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DIOXINS AND THEIR EFFECTS ON HUMAN HEALTH

What are dioxins?

Dioxins are environmental "repeat offenders". They have the dubious distinction of belonging to "dirty dozen club" - a special group of dangerous chemicals known as persistent organic pollutants. Once dioxins have entered the environment or body, they are there to stay due to their uncanny ability to dissolve in fats and to their rock-solid chemical stability. Their half-life in the body is, on average, seven years. In the environment, dioxins tend to bio-accumulate in the food chain. The higher in the food chain one goes, the higher is the concentration of dioxins.

It takes a good chemist to remember dioxin's proper name: *2,3,7,8-tetrachlorodibenzo-para-dioxin (TCDD)*. The name dioxin is also used for the family of structurally and chemically related *polychlorinated dibenzo-para-dioxins (PCDDs)*, *polychlorinated dibenzofurans (PCDFs)*, and the certain *polychlorinated biphenyls (PCBs)*. Some 419 types of dioxin-related compounds have been identified but only about 30 of these are considered to have significant toxicity, with TCDD being the most toxic.

What are the sources of dioxin contamination?

Dioxins are mainly by-products of industrial processes but can also result from natural processes, such as volcanic eruptions and forest fires. These compounds are also unwanted by-products formed when thermal processes produce chlorine-containing organic substances. Dioxins are unwanted by-products of a wide range of manufacturing processes including smelting, bleaching of paper pulp and the manufacturing of some herbicides and pesticides. In terms of dioxin release into the environment, solid waste incinerators are the worst culprits due to incomplete combustion.

Dioxins are found throughout the world in practically all media, including air, soil, water, sediment, and food, especially dairy products, meat, fish and shellfish. The highest levels of these compounds are found in some soils, sediments and animals. Very low levels are found in water and air.

Extensive stores of waste industrial oils with high levels of dioxins exist throughout the world. Long term storage of this material may result in dioxin release into the environment and the contamination of human and animal food supplies. Dioxins are not easily disposed of without contamination of the environment and human populations.

How can dioxins be destroyed?

Incineration is the best available answer although other methods are being investigated. The process requires high temperatures, over 850° C. For destruction of large amounts of contaminated material, even higher temperatures -1000° C or more - are required.

Have there been dioxin contamination incidences?

High levels of dioxins were reported to have been found in poultry and eggs in Belgium. The cause of the contamination is thought to have been animal feed.

One particular dioxin, TCDD, was extensively studied for health effects linked to its presence as a contaminant in some batches of the herbicide Agent Orange used during the Vietnam War.

TCDD was also studied in a serious accident at a chemical factory in Seveso, Italy in 1976. A cloud of toxic chemicals, including dioxins was released into the air and eventually contaminated an area of 15 square kilometres with a population of 37,000 people.

A more recent case of dioxin contamination of food occurred in the southern part of the United States of America in 1997. Chickens, eggs, and catfish were contaminated with dioxin when a contaminated ingredient (bentonite clay or sometimes called "ball clay") was used in the manufacture of animal feed. American regulators eventually traced the contaminated clay to a bentonite mine. As there was no evidence that hazardous waste was buried at the mine, investigators speculate that the source of dioxins may be prehistoric.

Earlier incidents of food contamination reported in other parts of the world. Although all countries could be affected, most contamination cases have been reported in industrialized countries where adequate food contamination monitoring, greater awareness of the hazard and better regulatory controls are available for the detection of dioxin problems.

What are the effects of dioxins on human health?

Short-term exposure of human to high levels of dioxins may result in skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. Chronic exposure of animals to dioxins has resulted in several types of cancer. TCDD was evaluated by International Agency for Research on Cancer (IARC) in 1997. Based on human epidemiology data, dioxin was categorised by IARC as a "known human carcinogen". However, TCDD does not affect genetic material and there is a level of exposure below which cancer risk would be negligible.

Are certain population subgroups at greater risk from dioxins?

Foetuses are most sensitive to dioxin exposure. Newborns may also be more vulnerable to certain effects. Some individuals or groups of individuals may be exposed to higher levels of dioxins because of their diets (e.g. high consumers of fish in certain parts of the world) or their occupations (e.g. workers in the pulp and paper industry, in incineration plants and at hazardous waste sites, to name just a few).

How do you estimate the risks to consumers from consumption of food products contaminated with dioxins?

Risk must be calculated on a case by case basis taking into account the levels of exposure and population sub-groups affected. Accurate information about the level of dioxin in the food, the amount of contaminated food consumed, and the duration of exposure to dioxin is needed to assess the actual risk of exposure. With this information at hand, an assessment of the health impact can be performed and used as a basis for policy decisions. A Tolerable Daily Intake (TDI) has been recommended as a tool for long term safety assessment. The TDI is calculated on the basis of exposure over a lifetime and the accumulated amount of dioxins in the body.

What can countries do to protect public health from dioxins?

It is estimated that 90% of human exposure to dioxins is through the food supply. Consequently, protecting the food supply is critical. Contamination of the food can occur at any point from "farm to table". The safety assurance of food is a continuous process that begins with production and ends in consumption. Good controls and practices during primary production, processing, distribution and sale are all essential to the production of safe food.

Food contamination monitoring systems must be in place to ensure that tolerance levels are not exceeded. When incidents of contamination are suspected, countries should have contingency plans to identify, detain and dispose of unsafe food. The exposed population should be examined in terms of exposure (e.g. measuring the contaminants in blood or mother's milk) and effects (e.g. clinical surveillance to detect signs of ill health).

What should consumers do to reduce their risk of exposure?

Though speculative, trimming fat from meat, consuming low-fat dairy products, and simply cooking food may eventually decrease the body burden of dioxin compounds. Also, a balanced diet (including adequate amounts of fruits, vegetables and cereals) will help to avoid excessive exposure from a single source. However, the ability of consumers to mitigate their own exposure is limited. It is the role of national governments to monitor the safety of the food supply and to take action to protect public health.

What does it take to identify and measure dioxins in the environment and food?

The analysis of dioxins requires sophisticated methods that are available only in a limited number of laboratories around the world. About 100 laboratories are able to analyse dioxins in environmental samples (e.g. ashes, soil, or water) and in food but about 20 laboratories in the world are able to reliably measure dioxins in biological materials (e.g. human blood or mother's milk). These are mostly in industrialized countries. Costs vary according to the type of sample, but range from US $1,200 for the analysis of a single biological sample to US $10,000 or more for the comprehensive assessment of release from a waste incinerator.

What is WHO doing about the problem of dioxins in the food supply?

Reducing dioxin intake is good public health policy and an important aspect of sustainable development. In 1998 WHO convened a consultation in Geneva to evaluate the tolerable daily dose of dioxins to which a human can be exposed without harm, the Tolerable Daily Intake (TDI). In light of new epidemiological data concerning dioxins' effects at low levels of exposure and based on animal studies, the TDI was reduced from 10 picogrammes/kilogram body weigh to a range of 1 to 4 picogrammes/kilogram body weight. The current levels of exposure in industrialized countries are in the range of 1 to 3 picogrammes/kilogram body weight. The TDI recommended by the WHO consultation is internationally recognized as a reference value for ensuring that safe levels of exposure are not exceeded.

WHO in collaboration with the Food and Agriculture Organization (FAO) through the joint FAO/WHO Codex Alimentarius Commission is considering the establishment of guideline levels for dioxins in foods. WHO is also working with the United Nations Environmental Programme (UNEP) by providing risk assessments of persistent organic pollutants (POPs), including dioxins. A number of actions are being considered internationally to reduce the production of dioxins during incineration and manufacturing processes.

WHO, through its European Center for Environment and Health in Bilthoven, The Netherlands, conducts periodic studies on levels of dioxins in mother's milk, mainly in European countries. These studies provide an assessment of human exposure to dioxins from all sources. Recent exposure data show that measures introduced to control dioxin release in a number of countries have resulted in a substantial reduction in exposure to of these compounds over the past few years.

Since 1976, WHO has been responsible for the Global Environment Monitoring System's Food Contamination Monitoring and Assessment Programme. Commonly known as GEMS/Food, the programme provides information on levels and trends of contaminants in food through its network of participating laboratories in over 70 countries around the world.

Are there other sources of information about dioxins within WHO?

The WHO Food Safety Programme has established a web page (*www.who.int/fsf*) with general information about dioxins as well as links to other web sites with possible information on dioxins.

The International Programme on Chemical Safety (UNEP/ILO/WHO) has made the Executive Summary of the **Assessment of the health risk of dioxins: re-evaluation of the Tolerable Daily Intake (TDI)** is available at *www.who.int/pcs* and *www.who.int/peh*

The WHO Regional Office for Europe (EURO) has produced a fact sheet on the dioxin incident in Belgium which is available at http://www.who.dk/envhlth/dioxin/dioxin.htm

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For further information, journalists can contact:
WHO Press Spokesperson and Coordinator, Spokesperson's Office,
WHO HQ, Geneva, Switzerland / Tel +41 22 791 4458/2599 / Fax +41 22 791 4858 / e-Mail: inf@who.int

Press Release WHO/45
3 June 1998

WHO EXPERTS RE-EVALUATE HEALTH RISKS FROM DIOXINS

Forty specialists from 15 countries met at the headquarters of the World Health Organization (WHO) in Geneva from 25 to 29 May to evaluate the risks which dioxins might cause to health. Since the Seveso incident in 1976, this group of persistent environmental chemicals has consistently grabbed the headlines, although the real effect of these substances is difficult to determine. This group of chemicals includes polychlorinated dibenzodioxins (PCDDs), polychlorinated dibensofurans (PCDFs) and polychlorinated biphenyls (PCBs), although the most toxic dioxin of all is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). TCDD has been shown to cause dermatological problems, notably chloracne, a chronic and disfiguring skin disease.

These substances are omnipresent in the ground, river beds and air. They are involuntary by-products formed when thermal processes produce chlorine and other organic substances. They can also be produced by volcanic activity, which cannot be controlled, and by forest fires, but the principal controllable sources of dioxin production are waste incinerators.

In recent years, the WHO European Centre for Environmental and Health (WHO-ECEH) has been coordinating a comprehensive programme, in collaboration with the International Programme on Chemical Safety (IPCS) on PCDDs, PCDFs and PCBs, to evaluate the possible health risk, as well as methods of prevention and control of environmental exposure of the general population to these chemicals.

During a previous meeting on dioxins, held at Bilthoven, in the Netherlands, in 1990, WHO experts established a tolerable daily intake of 10 picogrammes/kilogram body weight for TCDD, said to be the most toxic dioxin. (One picogramme equals a millionth of a millionth of a gram).

Since then, new epidemiological data has emerged, notably concerning dioxins' effects on neurological development and the endocrine system, and WHO thus convened the consultation which has just taken place in Geneva to re-evaluate the tolerable daily dose of dioxins to which a human can be exposed. After ample debate, the specialists agreed on a new tolerable daily intake range 1 to 4 picogrammes/kilogram body weight. The experts, however, recognized that subtle effects may already occur in the general population in developed countries at current background levels of 2 to 6 picogrammes/kilogram body weight. They therefore recommended that every effort should be made to reduce exposure to the lowest possible level.

The background documents for the experts' meeting discussed carcinogenic and non-carcinogenic effects of dioxins on humans and animals, the risks for young children, transmission mechanisms, general exposure to dioxins and the compounds of the same nature, as well as current means of evaluating these risks in different countries.

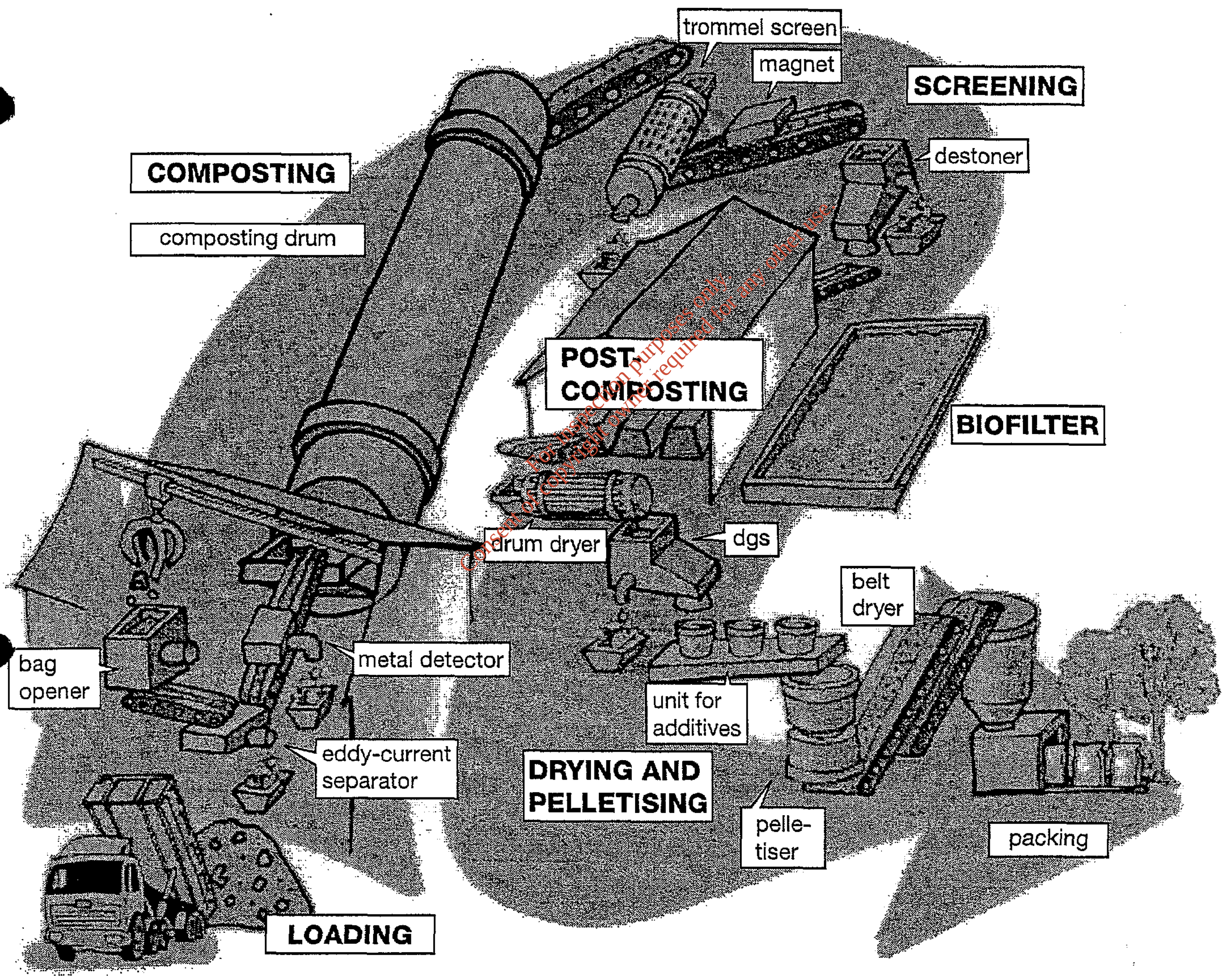
"Recent exposure data show that measures introduced to control dioxin release in a number of countries have resulted in a substantial reduction in intake of these compounds in the past few years", emphasized Dr Maged Younes, Chief of the Assessment of Risk and Methodology unit in the WHO Programme for the Promotion of Chemical Safety. "This is evidenced by a marked decrease in dioxin levels in human milk, as found in an exposure study conducted by the WHO European Centre for Environment and Health, with the highest rates of decrease being observed in areas which had the highest initial concentrations."

For further information, journalists can contact Philippe Stroot, WHO, Geneva. Tel: (41 22) 791 2535, Fax: (41 22) 791 48 58, E-Mail: strootp@who.ch , or Dr Maged Younes, IPCS, Geneva, Tel: (41 22) 791 35 74, Fax: (41 22) 791 48 48, E-mail: younesm@who.ch , or Dr F.X. Rolaf van Leeuwen, ECEH, Bilthoven Division, Tel: (31 30) 22 95 307, Fax: (31 30) 22 94 252, E-mail: rle@who.nl

All WHO Press Releases, Fact Sheets and Features as well as other information on this subject can be obtained on Internet on the WHO home page http://www.who.ch/

How to comply with the Landfill Directive without incineration: a Greenpeace blueprint

GREENPEACE



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Executive Summary

Landfilling of municipal waste has to be reduced for a variety of reasons. The current practice of landfilling mixed municipal waste is highly polluting, as well as unpopular and ultimately unsustainable. Now the European Landfill Directive, which came into effect on 16 July 2001, demands significant reductions in the quantity of biodegradable waste disposed of in this way. As part of the drive to comply with the Landfill Directive, the Government has set mandatory recycling targets for local authorities.

Some local authorities are arguing that incineration is necessary to meet the UK's commitments under the Directive, or to deal with residual waste left after maximum practical recycling levels have been achieved. Neither of these arguments is tenable.

If the UK does nothing more than recycle or compost 30% of newspaper, card and organic waste, we will have met the 2010 target in the Directive of reducing biodegradable waste going to landfill by 25% of 1995 levels. This target and the 2013 target of 50% can easily be exceeded with technology currently available and in use. The 2020 target of 65% may be more demanding, but we can learn from cities and regions around the world that have already achieved more than this. The Directive gives the UK almost two decades to put in place the necessary systems.

The techniques and technology needed to meet the Landfill Directive targets should also enable local authorities to meet the UK Government's mandatory recycling targets. Once implemented, the strategy set out below will ensure recycling is maximised, and provide the means to go beyond currently perceived limits to recycling.

Organising efficient kerbside collection and composting of kitchen and garden waste is the single most significant step authorities can take towards meeting the Landfill Directive and recycling targets. Getting this stream right is the key – taking us from waste management to waste utilisation.

The basic infrastructure for managing source separated domestic stream materials can also be used for recyclable and organic material from trade and other non-dustbin streams.

Residual Waste

When the types of collection, composting and recycling systems described below are in place, residual waste can be reduced to a very small fraction of the municipal waste stream. Eventually, these residuals can be dealt with by a combination of regulatory, fiscal and consumer driven mechanisms such as producer responsibility legislation (e.g. the Waste Electrical and Electronic Equipment Directive), disposal taxes (e.g. the Landfill Tax and an incineration tax) and design efficiency. In the meantime, material that cannot be re-used, recycled or composted, should be cleaned and stabilised, then landfilled.

Mechanical Biological Treatment (MBT) systems, which stabilise and reduce the volume of residual waste still further, can be used to achieve this cleaning and stabilising function at the 'back end' of kerbside collection, composting and recycling schemes. They can also provide the 'failsafe' that some managers are currently seeking – a way to guarantee mandatory targets are met.

There are several reasons why using landfill for cleaned residual waste is better than building incinerators, the most important of which are:

- Unlike incineration, landfill does not perpetuate the need for waste. Source separation schemes like those outlined here mean that residual municipal waste will be less toxic and much reduced in volume compared to current levels. Continuing improvements in recycling, product design and buying habits mean landfill can be reduced incrementally and eventually phased out. Incinerators on the other hand must operate at near capacity throughout their 25-30 year lifetime if capital investments are to secure a return. Once built, they are a structural impediment to significantly reduced levels of waste disposal.

Meeting the Landfill Directive targets

'It is entirely possible to achieve the Landfill Directive without using incineration, using a flexible 'pick and mix' option. Such an option would utilise source separation, kerbside collection, composting, recycling and mechanical screening to deal with municipal waste in a way that actively contributes to the economic, social and environmental goals of sustainable development.'
– Peter Jones, Director, Biffa Waste Services

The European Landfill Directive sets mandatory targets for a three step reduction in biodegradable waste going to landfill. Set against a 1995 baseline, it requires a reduction of 25% by 2010, 50% by 2013 and 65% by 2020.

The targets apply only to untreated biodegradable municipal waste. They are intended to reduce the role of landfill in producing methane, a potent greenhouse gas, as well as reducing the quantity and toxicity of leachate produced by landfill sites and the volume of waste landfilled. According to Government estimates, 60% of the current municipal waste stream is thought to be biodegradable.[2] The real figure may be higher than this.

One way of meeting the first target of a 25% reduction would be to recycle or compost just 30% of newspaper, card and putrescible waste. We have until 2010 to do that. Any local authority that cannot meet that target without resorting to incineration deserves to have serious questions asked about its policy and management. In fact, much greater recycling rates than this can be achieved. Once the initial investment is made in effective systems, the cost per tonne for waste management begins to decline significantly.[3]

It is necessary to reduce the amount of all types of waste going to landfill. But it is not desirable, or necessary, to do this by increasing reliance on incineration. Incineration is hugely unpopular and highly polluting. And it does not solve the landfill problem. 30% by mass of the waste burnt remains as ash and 15% of municipal waste by-passes incinerators as large non-combustible items.

Cities and regions in Canada, the USA, Australia and New Zealand have achieved significantly larger reductions in landfilling – up to 70% – without using any incineration. Moreover they have done this relatively quickly, generally in a period of five years or less. In the UK, there are several examples of communities that have achieved recycling rates of over 50%.

Many waste professionals in the UK see a dramatic increase in recycling and composting as severely constrained by logistical, cultural, technical and economic factors. Some put a limit of around 50% on what they believe can be diverted. Any strategy has to be shaped with respect for the experience of waste managers, but the experience of municipalities and regions in other countries also provides valuable insights. Leading waste authorities elsewhere have reached 60% diversion and are now planning strategies to reach 85%. Edmonton in Canada has already attained a 70% diversion of residential waste from landfill without any incineration. In the UK, Essex has been the first county to adopt a 60% target by 2007, and its first pilot scheme is already approaching this target. According to Peter Jones of waste management company Biffa, 'Most in the industry agree that at least 60% is a realistic target for diversion from landfill into biodegradation and recycling.'[4]

Mersea Island, Essex
Mersea Island has achieved a recycling rate of 57% and a participation rate approaching 90% in the 4,500 households covered by its recycling scheme.

Contact Chris Dowsing, Waste Policy Officer, Colchester Borough Council, Tel 01206 282736. chris.dowsing@colchester.gov.uk

Source Separation – as easy as 1-2-3

The first principle of any waste management scheme that hopes to achieve high diversion rates and good quality recyclables is source separation of waste. This means kerbside collection of three streams:[5]

- dry recyclables
- compostable material
- residuals

Additionally, hazardous materials (paint, oil, pesticides, fluorescent light bulbs etc) should be kept out of the municipal waste stream, either by separate collection or by utilising "bring" points at civic amenity sites, or a combination of both.

Stream 1 – wet organics

After source separation, composting is the most important step towards sustainable waste management.

Composting quickly reduces the volume of waste landfilled. All waste authorities achieving 50% plus recycling levels have paid close attention to the collection of the organic stream.

Separation of the organic stream reduces the toxicity of residual waste because it removes organic acids, which dissolve heavy metals in the waste and cause them to leach. In fact, it is the organic material in landfill that causes many of the environmental problems associated with this form of disposal.

Profiting from waste – Isle of Wight
Demand for compost produced from household waste on the Isle of Wight far outstrips supply – the source separated green and organic waste produces high quality compost used by local tomato growers. Compost mechanically sorted from residual mixed waste is used as a landfill cover material that would otherwise have to be imported onto the island.

Contact Sarah Humphries, Island Waste Services, Tel 01983 821234

Instead of being a disposal problem, organic household waste can be used to generate useful end products that have both a market value and an environmental value.

Organic waste often makes up over 40% of the household waste stream. Diverting the full range of organic materials combines with dry recycling to dramatically reduce the volume, weight and odour causing potential of the residual stream. The organic and dry-recyclable stream can potentially take 70%-80% of total household waste.

Diverting food waste is the step that crosses the threshold from 'add-on' recycling/composting services to a true three stream system. It brings high diversion levels within councils' reach and is a useful source of nitrogen where high quality, high value, compost is the objective.

Garden (green) waste can be diverted rapidly and at low cost. Its diversion enables waste managers to make major cost savings. It is relatively easy to handle through home composting, at Civic Amenity (CA) sites, through wheeled bin or paper sack kerbside collections, and at central composting sites.

Experience has shown that it is generally best to treat the green garden waste and kitchen waste as two separate streams. Food waste has a high density, hence can be collected in small buckets and does not need compacting. It will need composting at enclosed facilities due to the presence of meat and fish. Green waste is low density and best compacted when collected. Separate collection also allows green and kitchen waste to mixed in the correct proportions for the required end products.

Garden waste Home Composting.
Home composters cost £10-£15 per unit and divert an average of 120kg per household per year, and in some cases up to 250 kg. Over ten years, this means the Council pays a maximum of £15/tonne to divert this material – with savings including disposal costs (£20-£35/tonne), refuse collection costs and gate fees at central composting sites.

The Government strongly supports the composting of waste, this is a vital component of meeting Waste Strategy targets for recycling and composting and targets under the Landfill Directive to reduce the landfilling of biodegradable municipal waste

Collection of kitchen waste

There are two main methods of collecting food waste at the kerbside:

- Mixed with green waste and potentially cardboard in wheeled bins @£12-£18/unit, or in reinforced paper sacks @20p
- Separately in a small bucket or other compost container @£2-£8/unit

The two principal practices used to accomplishing cost efficient collection of organic waste are to introduce alternating fortnightly collections of refuse and organics; or fortnightly residual refuse collections with weekly organics. Weekly collection of kitchen waste should be given preference where possible as this minimises potential odour problems and is therefore more readily accepted by the public.

Richard Boden of WyeCycle offers the following advice for achieving maximum collection rates:

- Treat kitchen and garden waste as two separate streams
- Collect all kitchen waste
- Ban garden waste from the mixed waste bin
- Make a charge for collection of garden waste (so smaller properties which produce little of this waste are not subsidising householders in larger properties which produce a lot).
- Don't provide a wheelie bin for garden waste
- Do not collect mixed (residual) waste weekly
- Do collect kitchen waste weekly

'Organise your organics' – Isle of Wight

On the Isle of Wight over 15,000 small buckets for collecting organic waste have been distributed to households that have requested them. The service began in December 1998, about 30% of households on the island participate and this figure continues to rise. Most island schools also separate their waste.

Contact Sarah Humphries, Island Waste Services, Tel 01983 821234

The Animal By-Products Order

Organic waste, including kitchen and catering waste that may contain meat, will be subject to new EU regulations due to come into force in Spring 2002. These regulations are intended to control the transport, handling and disposal of animal derived products in order to increase food safety. They will stipulate that such waste must be composted in an enclosed environment and must reach a specified temperature (likely to be 70°C for 60 minutes). The EU Animal By-Products Regulation will allow composted kitchen waste to be used on all land except pasture land, used for grazing animals.

This means there will be a huge potential market for properly composted household kitchen and garden waste; agricultural and horticultural uses, greenhouse growing, retail for the domestic market, turf growing, landscaping, roadside soil improvement, mulching applications etc.

DEFRA sees composting as vital to the future of waste management:

"The Government strongly supports the composting of waste, this is a vital component of meeting Waste Strategy targets for recycling and composting and targets under the Landfill Directive to reduce the landfilling of biodegradable municipal waste...Where catering or household waste contains meat or other products derived from animals then, although it may be composted, it may not, currently, be used on land...where animals (including wild birds) may have access. However this position is set to change. The draft EU Regulation on Animal By-Products will allow the use of properly composted mixed waste on all land except pasture land. We expect this regulation to come into force in the Spring of 2002."

DEFRA Briefing note on composting 21 June 2001

There will be no restrictions on the composting or use of green waste (garden waste).

Vertical Composting Units – odourless, small footprint, low cost

By raising the composting process into 6 to 12 metre high vertical compartments, Vertical Composting Units's (VCUs) greatly reduce the land area required. A single VCU will process up to 1500 tonnes annually, on a area of 11m^2 – while a 10 unit placement will process 10-15,000 tonnes on under 200 m^2 of concrete. The critical advantage for urban waste managers is that VCUs can be easily placed at CA sites, waste depots, within some Materials Reclamation Facilities (MRFs) or directly attached to organic-waste generating firms or facilities.

The VCU process was designed by microbiologists to break down and eliminate odours within the chamber. The enclosed chambers make it impervious to pests and vermin. Gravity draws the organic material down through the system, reducing the number of moving parts and operational costs. Naturally generated temperatures reach over 75°C, ensuring a pasteurised and odour stabilised end product. The system requires as little as 11kWh energy to process a tonne of waste.

VCUs have a capital cost of around £70,000 for one unit. One operative is able to feed up to 5 units. CA sites generally offer the lowest cost composting through VCUs. Capital, equipment, running and maintenance costs are £15-£20/tonne if every component must be purchased – but at CA sites these costs fall to the £10/tonne range.

Anaerobic digestion

Anaerobic digestion is an alternative form of composting, which takes place in an oxygen-free environment. It produces two streams of useable products. The first is biogas (consisting primarily of methane and carbon dioxide with small amounts of hydrogen sulphide and other gases) which can be burnt to generate electricity or heat or used as a vehicle fuel. The second is a 'digestate' – a thick slurry or near solid residue. Assuming contaminated waste has not been used as the feedstock, this can be used as a nutrient rich soil conditioner or liquid fertiliser.

There are about 70 plants operating around the world that use MSW (Municipal Solid Waste) as a feedstock. Anaerobic digesters currently have higher capital and operating costs than composting systems, and there will be emissions from burning gases for energy. The best results from this technology have so far been achieved in conjunction with sewage sludge handling systems. However, contaminated feedstocks will result in contaminated residues.

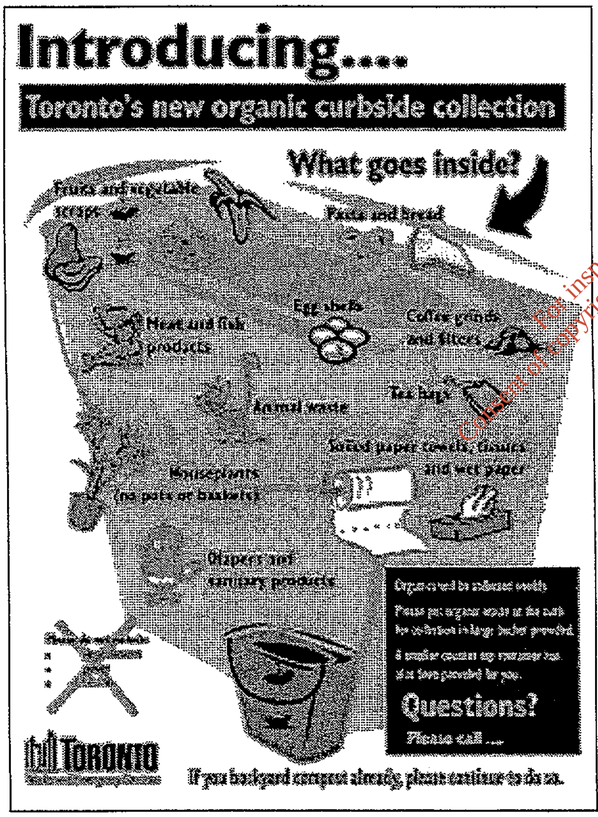
Multi-story blocks

Experience in North American cities and pilot schemes in the UK have shown that high capture rates from high rise and multi-story blocks are possible and can have significant benefits. Convenience is the key. Modification of waste chutes has proved successful but costly. Door to door (or floor to floor) collection schemes can offer a greatly improved waste disposal system for high rise tenants. The convenience of putting out waste for recycling rather than taking it to a paladin or chute provides a major incentive for recycling beyond any householder commitment to the principle of recycling.[7] Costs of door to door collection systems are partly offset by recycling credits, avoided disposal costs and reduced cleaning time from blocked chutes and overspilling paladins. The key to success seems to be in getting residents to see the benefits in terms of an improved service. Pilot schemes in London have shown that the improved service to residents, together with appropriate educational measures can achieve 58% set out rates and 75% participation.

'Core' dry recyclables are 30%-40% of household waste (paper, metal cans, glass bottles and textiles.)

Successful recycling programmes provide some key insights in 'how to do' recycling education.

- Keep It Simple
- Always Use Graphics
- Make It Personal
- Target Feedback
- Repeat, repeat, repeat



Sending someone to the door to deliver the box and answer any questions is much better than just dropping a box with a brochure in it on a doorstep. Successful programmes have used local residents or the new kerbside collection staff to make the delivery personal, answer residents questions and encourage participation. Feedback cards are also useful. Waste composition studies will reveal which materials households don't know they can recycle, enabling managers to target the 'missing' materials for follow-up promotions. These often focus on high-value aluminium cans and textiles, and can rapidly boost overall programme sales revenues.

After (but not instead of) education, there is no doubt that some gentle coercion can increase quantities collected dramatically and rapidly. Some European cities return bins unemptied, with an explanatory sticker, if organic waste has not been separated. Some impose a fine for non-separated waste, others charge for waste collection by weight or volume. Rebates or cash incentives for households that do source separate may also increase participation rates.

B – New collection technologies.

The success of kerbside schemes depends heavily on the collection method employed. It determines the participation rate and levels of contamination of collected material. Getting the collection right is crucial. Participation rates are closely linked to the convenience of the systems. At the same time the collection method must be compatible with the treatment technology. Collection and disposal authorities must work together on this.

High-productivity, low cost recycling vehicles.

Most recycling vehicles developed in the 1980s had multiple fixed compartments, often with hydraulic lifting equipment, cost £70-£120,000, and have a long wide profile. Such vehicles simply do not work in many parts of the UK. This has resulted in a number of collection vehicle innovations:

Pedestrian Controlled Vehicles (PCVs).

PCVs are small, electrically-powered, recycling vehicles currently used to collect recyclables from 100,000 households in Haringey, Islington and other parts of the UK. Manufactured in the UK, PCVs are designed to be light, no wider than a street sweepers barrow, and to travel at walking speed. Because PCVs operate on pavements, they cut the time taken to carry boxes to the vehicle.

The materials collected are sorted into variously sized, labelled, builders bags on the platform of the PCV. The bags are rolled off into empty parking spaces or other collection points once full. The operative then unfolds a new set of bags and continues collecting, while a single, larger, crane equipped vehicle (@£35,000-£40,000) collects the sacks from 6 to 8 PCVs. The fact that one crane-vehicle driver can serve

A PCV and operative at work in Islington

Add cardboard and plastics... get MORE newspapers and cans. Adding the expanded recyclables has the surprising side-benefit of ALSO boosting the capture rates for the core recyclables. This seems to occur because households now find it easier to separate out ALL paper and board for recycling than they did to pick out specific grades – and because every material that is added furthers the practices and culture of recycling.

Toronto's waste plan – 60% diversion by 2006, 100% by 2010

'We are proposing transformational change, but the net result will be a simple and convenient system that will be easy for the resident to understand and take part in.'

Key assumptions to achieving its targets:
- organics will be collected each week
- anaerobic digestion will be the main treatment method for organic materials
- recyclables will be collected every two weeks
- residual resources will be collected every two weeks
- costs are based on a four-day 10-hour working week using existing staff

The practical plans:
- Just one collection truck will go down the resident's street on the same day each week; it will be a modern truck with two compartments.
- On one week the truck will collect organics from a hard, animal-proof container placed at the kerb, and also pick up recyclables which will be placed kerbside in one or more containers or bags; all dry recyclables can be 'co-mingled.' No need anymore to have a separate Grey Box for papers and Blue Box for bottles and cans.
- On the second week the organics will be picked up again, this time along with the residuals (anything that can't be recycled or composted).

'We will begin the four-year implementation of the new programme in 2002, starting with 170,000 residences. We will expand the number aggressively in the ensuing years.

When fully implemented, the net operating costs of the new system will be about $157 million per year (2006) or $160 per household per year. We asked ourselves how this would compare with other, more modest approaches to resource diversion. We were delighted to discover that it compares almost equally to keeping the status quo ($155 million or $158 per household in 2006) or just adding weekly recycling to the status quo ($158 million or $161 per household). The costs per household are the base costs and do not include debt service and indirect corporate charges. Meanwhile the big payoff is in a programme that is simpler to understand, easier to participate in, and much better for the environment that we live in.'

Waste Diversion 2010 Report, City of Toronto

Stream 3 – Residual Waste

The Last Resort – MBT systems

The three stream system outlined above points to a new way of thinking about the handling of residuals. Best known in Europe as Mechanical-Biological Treatment (MBT), these systems are built on the three stream logic. This moves us from a time when we could simply landfill or incinerate mixed, unsorted waste into an era of 'streaming' materials into their highest economic and environmental value.

The objective of MBT systems is to avoid putting toxics, recyclables and organics together into any final disposal option where they can interact and contaminate each other. Instead, MBT systems combine a series of treatment steps to remove as much recyclable, organic and toxic material from the residual as is possible – thereby producing an inert, 'stabilised' final product. MBT systems generally reduce the weight of the residuals they receive by a further 50%.

MBT systems enables cities and regions on both sides of the Atlantic to increase greatly their waste diversion rates – e.g. Halifax, Nova Scotia's 350,000 people boosted their diversion rate to 61% when launching their full 3-stream + MBT system; Edmonton, Alberta's 900,000 citizens reached 70% last year; and there are now dozens of such 3-stream + MBT systems across Europe, in Germany, Austria, Italy, Flanders and other regions.

The 'Bedminster' System

This modular system can be used for source separated or mixed waste. Mixed waste can be sorted manually or mechanically. Mechanical pre-sorting may include bag openers, eddy-current separators, metal detectors etc. The main component of the system is a sealed unit, rotating drum, designed to mix, aerate and homogenise the material. After the drum, raw compost is passed through a trommel for screening, and cleaned again to remove small items such as screws, paperclips and pieces of plastic. The compost can be left to mature for three to seven weeks either outdoors or indoors. Turning, aerating and sprinkling can be manual or via computer controlled automation. Sophisticated monitoring of the process and analysis of the product assure quality.

How MBT systems work:

1. **Source separate first.** MBTs should receive the residuals left after the maximum front-end source separation has been achieved – thus maximising the economic and environmental benefits from source-separation and minimising the size, cost and complexity of the MBT plant required.

2. **The mechanical stage.** Residuals are fed into a highly-mechanised front-end (to remove metals, plastics and other materials). This maximises the diversion of recyclable materials, separates of the compostable element and ensures the cleanest feedstock possible for the next stage.

3. **The biological stage** is usually an enclosed, in-vessel composting system which is intended not primarily to produce a saleable compost product, but rather to reduce the weight, and render inert any biologically active organic materials (that is, to 'stabilise' the residue.) The materials broken down and composted at this stage include paper and board, green/kitchen organics, and the organic content contained within nappies, packaging, textiles etc.

4. **The residue** is both greatly reduced in weight, and is stabilised. It can be landfilled, greatly reducing the risk of methane production, leachate difficulties and landfill fires, used as landfill cover or if contamination is low enough, as low grade compost.

The objective of MBT systems is to avoid putting toxics, recyclables and organics together into any final disposal option where they can interact and contaminate each other.

Edmonton, Canada, (population 636,000) has already diverted 70% of household waste from landfill, without using incineration. This is a recent achievement made possible by:

- Separate doorstep collection of dry recyclables, from all households (recycling rate achieved 15 – 18%)
- Mechanical separation and composting of the remainder
- "Take" collection points for household hazardous waste.

The only sorting Edmonton residents are required to do is for recyclables and household hazardous waste (2 bin system). The remainder is sent to a state of the art screening and composting facility, which produces a compost product in four weeks.

30 – 35% of material entering the composting process is landfilled. This is comparable to the solid waste volume reductions obtained by incineration, where 30% of material is left as ash and 10 – 15% is rejected as oversized non-combustible.

Edmonton residents have 2 containers. A blue bag for dry recyclables, (glass, paper, card, metals, plastic) and a bin for everything else.

1. Dry recyclables are processed at a materials recovery facility.

2. Householders are not allowed to put hazardous materials into the waste stream. Instead they must be taken to "Eco-Stations", which keeps dangerous waste out of the landfill. It can then be directed to facilities for reúse or recycling.

3. The household waste in the "everything else" bin is taken to the composting facility. There it is:

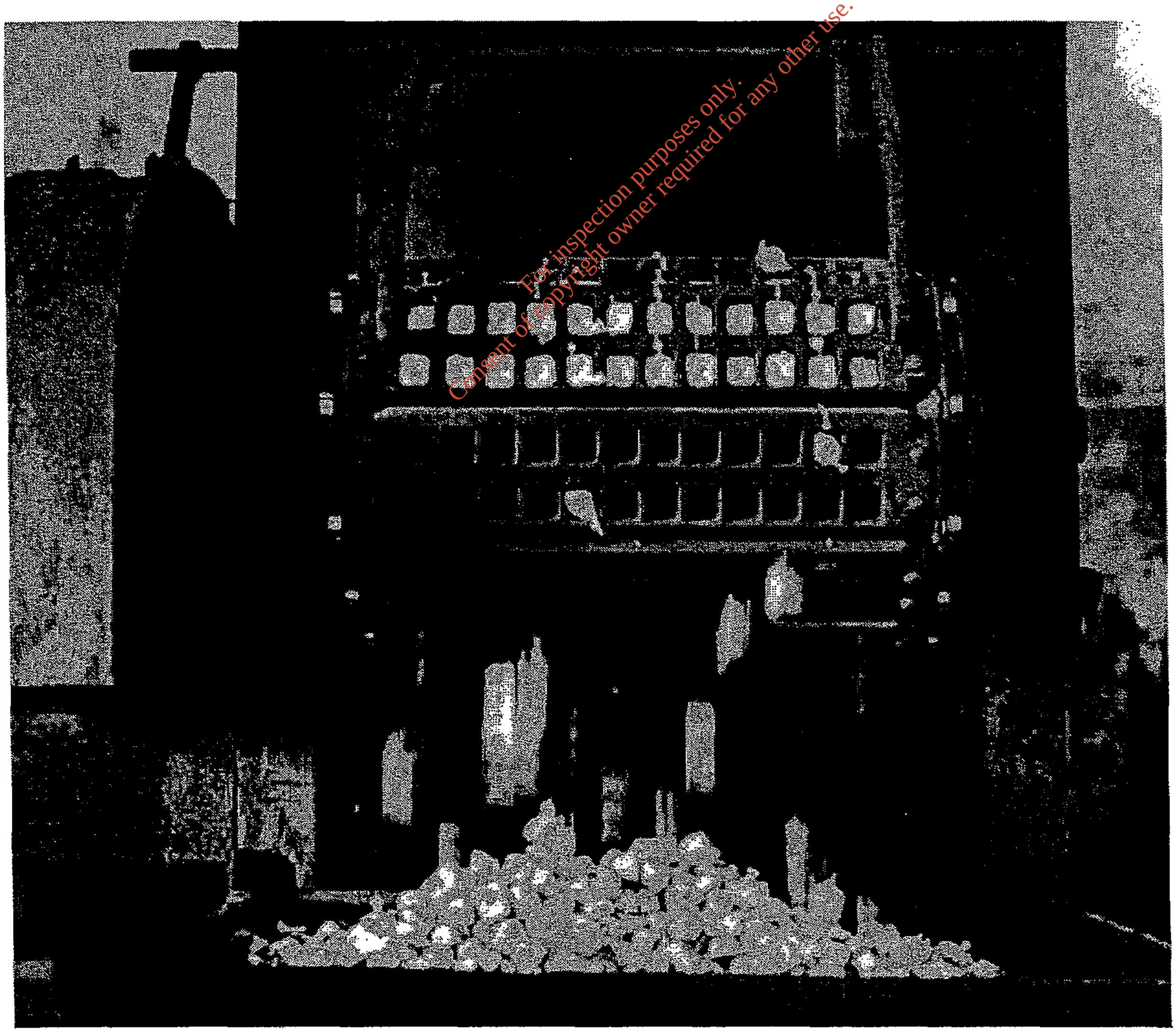
- Tipped. Oversize and unacceptable items are removed
- Screened. The material is transported by conveyor belt to a screen which removes non-biodegradable materials
- Composted. The conveyor moves the screened material to three aeration bays, where the material is regularly turned and air is drawn through it. After 4 weeks the compost is finely screened and the product is ready for marketing.

Details of the Edmonton system can be found at: http://www.gov.edmonton.ab.ca/am_pw/waste_management/

Re-use

Local authorities should do what they can to encourage producer responsibility. They can also take a variety of measures themselves to increase re-use. Central to every waste strategy is a serious waste reduction programme. Refurbish and re-use schemes not only reduce waste, but also provide good quality employment and encourage small scale businesses which generate money for the local economy. Local 'swap days' reduce waste at minimal cost.

There are many imaginative schemes in the UK and around the world in which waste reduction schemes play a significant part in waste strategies. Local authorities also have a considerable amount of buying power. Buying large quantities of refurbished and recycled products, particularly through supply-and-buy-back agreements can help stabilise markets for recyclates and recycled products.



Aluminium moulding machine

Zero Waste (or damn close!)

Waste is not inevitable. It is the result of a series of decisions such as what a product is made of, how it is made, how it is designed, the thought put into what will happen at the end of its life etc. In this respect, a great deal of waste is the result of bad design.

Economic imperatives are sometimes the cause of this sort of bad design. A product that is cheaper than a competitor's because it can be thrown away without regard for the environment is in fact receiving a subsidy through public money spent on costs associated with its disposal. One way of internalising these costs into the cost of the product is through individual producer responsibility. Put simply, this means that if a product (and its packaging) cannot be re-used, recycled or composted then the individual producer must be responsible for collecting and safely dealing with the product at the end of its life. The financial imperatives inherent in individual producer responsibility will tend to lead to products designed to eliminate waste. European Legislation is emerging to address this issue. For example the Waste Electrical and Electronic Equipment and End of Life Vehicles Directives.

Individual producer responsibility is the final piece of the jigsaw that makes Zero Waste an achievable target. It is one mechanism by which reductions in the production of waste can be implemented. In conjunction with the source separation of waste for all households, intensive composting and recycling programmes and effective refurbish and re-use schemes, residual waste can be considered a temporary phenomenon. Whether or not we can achieve zero waste or can only get close, Zero Waste as a policy is proving to be the most effective driver in achieving waste diversion beyond what used to be imagined as maximum limits. Those implementing Zero Waste policies are showing that the only real limits are those imposed by lack of imagination and lack of political will.

Canberra, Australia, has gone from 22% to 66% recovery of waste in six years (93/94 – 99/2000), with no incineration. The success is part of a drive to achieve 'zero waste' by the year 2010 utilising systems designed to separate waste into streams to maximise recycling.

Details:
www.act.gov.au/nowaste/wastestrategy/index.htm

Finances – cutting costs, raising revenues and new external funds

Dramatic improvements in the financial costs/benefits of recycling and composting have been made in the past three years: the net costs of recycling have continued to fall; new external funds have been announced (below); rising landfill taxes have increased the value of recycling credits; and Materials Marketing Consortia have been successfully developed.

External Funds

There is a range of funding coming on-stream that provides a new opportunity for local authorities to invest in recycling:

- £50 million through the New Opportunities Fund
- £140 million through a ring-fenced recycling/composting fund
- £1.127 billion in new Standard Spending Assessment (SSA) funding
- PFI funding in Sept/2000 revised its criteria to prioritise recycling/composting
- Landfill credits (£100 million annually) now target recycling more directly
- SRB (Single Regeneration Budget) -related funding
- The Neighbourhood Renewal Fund (£900 million for 88 Boroughs)
- Social Exclusion Funding
- Market development funds (e.g. the £40 million WRAP programme)
- An annually rising set of PRN targets

These funds offer the UK's local authorities access to a major share in £2 billion to £3 billion over the next three years. By contrast, landfill and incineration face ever rising costs through rising landfill taxes; Parliamentary support for a proposed incineration tax; the end of renewable energy funding, and the tightening of PFI limits on incineration.

The opportunities for local authorities to act now and accelerate their shift toward high recycling and composting systems are clearer than ever before.

Other benefits

When costing changes in waste systems – market sales, recycling credits, external funding and waste systems savings are usually included. However, there are additional important benefits that waste managers should include when making the case within the local authority for investment in new systems:

- Increased recycling employment generates additional financial benefits for the local economy – e.g. adding 50 new collection jobs injects £750,000 into the local community, often more than any increased waste management costs.[8]
- Tangible, visible progress in recycling helps to constructively engage neighbourhoods, estates and businesses – with consequent savings in Council decision-making time by reducing damaging 'Council vs. The Public' battles.
- Quality of life gains include reduced street litter, cleaner neighbourhoods, and, most significantly, the improvement in quality of life on estates.
- Finally, the environmental gains from reducing waste going to landfill and incineration – in energy use, in improved air and water quality, reduced CO_2 emissions and in global resource conservation – may provide the greatest benefits of all.

Further information

The Composting Association:
2001 Large Scale Composting: a practical manual for the UK.
1998 A Guide to In-vessel Composting – Plus a Directory of Systems
www.compost.org.uk

Progressive Farming Trust (2000).
Kerbside collection of source separated compostable household waste – a review of methods of encouraging the establishment and expansion of such schemes. Bulson, H.A.J and Purbrick E.A.
ISBN 1-1872064-31-0

Greenpeace UK 2001:
Achieving Zero Waste
www.greenpeace.org.uk

Waste reduction Programs
www.city.toronto.on.ca/taskforce2000
www.targetzerocanada.org
www.gov.edmonton.ab.ca

Manufacturers/distributors of in-vessel and other composting systems

Alpheco Ltd. Ipswich
tel 01473 730259 fax 01473 730295
alpheco@anglianet.co.uk
www.alpheco.co.uk

Bedminster AB, Sweden
tel +46 8 52 03 59 00.
bedminster@bedminster.se www.bedminster.se

EcoSci Ltd. Exeter.
tel 01392 424846 fax 01392 425302.
Ecosci@mail.zynet.co.uk

Farrington Environmental Ltd. Wells, Somerset.
tel 01749 676969 fax 01749 679915

Plus Grow Environmental Ltd. Manchester.
tel 0161 872 3022 fax 0161 972 9756

Wilkie Recycling Systems, Berks,
tel 0118 981 6588/6330
info@wilkiwrecycling.com

Wright Environmental Management UK Ltd. Belfast.
tel 01232 640972 fax 01232 640976
www.wrightenvironmental.com

Notes

[1]DoE 1995, Making Waste Work.

[2]DETR 2000 'Waste Strategy 2000' part 2, p.191.

[3]See for example EA/LPAC/Ecologica 1998, Re-Inventing Waste: towards a London Waste Strategy, and Robin Murray 1999, Creating Wealth from Waste, Published by Demos.

[4]*Biffa, July 2001, PFI Update.*

[5]In some circumstances where it is felt that a three bin system is not workable a two bin system can be used. (Dry recycleables in one bin the rest in the second stream, or compostable material in one bin and the rest in the second), followed by mechanical separation before recycling. Edmonton, Canada has reached 70% diversion using two bins. However organic waste collected without source separation is likely to be contaminated to some degree and will have restricted end use applications and a lower market value.

[6]The Composting Association, 2001. Large Scale Composting. A Practical Manual for the UK. p 27.

[7]Re-inventing Waste: Towards a London Waste Strategy. Robin Murray/Ecologica 1998.

[8]See for example Robin Murry "Creating Wealth from Waste" DEMOS (1999).


CLEANSING
INCINERATOR

'There is no question that the Landfill Directive can be met by local authorities without mass burn incineration'

Philip Cozens, Major Projects Development Officer, Shanks.

'It is entirely possible to achieve the Landfill Directive targets without using incineration'

Peter Jones, Director, Biffa Waste Services

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GREENPEACE
Canonbury Villas London N1 2PN Tel: 020 7865 8100 www.greenpeace.org.uk

FRIENDS of the earth
for the planet for people

Up in Smoke

Why Friends of the Earth opposes incineration

Briefing Sheet

INTRODUCTION

The UK Government and local authorities are currently looking at burning more waste from households, shops and offices in incinerators. This would mean literally sending valuable resources up in smoke, as well as increasing pollution levels and losing the chance to increase employment.

In recent years, most UK waste has been landfilled (that is, buried in huge holes in the ground, for instance in old quarries.) In many areas, especially urban ones, there are few suitable landfill sites now still available, which means that local authorities are looking for alternatives. However, neither burning waste nor burying it is the answer - instead, we need to be recycling materials, and finding ways to waste less in the first place.

Most of these new proposed incinerators will be equipped to generate electricity from the heat produced by burning the waste. Some of them will also use some heat directly to heat buildings. Hence they are not being called 'incinerators', a word which people associate with pollution problems, but 'waste-to-energy' or 'energy-from-waste' facilities.

Superficially, the idea of burning waste to generate useful energy sounds environmentally sensible, and this is certainly how the new incinerators are being marketed by their operators. But Friends of the Earth opposes incineration of waste, including that with energy recovery. This is for three main reasons:

* **Incineration wastes valuable resources**
* **Incineration pollutes**
* **Incineration is bad for climate change**

This briefing looks at these reasons in depth, at some of the financial and employment implications, and at Friends of the Earth's recommendations as to the way forward.

INCINERATION WASTES VALUABLE RESOURCES

Waste or resource?

We still live in a throwaway society. For example:

* In the UK we throw away 20 million tonnes of waste every year, and that's just from our houses. Another 15 million tonnes is thrown out by offices and shops, and 70 million tonnes by industry.[1]

* In 1994 the UK packaging industry predicted that packaging waste would increase by 10% by the year 2000.[2] Meanwhile the Netherlands is aiming to decrease its packaging waste to 10% lower than it was in 1986 by the year 2000.[3]

* It has been estimated that for every tonne of 'product' that we buy, ten tonnes of resources have been used to manufacture them.[4]

Although we call the materials we throw away 'waste', this is a rash judgement - most of it either does not need to be produced in the first place, or could be reused or recycled as a useful resource.

It is very important that instead of wasting resources we use them more efficiently. Recent research published by Friends of the Earth shows that, for an environmentally sustainable and equitable future, we need to reduce our consumption of wood products (including paper) by 65% by the year 2010[5] and of non-renewable resources (like aluminium, steel and cement) by around 80% by 2050.[6] This is not because resources are about to run out in the near future (although we potentially do have this problem with oil[7]), but because of the effects of the current fast rate of consumption. For example:

* The last 5% of old forest in Scandinavia is still being cut down to provide paper for us to use and the loggers have now moved into wildlife rich forests in Russia. These forests are the remaining home to a rich variety of plants and animals, including the flying squirrel, the brown bear, and the white-backed woodpecker. In Sweden alone, over 1700 forest- dwelling species are on the national threatened species list.[8]

* An aluminium mine in Ghana, which provides 1% of the world's aluminium, is powered by a hydroelectric project. An artificial lake half the size of Wales has been built to do this, displacing 80,000 people.

* Pollution from the Ok Tedi copper and gold mine in New Guinea has contaminated local seafood, and is now considered to have destroyed the ecosystem on which 30,000 people depended for their livelihoods.

* Plastic production accounts for 4% of oil consumption; oil is a non-renewable resource. It has been estimated that, at current projected consumption rates, and allowing for likely future oil discoveries, we will run out of oil by the middle of the next century.[9]

Preventing these kinds of impacts means making things last twice as long and using half as much. Wasting much less and recycling much more is an important place to start.

Incineration and recycling - are they compatible?

If we build incinerators, we are not only quite literally sending resources up in smoke, but also accepting that we do not need to reduce wastage. Because building an incinerator has such high capital costs, incinerator operators typically require contracts with local authorities to supply them with a minimum amount of waste to burn over a long time - 25 to 30 years. In some cases, if the local authority does not supply the full amount of waste required, it has to pay the incinerator operator to compensate for their profit shortfall. This assurance of return on investment is a logical requirement from the incinerator operators' point of view, but once incineration is established as an area's mode of waste management, it hampers waste reduction and recycling measures. The incentive on the local authority will be to ensure *enough* waste is produced, not to ensure that it's reduced.

An example of this has occurred in Cleveland. In mid-1995 Cleveland County Council (now reorganised into unitary authorities) signed a contract with a waste company to supply at least 180,000 tonnes for incineration and 80,000 tonnes for landfill each year. There was a 'shortfall' of 12,000 tonnes in the first year of the contract, and the authorities have thus incurred penalties of £147,000. The Associate Director of Environmental Services at Stockton Borough Council has said “essentially we are into waste maximisation”, and that they are constrained by the contracts from doing even a modest amountof recycling.[10]

The incineration industry and the Government argue that incineration and recycling can exist side by side. This is because their aspirations and targets for waste reduction and recycling levels are much less ambitious than is necessary. Some incinerators have facilities for removing glass and metals. But if paper and plastic waste were minimised and recycled as much as possible, in most areas there would not be enough left to make incineration financially worthwhile. If there is less waste a smaller incinerator is required. The costs of some pollution abatement equipment are the same irrespective of the plant to which they are fitted, and can be a high proportion of the costs of a small incinerator[11], potentially making small incinerators uneconomic.

Similarly, although it might appear that incinerators would not affect recycling of metals and glass, in practice there would be little incentive for separating out these materials, since they can go through the incineration process.[12]

Energy from recycling, not energy from waste

By recycling instead of producing goods from raw materials, substantial amounts of energy are saved. Recycling cuts out the energy consumption associated with the extraction and initial processing of raw materials. In addition, the recycling process itself is often more energy efficient than production from raw materials. Energy can be obtained from incineration, but this is less than can be saved by recycling. The most recent European waste strategy assumes that in general recycling is preferable to incineration in energy terms.[13]

A Canadian study found the following figures for energy saved by recycling materials as opposed to burning them.[14] The savings still apply when the energy used to transport materials for recycling is taken into account - this energy is relatively insignificant.

Material	Energy saved
Paper	3 times
Plastic	5 times
Textile	6 times
Food and garden waste	None

Studies on individual materials yield similar results. In ten out of eleven analyses on paper, recycling has been found to result in lower total energy use than incineration (although possibly more carbon dioxide emission - but this is changing with the UK using different fuel mixes and would change further if recycling mills were built in urban areas and used more sustainable energy sources).[15] [16] The most recent report looking at greenhouse gas emissions from different waste treatment options for different materials found that recyclingis preferable for paper, cardboard, plastics and metals. Interestingly it also suggested that landfill is better than incineration for plastics and some papers (for example newspaper) because the carbon is trapped in the landfill rather than released in the environment[17]. And a study by the British Plastics Federation has found that recycling of plastic cups is preferable to incineration in energy terms.[18]

Different studies in this field obtain different results. This can depend on the scope of the study. For example, a comparison of the amount of energy used at manufacturing versus recycling plants should include the energy needed to extract the raw materials to make the virgin products, but does not always do so.

INCINERATION POLLUTES

Air pollution

Incinerator chimneys emit organic substances such as dioxins, heavy metals such as cadmium and mercury, dust particles and acid gases such as sulphur dioxide and hydrochloric acid. These can have the following health effects:

* Dioxins - according to a draft report from the US Environment Protection Agency, dioxins may be associated with cancer, hormonal effects such as endometriosis in women and reduced sperm counts in men, and reduced immune system capacity. They may also affect foetal development.[19] See box overleaf.

* Heavy metals - cadmium may cause lung and kidney disease, and mercury can affect the nervous system.

* Dust particles - these exacerbate lung diseases such as asthma or chronic bronchitis, and heart disease

* Acid gases - these also exacerbate lung disease

The permissible limits for emission of these substances (apart from dioxins) have been tightened by a European law which came into force on 1 December 1996. The European law does not specifically set limits for dioxins but a limit for these has been set by the UK Environment Agency. This means that all working incinerators in the UK will operate to standards more stringent than previously. New European legislation will tighten the standards further, and other countries are already operating to higher standards. For example, standards for dioxin emissions in the Netherlands are ten times more stringent than the new UK standards.*20* A recent report for the European Commission, which was prepared to help them consider how tough the new standards should be, suggested that for every tonne of municipal waste burnt between £21 and £126 worth of environmental and health damage is caused (depending on the location of the incinerator)*21*.

For some of the pollutants, (such as dioxin and cadmium), the overall amount of the pollutant in the area, some of which willcome from the incinerator and some from other sources, is not taken into account when the incinerator emission limits are set. Because of this it is often not possible to tell whether the incinerator emissions will lead to unacceptable exposure or not. Moreover, for pollutants where the overall impact *is* allowed for (such as with particles and lead) the standards do not take into account the fact that two or more pollutants might act in combination to produce a greater effect than they would singly.

Monitoring for dioxins (and also for heavy metals), is done at intervals - for example, twice a year.*22* The amount of each pollutant will vary depending on the particular composition of the material going into the incinerator at any given time and the temperature of the incinerator. To get the most favourable results it is likely that the operators will ensure that ideal conditions are present at the times of the tests. This may not always be the case at other times the incinerator is operating.

Incinerator ash

One of the main arguments put forward for incineration is that it saves on landfill space - but a significant amount of ash is produced. When waste is landfilled it is compacted. According to the Government's own waste strategy, the ash produced by incineration occupies 40%-50% of the space that compacted unburnt waste would.23 Therefore, whilst it is often said that the ash occupies only 10% of the volume of unburnt waste, this figure is misleading as it applies to uncompacted waste.

The ash is toxic; the toxins include heavy metals and dioxins. This particularly applies to ash which is 'caught' by pollution abatement equipment and prevented from going up the chimney, known as 'fly ash'. However, the main volume of the ash - 'bottom ash' - also contains some toxins. Most of it goes to landfill, and this means that the pollutants may eventually leak into groundwater, from where it is virtually impossible to clean them up. Moreover, the heavy metals are present in a form where they are more liable to leach if they are in ash than if they are in unburnt waste.*24*

Incineration companies are now looking for ways to use bottom ash for construction purposes. Even if acceptable uses could be developed, it does not solve the problem of what to do with the toxic fly ash.

LOCAL EFFECTS OF INCINERATORS

An incinerator has impacts other than local pollution on the community where it is sited. Traffic congestion and noise arise from the lorries transporting waste to, and ash away from, the incinerator. The incinerator itself is unsightly. And property values and local businesses (such as food processing, which needs to maintain confidence that its products are not contaminated) may be adversely affected.

Dioxins

Dioxins are a by-product of burning chlorine-containing materials, such as PVC plastic. Dioxins have a particular set of properties which make them worthy of special consideration:

- They are extremely toxic - that is, their effects are seen at very low doses
- They are persistent - that is, they take a very long time to break down, either in the body or in the environment
- They are bioaccumulative - that is, they build up in people's bodies, and in the food chain, over time.

There has been considerable debate over just how much risk to health they pose. However, everyone is now unavoidably carrying a certain amount of dioxin in their bodies as a consequence of living in the industrialised world. Worryingly, some of the health effects described earlier in the briefing are seen in people with levels of dioxin not much higher than the amount many people have anyway.*25* This does not prove that the dioxin is *definitely* causing the health effects. But it should not be necessary to wait for definite proof - the 'precautionary principle' should be applied and no more avoidable dioxin should be added to the environment.

The UK Government considers that there is very little health risk from current levels of dioxins. This belief is based on a particular 'tolerable daily intake' (TDI) that it considers safe, which is also the one used by the World Health Organisation. However, this TDI is based on assumptions which, according to the US Environmental Protection Agency, do not necessarily stand up. For example, the safe intake is calculated is calculated on the basis of experiments on rats, and does not make enough allowance for the fact that dioxin breaks down in rats' bodies much more quickly than in humans.*26*

The UK's TDI is about 100 times less stringent than the US Environment Protection Agency considers to be safe for the non-cancer health risks (such as reduced fertility, and endometriosis), and about a thousand times less stringent than they calculate to give a cancer risk of one in a million (their usual benchmark).*27*

INCINERATOR COSTS

It is not surprising that, at present, incineration appears to be a financially attractive option for waste authorities which are hard pressed for landfill space because at present, incineration appears to be a cheaper option than recycling. However, incinerators could end up being expensive white elephants for four reasons:

* As emissions standards continue to improve, costs will increase. For example, there is a new European draft waste incineration Directive.*28* A study has estimated that retrofitting plants which already comply with the current law to comply with the new proposed law may be around £8 per tonne of waste.*29*

* Incinerator operators may in the future find themselves liable for large litigation claims from local residents whose health has been damaged by the emissions.

* The landfill tax may be increased, and to be extended to incineration, so that the environmental costs of these waste disposal options are more fully reflected in the price paid for them.
* At present, many incinerators are subsidised by the Government through the Non-Fossil-Fuel-Obligation. This subsidy is to encourage renewable sources of energy. We believe that it should not be used to subsidise incineration (which burns fossil fuels in the form of plastics). If it were to be withdrawn, incineration would be much less financially attractive.

Investment in recycling, on the other hand, will pay off more and more as recycling infrastructures and markets for recycled materials develop. It also creates far more jobs than either landfill or incineration - see below.

But regardless of the current financial situation, local authorities do not have to go for the cheapest option for waste disposal - the Department of the Environment says "Under the Environment Protection Act 1990, local authorities, in their role as waste disposal authorities, are not required to accept the lowest tender for their contracts where an alternative offers environmental benefits."*30*

Waste management and employment

Once they have been built, incinerators create few jobs compared with recycling. A New York study found thefollowing*31*:

Jobs per one million tons of waste processed

Type of waste disposal	Number of Jobs
Landfill	40 - 60
Incineration	100 - 290
Composting	200 - 300
Recycling	400 - 590

The British Newsprint Manufacturers Association found that recycling of newspapers would create three times as many jobs as incinerating them. In addition, a higher proportion of the jobs created by incineration were associated with building the incinerator, so they were not permanent jobs.*32*

A strategy drawn up for London suggested that increasing recycling in London to around 50% by 2005 would create around 15,000 jobs*33*.

WHAT DO WE WANT TO SEE?

First, there are many ways of using materials far more efficiently than we do at present. And it is not just Friends of the Earth calling for this. The World Business Council for Sustainable Development has estimated that a ten fold increase in efficiency of material throughput is necessary.*34* For example, we need to design products to carry out the same functions using fewer materials, and to be durable, repairable and have reusable parts. We need to make much greater use of recycled materials. We need to replace products with services (for example, nappy washing services and tool hire), and we need to start asking ourselves how much we really need. All of this would mean less in the dustbin.

Secondly, the waste we do produce needs to be recycled to a far greater extent than happens at present. It has been estimated that around 80% of household dustbin waste is recyclable or compostable*35*; this estimate allows for practical and economic factors. Recycling saves materials and the waste created by obtaining raw materials, saves energy, and most recycling processes are less polluting than raw materials processes.*36*

In parts of the USA, Canada, Japan and Germany recycling levels of between 50-75% have already been achieved.*37* It can be done here too. For example, the city of Bath has already reached the Government's target of recycling 25% of household waste, and Leicester City has recently set a target of recycling 40% of household waste by 2000. The London Borough of Sutton is recycling 19%, and aiming for 50% by 2001.

Soiled paper (eg that which has been in contact with food, or paper that has been recycled the maximum number of times and is no longer good enough quality for further recycling), can be composted or anaerobically digested. These processes also deal with food and garden waste. They can produce a useful product (compost or soil conditioner) and are more flexible (in terms of plant size) and less polluting than incineration.

Local Authorities have a very important role to play in sustainable waste management. We recommend they do the following:

* Reject incineration as a backward-looking option, and instead expand recycling facilities, preferably by means of comprehensive kerbside collection, and look to anaerobic digestion and composting

* Provide public education on minimising waste and recycling more

* Support waste exchanges, and reuse schemes such as furniture repair

* Minimise internal waste from the Authority, and specify that materials purchased by the Authority should be recycled

CONCLUSION

Incineration is a backward-looking technology - it allows us to continue with our throwaway habits, instead of looking to the future when we will be conserving resources much more carefully than we do now. It also adds to pollution of both air and land, and may turn out to be very expensive.

Building incinerators now commits us to this wasteful way of managing resources for several decades hence.

Don't let the future go up in smoke!

FURTHER READING

Incineration Campaign Guide, February 1998, £15
Landfill Campaign Guide, July 1997, £15
Waste - A5 16 page booklet/leaflet, Friends of the Earth, 1996, £0.50
Don't throw it all away - Friends of the Earth's Guide to Waste Reduction and Recycling, 50 page book, 1992, £3.45

All the above can be ordered from:

Publications Despatch, Friends of the Earth, 56-58 Alma Street, Luton, LU1 2PH
Tel 01582 482297 (2pm-4pm)

Send payment with your order - P&P is free

Also visit our web site for much more information on waste and useful links to other web sites:

http://www.foe.co.uk:/campaigns/industry_and_pollution/

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Friends of the Earth England Wales and Northern Ireland
26-28 Underwood Street
London N1 7JQ
Telephone 0171 490 1555
Email: info@foe.co.uk
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Five Popular Myths About Incineration

by Paul Mobbs, environmental consultant, June 1997

Communities across the UK are under pressure from developers and/or local authorities to accept the development of "*waste to energy*" plants - incinerators - in their area. The arguments which are put forward to support incineration are based on 'facts' - and the development of 'waste to energy' is apparently supported by the Department of the Environment. But, if we examine the arguments in favour of incineration, there is very little substance to them, and many of the arguments are based on very poor science. *The arguments are no more than myths.*

The main five myths promoted about incineration are:

- Incineration reduces the need for landfill;
- Incineration is a way of recycling energy;
- Incineration is safe;
- Incineration and materials recycling can work together;
- Incinerators solve the waste 'problem'.

"Incineration reduces the need for landfill"

There are many figures put forward for how much landfill space is saved by building incinerator plants. Incinerators do not mean we get rid of landfill - in fact the adoption of incineration creates wastes which themselves can be difficult to safely dispose of.

The Department of the Environment booklet on energy from waste [1] states that, "*energy from waste plants reduce the waste for disposal by 90%*" (70% by weight). This statement is extremely 'economical with the truth. Studies of the waste streams associated with incineration, commissioned by the Government's renewable energy body ETSU [2], show that the real figure for the whole waste stream is about 50% (by weight.

The reason for the difference in figures is that the 'official' figure only includes waste burnt. In reality incinerators close for maintenance, and waste quantities vary over the year, so a significant quantity of waste still goes to landfill, 'diverted' from the incinerator.

There are problems with the disposal of the ash from incinerators. The bottom ash, while being described as 'inert' will leach pollutants such as heavy metals if it becomes wet. The 'fly ash', from the pollution control equipment, is extremely toxic and has to be disposed of as 'special waste'. There are few sites equipped to handle such large quantities of special waste. If we take as an example the 'flagship' of all incinerators - the SELCHP plant in London - it had to send its fly ash to a site near Cheltenham because no one else would take it.

"Incineration is a way of recycling energy"

Waste materials have two values: -

- the quantity of energy that was expended in their manufacture, and hence which must be

expended again to replace the material;
- the quantity of energy that is released when the material is burnt.

For most materials the amount of energy produced by burning in incinerators is significantly less than that invested in their manufacture. See the example below for a more detailed explanation. This means that incineration is the 'worst environmental option' when compared to other solutions such as recycling or reuse.

Energy implications of plastics incineration

Energy in manufacture (a), MJ/kg:	120
Energy from combustion (b), MJ/kg:	44
Efficiency of generation (c):	0.33
Electricity produced (d), MJ/kg (b x c):	14.5
Energy efficiency of plastics incineration (d / a):	**12%**

In terms of the practicalities of waste combustion as an energy source, if we take a traditional fossil fuel such as coal, coal contains more energy per unit volume than mixed waste. You have to burn three times more mixed waste for the same energy release.

What, we have to ask, is the primary purpose of an incinerator - to generate power or to dispose of waste?:

- If it is to produce power, there are other generation options with lesser environmental impacts, and an equal or smaller capital cost - e.g., wind, micro-hydro and wave/tidal devices;
- If it is to dispose of waste there are other options with lesser environmental impacts - e.g., anaerobic digestion, source separation of recyclable materials, or better still waste avoidance/minimisation. More importantly, if the primary purpose of waste combustion is waste disposal, it cannot be regarded additionally as a renewable energy source;
- Another way to look at the issue - £60M (the cost of an average incinerator) would buy around 5 million low energy bulbs, and would save about 1 billion kWh of electricity - equal to the energy production of an average incinerator over 15 years. Do we therefore regard the sales of low-energy light bulbs as renewable?

"Incineration is safe"

The combustion of waste produces substances that are harmful to health. Some of these substances are harmful in extremely small quantities - such as dioxin. Others are produced in large quantities and add to the general 'background' levels of pollution.

There has been much publicity about the toxicity of dioxin, and the effects of dioxin from incinerators. In 1996 Her Majesty's Inspectorate of Pollution, one of the agencies which was later incorporated into the Environment Agency, produced a report on dioxin releases from waste incineration [3]. This report, supported by many in the incineration industry, concludes that there is little risk from the dioxin emissions of incinerators. However, the research which forms the basis of this report has recently been reassessed [4]. Combined with the uncertainties within the HMIP report - which are many - it can be shown that dioxin intakes have been significantly underestimated. This means that any significant new source of dioxin in a community poses a threat to health.

Although there has been much attention given to dioxin. the more 'conventional' emissions from incinerators have been largely ignored. For pollutants such as particulates (soot) or carbon monoxide it is difficult to find a comparison to give an idea of the size of discharge an incinerator represents. It is therefore necessary to convert the figures to some other meaningful quantity. If we consider an average 200,000 to 250,000 tonne per year incinerator, the particulate emissions from the chimney are around 100 kilos per day. That is equivalent to 1.7 million diesel vehicles travelling down a road every hour.

Incinerators also produce high levels of localised pollution. Although the tall chimney dilutes pollution in the air, at certain times emergency vents (called 'dump stacks') discharge pollution from the top of the pollution control plant with minimal dilution. The effect on communities within a few miles of the plant is significant. Any waste management option will produce polluting emissions. But compared to other options waste incineration represents on of the largest 'point' sources of air pollution.

"Incineration and materials recycling can work together"

The main attraction of incineration to local authorities is that it does not require any of their 'systems' to change. They can still collect waste in bulk without the need to ask their citizens to separate it, and then they can deposit that waste in bulk at one central point. This poses the question as to whether working incinerators can really benefit materials recycling.

For an incinerator to operate it has to secure waste contracts with local authorities in the area. In order to ensure that incinerators work at maximum load, the operator must ensure a steady supply of waste. This puts obvious restrictions on the authorities in the area to divert waste to other waste management options, or enage in waste minimisation.

Another problem with the recycling side of things is that all materials have two economic values - one based on their value as recycled material. and one according to their potential to burn and produce electricity. From this perspective the burn value of glass and metal is negative - because they do not burn, and actually remove energy from the system as they heat up. Plastics and paper on the other hand have a great burn value. Balancing this. metal. glass. paper and plastics have a reclaim value, based on their economic value or the energy used in manufacture. Those materials which are extremely energy intensive to produce, but which have a high calorific value (such as plastics) will not be reclaimed. Even aluminium, because of the difficulties of segregating small items of non-ferrous metal. will be destroyed in the incinerator.

There is evidence emerging [5] that the practical effects of long-term contracts for incinerators work against the best interests of recycling. In mid-1995. Cleveland Waste Management signed a 25-year contract with Cleveland County Council based on projected long-term waste arisings of 310.000 tonnes. However. in the first year of the contract the region supplied only 248.000 tonnes - and the county and four borough councils which succeeded it incurred penalty charges of £147.000 because of the shortfall. The Assistant Director of Environmental Services at Stockton Borough Council. observed that the penalty clauses "*mean that fundamentally we are into waste maximisation.*" According to the Assistant Director. the councils. "*are already constrained by the contracts from doing even a modest amount of recycling,*" and the future of two materials reclamation facilities is in jeopardy.

"Incinerators solve the waste 'problem'"

The perceived 'problems' with waste at the moment are three-fold: -

- traditional landfill sites are filling up;
- waste management is unsustainable - huge quantities of resources are thrown away each year;
- landfill is becoming more expensive.

The problems of landfill will not be solved by more incineration of waste. Landfill will still be needed for significant quantities of waste.

In terms of the 'sustainability' of incineration, it is no better than landfill. It is still wasteful of resources which could have been recycled, reused, or not produced at all.

Finally, when considering costs, it is misleading the public for any body to state that incineration will be cheaper in the longer term. It is true that the costs of landfill are rising because of higher technical standards and the landfill tax. However, it is likely that in the next few years the landfill tax will be extended to cover incineration. Also, the emission standards for incinerators will be soon be raised yet again, and the terms of most waste contracts mean that these costs will pass directly to local authorities.

But, what is the answer to waste disposal?

In essence, the purpose of waste management is to dispose of waste materials in a manner which causes the least damage to the environment. There are three priorities:

Firstly, we have to minimise the amount of waste we produce. This will require national legislation as local authorities have very little power in this area. As well as minimising quantities, we need to improve the 'service life' of goods. If your ink pen lasts twice as long you produce half the waste. Making goods of higher quality and which are easily repairable reduces waste in the short term, and will save the consumer money in the long term. Only by addressing the actual production of waste will we be able to control the total quantity.

Secondly, we have to encourage reuse. This means encouraging the use of reusable containers, and where possible encouraging bulk buying - buying products in large bags uses proportionately less materials.

Finally, we need to recycle more. This means getting the public to separate their waste before collection, and then reprocessing this material through a network of 'materials recovery facilities'. As well as simply recycling, we also have to consider the design of products. Where there are problems about recycling products we need to encourage the 'substitution' of problematic materials for ones which can be easily recycled.

There is no quick and easy fix to the waste problem. We will not be able to introduce more sustainable systems of waste management without fundamental changes to how we use goods and dispose of them.

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Page updated by Paul Mobbs, April 1998. Please send any comments or queries to mobbsev@gn.apc.org

Location - http://www.gn.apc.org/pmhp/dc/waste/incnmyth.htm

Why Ban Incineration?

Burning was once considered the most effective method for disposing of waste materials. But since industrialisation the nature of waste has changed dramatically. The mass production of chemicals and plastics mean that the burning or incineration of waste today is a complex, costly and highly polluting method of disposal. Based on the myth that burning makes waste disappear, incineration has emerged as a widely used method to dispose of many kinds of waste, including hazardous wastes.

However, far from making waste disappear incinerators actually create more toxic waste, and through this pose a significant threat to public health and the environment.

For example, incineration is touted as an alternative to land filling. Yet incinerator ashes - contaminated with heavy metals, unburned chemicals and entirely new chemicals formed during the burning process - are buried in landfill or dumped in the environment.

Through incineration, industry has found a way to break down its bulk waste and disperse it into the environment via air, water and ash emissions. Incineration is a convenient way for industry to mask today's waste problems and pass them onto future generations.

More info

View table of increase in incineration in the European Union from 1985-1996.

IMPACTS OF INCINERATION: EMISSIONS

Existing data shows that burning hazardous waste, even in "state-of-the-art" incinerators, will lead to the release of three types of dangerous pollutants into the environment:

1. **Heavy metals**
2. **Unburned toxic chemicals**
3. **New pollutants - entirely new chemicals formed during the incineration process.**

Toxic Metals

Metals are not destroyed during incineration and are often released into the environment in even more concentrated and dangerous forms than in the original waste. High-temperature combustion releases toxic metals such as lead, cadmium, arsenic, mercury and chromium from wastes that contain these substances, including batteries, paints and certain plastics. They are released in the form of tiny particles or gases, increasing the risk of inhalation. An average-sized commercial incinerator (32,000 tonnes per year) burning hazardous waste with an average metals content emits these metals into the air at the rate of 92 tonnes a year (total for lead,cadmium, arsenic, mercury and chromium); another 304 tonnes a year will be found in residual ashes and liquids. Pollution control equipment can remove some but not all heavy metals from stack gases. But even then the metals do not disappear; they are merely transferred from the air into the ash, which is then landfilled.

Subsequently, metals in the ash may leach into and contaminate soils and potentially groundwater. Presently, ash from incinerators is sometimes being used for construction purposes such as in asphalt, cement and for making paths. This practice can also have implications for the environment and for human health. For instance, metals can leach out of such construction materials. Ash from a municipal waste incinerator in Newcastle, UK, was used on local allotments and paths between 1994 and 1999. All of it had to be removed recently after it was found to contain unacceptably high levels of some heavy metals and dioxins.

Unburned toxic chemicals

No incinerator process operates at 100 per cent efficiency. Unburned chemicals are emitted in the stack gases of all hazardous waste incinerators. They also escape into the air as fugitive emissions during storage, handling and transport. While incinerators are designed to burn wastes, they also produce them in the form of ash and effluent from wet scrubbers and/or cooling processes. Incinerator ash carries many of the same pollutants that are emitted as stack gases. Studies have identified as many as 43 different semi-volatile organic chemicals in incinerator ash, and at least 16 organic chemicals in scrubber water from hazardous waste incinerators. Ash is commonly buried in landfill, while effluent is often treated before being discharged into rivers or lakes.

New pollutants - dioxins and furans

One of the most insidious aspects of incineration is the entirely new and highly toxic chemicals that can be formed during the combustion process.

When fragments of partially burned waste chemicals recombine within incinerator furnaces, smokestacks, and/or pollution control devices, hundreds, even thousands, of new substances are created, many of which are more toxic than the original waste itself.

There has been very little research on the identification of the multitude of pollutants emitted from incinerators. One study identified 250 volatile organic compounds, many of which are known to be highly toxic or carcinogenic, but it is likely that many other compounds are emitted which have yet to be identified.

Among these are dioxins and furans (often referred to just as dioxins) a class of chemical compounds widely recognised to contain many highly toxic compounds including TCDD, a chemical which has been described as the most toxic chemical known to man. Dioxins are created when chlorine-containing materials are burned. They have no useful purpose and are associated with a wide range of health impacts including, cancer, altered sexual development, male and female reproductive problems, suppression of the immune system, diabetes, organ toxicity and a wide range of effects on hormones.

DIOXINS - GLOBAL KILLERS

Once emitted into the environment dioxins can travel vast distances on air and ocean currents, and because of this globe trotting ability are a global contaminant. In 1997, the International Agency for Research on cancer (IARC) classified TCDD, the most toxic dioxin as a human carcinogen.

Dioxins are distributed into the environment as part of incinerator stack gases, bottom ash, fly ash and in the effluent of pollution control devices. The main route of exposure to dioxins in humans is through food intake. Once in the body they are only excreted very slowly and build up in fatty tissues. Studies suggest that people in the U.S. and some European countries now carry dioxins and furans that are at or near those levels which are suspected to cause health effects in humans.

Dioxin released from an incinerator can be readily taken up by grazing animals and fish.

- In 1989, 16 dairy farmers downwind of a Rotterdam incinerator were banned from selling their milk, because it contained dioxin levels three times higher than anywhere else in the Netherlands.

Residents of one property downwind of a chemical waste incinerator in Pontypool, South Wales, were advised not to consume duck or bantam eggs from their property.

Fugitive Emissions

Some waste is accidentally released when chemicals are removed from storage containers at the incinerator site, moved to transportation vehicles, or being shipped to and moved about within the incineration facility. An average incinerator burning 32,000 tonnes of waste per year will receive over 1500 tanker-truck shipments of wastes per year, or more than 28 trucks per week. According to the US EPA: "Fugitive emissions and accidental spills may release as much or more toxic material to the environment than direct emissions from incomplete waste incineration ..." There is also the risk of catastrophic waste releases in fires and explosions.

Incinerator Ash is Hazardous Waste

Leftover incinerator ash can be extremely toxic, containing concentrated amounts of lead, cadmium and other heavy metals, as well as dioxins and other toxic chemicals. Disposal of toxic ash in an environmentally sound manner is problematic and expensive. If handled properly, ash makes incineration prohibitively expensive for all but the wealthiest communities. If handled improperly it poses short and long-term health and environmental dangers. The better the pollution-trapping device in an incinerator smokestack, the greater the quantity and toxicity content of the residues will become. A hundred times more dioxin may leave an incineration facility on ash, than in air emissions. The average cost in the Midwest US for disposing a ton of hazardous waste is $210, compared to $23 for ordinary waste. Some experts recommend burying this ash in a landfill equipped with a plastic liner to prevent leaching into groundwater. But all landfill liners eventually leak.

INCINERATION IN ASIA

Developing countries in Asia are being swamped with proposals to build waste incinerator plants. Faced with shrinking markets in pollution-conscious Northern countries, incinerator companies are turning to Asia where they see a lucrative market for their outdated and poisonous technology.

Today, incinerators are being sold under a variety of guises – such as fluidised bed incinerators, thermal treatment plants or as waste-to-energy systems. Yet in countries, such as the Netherlands, Germany where pollution regulations are impossibly tight, incinerators still continue to incur monumental costs to clean up the pollution they cause. Many of the industrialised countries cited by incinerator salespersons as proponents of incineration technology, are rapidly shutting down their incinerators. By the end of 1998, more than 2000 industrial waste incinerators nation-wide were closed permanently or temporarily in Japan, as a result of tougher limits placed by the Japanese Government on the emission of cancer causing dioxins.

However, following developments in technology for controlling emissions to air, new incinerators are again being proposed in some European countries. Governments charged with managing industrial waste stand at a critical juncture. They can continue to approve and promote incineration, or they can encourage the development and use of clean production methods that eliminate toxic processes, products and waste.

IMPACTS OF INCINERATION: HEALTH AND ENVIRONMENT

- Increased cancer rates, respiratory ailments, reproductive abnormalities and other health effects have been noted among people living near some waste-burning facilities, according to scientific studies, surveys by community groups and local physicians.

- Cancer, birth defects, reproductive dysfunction, neurological damage and other health effects are also known to occur at very low exposures to many of the metals, organochlorines and other pollutants released by waste-burning facilities.

- Many pollutants released in incinerator air emissions have been shown to accumulate in and on food crops, especially crops where the edible portion is exposed such as leafy vegetables. While thorough washing of produce may remove a portion of pollutants on crop surfaces, a significant amount (typically from 15% to 50%) will remain.

THE FAILINGS OF INCINERATION

- Incineration relies upon the continued generation of waste to support the high operating costs. Pressure to pay back the high cost of building incinerators has had the effect of encouraging and perpetuating waste generation.

- Continued investment in incineration inhibits the development of more sustainable waste minimisation practices, as well as the exploration and development of products and processes that do not use toxic chemicals in the first place.

- Dispersing persistent, bioaccumulative pollutants into the air from incinerator emissions creates more pollution problems.

INCINERATION: THEORY VS PRACTICE

In theory, a properly designed incinerator should convert simple hydrocarbons into nothing other than carbon dioxide and water. Practical experience, however, has shown that even the best of combustion systems virtually always produce PICs [products of incomplete combustion], some of which have been found to be highly toxic. Even under the strictest of standards, "state-of-the-art" incinerators emit chemicals that have escaped combustion as well as newly-formed "products of incomplete combustion" - thousands of different chemicals of which only a small fraction have been identified.

The monitoring and measuring of incinerator performance is conducted in various ways and on various levels in different countries. Actual incinerator performance can deviate radically due to "combustion upsets" such as: equipment failure, human error and rapid changes in the waste fed to an incinerator. Only a small fraction of the total volume of waste needs to experience on one these "combustion upsets" for there to be significant deviations from the targeted destruction efficiencies.

Medical Waste - useful waste into hazardous waste.

Only 10 percent or less of a typical hospital's waste stream is potentially infectious, and that can be sterilised with heat, microwaves and other non-burn disinfection technologies. The remaining waste is not infectious. Most paper, plastic food waste and other hospital waste are similar to the same waste coming from hotels, offices or restaurants, since hospitals serve all of these functions. By burning medical waste in an incinerator the basic biological problem of disinfecting infectious material - which can be dealt with by various technologies - becomes a formidable chemical pollution problem that is costly to manage and difficult to contain.

Cement Kilns

Throughout the world some 60 cement kilns have been modified so that various wastes can be burned along with conventional fuels. But cement kilns are designed to make cement and not to dispose of waste. According to a study by the US Center for the Biology of Natural Systems, emissions of dioxins are eight times higher from cement kilns burning hazardous waste, than from those that do not burn it.

Pollution Control Devices

Pollution control technologies for different pollutants are often incompatible. So scrubbers designed to filter out particulate and heavy metals, will cool the exhaust gas to the ideal range for dioxin formation. This means that decreasing the emission of one pollutant often increases the emissions of others. And no pollution control device can eliminate dioxin or heavy metal emissions completely.

INCINERATION REMOVES THE INCENTIVE TO RECYCLE AND REUSE

Incinerators with state-of-the-art pollution control equipment are formidably expensive, but once authorities have invested in incineration they often don't have the money to invest in waste reduction. In this way, incineration directly competes with efforts to reduce and recycle waste.

Incineration actually perpetuates the use of landfills because of the large quantities of leftover ash produced by incinerators. It is estimated that for every three tons of waste that is incinerated, one ton of ash is generated. And this ash is very toxic, containing concentrated amounts of heavy metals and dioxins which, when buried, will eventually leach into the soil, potentially polluting groundwater.

Very few jobs are created in return for the huge economic investment in incineration. Most of the jobs are temporary, created during the building of the plant. A large incinerator may employ about 100 workers. On the other hand, community efforts into waste separation, reuse and repair, recycling and composting, can create more jobs, both in the handling of the waste and in secondary industries using recovered material.

Also, most of the money invested in the incinerator leaves the community. The huge engineering firms that build incinerators are seldom located within a community and so most of the money invested leaves the community. On the other hand, money invested in the low-tech alternatives stays in the community creating local jobs and stimulating other forms of community development.

Recycling saves more energy than incineration yields. For instance, if the United States burned all its municipal waste in incinerators, it would contribute less than 1% of the country's energy needs. Two studies performed in the US in 1993 and 1994 show that if the currently marketable recyclable material, which is typically burned in a modern trash incinerator, was recycled instead, some 3-5 times as much energy would be saved. The reason: Incineration can only recover some of the calorific value contained in the trash; it cannot recover any of the energy invested in extraction, processing, fabrication and chemical synthesis involved in the manufacture of the objects and materials in the waste stream. Reuse and recycling can. In fact, a wide-ranging cost-benefit study conducted for the European Commission 1997 concluded that even landfilling was better and more energy-efficient than incineration for managing household waste.

Ministry for the
Environment
Manatū Mō Te Taiao

Valuing New Zealand's Clean Green Image

The Ministry for the Environment commissioned PA Consultants to carry out this study (funded by the Contestable Research Fund of the Ministry of Research, Science and Technology) to provide an estimate of the value for New Zealand's export trade of our clean green image.

There is considerable discussion about New Zealand's clean green image, but relatively little solid information about its value. This was clear from an earlier study which the Ministry commissioned through the Sustainable Management Fund, *Green Market Signals*, published in 1999. The current study is, in part, a response to the suggestions received from industry groups and others at that time.

The aim of this current study is to quantify the extent to which particular New Zealand exports benefit from positive perceptions about our environment. The project focuses on three export sectors: dairy, inbound tourism, and organic produce. It assesses the potential consumer reaction to an illustrative decline in New Zealand's cleanness and greenness.

The empirical work done in this study reinforces the qualitative evidence that our clean green image is valuable, and provides some useful insights into the size and nature of that value. The results are of course not definitive – no contingent valuation study can ever be so – but they do strongly indicate a significant vulnerability of export value (through reduction in product quantities likely to be purchased by consumers) in the event of a (hypothetical) degradation of New Zealand's environment.

While the research's approach and findings have been robustly peer reviewed, like all empirical economic estimates, the conclusions rest on assumptions and a specific methodology. That said, the study certainly provides food for thought. Main findings are as follows:

- New Zealand's clean green image does have a value. Environmental image is a substantial driver of the value New Zealand can derive for goods and services in the international market place.
- The study suggests this image is worth at least hundreds of millions, possibly billions, of dollars – aggregating value elements from dairy, tourism, and organic produce, and extrapolating to other sectors such as meat.
- New Zealand is relatively clean and green. This is mainly attributable to our low population density resulting in relatively benign environmental pressures.
- However, there are environmental problems that are sufficient to raise questions about the sustainability of the value of New Zealand's exports attributable to its environmental image. There is a risk that New Zealand will lose value that is created by the current environmental image if we are not vigilant in dealing with the problems that could threaten the image.

If you would like to discuss this report further, please contact Dr Ralph Chapman, Manager of the Strategic Policy Group, Ministry for the Environment, at (04) 917 7444 or email him at ralph.chapman@mfe.govt.nz.

6. CONCLUSIONS

6.1 OVERVIEW

During the course of this investigation, it has become clear that New Zealand's environmental image is a key driver of the value New Zealand is able to obtain for its goods and services in the international market place.

At the qualitative level, there is evidence from previous surveys and analyses to suggest that environmental image is an important contributing factor to the behaviour of purchasers of New Zealand's exports. In addition, many of the key marketers of New Zealand product use New Zealand's image as part of their marketing strategies.

The empirical work done in the context of this study reinforced this assumption and provides some additional insights into the size and nature of the impact. Key conclusions with respect to the empirical work are outlined below:

6.1.1 Dairy sector

The analysis of the dairy sector found that Malaysian consumers purchasing New Zealand dairy products could be categorised into one of two groups. Those who would continue purchasing New Zealand dairy products under worsened environmental perceptions (i.e. New Zealand's "clean green" image is not a predominant factor in their purchasing decisions) and those who would stop buying New Zealand product under worsened perceptions.

Surveys undertaken in Kuala Lumpur indicated that the average percentage change in the amount of dairy product purchased by consumers was almost 54%. These results were used to generalise to other markets in Asia and Africa, India and Middle East (AIME) regions. We found that the approximate loss in revenue depended on how much "lost" product could be redirected to ingredients markets where environmental image plays a less important role. The loss in revenue varied from NZ$241 million (in the case where all the lost product was redirected to ingredients markets) to NZ$569 million (in the case where none of the lost product was redirected).

The approximate loss in profit depends on how much more profitable the consumer business is than its ingredients counterpart (as well as how much lost product is redirected). The worst case scenario (where the consumer business yields a profit ten times as much as the ingredients business) had a profit loss of around NZ$60 million associated with it.

The long-term profit loss would most likely be substantially less than that in the short-term. In the short-term, despite worsened environmental perceptions and a loss in volume from added value markets, the NZDB would still incur the costs of most of the existing business infrastructure, implying that a loss in revenue would have a large impact on profit. In the long-term, however, these costs will gradually decrease (as the industry adapts to a reduction in demand) yielding a less substantial loss in profit.

6.1.2 Organic produce

The valuation of the organic sector was particularly challenging. New Zealand's stance on GM and its subsequent effect on the organic sector will depend on consumer opinions in our key overseas markets coupled with the views and behaviour of relatively few individuals occupying key positions in the distribution chain. This makes the impact difficult to predict with any certainty.

Evaluating loss of profit to the organic sector under the two GM scenarios was another challenge. A small sample size, coupled with a lack of information about the cost structure of the organic fresh fruit sector made the task a difficult one. Given the difference in cost structure between organic and conventional orchards, aggregated profit figures from ENZA and Zespri annual reports provide very little insight into how much profit was attributable to organic lines.

The valuation was conducted individually for each survey response and loss in profit to the organic sector was evaluated for a variety of contrived profit margins. In the short-term the loss in profit would be considerably higher than that in the long-term, due to the high input costs associated with organic farming.

Overall, it appeared that in the short-term New Zealand's organic sector would not be affected by limited field trials going ahead. In the long-term, however, New Zealand organic producers may be replaced with alternative sources of supply. Price signals are also an important consideration, in that there may be no mitigating effect through price manipulation. A price drop may indicate that consumer interest in New Zealand organic products is waning. New Zealand already allows field trials of GMOs, but it is not clear if this was known to the survey respondents. Therefore the extent of the risk faced by organic growers is also unclear.

Under the "uncontrolled release" policy the New Zealand organic sector would almost certainly suffer immediate losses. The two survey responses (Worldwide Fruit and Organic Farmfoods) indicated that under an uncontrolled release scenario they would immediately decrease or sever supply.

6.1.3 Inbound tourism

The results from the inbound tourism survey, like those from the dairy sector survey, indicated that there were two distinct groups of tourists: those that would visit New Zealand (and stay the same number of days) irrespective of our environmental image and those that would not visit New Zealand at all under worsened perceptions.

The extent of the change in purchasing behaviour (measured here by the percentage change in length of stay) varied by country. Australians exhibited the least change at 48%), while Japanese and Korean tourists showed the highest change (at 79% and 77.5% respectively).

The loss to New Zealand from these five markets varied from NZ$938 million (loss in direct value added plus GST) to NZ$530 million (deducting the labour component from direct value added).

Change in visitor behaviour largely depends on the purpose of visit. Visitors on business were more likely to reduce their length of stay, as opposed to cancelling the trip entirely, as was the case with tourists visiting friends and family. The group, which showed the highest percentage change in length of stay, was, not surprisingly, those on vacation.

6.2 EMERGENCE OF GREEN PROTECTIONISM

The valuation methodology used in this investigation is based on the actions of consumers and retailers (under a hypothetically degraded environment), and the associated economic impacts. A second important economic dimension that should be mentioned is the emergence of "green protectionist" strategies in First World countries to limit food imports from countries such as New Zealand.[1]

McKenna and Campbell (1999)[2] noted an example regarding difficulties encountered by the New Zealand kiwifruit industry in the Italian market in 1992. Italian authorities claimed that New Zealand kiwifruit exceeded the maximum residue levels (MRLs) for certain agrichemicals. McKenna and Campbell (1999) further noted that such protectionist policies were not entirely independent of politics. The restrictions on New Zealand sales occurred at the same time as the harvest of the Italian kiwifruit crop. At the same time the New Zealand pipfruit industry also experienced difficulty satisfying sanitary and phytosanitary (SPS) criteria established for entry into the US market with lower MRLs.

In the early 1990's these moves intensified after the completion of the GATT round in 1995. SPS barriers now involve much lower MRLs, an increasing range of banned inputs and clauses enabling embargoes on goods that might cause environmental damage or compromise animal welfare. Campbell and Coombes (1999)[3] suggest that such "food barriers" have become a mechanism for protecting Japanese and EU farmers against a tide of cheap, intensively produced imports from the US.

Campbell and McKenna (1999) noted that the process for establishing legitimacy for environmental claims has proved problematic. While the principle of providing "scientific proof" was agreed upon, the practice of attaining scientific consensus was another matter entirely. An example quoted was the widespread agreement in 1999 of US science establishments that Bovine Growth Hormone (BGH) has no adverse effects, while EU scientists contended that there are potential human and animal welfare risks from using this particular input.[4]

The second example discussed by McKenna and Campbell (1999) involved the debate over the potential environmental and health risks associated with GM foods.

It was noted that it is unlikely that markets will move towards more permissive SPS regimes. Rather, it is more likely that some First World markets will become more restrictive. New Zealand fresh fruit and vegetables (FFV) exporters have identified these trends as threatening to the long term market access for conventionally produced FFV from New Zealand.

Given the emergence of such protectionist strategies any perceived change in the state of New Zealand's environment (or indeed New Zealand's stance on GM) could be capitalised upon by markets wishing to restrict New Zealand food imports.

---

1 Hugh Campbell.

2 McKenna and Campbell (1999), Strategies for "Greening" the New Zealand Pipfruit Export Industry: The Development of IFP and Organic Systems.

3 Campbell and Coombes (1999), "Green Protectionism and Organic Food Exporting from New Zealand: Crisis Experiments in the Breakdown of Fordist Trade and Agriculturalist Policies", *Rural Sociology 64(2)*.

4 US meat imports into the EU were subsequently banned.

To assess the impact on New Zealand (in particular, with regard to the GM issue) under such a scenario, it is then worthwhile considering not only the economic impacts associated directly with the actions of consumers and retailers in our key overseas markets, but also those impacts associated with potential barriers arising from green protectionism.

6.3 QUALIFICATIONS TO THE VALUATIONS

Needless to say, one has to be extremely careful in attaching undue weight to the figures generated in the course of this work, or in generalising too quickly to the value of New Zealand's environmental image generally. In particular, there are reasons for thinking that the valuation might be too high – or too low.

Some of the factors that would tend to inflate the estimates of value include:

- The respondents may be acting strategically in responding to the questionnaire, ie they may overstate their reaction in the hope that it will lead to an improved focus on the environment;
- The questionnaire itself may draw the attention of the respondent to the issue of environmental image in a way that would not happen in reality; and
- The images chosen are relatively extreme, ie they represent a clear contrast which is unlikely to eventuate in practice; it is much more likely that a gradual (rather than step) change in environmental quality would occur which may lead to a more muted reaction.

Some of the reasons for believing that the results may underestimate the true value are:

- All of the industries subjected to the valuation work are growth industries; as volumes of goods and services sold in the future increase, so will the value able to be attributed to environmental quality;
- There is evidence to suggest that not all of the value able to be extracted from New Zealand's environmental image is being exploited. For example, the bulk of the exports of the New Zealand Dairy Board are into the global ingredients market where relatively little use is made of New Zealand's environmental image;
- The evidence seems to suggest that the importance of environmental factors in purchase decisions is growing in overseas markets;[5] and
- The threat of green protectionism (mentioned above).

For these reasons, we are reluctant to push the quantitative analysis too far – for example to develop Net Present Values of New Zealand's environmental image to the industries under consideration.

While these uncertainties might have been a concern if the change in purchase behaviour observed was relatively small, the size of the impact is such that they do little to undermine the significance of the result.

5 See Chapter **Error! Reference source not found.**

6.4 RISK ASSESSMENT

The size of the contribution environmental image is making to some of our major and emerging export industries, coupled with the degradation in environmental quality in some key areas, suggests that New Zealand may stand to lose the value created by its current environmental image.

On this issue, it is important to note that the relationship between environmental quality and export value is somewhat indirect in nature. In particular, it is the environmental image that creates the value, not environmental quality *per se.*

Furthermore, environmental image and environmental quality may move independently of one another. For example, it is quite possible that the efforts of marketers could maintain an image of environmental quality in spite of a deterioration in environmental quality – particularly in the dairy sector where the consumer has no direct experience of environmental quality.[6] Similarly, it is possible that New Zealand's environmental image could deteriorate without any change in environmental quality – the concern over the misreporting of the incidence of scrapie in New Zealand in Germany in early 2001 is a good example.

Thus it is quite possible that, in the short term at least, New Zealand may be able to maintain at least some of the contribution to environmental value in the face of declining environmental quality. However, it seems unlikely that this could be sustained over the long term. In the long term, one can expect environmental image and environmental quality to track one another.

Before leaving the discussion of risk, it is perhaps also worthwhile reflecting on the chances of reversing a loss of value attributable to a loss of environmental quality. While, this matter was not explicitly addressed in this study, it seems likely that it would be difficult to restore the positive image of New Zealand's environment held by overseas consumers should this be shattered through an adverse environmental effect. If this was in fact the case, it would argue for a risk averse approach to environmental management.

6.5 EXTENDING THE RESEARCH TO FUTURE WORK

This investigation has made a first attempt at valuing New Zealand's environmental image in terms of export receipts with respect to three sectors. There are areas in which this investigation can be further extended in the future. These are discussed below.

The basis of the contingent valuation used in this research was to measure change in consumer purchasing behaviour by exposing survey subjects to "environmental" stimuli. In this case, stimuli comprised sets of idyllic and degraded environmental images, as well as alternative stances on the GM issue. In reality, however, environmental image is only one of the many drivers, which may induce a consumer to purchase New Zealand product. For example, Malaysian consumers purchasing New Zealand dairy products will be affected not only by New Zealand's "clean green" image, but also a variety of factors such as price and taste.

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[6] This is less likely to be the case in the tourism and organics sectors where, respectively, the tourists, and the international buyers, will tend to have first hand experience of New Zealand's environmental quality.

Future research in this area could include valuing these other "purchasing drivers" concurrently with environmental image.[7] This would enable us to not only value New Zealand's environmental image, but also the contribution it makes to our export receipts, relative to other drivers such as price and taste.

The contingent valuation applied in this investigation only measured change in purchasing behaviour given a perceived degradation in New Zealand's environment. The implicit assumption was that the end-consumer would purchase less, given a change for the worse in New Zealand's environment. To this end, it may also be interesting to measure the potential gains to New Zealand, given an improvement in its environmental image.[8] That is, we could test both:

- *scenarios that measure sales loss due to environmental degradation; and*
- scenarios that measure sales gains due to environmental improvement.

Given our prior beliefs about the value of New Zealand's environment, we would expect studies measuring gains to New Zealand due to environmental improvement to display an upward response (while studies measuring losses to New Zealand due to environmental degradation would display a downward response).

One aspect of "clean green" marketing strategies, which was omitted in the report was the relativity of New Zealand's "clean green" image to other "clean green" nations.[9] It is important to note that New Zealand is by no means the only country which takes advantage of such "clean green" positioning. Countries such as Australia and Canada have also adopted similar marketing strategies. An interesting question is whether (perceived) environmental degradation in New Zealand would have a more severe effect, if our "clean green" competitors were seen to retain or improve their environmental image and vice versa.

7 A conjoint analysis would enable us to determine the exact role that the various purchasing drivers play.

8 Andy Heinemann, National Research Bureau.

9 Andy Heinemann, National Research Bureau.

THE IRISH FARMERS' ASSOCIATION

Regional Office: Farm Centre, Mill Park Road, Enniscorthy, Co. Wexford.
Telephone: (054) 33090 / 33807
Fax: (054) 33807
E-mail: wexford@ifa.ie

:sident: Tom Parlon
neral Secretary: Michael Berkery

Date:

9 December 1999

Statement from Wexford Co Executive Meeting held on Monday 6th December 1999

Farmers have responsibility for their produce and are governed by a number of laws surrounding food production; emissions from an incinerator whether real or imaginary could cause food quality concerns with retailers or consumers. Therefore, Wexford IFA would urge Wexford Co Council to reject the South East Regional Authority's Waste Strategy

Yours sincerely

Peter Earle

Peter Earle
Wexford IFA Co Chairman

EMBASSY OF BELGIUM

Agricultural Department
103 Eaton Square
London SW1W 9AB

Tel : 0171/235 4414
Fax : 0171/245 9080
E-mail : agrilabellon@lanz.co.uk

FAX MESSAGE

To : Dr. Michael Prendergast

Fax : 00/353/51/425.521

Date : 1 October 1999

Number of pages : 2

Our ref : 4.14/463/avg
cc. M. Michielsen, Eerste Sekretaris, Ambabel Dublin.

Re : dioxins/incinerators/industrial pollution

Dear Dr. Prendergast,

Thank you for your fax message of 28 September 1999 which the Belgian Embassy in Dublin forwarded for my attention.

The idea that a link may exist between increased levels of dioxin in fat/meat tissue of cattle and pollution from particular types of industrial activity (cfr. incinerators) is not new. It is exactly this hypothesis which lay behind an EU-wide monitoring programme on PCBs in milk (fat) in which all Member States were requested to submit their results to the Commission.

The recent 'dioxin crisis' in Belgium has led to a significant increase in the number of dioxin analyses being carried out. High levels of PCBs were detected in a few beef samples, originating from farms that could not have been contaminated by the suspected source of the recent dioxin scare. To explain the result, reference was made to the farms' proximity to incinerators.

As you know, the E.U.Commission recently queried Member States on their experience in the light of the above hypothesis. So far, it appears that the response has been rather disappointing.

Pollution and health impacts of waste incinerators

Summary

The recent European Landfill Directive will force the UK to reduce the amount of biodegradable waste it disposes of in landfill sites. This is causing panic among waste disposal authorities, who have failed for years to address the question of what to do sustainably with our household waste. Local authorities in the UK are now stampeding towards huge incineration plants, capable of burning 200,000 tonnes of rubbish per annum, to meet the EU targets.

There are currently 15 municipal waste incinerators in the UK, of which Edmonton in North London is the biggest. 3 new ones are under construction and 30 in various stages of planning. (1) The Environment Agency, whose duty it is to regulate the plants, are still talking in terms of a hundred or more being built. (2) If this massive expansion goes ahead it will undoubtedly effect the UK's air quality. The many toxic pollutants contained in the stack gases and ashes produced by all incinerators will threaten the health and quality of life of millions of people.

Many people would like to believe that waste disappears when it is burnt. In fact the burnt waste is transformed into ashes and gas. (A large incinerator produces about 80 wheelie bins of exhaust gases from its chimneys every second). As this happens, chemical reactions lead to the formation of hundreds of new compounds, some of which are extremely toxic. The number of substances released from a waste incinerator may run into thousands. So far, scientists have identified a few hundred substances as hazardous. There are many we know nothing at all about about. Studies on these have shown they are capable of causing a wide range of health effects including cancer, respiratory illnesses and birth defects. In August last year, research found that between 1974 and 1987, children who had lived within 5km of incinerators were twice as likely to die of cancer. (3)

In a House of Lords enquiry on 14th April 1999, Environment Minister Michael Meacher said,

"Incinerator plants are the source of serious toxic pollutants: dioxins; furans; acid gases; particulates; heavy metals; and they all need to be

release into the atmosphere hundreds of kilograms of highly toxic heavy metals as well as hundreds of tonnes of acid gases and highly dangerous microscopic dust particles. This is in addition to many other pollutants that are not measured or monitored at all.

Incinerators also produce around a million tonnes of contaminated ash each year. Attempts to dispose of this material have led to increasingly dangerous and irresponsible practices. In Newcastle ash was spread on allotments and footpaths, culminating in what may turn out to be some of the worst environmental contamination seen in the UK for many years.

What happens to rubbish when it is burned?

Roughly two and a half million tons of waste are incinerated in the UK every year. Of this, a third comes out as contaminated ash and the rest goes up into the air as exhaust gases.

Exhaust gases

Each tonne of waste burnt releases around 5000 cubic metres of gases containing many pollutants. The pollutants are transported in the air and deposited in water and soil, both near and far from the incinerator. Even though the gases coming from the chimney stack often appear clean (it may sometimes appear as if nothing is coming out), they contain very fine particles of dust. Metals in the waste vaporise and become attached to the dust particles formed by incineration. Some are caught in filters and become fly ash, others are washed out in the gas cleaning unit and the rest are released into the air from the chimney stacks.

Contaminated ashes

Incinerators in the UK create almost a million tonnes of ash every year. The ashes, which are contaminated with heavy metals like lead and cadmium as well as toxic compounds like dioxins, are usually deposited in landfills leaving a toxic heritage for future generations. These pollutants can leach out posing a more immediate threat to ground water and rivers. The highest concentrations of pollutants are in residues from the pollution control devices. These residues are supposed to be sent to "special waste" landfills but it has recently emerged that the Byker incinerator in Newcastle has been routinely mixing this "fly" ash with other ashes. This toxic mixture was spread on allotments and paths in Newcastle. Highly toxic fly ash from the Edmonton incinerator has been mixed with bottom ash and used in road building in London. The practice of mixing ash with aggregate or asphalt for use in construction is increasing. It allows incinerator operators to avoid disposal costs as well as generating extra income, but even when used in 'bound applications', erosion will eventually release the heavy metals and dioxins into the environment and workers may be at risk of exposure to dioxins and metals in dust particles.

Fly ash residues from the gas cleaning filters of incinerators are classified as hazardous waste and should be disposed of in special landfills. According to the European Environment Agency "the disposal of filter dust/ fly ash from waste incineration plants is a serious problem". Filter ash contains very high concentrations of heavy metals and chlorinated organic compounds, which can cause cancer and other health problems.

Health effects of incinerators

Dioxins

The most notorious of incineration by-products are dioxins. These are long-lived organic compounds, which forms when chlorinated substances in the waste, such as PVC plastic, are burnt. While dioxin emissions to air from incinerators are thought to have decreased significantly in recent years, the amounts in ash may well have increased. Moreover official figures of dioxin emissions are unreliable and are probably significantly under estimated. (4) Point measurements are taken only twice a year, a method that is likely to miss peaks of dioxin production.

Dioxins are persistent, toxic, and accumulate in the food chain. Because they are transported for long distances on air currents they are now a global contaminant and are thought to be present in the body tissues of every human being on the planet at levels that may already be affecting our health. The most toxic of these dioxins has been shown to cause cancer and has been described as the most toxic chemical known to human society.

The intake of dioxins in the diet of people in Europe often exceeds the tolerable daily intake (TDI) set by the World Health Organisation (WHO). Intake by breast-fed infants is very high compared with the TDI. WHO experts acknowledge that subtle effects on health may already be occurring in the general population (5). At, or near the concentrations found in populations of industrialised countries, dioxins can affect the levels of certain hormones, enzymes and immune system cells.

In addition to the chlorinated dioxins, brominated dioxins are also known to be formed and emitted by municipal solid waste incinerators. These have a similar toxicity to the chlorinated dioxins but at present are entirely unregulated.

Along with dioxins, numerous organic compounds are known to be emitted from incinerators, including polychlorinated biphenyls (PCBs), chlorinated benzenes and other volatile organic compounds (VOCs). Many of these are persistent, toxic and accumulate in the food chain. Some cause similar effects to dioxins and some are known to cause cancer.

Heavy metals

Heavy metals, including lead, cadmium and mercury are also emitted. Heavy metals cannot be destroyed by incineration. Improvements in

Greenpeace, Canonbury Villas, London, N1 2PN Tel: 0171 865 8100 Fax: 0171 865 8200 Join: FREEPHONE 0800 269 065

pollution control technology mean that a large proportion of heavy metals remain in the fly ash and bottom ash and end up in landfill tips or increasingly are used as aggregate in roads and paths. One exception is mercury, which is the most volatile and difficult to control and tends to be emitted with the flue gases. Many heavy metals are persistent, toxic at low concentrations and exert a wide range of adverse impacts on health.

Particulates

Pollution control devices can do little to prevent ultra-fine particles from being released, which are the most dangerous particles for human health. Although modern incinerators emit lower overall levels of particulates (EC 1998), some modern pollution abatement equipment may actually increase the emissions of the finest, most dangerous particles. Furthermore, the new EC Directive on incineration sets no limits for fine particles. Health effects from fine particles are thought to range from premature deaths from respiratory and cardiovascular diseases to exacerbation of mild and severe asthma attacks in children and adults. Many studies have associated these impacts on health with particulate air pollution.

Inorganic acidic gases

Inorganic acidic gases such as hydrogen chloride, hydrogen fluoride, hydrogen bromide, sulphur oxides and nitrogen oxides are also formed and emitted by incinerators. Exposure to nitrogen and sulphur oxides has also been linked to adverse impacts on respiratory health.

"Waste to energy"

Incinerators are now often called "waste to energy" facilities or "combined heat and power stations". Although incinerators can use some of their heat to produce electricity it is an inefficient way of generating power. To replace the materials burnt as rubbish in an incinerator uses much more electricity than can be produced by burning it.

Building new incinerators actually works against targets to reduce and recycle our rubbish. Contracts with incinerator operators currently lock local authorities into long-term commitments to provide guaranteed amounts of waste to avoid incurring financial penalties. The option to incinerate reduces the incentive to collect, recycle and compost.

Solutions

The European Landfill Directive requires the UK to reduce landfill of organic waste by 25% by 2010 and 65% by 2020. This is not a difficult task. Several cities and regions around the world have achieved close to 70% diversion of municipal waste from landfill in time frames of 5 years or less, without using incineration.

Edmonton in Canada, (population 636,000) recycles and composts 70% of household waste. This is a recent achievement made possible by:

Separate doorstep collection of dry recyclables, and hazardous wastes from all households (recycling rate achieved 15 – 18%)
Mechanical separation and composting of the remainder

The London borough of Edmonton in the UK recycles a mere 6% and incinerates the rest.

Levels of recycling in the UK are the lowest in Europe. As the Government has recognised, waste must be separated at source at both the household and commercial level. Up to 80% could then be recycled or composted. Materials that cannot be safely recycled or composted, like PVC plastic, must be phased out and replaced with sustainable alternatives. Producer responsibility legislation, already proposed by the EU for electronic equipment and end of life vehicles, must be brought in for all goods. Longer-term, products and packaging needs to be rethought and redesigned. This will force companies to think about disposal when designing products and packaging. It could offer British industry an opportunity to be at the leading edge of green product design.

Finally the UK must draw up and implement a zero waste policy. Zero waste can be achieved by:
minimising waste creation
maximising product and packaging re-use
separate collection and recycling of dry recyclables
separation and composting of organic waste
producer responsibility for hazardous products
phase out of non-reusable, non recyclable materials

Notes

Energy from Waste Association figures (http://www.efw.org.uk)
"The number of incinerators in England and Wales may have to rise from 11 to over 100 (depending on their size; capacity may have to quadruple)" Environment 2000 and Beyond, Dec 2000.

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De Fre R. and Wevers M. (1998). Underestimation in dioxin inventories. Organohalogen Compounds 36: 17-20
World Health Organisation (1998): WHO experts re-evaluate health risks from dioxins. WHO/45 3 June 1998

For further information please contact the Greenpeace Press Office on 0207 865 8255/6/7/8 or visit **http://www.greenpeace.org.uk**

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. DIOXIN INQUISITION

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DIOXIN INQUISITION

People calling themselves "conservatives" in Congress are preparing to flay U.S. Environmental Protection Agency (EPA) scientists for their reassessment of dioxin --the agency's 4 effort to determine the true hazards of dioxin. Dioxin is a highly toxic byproduct produced in the manufacture of many pesticides, and by the routine operation of all incinerators metal smelters, and chlorine-using paper mills. In 1986, EF concluded that dioxin was one of the two or three most power poisons ever studied, and accordingly, set strict limits on certain releases into water. As the agency moved to enforce those limits in the late 1980s, industrial dioxin-producers developed a strategy for reversing EPA's stance: They would the agency to undertake a scientific reassessment of dioxin, reassessment they evidently thought they could control.

The paper industry took the lead in pressuring EPA to formal reassess dioxin. (See REHW #269, #270 and #275.) On January 1991, four chief executive officers of paper companies visit William Reilly, who was then the head of EPA. The four execu memorialized their meeting by sending Reilly a letter dated January 25th --a letter that (thanks to Greenpeace) found it into the record of a public hearing on the dioxin reassessme which EPA held in Washington, D.C. November 15, 1991. In th letter, the four executives (John A. Georges, International Paper; T. Marshall Hahn, Jr., Georgia-Pacific Corp.; Furman Moseley, Simpson Paper; and Andrew C. Sigler, Champion International) thanked Reilly for his receptiveness to their ideas during the meeting January 23: "We were also encourage what we perceived as your willingness to move expeditiously re-examine the potency of dioxin and chloroform in light of important new information that has been submitted with respe those chemicals," the paper company executives said. They rebuked EPA for "failure to act on the emerging health scien They told Reilly there is now a "prevailing view that low-le dioxin exposures do not pose a serious health threat." "Desp this new reality," they said, "EPA has taken no tangible or timely steps to revisit its health criteria for dioxin, and even failed to temper the Agency's zeal in acting on the wor risk estimates...."

As a direct result, EPA's "scientific reassessment" of dioxi born. By April, 1991, Reilly had geared up his agency for a effort to reassess the toxicity of dioxin, just as the paper industry had requested. In August, just 4 months into the multi-year study, Reilly told the NEW YORK TIMES how he expe the dioxin reassessment to turn out: "I don't want to prejuc the issue, but we are seeing new information on dioxin that suggests a lower risk assessment for dioxin should be applie Reilly told the TIMES (August 15, 1991, pg. 1).

However, the scientific reassessment did not turn out as Rei and the paper industry supposed it would. EPA scientists evidently took their mandate seriously. They designed a reassessment process that involved original laboratory resea many meetings with non-government scientists, at least 2 pub hearings, and many drafts of the 9-volume reassessment docum which was peer-reviewed prior to release. Eight of the nine volumes were written by non-governmental scientists. EPA ha never before involved such a large number of non-agency scientists in its work. It managed to solicit and include t viewpoints of industry, academia, government, and the genera public.

As a result, EPA scientists concluded a year ago that dioxin probably causes cancer in wildlife and humans, and that it h the immune system and the reproductive systems in fish, bird and mammals (including humans) at doses that are miniscule. lead scientist on the EPA reassessment team, Dr. Linda Birnb said she and her colleagues now consider dioxin an "environm hormone" capable of disrupting a large number of bodily proc in fish, birds, and mammals, including humans. Dioxin, EPA is especially powerful in its effects on the unborn and the newly-born. (See REHW #290, #390, #391, and #414.) This was hardly the outcome the paper industry had expected.

The final draft of the 9-volume reassessment document went t EPA's science advisory board (SAB) this year; at an SAB meet May 16, 1995, parts of the dioxin reassessment were criticiz Specifically, the SAB asked EPA to provide better support fc some of the conclusions in Volume 9 (conclusions which we summarized in REHW #390 and #391), but they did not tell EPA do any additional scientific work.

Using the SAB's comments on the reassessment (which have not been made public) as a political springboard, a group of so-called "conservatives" of both parties in Congress are planning to investigate "whether sound science is being dist for preconceived policy ends, and the potential economic imp of future mandates based on this reassessment."[1]

Congress has scheduled a public hearing Sept. 13 before the Subcommittee on Energy and the Environment of the Committee Science. It is widely understood in Washington that this hea is going to be a "witch hunt" aimed at punishing EPA for rea conclusions that the paper industry and other industrial poisoners don't like.

Everyone who has followed the story of tobacco during the la years knows there are a handful of scientists who still clai there is no compelling evidence that tobacco causes lung car in humans. These "tobacco scientists" have counterparts in dioxin world, and this little group of dioxin denial special will be showcased at the hearing September 13. They are exp to say that EPA and its 100-or-so independent outside scient advisers have made a mountain out of a mole hill. Congress use their testimony as an excuse to further slash EPA's rese

budget, thus exorcising the source of much recent bad news a
dioxin.

Meanwhile, the scientific evidence linking dioxin to serious reproductive disorders in mammals has continued to accumulat Just this month, Dr. Earl Gray (a respected EPA researcher) published the third in a series of studies of the effects of single low dose of dioxin on rats and hamsters. This series began with 3 studies published in 1992 by Dr. Richard E. Pet at the University of Wisconsin.[2]

In the Peterson studies, young male rats whose mothers were as little as 0.064 micrograms of dioxin per kilogram of body weight showed consistently reduced levels of male hormones, a variety of sex-related changes, including:

** smaller accessory sex organs, including smaller testicles

** slower sexual maturation;

** distinctly feminine-style regulation of one hormone relat testosterone production;

** greater willingness to assume a receptive-female posture approached by a sexually stimulated male.

Other effects revealed by the Wisconsin studies included:

** Even the lowest dose tested (0.064 micrograms of dioxin p kilogram of the mother's body weight), yielded consistent reductions in a male offspring's daily sperm production.

** The developing male reproductive system is more sensitive the effects of this hormone-like toxicant [dioxin] that any organ or organ-system studied.

** The unborn or newborn is about 100 times more sensitive t dioxin than the sexually mature animal.

What do these studies mean for humans?

The Wisconsin researchers speculated, "Thus the findings fro this study raise the possibility that TCDD could potentially affect sexually dimorphic behavior in man if exposure were t occur during fetal development." "Sexually dimorphic behavio refers to the bodily and behavioral differences between men women. Is it possible that homosexual behavior in some individuals may be conditioned by exposure to chemicals befo birth? It seems to be so in laboratory animals, in wildlife in some humans whose pregnant mothers were exposed to diethylstilbestrol (DES), a powerful hormone.[3]

Commenting in 1992 on the Peterson rat studies (which she ca "highly significant"), Linda Birnbaum of EPA said, "The real question is how general these effects are." And if these ef occur in another species? "I would get very concerned [abou potential human-health implications]," Birnbaum told Janet Raloff, a reporter for SCIENCE NEWS.[4]

In March, 1995, Birnbaum herself (with Earl Gray, William Ke and others) published studies confirming that many of Peters findings could be reproduced in another strain of rat, and i another species entirely, the Syrian hamster. The hamster i known for being insensitive to dioxin's effects, yet single dose exposures of pregnant hamsters to dioxin produced nearl 60% reduction in sperm count in male offspring, plus other important changes, such as a 23% reduction in the size of th adrenal gland.[5]

This month, Earl Gray published a third study showing that a single low dose of dioxin to pregnant rats could produce hermaphroditic FEMALE offspring. Hermaphroditic means havin male and female sex organs simultaneously.[6] Other effects included 30% reduction in the weight of the ovaries; shorter reproductive life span; and increased incidence of cystic hyperplasia of the endometrium (formation of multiple cysts the tissues lining the uterus).

There can no longer be any doubt that dioxin in very low exposures during early development in mammals can dramatical alter sexual development and behavior. The public health implications are enormous.

This Congress seems in a mood to crucify EPA scientists for reaching politically incorrect conclusions about dioxin. In earlier time (1632), a scientist like Galileo, threatened by powerful religious zealots of his day, saved himself by recanting. Will EPA scientists be forced to do the same?

--Peter Mont

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[1] Letter dated August 10, 1995, from Dana Rohrabacher to E chief Carol Browner inviting her to testify September 13, 19 before the House Energy and Environment Subcommittee of the Committee on Science.

[2] Thomas A. Mably and others, "IN UTERO and Lactational

Exposure of Male Rats to 2,3,7,8-Tetrachlorodibenzo-p-dioxir Effects on Androgenic Status." TOXICOLOGY AND APPLIED PHARMACOLOGY Vol. 114 (May, 1992), pgs. 97-107. And: Thomas Mably and others, "IN UTERO and Lactational Exposure of Male to 2,3,7,8-Tetrachlorodibenzo-p-dioxin. 2. Effects on Sexual Behavior and the Regulation of Luteinizing Hormone Secretior Adulthood." TOXICOLOGY AND APPLIED PHARMACOLOGY Vol. 114 (Ma 1992), pgs. 108-117. And: Thomas A. Mably and others, "IN UT and Lactational Exposure of Male Rats to 2,3,7,8-Tetrachlorodibenzo-p-dioxin. 3. Effects on Spermatogenesis and Reproductive Capability." TOXICOLOGY ANI APPLIED PHARMACOLOGY Vol. 114 (May, 1992), pgs. 118-126.

[3] Relevant studies are reviewed in Glen A. Fox, "Epidemiological and Pathobiological Evidence of Contaminant-Induced Alterations in Sexual Development in Free-Living Wildlife," in Theo Colborn and Coralie Clement, editors, CHEMICALLY-INDUCED ALTERATIONS IN SEXUAL AND FUNCTI DEVELOPMENT: THE WILDLIFE/HUMAN CONNECTION [Advances in Mode Environmental Toxicology Vol. XXI] (Princeton, N.J.: Prince Scientific Publishing Co., 1992), pgs. 147-158. The human evidence from DES exposures is described in the same volume Melissa Hines, "Surrounded by Estrogens? Considerations for Neurobehavioral Development in Human Beings," pgs. 261-281.

[4] J. Raloff, "Perinatal dioxin feminizes male rats," SCIEN NEWS Vol. 141 (May 30, 1992), pg. 359.

[5] L.E. Gray, Jr., and others, "Exposure to TCDD during Development Permanently Alters Reproductive Function in Male Evans Rats and Hamsters: Reduced Ejaculated and Epididymal S Numbers and Sex Accessory Gland Weights in Offspring with Nc

Androgenic Status," TOXICOLOGY AND APPLIED PHARMACOLOGY Vol. (1995), pgs. 108-118.

[6] Leon Earl Gray, Jr., and Joseph S. Ostby, "IN UTERO 2,3,7,8-Tetrachlorodibenzo-P-dioxin (TCDD) Alters Reproducti Morphology and Function in Female Rat Offspring," TOXICOLOGY APPLIED PHARMACOLOGY Vol. 133 (1995), pgs. 285-294.

Descriptor terms: dioxin; toxicity; endocrine system; endoc disrupters; congress; public hearings; conservatives; conservatism; hermaphroditism; homosexuality; sperm count; growth; rats; hamsters; humans; morbidity; epa; linda birnba earl gray; studies; janet raloff; dioxin reassessment; pulp paper industry; corruption; science; epa science advisory bc environmental hormones; fish; birds; wildlife; mammals; adre gland; testicles; feminization; masculinization; tobacco; wi kelce; endometrium; galileo;

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NOTICE

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Incineration in the context of sustainability and sustainable development.

Sustainable development is generally described as development that meets the needs of the present generation, without jeopardising the ability of future generations to meet their needs, that is, living within the carrying capacity of the Earth. Post Rio (UN Conference on Environment and Development, Rio, 1992) sustainability should be a key goal of our society. decoupled from resource depletion. This is clarified by consideration of our current system of resource use, which follows a predominately linear pattern. Resources are extracted, used to manufacture a product that is bought by a consumer and subsequently thrown away. The rapidly increasing amounts of waste generated have reached critical levels. In fact, industrial development and its associated waste products has accelerated at a rate far surpassing the adaptive capacity of natural systems and if wastes continue to be produced at current or increased volumes, then any 'management' system will eventually become overwhelmed.

On the other hand, the rapid depletion of the Earth's natural resources is endangering the supply for future generations. Global calculations show that humans are consuming over one third more than nature can reproduce. The rate for industrialised countries is even higher. The current consumption levels of the industrialised world, along with the energy required and the greenhouse gases as a result, are unsustainable.

There is an imbalance between our current development patterns and the natural capacity of the Earth's systems to adapt to the over consumption of resources and to absorb waste at its current rate of production.

Currently an inequitable distribution of the worlds resources exists, which the following UK House of Commons report highlights. '*At present 20% of the world's population use 80% of the world's resources: the other 80% - the population of the developing world – uses only 20% of these resources. Such inequity cannot continue. Traditionally it has been believed that as the less developed world developed, it would use more and more resources and that the world's supply of resources would expand to accommodate that; any shortage of raw materials would either stimulate the search for new supplies or encourage the use of alternatives. Now, we are having to face the fact that such a level of resource use would push the world way beyond what is sustainable; so that either the developing world has to be held back or the developed world has to find ways to sustain current standards of living while using far fewer resources; maybe as little as 10% of the resources we use now.*

Such a revolution in resource use, and possible reuse is the real driving force behind today's needs for the developed world to take waste minimisation and sustainable development seriously.' [1]

Traditionally, the primary focus has been on what to do with waste after it has been produced i.e. end of pipe solutions. For sustainable development, the *closing of the material loop* must be achieved, i.e. turning our present linear use of resources into a cyclical one. *To close the material loop* there needs to be an incremental reduction in the amount of virgin resources feeding into the production chain coupled with a continuous decrease in waste produced. The EU Waste Management Hierarchy, which lists waste management options in order of preference, aims to promote sustainable waste systems. According to this hierarchy prevention and minimisation of waste are the most favourable option. Anything that cannot be prevented or minimised should be reused, repaired, recycled or composted. Energy recovery and landfill are the least favourable options.

Sustainable waste-resource programs focus on the upper and middle parts of this hierarchy. Such an approach furthers the development of cyclical production and consumption patterns and thus the advancement of closed loop processes. Unlike options such as landfill or incineration, recycling and reuse result in material being returned to the production process, where it can be made into the same or similar product from which the material arose, or it can be fashioned into something entirely different. This means that for the economy as a whole there is a reduced need for primary extraction, hence resources are saved and there is a reduction in the environmental effects from the production, processing and transport of the raw material, which also results in considerable economic savings. Recovery of energy from waste may appear to have a similar effect, yet on closer examination it becomes evident that this is not the case. Recovering energy from waste by incineration can only recover the energy contained within the actual material and of course this can only be recovered once. The energy used in the extraction of resources, in transport etc. cannot be recovered. Conversely this energy can be saved by methods such as reuse and recycling.

For many substances, recycling cannot occur indefinitely (for example, due to shortening of fibers in newsprint recycling), but usually recycling can take place more than once. Therefore,

[1] UK House of Commons Environment, Transport and Regional Affairs Committee, (1998), *Report on Sustainable Waste Management.*

there is an element of circularity in the recycling process that is absent in the case of incineration with energy recovery. Also, sustainable development requires a reduction in raw material usage. Incineration effectively results in these material resources 'going up in smoke'.

Incineration as an outdated technology

Waste incinerators are not new: they were first developed in the late nineteenth century, and became the main means of disposal in some European and North American cities in the early twentieth century, until their costs rose above that of landfill. A number of countries that were unsuited for landfill (Japan, the Netherlands, Denmark, Switzerland, for example) came to burn the majority of their household waste. Others, such as some US states, looked to incineration in the late 1980s when landfill shortages were forecast. What is new is the introduction of stricter and increasingly expensive controls on the incineration process.
As a technology, incineration is about the destruction of materials and the management of the associated hazards. Pollution control constitutes a major proportion of the cost, technological capacity and space requirement of an incinerator. Therefore, the incineration process involves spending vast sums of money on the destruction of potentially valuable materials and the control of the pollutants. This contravenes the objectives of sustainability, which require recovery and conservation of materials and resources.

Many modern incineration plants recover energy from the waste materials. Many view this as an advantage of a modern incineration process. However, the energy produced is merely a by-product and mixed waste incinerators are inefficient energy producers. Also the more preferential alternatives to incineration are also more preferable in energy saving terms. For example, far more energy is actually saved by recycling materials than burning them due to the fact that significantly more energy is required to produce virgin materials than to recycle. It has been estimated that for every tonne of 'product' we buy, ten tonnes of resources have been used in the manufacturing process[2]. Reuse and recycling have a far better energy recovery record, with savings of up to 70-90% despite energy lost in transport and cleaning compared to an expected efficiency of 25% recovery from incineration[3]. This fact is reiterated by the a recent report by the European Commission, which asserts that in general recycling is preferable to incineration in energy terms[4]. This is further reiterated by the following examples,

[2] FoE UK & CRN (1998), Recycling Works, UK.
[3] Earthwatch submission to MCCK consultant group (1997) Local Authority Waste Management Policy suggestions.
[4] Review of Waste Management Strategy, European Commission, COM (96) 399, 30 July 1996.

- Recycling aluminum cans in the United States in 1996 saved enough energy to power a city the size of Philadelphia for one year.[5]
- Germany has 53 incinerators burning 14 million tonnes of waste per annum. The burning of this massive amount of waste produces 0.5% of German energy requirements. The incineration of every single atom of waste produced in Germany would provide 1.5% of all German energy requirements.[6]

Also the utilisation of this energy by-product requires capital investment. For example for home heating systems, massive capital investment would be needed to distribute the heating system.

Incineration, particularly in light of sustainability objectives, is obviously a technology that belongs to the previous industrial era. The following quote from an article recently published in The Guardian newspaper, in response to the British Government's proposal to introduce a number of new incinerators, highlights the fact that incineration is a dying industry. *"Europe is moving to phase out the building of huge incinerators just as Britain is planning a new chain across the country as part of the government's waste strategy, Ludwig Kraemer, head of the EU waste management directorate, revealed last night. In France, Belgium, Holland, Italy, Germany and Portugal no more new incinerators are being built because the public will not stand for them"* [7].

Economics of Incineration

The incineration of waste materials involves large financial costs, in terms of both capital investment and operational costs. A 420,000 tonnes incinerator now requires an investment of £125 million. A typical waste incineration contract over 25 years costs £1 billion, once recycling, composting, residual landfill and the return on investment are taken into account.[8]

External costs of incineration:

- **Ash and Residue**

  Generally speaking for every three tonnes of waste materials incinerated, one tonne of ash and other residue are created. This ash and residue has then to be treated before

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[5] The Worldwatch Institute http://www.worldwatch.org/alerts/981217.html
[6] Der Grune Punkt, (1998) Edition 3: Waste Incineration Processes in Germany.
[7] Hencke, D., (2000), The Guardian, Friday May 19.

landfilling or directly landfilled. Due to stricter environmental controls the cost of landfill is expected to increase in Ireland considerably in coming years. Also approximately 5% of the incineration residue is classified as hazardous waste and has to treated accordingly.

- **Health effects**

  A report for the European Commission suggests that for every tonne of municipal waste burnt between GBP£21 and GBP £126 worth of environmental and health damage is caused [9]

  A 400,000 tonne per annum incinerator is estimated to cause 48m ECU per year in health damages.10

  In relation to emissions of particulates, it has been estimated that the total health damages due to chronic effects of primary and secondary particulates alone, from a single 400,000 tonne/year incinerator, costs up to 48,000,000 ECU/year.11

- **Effects on the agricultural economy**

  Incineration also poses a threat to the quality of Irish agricultural produce. In 1999, 1 gramme of Dioxin caused $3 billion worth of damage to Belgium's food industry.

  According to a Seanad debate report in June 2000, Sen. JJ Walsh was quoted the following,

  "I understand that one of the major food producers in the region was contacted by overseas customers to secure a guarantee that there was no incinerator within 40 kilometers of the company"

Studies have shown that the more sustainable alternatives to incineration are also more preferential in economic terms. A number of such case studies are presented below.

1. Seattle, Washington

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[8] Murray, R. (1999), Creating Wealth from Waste, Demos, UK.

[9] ETSU (1996), Economic evaluation of the draft incineration Directive, European Commission.

[10] Economic Impact Assessment of Draft EU incineration Directive, 1999

[11] Howard, V, Department of Foetal & Infant Toxico-Pathology, University of Liverpool.

In Seattle a fast-track proposal was initiated in the mid-1980s to cite one large or several smaller incineration facilities. In response to citizen concerns about environmental impacts of incineration and the substantial expenditure of City funds required to site and construct incineration capacity, Seattle's City Council instructed the Engineering Department's Solid Waste Utility to look at how much waste reduction and recycling could be achieved if similar amounts were spent on diversion instead of incineration. **The resultant Environmental Impact Statement compared the reduction and recycling alternative to several incineration alternatives and found reduction and recycling preferable in terms of overall economic and environmental (including energy, air pollution, water pollution, mining waste and water use) impacts.**[12]

2. Halifax, Nova Scotia

In 1990 Halifax's Metropolitan Authority (a public corporation governed by elected representatives from the City of Halifax, the County of Halifax, and two smaller municipalities in Halifax County - the City of Dartmouth and the Town of Bedford) determined that "incineration would be a sound environmental choice and provide dependable waste management for the Region."[13] Upon reviewing the Metropolitan Authority's rationale, the City of Halifax became concerned about the cost and environmental impacts of incineration, and established the City of Halifax Waste Management Task Force to review waste management options. The resultant study concluded that **3Rs alternatives were cheaper than incineration, had better long-term economic and employment impacts, conserved energy, and did not entail the public health risks associated with the incineration option.** With respect to this last point it is important to note that the Task Force's study also concluded that the incineration technology proposed by the Metropolitan Authority did not represent Best Available Technology (BAT). Upgrading to BAT for controlling emissions was estimated to nearly double construction costs for the proposed facility.[14]

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[12] 10 Seattle Solid Waste Utility, Final Environmental Impact Statement - Volume 1: Programmatic Alternatives, Volume II: Recycling Potential Assessment and Waste Stream Forecast, Volume III: Seattle Waste-to- Energy Plant Alternatives, Appendix A: Waste-to-Energy Project Description, Appendix B: Air Emissions Factors, Appendix C: Air Quality/Odor/Noise, Appendix D: Health Risk Assessment, Appendix E: Recycling Potential Assessment and Waste Stream Forecast, Appendix F: Economic Analysis, and Appendix G: Ecology and Water Quality, prepared by a variety of engineering and consulting firms including Gershman, Brickner & Bratton, SCS Engineers, Resource Conservation Consultants, CCA, Fernandes Associates, and Sound Resource Management Group, July 1988.

[13] Memorandum to Chairman and Members of the Metropolitan Authority from R. Mort Jackson, Executive Director of the Metropolitan Authority, regarding Solid Waste Master Plan Recommended Solid Waste Management System, dated December 31, 1990.

[14] The City of Halifax Waste Management Task Force, Review of Waste Management System Options, prepared by Sound Resource Management Group, Inc. in association with Angus Environmental Limited, March 1992.

3. Further research in the UK suggests that a system involving a recycling scheme and landfill is preferable to incineration only or even incineration combined with a recycling scheme, in economic terms. However, given that not all costs of environmental impacts have been included these figures need to be interpreted with caution. The authors of the study suggest that including "missing" externalities is likely to show an increased benefit for recycling, but importantly they suggest that weaknesses in this type of analysis makes these decisions political in nature and that politicians should recognise that the public want increased recycling with reduced roles for landfill and incineration[15].

Reduction and recycling are preferential to incineration in economic terms, yet incineration can stifle the development of such initiatives.

Increased diversion rates, as a result of alternatives such as recycling and potential declines in quantity or heating value of disposed waste pose significant threats to the economic viability of incineration facilities. For example, the Quinte, Ontario, Blue Box 2000 diversion system has reduced annual residential waste disposal from over 900 kilograms to about 320 kg, while reducing the portion of burnables in waste disposal from 56% to 47%. At system maturity waste disposal is projected to be just 257 kg per year, and burnables are expected to comprise just 33% of this disposed waste[16]. At the same time that there are risks from insufficient waste quantities and too few burnables, there also are significant economies of scale for incineration facilities. Further, incinerator vendors profit more when building larger facilities. For these reasons incineration facilities may be sized based on relatively pessimistic projections for potential diversion levels.

Paper and paperboard, wood and plastics also comprise most of the burnable portion of solid waste. Without combustible waste materials to supply heating value, solid waste incineration requires consumption of substantial amounts of auxiliary fuel and generation of steam or electrical energy is impossible. When the combustible portion of incinerated waste declines, net operating costs escalate -- both because marketable energy, and consequently revenues, decline, and because costs for auxiliary fuel increase [17]. **Therefore incineration poses a threat to the viability of the more preferential waste management options. They are also**

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[15] Waste Watch & ECOTEC Research and Consulting Ltd., Beyond the Bin: The Economics of Solid Waste Management Options. London.

[16] Robert Argue, REIC Ltd., "3Rs Diversion Potential," presentation at Recycling Council of Ontario's Forum on Energy from Waste: Understanding the Issues, May 4, 1995.

inflexible as authorities are locked into producing enough waste materials to feed the incinerator for a protracted period. According to Ludwig Kraemer, head of the EU Waste Management Directorate, "*An incinerator needs to be fed for about 20 to 30 years and in order to be economic it needs an enormous input. For or 20 to 30 years you stifle innovation, you stifle alternatives, just in order to feed that monster which you build*".

Privately-owned incinerators typically shield themselves from risks of inadequate waste flow by requiring host communities disposing of waste at the incinerator to pay substantial fixed annual fees or to guarantee that certain quantities of waste will be delivered for disposal. Whether publicly or privately owned, incinerator capacity may prove to be too large relative to attainable diversion levels. **When this occurs, businesses and households end up paying for idle incineration disposal capacity, having feasible and cost-effective diversion programs postponed until population increases or economic growth results in additional waste generation, and/or in the worst case having existing recycling programs cancelled or curtailed[18].** Examples of such occurrences in the USA are provided below.

- Norwich, Connecticut

  All four incineration facilities developed by the Connecticut Resources Recovery Authority (CRRA) have experienced difficulty meeting committed tonnage. Waste streams were overestimated, recycling underestimated and the impact of an economic downturn not anticipated. Norwich, for example, has a mandatory recycling program and has paid annual penalties exceeding $300,000 for failing to deliver its contracted minimum waste quantity of 25,000 tons to CRRA's plant in Preston.[19]

- Springfield, Massachusetts

  The City of Springfield contracted with a privately-owned incineration plant to handle up to 58,000 tons per year at a fixed annual fee of $2,600,000. Trash disposal in the city then declined by 12,000 tons due to recycling and composting, with no reduction in the annual incineration fee. The average $100 per ton cost of these diversion programs was cheaper than the cost of garbage collection and incineration. But the diversion program reduced disposal tonnage below the 58,000 guarantee, and resulted in Springfield paying several

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[17] Morris,J., Ph.D. (1996), Competition between Recycling and Incineration, Economics Sound Resource Management, Seattle, Washington.

[18] Morris,J., Ph.D. (1996), Competition between Recycling and Incineration, Economics Sound Resource Management, Seattle, Washington

[19] Apotheker, Steve, "Waste-to-energy and recycling: Tango or tangle?", Resource Recycling, September 1994,

hundred thousand dollars to the incineration facility for waste it recycled and didn't need to have incinerated[20].

- La Crosse County, Wisconsin

  La Crosse County filed a successful lawsuit against its consultants, Black and Veatch, and Gershman, Brickner and Bratton, because the firms overestimated the capacity that would be needed at an incineration plant opened in 1988. The County only used half the facility's capacity, and had to join with other EFW facility host communities to obtain an exemption, both from Wisconsin's state law requiring adoption of volume-base garbage collection fees wherever a 25% diversion goal was not met, and from Wisconsin's disposal bans[21].

- Smithtown, New York

  To protect its EFW facility the Town of Smithtown filed a lawsuit against a local hauler, USA Recycling Inc., to prevent the firm from sorting out paper, metal and wood from commercial waste before taking the residue to the Town's incineration plant. This despite that fact that New York state has a 60% diversion goal[22].

As incineration requires potentially recyclable material to operate more effectively it poses a threat to more economically and socially preferential options. Opportunities for recyclers are particularly significant. Faced with diminishing primary resources and tighter regulation of energy use, major industrial sectors have been shifting their sources of supply from secondary to virgin materials. A typical example is paper. Over the past decade or so the paper industry has been transformed by the necessity to protect rainforests and biodiversity. Improvements in deinking technology have cut costs so that, in Germany, France and Britain, it is now 35% cheaper to produce newsprint from recycled paper than virgin pulp. The same situation is visible for other industries. Foundries for aluminium auto parts are using recycled cans. Glass factories can now use up to 90% recycled inputs and new technologies are emerging for recycling electronics and plastics. [23]

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[20] Morris,J., Ph.D. (1996), Competition between Recycling and Incineration, Economics Sound Resource Management, Seattle, Washington.

[21] Morris,J., Ph.D. (1996), Competition between Recycling and Incineration, Economics Sound Resource Management, Seattle, Washington.

[22] Morris,J., Ph.D. (1996), Competition between Recycling and Incineration, Economics Sound Resource Management, Seattle, Washington.

[23] Murray, R. (1999), Creating Wealth from Waste, Demos, UK.

However, to operate efficiently incinerators need materials which could otherwise be recycled, reused or composted. **Therefore incineration removes a valuable opportunity in social and economic terms. On an international scale, many regions are driving waste diversion from landfill of solid waste way beyond Irish targets, and are creating jobs and providing further social and economic benefits. Rather than seeing resource constraints and tighter regulation as a brake on economic growth, governments are beginning to recognise that the emerging 'secondary materials' economy and 'eco-efficiency' offer opportunities to stimulate innovation and create new sources of wealth and jobs.** For example, the province of Nova Scotia, Canada increased its solid waste diversion from landfill and incineration rate from 7% to 51% between the years 1995 to 2000. One of the goals of the solid waste-resource management strategy for the region was to maximise on the economic opportunities associated with waste materials. To date, over 3,000 jobs have been created as a direct result of the strategy.

As incineration poses a threat to the development of more sustainable, preferential methods of waste management, it also threatens the economic and social advantages of such methods. For example the benefits of recycling expand beyond the saving of energy and other resources. It can help revitalise existing industries and attract new industries to urban and rural communities. Recycling is an economic development tool as well as an environmental tool. Reuse, recycling, and waste reduction offer one of the most direct development opportunities for communities. Discarded materials are a local resource that can contribute to local revenue, job creation, business expansion, and the local economic base. For example, just sorting and processing recyclables alone sustains 5 to 10 times more jobs than landfilling or incineration[24]. A UK study has shown that attaining the national target of 30% recycling could potentially create 45,000 jobs[25].

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[24] Institute for Local Self Reliance & GRRN, GRRN Green Paper #3: Create Jobs from Discards, USA.
[25] Waste Watch (1999), Jobs from Waste, London.

SOME OBSERVATIONS on the
DRAFT WASTE MANAGEMENT PLAN for the NORTH EAST REGION (1999-2004)

by MAURICE OREILLY
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These comments are put together to support an argument that the case for a thermal treatment facility in the Draft Waste Management Plan is unfounded.

1 The impetus for the Waste Management Plan appears to come from the National Waste Policy Framework and from Ireland's obligations under EU legislation, which, no doubt, are linked. There are many good suggestions in the plan. However we strongly disagree with the conclusion that thermal treatment, energy recovery or incineration facilities - by whatever name - are necessary, much less desirable.

2 The intrinsic argument against such facilities has been made elsewhere. Here, we argue that the case for them has certainly not been made in the Draft Waste Management Plan.

3 Thermal treatment, among other possible solutions, is first admitted for consideration on the first page of the Plan Summary in the context of 'the policy trend away from landfill and towards more innovative solutions to solid waste management'.

4 Targets of the National Waste Policy Framework are summarised on the next page. These include (a) diversion of 50% of overall household waste away from landfill and (b) recycling of at least 85% of construction & demolition waste in 15 years.

5 On page iii, we note that agricultural waste at present constitutes 87.1% of all waste in the Region. Of non-agricultural waste, 20.3% is household, while 33.8% comes from construction & demolition.

6 On page iv, we are told that three scenarios were modelled by computer. We wonder how this was done. What was the objective of the modelling? What constraints were identified and how were they expressed in the model? How was the changing attitude of the public to waste management included in the model?

7 Putting aside the details of the modelling process, we are presented on the next page with the results. The first scenario, which is the only one not involving thermal treatment is rejected since it 'does not meet all of the Government's new targets'. The last of the other two is 'recommended on its ability to meet the new national targets not involving excessive costs'. This scenario 3, as it is called, offers a 12% saving on scenario 2; however, a case is not made why this reduced cost (of M£258) is itself not excessive.

8 But, what about those Government targets? Of the seven targets summarised on page ii, Table 2 allows us to assess only targets (a) and (b) mentioned above. Target (a) is violated by Scenario 1, however not one of the three scenarios satisfies target (b), relating to construction & demolition waste. How then can any of these scenarios be accepted?

9 In view of the fact that no scenario considered is expected to reach the Government's targets, it is necessary to find an alternative scenario. We recommend that efforts be put into finding a scenario which involves most of the policy issues outlined in Section 8 of the Plan Summary, but which excludes thermal treatment.

10 In Part 1 (Preface to the Waste Management Plan, pp 1-16), reference is made to four earlier reports, all by MCOS/COWI, recommending thermal treatment in the Region (pp 1-3). However it is not clear that these recommendations have been scrutinised adequately on technical, economic or environmental grounds.

11 In Part 2 (Present Position regarding Waste Management, pp 17-57), two types of option for the treatment of excess animal slurries are considered: biological and thermal (p 25). It has already been acknowledged (p 9) that the use of large quantities of animal slurry as fertiliser needs to be in accordance with a Nutrient Management Plan. Some details of other approaches to agricultural waste management (such as river Catchment Management and use of Phosphorous Measures Reports) are given. However, the analysis of Agricultural Waste Management is almost entirely qualitative with little indication of how much of the 3.5Mt (million tonnes) of agricultural waste - 87.1% of the Region's total - is actually in need of treatment.

12 Deficiencies in waste statistics are acknowledged (p 30). Nonetheless, it is foolish to propose the adoption of a plan in the absence of reliable statistics and, in particular, statistics in the agricultural sector (see also pp 62/3).

13 Thermal treatment is described in detail in the Draft Plan in the context of agricultural waste (p 26). We propose at the very least that thermal treatment be excluded from consideration until a convincing case can be made backed up by compelling statistics.

14 As far as packaging waste is concerned, the implementation of both the European Packaging Waste Directive and the Waste Management (Packaging) Regulations (p 31), complemented by the efforts of the Environmental Education Officers can reduce household waste by up to 25.6%, commercial waste by up to 50.9% and industrial waste by up to 28.6%. For the combined household and commercial sector, packaging contributes 35.7% of total waste. The (rejected) Scenario 1, above, targets recycling (of all waste in this sector) at only 38.9%. It appears possible that, with some effort, this scenario might be at least as attractive as the other scenarios involving thermal treatment.

15 At present, recycling represents a mere 1.9% of total landfill waste in the Region (pp 42-43). In a pilot project in 1998 in Kells (p 50), the recycling rate was improved to 13-17%, under the auspices of the Meath Environmental Education Officer. Learning from this project, further improvements in this rate may be possible.

16 In Part 4 (Waste Management Policy), we learn, for the first time in the document that agricultural wastes were not considered in the modelling process (p 59). Household, commercial, industrial and construction/demolition waste were included in the model. It is not entirely clear whether or not the other waste types (viz. ash/incineration residue, contaminated soil, litter/street sweepings, water treatment sludge, wastewater treatment, mining & quarrying and healthcare) were included.

17 The estimated nominal annual capacity for the proposed incinerator is 0.2-0.3Mt (p 61).

18 In spite of providing some detail on the technical aspects of thermal treatment facilities (pp 26/7), the Draft Plan has surprisingly little to say about the siting of such a facility (p 66).

19 Funding implications for each of the three scenarios are summarised in two tables: Table 9.1 (p 69) shows average annual costs, total investments and revenue (from sale of recyclable materials and energy), while Table 9.2 (p 70) shows total annual net costs. However, the basis on which these data were derived is not given.

20 In Part 5 (Implementation of Waste Management Policy over the Plan Period) we see (for the first time, p 76) that 50000-100000 tonnes of agricultural waste is expected to be incinerated per annum.

21 The Draft Plan itself - an example of the work of MCOS/COWI - is sloppy, misleading and inaccurate in many places as instanced below. It is unfortunate that a document of such importance should not be presented to a higher standard. It is perhaps easy for those without the time for careful reading, to be impressed by the maps, tables and other figures in the Draft Plan. On the other hand, it is difficult for those without detailed technical, economical and environmental knowledge to appraise the document. This difficulty is compounded by lack of clarity and attention to detail of presentation.

(a) The modelling process (p 59) - which is kept obscure in the plan - is the main quantitative tool for decision-making. The confusion of elements which were included in the model (eg household waste) with those which were excluded (eg agricultural waste) undermines the entire modelling process and, in particular, the conclusions drawn.

(b) Table 3.3, p 20, purports to give a breakdown of household waste in the Region according to waste type in urban and rural areas. The percentage of each of the ten waste types is identical for urban and rural areas. Such a coincidence is incredible.

(c) Table 5.6, p 42, on quantities of materials recovered for recycling in the Region, the totals simply do not add up. If the figures in the body of the table are correct, the overall total should be 5625 tonnes, not 23110 tonnes!

(d) The 61105 tonnes of agricultural waste not derived from animals (mentioned p 23) do not appear in Table 3.1 (p 18) nor in Table 3.5 (p 22). This omission is significant since it is equivalent to 58% of all household waste as shown in Table 3.1.

(e) Unrecycled household and commercial waste is expected to increase by 7.1% from 1998 to 2014 (Tables 1 & 2). It is not clear how this figure arises, but certainly it involves many factors (such as demographic and waste generation trends, p 54, and expected recycling rate). Its derivation should be transparent, as should that of the corresponding figures for industrial (down 31.2%) and construction/demolition (down 88.6%).

(f) Proper references are not given for the document as a whole - Appendix C is grossly inadequate.

(g) Lists are presented in arbitrary order, not alphabetic, chronological or otherwise, for example, Appendix A.

(h) Figures have been labelled or referenced carelessly, for example, Figures 2.6 and 2.8 appear to have had their captions interchanged.