

An Action Plan for Reducing Discharges of Dioxin to Air

The setting of a national environmental standard as proposed in this action plan would require technical amendments to the Resource Management Act 1991 to apply this standard.

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<http://www.dioxinplan.mfe.govt.nz>



Foreword

This dioxin action plan builds on the extensive work the Ministry has done through the Organochlorines Programme over the past six years and proposes a number of important actions that will reduce dioxin in our environment.

The dioxin action plan involves everybody. Almost as much dioxin is discharged to air from everyday activities (like burning waste in a backyard fire) as from industry. For some of us, reducing dioxin emissions will involve changing the habits of a lifetime and that is never easy. But this is our chance to make a difference and I invite you to look at the proposals and have your say.

In asking the Ministry for the Environment to develop ways to reduce dioxin in our environment, this Government aims to protect the health of all New Zealanders. We are fortunate that dioxin levels in New Zealand are relatively low, but this is not something we can be complacent about. The actions we take now will reduce dioxin exposures for our children and our children's children.

The plan proposes to reduce dioxin discharges to air through a National Environmental Standard (NES) that will:

- set dioxin discharge limits on waste incinerators, and
- ban landfill fires and the burning of household wastes.

This is the first NES regulation to be proposed under the Resource Management Act 1991.

New Zealand is part of the global initiative of the Stockholm persistent organic pollutants (POPs) Convention to reduce people's exposure to dioxin. The actions recommended in this plan will enable us to keep pace with our international partners under this Convention in reducing dioxin levels worldwide.

You can look at the plan and other information, as well as make a submission, on the Ministry's dioxin action plan website – <http://www.dioxinplan.mfe.govt.nz>. I invite you to take the time to have your say.

To protect our environment and our future, let's take action now.



Hon Marian L Hobbs
MINISTER FOR THE ENVIRONMENT

Feedback

The Ministry for the Environment seeks your comment on this dioxin action plan proposal. Your input will help Government make decisions on dioxin policy.

We encourage you to make an electronic submission by visiting the Ministry's dioxin action plan website – <http://www.dioxinplan.mfe.govt.nz> - and following the instructions.

Alternatively, submissions can be mailed to: Dioxin Plan, Ministry for the Environment, PO Box 10-362, Wellington, or faxed to: (04) 917 7528,

Closing date for comments is 31 January 2002.

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Following receipt of submissions, the Ministry for the Environment will revise the NES proposal and prepare a report to the Minister for the Environment. The report will:

- (i) summarise the public comments made on the action plan and NES proposal
- (ii) make a government recommendation on the NES regulation.

The report will be publicly notified.

The action plan is intended for consultation. The details of the plan as proposed in this document may change as a result of consultation, Cabinet decisions, and the consideration of funding priorities.

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Executive Summary

1 Introduction

Dioxin belongs to a class of environmental pollutants known as organochlorines. Persistent organochlorines are toxic, do not readily break down in the environment, and accumulate in human and animal tissue. The Government's goal is to protect human health and the environment from risks posed by dioxin. Work being done on dioxin by the Ministry for the Environment is focused on four areas: discharges to air, deposition on to land and into landfills, soil concentrations appropriate for different land uses, and direct entry into food manufacturing processes.

The current proposal is an action plan for reducing dioxin discharges to air. There are good reasons for choosing discharges to air as the first priority, not the least of which is that this is probably the most important pathway of human exposure for the general population. Further action plans aimed at reducing people's exposure to other sources will be developed and reported on separately.

2 Taking action on dioxin

Action has been taken by many developed countries to reduce releases of, and exposure to, dioxin. The United Nations has developed a global convention (the Stockholm Convention) on persistent organic pollutants, including dioxin. New Zealand is a signatory, and the development of a dioxin action plan is required under the convention. The current document will address some, but not all, of New Zealand's obligations under the Stockholm Convention, and other work will be forthcoming.

This action plan for air discharges should be designed at a national level, but must be implemented at a regional level because of the requirements of the Resource Management Act 1991. Much of what is proposed is consistent with regional council air plans.

Because the sources of dioxin discharges to air are so diverse, the action plan is likely to include different kinds of policy instruments. The components of the dioxin action plan must be both effective and efficient.

3 Why we should take action on dioxin

Animal studies show that dioxin is extremely toxic. Although less is known about its impact on human health, it is widely assumed that dioxin has the potential to cause neurobehavioural, developmental, reproductive and immunotoxic effects, and cancer.

Although the current dioxin intake of New Zealanders is relatively low compared with other industrialised countries, and is falling, it is close to the World Health Organization's tolerable daily intake. A major portion of the dioxin that enters the body of the typical New Zealander originates as a discharge to air and is eventually ingested in meat and dairy products.

New Zealand should take action to safeguard the quality of its foods, both to protect the health of its people and avoid any potential for damage to the economy. Increasingly our clean green image is used for promoting New Zealand and biologically based products in export markets.

4 Sources of discharges of dioxin to air

There are many different sources of dioxin discharges to air, but four categories can be distinguished: waste combustion, fuel combustion, metallurgical production and processing, and other sources such as accidental fires. Recommended actions to reduce dioxin emissions to air have been made on a source-by-source basis by applying a set of decision criteria.

5 Actions for waste disposal sources

Waste disposal sources of dioxin discharges are clearly the highest priority for action. Table 1 contains a summary of the recommended actions.

The single largest source of dioxin discharges to air is landfill fires. If this source is not minimised, the case for controlling any other source is weak. A ban on dioxin discharges to air from landfill fires through a national environmental standard (NES) is recommended. If the recommended ban can reduce the incidence of landfill fires – both intentional and accidental – by 90%, then *total current discharges of dioxin to air would fall by about 35%*.

The second largest source is the burning of waste in ‘44-gallon drums’ or in backyard fires. An NES that bans the discharges of dioxin to air from the domestic burning of waste (excluding vegetation, untreated wood, paper and cardboard) is recommended, although its effectiveness would be less than the landfill fire ban. If the amount of dioxin-creating waste burned in this uncontrolled manner were halved, then *total current discharges of dioxin to air would fall by at least 5%*. The ban should extend to waste burned on farms, including agrichemical wastes.

An NES setting an upper limit on discharges of dioxin to air is recommended for waste incineration. The proposed upper limit on the concentration of dioxin in exhaust gases is 0.1 ng TEQ/Sm³, and is the same as the European Commission directive on waste incineration.¹

Although there are as yet no municipal waste incinerators in New Zealand, there is potential for this technology to become established. Just one large poorly performing municipal incinerator could double the total amount of dioxin currently discharged to air from all existing sources. Establishing a limit on dioxin discharges now is seen as taking a preventive and precautionary approach. The existence of an NES governing dioxin discharges would also assist the resource consent process, and will save costs to developers and regional councils required to process such a consent.

The NES would also apply to the co-incineration of municipal waste, as well as to the incineration of medical waste, hazardous waste and sewage sludge. If applied to all existing incinerators that burn waste, it will virtually eliminate dioxin discharges from these sources. *Total current discharges of dioxin to air would fall by at least 6%*. A draft of the proposed NES is given in this action plan.

¹ ng TEQ/Sm³ = nanograms of dioxin toxic equivalents per reference-standardised cubic metre of gas.

Table 1: Summary of recommended actions on sources of dioxin

Source	Current size (% of total)	Recommended actions
Waste combustion	56	
Landfill fires	39	NES banning dioxin discharges to air from landfill fires. Develop educational material
Domestic waste burning	11	NES banning dioxin discharges to air from the outdoor burning of certain wastes, including agricultural wastes. Develop educational material
Municipal waste incineration	0*	NES setting a dioxin limit on discharges from waste incinerators (including co-incinerators)
Medical waste incineration	6	NES setting a limit on dioxin discharges
Hazardous waste incineration	< 0.1	NES setting a limit on dioxin discharges
Sewage sludge incineration	< 0.1	NES setting a limit on dioxin discharges
Fuel combustion	31	
Industrial fuel combustion		
• coal and virgin wood	10	No action required
• contaminated wood	3	Monitor burning of contaminated wood
• gas and used oil	< 0.1	No action required
Domestic fuel combustion	16	Educate on environmental benefits of enclosed solid fuel burners, and energy efficiency improvements
Vehicle fuel combustion	2	No dioxin-specific action required
Metallurgical production	5	
Iron and steel manufacture	0.4	No national action required
Non-ferrous metals processing	5	NES banning dioxin discharges to air from the burning of insulated copper wire Monitor foundries
Other sources	8	
Crematoria	0.7	Best practice note on operating conditions, including reducing entry of plastics in the furnace
Accidental fires	7	Monitor international changes in use of chlorinated plastic in buildings
Minor miscellaneous sources	< 0.2	Do nothing

* There are no municipal waste incinerators in New Zealand, therefore the size of this source is assigned as 0%. However, some waste is thought to be co-incinerated in smaller boilers on an *ad hoc* basis. The extent of this practice is unknown.

6 Actions for sources other than waste disposal

Options for reducing dioxin discharges from sources *not* involving the combustion of waste are more limited. In some instances, changes taking place for other reasons are reducing dioxin discharges as a side-benefit.

The two largest non-waste disposal sources are fuel combustion in industry and in homes. Because the concentration of dioxin in exhaust gases from burning fuel is generally low, control technology is much less cost-effective than it is when waste is burned. The trend from open

fires to enclosed solid fuel burners should increasingly reduce dioxin from domestic fuel combustion.

The focus for action should be on industrial burning of ‘contaminated’ wood. There is some evidence that dioxin discharges from the combustion of contaminated wood are much greater than dioxin discharges from the combustion of virgin wood and virgin wood waste.

Recommendations for dioxin sources other than waste disposal are as follows.

- Relatively little national data exists about the extent of the practice of burning contaminated wood in industry, and action to gather information should be undertaken.
- No action is required for discharges from vehicle fuel combustion. Technological change and initiatives in the Vehicle Fleet Emissions Control Strategy will result in this source continuing to decline.
- Dioxin discharges from iron and steel manufacture are already well controlled, and no national action is required.
- Monitoring is recommended for non-ferrous foundries, with one exception. The practice of burning insulated copper wire in order to reclaim the copper is unacceptable, and an NES that bans the discharge of dioxin to air from this practice is recommended.
- Crematoria account for less than 1% of all dioxin discharges to air, and this is likely to decline as modern crematoria replace the existing older-style units. Educational initiatives are appropriate for this source.
- Accidental fires are a significant source of dioxin discharges, which can be reduced if chlorinated materials are not used in buildings. The monitoring of international initiatives in this area is recommended. Fire prevention programmes can also help to reduce dioxin discharges in the future.
- No national action is required for minor miscellaneous sources such as cigarette smoking.

7 Application of actions

Implementation and enforcement costs of an NES will fall primarily with regional councils. For some sources, for example outdoor burning, the cost will vary with the level of enforcement chosen by local authorities. In cases where actions within this plan are complementary to activities set out in regional air plans, there will be no additional costs to councils. Educational material will be required for some of the actions, which will be prepared by the Ministry for the Environment in liaison with local authorities and the industry sectors.

Compliance costs to industry will include technology costs if plant upgrades or process modifications are required, initial costs of dealing with new regulations, and the annual cost of monitoring discharges.

For discharges that are prohibited by the NES or for new sources required to meet an upper discharge limit, these sources must comply with the NES from the date the standard comes into force. The NES will not apply retrospectively to existing resource consents, but regional councils may review consents when the NES comes into force. In such cases, transitional provisions will be determined on a case-by-case basis. An NES will override regional air plans.

Two industrial sources of dioxin are particularly uncertain, and require the collection of additional information. This data could be either volunteered by the industry or industry could be required to report it.

1 Introduction

This paper presents a national action plan for *reducing discharges of dioxin to air*.

‘Dioxin’ is used as shorthand for a family of 210 chemical compounds that belong to a class of environmental pollutants known as *organochlorines*. Organochlorines are toxic, do not break down in the environment, and accumulate in human and animal tissue. In New Zealand, residues of persistent organochlorines can be found in our environment, in food and in people. This environmental health problem is being addressed at a national level in New Zealand through the Organochlorines Programme in the Ministry for the Environment.

1.1 Dioxin in New Zealand’s organochlorines programme

New Zealand’s Organochlorines Programme was begun by the Ministry for the Environment in 1995. The focus of the programme is on:

- dioxin²
- polychlorinated biphenyls (PCBs)
- persistent organochlorine pesticides.³

In New Zealand the use of PCBs and persistent organochlorine pesticides has largely ceased, so the main task is to collect the existing stocks within the community and to clean up or secure reservoirs of these pollutants.⁴ This will require actions that are likely to include the development of environmental guidelines, and the formal banning of the use of these specific organochlorine pesticides under the Hazardous Substances and New Organisms Act 1996.

‘Old’ dioxin is also stored in reservoirs, but in contrast with PCBs and organochlorine pesticides, ‘new’ dioxin flows from many sources into the New Zealand environment. Of all these persistent organochlorines, action on dioxin is seen as the highest priority.

² Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), referred to collectively as ‘dioxin’.

³ Aldrin, dieldrin, chlordane, DDT, lindane, hexachlorobenzene and heptachlor.

⁴ Reservoirs of organochlorines are places or materials that contain these chemicals. They include contaminated sites, waste dumps and landfills.

Flows and reservoirs of dioxin

Flows of new dioxin

Dioxin is still being created and released for the first time into the environment. This new dioxin is created as an unwanted byproduct of industrial and domestic activities and is discharged primarily to air and land. Much smaller amounts are discharged to water. 'Flows' of dioxin also occur when reservoirs are breached.

Reservoirs of old dioxin

Some reservoirs of dioxin, such as those left behind from the use of the pesticide 2,4,5-T and from the combustion of wastes, are dispersed widely throughout the environment. Other reservoirs, such as sawmill and timber treatment sites where pentachlorophenol was used, are relatively localised and more concentrated.

An inventory has been made of the flows and reservoirs of dioxin in New Zealand. How dangerous a particular flow or reservoir of dioxin is depends on how likely it is to travel along a pathway that ends in human or animal body tissue.

Summary of the New Zealand science on dioxin

The Organochlorines Programme has undertaken national surveys to identify the sources of dioxin in New Zealand, and to measure the levels in our atmosphere, in our terrestrial and aquatic ecosystems, and in our foods and the bodies of New Zealanders. The overall findings of this work are as follows.

- 1 There is a broad range of dioxin sources in New Zealand. The burning of wastes, wood and coal, and metallurgical processes are the major sources of discharges to air. Compared to inventories from northern hemisphere countries, New Zealand's discharges are low, consistent with our comparatively limited industrial base and low population density.
- 2 The background levels of dioxin in our environment are generally low relative to other countries. With the possible exception of coastal marine mammals such as Hector's dolphin, there is minimal risk to wildlife from background exposures to dioxin.
- 3 Very low levels of dioxin were measured in retail foods, indicating that the current level of exposure for the population is low relative to other countries. Nevertheless, because dioxin is stored in people's bodies and only slowly eliminated, and because higher levels of exposure have occurred in the past, the levels of dioxin present in New Zealanders are, on average, half those measured in populations from Europe and North America.
- 4 Although dioxin levels are believed to have fallen in New Zealand over the last decade, and despite the fact that our environmental levels and dietary intakes are low relative to other countries, the margin of safety to protect New Zealanders' health is judged to be small.

The technical reports on these studies are listed in Appendix 1, and are available from: www.mfe.govt.nz/issues/waste/organo/ocreports.

1.2 Objectives for action on dioxin

The *objectives* of New Zealand's action on dioxin are to:

- i) protect the health of New Zealanders by reducing their exposure to dioxin
- ii) protect future generations of New Zealanders by reducing the creation of dioxin and its release into the environment
- iii) safeguard the quality of our foods, especially meat and dairy products
- iv) prevent the accumulation of dioxin in our environment and, where possible, reduce its concentration in reservoirs
- v) strengthen and protect New Zealand's clean green image.

These objectives can be achieved by developing action plans focused on four areas:

- discharge to air
- discharge on to land and into landfills
- soil concentrations appropriate for different land uses
- direct entry into food manufacturing processes.

No action on releases of dioxin to water is planned at this time. Current discharges from high-profile sources, such as bleached pulp and paper mill effluent, are only a very small source of dioxin. The major source of discharges to water is wastewater treatment, and this source is expected to decrease due to current industry improvements in treatment processes. However, reducing dioxin in wastewater can lead to increased levels in sewage sludge, and since sewage sludge is increasingly being applied to food-producing land, this must be addressed in an action plan.⁵

The first stage of New Zealand's initiatives is an action plan that deals with the discharge of dioxin to air.

1.3 Dioxin discharge to air is a priority

There are good reasons for choosing the discharges of dioxin to air as the first priority for action.

- The sources of dioxin discharges to air and the pathways of population exposures are relatively well understood.
- Most of the dioxin stored in body tissue of the average New Zealander has originated from processes that discharged this dioxin to air.
- Most dioxin discharged to air is newly created. Because dioxin persists in the environment, reducing dioxin discharges to air will diminish the amount of dioxin that ends up being stored in the environment.

⁵ Other contaminants are present in sewage sludge, including the persistent organochlorine pesticides, PCBs and metals, so any action would have additional environmental benefits.

- Analysis has shown that certain discharges of dioxin to air can be reduced substantially at relatively little cost.
- New Zealand would be following other countries, where the primary focus has been on reducing dioxin discharges to air from industrial sources. For example, Europe and North America have already set compulsory limits on discharges of dioxin to air from waste incinerators.
- Dioxin discharges to air result in contamination of meats and dairy products. In Europe there is a high level of concern about food safety as a result of recent food contamination problems, several of which have involved dioxin. It is therefore economically prudent to minimise the discharge of dioxin to air to protect New Zealand's export markets.
- Dioxin control technologies may also reduce other pollutants such as airborne particulates.
- PCBs may sometimes be discharged from the same industrial processes as dioxin, but because the pathways by which dioxin and PCBs are formed in these processes are similar, control of dioxin will also control these PCBs.

1.4 Aim of this action plan

This paper is concerned with the unwanted creation of dioxin and its release to air. The aim of this action plan is to:

- i) find efficient and effective ways of reducing the discharge of dioxin to air from point and non-point sources
- ii) identify sources where:
 - dioxin reduction initiatives can be established immediately
 - the gathering of additional information is warranted before initiatives can be proposed
 - no action is justified solely for controlling dioxin discharges
- iii) contribute to fulfilling New Zealand's future obligations under the Stockholm Convention on persistent organic pollutants.

2 Taking Action on Dioxin

2.1 An international commitment

International concern about organochlorines has increased steadily since the early 1970s. Most developed countries have taken a variety of initiatives to deal with environmental problems caused by these chemicals.

In 1997 the United Nations Environment Programme (UNEP) began work on developing an international legally binding instrument on certain persistent organic pollutants (POPs), including dioxin. An intergovernmental negotiating committee has drawn up a convention, the Stockholm Convention, which New Zealand signed in May 2001. This convention requires that each signatory develop an action plan for dioxin. The action plan is to contain both techniques and environmental practices that are the ‘best available’.

‘Best’ is defined as *“most effective in achieving a high general level of protection of the environment as a whole”*.

‘Available’ is defined as meaning *“those techniques that are accessible to the operator and that are developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages”*.

The recommendations made in Sections 5 and 6 of this action plan provide a basis for a major part of New Zealand’s dioxin action plan, in the form of a set of initiatives consistent with the Stockholm Convention that will reduce discharges of dioxin to air.⁶ The action plan will not meet all of New Zealand’s obligations under the Stockholm Convention, and other actions will be forthcoming.

⁶ The technical reports that provide the basis for these recommendations are listed in Appendix 1.

Stockholm Convention on POPs

The Stockholm Convention requires signatory countries “to reduce total releases derived from anthropogenic sources ... with the goal of their continuing minimisation and, where feasible, ultimate elimination” by developing an Action Plan within two years of entry into force which identifies and addresses releases through:

- 1 evaluating current and projected releases
- 2 evaluating the efficacy of law/policies
- 3 developing strategies to reduce releases
- 4 promoting, educating, and training
- 5 reviewing strategies every five years
- 6 scheduling implementation of the Plan
- 7 promoting available, feasible, practical measures to achieve a realistic and meaningful level of release reduction or source elimination
- 8 promoting substitution/change in materials, products, processes
- 9 requiring the use of ‘best available techniques’
- 10 promoting ‘best available techniques’ and ‘best environmental practices’.

The current action plan specifically addresses, or contributes to, all of New Zealand’s obligations as outlined above in respect of discharges to air.

The text of the Stockholm Convention, as it relates to action on dioxin, is reproduced in Appendix 2.

2.2 Dioxin policy at a national level

Dioxin control policies, including regulation, may be set *nationally* by central government or *regionally* by local authorities. The Ministry for the Environment believes that policy instruments for controlling dioxin should be adopted at a *national* level for the following reasons.

- *Movement of dioxin across regional boundaries:* The pathways by which dioxin finds its way into human tissue cross regional boundaries. People can be exposed by drinking milk and eating meat from distant farms where dioxin discharged to air has been deposited on to pasture.
- *The effect on trade and tourism:* Our agricultural exports are labelled ‘from New Zealand’ and their quality reflects on the entire country. New Zealand’s relatively clean environment has economic value, which we must protect.⁷ Our clean green image is a national image.
- *Action on an international stage:* New Zealand’s commitment to the Stockholm Convention means that leadership needs to be shown at a central government level to ensure the country is well prepared and able to meet its international obligations on POPs.
- *The costs of policy-making:* The control of dioxin is a complex matter, and the costs of evaluation and decision-making are high. One national policy-making exercise is much cheaper than many regional policy-making exercises. As well as improved efficiency, consistency nationally will result in overall improved results.

⁷ A loss in revenue from selected markets of up to \$569 million for the dairy sector and \$938 million for the inbound tourism sector has been estimated if New Zealand’s environment was seen to be degraded; *Valuing New Zealand’s Clean Green Image*, Ministry for the Environment, Wellington, August 2001.

Although it makes sense to design dioxin policy at a national level, the dioxin action plan must then be implemented by regional councils, because these agencies are responsible for controlling discharges to air under Section 30 of the Resource Management Act 1991 (RMA). In particular, councils will be responsible for monitoring and enforcing any regulatory initiatives of the action plan.

Many regional councils have already taken steps to improve air quality and environmental management practices through regional air plans. For the most part, these plans will have a beneficial effect in reducing dioxin discharges. It is desirable that the steps proposed in this action plan are not inconsistent with regional air plans.

2.3 Choosing appropriate actions

Because the sources of dioxin discharges to air are diverse, a dioxin action plan will contain different kinds of control measures or policy instruments. Six generic types of policy instruments are potentially relevant.

Types of Policy Instruments

Do nothing: The value from reducing dioxin discharges from a source may not be worth the cost.

Monitoring and analysis: For some sources of dioxin, the best option might be to defer policy design until further information has been collected.

Encourage voluntary abatement: Voluntary reduction of dioxin discharges may occur in response to the provision of information.

Set upper limits: For point sources of dioxin, such limits would be 'end-of-pipe' concentration or mass limits. For diffuse discharge sources, such limits would be set on ambient concentrations of dioxin in air.

Ban certain activities: Discharges of dioxin from an activity that cannot be controlled could be banned. In effect this is a ban on the activity.

Economic instruments: Theoretically, pollution taxes or tradable pollution permits could be used to control dioxin discharges.

Some general comments on the advantages and disadvantages of the different types of policy instruments for reducing dioxin discharges to air can be made.

Do nothing

This choice should be made if the source is collectively small, or it is expected that dioxin discharges from the source are declining steadily from changes taking place for other reasons.

Monitoring and analysis

There is great uncertainty about the amount of dioxin being discharged from some sources. Information may be gathered through mandatory reporting as well as through publicly funded research. If a source is potentially large, though little is known about it, then information collection may be the best choice.

Encourage voluntary abatement

Voluntary abatement may be especially effective for sources where dioxin discharges can be reduced at relatively low cost. Greater progress may be achieved by the use of ‘carrots’ such as green awards and ‘sticks’ such as the threat of regulation. Guidelines and targets have preceded dioxin regulation in some countries, and have the cost-saving advantage of not attracting legal challenges. However, encouraging voluntary abatement for sources that are regulated in other countries will not send a strong clean green message, and may not be protective of New Zealand’s economic interests.⁸

Set upper limits on discharges

Compulsory upper limits on end-of-pipe discharges of dioxin from major point sources could be set in the form of a National Environmental Standard (NES) under the RMA. Other OECD countries have taken this regulatory approach, with waste incineration as the first priority. An advantage is that such a standard would bring New Zealand into line with our trading markets, and send an unequivocal clean green message offshore.

It is difficult to see how a compulsory upper limit on the concentration of dioxin in ambient air could be enforced. Elsewhere, such limits have been set as guidelines.

Ban certain activities

The RMA controls the discharges from an activity, rather than the activity itself. As such, activities cannot be banned. But if the dioxin discharges from an activity cannot be controlled and other activities can be substituted, it is possible – and may be appropriate – to ban the discharge from the activity altogether. An example is a ban on discharges from landfill fires. In practical terms, this amounts to a ban on the activity.

Economic instruments

In theory, economic instruments automatically generate efficient outcomes. For instance, tradable permits for discharging dioxin would lead those for whom dioxin control is expensive buying permits from those for whom dioxin control is cheap. However, neither a pollution tax nor a tradable permit system is practicable for controlling a ‘trace’ pollutant like dioxin.

⁸ It is important, however, that the intent of regulatory intervention is for dioxin reduction, rather than simply to keep up with the quantum of international regulation.

2.4 An effective and efficient action plan

Section 32 of the RMA requires that the policy instruments chosen to reduce dioxin discharges to air be both *effective* and *efficient*. For some sources, this may mean no action at all; for others it may mean the encouragement of behaviour change through education, and for others it may mean regulation of some kind.

An action plan for reducing discharges of dioxin to air will be:

- *effective* if the objective of a significant reduction in the creation of dioxin is achieved
- *efficient* if the objective is achieved at least cost.

Assessing effectiveness

For dioxin reduction to be effective, it must be technically feasible. Which is to say, no policy instrument can be effective unless technical options for reducing dioxin discharges exist. These options may be pollution control equipment, or substitute process technologies that can replace the dioxin-discharging technologies. Checking technical feasibility is particularly important when regulation is the chosen policy instrument. Note, however, that regulation should not prescribe technical solutions.

Effectiveness can be undermined by human behaviour. For example, control technology may be installed, but operated incorrectly. Thus, monitoring will be an important component of a dioxin action plan.

The degree of confidence that the predicted effectiveness of a dioxin policy instrument will actually be realised is also important. If information about a source of discharges is poor, then predictions of reductions in dioxin from that source will be very uncertain.

Assessing efficiency

The most *efficient* dioxin action plan will be the one in which the benefits exceed the costs by the greatest amount. If the policy instruments to be used are not economic, some other way must be found of building in efficiency. For instance, choices about details such as allowable limits and sources covered by a standard can be made to lead to efficient outcomes.

Cost-effectiveness analysis has been used to assess a variety of technical options for reducing dioxin discharges from some major sources. The cost-effectiveness of a technical option for dioxin control is expressed as a ratio of cost to effectiveness. These ratios are measured in units of dollars per milligram of dioxin reduced. The lower the ratio, the cheaper it is to reduce dioxin discharges by one milligram, and the more cost-effective the technical option is.

3 Why We Should Take Action on Dioxin

3.1 Health effects

In the last 30 years dioxin has been widely studied. Despite this, there is still much we do not know about its effects on human health. However, animal studies show that dioxin is an extremely toxic chemical capable of causing a wide range of effects. It is generally assumed that dioxin has the potential to cause these effects in people.

Effects on animals

Dioxin is a very potent animal carcinogen that can cause a wide range of cancers. Other adverse effects seen in animals include neurobehavioural, development, reproductive and immunotoxic effects.

Characteristic signs of lethal exposure to dioxin are severe weight loss and atrophy of the thymus gland. Non-lethal doses can lead to weight loss, and biochemical and degenerative changes in the liver. Reproductive damage includes decreases in fertility, changes in sex hormone levels, reduced sperm production and increased rates of miscarriage. Birth defects include cleft palate and kidney damage.

Effects on humans

Scientific understanding of the human health effects of dioxin is incomplete, especially for effects other than cancer. *Direct* evidence of adverse effects in humans is limited. Some effects have been observed in people exposed to relatively high levels of dioxin, the most obvious of which is chloracne, a severe skin disease characterised by acne-like lesions.

Several studies of industrial workers exposed to high levels of dioxin have shown increased risks of cancer. As a result, the World Health Organization (WHO) and the United States National Toxicology Programme both list dioxin as a human carcinogen. In New Zealand the Ministry for the Environment estimates that up to 50 cancers each year may be due to dioxin.

Non-cancer effects, such as immunotoxicity and neurobehavioural and reproductive effects, might turn out to be the most important in terms of their overall health impact. The margin of safety between the current body burdens in New Zealanders and body burdens known to cause adverse health effects in animals is considered to be small.⁹

⁹ *Evaluation of the Toxicity of Dioxins and Dioxin-like PCBs: A Health Risk Appraisal for the New Zealand Population.* Ministry for the Environment, Wellington, February 2001.

3.2 Exposure of New Zealanders to dioxin

Dioxin exposure for the general population has been assessed in two ways: measuring the levels in food, and measuring the levels already present in people's bodies. Dioxin exposure can be measured in units of picograms per kilogram of body weight per day (pg/kg bw/day).¹⁰ Both measurement methods have provided similar estimates of exposure.

From the first method, a dietary survey, the *current* dioxin intake of New Zealanders has been estimated to be approximately 0.5 pg/kg bw/day. The dioxin intake of people in industrialised northern hemisphere countries is between two and five times as great (Figure 1).

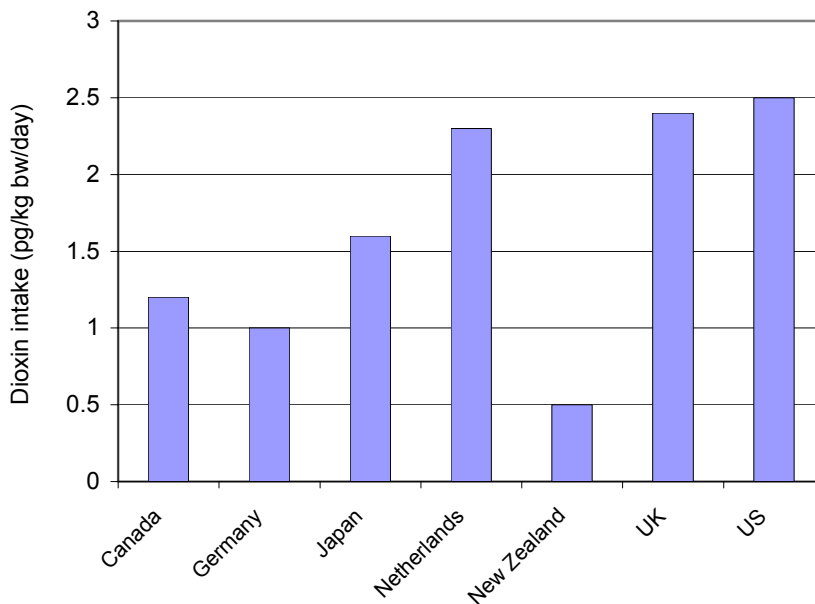


Figure 1: Dioxin dietary intake for various countries

The second method, a study of concentrations of dioxin in blood, suggests that over the last 25 to 40 years the *average* exposure has been about three times higher – 1.4 pg/kg bw/day in comparison with the *current* 0.5 pg/kg bw/day from the dietary study. Because dioxin is only slowly excreted from the body, levels in blood reflect both *current* and *historical* exposures.

The amount of dioxin present in people's bodies rises markedly with age. This is because dioxin accumulates throughout life. It also suggests that in the past New Zealanders were exposed to more dioxin than they are now. Other evidence for falling exposures comes from studies of dioxin in breast milk, which suggest that exposure has decreased by about 70% in the last decade (Figure 2). Decreasing exposure has also been reported in several European countries, in Canada and the United States.

¹⁰ A picogram is a trillionth of a gram.

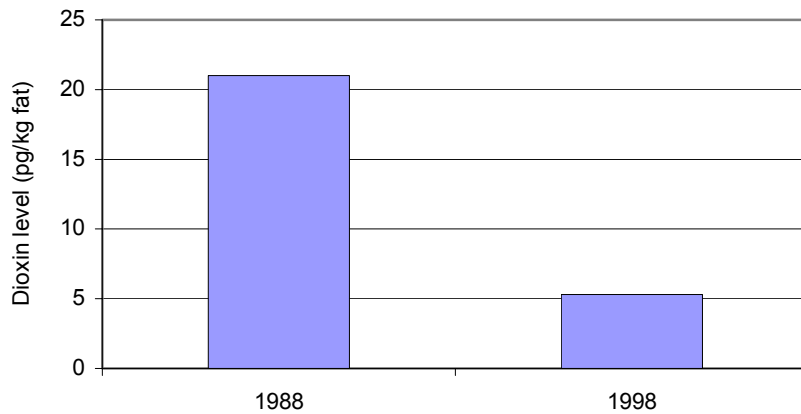


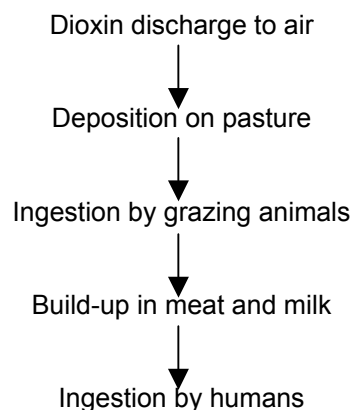
Figure 2: Decreasing dioxin levels in breast milk from New Zealand women

Despite encouraging signs of comparatively low dioxin intake and decreasing exposures, the existing *average* level of human exposure in New Zealand is still close to the WHO tolerable daily intake of 1 pg/kg bw/day.¹¹ Some members of the population will exceed this WHO value. The New Zealand exposure is also about 100 times greater than the safe measurement of exposure set by the United States Environmental Protection Agency of 0.006 pg/kg bw/day.

To improve the margin of safety between New Zealanders' intake of dioxin and levels that may cause adverse effects in humans, actions should be taken so that people's exposure continues to trend downward over time.¹²

3.3 How dioxin travels from air into humans

Over 90% of the dioxin entering the body of the typical New Zealander is thought to have come from eating animal foods. For discharges to air, exposure takes the following pathway:



¹¹ Established as a range of 1–4 pg/kg bw/day, with a target tolerable daily intake of 1 pg/kg bw/day.

¹² The situation is similar in other countries, and is the reason why global (i.e. the Stockholm Convention), regional and countrywide initiatives are being taken.

Variations to the dietary exposure pathway include:

- the discharge of dioxin-containing effluent to waterways and consequent bioaccumulation in fish and shellfish
- the application of solid waste, such as sewage sludge, to agricultural soil and consequent ingestion by grazing animals.

Exposure also occurs from the inadvertent ingestion of soil containing dioxin, and from inhalation.

Because contamination of food is the primary route for human exposure, people who live near a major point source are *not* likely to have a higher than average body burden of dioxin, unless most of the food they eat is grown locally and contaminated by the discharge source. In fact, the level of exposure to dioxin will be similar for the majority of New Zealanders, because most people eat foods produced commercially across the country.

3.4 Economic considerations

New Zealand increasingly uses its clean green image for marketing biologically based products in export markets and tourism,¹³ as well as for other economic activities. Dioxin discharges are low compared with other countries, because New Zealand is not heavily industrialised and population density is low. Despite this, if no action is taken to reduce discharges of a toxin of such international concern, then our clean green image will be undermined.

A clean green image should be supported by a clean green reality. Increasingly, non-tariff barriers to trade are environmental. Meat and dairy products are both New Zealand's largest export earners *and* the products most susceptible to dioxin contamination. Dioxin is measured in our foods only at very low levels, if at all, so it is important that actions are taken to ensure that this favourable position is maintained. Overseas experience has shown the negative effect on a region's and country's economy if dioxin contamination of food occurs.

No residue limits have yet been established for dioxin in food with respect to overseas trade, although the WHO and the Food and Agriculture Organization of the United Nations have begun discussions. The European Commission has recently proposed maximum limits for dioxin levels in animal foods, with the intention of regulation from 2002 onwards. The first World Trade Organization notification of maximum dioxin levels in agricultural products has also been made. Other countries can be expected to follow, and monitoring of dioxin residues in New Zealand agricultural exports appears inevitable.

Given the growing export market for demonstrably 'pure' agricultural produce that sells at high prices, there is potential for economic advantage from demonstrating the continued absence of dioxin in New Zealand's exports.

¹³ For example, the slogan of the Tourism Board is '100% Pure New Zealand'.

3.5 A preventive and proactive response

New Zealand action on dioxin should be seen as both *preventive* and *proactive*.

A preventive measure is justified in view of the potential health effects, recognising the goal of New Zealand's dioxin policy is to protect human health and the environment. Preventive action will also protect the quality of our foods and reduce any potential for damage to the economy.

Initiatives on dioxin are already happening in other countries. A proactive response to these global initiatives will help to maintain New Zealand's comparative clean green advantage. Action should also be proactive in the expectation of new dioxin sources (such as municipal waste incineration) being established in New Zealand.

4 Sources of Discharges of Dioxin to Air

4.1 Source categories

Sources of dioxin in New Zealand have been assessed by the New Zealand Inventory of Dioxin Emissions.¹⁴ This shows that dioxin discharges to air can be placed into four categories: waste combustion, fuel combustion, metallurgical production and processing, and other sources.

Waste combustion

The burning of waste is the major source of dioxin discharges to air in New Zealand. Waste combustion takes place predominantly in open fires at landfills, in backyard fires, in commercial incineration units such as those that burn medical waste, and in combustion units that are not designed to handle waste, such as boilers. Landfill fires have the worst discharges by far.¹⁵ There are no municipal waste incinerators in New Zealand.

Fuel combustion

Dioxin is discharged to air whenever hydrocarbon fuels are burned. A chlorine source is required, but this can be as simple as salt present in the combustion air. Wood and coal are important industrial fuels, and discharges of dioxin depend on the fuel and the type of boiler or combustion unit in which they are burned. Wood and, to a lesser extent, coal are also used for heating buildings. The combustion of petrol and diesel in motor vehicles and the burning of used oil also discharge dioxin.

Metallurgical production and processing

This category can be divided into the manufacture and processing of iron and steel and the processing and recovery of non-ferrous metals.

¹⁴ *New Zealand Inventory of Dioxin Emissions to Air, Land and Water, and Reservoir Sources*. Ministry for the Environment, Wellington, March 2000.

¹⁵ Reference to 'landfill fires' in this action plan refers solely to the uncontrolled burning of waste at a landfill. It does not include the collection and burning of landfill gas.

Other sources

Other sources of dioxin discharges to air fall into three groups: crematoria, accidental fires, and minor miscellaneous sources including cigarette smoking, the burning of landfill gas, and chemical recovery boilers at pulp and paper mills.

The relative sizes of dioxin discharges from these categories are shown in Figure 3.

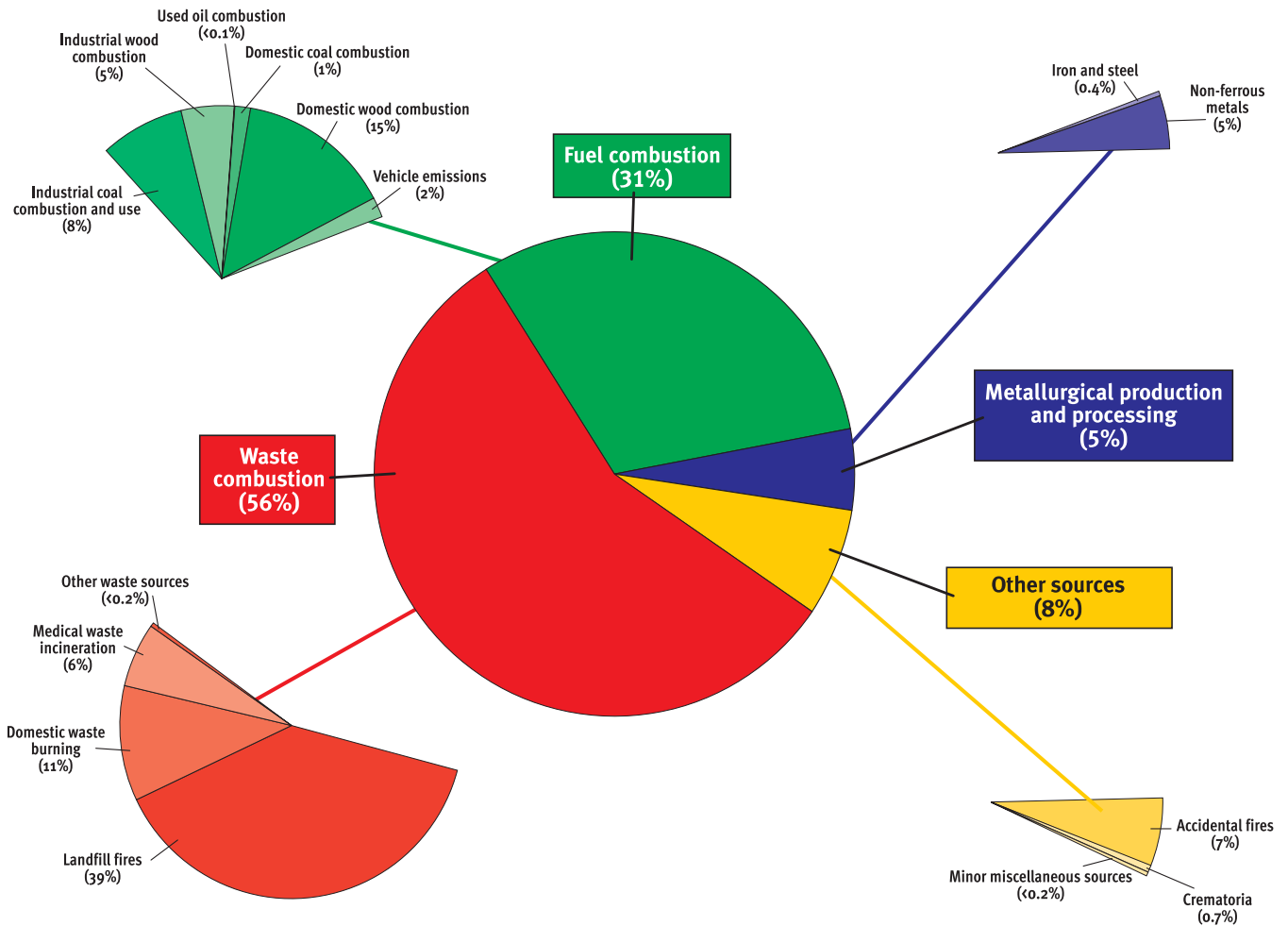


Figure 3: The sources and relative sizes of dioxin discharges to air in New Zealand

4.2 Source-by-source decision-making

In Sections 5 and 6 of this action plan, each source of dioxin discharge to air is considered separately and actions are recommended. These actions range from 'do nothing' to regulation by way of an NES under the RMA.

A set of criteria have been used (with varying degrees of formal analysis) as a basis for recommending the source-specific actions. These include the Section 32 RMA criteria of effectiveness and efficiency. Some of the criteria are related. For some sources, conflicts between different criteria exist and tradeoffs are inevitable.

Criteria for source characteristics

- *Total size of source:* little reduction in overall dioxin discharges can be achieved from targeting small sources.
- *Potential for growth:* the pie chart in Figure 3 shows the relative sizes of *current* sources. The introduction of a large uncontrolled and badly operated municipal waste incinerator would change the figure dramatically.
- *Trends:* some sources are already declining due to changes taking place for other reasons.
- *Certainty of information:* there is always a balance between collecting too much and not enough information. What information is collected must be accurate and representative of the source for policy-making purposes.
- *Technical options:* dioxin is an unwanted byproduct of many processes. Feasible control technologies or alternative processes must exist before these dioxin discharges can be reduced.

Effectiveness, cost and efficiency criteria

- *Effectiveness:* a dioxin discharging ‘unit’ may be, for example, a landfill fire, a waste incinerator, or a ‘44-gallon drum incinerator’. An action is judged to have high ‘total effectiveness’ if it would make a significant reduction in the total amount of dioxin discharged to air from all units of the same type (for example, from all landfill fires).
- *Cost:* most of the cost of an action will fall on a householder or company, and so the size of this cost must be considered. The ‘total cost’ of a recommended action should be, in the words of the Stockholm Convention on POPs, “economically viable” in the relevant sector. Costs to industry may include some initial ‘up-front’ costs, technology and monitoring costs. Government expenditure will also need to occur, both at a national and regional level.
- *Cost-effectiveness:* the reduction of dioxin discharges to air should be achieved at the lowest cost possible.

Other criteria

- *Overseas action:* if proposed actions differ greatly from what has been done in other countries, this may signal potential problems.
- *Consistency/fairness:* some degree of consistent treatment is reasonable, but taken to its extreme this criterion would lead to paralysis.

5 Actions for Waste Disposal Sources

There are important reasons for making waste disposal the first priority in a dioxin action plan.¹⁶

- Over half the dioxin currently discharged to air comes from the combustion of waste materials.
- Even one large municipal waste incinerator could increase total dioxin discharges significantly.
- Because dioxin concentrations in combustion gases are relatively high, control technologies will be relatively cost-effective.
- The focus for action in other developed countries has been on dioxin discharged from waste incineration.

The actions recommended in this chapter on waste disposal sources are consistent with and complementary to the Government's proposed Waste Minimisation and Management Strategy.¹⁷ As a minimum, the proposed actions should encourage waste minimisation including increased recycling initiatives.

5.1 Landfill fires

Uncontrolled burning of rubbish in landfills is estimated to be the largest source of dioxin discharges to air in New Zealand (39%). Combustion gases from such fires contain more dioxin when the rubbish contains chlorinated materials such as PVC. However, the very poor combustion conditions are also an important factor in the high dioxin discharges.

While landfill fires do reduce the volume of municipal waste, the environmental damage from the discharge of products of incomplete combustion, including dioxin, far outweighs any environmental value of waste reduction. If municipal waste is to be burned, it should be done in a controlled manner using a purpose-built waste incinerator with state-of-the-art emission control systems. The only practical means of reducing discharges from landfill fires is by minimising their occurrence. If this very large source of dioxin discharges to air is not eliminated, the case for controlling any other source is weak.

In 1997 the Ministry for the Environment released guidelines on the hazards of burning at landfills, which explicitly stated, "*deliberate burning should not occur*". These guidelines, together with regional and industry initiatives, appear to have had some positive effect, with an approximate 50% reduction in the occurrence of landfill fires over the last five years. Nonetheless, data from the New Zealand Fire Service for 2000/01 show that there were still around 130 fires at public and private landfills, not including fires at waste transfer stations. Since action to date has been only partially effective, there is a strong case for banning the

¹⁶ For the purpose of action on dioxin as proposed in Sections 5 and 6, and Appendix 3, dioxin includes the dioxin-like PCBs.

¹⁷ Action to manage and minimise waste is an important element of the Government's programme for environmental issues (cf. the December 1999 Speech from the Throne).

discharges to air from the burning of wastes at landfills by way of an NES. This will send a clear and unequivocal message that these discharges are unacceptable.

When landfill fires do occur, it would be important for landfill operators to report these incidences along with information on the severity of the fire, including an estimate of the volume of waste burned. This will enable more accurate discharge estimates to be made for this source in future dioxin inventories.¹⁸

A ban would have additional environmental benefits; it would prevent loss of amenity values to a local community arising from a landfill fire, and would reduce the discharge to air of other toxic contaminants. Most regional council air plans already list waste burning at landfills as a prohibited activity. A ban on air discharges is therefore consistent with these regional initiatives. A ban is also consistent with the Government's current Landfill Management Programme, which seeks to improve landfill standards including management practises.

Regional councils could also require that landfill management plans include mechanisms for the early detection of fires, and procedures for prompt, effective action to extinguish fires that do occur.

Actions

- Ban discharges to air from the burning of waste within landfill sites, waste transfer stations, and waste recovery sites, through a National Environmental Standard.
- Educate waste management operators on the environmental impacts of waste burning, and the need for information when landfill fires do occur.

¹⁸ An obligation of the Stockholm Convention is the development and maintenance of a dioxin source inventory and release estimates. Re-evaluation of landfill fires should form part of any future New Zealand dioxin inventory.

What do we mean by waste when considering action for waste disposal?

Defining waste is problematic. It could be defined generally with specified exclusions, or defined specifically with a detailed list of waste materials. However, the range of possible materials is exceedingly wide and it would be difficult to ensure that all wastes are included in any specific definition. A more general definition is therefore preferred.

For the purposes of dioxin action on waste disposal sources, waste is defined as:

"Any material, whether it is a solid or liquid, that is discarded or discharged for final disposal by its holder".

Disposal means:

"Incineration, co-incineration, burning or any other thermal treatment process, with or without recovery of the heat generated".

Dioxin discharges from waste detailed on the New Zealand Waste List are covered by the proposed actions in this plan. Waste includes but is not limited to:

- 1 refuse, garbage or municipal waste
- 2 hospital, medical, clinical, pathological or veterinary waste
- 3 quarantine waste
- 4 sludge or solids derived from liquid-borne municipal, industrial or trade waste
- 5 agricultural chemicals or agricultural chemical waste
- 6 wood preservatives or biocides
- 7 wood waste including plywood, particle board, or wood waste and timber that may contain halogenated organic compounds, including pentachlorophenol (PCP), or metals as a result of treatment with wood-preservatives or coatings, or wood waste originating from construction and demolition waste.
- 8 plastic, rubber, resins or adhesives
- 9 paints, inks, dyes, pigments, liquors, varnishes or other surface coatings
- 10 halogenated solvents or solvent residues
- 11 waste liquids, including used oil or other waste petroleum products, with a calorific value of 30 megajoules per kilogram (MJ/kg) or less, or containing 10 milligrams per kilogram (mg/kg) or more of polychlorinated aromatic compounds, PCP or polychlorinated biphenyls (PCBs), or 1000 mg/kg or more of chlorine
- 12 unidentified chemicals or laboratory residues
- 13 waste from contaminated sites or buildings
- 14 motor vehicles or vehicle parts, or any other combination of metals and combustible material.

Some materials often considered 'wastes' might be more appropriately termed 'fuels' because they are primarily used to generate energy or material products, and burn with similar discharge characteristics to fuels like coal, oil or gas. To ensure such fuels are not captured under the definition of waste, it is important to specifically exclude these types of materials. Other exclusions may also be appropriate, such as bodies destined for cremation. Discharges from activities or materials that should not be captured by the proposed dioxin action on waste disposal are:

- 1 cremation of human beings or pets
- 2 burning of vegetable wastes from agriculture, forestry or food processing
- 3 burning of virgin wood or virgin wood waste
- 4 burning of waste liquids with a calorific value greater than 30 MJ/kg, containing less than 10 mg/kg of polychlorinated aromatic compounds, PCP or PCBs, and less than 1000 mg/kg of chlorine
- 5 burning of black liquor or fibrous vegetable waste from virgin pulp and paper production
6. incineration plants used for research, development or testing in order to improve the incineration process and which treat less than 50 tonnes of waste each year.

5.2 Domestic waste burning

The second largest source of dioxin from waste combustion is the burning of domestic waste in backyard fires and '44-gallon drum incinerators'. About 11% of all dioxin discharged to air comes from this source.

It is thought that some waste is also burned on indoor fires and in wood burners, although no information is available on the prevalence of this practise or how much waste is burned.

Combustion gases from uncontrolled burning of mixed household waste contain about the same concentration of dioxin as waste burned in landfill fires. Burning garden waste (i.e. vegetation, such as shrub and tree prunings) will discharge much less dioxin than burning household waste.

Although the estimate of dioxin produced from the backyard burning of domestic waste is highly uncertain, gathering more data and more analysis would add little value. Like landfill fires, this is a major source of dioxin due to an undesirable practice, and dioxin discharge to air from the practice should be prohibited, at least for certain types of wastes.¹⁹

Generally, backyard burning of most domestic waste occurs in an unselective manner, with little or no segregation of the waste streams. Therefore, the most effective way to reduce dioxin discharges from this source would be to ban the discharge from all items that make up domestic waste. There is an argument to extend a ban to include vegetation in urban areas. This approach recognises the availability of alternatives, such as composting and recycling, and would make enforcement much simpler and more effective.

However, it does not recognise that some waste items will discharge much less dioxins when burned than other wastes, or that segregation of some wastes such as vegetation and paper are common and effective. Most regional council air plans regulate the open burning of certain wastes²⁰ as either a permitted activity (subject to conditions) or discretionary activity, and for other specified wastes²¹ as a prohibited activity. A similar approach should be adopted here. In summary, a ban on discharges from domestic waste burning should not apply to vegetation, untreated wood (i.e. virgin wood), paper or cardboard.

The amount of household waste burned in backyard fires is only about 1% of the total amount of domestic waste landfilled in New Zealand. Consequently, any ban on discharges from this activity would have a very small effect on the quantity of waste taken to waste disposal facilities, or on the amount of waste that is illegally dumped.

Bans on outdoor fires of all kinds are common in summer because of the fire risk. Because of other adverse air quality effects, outdoor fires are also banned during winter in Christchurch.

¹⁹ Cost effectiveness analysis indicates that a ban on waste burning would be economically efficient, costing around \$1000 for each milligram of dioxin *not* discharged.

²⁰ Such as vegetation, untreated wood, paper and cardboard.

²¹ Such as plastics (including PVC), tyres, treated timber and used oil.

The problems with addressing waste in rural New Zealand

Rural New Zealand creates a significant portion of New Zealand's waste stream, much of which is thought to be inadequately managed due to a lack of environmentally sound disposal choices. Farms and other rural properties are often without kerbside collection schemes, and may be located far away from landfills.

As well as general household wastes, the agricultural sector generates an estimated one million 20 litre plastic agrichemical containers, thousands of kilometres of plastic baling wrap, together with a variety of other wastes. Some of this waste is known to be disposed of in farm 'waste pit' fires, which is effectively uncontrolled burning.

More recently, small-scale incinerators have been developed for disposing of tripled rinsed high density polyethylene agrichemical containers. These incinerators are simply a 44-gallon drum modified for improved airflow. They are unlikely to meet the discharge limit of a national environmental standard (NES) as outlined in Section 5.3 (especially if mixed wastes or chlorinated materials are burned, or if combustion conditions are poor) nor will they meet the operating requirements of this standard. Because of a lack of waste segregation, ready access to an incinerator whether on a farm or any rural property will only encourage the disposal of waste for which the incinerator was not intended.

Waste disposal burning in flare pits or 44-gallon drums is likely to be as environmentally damaging as domestic backyard burning, if not more so given the volume and types of waste burned. Ironically, dioxin discharges in rural areas can be the most dangerous because of the greater potential for dioxin to be deposited onto farmland and to enter the food chain.

With an increasing likelihood that New Zealand agricultural produce will need to meet export produce requirements for dioxin, the need to demonstrate good environmental practice will become increasingly important. There is little justification from an environmental perspective why waste burning in rural areas should be treated any differently to backyard burning in urban centres. Accordingly, action by way of an NES that bans dioxin discharges to air from waste burning on outdoor fires must also include waste burning in rural New Zealand. This standard should therefore apply to discharges from small-scale 44-gallon drum incinerators.

Current alternatives to the burning of waste in rural New Zealand are landfilling, recycling and waste minimisation. For some waste streams, such as agrichemical containers, the establishment of a collection and recycling scheme is an option that should be explored. Schemes for farm plastic wastes already operate overseas. The used oil collection and recovery programme already established in New Zealand suggest that similar approaches for other wastes are possible. These types of initiatives will need careful evaluation during the transition period suggested for the NES.

There will be a comparatively high cost of enforcement of an NES in rural areas, because dioxin discharges from waste burning on outdoor fires are highly dispersed. In addition, there will be higher disposal costs where wastes have to be transported long distances for landfilling, recycling or for other means of waste management. The burning of polyethylene agrichemical containers is a permitted activity in some regional council air plans. Costs will be incurred by councils required to review and revise air plans to reflect the NES.

Community education will contribute to an increased awareness of the environmental damage of waste burning, both on outdoor and indoor fires, and raise the level of compliance. It will also assist with self-monitoring and enforcement, especially within residential neighbourhoods. A mechanism for reporting plumes of offensive smoke is already in place as part of existing pollution response services operated by regional councils.

A short (two to three year) transition period is suggested to facilitate a change in behaviour not to burn waste. Thereafter, the extent to which councils should become proactive in identifying breaches of the NES would need to be chosen after assessment of costs. The cost of enforcement would probably be quite small in urban areas, but comparatively more expensive in rural areas.

Notwithstanding, it may be expected that regional councils would progressively enforce the standard, including prosecutions where necessary, when they become aware of occurrences of domestic waste burning.

The proposed action would be complementary to the nuisance provisions of the Health Act, enforced by territorial authorities. But, it will be necessary to avoid the duplication of functions. Territorial authorities are empowered by the Health Act to monitor and control activities causing a nuisance or likely to be injurious to health, and on this premise, the proposed action on dioxin could equally be regulated under the provisions of this Act.

Actions

- Ban discharges to air from the burning of waste (excluding vegetation, untreated wood, paper and cardboard) on outdoor fires in urban and rural areas, including agricultural waste burning, through a National Environmental Standard.
- Develop educational material on the health and environmental effects of waste burning in outdoor fires.

5.3 Municipal waste incineration

Municipal waste incinerators are designed to burn refuse that would otherwise be deposited in landfills. As yet there are no municipal waste incinerators in New Zealand, although some have been proposed. State-of-the-art municipal waste incinerators that are operated well could decrease the incidence of landfill fires, and could therefore result in an overall reduction in dioxin discharges. However, a single large incinerator, if badly designed and operated, could discharge as much dioxin to air as has been estimated for all sources in the New Zealand inventory.²²

Overseas, the reduction of dioxin discharges from municipal waste incinerators has been achieved through regulation. Because any municipal waste incineration plant in New Zealand would be new, it is appropriate to follow best international practice, and as such overseas discharge limits for such plants are especially relevant. The European Commission (EC) has set an upper limit on the concentration of dioxin in exhaust gases of 0.1 ng TEQ/Sm³, and the United States limit is equivalent to approximately 0.2 ng TEQ/Sm³.

Measuring dioxin in exhaust gases

The use of toxic equivalents (TEQ) is an internationally adopted procedure for assessing the combined toxicity of a mix of different dioxins. A limit of 0.1 ng TEQ/Sm³ means that each cubic metre of exhaust gas (standardised to reference conditions) must contain no more than 0.1 nanograms of dioxin adjusted for toxicity. A nanogram is a billionth of a gram.

²² This is hypothetical, and many would argue highly improbable; it is unlikely such an incinerator would ever be given resource consents to operate. However, section 3(f) of the RMA does allow for consideration of 'any potential effect of low probability which has a high potential impact'.

Because it is important that New Zealand protects and strengthens its clean green image, and because our markets in Europe are increasingly environmentally sensitive, New Zealand should adopt the more stringent EC limit. Dioxin discharges from a waste incinerator of 0.1 ng TEQ/Sm³ would not be expected to result in adverse effects on human health or the environment.

A limit of 0.1 ng TEQ/Sm³ would be effective since dioxin discharges would be only about 1% or less of those from an uncontrolled plant. In practice, many modern municipal waste incineration plants achieve average dioxin discharges of less than 0.05 ng TEQ/Sm³, with some operating as low as 0.002 ng TEQ/Sm³.

Assessing efficiency or cost-effectiveness is more complex. The cost-effectiveness of different levels of dioxin control can be estimated in the form of cost-effectiveness ratios. The control technologies required for an upper limit of 0.1 ng TEQ/Sm³ would prevent dioxin discharges at a cost of about \$400 for each milligram of dioxin *not* discharged. Cost-effectiveness analysis has shown that this is a dioxin reduction 'bargain'. The control technologies required for an upper limit of 0.1 ng TEQ/Sm³ are estimated to account for a significant proportion (30 to 50%) of the capital cost of a municipal waste incinerator.

Since dioxin control technologies are standard in new municipal waste incinerators, an upper limit on dioxin discharges would be expected as a condition of a resource consent for such an incinerator. The establishment of an NES that sets an upper discharge limit can be seen as a proactive approach to the possible introduction into New Zealand of this technology at some future date. An NES that covered municipal waste incinerators would save developers and consenting authorities time and resources, and represents cost savings.

Appendix 3 contains a proposed NES restricting dioxin discharges to air from the incineration of waste. As well as setting an upper discharge limit, the NES includes requirements for incinerator operation, monitoring and reporting. The banning of dioxin discharges to air from uncontrolled waste burning in landfills, and from the burning of waste in outdoor fires is included in this NES.

Co-incineration – the burning of waste to generate heat as well as to dispose of the waste – is a special case of municipal waste incineration. New Zealand does not have any large co-incinerators, and any applications for such facilities should be covered by the proposed NES. Anecdotal evidence suggests that co-incineration occurs to some extent on an *ad hoc* basis in small to medium sized boilers, including those found at educational and healthcare institutions and possibly some trade and industrial premises. Such boilers are unlikely to be able to be equipped to meet the operational and monitoring requirements proposed in the NES, and furthermore, would be unlikely to meet the discharge limit if burning waste in any significant quantity. In any case, for co-incineration to continue in this way, the discharge from such boilers would need to comply with the discharge limit of 0.1 ng TEQ/Sm³, as well as the monitoring requirements of the NES.

It is also known that the burning of waste at trade and industrial premises occurs in units that are not even designed for fuel combustion purposes. This practice is most commonly found in the smaller towns around New Zealand, and includes waste burned in 44-gallon drums tucked away at the rear of a building or property, and even in open fires. It is reasonable to assume that discharges from waste burned in this way will not comply with any aspect of the NES, and effectively this type of activity will have to cease.

Action

- Make a National Environmental Standard setting an upper limit of 0.1 ng TEQ/Sm³ on dioxin discharges to air from the burning of waste in specified circumstances, including municipal solid waste.
- Prepare information material on the National Environmental Standard, including material to assist in identifying co-incinerators.

5.4 Medical waste incineration

The incineration of clinical, pathological, quarantine and veterinary wastes²³ is responsible for about 6% of dioxin discharges to air in New Zealand.

Overseas, the reduction of dioxin discharges from medical waste incinerators has been achieved through regulation by setting maximum discharge limits. The EC upper limit for medical waste incinerators is the same as for municipal waste incinerators – 0.1 ng TEQ/Sm³.

Dioxin discharges from *large* and *medium*-sized medical waste incinerators in New Zealand are already, or soon will be, at low levels. The largest medical waste incinerator in the country has been fitted with control technologies that enable it to comply with the European discharge limit of 0.1 ng TEQ/Sm³. The next largest has been replaced by an autoclave system.²⁴ Of the two medical waste incinerators of medium size, one is soon to be replaced by an autoclave system, while the other must comply with a limit of 0.1 ng TEQ/Sm³ by 2004 as a condition of its resource consent.

Accordingly, there has already been a decrease in dioxin discharges from medical waste incineration compared with the estimates made in the New Zealand inventory. The priority now is *small* medical waste incinerators. There are about 19 small medical waste incinerators still being used in New Zealand. Although these incinerators collectively handle about 20% of the waste burned by each of the medium incinerators above, some probably discharge as much dioxin. They have no control equipment, and achieving and maintaining good combustion conditions is difficult because of their size. Many are old and in poor condition.

An estimate of the cost to the owner of a small medical waste incinerator of complying with a limit of 0.1 ng TEQ/Sm³ can be made by assuming that the incinerator is replaced by an autoclave system. The capital cost of an autoclave system large enough to replace a small medical waste incinerator is about \$400,000²⁵ – less than or about the same as a new incinerator. If an existing incinerator is due for replacement, then the cost of installing an autoclave system instead is zero. If an existing incinerator is *not* due for replacement, then its premature replacement by an autoclave system involves early expenditure of \$400,000, which incurs a financial penalty. Operating costs for autoclave systems are likely to be, at most, similar to those for incinerators.

²³ Referred to in this action plan generically as ‘medical waste’.

²⁴ Dioxin discharges from autoclaves are negligible, and are primarily associated with the burning of coal to generate steam required for sterilisation.

²⁵ This cost does not include a boiler. Small autoclaves would generally be based on hospital sites where steam is likely to be available.

The effectiveness of the autoclave option in virtually eliminating dioxin discharges to air from this source is assured, and it is much more cost-effective than control technologies on small waste incinerators. This supports the adoption of relatively stringent discharge limits for this source of dioxin discharges to air. It is proposed that the NES for municipal waste incinerators be applied to medical waste incinerators as well.

Immediately replacing all small medical waste incinerators with autoclave systems would cost about \$8 million. This estimate is based on two assumptions. The first is that all the replaced incinerators are new and immediately junked; clearly, this is not so. The second assumption is that in all cases a nearby boiler is available to provide steam. This may not always be so, in which case the economics would probably lead to transporting the waste to an autoclave system or to a complying 'regional' incinerator. Such decisions have already been made by operators of incinerators that have closed down in the last decade.

A more reasonable estimate of total costs can be made by assuming that the average remaining lifetime of small medical waste incinerators is five years. This gives a total cost of about \$3 million.

The actual costs to individual owners of these incinerators would depend on how regional councils decide to implement the proposed NES in reviewing existing resource consents. At one extreme, a regional council might require a phase-in period of a year; at the other extreme, it might not require compliance until incinerators reach the end of their useful lives. In the latter case, the cost to owners would be close to zero.

Action

- Include dioxin discharges from the burning of medical waste in the National Environmental Standard presented in Section 5.3, with a discharge limit of 0.1 ng TEQ/Sm³.

5.5 Other waste sources

Other waste sources – hazardous waste and sewage sludge incineration – are currently relatively small sources of dioxin discharges to air. Thus, even substantial reductions in dioxin discharges from these sources would have only a marginal effect on total dioxin discharges.

Hazardous waste incineration

There is only one hazardous waste incinerator in New Zealand. The volume of hazardous waste incinerated is minimal, and discharges from the unit are accordingly low. The plant is extensively monitored to ensure compliance with its resource consent, although the discharge limit of 5 ng TEQ/m³ specified in this consent is relatively high and out dated compared to current international best practise.

Action

- Include dioxin discharges from the burning of hazardous waste in the National Environmental Standard presented in Section 5.3, with a discharge limit of 0.1 ng TEQ/Sm³.

Sewage sludge incineration

Dioxin discharges from New Zealand's only operational sewage sludge incinerator are estimated to be low. Although this incinerator has never been monitored for dioxin, it operates with a large biofilter that should effectively trap any dioxin present in the discharges.

Resource consents have been given for the construction and operation of a sewage sludge vitrification plant – in effect, a high-temperature incinerator – in the lower North Island. The consent condition for this facility specifies a dioxin discharge limit of 0.1 ng TEQ/Sm³.

Action

- Include dioxin discharges from the burning of sewage sludge in the National Environmental Standard presented in Section 5.3, with a discharge limit of 0.1 ng TEQ/Sm³.

6 Actions for Sources other than Waste Disposal

Options for reducing dioxin discharges from sources other than waste disposal in the near future are much more limited, for a variety of reasons. This does not mean that the objective of a substantial reduction in overall dioxin discharges cannot be achieved. Some of these sources of dioxin are declining due to other factors. Moreover, as shown in the previous section, waste combustion is the primary target and dioxin discharges from waste disposal sources can be reduced to a very low level.

This section deals with the three categories of non-waste disposal sources: fuel combustion, metallurgical production and processing, and other sources.

6.1 Fuel combustion

Industrial fuel combustion

Wood and coal

There are many boilers of varying sizes throughout the country burning wood and coal to generate process heat and space heat. Although the amount of dioxin discharged from any one unit is likely to be low, about 12% of total dioxin discharges to air come from this source. Cement manufacture, which also combusts coal, is included in this source category. Discharges from New Zealand's two cement producers are estimated to be 1% of total dioxin discharges to air.

Technical options for reducing dioxin discharges from wood-fired and coal-fired boilers do exist, so reduction of dioxin discharges is technically feasible. The installation of a baghouse²⁶ will reduce dioxin discharges from wood-fired boilers burning virgin wood by 15 to 40%, and from coal-fired boilers by about 80%. If the filters in the baghouse are impregnated with a catalyst capable of destroying dioxin, discharges can be reduced still further.

However, cost-effectiveness analysis shows that these gains would be economically inefficient compared with that from, for example, waste incinerators. Each milligram of dioxin not discharged would come at a high cost,²⁷ especially if the boiler is small. This is because the concentration of dioxin in the exhaust gases is very low compared with that in exhaust gases from waste incinerators, and the exhaust gas flows are typically high.

²⁶ It is not intended to prescribe control technologies. The use of a baghouse was selected as an example of an available technology, allowing cost-effectiveness analysis to be undertaken. A baghouse provides a high level of particulate control, they are commonly used overseas and are becoming increasingly so.

²⁷ Costs could be of the order of \$50,000 to \$250,000 per milligram of dioxin not discharged.

Over time, both boiler turnover and boiler upgrading will lower dioxin discharges to air from this source, although this may be partly counterbalanced by an increasing numbers of boilers. New boilers discharge less dioxin than old boilers because they burn fuel more efficiently, and can often achieve a higher standard of particulate control. Reducing particulate discharge will also reduce dioxin discharge. Both the decrease in the amount of fuel burned and the better combustion performance mean that less dioxin is created per unit of heat output from the boiler. Energy efficiency improvements to existing boilers, such as better control of the fuel/air mixture, are increasingly being done, especially in small boilers.

One study has shown that when 'contaminated' wood is burned, dioxin discharges can increase by a factor of 10 or more. Contaminated wood includes processed wood such as particle board and plywood, and chemically treated wood including wood treated with chlorinated pesticides. Contaminated wood may be burned primarily as a source of energy, but it also serves as a convenient disposal option for wood waste that would otherwise have to be taken to landfills. If contaminated wood waste were to be included in the group of waste covered by the NES, wood-fired boilers that burn contaminated wood would be classed as co-incinerators and the discharges would have to meet the 0.1 ng TEQ/Sm³ limit of the NES.

However, dioxin discharges from burning contaminated wood in New Zealand may be very small. Relatively little national data exist about the extent of the practice, or the types of contaminated wood burned. Any action on this source should begin with gathering information.

There is one caveat to this proposed action on contaminated wood burning. Pentachlorophenol (PCP) treated timber is contaminated wood, and PCP treated timber (and associated wood wastes) should not under any circumstances be burned in industrial boilers without meeting the 0.1 ng TEQ/Sm³ limit of the NES, and the associated requirements of this standard.²⁸ This recommendation is not included in this section, but is incorporated within the proposed actions on waste disposal sources from the co-incineration of waste detailed in Section 5.

In summary, environmental concerns about the industrial combustion of coal should not be focused on dioxin. Concern about the dioxin from the industrial combustion of wood should be focused on the burning of contaminated wood.

Gas

Dioxin discharges from the burning of gas are very low and not of concern. No action is required.

Used oil

Another fuel used in industry is used oil. Low-temperature burning of used oil in small boilers or space heaters and in larger industrial boilers occurs under varying combustion conditions, and pollution control equipment may often be absent. However, because of the relatively small volume of used oil burned in low-temperature appliances nationally, this source contributes < 0.1% of the total dioxin discharges to air. If the volumes of used oil burned at low temperatures were to increase significantly, or if new information showed higher than expected emissions, it would be appropriate to re-evaluate the significance of this activity as a source of dioxin as part of future inventories, and the need for policy interventions.

²⁸ The burning of PCP treated timber and PCP contaminated wastes would be a significant source of dioxin discharge to air if burned under poor combustion conditions or without appropriate pollution control equipment.

Used oil is also burned at a high temperature at a cement kiln. Here conditions ensure good combustion, and gas cleaning occurs. Dioxin discharges to air are known to be low.

An important step to minimise discharges of dioxin from used oil burning, especially at low combustion temperatures, is to ensure the oil is not contaminated with high levels of chlorinated chemicals, such as PCBs.

The Ministry for the Environment is currently addressing the future management of used oil in New Zealand. Following consultation on an issues and options paper,²⁹ improvements to the recovery programme for used oil collection is the policy priority. Many regional councils address used oil burning in their regional plans, and the need to develop environmental standards for used oil is not thought to be strong. Also, the Chief Inspector, Explosive and Dangerous Goods, has set fuel specifications for used oil reprocessed as a fuel oil, which should address many of the concerns for adverse environmental effects from burning.³⁰

Action

- Collect information on contaminated wood burning, including wood treated with antisapstain agents. This should include information on the extent of this practice nationally, data on dioxin concentrations in exhaust gases, source feed (including nature of contamination and feed rate), control equipment and operational parameters.

Domestic fuel combustion

Coal

Coal is not used extensively in many parts of New Zealand for home heating, although there are exceptions like the West Coast. Nationally, less than 1% of total dioxin discharges to air come from this source. Because poorer combustion conditions exist in open home fires and small solid fuel burners, dioxin concentrations in exhaust gases are typically higher than those from industrial coal combustion. Nevertheless, the smaller volume of coal used domestically means that the total amount of dioxin discharged from this source is currently only about a fifth of that discharged from industrial coal combustion.

Wood

The burning of wood for home heating is a major contributor to dioxin discharges, making up about 15% of the total estimated in the New Zealand inventory. Although there is some uncertainty about this estimate, a strong correlation between domestic wood combustion and dioxin levels in air in New Zealand cities has been found. It is also known that when contaminated wood is burned on home fires,³¹ there is a significant increase in dioxin discharges.

²⁹ *Used Oil Recovery, Reuse & Disposal in New Zealand*, Ministry for the Environment, Wellington, December 2000.

³⁰ This sets a maximum limit of 1000 milligrams per kilogram for halogens; *Guidelines for the Management and Handling of Used Oil*, Ministry for the Environment, Wellington, December 2000.

³¹ In practise, this amounts to people burning off-cuts of processed or treated timber products. This type of waste should be landfilled.

The trend away from *open fires* to *enclosed wood burners* should be reducing dioxin discharges from this source for two reasons:

- an open fire discharges about 10 times as much dioxin per kilogram of wood burned as does an efficient enclosed wood burner
- enclosed wood burners are much more energy efficient than open fires, so less wood need be burned for the same amount of useful indoor heat.

A second beneficial trend is toward better home insulation and, all else being equal, this will also reduce the amount of wood that need be burned and the accompanying dioxin discharges. However, all else is not equal, and the efficiency gains from insulation and from the switch to an enclosed wood burner are likely to be taken partly as a reduced fuel requirement and partly as a warmer indoor environment.

Both these trends should bring other environmental health benefits, such as the reduction of suspended particulates in locations where atmospheric temperature inversions lead to the formation of winter smog.

Some dioxin will still be discharged from domestic wood burning and the question of whether alternative heating fuels should be encouraged is legitimate. There are two ‘global sustainability’ reasons that make wood a good choice for a home heating fuel. First, the combustion of wood produces no net carbon dioxide, and so is positive from a climate change perspective. Second, wood is a renewable form of energy. The Energy Efficiency and Conservation Act 2000 requires that the use of renewable sources of energy be promoted.

Action

- Educate on the advantages of efficient enclosed solid fuel burners over open fires for dioxin and particulate reduction, and on side benefits that accrue from energy efficiency initiatives such as home insulation.

Vehicle fuel combustion

The concentration of dioxin in the exhaust from vehicles is very low, although it is markedly higher for heavy diesel compared with light diesel and petrol. Before 1996 dioxin discharges from cars were higher because chlorinated chemicals had to be added to leaded petrol. About 2% of total dioxin discharges to air comes from motor vehicles.

Dioxin discharges from this source can be expected to continue to decline with increasing energy efficiency, the use of cleaner fuels and of control technologies such as catalytic converters. Government action to better manage the impacts of vehicle emissions on air quality is already taking place through the Vehicle Fleet Emissions Control Strategy.³² However, a decrease in dioxin discharges from existing initiatives would be partly offset by any increase in fuel consumption with increasing vehicle kilometres travelled.

³² For example, the new ‘10 second rule’ is aimed at reducing particulate emissions from smoky vehicles. This should also simultaneously reduce dioxin discharges.

There is no reason for taking any dioxin initiatives on this source, since changes taking place for other reasons should lead to the size of this dioxin source continuing to decline.

Action

- Do nothing specifically for dioxin reduction.

6.2 Metallurgical production and processing

In other developed countries, metallurgical production and processing is the second priority for dioxin discharge control after waste combustion. The United Kingdom has set a single concentration-based limit for the metallurgical industry, encompassing iron and steel works, and foundry operations processing zinc, lead, copper and aluminium.

Iron and steel manufacture

The iron and steel industry in New Zealand consists of only two major plants, one producing primary steel and the other recycling steel. These two plants account for about 0.4% of total dioxin discharges to air.

Dioxin discharges from the plant that produces primary steel are low, in large part because a sintering stage is not part of its operation. Overseas, high dioxin discharges from primary steel production have been associated with discharges from sintering of the raw iron ore. The plant that recycles steel has recently been upgraded with new pollution control equipment, and its dioxin discharges are also low.

This industry is localised to one region of New Zealand, and dioxin discharges are already at a comparatively low level.

There are also many smaller foundries that deal in ferrous metals as well as non-ferrous metals. Consideration of dioxin discharges from foundries that process scrap iron are included in the following section.

Action

- No national action is required.

Non-ferrous metals

Secondary non-ferrous metal foundries process and recover metals and alloys from new and used scrap materials.³³ Many of the foundries also deal in ferrous metal products, and there is often no clear distinction between the two.³⁴ Dioxin is mainly discharged from the secondary processing of scrap that may contain organic impurities such as plastics and paint, and from the use of chemicals that contain chlorine.

Estimates of typical dioxin discharges from foundries are very uncertain because the industry is so varied and dispersed, but it is thought to account for about 5% or less of total dioxin discharges to air. However, the proportion could be much higher, and gathering more information about foundry sizes, discharges and practices should be included in a dioxin action plan.

Some foundries will have comparatively high discharges because of the variable nature of the furnace operations and because pollutant control systems are often absent. The installation of a baghouse can reduce dioxin discharges by up to 85%, but it may not be effective in some plants. Other control options are also potentially available.

Cost-effectiveness analysis shows that the economic efficiency of these technical options probably lies between that for waste incinerator options and that for wood-fired and coal-fired boiler options.³⁵ When additional information becomes available, the need to set a voluntary or compulsory upper limit (i.e. a target or a standard) on dioxin discharges for non-ferrous foundries should be reconsidered.

From the few measurements that have been made so far, it appears that the average concentration of dioxin in exhaust gases of non-ferrous foundries in New Zealand is about 0.2 ng TEQ/Sm³, well within the UK limit of 1 ng TEQ/m³.

However, concentration-based limits are not appropriate if the amount of air flowing through the system is variable, as it is in foundries, because compliance can be achieved by increasing ventilation. Any proposed limits for foundries should be mass-based, and measured in units of ng TEQ/unit of throughput; for example, ng TEQ/tonne of raw material. The United States has recently set a mass-based limit on dioxin discharges from secondary aluminium production.

It would be premature to propose a discharge limit for secondary metal processing generally, because very little is known about foundries in New Zealand. However, actions to discourage, or prohibit, certain activities could be taken.

In general, the entry of plastic material into furnaces should be minimised. In particular, the burning of copper wire for reclamation should cease, because copper catalyses the formation of dioxin, and the insulation often contains PVC. This practice can be a significant source of dioxin. Although no precise details are available on the extent of this practice, and any operations are likely to be small scale and occurring without resource consents, available information indicates that this has occurred in the past, and probably still continues. There are alternative mechanical stripping processes available for separating the copper from the plastic insulation, which do not involve any thermal treatment. The proposed action is consistent with regional council air plans that classify the burning of electrical cable as a prohibited activity.

³³ These include aluminium, copper, lead, zinc and brass.

³⁴ For the purposes of proposed action on dioxin, no distinction is made between ferrous and non-ferrous foundries.

³⁵ Estimates of cost effectiveness range from \$2,000 to \$30,000 per milligram of dioxin not discharged.

Actions

- Ban the discharges to air from the burning of materials associated with the recovery of metal from coated or covered copper wire through a National Environmental Standard.
- Collect information on non-ferrous foundry operations including data on dioxin concentrations in exhaust gases, source feed (including rate), control equipment, and operational parameters.

6.3 Other sources

Crematoria

Crematoria account for less than 1% of all dioxin discharges to air, and discharges are likely to decline as more-modern crematoria replace the existing older-style units. New Zealand guidelines already exist for crematoria that specify furnace operation conditions to ensure complete combustion is achieved.³⁶ Although not directed specifically at dioxin, these conditions should minimise their discharge.

It is possible to retrofit dioxin control technologies to crematoria, but the effect on national discharges of dioxin would be extremely small. Moreover, because the concentration of dioxin in the exhaust gases of crematoria is relatively low, and because crematoria are small incinerators, these dioxin control technologies are not nearly as cost-effective as they are on municipal and medical waste incinerators.

Dioxin emission limits have been set for crematoria in the UK and Germany, but a similar approach is difficult to justify in New Zealand. Other options appear more favourable.

Avoiding the entry of chlorinated and other plastics with the casket into the furnace would reduce dioxin discharges. This could be achieved by developing a best practice note to crematoria operators advising, for example, on the optimum operating conditions required to minimise dioxin formation and discharge, including the removal of plastic handles and other superfluous plastic materials before the casket is loaded into the furnace.

Action

- Develop best practice note for crematoria on optimum operating conditions, and the need to avoid the combustion of chlorinated and other plastics.

³⁶ *Guidelines on the Siting and Construction of Crematoria*, Department of Health, Wellington, 1992.

Accidental fires

Building fires, vehicle fires, and forest and scrub fires produce about 7% of the total dioxin discharges to air. Dioxin discharges from accidental fires could be reduced if smaller amounts of chlorinated materials were used in building construction, fittings and furnishing.³⁷ More information about dioxin sources and alternative building materials is required before recommending this action. Fire prevention programmes run by the New Zealand Fire Service to reduce the frequency and severity of building fires can be expected to result in a reduction in dioxin discharges.³⁸

Action

- Reassess accidental fires as a source of dioxin discharges, and report on international initiatives on the acceptability of the use of chlorinated materials in building construction, fittings and furnishings, including the availability of alternatives.

Minor miscellaneous sources

The New Zealand Inventory of Dioxin Emissions identified a number of other sources that discharge dioxin to air. These included cigarette smoking³⁹, the burning of landfill gas, and chemical recovery boilers at pulp and paper mills. Collectively, these various sources are estimated to contribute less than 0.2% to the total dioxin discharges, and no action is justified.

Action

- Do nothing.

³⁷ PVC, for example, a plastic commonly found in New Zealand buildings, can produce very high emissions of dioxin when burned.

³⁸ The New Zealand Fire Service Commission has adopted as a high level strategic direction a “*Focus on fire prevention, fire safety and fire outcomes*”.

³⁹ Although smoking leads to dioxin directly entering the lungs, there is no evidence that this source and pathway is an important route of exposure. New Zealand research has found that there is no significant difference in the concentration of dioxin TEQ in the breast milk of smoking and non-smoking mothers.

7 Application of Actions

7.1 Responsibilities and costs

A summary of the responsibilities and costs of implementing the actions proposed in this dioxin action plan is given in Table 2.⁴⁰

Primarily, implementation and enforcement costs will fall on regional councils. For some sources, for example outdoor burning, the cost will vary with the level of enforcement chosen by local authorities. In cases where actions within this plan are complementary to activities set out in regional air plans, there will be no additional costs to councils. Presumably, councils intend to implement and enforce their air plan regardless of central government initiatives.

Educational material will be required for some of the actions. This explanatory and promotional material will be prepared by the Ministry for the Environment, in liaison with local authorities and the industry sectors. This will include advising of the existence of a dioxin NES. The material will be available for dissemination by councils, public health, education, and industry groups. In many cases, this material should be able to ‘piggy-back’ on existing information networks.

Compliance costs to industry will include technology costs if plant upgrades or process modifications are required and initial costs associated with dealing with new regulations. For those industries required to demonstrate compliance against a dioxin discharge limit, there will be the ongoing annual cost of monitoring. Again, for those sources where industry has to comply with equivalent requirements within regional air plans, there will be no additional compliance costs.

The promulgation of a dioxin NES for municipal waste incineration will reduce the initial costs to applicants, regional councils and the Environment Court, because the NES will speed up part of the resource consent process. It will also provide certainty to potential applicants, as their requirements with respect to dioxin discharges will be clear from the outset.

Other expenditure will follow from the proposed actions. This will include costs to:

- monitor the effectiveness of the actions⁴¹
- monitor the implementation of the NES by regional councils.⁴²

⁴⁰ Providing cost estimates for the proposed actions does not necessarily mean that these actions will proceed.

⁴¹ This could include studies of breast milk or serum to measure peoples’ exposure to dioxin, and to establish whether the current trend of declining exposure continues. The Ministry for the Environment’s Environmental Performance Indicators Programme already proposes the use of breast milk as an indicator of toxic contaminants, including dioxin, in the environment.

⁴² Under section 24(f) RMA, the Minister for the Environment has a statutory responsibility of “*monitoring of the effect and implementation of this Act (including any regulations in force under it)*”.

Table 2: Summary of responsibilities and costs for proposed actions on dioxin discharges

Action and dioxin source	Discharge estimate (% of total)	Administrative responsibility	Fiscal cost (central government)	Implementation and enforcement cost (regional council)	Compliance cost (owner)
Ban on discharge					
Landfill fires	39	MfE – preparation of information Local government/waste management industry/MfE – distribute, inform and educate	\$5,000	None. Already a prohibited activity within regional air plans.	None
Domestic waste burning	11	MfE – preparation of information Local government/waste management industry/MfE – distribute, inform and educate	\$15,000	\$10,000 per year per council (less in urban areas). Costs will diminish with time as becomes accepted practice. \$25,000 to revise air plans (where necessary).	Small additional cost for landfill charges, or for kerbside collection. Higher costs in rural areas.
Copper wire burning	Unknown	MfE – preparation of information Local government/metallurgical industry/MfE – distribute, inform and educate	\$5,000	\$5,000 per year per council. None if already a prohibited activity within some air plans.	None
Limit on discharge					
Medical waste incineration	6	Regional council – implementation and enforcement	None	\$20,000 per existing consent reviewed. Cost savings for consents for new incinerators.	Technology costs for existing plant upgrades. \$20,000 monitoring costs per facility per year.
Hazardous waste incineration	< 0.1	Regional council – implementation and enforcement	None	\$20,000 per existing consent reviewed. Cost savings for consents for new incinerators.	No technology costs; New Zealand's only incinerator already meets discharge limit. \$20,000 monitoring costs per facility per year.
Sewage sludge incineration	< 0.1	Regional council – implementation and enforcement	None	\$20,000 per existing consent reviewed. Cost savings for consents for new incinerators	No technology costs; one facility already required to meet discharge limit. \$20,000 monitoring costs per facility per year.
Municipal waste incineration	No municipal waste incinerator at present	Regional council – implementation and enforcement	None	None. Any incinerator will be new. NES will provide <i>cost savings</i> for new consents.	None. Any incinerator will be new. \$40,000 monitoring costs per incinerator for the first year of operation, then \$20,000 per year thereafter.
	Co-incineration in boilers [activity believed to occur on an <i>ad hoc</i> basis, but no definitive data available]	MfE – preparation of information Central and local government /industry sectors – distribute, inform and educate Regional council – implementation and enforcement	\$10,000	\$15,000 per council to identify sources (boilers) where waste is co-incinerated.	Upgrade costs for any boiler that co-incinerates waste, plus \$20,000 annual monitoring costs, OR (more likely) increased costs for waste disposal to landfill.

Action and dioxin source	Discharge estimate (% of total)	Administrative responsibility	Fiscal cost (central government)	Implementation and enforcement cost (regional council)	Compliance cost (owner)
Monitor and research					
Industrial fuel combustion (contaminated wood waste)	3	MfE: prepare information; design contaminated wood combustion air discharge monitoring programme in liaison with regional council and industry	\$150,000 for data collection programme	Data collection programme	Data collection programme
Non-ferrous metal processing	5	MfE: prepare information; design foundry air discharge monitoring programme in liaison with regional council and industry	\$150,000 for data collection programme	Data collection programme	Data collection programme
Accidental fires	7	Central government: report on chlorinated materials in buildings and available alternatives	\$50,000	None	None
Education					
Domestic fuel burning	16	MfE with other government agencies and industry	\$10,000	None	None
Crematoria	0.7	MfE/MoH/sector agencies (e.g. funeral directors association) – guideline for crematoria operation.	\$5,000	None	None
Do nothing					
Industrial fuel combustion (coal, virgin wood, gas and used oil)	10		None	None	None
Vehicle fuel combustion	2		None	None	None
Iron and steel manufacture	0.4		None	None	None
Minor miscellaneous sources	< 0.2		None	None	None

National estimate of costs

Costs need to be distinguished between *one-off costs* that will follow from the actions proposed and *on-going costs* for implementation and enforcement by local authorities and on-going compliance costs to industry.

One-off costs: These will include costs of \$50,000 to central government for the preparation of information and educational material, \$240,000 nationally to regional councils for the identification of sources and information dissemination, \$350,000 for research and data collection, and small ‘set-up’ costs to industry for dealing with new regulations.

A further \$400,000 could be expended if regional councils were to review all existing consents for waste incinerators. However, if councils decided not to implement the NES on all incinerators, at least not initially, this cost would be significantly less.

Technology costs to industry to meet the NES discharge limit for waste incinerators is estimated at approximately \$3 million assuming the average remaining lifetime of existing small medical waste incinerators is five years. Higher costs will be incurred if regional councils decide to review consents and implement the NES sooner, or alternatively, costs to industry could be close to zero if regional councils were not to require compliance until incinerators reach the end of their useful lives.

On-going costs: Annual costs to local government for enforcement of the ban on dioxin discharges to air are likely to anywhere between \$100,000 to \$250,000 nationally. Actual costs will depend on the level of action taken by individual councils; these costs can be expected to progressively decrease, as a change in behaviour not to undertake waste burning becomes habitual and adopted as customary practise.

Annual compliance costs to industry to monitor incinerator discharges will depend on how regional councils decide to implement the NES, and whether existing incinerators continue to operate (or continue to burn waste in the case of co-incinerators). As a worst case, compliance costs could be up to \$400,000 per year nationally assuming all existing consents were reviewed, and all incinerators were required to meet the NES discharge limit with no transition period. More realistically, compliance costs should be significantly less than this, as regional councils are unlikely to immediately review all existing consents, and of those that are reviewed, not all incinerators will be able to meet the discharge limit. These incinerators could either be replaced with alternative technology or the industry may outsource its waste disposal needs.

7.2 Transition provisions for an NES

The promulgation of an NES for dioxin discharge to air will require transitional provision arrangements. The nature of the transition provisions will be subject to whether the discharge is:

- i) prohibited by the NES
- ii) permitted by the NES, setting an upper discharge limit of 0.1 ng TEQ/Sm³
- iii) from a new or existing source.⁴³

Discharges that are prohibited

All discharges that are banned by the NES must meet the requirements of the standard from the time the NES comes into force.

New sources complying with an upper discharge limit

Discharges from new sources will be required to meet the upper discharge limit of 0.1 ng TEQ/Sm³ from the time the NES comes into force.

Existing sources complying with an upper discharge limit

The NES will not automatically apply retrospectively to any existing resource consent, but, at the discretion and instigation of regional councils, consent conditions may be reviewed when the NES comes into force. The transition provisions of the NES will apply to partly processed resource consent applications to discharge dioxin to air.

⁴³ The Stockholm Convention on POPs establishes more stringent requirements for reducing dioxin discharges from new sources than from existing sources.

For existing resource consents reviewed by regional councils in response to promulgation of the NES, the transitional provisions will be set on a case-by-case basis. In determining appropriate transition provisions, account should be taken of the:

- i) existing discharge concentration relative to the upper discharge limit of 0.1 ng TEQ/Sm³ specified within the NES
- ii) potential for adverse environmental and human health effects of the discharge
- iii) remaining life of the plant
- iv) cost of compliance with the NES.

Transition provisions commonly applied to waste incinerators in Europe and the United States typically allow three to five years for existing sources to achieve compliance with a dioxin standard.

An NES will override regional air plans, and some review and revision of air plans will be necessary, particularly with respect to the provisions covering open fires and open domestic burning.

7.3 Collection of additional data

The action plan highlights two areas of particular uncertainty concerning dioxin discharges to air that need to be addressed. These are the potential for dioxin discharge from secondary metals processing (both ferrous and non-ferrous metals) and from the combustion of contaminated wood as fuel in wood-fired boilers (co-incineration). Present estimates identify these two sources as comprising 5% and 3% respectively of current total dioxin discharge to air, but there is insufficient data available to be confident about these estimates.

Under the action plan it is proposed to collect additional information before deciding whether further policy interventions should be followed to reduce dioxin discharges from these sources. The Ministry for the Environment must clearly specify the data required.

- (i) The information is volunteered: in this scenario, the Ministry designs and implements a study cooperatively with regional councils and affected industries. The major part of the costs of the study are likely to be borne by the government.
- (ii) Required reporting: in this scenario, the Ministry in liaison with regional councils specifies the nature of data needed. Regional councils then require the reporting of the data as a condition of resource consents. This would apply to any new consents and existing consents upon review. The major part of the costs of data collection will be borne by the respective facility owners.

The Ministry for the Environment prefers the voluntary method as the more efficient and targeted way of collecting data. The necessary study could be initiated immediately funding was available and without having to wait for the review of existing consents. If funding was not available, the required reporting method could be progressed. The level of funding required to collect the necessary data is estimated at up to \$300,000.

It is recommended that data collection for both foundry operations and contaminated wood combustion be undertaken and completed within three years of the release of this action plan.

Research on the discharge of dioxin from accidental fires would enable more reliable estimates to be made for this source. This research would include an assessment of the quantity of materials consumed in building fires in New Zealand, and the availability of alternatives to chlorinated material for building construction. Possibly, this research could be undertaken using existing funding sources.⁴⁴ It is recommended that a report be completed within five years of ratification of the Stockholm Convention.

⁴⁴ For example, the New Zealand Fire Service Commission operates a contestable research fund.

Appendix 1: Supporting Documentation

This action plan is supported by the following technical documents, which have been published by the Ministry for the Environment. Although not all of these publications are specifically referenced within this action plan, information and policy decisions made draw primarily on the material given in these reports.

- 1 *Ambient Concentrations of Selected Organochlorines in Soils* (December 1998)
- 2 *Concentrations of PCDDs, PCDFs and PCBs in Retail Foods and an Assessment of Dietary Intake for New Zealanders* (September 1998)
- 3 *Ambient Concentrations of Selected Organochlorines in Estuaries* (June 1999)
- 4 *Ambient Concentrations of Selected Organochlorines in Rivers* (December 1999)
- 5 *Ambient Concentrations of Selected Organochlorines in Air* (December 1999)
- 6 *New Zealand Inventory of Dioxin Emissions to Air, Land and Water, and Reservoir Sources* (March 2000)
- 7 *Evaluation of the Toxicity of Dioxins and Dioxin-like PCBs: A Health Risk Appraisal for the New Zealand Population* (February 2001)
- 8 *Concentrations of Selected Organochlorines in Serum from the Non-occupationally Exposed New Zealand Population* (May 2001)
- 9 *Dioxin Discharges from Waste Incinerators: Technical Specifications for a National Environmental Standard* (August 2001)
- 10 *Multi-pathway Estimates of Exposures to Dioxin from Emissions to Air from Waste Incinerators* (August 2001)
- 11 *The Cost-effectiveness of Reductions in Dioxin Emissions to Air from Selected Sources: Economic Analysis for Section 32 of the Resource Management Act* (August 2001)

Copies of these reports are available from the Ministry for the Environment's web site: www.mfe.govt.nz/issues/waste/organo/ocreports or from www.dioxinplan.mfe.govt.nz

Appendix 2: Stockholm Convention

Articles 1 and 5 and the referred Annex C from the Stockholm Convention are reproduced in full in this Appendix. These excerpts are of direct relevance to the current action plan, and outline New Zealand's obligations under the terms of this convention.

Article 1

Objective

Mindful of the precautionary approach as set forth in Principle 15 of the Rio Declaration on Environment and Development, the objective of this Convention is to protect human health and the environment from persistent organic pollutants.

Article 5

Measures to reduce or eliminate releases from unintentional production

Each Party shall at a minimum take the following measures to reduce the total releases derived from anthropogenic sources of each of the chemicals listed in Annex C, with the goal of their continuing minimization and, where feasible, ultimate elimination:

(a) Develop an action plan or, where appropriate, a regional or subregional action plan within two years of the date of entry into force of this Convention for it, and subsequently implement it as part of its implementation plan specified in Article 7, designed to identify, characterize and address the release of the chemicals listed in Annex C and to facilitate implementation of subparagraphs (b) to (e). The action plan shall include the following elements:

(i) An evaluation of current and projected releases, including the development and maintenance of source inventories and release estimates, taking into consideration the source categories identified in Annex C;

(ii) An evaluation of the efficacy of the laws and policies of the Party relating to the management of such releases;

(iii) Strategies to meet the obligations of this paragraph, taking into account the evaluations in (i) and (ii);

(iv) Steps to promote education and training with regard to, and awareness of, those strategies;

(v) A review every five years of those strategies and of their success in meeting the obligations of this paragraph; such reviews shall be included in reports submitted pursuant to Article 15;

(vi) A schedule for implementation of the action plan, including for the strategies and measures identified therein;

(b) Promote the application of available, feasible and practical measures that can expeditiously achieve a realistic and meaningful level of release reduction or source elimination;

(c) *Promote the development and, where it deems appropriate, require the use of substitute or modified materials, products and processes to prevent the formation and release of the chemicals listed in Annex C, taking into consideration the general guidance on prevention and release reduction measures in Annex C and guidelines to be adopted by decision of the Conference of the Parties;*

(d) *Promote and, in accordance with the implementation schedule of its action plan, require the use of best available techniques for new sources within source categories which a Party has identified as warranting such action in its action plan, with a particular initial focus on source categories identified in Part II of Annex C. In any case, the requirement to use best available techniques for new sources in the categories listed in Part II of that Annex shall be phased in as soon as practicable but no later than four years after the entry into force of the Convention for that Party. For the identified categories, Parties shall promote the use of best environmental practices. When applying best available techniques and best environmental practices, Parties should take into consideration the general guidance on prevention and release reduction measures in that Annex and guidelines on best available techniques and best environmental practices to be adopted by decision of the Conference of the Parties;*

(e) *Promote, in accordance with its action plan, the use of best available techniques and best environmental practices:*

(i) *For existing sources, within the source categories listed in Part II of Annex C and within source categories such as those in Part III of that Annex; and*

(ii) *For new sources, within source categories such as those listed in Part III of Annex C which a Party has not addressed under subparagraph (d).*

When applying best available techniques and best environmental practices, Parties should take into consideration the general guidance on prevention and release reduction measures in Annex C and guidelines on best available techniques and best environmental practices to be adopted by decision of the Conference of the Parties;

(f) *For the purposes of this paragraph and Annex C:*

(i) *“Best available techniques” means the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for release limitations designed to prevent and, where that is not practicable, generally to reduce releases of chemicals listed in Part I of Annex C and their impact on the environment as a whole. In this regard:*

(ii) *“Techniques” includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;*

(iii) *“Available” techniques means those techniques that are accessible to the operator and that are developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages; and*

(iv) *“Best” means most effective in achieving a high general level of protection of the environment as a whole;*

(v) “Best environmental practices” means the application of the most appropriate combination of environmental control measures and strategies;

(vi) “New source” means any source of which the construction or substantial modification is commenced at least one year after the date of:

a. Entry into force of this Convention for the Party concerned; or

b. Entry into force for the Party concerned of an amendment to Annex C where the source becomes subject to the provisions of this Convention only by virtue of that amendment.

(g) Release limit values or performance standards may be used by a Party to fulfill its commitments for best available techniques under this paragraph.

Article 7

Implementation plans

1. Each Party shall:

(a) Develop and endeavour to implement a plan for the implementation of its obligations under this Convention;

(b) Transmit its implementation plan to the Conference of the Parties within two years of the date on which this Convention enters into force for it; and

(c) Review and update, as appropriate, its implementation plan on a periodic basis and in a manner to be specified by a decision of the Conference of the Parties.

2. The Parties shall, where appropriate, cooperate directly or through global, regional and subregional organizations, and consult their national stakeholders, including women’s groups and groups involved in the health of children, in order to facilitate the development, implementation and updating of their implementation plans.

3. The Parties shall endeavour to utilize and, where necessary, establish the means to integrate national implementation plans for persistent organic pollutants in their sustainable development strategies where appropriate.

Annex C

UNINTENTIONAL PRODUCTION

Part I: Persistent organic pollutants subject to the requirements of Article 5

This Annex applies to the following persistent organic pollutants when formed and released unintentionally from anthropogenic sources:

<i>Chemical</i>
<i>Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF)</i> <i>Hexachlorobenzene (HCB) (CAS No: 118-74-1)</i> <i>Polychlorinated biphenyls (PCB)</i>

Part II: Source categories

Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls are unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions. The following industrial source categories have the potential for comparatively high formation and release of these chemicals to the environment:

- (a) Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge;*
- (b) Cement kilns firing hazardous waste;*
- (c) Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching;*
- (d) The following thermal processes in the metallurgical industry:*
 - (i) Secondary copper production;*
 - (ii) Sinter plants in the iron and steel industry;*
 - (iii) Secondary aluminium production;*
 - (iv) Secondary zinc production.*

Part III: Source categories

Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls may also be unintentionally formed and released from the following source categories, including:

- (a) Open burning of waste, including burning of landfill sites;*
- (b) Thermal processes in the metallurgical industry not mentioned in Part II;*
- (c) Residential combustion sources;*
- (d) Fossil fuel-fired utility and industrial boilers;*
- (e) Firing installations for wood and other biomass fuels;*
- (f) Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil;*

- (g) Crematoria;
- (h) Motor vehicles, particularly those burning leaded gasoline;
- (i) Destruction of animal carcasses;
- (j) Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction);
- (k) Shredder plants for the treatment of end of life vehicles;
- (l) Smouldering of copper cables;
- (m) Waste oil refineries.

Part IV: Definitions

1. For the purposes of this Annex:

(a) “Polychlorinated biphenyls” means aromatic compounds formed in such a manner that the hydrogen atoms on the biphenyl molecule (two benzene rings bonded together by a single carbon-carbon bond) may be replaced by up to ten chlorine atoms; and

(b) “Polychlorinated dibenzo-p-dioxins” and “polychlorinated dibenzofurans” are tricyclic, aromatic compounds formed by two benzene rings connected by two oxygen atoms in polychlorinated dibenzo-p-dioxins and by one oxygen atom and one carbon-carbon bond in polychlorinated dibenzofurans and the hydrogen atoms of which may be replaced by up to eight chlorine atoms.

2. In this Annex, the toxicity of polychlorinated dibenzo-p-dioxins and dibenzofurans is expressed using the concept of toxic equivalency which measures the relative dioxin-like toxic activity of different congeners of polychlorinated dibenzo-p-dioxins and dibenzofurans and coplanar polychlorinated biphenyls in comparison to 2,3,7,8-tetrachlorodibenzo-p-dioxin. The toxic equivalent factor values to be used for the purposes of this Convention shall be consistent with accepted international standards, commencing with the World Health Organization 1998 mammalian toxic equivalent factor values for polychlorinated dibenzo-p-dioxins and dibenzofurans and coplanar polychlorinated biphenyls. Concentrations are expressed in toxic equivalents.

Part V: General guidance on best available techniques and best environmental practices

This Part provides general guidance to Parties on preventing or reducing releases of the chemicals listed in Part I.

A. General prevention measures relating to both best available techniques and best environmental practices

Priority should be given to the consideration of approaches to prevent the formation and release of the chemicals listed in Part I. Useful measures could include:

- (a) The use of low-waste technology;
- (b) The use of less hazardous substances;

(c) *The promotion of the recovery and recycling of waste and of substances generated and used in a process;*

(d) *Replacement of feed materials which are persistent organic pollutants or where there is a direct link between the materials and releases of persistent organic pollutants from the source;*

(e) *Good housekeeping and preventive maintenance programmes;*

(f) *Improvements in waste management with the aim of the cessation of open and other uncontrolled burning of wastes, including the burning of landfill sites. When considering proposals to construct new waste disposal facilities, consideration should be given to alternatives such as activities to minimize the generation of municipal and medical waste, including resource recovery, reuse, recycling, waste separation and promoting products that generate less waste. Under this approach, public health concerns should be carefully considered;*

(g) *Minimization of these chemicals as contaminants in products;*

(h) *Avoiding elemental chlorine or chemicals generating elemental chlorine for bleaching.*

B. Best available techniques

The concept of best available techniques is not aimed at the prescription of any specific technique or technology, but at taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions. Appropriate control techniques to reduce releases of the chemicals listed in Part I are in general the same. In determining best available techniques, special consideration should be given, generally or in specific cases, to the following factors, bearing in mind the likely costs and benefits of a measure and consideration of precaution and prevention:

(a) *General considerations:*

(i) *The nature, effects and mass of the releases concerned: techniques may vary depending on source size;*

(ii) *The commissioning dates for new or existing installations;*

(iii) *The time needed to introduce the best available technique;*

(iv) *The consumption and nature of raw materials used in the process and its energy efficiency;*

(v) *The need to prevent or reduce to a minimum the overall impact of the releases to the environment and the risks to it;*

(vi) *The need to prevent accidents and to minimize their consequences for the environment;*

(vii) *The need to ensure occupational health and safety at workplaces;*

(viii) Comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;

(ix) Technological advances and changes in scientific knowledge and understanding.

(b) General release reduction measures: When considering proposals to construct new facilities or significantly modify existing facilities using processes that release chemicals listed in this Annex, priority consideration should be given to alternative processes, techniques or practices that have similar usefulness but which avoid the formation and release of such chemicals. In cases where such facilities will be constructed or significantly modified, in addition to the prevention measures outlined in section A of Part V the following reduction measures could also be considered in determining best available techniques:

(i) Use of improved methods for flue-gas cleaning such as thermal or catalytic oxidation, dust precipitation, or adsorption;

(ii) Treatment of residuals, wastewater, wastes and sewage sludge by, for example, thermal treatment or rendering them inert or chemical processes that detoxify them;

(iii) Process changes that lead to the reduction or elimination of releases, such as moving to closed systems;

(iv) Modification of process designs to improve combustion and prevent formation of the chemicals listed in this Annex, through the control of parameters such as incineration temperature or residence time.

C. Best environmental practices

The Conference of the Parties may develop guidance with regard to best environmental practices.

Appendix 3: Proposed National Environmental Standard for Dioxin Discharge to Air

Resource Management (National Environmental Standard for Dioxin) Regulations 2001

1. Title

These regulations are the Resource Management (National Environmental Standard for Dioxin) Regulations 2001.

2. Commencement

These regulations come into force on [to come]

3. Interpretation

In these regulations

Burning means incineration, co-incineration or any other thermal treatment whether or not it is carried out in any equipment and whether such equipment was built for the purpose of incineration, co-incineration or thermal treatment.

Co-incineration means a process where the main purpose is the generation of energy or production of material products and that

- (i) uses waste as a regular additional fuel; or
- (ii) thermally treats the waste for the purpose of its disposal,

but does not include co-incineration that takes place in such a way that the main purpose of the plant is not the generation of energy or the production of material products but the thermal treatment of waste.

Dioxin means one or more of the polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans or dioxin-like polychlorinated biphenyls listed in **Schedule 1**.

Incineration means the thermal treatment of waste with or without recovery of the heat generated and includes the incineration by oxidation of waste as well as other thermal treatment processes such as pyrolysis, gasification or plasma processes in so far as the substances resulting from the treatment are subsequently combusted.

Landfill means any land or premise used for the storage, transfer, treatment, or disposal of waste materials or other waste management purposes or for composting organic material.

Oxygen-enriched atmosphere means combustion conditions in which the oxygen is supplied by a source in a greater concentration than that obtained from ambient air; and includes conditions where the source of concentrated oxygen is used as the principal oxygen supply or for supplementary oxygen.

PCBs means polychlorinated biphenyls and includes but is not limited to the dioxin-like PCBs listed in **Schedule 1**.

PCP means pentachlorophenol.

Waste means any material, whether it is a solid or a liquid, discarded or discharged for final disposal by its holder, and includes but is not limited to-

- (a) refuse, garbage or municipal waste:
- (b) hospital, medical, clinical, pathological or veterinary waste:
- (c) quarantine waste:
- (d) sludge or solids derived from liquid-borne municipal, industrial or trade waste:
- (e) agricultural chemicals or agricultural chemical waste:
- (f) wood preservatives or biocides:
- (g) wood waste including
 - (i) plywood, particle board; or
 - (ii) wood waste and timber that may contain halogenated organic compounds, including PCP, or metals as a result of treatment with wood preservatives or coatings; or
 - (iii) wood waste originating from construction and demolition waste.
- (h) plastic, rubber, resins, or adhesives:
 - (i) paints, inks, dyes, pigments, liquors, varnishes or other surface coatings:
- (j) halogenated solvents or solvent residues:
- (k) waste liquids including used oil or other waste petroleum products
 - (i) with a calorific value of 30 megajoules or less per kilogram of waste liquid; or
 - (ii) containing 10 milligrams or more of polychlorinated aromatic compounds, PCP or PCBs per kilogram of waste liquid; or
 - (iii) containing 1000 milligrams or more of chlorine per kilogram of waste liquid:
- (l) unidentified chemicals or laboratory residues:
- (m) waste from contaminated sites or buildings
- (n) motor vehicles or vehicle parts, or any other combination of metals and combustible material.

4. Application of Standard

- (1) These regulations apply to the discharge of dioxin as a contaminant to air from the burning, incineration or co-incineration of waste.
- (2) These regulations do not apply to the discharge of dioxin as a contaminant to air from the following activities:
 - (a) Cremation of human beings or pets:
 - (b) Burning of vegetable waste from agriculture, forestry or food processing:
 - (c) Burning of virgin wood or virgin wood waste:
 - (d) Burning of liquids with a calorific value greater than 30 megajoules per kilogram of liquid if that liquid –
 - (i) contains less than 10 milligrams of polychlorinated aromatic compounds, PCP or PCBs per kilogram of liquid; and
 - (ii) contains less than 1000 milligrams of chlorine per kilogram of waste liquid.
 - (e) Burning of black liquor and fibrous vegetable waste from virgin pulp and paper production:
 - (f) Incineration plants used for research, development, or testing in order to improve the incineration process and which burn less than 50 tonnes of waste each year.

5. Discharges to air from industrial and trade premises permitted

- (1) The discharge of dioxin as a contaminant to air from the incineration of waste in any incineration or co-incineration plant located on any industrial or trade premise is permitted if the discharge from each plant
 - (a) complies with the discharge limit in **regulation 6**;
 - (b) complies with the reporting conditions in **regulation 10**; and
 - (c) complies with the operating conditions in **Schedule 2** or in a resource consent that is authorised by **regulation 11**.
- (2) For the purposes of **this regulation** and **regulations 6 to 12** "waste" does not include -
 - (a) plywood, particle board; or
 - (b) wood waste and timber that may contain halogenated organic compounds (other than PCP) or metals as a result of treatment with wood preservatives or coatings.

6. Discharge concentration limit

- (1) A discharge of dioxin to air must not exceed 0.1 nanograms of toxic equivalents (TEQ) per cubic metre of discharge at a temperature of 0 degrees Centigrade, a pressure of 101.3 kilopascals, no moisture content and 11% oxygen when measured by volume or the percentage of oxygen specified in a resource consent granted in accordance with **regulation 11**.
- (2) The concentration of dioxin TEQ for a discharge must be calculated in accordance with **regulation 7**.

7. Calculation of TEQ for a discharge

- (1) The concentration of dioxin TEQ for a discharge must be calculated as follows:
 - (a) the concentration of each dioxin derived from a measurement taken in accordance with **regulation 8** and adjusted in accordance with **regulation 9** must be multiplied by the toxic equivalency factor listed in **Schedule 1** for that dioxin;
 - (b) the results from the calculations in paragraph (a) must be added together.
- (2) If a dioxin listed in **Schedule 1** is not detected in a discharge when the measurement is made under **regulation 8** that dioxin must be assumed to be present in the discharge and an amount equal to half the limit of detection must be used in the calculation in **subclause (1) (a)**.
- (3) For the purposes of this regulation limit of detection means a concentration of a dioxin at the lowest level at which that substance could be detected in a discharge using the methods specified in **regulation 8**.

8. Sample collection and analysis of a discharge

- (1) A discharge must be sampled in accordance with this regulation to determine the dioxin concentration in a discharge, the temperature and pressure of the discharge and amount of oxygen and moisture in the discharge.
- (2) A discharge sample must be collected when the incineration or co-incineration plant is operating at normal combustion temperatures and with normal control equipment, and the waste fed to the plant is waste that generates the highest dioxin discharges for that plant.
- (3) A discharge must be sampled in accordance with United States Environmental Protection Agency Method 0023A.
- (4) Every sample must be analysed for each dioxin in accordance with United States Environmental Protection Agency Methods 8290 and 1668A.

- (5) The location of every point at which a sample is taken must comply with United States Environmental Protection Agency Method 1.
- (6) The temperature of the discharge at the sample point must be less than 200 degrees Centigrade.
- (7) The time during which a sample of the discharge is measured must be not less than 3 hours.
- (8) At least 3 samples must be taken and, each sample result calculated in accordance with **regulation 7** and adjusted in accordance with **regulation 9**, and the arithmetic mean of the 3 results must be treated as the discharge concentration.
- (9) The oxygen content of the discharge must be measured over the same period as a sample of the discharge is measured.
- (10) The sampling must be carried out by an agency accredited for the sampling of the discharge of dioxin and the analysis must be carried out by an agency accredited for the analysis of dioxin by International Accreditation New Zealand, or the National Association of Testing Authorities.

9. Reference conditions to determine dioxin in discharge

- (1) The concentration of dioxin in a discharge to air must be determined by adjusting the actual dioxin content of a sample taken in accordance with **regulation 8** to the dioxin content that would have been present had the sample been taken at a temperature of 0 degrees Centigrade, a pressure of 101.3 kilopascals, no moisture content and 11% oxygen when measured by volume or the percentage specified in a resource consent granted in accordance with **regulation 11**, instead of the actual conditions at which the sample was taken.
- (2) The calculations in United States Environmental Protection Agency Method 0023A must be used to adjust-
 - (a) the temperature from the actual temperature at which the sample was taken to 0 degrees:⁴⁵
 - (b) the pressure from the actual pressure at which the sample was taken to 101.3 kilopascals:
 - (c) the moisture content from the actual moisture content at which the sample was taken to no moisture content.
- (3) The oxygen content must be adjusted from the actual oxygen content at which the sample was taken to 11% oxygen content by using the following calculation:

$$C_{\text{ref}} = C_{\text{meas}}(20.9 - \%O_{2 \text{ ref}})/(20.9 - \%O_{2 \text{ meas}})$$

where:

C_{ref} is the dioxin concentration expressed at the oxygen concentration referred to in **regulation 9 (1)**

C_{meas} is the dioxin concentration at the oxygen concentration measured in the discharge, expressed for gas with no moisture content

$\%O_{2 \text{ ref}}$ is the oxygen concentration referred to in **regulation 9 (1)**

$\%O_{2 \text{ meas}}$ is the measured oxygen concentration in the discharge, expressed for gas with no moisture content.

⁴⁵ It is noted that United States Environmental Protection Agency Method 0023A requires that the temperature be corrected to 20 degrees Centigrade. The National Environmental Standard for dioxin requires the same procedure to be applied as stipulated in Method 0023A, but the temperature must be corrected to a temperature of 0 degrees Centigrade as specified in **regulation 9 (1)** of these regulations.

10. Reporting of the discharge of dioxin

- (1) The owner or occupier of the industrial or trade premises on which an incineration or co-incineration plant is located must report in accordance with this regulation the discharge of dioxin to air from each incineration plant on the premises to the regional council of the region in which the premises is situated.
- (2) The owner or occupier of the premises must report -
 - (a) every 6 months for 2 years after commencing the discharge of dioxin from a new incineration or co-incineration plant:
 - (b) every 2 years on an incineration or co-incineration plant, other than a plant to which paragraph (a) applies, if the discharge of dioxin from an incineration or co-incineration plant is less than half the discharge limit specified in **regulation 6** for 2 consecutive reports and the plant complies with these regulations:
 - (c) every year on any other incineration or co-incineration plant.
- (3) A report must contain the information set out in **Schedule 3**.
- (4) Despite subclause (2), the regional council may by notice in writing require the owner or occupier to report to the council more frequently if the incineration or co-incineration plant has not complied with the discharge limit specified in **regulation 6**.

Resource consents and rules in plans

11. Resource consents for controlled activities

- (1) A resource consent for a controlled activity may be granted for the incineration or co-incineration of waste in trade and industrial premises for the following matters:
 - (a) For an incineration or co-incineration plant in use at the date these regulations come into force, to specify the location of a sampling port instead of the location specified in the United States Environmental Protection Agency method referred to in **regulation 8 (4)**.
 - (b) To specify operating conditions other than those specified in **Schedule 2** if the operating conditions specified in the resource consent ensure that the discharge of dioxin does not exceed the discharge limit specified in **regulation 6**.
 - (c) To specify the percentage of oxygen, other than the percentage specified in **regulation 9 (1)**, to which the actual oxygen percentage must be adjusted if the waste is incinerated or co-incinerated in an oxygen enriched atmosphere.

12. Resource consents or rules in plans for discharge of dioxin

- (1) A rule must not be included in a plan allowing the discharge of dioxin as a contaminant to air from the burning, incineration or co-incineration of waste at any trade or industrial premises, any place, or any source whether moveable or not.
- (2) A resource consent must not be granted allowing the discharge of dioxin as a contaminant to air from the burning or incineration or co-incineration of waste at any industrial or trade premises any place, or any source whether moveable or not.
- (3) Despite **subclause (2)**, a resource consent may be granted for the matters specified in **regulation 11**.

13. Discharge of dioxin from places, including landfills, or any source prohibited

- (1) The discharge of dioxin as a contaminant to air from the burning of waste at any place, or from any source whether moveable or not, is a prohibited activity unless the discharge complies with **regulations 5 to 11** of these regulations.
- (2) A resource consent may be granted for the matters specified in **regulation 11**.
- (3) For the purposes of this regulation, "place" includes a landfill but does not include a dwellinghouse or the land on which a dwellinghouse is sited.

14. Burning of waste on land on which a dwellinghouse is sited

- (1) The burning of waste on any land on which a dwellinghouse is sited is a prohibited activity unless that waste is vegetative waste, paper, cardboard waste, or virgin wood waste.
- (2) **Subclause (1)** does not permit the burning of vegetative waste, paper or cardboard waste, or virgin wood waste in contravention of a rule in a plan or a resource consent.

15. Incineration of PCP treated timber and PCP contaminated wood waste

Despite any other provision in these regulations, the discharge of dioxin as a contaminant to air from the incineration of timber or wood waste treated or contaminated with PCP in any incineration or co-incineration plant located on any industrial or trade premises is a prohibited activity unless the discharge complies with **regulations 5 to 11** of these regulations.

16. Burning of copper wire a prohibited activity

Despite any other provision in these regulations, the discharge of dioxin as a contaminant to air from the burning of copper, including electrical copper wire and cabling, coated with polyvinyl chloride or any other plastic material is a prohibited activity.

Schedule 1

Reg. 2, Reg. 7,

Dioxin	Toxic Equivalency Factor
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01
Octachlorodibenzo-p-dioxin	0.0001
2,3,7,8-Tetrachlorodibenzofuran	0.1
1,2,3,7,8-Pentachlorodibenzofuran	0.05
2,3,4,7,8-Pentachlorodibenzofuran	0.5
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01
Octachlorodibenzofuran	0.0001
3,3',4,4'-Tetrachlorinated biphenyl (77)	0.0001
3,4,4',5'-Tetrachlorinated biphenyl (81)	0.0001
3,3',4,4',5'-Pentachlorinated biphenyl (126)	0.1
3,3',4,4',5,5'-Hexachlorinated biphenyl (169)	0.01
2,3,3',4,4'-Pentachlorinated biphenyl (105)	0.0001
2,3,4,4',5'-Pentachlorinated biphenyl (114)	0.0005
2,3',4,4',5'-Pentachlorinated biphenyl (118)	0.0001
2',3,4,4',5'-Pentachlorinated biphenyl (123)	0.0001
2,3,3',4,4',5'-Hexachlorinated biphenyl (156)	0.0005
2,3,3',4,4',5'-Hexachlorinated biphenyl (157)	0.0005
2,3',4,4',5,5'-Hexachlorinated biphenyl (167)	0.00001
2,3,3',4,4',5,5'-Heptachlorinated biphenyl (189)	0.0001

Schedule 2

Reg. 5

Operating conditions

1. The following operating conditions apply to incineration plants that incinerate waste and do not apply to co-incineration plants:
 - (a) The incineration plant must be designed, equipped, built and operated in such a way that the gas resulting from the process is raised, after the last injection of combustion air, in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of 850 °C, as measured near the inner wall, for two seconds. If waste with a content of more than 1% of chlorinated organic substances by weight, expressed as chlorine, is incinerated, the temperature must be raised to 1100 °C for at least two seconds.
 - (b) Each line of the incineration plant must be equipped with at least one auxiliary burner. This burner must be switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below 850 °C or 1100 °C as the case may be. The burner must be used during plant start-up and shut-down operations in order to ensure that the temperature of 850 °C or 1100 °C as the case may be is maintained at all times during these operations and as long as unburned waste is in the combustion chamber.
 - (c) During start-up and shut-down or when the temperature of the combustion gas falls below 850 °C or 1100 °C as the case may be, the auxiliary burner must not be fed with fuels which can cause higher emissions than those resulting from the burning of gas or diesel.
2. The following operating condition applies to co-incineration plants only:

The co-incineration plant must be designed, equipped, built and operated in such a way that the gas resulting from the co-incineration of waste is raised in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of 850 °C for two seconds. If waste with a content of more than 1% of chlorinated organic substances by weight, expressed as chlorine, is co-incinerated, the temperature must be raised to 1100 °C.
3. The following operating conditions apply to both incineration plants and co-incineration plants.
 - (a) Incineration and co-incineration plants must have and operate an automatic system to prevent waste feed:
 - (i) at start-up, until the temperature of 850 °C or 1100 °C as the case may be has been reached;
 - (ii) whenever the temperature of 850 °C or 1100 °C as the case may be is not maintained;
 - (iii) whenever the continuous measurement of carbon monoxide required by **subclause 3 (b)** show that the carbon monoxide discharge limits specified in **subclause 3 (e)** are exceeded.
 - (b) Incineration and co-incineration plants must have systems for continuously measuring carbon monoxide concentrations and the temperature of the combustion gases and the measurements recorded by these systems must be kept by the owner or occupier of the premises for a period of 5 years from the date the measurement is recorded.

- (c) The combustion gases must be sampled for carbon monoxide in accordance with the methods and performance specifications set out by United States Environmental Protection Agency Performance Specification 4.
- (d) The carbon monoxide concentration of the combustion gases must be determined by adjusting the actual carbon monoxide concentration measured in accordance with **subclause 3 (c)** to a concentration that would have been present had the measurement been made at a temperature of 0 degrees Centigrade, a pressure of 101.3 kilopascals and no moisture content, instead of the actual conditions at which the measurement was made.
- (e) The following discharge limits for carbon monoxide concentration, at a temperature of 0 degrees Centigrade, a pressure of 101.3 kilopascals and no moisture content, must not be exceeded except during start-up and shut-down of the incineration and co-incineration plant:
 - (i) 50 milligrams of carbon monoxide per cubic metre of combustion gas determined as a 24-hour or daily average; or
 - (ii) 150 milligrams of carbon monoxide per cubic metre of combustion gas determined as a 10-minute average for more than 5% of all measurements over a 12 month period; or
 - (iii) 100 milligrams of carbon monoxide per cubic metre of combustion gas as a 30-minute average for more than 5% of all measurements over a 12 month period.
- (f) Not more than 10% of all 30-minute average carbon monoxide measurements, with each individual measurement having been measured in accordance with **subclause 3 (c)** and adjusted in accordance with **subclause 3 (d)**, may be discarded due to instrument malfunction or maintenance over a 24 hour operating period, and not more than 3% of all 24-hour or daily average carbon monoxide measurements may be discarded over a 12-month period.

Schedule 3

Reg. 10

Information to be included in a dioxin discharge report

- (a) Name and address of owner of the facility being monitored:
- (b) Name and address of the reporting organisation or individual:
- (c) Details, including accreditation, of the sampling and analytical personnel and their organisation:
- (d) Date on which the discharge samples were collected, start and completion times, place of measurements and the report date:
- (e) Details of process operating conditions during sampling, including a record of the waste feed rate, combustion chamber temperatures and control equipment operating conditions:
- (f) General description of the waste feed composition, rate including chlorine content:
- (g) Location of the sample plane, with respect to the nearest upstream and downstream flow disturbance:
- (h) Number of sampling points (traverses) across the sample plane:
- (i) Sampling start and stop times:
- (j) Average chimney gas velocity at the point of sampling:
- (k) Average chimney gas temperature at the point of sampling:
- (l) Moisture content of the chimney gas:
- (m) Oxygen content of the chimney gas:
- (n) 10-minute average carbon monoxide concentrations during each dioxin test run:
- (o) Chimney gas sample volume collected under actual field conditions:
- (p) Chimney gas sample volume collected when adjusted for temperature, pressure, moisture content and oxygen in accordance with **regulation 9**:
- (q) Concentration (mass per volume basis) of each dioxin, after adjusting for temperature, pressure, moisture content and oxygen in accordance with **regulation 9**:
- (r) Mass discharge of each dioxin:
- (s) The limit of detection (mass per volume basis) of each dioxin listed in **Schedule 1** that was not detected, using a gas sample volume adjusted for temperature, pressure, moisture content and oxygen in accordance with **regulation 9**:
- (t) Recovery of isotopically labelled standards used in the sampling and analytical procedures:
- (u) Concentration (mass per volume basis) of each dioxin as a TEQ and the concentration of the total dioxin TEQ for a discharge calculate in according with **regulation 7**:
- (v) Mass discharge of each dioxin as a TEQ and the concentration of the total dioxin TEQ for a discharge calculated in according with **regulation 7**, but without adjusting for temperature, pressure, moisture content and oxygen as required by **regulation 9**:
- (w) Any factors that may have affected the discharge sampling and analytical results:
- (x) The precision of the discharge results:
- (y) Calibration details for each instrument used to take measurements:
- (z) Verification of sampling and analytical methodologies used.