Alternatives to Incineration

Municipal and hospital waste incinerators, are considered to be the largest dioxin sources in industrial countries. PVC plastic is probably the single most significant source of chlorine in these incinerators - the element necessary for dioxin generation. Incinerators that burn hazardous waste from industry are also point sources of dioxin.

Strategies to prevent the generation of these incinerable waste streams currently exist: by toxic use reduction planning within industries; by waste reduction and alternative forms of sterilisation in hospitals; and by efficient reduction, recycling and compost actions at community level for household waste.

"State of the Art" incinerators and cement kilns that burn hazardous waste can never solve our toxic waste problems. We need a Clean Production approach that substitutes safe materials and processes to stop the generation of hazardous waste in the first place.

Alternatives to Household Waste Incineration
Alternatives to Medical Waste Incineration
Alternatives to Hazardous Waste Incineration
Benefits of toxic use reduction in the US

Alternatives to Municipal Waste Incineration

Municipal and biomedical waste incinerators, are considered to be the largest dioxin sources in industrial countries, according to the US Environmental Protection Agency. Although it only accounts for approximately 0.5% of municipal waste by weight PVC provides more than 50% of available chlorine - the element essential to dioxin formation. According to the majority of studies on incineration, when all other factors are held constant, there is a direct correlation between input of PVC and output of PCDD/PCDF [dioxin]. For this reason the Danish government policy is to avoid the presence of PVC in incinerators.

"Cleaner production is as much about attitudes, approaches and management as it is about technology. This is why it is called cleaner production and not cleaner technology."

Cleaner Production in the Mediterranean Region, 1995

Even if all the PVC and chlorinated wastes were taken out of the waste stream, incineration would still be a poor solution due to high costs, loss of jobs in the recycling industry, lost profits from secondary resale and ongoing contamination from heavy metal, hydrocarbon and other air emissions,

Cost effective and eco-efficient waste management alternatives to incineration exist. Glass, metals and paper can be easily recycled and reused. Organic waste fractions can be composted at household or community level. Some plastics such as polyethylene and polypropylene can be efficiently recycled if collection and recycling systems are based within the region.

Recycling is also profitable. A ban on incinerators, legislated in 1992 in the province of Ontario, Canada, stimulated both job creation and the price of secondary materials. Within two years the recycling industry had benefited from price increases of 163% for aluminium cans, 25% for PET bottles, 350% for cardboard, 210% for fine paper, 500% for HDPE, and 350% for newspapers.

A highly successful recycling programme has been running in Curitibi, Brazil since 1989. Ten thousand families participate in the "Garbage That is Not Garbage" programme receiving two kilos of food for every four kilos of recyclable garbage collected and delivered to the mobile units. The programme was initially implemented to foster the separation of organic from inorganic garbage at source as part of the city's environmental programme. Even the admittance to the municipal open air shows requires bringing in a bag for recycling rubbish. Approximately 60 tonnes of paper are recycled every day equivalent to 1,200 trees. The goals for the future are to transform Curitiba into a centre of excellence in the areas of urban planning and transportation and demonstrate the success of good city planning in developing countries.

A study to show the feasibility of a recycling/composting plan in the island of Mallorca in the Mediterranean was prepared by Greenpeace Spain in 1995. The annual waste production of waste is 329,000 tonnes - the majority of which is:

compostable material	37.4%
paper	22.2%
plastics	11.5%
glass	10.6%
textiles	7.2%
metals	5.1%
other	6.1%

An analysis of recycling potential including composting found that 72.8% of waste reclamation was possible. The financial costs of incineration (even with energy recovery) were calculated to be 6,000 pesetas/tonne compared to 2,325 pesetas/tonne if materials were recycled. Implementation could achieve a 60% beneficial use within five years and solve the country's escalating waste problem.

A study was done by the Centre for the Biology of Natural Systems in New York, USA in 1996 to examine the costs and benefits of eliminating dioxin sources from all combustion processes in the Great Lakes region of North America. The study found that replacing all municipal waste incinerators in the region with intensive recycling programmes would result in approximately $530 million annual savings.

The consequences of closing all the 52 Great Lakes garbage incinerators and creating programs of intensive recycling capable of diverting the same tonnage of waste that is currently burned involves an increase in collection costs and an increased education cost to the municipalities. But this is balanced against the net income from processing and marketing collected recyclables, the savings from avoiding disposal costs and paying off the debt for the incinerator.

The study estimated that 6,100 jobs would be created from additional collection and processing jobs after deducting job losses at incineration closures. Further job increases of 21,000 are predicted if the additional recycled materials are used by current and new manufacturing firms within the region.

A previous 1991 study by the Worldwatch Institute calculated the number of jobs per 1 million tonnes of waste processed in New York City.

Type of waste disposal	**Number of jobs**
Landfill	40-60
Incinerators	100-290
Mixed waste composting	200-300
Recycling	400-590

Recycling is not the answer to waste reduction however. We need to reduce our use of packaging and products and advocate reusable, returnable packaging and better product design for durability and
reparability.

Alternatives to Medical Waste Incineration

In medical waste incinerators, the dominant chlorine donor is PVC plastic, which enters these facilities as packaging and in many disposal medical products. An estimated 9.4 percent of all infectious waste is PVC, and virtually all available chlorine fed to medical waste incinerators comes from PVC.

In reality there are dioxin-free means of disposing of 99.7% of the medical waste stream.

Because medical waste incinerators are major point sources of dioxins some countries have brought in more stringent regulations. This has resulted in many hospitals closing their own on-site incinerator and shipping waste to a commercial incinerator with more pollution control devices. However, this is increasingly seen as an inadequate solution. Increasingly hospitals in Austria, Germany and Denmark are reducing the amount and nature of wastes by switching to reusables which can be sterilised. Substitution of PVC products go hand in hand with programmes to prevent waste and separate for recycling.

Reasons for phasing out PVC in these hospitals: municipal incineration plants either did not accept wastes in which the chlorine content exceeded the determined percentage, or would do so only at a considerably increased price; incineration plants had to be closed due to more stringent emission regulations; and repeated complaints from the community.

Other reasons exist to substitute PVC products within hospitals. Medical objections against the use of PVC are mainly based on the migration of the plasticiser DEHP. It is soluble in fat-containing fluids such as blood and may cause diseases of the liver, skin and cardiovascular system. Animal experiments have shown a significant increase in liver tumours, when DEHP is added to the food of mice and rats. For this reason DEHP was classified as "carcinogenic in animal experiments" and for lack of adequate epidemiological studies in human beings as "possible human carcinogen" . Recent evidence points to its hormone disrupting potential.

Currently there are often increased costs for PVC alternatives (often 20-30% more expensive). However these costs must be balanced against the cost of ongoing incineration fees and dioxin emissions.

Non-PVC Hospital Products

PVC Use	**Alternatives**
Examination gloves:	PE and/or PE copolymers are recommended. Latex is of higher quality and proven barrier to viruses.
Overshoes:	clogs with leather tops in operating rooms; multiple-use rubber shoes, shoes made of cloth or overshoes made of PE for single use e.g. visitors in intensive care rooms.
Aprons:	cloth alternatives used in low contamination areas PE coated in operating rooms.
Mattress covers:	alternative plastic and rubber use only where necessary washable microfibre - e.g. "Kortex" or "Geritex" more comfortable to patient.

Wound plasters and dressings:	textile materials recommended.
Bedpans:	Stainless steel
Syringes:	PE and PP, sometimes ABS and natural rubber, Glass syringes for blood extraction
Infusion equipment, bottles, and/or bags with suspension devices, tubings, tubing clamps, stop cocks:	Non-PVC infusion equipment, eg. glass for certain uses, PP, PE, PE/PA, EVA PCCE and PSU as well as multi use suspension devices for all common infusion receptacles.
Tubing:	EVA and EVA copolymers, PCCE or PE, In other fields of application, e.g. for respiration, silicon or rubber tubings
Stop cocks:	PE, PC and PSU, often in combination of several plastics. Silicon adapters with connecting parts of PE and PP
Gastric probes:	Silicon and PP
Catheters silicon and latex drainage bottles, collecting bags:	glass, PE, PE/PP
Scalpels: (disposable with PVC handles)	Metal handles with interchangeable, sharpened blades
Breathing masks	rubber, silicon, latex
Special Case Blood Bags	supplier with prototype in USA
Packaging	Mostly PVC free now. PP Blister packs

In general, eighty five percent of the total medical waste stream in hospitals consists of the same mixture of discarded paper, plastic, glass, metal and food waste that is found in ordinary household waste. The remaining 15% is defined as infectious and these wastes must be sterilised. before disposal. A small percentage of this waste or 0.3% of the total medical waste stream, can only be incinerated, in part for cultural or aesthetic reasons, but also because it is difficult to sterilise in any other way. Thus there are dioxin-free means of disposing of 99.7% of the medical waste stream. Non hazardous waste can be recycled within a household waste recycling plan.

Alternative Disinfection

For disposing of infectious waste there are several alternative dioxin-free methods that are cost comparative

Three of these are:
Autoclaving
Microwave Disinfection

Superheated Steam Sterilisation

Autoclaving

An estimated 45% of infectious medical equipment from Western hospitals is already reused through autoclaving. This is basically steam sterilisation which encourages the reuse or recycling of medical equipment. Autoclavers are commercially available in varying sizes from desktop to industrial units.

The process involves heating bags of medical waste at between 120 and 1650C for 30 to 90 minutes in chambers into which pressurised steam is introduced. The steam penetration ensures destruction of bacteria and pathogenic micro-organisms. Waste is reduced by an estimated 75% of its volume and can either be landfilled directly or compacted further. The autoclaved infectious waste adds to the landfill burden, but the amount is usually less than 0.2% of the municipal solid waste stream. According to a recent survey of hospitals that have installed autoclaves, they are easier to operate than incinerators.

Cost Benefits of Autoclaving

A 1996 study by the Centre for the Biology of Natural Systems in New York examined the annual operating costs of hospital incinerators in the Great Lakes Region of North America and found that autoclaving was more profitable.

Total Estimated Costs of Alternative Infectious and Pathological Medical Waste Disposal Methods, for All (609) Hospitals in the Great Lakes Region

DISPOSAL METHOD (Millions of 1994 dollars)	ANNUAL OPERATING COST
Existing incinerators (uncontrolled)	9.8
Existing incinerators with mandatory upgrading	55.5
Autoclaves plus small pathological waste incinerator	23.0
Ship to commercial facility	28.0

Autoclaving is the most profitable investment unless there are no regulations at all on incineration emissions. Further assessment was made of the costs to hospitals of converting to autoclaves including paying off the debt on the original purchase of an incinerator. In this scenario conversion costs (2.9 million dollars) are still cheaper than the annual operating cost of incineration with mandatory emission upgrading (3.4 million dollars per year).

Microwave Disinfection

Microwaving is economically competitive, versatile and studies in Europe have shown virtually no emissions since the internal heating system is closed. Consequently there is no need for pollution control devices. Microwave disinfection relies on treating hospital waste with moist heat and conventional microwaves at temperatures of 940C. The equipment can be installed on or off site in stationary or mobile units. The remaining residues which have been reduced by 80% in volume can be landfilled

Superheated Steam Sterilisation

This technology comprises a heated shredder and sterilisation unit. In the shredder, organic liquids are vaporised and solids reduced to gas by superheated steam at temperatures between 500 and 700C. Medical equipment is melted into a sterile mass in under an hour. Remaining residues are cooled and dropped into a collection bin or ground in a heated shredder. The process has been shown to reduce medical waste by 50 to 80% of its original volume.

Alternatives to Hazardous Waste Incineration

It is estimated by European researchers that 70% of all current waste and emissions from industrial processes can be PREVENTED AT SOURCE by the use of technically sound and economically profitable procedures.

No country should contemplate a commercial hazardous waste incinerator without a national programme of cleaner production. Policy measures to achieve this have been well documented by UNEP, USEPA, UNIDO and others and cleaner production initiatives have achieved significant results particularly within small and medium scale industries.

Once an incinerator is built, ongoing toxic waste generation is legitimised and there is little incentive to investigate process changes within industry even if cleaner production methods are more profitable. For this reason, mandatory toxic use reduction plans should be prepared by each facility currently generating toxic waste.

BENEFITS OF TOXIC USE REDUCTION:
Massachusetts, USA

The state of Massachusetts in the United States has achieved significant reduction of hazardous waste through mandatory company planning. This legislation and training programme has become a model for pollution prevention activities around the world.

The Toxic Use Reduction Act (TURA) was passed in 1989. The goal of the legislation is to develop toxics use reduction as its primary tool for industrial pollution control while enhancing the competitive position of Massachusetts enterprises. The first goal is to reduce toxic waste generation by 50% through toxics use reduction over a ten year period (1987-1997).

Under TURA firms that use any of a list of approximately 800 chemicals in quantities that annually cross a minimum threshold must:

annually report publically on the amount of chemical used and released; pay an annual fee prepare a plan (updated every two years) on how to reduce or eliminate the use of those chemicals that is certified by a licensed Toxics Use Reduction Planner.

In 1995, 603 firms participated. Over 87% of the participating firms implemented TUR programs. Twenty of the firms eliminated 1.29 million pounds of by-product (wastes) and on average companies saved $35,000 per year.

Between 1990 and 1993 all firms cut their toxic by-product (waste) by 14.5% and plan to generate 23% less waste in 1998. Total volume of listed toxic chemicals in the state dropped by 6% within these three years. Of the 29 firms applying for awards in toxics use reduction, together they had eliminated the use of 2,870 tons of toxic chemicals, reduced 750 tons of hazardous wastes and saved $44 million per year.

Benefits of Toxic Use Reduction: New Jersey, USA

Similar to Massachusetts, the state of New Jersey in the USA has a toxic use reduction goal of 50% within five years. New Jersey mandates pollution prevention planning based on full materials tracking throughout each industry covered by the state regulation. The total net savings to companies as a result of pollution prevention techniques amounts to $105 million dollars per year.

For every dollar spent on the entire process, including Government costs, company costs for compliance and capital costs, the companies' achieved net savings of $5 to $8.

Although all companies had achieved reductions, one-quarter of those who sent in plan summaries had reduction goals of zero for all chemicals reported. The most common pollution prevention methods determined were

raw material substitution
substituting different coating materials
changing to aqueous cleaners

Chlorinated solvents were among the top three chemicals targeted for toxic use elimination by companies.

Alternatives to Other Combustion Sources of Dioxin

Cement Kilns

Increasingly cement kilns are burning hazardous waste as fuel thereby generating dioxins in air emissions and ash. Cement products are now contaminated with heavy metals and dioxins.

A phase out of incinerable waste streams is possible via toxics use reduction legislation. The economic costs of converting these cement kilns back to fuel has been done by the Centre for the Biology of Natural Systems in 1996. The study found that the added expected income from burning hazardous waste in cement kilns is likely to be less than the model estimates due to a declining market share. This would enable kilns to resume former fuel burning of coal, coke, oil or natural gas, as currently practised by three quarters of the kilns in the region. However instead of receiving a tip fee (which in 1993 amounted to $68 million), the 9 cement kilns in the region would then pay for the normal fuel (about $9 million per year) amounting to an increase of approximately $77 million. At the same time, the transition results in a payroll saving since additional employees that handle the hazardous material are no longer needed. Furthermore the kiln could avoid the operational costs of installing control devices and more importantly would not generate dioxin-contaminated emissions and wastes.

Source documents for the information in this section, include:

DIOXINS IN THE MEDITERRANEAN. Greenpeace, October 1996.