktail of chemicals released by incinerators. While this may have only minor implications for an individual it can have major implications for a population[5]. For instance a 5 point drop of IQ in the population reduces by 50% the number of gifted children (IQ above 120) and increases by 50% the number with borderline IQ (below 80)[xlv]. This can have profound consequences for a society, especially if the drop in IQ is accompanied by behavioural changes.

The Chemically Sensitive

A proportion of the population react to chemicals (eg lead) and pollutants (eg benzene) at several orders of magnitude below that normally thought to be toxic (Ashford and Miller[xlvi]). BSEM[5] report studies showing a tenfold difference between different individuals in the metabolism of the carcinogenic PAH benz(a)pyrene. Ashford and Miller also noted that studies in both toxicology and epidemiology have recognised that chemicals are harmful at lower and lower doses and that an increasing number of people are having problems. A significant percentage of the population have been found to react this way (15 to 30% in several surveys with 5% having daily symptoms). Research has shown 150 to 450 fold variability in response to airborne particles[xlvii]. Chemical sensitivity is typically triggered by an acute exposure after which symptoms start to occur at very low levels of exposure. BSEM believe that faults are all too common with modern incinerators leading to discharges of pollutants at levels that endanger health – giving a very real risk of long-term sensitization and that certain susceptible individuals will be highly affected by these pollutants. They state that these effects will be difficult to anticipate and that people affected this way are extremely difficult to treat.

Health Effects – Neurological and Behavioural Effects

Most toxic compounds are preferentially stored in fatty tissue and this includes the brain while ultrafine particulates can carry pollutants across the blood-brain barrier. Heavy metals and compounds such as PCBs and dioxins cause cognitive defects, learning problems and behavioral disturbances in children and these effects occur at levels previously thought to be safe; this suggests that these pollutants also impact on adult brain function. Indeed, some organochlorines, especially those with toxic metabolites and those that dissolve in the cell membranes are known to kill brain cells and even an undetectable annual loss rate of 0.1% of neurones would lead to a major decline in brain function by middle age. A recent study has noted substantial increases in neurological diseases (Alzheimer's disease, Parkinson's disease and motor neurone disease) in the last two decades coupled with earlier onset of these illnesses[xlviii]. Similarly diseases affecting the brain (including ADHD, autism and learning difficulties) have also shown large increases in the young[xlix] and these diseases probably have aetiological[15] factors in common. BSEM note that heavy metal exposure is known to correlate with both Parkinson's disease and Alzheimer's disease and that both diseases have increased dramatically over the last 30 years.

BSEM note that many pollutants pass straight from the nose to the brain where they affect brain function and that air pollution correlates with inpatient admissions with organic brain syndrome, schizophrenia, major affective disorders, neurosis, behavioral disorder of childhood and adolescence, personality disorder, depression and alcoholism and that increases in the total number of psychiatric emergency room visits and in schizophrenia correlate to high air pollution. Additionally, BSEM note studies relating violence and crime to heavy metals and these include lead, cadmium and manganese, with most studies focusing on lead including raised levels of lead in the air. This growing literature should serve as a warning about the dangers of allowing heavy metals to be emitted into the environment and BSEM therefore note that we need to consider the effect of incinerators, not only on health, but on education and on quality of life, including the impact of violence and crime.

Cancer - Epidemiological Evidence

Carcinogenicity is a recurring theme among many of the pollutants emitted by incinerators and epidemiological studies have been carried out on this subject[16]. Unsurprisingly, they do not provide proof but the do provide strong support for the excess of cancer deaths close to incinerators. A major difficulty is that in most studies, the incinerators were situated near other sources of pollution and often in areas of deprivation, both likely to confound the findings since both are associated with higher cancer incidence. Another problem is that many of these studies predate recent emission limits and the populations were therefore likely to be subject to greater pollution than would be the case today.

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[15] **Aetiology:** The study of the causes (eg of a disorder). The word "aetiology" is mainly used in medicine, where it is the science that deals with the causes or origin of disease, the factors which produce or predispose toward a certain disease or disorder.

[16] These studies include Elliott et al[16](who compared the numbers of registered cancer cases within 3 km and within 7.5 km of the 72 municipal waste incinerator sites in the UK with the number expected, Knox[16] (who considered results for childhood cancers around municipal and hospital incinerators), Biggeri et al[16] (lung cancer deaths in Trieste) Viel et al (incidence of soft tissue sarcoma and non-Hodgkin's lymphoma from French Cancer Registry data in two areas close to an incinerator), Ohta et al[16] (incinerators in Japan), Comba[16] (increased incidence of soft tissue sarcoma in an Italian population living within 2 km of an incinerator). Zambon et al[16] (exposure to dioxin), Gustavsson[16] (increased lung cancer in incinerator workers in Sweden), the French Institute for Public Health Surveillance[16] whose objective was to analyze the relation between cancer risk and past exposure to MSW Incinerators

BSEM comment that "*the authors of some of these reports did not consider that they had sufficient grounds for concluding that the health effects round incinerators were caused by pollution from the incinerators. However, statistically their findings were highly significant and, taking the studies together, it is difficult to believe that all their results could have been due to unrecognised confounding variables. This is even less likely when you consider the nature of the pollutants released from incinerators and the scientific evidence for the health effects of those compounds. The concordance of increased cancer incidence in local areas demonstrated to be more polluted also points to a causal association, although it does not necessarily imply that the pollutant measured contributed to the increase*". They also feel that the studies may have underestimated the risks. At 13 years, the follow-up period of the large British study was probably too short: at Sint Niklaas adult cancer cases seemed to increase from 13 years onward (although children's cancers occurred earlier), and in Japan, Ohta noted that cancer caused 42% of all deaths in the lee of incinerators from 14 to 24 years after the incinerator was commissioned[l]. The reported risks were higher in the studies in which allowance was made for the direction of prevailing winds, possibly because of dilution elsewhere by relatively unexposed persons.

BSEM note that these studies apply to the older incinerators: newer incinerators may have better filters but fine particulates and metals are incompletely removed. They argue that as some of these pollutants, notably fine particulates, do not appear to have a safe threshold, it is clearly incorrect to claim that incinerators are safe. The higher quantity of toxic fly ash produced by modern incinerators, which is easily wind-borne, represents an additional hazard. Even if incinerators were equipped with perfect filters, their huge size and tendency to faults means that the risk of intermittent high levels of pollution is a real concern.

Health Costs of Incineration

Incineration creates substantial costs. A 1996 ETSU (Harwell) report for the European Commission suggested that for every tonne of waste burnt there would be between £21 and £126 of health and environmental damage, thus a 400,000 tonnes per year incinerator would cost the tax-payer between £9m and £57m / year[li]. Better emission control means these costs would now be lower but this is offset by the corresponding increase in costs that is now needed to make fly ash safe.

Estimates of the health costs of incineration are surprisingly high. DEFRA's report in 2004 found that the health costs from PM_{10} particulates from incinerators alone, using a central to high estimate, would be £39,245 per tonne of particulates emitted[lii]. A 400,000 tonne per year incinerator would produce about 24,000kg (24 tonnes) of particulates per year and the DEFRA estimate of health costs would be £941,000 per annum. There is, however, a wide range of estimates. DEFRA looked at 13 studies of $PM_{2.5}$ and PM_{10} particulates and noted that the health costs ranged from £2,000-£300,000 per tonne for $PM_{2.5}$ and £1,800-£226,700 for PM_{10}. These estimates were based on modelling data which fail to take account of all the risks and do not take into account recent data demonstrating high levels of pollutants emitted during start-up and shut-down. Thus they are likely to underestimate particulate emissions and the costs are probably towards the upper end of the range. BSEM suggest a total health cost per annum for particulates alone of £6.5 million[17], though this could be on regarded

[17] BSEM calculate as follows. The Quality of Urban Air Review Group has estimated that the PM2.5 fraction of total particulates is between 28% and 100%. Leaving aside the likelihood that the PM2.5 fraction is higher from incinerator emissions an average figure of 60% PM2.5s would be likely. This calculation therefore estimates that a 400,000 tonne incinerator would produce 24 tonnes of particulates, that 60% would be PM2.5 particulates at a cost of £4.32 million per annum and 40% would be at the lower cost for

as a maximum on the evidence available. To give a realistic estimate of the health costs of incineration, the additional costs from the other pollutants must be added to this.

Eshet's review of health costs of incineration noted the complexity and difficulty of these calculations, with estimates varying between $1.3 and $171 per tonne of waste burnt[liii]. A study of British incinerators estimated the cost to be between $2.42 and $13.16 per tonne of waste burnt[liv]. BSEM[5] note that most of these studies do not take into account the cost of ash, the cost of clean-up of accidents or water contamination or the more subtle health effects such as behavioural changes, reduction in IQ, reproductive and hormonal effects which have become apparent in recent years with many pollutants such as lead and organochlorines and suggest that the costs could be considerably higher than estimated. The use this data to can estimate that a 400,000 tonne a year incinerator will cause millions of pounds worth of health damage annually and opine that this makes incinerators a poor choice for waste management. They note that the health costs of alternative waste technologies such as mechanical biological treatment (MBT), aerobic digestion and plasma gasification have low environmental and health costs.

Reducing pollution reduces health costs and this has been demonstrated in a variety of industries in the UK and USA[lv,lvi] For example, a White House study by the Office of Management and Budget in 2003 concluded that enforcing clean air regulations led to reductions in hospitalisations, emergency room visits, premature deaths and lost workdays which led to a saving of between $120 and $193 billion between October 1992 and September 2002 (and this excluded prescription costs and primary care costs). In the case of incineration, the best choice is to use an alternative, safer technology

There are high unanticipated costs to society associated with pollution from other sources. The International Joint Commission's Science Advisory Board, the Workgroup on Ecosystem Health (SAB-WGEH) looked at a series of health problems where there was hard evidence for environmental causation. Reasoned arguments suggested that the contribution made by toxic substances to these health problems was between 10 and 50%. Four of the health problems they considered involved pollutants similar to those released from incinerators: neurodevelopmental defects, hypothyroidism, loss of 5 IQ points and Parkinson's disease. The cumulative costs in the USA for these disorders alone were considered at $370 - $520 billion per year. Even using the lowest estimate of environmental contribution (10%), the costs due to pollutants was $40 billion dollars annually[lvii]. Similarly, the WWF investigated three conditions (mental retardation, cerebral palsy and autism) to assess the impact of chemical pollution, and calculated the cost of toxic chemicals on children's brain development to be approximately £1 billion annuallylviii.

This illustrates the scale of costs of health problems arising from pollution. While incineration is only a small fraction of this, it suggests that gratuitously adding to such costs is unwise, especially where safer alternatives exist.

other PM10s costing £2.18 million per annum. The total cost in health damage from particulates would therefore be £6.5 million per annum

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