

Money to Burn

Pollution and health impacts of incinerating resources

The current UK Government, some local authorities and incinerator operators have recently embarked on a campaign to hoodwink the public into believing that waste incineration is somehow a green option for waste management.

Words such as "renewable", "recycling" and "sustainable", are being used by the authorities and the industry to describe the burning of mixed streams of municipal waste. Incinerators have been renamed and transformed into benign sounding "Energy from Waste" plants, the toxic ash they produce is "recycled" into road aggregate and burning discarded products and packaging is no longer a method of waste disposal but, according to the Government, a renewable energy source.

This attempt to spin-doctor away the fundamental problems of incineration threatens not only human health and the environment by ignoring the serious pollution generated by incinerators, but also undermines targets and goals for reducing waste and increasing re-use and recycling of resources. By a cynical sleight of hand the UK Government's waste strategy allows local authorities to meet recycling targets by increasing incineration and disposing of the contaminated ash in reckless schemes which spread it far and wide over the country - using it to build roads and cycle tracks.

New Incinerators - Old Technology

No matter what the Government elects to call them, incinerators are nothing more than huge, indoor fires in which mixed rubbish is burned. Filters are added to capture some of the pollutants in the smoke and transform them into filter ash. The heat is used to make steam and generate electricity, but essentially the process is no different from the medieval practice of building a bonfire from rubbish and setting it alight. This process, whether it is called incineration or "energy recovery", is not possible without releasing hazardous substances to the air, water and soil.

Incineration – what goes in must come out

It is a common misconception that things disappear when they are burned. But the laws of physics dictate that nothing can disappear – matter cannot be destroyed, it can only be transformed into new forms. Roughly two and a half million tons of waste are incinerated in the UK every year.¹ But where does it go, and what does it become?

¹ ENDS report 293 June 1999 p 24

Where does waste go when it is incinerated?

The answer to this question is simple but unpleasant: a third of it comes out as ashes and slag, and the rest goes up into the air. The ashes will sooner or later be dispersed to water, air and soil from the landfills where they are deposited. The part that goes up into air, in the form of flue gases, will remain in the air or be deposited in water and soil, much of it in close proximity to the incinerator, the rest far away.

If waste does not disappear when it is incinerated, what does it become?

The answer to this question is even more discomfoting: no one has full knowledge of what products burnt in an incinerator are transformed into. However we do know that some of the substances produced are extremely hazardous.

During incineration of household waste the intense heat causes chemical reactions in which new, and often extremely toxic, compounds are formed. For example chlorine in the waste, (from products made from PVC or materials that contain chloride salts), combines with organic molecules to form dioxins and other highly toxic and cancer causing compounds. There are many more we know nothing about. The number of organic substances in the releases from waste incinerators may be counted in thousands. Scientists have so far identified a few hundred such substances that are hazardous. These include some of the most toxic substances in the environment today, many of which have been listed for priority action by governments and international bodies. Hazardous chemicals routinely released to the environment by municipal waste incinerators include, dioxins, furans, lead, cadmium and other metals, particulate matter (dust) including PM10's, benzene, phenols and polyaromatic hydrocarbons.²

Filter systems, controlled temperatures of the burn and in the flue gas scrubbers and the addition of ammonia and lime can help to take out some of the harmful substances from the gases emitted to the air. But significant amounts remain. Exhaust gases come out of the incinerators chimney at the rate of around 80 cubic metres every second. (This is called the flow rate. In simple terms it means that, for a large incinerator, about 300 wheelie bins of exhaust gases, contaminated with many types of pollutants, flow from the chimney of a large incinerator every second.)³

² European Environment Agency Technical report no 38, Feb. 2000. Dangerous substances in waste p 18

³ Figures based on the SELCHP incinerator in SE London. See Environment Agency report "Measurements of gaseous and particulate releases to atmosphere from Onyx SELCHP Ltd". Report No, 8467/990804, 7 March 2000 (average flow rate 40m³/s for each of 2 burners)

Emissions from incinerators

To air

Incineration, far from making waste disappear, just transforms it into ash and small particles which are dispersed into the environment. Each tonne of waste burnt releases around 5000 cubic metres of contaminated exhaust gases into the air.⁴

Even though the gases coming from the stack may appear clean, (it may often look as though nothing is coming out) they contain very fine particles of dust including PM10's and PM2.5's. The heat in an incinerator turns metals into gases. These gases condense and attach themselves to the dust particles. Some are caught in filters and become fly ash. Others are washed out in the gas cleaning unit. The rest are emitted to air through the chimney stacks. For example the European Environment Agency note that "because of the high vapour pressure of elemental mercury, there is almost no binding of mercury in slag or filter dust. Almost 100% of elemental mercury present in the waste is therefore emitted (to air)"⁵

Incinerators operate within strict regulations don't they?

SELCHP the so called "combined heat and power" incinerator in South East London, is a flagship among the dozen municipal waste incinerators currently operating in the UK. Environment Agency figures, from measurements of gases coming from its stack in November 1999, show that by and large it operates within limits set by the European Union. However these limits are more concerned with what incinerators can practically achieve than what is good for human health and the environment.

As acknowledged by the multi-party Environment Select Committee of the House of Commons in March 2001, the legitimate public "concern about the impacts of emissions from incinerators upon human health" cannot be assuaged or dismissed while "emissions standards are still based on what can be *measured* and what is technologically achievable, rather than what is *safe*".⁶

The Environment Agency monitoring report for SELCHP shows an average of 4.8kg per hour of dust particles being release to air. This is equivalent to almost 100kg per day. (Much of this dust is microscopically small, yet the total amount emitted every day weighs as much as 100 bags of sugar). Lead has been banned from use in petrol because of its poisonous

⁴ Calculated from Environment Agency report "Measurements of gaseous and particulate releases to atmosphere from Onyx SELCHP Ltd". Report No, 8467/990804, 7 March 2000 (average flow rate 40m³/s for each of 2 burners operating 6 days a week, burning 420 000 tonnes of rubbish per annum .

⁵ European Environment Agency, Feb 2000 *op cit* p 19

⁶ [Environment, Transport and Regional Affairs Committee, *Delivering Sustainable Waste Management*, 14 March 2001](#)

effects on children, but SELCHP churns out seven grams a day from its chimneys. Seven grams may not sound like much. However, the US Public Health Service (USPHS) estimates measures the impacts of lead on childhood development in millionths of a gram and it has been suggested that there is no safe blood lead level.⁷ In addition to lead, SELCHP also discharges significant amounts of cadmium and mercury.

In addition to the emission of heavy metals, dioxins and particulate matter, incinerators also emit acid gases. These cause environmental damage from "acid rain" and exposure to acid gases can cause respiratory problems such as asthma, both directly and by combining with oxygen in air to form ozone. SELCHP releases more than 24 tonnes of hydrogen chloride (aka. hydrochloric acid), into the air each year, as well as 800 tonnes of nitrogen oxides and significant amounts of other acid gases including sulphur dioxide and hydrogen fluoride⁸.

To land

Grate ash

Incinerating municipal waste leaves ash which has about one third the mass of the rubbish entering the incinerator. This ash is contaminated with heavy metals (lead, cadmium, mercury, chromium and others⁹), dioxins and other toxic compounds. Most of it is landfilled in ordinary waste dumps where the leachable nature of pollutants in the ash pose a long term threat to groundwater. Ash is increasingly being mixed with concrete blocks and asphalt for use in the construction of roads and cycle paths. Cynically called "recycling" by incinerator operators, this practice spreads hazardous chemicals across the country, posing a threat to workers who have to dig up roads and leaving a heritage of contamination for future generations.

Incinerators in the UK between them currently create about a million tonnes of contaminated ash every year. It's not just the atmosphere that incinerators pollute. They leave a legacy of contaminated ground spread across the whole country and threaten water, food and public health for current and future generations.

Filter ash

Residues from the gas cleaning filters are even more hazardous than the bottom ash (from the grates at the bottom of the fire itself). Filter ashes are classified as hazardous waste and have to be transported across the country and disposed of in special landfills.¹⁰ According to the European

⁷ Goyer, RA (1993) 'Lead Toxicity: Current concerns', *Environmental Health Perspectives* 100: 177-187

⁸ Environment Agency Pollution Inventory, Details for Authorisation AE7236, May 2000

⁹ European Environment Agency, Feb 2000. Technical report No 28, Dangerous Substances in Waste p.19

¹⁰ Air Pollution Control (APC) residues are classified as hazardous waste ... APC residue has therefore to be managed in accordance to the hazardous waste regulation and placed in appropriate

Environment Agency (EEA) "the disposal of filter dust/fly ash from waste incineration plants is a serious problem".¹¹ It contains very high concentrations of heavy metals and chlorinated organic compounds, which have carcinogenic and other health threatening properties. According to the EEA incinerators are a major contributor of dioxin, other organic compounds, heavy metals and acid gases to the environment.¹²

The need to dispose of large quantities of both fly and bottom ash has led not only to bogus "recycling" but sometimes to even more irresponsible schemes. In Newcastle where a mixture of fly and bottom ash from the Byker incinerator has for 5 years been spread over 27 allotment sites, numerous public footpaths and children's play areas throughout the city. Tests in May 2000 not surprisingly revealed high levels of dioxins and heavy metals in the soil of affected allotments. Residents have now been told not to eat food produced on the allotments and children are barred from them. It has recently emerged that the Edmonton incinerator in North London has been mixing fly ash with bottom ash and selling on for use in road building. They abruptly stopped this practice last year after questions were asked in Parliament.

Health effects of incinerators

The European Commission and the European Environment Agency have listed some of the better studied pollutants emitted to air land and water from incinerators, and their health effects.

Dioxin: A Class 1 Human Carcinogen (known to cause cancer in humans) and a reproductive toxicant¹³. A recent study of dioxin exposure in Seveso, Italy associates it with an imbalance in the sex ratio of babies born, (50 males to 81 females for fathers who were exposed to dioxin when they were under 19).¹⁴ The European Commission states dioxins and furans "are known to produce chloracne at high exposures and a wide-range of non-cancer effects are thought to occur at extremely low levels of chronic exposure, including adverse effects on reproduction, impacts on development of the unborn foetus and associations with impaired mental ability".¹⁵ The World Health Organisation says that general pollution from dioxins is already at the level where it may be having adverse effects on human health.¹⁶ The US Environmental Protection Agency has recently stated that the risk of contracting cancer from dioxin pollution may be as high as one in a hundred.¹⁷ Their eight year study on dioxin also states

storage (landfill or mines). European Commission, "The influence of PVC on the quantity and hazardousness of flue gas residues from incineration", April 2000.

¹¹ European Environment Agency, Feb 2000. Technical report No 28, Dangerous Substances in Waste p.20

¹² IBID p29

¹³ The Lancet. Vol 355 May 27 2000 p1839

¹⁴ Paolo Mocarelli et al. Paternal concentrations of dioxin and sex ratio of offspring. In The Lancet. Vol 355 May 27 2000

¹⁵ European Commission proposal for a Council Directive on the incineration of waste 07/10/98 p. 6

¹⁶ WHO paper submitted to the Dioxin 98 conference, reported in ENDS 281 June 1998 p.5

¹⁷ Dioxin Briefing for the EPA Senior Management May 10th, 2000, leaked to the Washington Post.

that they produce a variety of non-cancer effects in animals and humans including developmental toxicity, immunotoxicity, endocrine effects and chloracne and that part of the general population is at or near exposure levels where adverse effects can be anticipated.

Acid Gases (hydrogen chloride, sulphur dioxide, Nitrogen oxides or NOx, hydrogen fluoride): Exposure to acid gases can cause respiratory problems.

Heavy Metals Incinerators emit lead, cadmium, mercury, chromium, arsenic and other metals to air and land. According to the European Commission incineration is a major contributor to overall emissions of mercury and cadmium in Europe.¹⁸ Lead is associated with learning impairment¹⁹ and behavioural problems in children²⁰. High levels of cadmium are associated with lung cancer and a range of other effects and mercury exposure has been found to affect behaviour and lead to renal damage even at low levels.²¹

Particulate matter (dust): A typical modern incinerator releases around 5kg of contaminated particulate matter into the air every hour it operates.²² According to the European Commission "particulate matter in the atmosphere has been associated with large-scale chronic adverse effects on human health". Operators of the South East London incinerator themselves estimated they released 8.6 tonnes of the notorious PM10's (very fine dust particles) into the surrounding area in 1998.²³ The European Commission is concerned that these sort of emissions may be having health impacts on local populations.²⁴

Incineration also leads to the generation and release of a number of other highly toxic and carcinogenic organic compounds such as benzene, phenols, polyaromatic hydrocarbons, benzo(a)pyrene, chlorinated organic compounds and soot.²⁵

Energy "recycling" and recovery

In an attempt to disguise the real nature of incinerators they are now often called "Waste to Energy" facilities or sometimes "combined heat and power" stations. Waste to energy facilities use some of the heat to produce electricity. However this is a very inefficient way to generate electricity. To replace the materials which are burnt in an incinerator uses much more electricity than can be produced by burning it. It's a bit like setting fire to old furniture to heat your house. It might keep you warm

¹⁸ *ibid* p. 7

¹⁹ European Commission proposal for a Council Directive on the incineration of waste 07/10/98 p. 7

²⁰ see eg. The Independent 16th May 2000 p 11

²¹ European Commission proposal for a Council Directive on the incineration of waste 07/10/98 p. 7

²² Figure based on EA report 8467/990804 OF sampling done at the SELCHP incinerator in SE London 9 -11 Nov. 1999

²³ UK Environment Agency Pollution Inventory Details for Authorisation AE7236 Feb 2000

²⁴ European Commission proposal for a Council Directive on the incineration of waste 07/10/98 p. 7

²⁵ European Environment Agency, Feb 2000 *op cit* p 18

for a while but it would be much better, environmentally and economically, to repair the furniture and use more efficient means to heat your house. Not many would stoop low enough to claim they are recycling furniture by burning it! Yet this is exactly what the Government is doing by calling incineration "Energy from Waste" and by attempting to include it in official recycling figures.

"Renewable energy" and "sustainability"

Building new incinerators actually works against waste minimisation and increasing re-use and recycling rates. Contracts with incinerator operators lock local authorities into long term commitments to provide huge amounts of waste each year. Intensive re-use and recycling programs could divert 80% or more of municipal waste away from incinerators, transforming them into valuable resources. But local authorities locked into incineration contracts would have to pay financial penalties to incinerator owners if they did this. Council-tax payers in areas where the local authority chooses to incinerate its rubbish must therefore pay through the nose to burn resources. A scandalous waste that at the same time creates an unacceptable environmental and public health risk.

Attempts by Government and operators to classify "waste to energy" incinerators as "renewable energy" or "sustainable waste management" are cynical attempts to pull the wool over the eyes of the public and do a great deal of harm to genuinely renewable energy sources and sustainability programs. Waste incinerator operators have for years parasitically consumed Non Fossil Fuel Obligation Subsidies intended to aid the development of real renewable energies. The raw materials, resources and energy that go into making the disposable products and packaging that create our waste mountains are often not renewable. Nor is it in any way "sustainable" to squander resources by burning them, while producing many millions of tonnes of hazardous ash dust and gases in the process.

This view was supported in the recent Environment Select Committee report, which stated that incineration "will never play a major role in truly sustainable waste management and cannot, and should not, be classified as producing renewable energy". They concluded that "sustainable waste management has as its cornerstone the minimisation of waste, and the explicit maintenance of waste streams for the purpose of incineration is a complete contradiction of this principle".²⁶

The Solution

It is clear that incineration is a logically flawed and technologically backward approach to waste. Recovering some energy from heat generated during burning does nothing to bring it into the 21st century. Neither do increasingly complex and expensive filter systems, which

²⁶ [Environment, Transport and Regional Affairs Committee, *Delivering Sustainable Waste Management*, 14 March 2001](#)

merely transfer some of the pollutants from exhaust gases to fly ash, from air, to land and water. Throwing municipal waste into huge holes in the ground is hardly less primitive and has a whole set of problems of its own. So what is the modern, forward thinking solution to the waste problem facing the UK and other countries?

To meet the reduction targets set by the European Landfill directive the Government must set up an intensive drive to re-use and recycle (including composting). The UK is currently bottom of the table of recyclers in Europe managing a feeble 8% (the Netherlands recycles 46% of municipal waste). The city of Edmonton, in Canada, reuses, recycles or composts 70% of household waste.

To begin this recycling program source separation of waste (at household and commercial level) must be implemented across the country. Separate waste streams (of organic waste, paper, metals, etc) are immediately easier to deal with and straight away begin to have a value. Materials that are particularly troublesome or hazardous can be more easily be dealt with. It is the mixed nature of the waste stream we have got used to that creates many of the waste disposal headaches.

This drive to re-use and recycle must include:

- Financial and legal mechanisms to increase re-use of packaging (e.g. bottles, containers) and products (e.g. computer housings, electronic components).
- Financial mechanisms (such as the landfill tax) used directly to set up the necessary infrastructure for effective recycling.
- Stimulating markets for recycled materials by legal requirements for packaging and products, where appropriate, to contain minimum amounts of recycled materials.
- Materials that cannot be safely recycled or composted at the end of their useful life (for example PVC plastic) must be phased out and replaced with more sustainable materials.
- Materials and products that add to the generation of hazardous substances in incinerators must be removed from the waste stream and reused, recycled or dealt with in an environmentally sound manner at the cost of the producer. Such products would include electronic equipment, metals and products containing metals such as batteries and florescent lighting and PVC plastics (vinyl flooring, PVC electrical cabling, PVC packaging, PVC-u window frames, etc) and other products containing hazardous substances.

These are short term measures that can eliminate the need for any more incinerators while enabling the UK to meet targets set down by the European Landfill Directive.

The complete solution to waste will take longer to implement, but must be central to an integrated strategy. The target must be to eliminate the production of waste and products that cannot be re-used or efficiently and safely recycled. This means the rethinking and redesigning of products, packaging and production processes. Consumers, manufacturers and retailers all need to play their part in this. But the Government must set the process in motion by bringing in tangible incentives for clean production that includes producer responsibility for end of life products and packaging.

This challenge offers tremendous opportunities to British industry. The outcomes could be huge savings through minimisation of waste, value recaptured through re-use of materials and jobs created through booming re-use and recycling industries. It could also mean UK firms at the leading edge of innovative product design that eliminates hazardous materials and waste from product life cycles.

On the other hand failure to come to grips with this challenge now will keep the UK firmly rooted to the bottom of the European waste management league table and British industry locked in a vain struggle to keep up with its European counterparts.

A modern waste strategy should be geared towards the goal of "Zero Waste". Such a strategy could not only have an enormous affect on pollution and public health but can act as a stimulus for job creation and innovation. But to do this we must ditch the primitive "burn or bury" attitude of the past and make resources available to truly modern, innovative solutions.