Canadian Environmental Protection Act

Strategic Options for the
Management of Toxic Substances

Electric Power Generation (Fossil Fuel) Sector

Report of Stakeholder Consultations

Canada

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BACKGROUND

The Ministers of Environment and Health made a commitment to consult stakeholders following their announcement of the results of substances found to be toxic in the first Priority Substances List(PSL), pursuant to the *Canadian Environmental Protection Act* (CEPA). To ensure that the most effective and efficient environmental management options would be addressed, within the context of pollution prevention and sustainable development, the Strategic Options Process was developed with Environment Canada and Health Canada as the key partners. This consultative mechanism provides the basis for recommendations to the accountable ministers.

DISCLAIMER

This report on stakeholder consultations is published by Environment Canada. It presents the results of the consultations, requested by the Minister of Environment and the Minister of Health, regarding management options for substances that have been declared toxic under the *Canadian Environmental Protection Act* which are released by the electric power generation (fossil fuel) sector.

Publication of this report does not constitute approval of its content by the Minister of Environment or the Minister of Health.

ACKNOWLEDGEMENT

The Chair would like to extend appreciation to all the members, corresponding members and other stakeholders who participated in the development and review of this report.

List of Acronyms

BTU	British Thermal Unit
CCME	Canadian Council of the Ministers of the Environment
CEN	Canadian Environmental Network
CEPA	Canadian Environmental Protection Act
ECE	Economic Commission for Europe
ENGO	Environmental non-governmental organization
EPA	Environmental Protection Agency (U.S.)
EPG	Electric Power Generation
GATT	General Agreement on Tariffs and Trade 1994 (now Annex 1A of the WTO Agreement)
HAP	Hazardous air pollutants
LRTAP	Long range transport of air pollution
NAFTA	North American Free Trade Agreement
NPRI	National Pollutant Release Inventory
NUG	Non-utility generator
PM	Particulate matter
PM_{10}	Particulate matter with diameter less than or equal to 10 micrometres
$PM_{2.5}$	Particulate matter with diameter less than or equal to 2.5 micrometres
POP	Persistent organic pollutant
PSL	Priority Substance List
RfC	Inhalation reference concentration (used in risk assessment)
SOP	Strategic Options Process
SOR	Strategic Options Report

STOP	A Montréal-based environmental group which is a member of CEN
TBD	Technical Background Document
UNCED	United Nations Conference on Environment and Development
WTO	World Trade Organization (established 1995)

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1. Introduction

Under the Canadian Environmental Protection Act (CEPA), the first Priority Substances List (PSL 1) assessments have declared 25 of the 44 substances assessed, as toxic. Based on preliminary information developed to date by Environment Canada, a number of PSL 1 toxic substances and one CEPA Schedule 1 toxic substance were believed to be released from the fossil fuel Electric Power Generation (EPG) sector and to require consideration under the Strategic Options Process. These substances were: **mercury, inorganic arsenic, inorganic cadmium, hexavalent chromium compounds, inorganic fluorides and nickel (oxidic, sulphidic and soluble) compounds**.

To ensure that, where it is deemed to be warranted, the most effective and efficient options for managing releases of toxic substances from the EPG Sector are considered, Environment Canada, Health Canada, and key partners from other federal departments, provincial governments, the electrical utilities and environmental non-governmental organizations have participated in the Strategic Options Process (SOP). The multistakeholder EPG Sector Issue Table was formed in response to the decision by Environment Canada, supported by the Federal/Provincial Advisory Committee on CEPA, to proceed under the SOP.

Further deliberations of the Issue Table, subsequently added **lead, polyaromatic hydrocarbons, benzene, dibenzodioxins/dibenzofurans, trichloroethylene and dichloromethane** as well as **total particulate matter**[1] for consideration. The last substance is associated with respirable particulate matter with diameters less than or equal to 10 micrometres (PM_{10}) which is undergoing assessment under the Priority Substances List 2, and the attached metals. A scoping exercise by the Issue Table narrowed further considerations to particulate matter, metals and fluorides. Based on further screening of management options and industry response measures, it was finally decided to focus the development of management options on particulate matter and its associated metals. Given the risk assessment information submitted to the Issue Table, utilities did not agree with further pursuing specific management options of metals associated with particulate matter with the exception of nickel, for which utilities concluded that further assessment might be recommended on a case-by-case basis in connection with oil-fired power plants. Mercury and fluoride were excluded from further screening because: 1) there are uncertainties regarding the extent to which mercury emissions from the EPG Sector may pose a risk to health or the environment; 2) there are no demonstrated environmental effects resulting from emissions of fluorides by the EPG sector and 3) there are no demonstrated add-on (efficient and cost-effective) technological control systems for mercury or fluoride. However, it has been accepted by this Issue Table that follow-up work on these substances may be required.

1 "Total particulate matter" refers to emitted particulate matter of all size ranges. "Respirable particulate matter" can be inhaled and could pose a health risk; it is generally less than or equal to 10 micrometres in diameter and is often referred to as "PM_{10}".

Management options were not pursued for dichloromethane, trichloroethylene, PAHs, dibenzodioxins, dibenzofurans and benzene because emissions of these substances were believed to be minimal based upon the available testing and inventory information.

Four proposals regarding the reduction of particulate matter emissions from the electric utility sector, one from the Canadian electrical utilities, two from environmental non-government organizations and one from Environment Canada, were received by the Issue Table.[2]

2. Points of Consensus Reached by the Issue Table

The Issue Table as a whole could not support a specific proposal. Nevertheless, the Issue Table, working in the spirit of cooperation and assessing the information gathered and shared during the SOP, did reach consensus on a number of issues, in particular, the following:

- The original 6 substances being considered under the Strategic Options Process were expanded to 13. After the problem definition phase of the process, the list for the further assessment of management options was narrowed to 7 CEPA PSL 1 /Schedule 1 toxic substances (cadmium, arsenic, hexavalent chromium, lead, nickel, fluorides from coal-fired facilities and mercury), plus particulate matter. The utilities supported the further evaluation under the SOP only of particulate matter and mercury, with nickel from oil-fired stations suggested for evaluation on a local basis as required.

- Management options would be focused on atmospheric emissions. Releases of the SOP substances to solid and liquid waste are controlled by provincial regulations and permits. (Environment Canada will follow up on these issues.)

- Management options would focus on coal and oil-fired steam plants. Gas-fired plants contribute negligible releases of the SOP substances.

- It was agreed that a reduction of particulate matter emissions from this sector would be a proactive and positive step forward, in view of the growing concern about the possible health effects of particulate matter emissions. Reductions in particulate matter emissions would also result in reductions in emissions of associated metals.

- Mercury was excluded from consideration for management options because there are uncertainties regarding the extent to which mercury emissions from the EPG sector may pose a risk to health which require further research. Furthermore, there are no demonstrated add-on (efficient and cost-effective) technological control systems for mercury.

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2 The proposal from Environment Canada was received by the Issue Table after its last meeting on 27 November 1996.

- Fluoride was excluded from consideration for management options because there are no demonstrated environmental effects resulting from emissions of fluorides by the EPG sector. As well, there are no demonstrated add-on (efficient and cost-effective) technological control systems for fluoride.

- An improved and updated air emission inventory for the utility sector was completed[3]; emissions from this sector are significantly smaller than originally estimated.

- It was not possible to quantify the benefits to health or the environment resulting from reductions in emissions of SOP substances from this sector.

Of the four possible management options (regulatory performance standards, emission trading/bubbles, negotiated agreements and voluntary measures) that resulted from the screening described in Chapter 4 of this report, two, *negotiated agreements* and *regulatory performance standards*, were favoured by various members of the Issue Table. The utilities (and some federal government members) preferred negotiated agreements, while the two ENGOs (environmental non-governmental organizations CEN and STOP) specified regulatory performance standards. However, it appeared that ENGOs would accept negotiated agreements if they were developed in a transparent process, and if they included firm targets, deadlines and penalties.

3. Recommendations for Management Options and Targets (Minority Positions)

a) Recommendations of the utilities

It was recommended by the utility participants at the Issue Table that the utilities and the Government of Canada, with the participation of the provinces, enter into a covenant:[4]

> 1) For utilities and the Government of Canada to cooperate in the further assessment of potential risks, if any, associated with emissions of mercury and particulate matter from fossil fuel electric utilities. This assessment will be a mutually agreeable effort of the Government of Canada and Canadian electric utilities, and any determinations will be based on a rigorous, science-based approach that will include current knowledge, complete risk assessment information, and characterization of uncertainty in management decisions. This determination will also include full knowledge and understanding of the

[3] The Canadian Environmental Network dissented with this conclusion. See Appendix C of this report for details.

[4] It must be stressed that all recommendations put forth by the utilities are conditional upon the acceptance of all parts of their proposal. The utility members stated that it was not possible to modify their proposal within the Issue Table.

contribution of emissions from all sectors of the economy, and a rigorous inventory of naturally occurring substances which will assist in the assessment of cost-effectiveness and benefits to the environment of any proposed action. The information used for the determination will be reviewed by a Science Advisory Panel acceptable to both Government and utilities, and it will form part of the information used in any future initiatives pertaining to these substances.

2) for reducing the particulate emission rate for new plants starting first commercial operation after 31 December 1997 to 0.03 pounds per million BTUs of heat input (12.9 nanograms per Joule).

3) for utilities to review particulate emissions from existing plants with their respective province and to reach agreement by 31 December 2000 on an appropriate plan of action. If a utility fails to reach agreement with its provincial regulator, it will achieve the following emission rates by 31 December 2005 for all facilities to be in operation after 31 December 2010.

- 0.2 pounds per million BTU (86 nanograms per Joule) for facilities with annual capacity factors of less than 20%

- 0.1 pounds per million BTU (43 nanograms per Joule) for facilities with annual capacity factors of greater than 20%

4) For the Government of Canada to commit that information leading to any future initiatives regarding the emissions of CEPA-toxic substances from the electric utility fossil fuel sector will include a rigorous, science-based approach which will encompass current knowledge, complete risk assessment information, characterization of uncertainty in management decisions, and utility emission inventories which have been reviewed and approved by both utilities and the Government of Canada. This information will also include full knowledge and understanding of the contribution of emissions from all sectors of the economy, and a rigorous inventory of naturally occurring substances which will assist in the assessment of cost-effectiveness and benefits to the environment of any proposed action. The information will be reviewed by a Science Advisory Panel acceptable to both Government and utilities.

b) Recommendation of the Canadian Environmental Network (CEN)

It was recommended by CEN that:

- all existing plants meet by federal regulation a limit of 0.03 pounds per million BTU (12.9 nanograms per Joule). (No deadline was specified.)

- a multi-media, mandatory pollution planning system be established under a federal permit system, as well as a mandatory reporting system for this sector under the National Pollution Release Inventory (NPRI).

c) Recommendation of STOP

It was recommended by STOP that

- all existing coal-fired plants meet by federal regulation a limit of 0.03 pounds per million BTU (12.9 nanograms per Joule) by 1 January 2000. (Oil-fired plants were not specified in the STOP recommendation.)

- further research be done on mercury emissions from this sector.

d) Recommendations of the Environment Canada members of the Issue Table

Environment Canada proposes the following actions:

i) New plants

It is recommended that the present Thermal Power Generation Emissions - National Guidelines for New Stationary Sources (CEPA, 1993) be revised so that the particulate matter emission limit for new plants commencing commercial operation after 31 December 1997 will be equivalent to 0.03 lb per million BTU heat input (12.9 nanograms per Joule).[5]

[5] It should be noted that the establishment of Canada-wide environmental performance standards should not be construed as baseline discharge limits derived on the basis of health or environmental and health risks.

ii) Existing plants

It is recommended that the Government of Canada (led by Environment Canada) and each of the major electric utilities, with input from the respective provinces, enter into a framework agreement on a process to reduce emissions of particulate matter and associated metals from coal and oil-fired power plants. The discussions of this framework agreement should begin as soon as possible and be completed by 31 December 1997. An opportunity for public comment will be provided. It is envisaged that the framework agreement will lead to the development of action plans by the utilities and their respective provincial governments. The action plans should contain quantitative targets that result in an emission rate equivalent to 0.1 lb/million BTU heat input (43 nanograms per Joule) or lower. Flexibility could be provided by emissions averaging or emission trading within provinces.

The finalization of action plans between utilities and their respective provincial governments should be completed by no later than 31 December 1998. Environment Canada will review these action plans and they will be made available to the public.

An assessment of progress in terms of reductions and impacts, and the need for further actions, will be completed by Environment Canada, with participation of utilities and provinces by 31 December 2003.

4. Estimated Ranges of Emission Reductions, Costs and Impacts of the Proposals

a) Emission reductions and costs

Environment Canada estimated the emission reductions and associated impacts which could result from the implementation of the various proposals. The following table shows total estimated Canadian emission reductions associated with the proposals. The costs resulting from these proposals are estimated to be in the range of 8 to 71 million dollars per year.

	Estimated emission reductions			
Substance of concern	**Utilities' proposal[6]**	**STOP proposal**	**CEN proposal**	**Environment Canada proposal**
Particulate matter	0, 105,000 to 107,000 tonnes (0, 83 to 85%	111,000 to 116,000 tonnes (88 to 92%)	114,000 to 119,000 tonnes (90 to 94%)	106,000 to 110,000 tonnes (84 to 87%)
Arsenic	0, 5.1 to 5.2 tonnes (0, 66 to 67%)	5.4 to 5.9 tonnes (70 to 76%)	5.4 to 5.9 tonnes (70 to 76%)	5.1 to 5.3 tonnes (66 to 68%)
Cadmium	0, 0.1 to 0.2 tonnes (0, 22 to 26%)	0.2 to 0.3 tonnes (31 to 51%)	0.2 to 0.3 tonnes (32 to 53%)	0.1 to 0.2 tonnes (23 to 27%)
Hexavalent chromium	0, 0.3 tonnes (0, 48 to 50%)	0.3 to 0.4 tonnes (53 to 61%)	0.3 to 0.4 tonnes (54 to 64%)	0.3 tonnes (49 to 51%)
Lead	0, 5.3 to 5.5 tonnes (0, 71 to 73%)	5.6 to 6.3 tonnes (75 to 83%)	5.7 to 6.3 tonnes (76 to 84%)	5.3 to 5.5 tonnes (71 to 73%)
Mercury	0, 0.1 tonnes (0, 5 to 7%)	0.2 to 0.4 tonnes (12 to 29%)	0.2 to 0.4 tonnes (13 to 30%)	0.1 tonnes (5 to 7%)
Nickel	0, 8.6 to 11.2 tonnes (0, 41 to 53%)	5.5 to 6.8 tonnes (26 to 32%)	13.5 to 15.8 tonnes (64 to 75%)	8.9 to 11.6 tonnes (42 to 55%)

Since one plant dominates the particulate matter emissions within the electric power generation sector, a reduction in emissions from this plant would also significantly reduce the total emissions from this sector in Canada.

b) Impacts and benefits

Environment Canada's comparison of the key financial indicators for the major utilities potentially affected by the proposals suggests that, even for the ENGO proposals, changes in the utilities' financial positions would be marginal. It was estimated, for example, that if the control cost increases were passed on through an even rate increase to all electricity consumers in a given province, the impact on electricity rates would be small (i.e. 1.6% or less for all provinces)[7]. As a basis for comparison, between 1985 and 1994 the lowest annual rate increase was 0.08% and the largest was 7.2%; these increases have however been smaller in recent years. Environment Canada also noted that (1) these rate increases would likely not occur immediately but would be tied to increases in spending on pollution control measures; and (2) though in the past it has been possible to pass cost increases on to the consumers of electricity given the status of most utilities as regulated monopolies, it is likely that under current conditions a utility may now have to absorb some or all of the increase in cost through reduced net revenues.

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6 The zero values reflect the possibility of agreements between the provinces and the utilities that result in no required action; the higher values reflect the implementation of the utilities' 'fallback' commitment if no action plans are developed.

7 These estimates do not take into account the anticipated increase in demand over the next decades, possible consumer response to increased prices or the effects on electricity prices of increased competition in the industry.

The utility members of the Issue Table wished to have it recorded that, in their opinion, the sector may not be able to pass these costs on through prices given the new competitive environment, and that a trade-off with other program expenditures, including other environmental programs, would be required. It was felt that even with an increase in the price of electricity as low as 2%, the competitive nature of the business will affect decisions regarding the location and relocation of new and existing industry with the consequent impact on employment. The utilities also believe that these added costs will put provinces heavily dependent on fossil fuel electricity generation at a disadvantage.

Environment Canada's opinion was that the broader macroeconomic impacts are very difficult to predict. If competitive pressures force the utilities to absorb the increased costs associated with the management of the substances of concern, there will be no inflationary effects. If, on the other hand, all of these costs are passed on to consumers (in the manner assumed above), the effect on inflation was estimated to be 0.05%, a magnitude that is probably not detectable in practice. [8]

It was the utilities' opinion that, given the evolution of the Canadian electricity sector from monopolies to a competitive market, the consequences of increasing electricity prices for Canadian utilities will be a reduction in opportunities to export electricity south of the border, additional risk on their ability to retain their current customer base, and increased vulnerability to U.S. plants taking away domestic market share.

Although an attempt was made by Environment Canada[9] to develop estimates of the benefits to health and the environment of reducing emissions of the SOP substances from this sector, it became evident that the benefits could not be quantified with any precision. Environment Canada concluded that, as it was only possible to estimate some of the potential benefits associated with controlling the substances of concern, and as there was considerable uncertainty associated with each step in this analysis, a comparison of the benefit estimates and the technical control costs would not be meaningful. Details on the estimates of emission reductions, costs and benefits associated with each proposal may be found in the report *Review of Proposals to the Power Sector Strategic Options Process Issue Table* prepared for Environment Canada by Resources Futures International, March 1997. This report may be found in Volume 3 of the Technical Background Document.

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8 Given the maximum increase of electricity rates of 1.6% and the contribution of electricity prices to the change in the Consumer Price Index of 3.13% averaged over the years 1988-1995, the maximum net effect on inflation would be 0.05%.

9 Estimates of increases in long-term ambient concentrations of the substances of concern were based on the results of modelling the dispersion of pollutants around most of the power plants addressed through the SOP. This information was then linked to the distribution of human population densities in the vicinities of the plants making possible crude exposure estimates. Finally, the results of this modelling exercise were combined with information on dose-response relationships and economic values from the PSL Assessment Reports and the Cleaner Vehicles and Fuels Study (Report to the Canadian Council of Ministers of the Environment by the Task Force on Cleaner Vehicles and Fuels, 23 October 1995.)

The utilities' view is that estimating health and environmental benefits from a sector of the economy is a complex matter even when a clear risk from the sector is identified. In the case of this SOP review, a risk from emissions of SOP substances from utilities was not identified. Therefore, the utilities' opinion is that the lack of an identified risk is the main reason for being unable to identify the benefits.

Health Canada stated that estimating the health risks from a sector of the economy is a complex matter because analyses and assumptions about human exposure are often incomplete and our understanding of the relevant biological, chemical and physiological processes are limited. In the Priority Substances Risk Assessment Documents, it was concluded that several substances, including a number of carcinogens, known to be emitted by this and other sectors, pose a health risk to the general public in Canada. In the case of the review within this SOP, the utilities concluded that the incremental health risks posed by some of the substances emitted from the electric power sector are essentially negligible, or not an identifiable health problem. Health Canada has countered that individual contributions to risk for specific substances may be negligible for many individual sectors; however, when taken together, the sum total of "negligible" risks may not be negligible.

It was, however, agreed by members of the Issue Table that the control of particulate matter emissions would be a proactive step in environmental management.

5. Recommendations of the Issue Table members for Further Investigations

Some of the members of the Issue Table were in agreement with respect to recommendations for further collaborative investigation among governments and the industry in the following areas:

a) Mercury and particulate matter

1) It is recommended that industry and governments work together in an effort to improve the knowledge on emissions from this sector of mercury and particulate matter and determine to what extent these emissions may pose a risk to health or the environment.[10]

[10] Utilities do not agree to this recommendation unless the terms of item 1 of the utilities' proposal concerning the Science Advisory Panel (see proposal in Section 5.1 of the text of the SOR) are met.

b) Inventories

2) It is recommended that up-to-date information on emissions from utilities be maintained as required by governments and/or industry. Releases to air, water and land will continue to be reported to provincial authorities as stipulated in the various jurisdictions.[11]

3) It is recommended that the Government of Canada continue to strive for better information from all industrial sectors through improved procedures and protocols which meet quality assurance criteria, and continue to improve the inventory of natural sources.

c) Fluorides

4) It is recommended that the Government of Canada clarify specific environmental impacts of fluorides as they relate to the utility sector and, if any environmental risk is identified, that the appropriate course of action be discussed with the utilities.[12]

d) Dioxins and furans

With the information available, releases of polychlorinated dibenzodioxins and polychlorinated dibenzofurans by this industrial sector appear to be relatively low. Measurements were made at five stations belonging to two utilities. However, Environment Canada believes that this amount of data may be insufficient to assess the releases of these substances from this industrial sector. If new information indicates that these emissions are in fact significant, it is recommended that:

> 5) the Government of Canada and the utilities review appropriate courses of action.

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11 Utilities committed themselves only to report to their respective provincial governments. The sharing of the information between the federal and provincial governments will be for governments to determine.

12 Utilities do not agree to this recommendation unless the terms of the paragraph of the utilities' proposal beginning with "In response to these commitments..." (see utilities'proposal in Section 5.1 of the text of the SOR) are met.

6. Comments of Stakeholders on the Strategic Options Process for the EPG Sector

Canadian utilities are appreciative of the improvement in the quality and quantity of information on the emissions from their sector. The utilities also note that their proposal was submitted even though, in their view, the information on risk assessment presented at the Issue Table concluded that there were no identifiable risks resulting from emissions from their sector. As well, from their perspective, the risk caused by emissions from the electrical utilities sector in the United States is essentially negligible, based upon a recent interim final report by the US Environmental Protection Agency. They believe that, based on available information, their proposal is proactive, practical, efficient, cost-effective and delivers real emission reductions sooner than would be the case with regulation by government, and at a fraction of the cost. In addition, the Canadian utilities wished to record their views on the Strategic Options Process itself, from the perspective of its "successes" and "shortcomings". These views are presented in Appendix C of this Strategic Options Report.

The federal government has identified the electric power generation sector as contributing to the presence of CEPA-toxic substances in the Canadian environment. As stated in the Problem Definition Statements (Appendix C in Volume 1 of the Technical Background Document), many of these substances are carcinogens for which there is believed to be some degree of risk at any level of exposure. For these substances, Health Canada maintains that effort should be directed towards reducing human exposure to the extent possible. In view of the fact that mercury and lead have been shown to cause serious adverse health effects, Health Canada believes that effort should be directed to minimizing exposure to these substances.

The Canadian Environmental Network (CEN) have noted their concerns related to the risk assessment process, since it involves scientific uncertainty due to theoretical and practical limitations in scientific knowledge, data collection and analytical methodologies. They felt that risk assessment also involves complex ethical issues surrounding trans-generational impacts for certain substances and the ability of individuals to understand and voluntarily assume risks associated with exposure to these substances. As a result, CEN does not agree that it is a useful tool in the decision-making process. CEN has also questioned the quality and reliability of the emission data submitted by the industry. CEN's views are presented verbatim in Appendix C of this report.

1. Introduction

1.1 Context

Environment Canada and Health Canada are responsible for providing advice to the Ministers of Environment and Health on the management of substances that have been declared toxic under Section 11 of the Canadian Environmental Protection Act (CEPA). This management involves identifying sources of these toxic substances, and management options to protect human health and the environment. The management of toxic substances is also guided by the federal government's Toxic Substances Management Policy (TSMP). The process of developing goals, targets and management options for substances declared toxic under CEPA is referred to as the Strategic Options Process (SOP).

Under CEPA, the first Priority Substances List (PSL 1) assessments have declared toxic 25 of the 44 substances that were assessed. Based on preliminary information developed by Environment Canada, a number of PSL 1 toxic substances and one CEPA Schedule 1 toxic substance were believed to be released from the fossil fuel electric power generation (EPG) sector and to require consideration under the Strategic Options Process. The PSL 1 substances were: **inorganic arsenic, inorganic cadmium, hexavalent chromium compounds, inorganic fluorides and nickel compounds (oxidic, sulphidic and soluble)**; the CEPA Schedule 1 substance was **mercury**. The decision to proceed with a sectoral Issue Table to develop recommendations for the management of these releases was supported by the Federal-Provincial Advisory Committee.

At the initial Issue Table meeting, it was decided to add the following PSL 1 and Schedule 1 toxic substances for consideration: **polyaromatic hydrocarbons, benzene, dibenzodioxins/dibenzofurans, trichloroethylene, dichloromethane and lead**. Subsequently the Issue Table added releases of **total particulate matter**[1] for consideration because respirable particulate matter with diameters less than or equal to 10 micrometres (PM_{10}) is undergoing assessment for toxicity. Environment Canada and Health Canada were supportive of including particulate matter because controlling emissions of particulate matter would also reduce emissions of metals bound to the particles.

Living organisms, including humans, may be exposed to these toxic substances which can enter the environment via atmospheric emissions, wastewater streams and the production of solid waste.

[1] "Total particulate matter" refers to emitted particulate matter of all size ranges. "Respirable particulate matter" can be inhaled and could pose a health risk; it is generally less than or equal to 10 micrometres in diameter and is often referred to as "PM_{10}".

1.2 The Strategic Options Process (SOP)

The EPG Sector Issue Table (to be referred to henceforth as the "Issue Table") was formed in response to the decision by Environment Canada, and supported by the Federal-Provincial Advisory Committee on CEPA during a conference call on 24 August 1995, to assess under the Strategic Options Process the management of toxic substances released from the electric power sector. More specifically, the Issue Table was to develop, where warranted, goals, targets, and effective and efficient options for managing releases of toxic substances from this sector in order to reduce potential risks to human health and the environment. The complete terms of reference for the EPG Issue Table are shown in Appendix A. Representatives from Environment Canada, Health Canada, and key partners from other federal departments, provincial governments, the EPG Sector and environmental non-governmental organizations participated in the process. A list of the participants is shown in Appendix B.

The full Issue Table subsequently met five times: 23-24 October 1995, 7-8 March 1996, 8-9 July 1996, 16-17 September 1996 and 27 November 1996[2]. The agenda and minutes of each meeting are available on public file.

The work of the Issue Table was organized, at least initially, around the work of three task groups. The three groups met on 10-12 January 1996; subsequent meetings were arranged by the chair of each task group. The objectives set out for the task groups are noted below; the full terms of reference for each group is given in Volume 2 of the Technical Background Document which is the supporting document for this Strategic Options Report.

> *Task Group 1 (Inventories):* To develop inventories of releases of toxic substances by the electric generating sector, other industrial sectors and natural sources to the atmosphere, wastewater streams, and solid waste.
>
> *Task Group 2 (Risk Assessment and Exposure Data):* To provide the Issue Table with information on risks to health and environment associated with the SOP emissions of the Electric Utilities sector, so that the Issue Table can determine which substances it should focus on in the management assessment phase.
>
> *Task Group 3 (Options and Costs):* 1) To provide information to finalize, if required, the scoping portion of the process and the setting of appropriate targets for the management of the toxic substances of concern and 2) to identify the management option or combination of options that would provide industry and government with approaches for ensuring that these targets are met in a manner that is environmentally effective and cost efficient.

[2] In addition to the full Issue Table meetings there was a meeting of all Task Groups simultaneously on 10-12 January 1996.

1.3 The Strategic Options Report (SOR)

The objective of this Strategic Options Report is to set out, for the Ministers of Environment and of Health, the recommendations of Issue Table members for the management of CEPA-toxic substances. Where warranted, goals, targets and the most effective and efficient options for managing releases of toxic substances of concern from the EPG Sector are recommended in this SOR. These recommendations are made within the context of pollution prevention and sustainable development and are consistent with the Toxic Substances Management Policy.

The supporting document for this Strategic Options Report is the two-volume Technical Background Document (TBD) for the Issue Table:

- Volume 1 summarizes the technical work carried out by the three task groups and contains Appendices A to D containing supplementary information that was submitted to the Issue Table as a whole, such as the Problem Definition Statements which summarize the information available on potential adverse effects on health and the environment from exposure to heavy metals, inorganic fluorides and particulate matter;

- Volume 2 comprises appendices containing: the reports of Task Groups 1 and 2; and reports on work carried out under contract to these Task Groups;

- Volume 3 comprises appendices containing: the reports of Task Group 3; and reports on work carried out under contract to this Task Group.

These documents are available upon request from Environment Canada (see Appendix D).

1.4 Industry Profile

Electricity generation, transmission and distribution is primarily within the jurisdiction of the provinces. The sector is dominated by 12 integrated companies across Canada.

The electric power industry has a significant presence within the Canadian economy. In 1995, there were about 88,000 people directly employed in the industry, accounting for 0.8 per cent of the total Canadian employment. Total revenue for 1995 was $27.6 billion. Of this total, approximately $1.2 billion or 4.3 per cent came from export earnings. The electric power industry has steadily increased its contribution to Canada's Gross Domestic Product (i.e., from 2.3 per cent in 1960, to 3.0 per cent in 1980, to 3.6 per cent in 1995).

The electric power industry accounted for a large share of investment in the energy sector in 1995, with capital expenditures of $7.6 billion accounting for 35 per cent of the total investment in the energy sector, and 6 per cent of the total investment in the economy.

Total electricity generated in Canada was 534,869 Gigawatt hours (GWh) in 1995. Of this total, 82 per cent came from provincially-owned utilities, 9 per cent came from investor-owned utilities and 9 per cent from industrial establishments. Hydro generation accounted for 62 per cent of the total generation, followed by nuclear generation (17 per cent), coal-fired generation (15 per cent), natural gas-fired generation (3 per cent), oil-fired generation (2 per cent), and other types of generation (1 per cent). Major coal-fired generation came from Alberta, Ontario, Saskatchewan, Nova Scotia and New Brunswick. The breakdown of fossil-fuel generation capacity by province is shown in Table 1.1.

Table 1.1: Fossil-fuel electricity generation capacity in 1995 by province (utilities only)

Province	Generating Capacity (Megawatts)	Province	Generating Capacity (Megawatts)
British Columbia	950	Québec	1602
Alberta	6691	New Brunswick	1787
Saskatchewan	1765	Nova Scotia	1932
Manitoba	369	Newfoundland & Labrador	500
Ontario	11296	**CANADA**	**26892**

The electric power industry in Canada is now under a restructuring resulting from technological developments and changes in electricity markets. As the many regulated utilities operating in a monopoly area are drawn into an increasingly competitive North American market for electricity, changes in both regulatory structures and business strategies will be required. At the same time, the industry is expected to face new and more stringent environmental standards. The challenge for electric utilities will be to respond to these forces without causing serious financial problems or structural dislocation.

During the past 15 years, Canada's electric utilities have been active in a number of national programs and studies, including those related to atmospheric emissions. In 1994 the electricity sector volunteered to participate in the Accelerated Reduction and Elimination of Toxics (ARET) program. All utilities participating in the ARET program have reviewed and analyzed their material purchases in terms of their content of ARET-listed toxic substances. Several utilities have retained the services of the Geological Survey of Canada (GSC) to monitor and analyze power plant stack emissions, focusing on toxic substances. Others have participated in a major international computer

modelling study of the pathways and chemical conversions of hazardous pollutants as they flow through generic power plants. When combined with the results of the stack tests undertaken by the GSC, the computer-based study should help the utilities identify and assess opportunities for managing trace emissions of toxic substances. An overview of the electricity sector's programs to control environmental emissions may be found in Volume 2 of the Technical Background Document.

1.5 Linkages of the Electric Power Sector Strategic Options Process to other initiatives

The Strategic Options Process is linked to several other initiatives within Canada related to toxic substances, as follows:

Canadian Environmental Protection Act (CEPA) received royal assent on 28 June June 1988 and, at the time of writing, is under review. The 'Thermal Power Generation Emissions - National Guidelines for New Stationary Sources' were first published under the Clean Air Act in 1981, and were re-issued under section 8 of CEPA in 1990. Revised Guidelines were published in the Canada Gazette, Part 1, on 15 May 1993. These guidelines contain limits for sulphur dioxide, nitrogen oxides and particulate matter discharges into the air from new fossil fuel fired power plants containing a steam cycle. Environment Canada led the development of a series of five 'Environmental Codes of Practice for Steam Electric Power Generation', the last three of which were published under section 8 of CEPA in the late 1980's and early 1990's and are meant to provide guidance on wastewater discharges and other matters relating to steam-electric power plants.

Accelerated Reduction/Elimination of Toxics (ARET) ARET is a voluntary multistakeholder process designed to determine if voluntary commitments to reduce or eliminate releases can achieve environmental goals faster and be more flexible than regulations alone. In 1994, ARET challenged selected companies and government departments to achieve the virtual elimination of 14 persistent, bioaccumulative and toxic substances, over the long term, with a target for the year 2000 of a 90% reduction. For 87 other hazardous toxic substances ARET seeks short-term emission reductions by the year 2000 of 50%. Candidate substances include; mercury, cadmium, arsenic, hexavalent chromium, lead and inorganic nickel.

Canada-Wide Accord on Environmental Harmonization A sub-agreement of the Canada-Wide Accord is the prioritization, development and implementation of environmental standards, guidelines and objectives for protecting the environment and human health. Particulate matter in air (ambient standards) and mercury in all media (discharge and ambient standards) are among the substances for which standards, guidelines or objectives may be developed.

The Canada-Ontario Agreement (COA) respecting the Great Lakes Basin Ecosystem The transboundary movement of toxic substances is addressed in the Canada-Ontario Agreement, which is designed to implement programs and actions by the federal and Ontario governments to restore and protect ecosystems in Great Lakes Basin. In particular, Canada and Ontario will work with the producers and sources of pollutants in the Great Lakes Basin Ecosystem to achieve significant interim reductions (90% by 2000) in the release of persistent, bioaccumulative and toxic substances by adopting the philosophy of zero discharge. COA is based on a two Tier system: Tier I substances are targeted for virtual elimination by adopting the philosophy of zero discharge for local or direct sources, and by encouraging similar actions binationally and globally in order to eliminate distant or long-range transport as inputs to the Great Lakes Basin; and Tier II substances which are to be managed by voluntary programs by industry (to be consistent with the ARET initiative) and others to reduce the use, release or generation, and to establish specific timelines and targets for achieving their virtual elimination. Mercury and cadmium are considered to be Tier I and Tier II substances under COA, respectively. In addition to the point of impingement standards under Regulation 346, some metals like mercury and cadmium are targeted for voluntary reductions under the Canada-Ontario Agreement.

The following international negotiations and agreements must be considered in any assessment on management options associated with mercury, cadmium and lead.

Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin. The binational strategy will provide a coordinated effort for the virtual elimination of specific, persistent, bioaccumulative and toxic substances, i.e., mercury and lead, between 1996-2005. A major issue which will be addressed under the strategy is the long-range transport of pollutants into the Basin and will build on existing efforts such as COA.

North American Free Trade Association (NAFTA/CEC) Resolution on the Sound Management of Chemicals. In October 1995, the United States, Mexico and Canada signed a Resolution on the Sound Management of Chemicals under the auspices of NAFTA/CEC. The Resolution established a trilateral Steering Committee to initiate action on the reduction of persistent, bioaccumulative and toxic substances, which include mercury. Country-specific action plans were to be submitted by December 1996. The Resolution gives priority to the management of substances of mutual concern that are persistent, bioaccumulative and toxic but allows for cooperation on a broader scale to ensure the sound management of chemicals.

United Nations Economic Commission for Europe (UN ECE) Convention on Long-range Transport of Air Pollution (LRTAP Convention). In November 1995, the Executive Body of the UN ECE LRTAP Convention decided to proceed with the negotiation of protocols to control the long-range atmospheric transport of persistant organic pollutants (POPs) and the following heavy metals: mercury, lead and cadmium. As a signatory of the LRTAP Convention, Canada will continue to be involved in these

Protocol negotiations and will be examining the range of options and deciding the specific nature of Canada's commitment. Provisions exist for additional heavy metals and POPs to be included in the protocol.

Protection of the Marine Environment from Land-Based Activities. One of the priorities identified at the 1992 UN Conference on Environment and Development (UNCED) Earth Summit in Rio was the protection of the marine environment from land-based activities. In November 1995, Canada and 110 nations adopted the Global Programme of Action (GPA) for the Protection of Marine from Land-Based Activities. The GPA identifies eight source contaminants for action, including heavy metals ie. mercury, cadmium and lead. The GPA invites nations to develop national and regional programmes of action. UNEP has decided on a legally binding instrument for POPs under the global program.

1.6 Provincial management of Electric Power Sector SOP substances

Many jurisdictions have regulatory standards, guidelines or objectives specifically focused on particulate matter. Most utilize these in conjunction with permitting regimes. Table 1.2 summarizes the variety of existing standards and objectives for particulate matter. The standards listed in the second through fourth columns of Table 1.2 are generally applicable ambient air quality or point of impingement standards. In addition, some jurisdictions (e.g. Québec) establish emissions standards for various sources, such as cement kilns and incinerators.

Most of these standards cover all particulate matter. Some focus on PM_{10} - particles with an average aeronautic diameter of less than or equal to 10 micrometres. Because of the emerging research into the health effects of smaller particles, many jurisdictions are now reviewing their standards for particulate matter. The Federal Provincial Advisory Committee under CEPA is reviewing Canada's National Ambient Air Quality Objective for suspended particulates. At present the standard specifies a maximum annual "desirable" concentration of 60 $\mu g/m^3$, maximum annual and 24 hour "acceptable" concentrations of 70 $\mu g/m^3$ and 120 $\mu g/m^3$ respectively, and a "maximum 24 hour average "tolerable" concentration of 400 $\mu g/m^3$. Environment Canada officials involved with this process suggest that they anticipate a new PM_{10} objective shortly, and a new $PM_{2.5}$ objective within a few months.

Table 1.2 also indicates the additional measures that may be taken for managing particulate matter emissions specifically from electric power plants. The approaches are very briefly summarized below. British Columbia and Prince Edward Island are not included because they do not currently contain power plants examined in detail by the Issue Table. It should be noted that both Ontario and Québec utilize risk assessment in setting standards.

Alberta. For plant-specific approvals, power plants are required to meet both an in-stack concentration and mass emission limit for particulate matter. As a minimum, the concentration of particulate matter is specified in the *Substance Release Regulation.* A more stringent limit can be specified based upon the control efficiency of the installed equipment. Compliance is based on manual stack surveys performed twice a year. Additionally, power plants have set opacity limits which range from 20% (four plants), 30% (one plant) and 40% (two plants). Compliance with this regulation is determined by a visible emission reader as specified in the *Substance Release Regulation.* Power plants are required to monitor by a continuous monitor six-minute averages of in-stack opacity. Frequency distributions of opacity are charted monthly; these are reviewed by the provincial ministry.

Saskatchewan. The plant-specific permits issued to power plants in Saskatchewan do not specify any limits on particulate matter in terms of rates of emission or mass loading. They are all supposed to meet a 40% opacity standard. Permits may require modelling dispersion and establishment of monitoring stations. They may also require supplying an emissions inventory.

Manitoba. Manitoba issues plant-specific permits that among other things requires operators to meet ambient air quality standards. There are no consistent additional standards for plants.

Ontario. Fossil plants in Ontario are usually used for peaking power. The emissions from electric power plants are covered under the *General Air Regulation 346* which employs a point of impingement approach (i.e. each plant must achieve emission levels such that the predicted maximum concentration at ground level is below the required standard). The predicted concentration will be a function of emission rates, stack height, local meteorological characteristics and other variables. All standards are expressed as half hour limits. Under Section 9 of the Ontario Environmental Protection Act, plants must receive a certificate of approval to construct, alter, extend or replace any structure, equipment, apparatus, mechanism or thing that may discharge into the natural environment. Certificates of Approval are also required when a process or rate of production is altered changing the rate of discharge into the natural environment. Under Regulation 346, visible emissions (opacity) are limited to 20% at the point of emission and, for a period of four minutes in the aggregate in any thirty minute period, to no greater than 40% at the point of emission. All thermal plants will have done source testing. Ontario does not regulate separately particulate matter of smaller size classes. All six metals of concern to this Issue Table are regulated by Ontario under its *General Air Regulation 346* using a point of impingement approach. Regulation 337 Ambient Air Quality Criteria provide limits for hourly concentrations of substances which are intended to protect the natural environment. Fossil fuel generating facilities are also covered under the acid rain program which establishes legal limits for SO_2 under Regulation 355 and a voluntary cap for NOx. Finally, a fine particulate matter strategy is being considered as an element of the Ontario Regional Smog Management Plan.

Table 1.2: Summary of provincial regulatory approaches for particulate matter and associated metals

Jurisdiction	Description	Ambient 24 hour mean for particulates	Ambient annual mean for particulates	Other regulatory measures for particulates from power plants (1)	Restrictions on associated metals (2)
British Columbia	Interim Objective	50 $\mu g/m^3$	NA	NC	NC
Alberta	Ambient Air Quality Guidelines	100 $\mu g/m^3$	60 $\mu g/m^3$	plant-specific approvals, particulate concentrations and mass emission limits, in-stack opacity monitoring, opacity limit (varies from 20% to 40%)	none
Saskatchewan	Air Regulations (ambient air quality standards)	120 $\mu g/m^3$	70 $\mu g/m^3$	plant-specific permits, no emission control except for opacity standard of 40%	none
Manitoba	Regulations for Various Pollutants (ambient air quality criteria)	120 $\mu g/m^3$	70 $\mu g/m^3$	plant-specific permits, may include emission limits	none
Ontario	Ambient Air Quality Criteria Regulation (337) General Air Pollution - Regulation 346	120 $\mu g/m^3$ 100 $\mu g/m^3$ (point of impingement criterion for PM_{44})	60 $\mu g/m^3$	Point of impingement standards -> Ambient Air Quality Criteria Opacity limits: 20%; 40% for 4 minutes in a 30-minute aggregate, 40% at point of emission	1/2 hour point of impingement standards: cadmium 5 $\mu g/m^3$ mercury (all) 5 $\mu g/m^3$, (alkyl) 1.5 $\mu g/m^3$ nickel 5 $\mu g/m^3$ lead 6 $\mu g/m^3$ new limits proposed for others
Québec	Quality of the Atmosphere Reg. (ambient air quality standards) Quality of the Atmosphere Regulations (emissions standard for fossil fuel burners)	150 $\mu g/m^3$	70 $\mu g/m^3$	60 - 85 ng/J (for existing installations, depending on size) 45 - 60 ng/J (for new installations, depending on size) no additional measures beyond regulated emission limits	none

Nova Scotia	Air Quality Regulations (ambient air quality standards)	120 µg/m^3	70 µg/m^3	plant-specific permits, requirements in different forms	none
New Brunswick	Air Quality Regulations (ambient air quality standards)	120 µg/m^3	70 µg/m^3	plant-specific approvals; opacity limit of 20%; some plants have emission rate limits	none
Prince Edward Island	Air Quality Regulations (ambient air q. stds)	120 µg/m^3	70 µg/m^3	NC	NC
Newfoundland	Air Pollution Control Regulations Ambient air quality standards Point of impingement standards	 120 µg/m^3 100 µg/m^3 (over 30 minutes)	 70 µg/m^3 60 µg/m^3	point of impingement standards for PM_{10} of 50 µg/m^3 and for $PM_{2.5}$ of 25 µg/m^3 ; concentration at property line for particulates less than 44 µm is limited to 80 µg/m^3	combination of point of impingement and property line standards (see text)

Notes:
(1) See text for more details.
(2) The metals that may associated with particulates include: arsenic, cadmium, chromium, lead, mercury and nickel.
(3) NA - not applicable, NC - not considered in detail because fossil fuel-fired electric generating stations were not evaluated by the Issue Table.

Québec. The oil and gas plants in Québec are used for peaking power only. The air quality regulation specifies a particulate matter emission standard for power plants of 60 ng/J for plants built before November 14, 1979 and 45 ng/J for plants built after that date. Plants receive certificates of authorization before starting up. They must then demonstrate that they can meet the terms of the regulation. Opacity is not controlled. There are no provisions for particulate matter of different size classes.

New Brunswick. The emissions of particulate matter are managed on a plant-specific basis. Approvals are issued to each plant that take account of its location, environmental context, fuel and air pollution control equipment. Dispersion modelling is required for each approval. Dispersion modelling is also used on a daily basis to predict possible exceedances of ground level limits depending on the meteorological conditions and load demand. The approvals may impose conditions for continuous emission monitoring (for some pollutants) or the establishment of a monitoring network (e.g. high volume samplers for total suspended particulate matter). All plants are required to limit opacity to 20% except during startup, when the limit is 40%. For some plants there may be emission rate constraints.

Nova Scotia. In addition to adhering the ambient air quality regulations, power plants in Nova Scotia receive individual approvals. The limits specified in each approval may vary from plant to plant. There may also be other requirements under the permits, such as for periodic stack tests.

Newfoundland and Labrador. There are two ways in which emissions are limited from power plants in Newfoundland and Labrador. A calculated point of impingement concentration must not be exceeded, nor should a different standard applied to concentrations at the property line. Newfoundland and Labrador has also established analogous limits for metals. In June of 1996, the province promulgated standards for PM_{10} and $PM_{2.5}$.

2. Problem Definition

2.1 Toxic substances emitted by the Electric Power Generation (Fossil Fuel) Sector

CEPA requires the Minister of the Environment and the Minister of Health to prepare and publish a Priority Substance List that identifies substances, including chemicals, groups of chemicals, effluents and wastes, that may be harmful to the environment or constitute a danger to human health. The Act also requires both Ministers to assess these substances and determine whether they are "toxic" as defined by Section 11 of the Act which states:

> "...a substance is toxic if it is entering or may enter the environment in a quantity or concentration or under conditions
>
> (a) having or that may have an immediate or long-term harmful effect on the environment;
>
> (b) constituting or that may constitute a danger to the environment on which human life depends; or
>
> (c) constituting or that may constitute a danger in Canada to human life or health."

Substances that are assessed as "toxic" as defined under Section 11 may be placed on Schedule 1 of CEPA. Consideration can then be given to developing regulations, guidelines, or codes of practice to control any aspect of these substances' life cycle, from the research and development stage through manufacture, use, storage, transport, and ultimate disposal.

Listed in Table 2.1 below are the CEPA-toxic substances on the Priority Substance List 1 (PSL 1) or, where noted, those on Schedule 1 of CEPA that may be released to the environment during the burning of fossil fuels to produce electric power:

Table 2.1: CEPA - toxic substances on PSL1 and substances on Schedule 1 of CEPA addressed by the Electric Power Generation (Fossil Fuel) Sector Issue Table.

inorganic arsenic (As)	**inorganic cadmium (Cd)**
hexavalent chromium (CrVI)	**inorganic fluorides (F)**
dibenzodioxins	**dibenzofurans**
lead (Pb) *(CEPA Schedule 1)*	**mercury (Hg) *(CEPA Schedule 1)***
trichloroethylene	**dichloromethane**
benzene	
oxidic, sulphidic and soluble nickel (Ni)	
polyaromatic hydrocarbons (PAHs): benzo(a)pyrene; benzo(b)fluoranthene; benzo(j)fluoranthene; benzo(k)fluoranthene; and indeno(1,2,3-cd)pyrene	

In addition to the above CEPA-toxic substances, **total particulate matter** was added by the Issue Table for evaluation under the Strategic Options Process. Particulate matter was considered important for two reasons: 1) respirable particulate matter with diameter less than or equal to 10 micrometres (PM_{10}) is undergoing assessment for toxicity and 2) Environment Canada and Health Canada were supportive of including particulate matter because controlling emissions of particulate matter would also reduce emissions of metals bound to the particles.

In the remainder of this report, the above substances will be called "SOP substances". All of the SOP substances were addressed by the Issue Table in the initial stages of its work, which was a scoping exercise to determine the substances and the types of electric generating facilities for which management options should be focused. This exercise will be described in the remainder of Chapter 2 and in Chapter 3 of this Report.

2.2 Toxicity of substances considered by the Issue Table

The following table summarizes the manner in which the SOP substances listed in Section 2.1 have been declared toxic under CEPA Section 11, or are regulated under CEPA Schedule 1.

Table 2.2: Status under CEPA of substances considered by the Issue Table

Priority Substance	**Toxic under Section 11(a):** *having or that may have an immediate or long-term harmful effect on the environment*	**Toxic under Section 11(b):** *constituting or that may constitute a danger to the environment on which human life depends*	**Toxic under Section 11(c):** *constituting or that may constitute a danger in Canada to human life or health*	**Present status under CEPA**
Inorganic arsenic compounds	√		√	
Inorganic cadmium	√		√	
Hexavalent chromium compounds	√		√	
Inorganic fluorides	√			
Dibenzodioxins and Dibenzofurans	√		√	Regulated under CEPA for pulp and paper plants.
Lead				On List of Toxic Substances (Schedule 1) of CEPA; regulated under CEPA for secondary lead smelters and gasoline products
Mercury				On List of Toxic Substances (Schedule 1) of CEPA; regulated under CEPA for chlor-alkali plants
Trichloroethylene	√		√	
Dichloromethane	√		√	
Benzene			√	
PAHs (see Table 2.1)	√		√	
Oxidic, sulphidic and soluble nickel compounds	√		√	
Total particulate matter				Respirable particulate matter PM_{10} is on Priority Substances List 2, and will be assessed under CEPA for toxicity.

The following is a brief synopsis of the potential risks to health and/or the environment from emissions of the SOP substances listed in Section 2.1. More complete information may be found in the CEPA Priority Substance List Assessment Reports (see the Bibliography) or from the Problem Definition Statements developed by Health Canada and Environment Canada. (The Problem Definition Statements may be found in Volume 2 of the Technical Background Document.)

The information presented in the CEPA Priority Substance Assessment Reports deals with the potential risks to health and/or the environment from emissions of the SOP substances. This information is not sector-specific. It deals with the toxicity to health and the environment posed by the substances in general, but does not deal in any way with the specific risks posed by emissions of the substances by the EPG Sector. A review of the most up-to-date information on sector-specific risks was provided by Task Group 2 and is discussed in Section 2.4.

a) Inorganic arsenic compounds

Inorganic arsenic compounds have been declared toxic under Sections 11(a) and 11(c) of CEPA because it has been concluded that current concentrations in Canada may be harmful to the environment and may constitute a danger in Canada to human health or life. In some areas, concentrations of arsenic are high enough to cause, or to have the potential to cause, adverse effects (including reduced growth and reduced survival) in a variety of aquatic and terrestrial organisms. Inorganic arsenic has been consistently demonstrated in numerous studies to cause cancer in humans exposed by inhalation or ingestion. The group of inorganic arsenic compounds as a whole (since data do not permit an assessment of individual compounds within the group) is therefore considered to be a "non-threshold toxicant" (i.e., a substance for which there is believed to be some chance of adverse health effects at any level of exposure). A comparison of estimated exposure to quantitative estimates of carcinogenic potency suggests that the priority for the analysis of options to reduce exposure would be moderate to high.

b) Inorganic cadmium

Inorganic cadmium has been declared toxic under Sections 11(a) and 11(c) of CEPA because 1) dissolved and inorganic forms are entering the environment in a quantity or concentration or under conditions that are having or may have a harmful effect on the environment and 2) inorganic cadmium compounds are entering the environment in a quantity or concentration or under conditions that may constitute a danger to human life or health in Canada. Mean levels of cadmium in some Canadian ecosystems in the vicinity of known anthropogenic sources (e.g., base metal smelters) have exceeded the estimated effects threshold for the most sensitive indicator species for the ecosystem. Inorganic cadmium compounds have been classified as "probably carcinogenic to

humans", i.e., substances for which there is believed to be some chance of adverse health effects at any level of exposure. Renal tubular dysfunction has been observed in human populations exposed to cadmium in the workplace or in the general environment. Mild effects on the kidney have been associated with levels at or near those to which a portion of the general Canadian population is exposed. A comparison of estimated exposure to quantitative estimates of cancer potency suggests that the priority for analysis of options to reduce exposure would be high.

c) Hexavalent chromium compounds

Hexavalent chromium compounds have been declared toxic under Sections 11(a) and 11(c) of CEPA because 1) it has been concluded that dissolved and soluble forms are entering or may enter the environment in a quantity or concentration or under conditions that are having or may have a harmful effect on the environment and 2) the group of hexavalent chromium compounds as a whole is entering the environment in a quantity or concentration or under conditions that may constitute a danger in Canada to human life or health. Typical concentrations of dissolved hexavalent chromium in some freshwater bodies are likely to be 5 to 15 times greater than the effects threshold for the most sensitive aquatic species identified. Average concentrations of chromium in soils contaminated with dissolved hexavalent chromium at several Canadian wood preservation facilities are 19 to 1700 times greater than levels reported to harm some plants and microbial communities. Based on the weight of evidence of carcinogenicity in occupationally exposed populations, the group of hexavalent chromium compounds as a whole is classified as "carcinogenic to humans", i.e., as substances for which there is believed to be some chance of adverse health effects at any level of exposure. A comparison of estimated exposure to quantitative estimate of carcinogenic potency suggests that the priority for analysis of options to reduce exposure would be moderate to high.

d) Inorganic fluorides

Inorganic fluorides have been declared toxic under Section 11(a) of CEPA as entering the environment in quantities or under conditions that may be harmful to the environment. The mean concentrations of inorganic fluoride in ambient air at several locations across Canada (in the vicinity of anthropogenic sources) are within the range of the effects threshold for several sensitive terrestrial plant species. The mean concentrations of inorganic fluoride in the majority of freshwaters and marine waters in Canada in the vicinity of known anthropogenic sources are equal to, or exceed, the lowest estimated effects threshold for freshwater and marine species. The levels of fluoride in vegetation near certain industrial sources such as aluminum smelters, phosphate fertilizer plants or phosphorous plants are similar to those that may induce adverse effects in sensitive wildlife populations.

e) Polychlorinated dibenzodioxins and polychlorinated dibenzofurans

These compounds have been declared toxic under Sections 11(a) and 11(c) of CEPA as they may enter the environment in quantities which have immediate and long-term harmful effects upon the environment, and which constitute a danger to human health. The compound 2,3,7,8-tetrachlorodibenzodioxin (and, to a lesser degree, other dioxins and furans) is extremely toxic to mammals. Exposure of women via ingestion to several milligrams of furans in contaminated rice oil in Japan and Taiwan may have been responsible for reproductive anomalies and infant mortality. To date, there has been no clear demonstration that human populations exposed to dioxins and furans have suffered excess cancer.

f) Lead

Lead is on the List of Toxic Substances (Schedule 1) of CEPA. Atmospheric emissions of lead from secondary lead smelters, and maximum concentrations of lead in gasoline products, are regulated under CEPA. Possible environmental impacts of exposure to lead include: mortality and reduced growth in algae, reduced growth of microorganisms, reduced survival, growth and reproduction of aquatic invertebrates, malformations and reduced survival of fish, mortality and reduced reproduction in amphibia, and reduced survival, growth and/or reproduction in terrestrial plants and invertebrates. Many adverse health effects are well documented for exposure to high lead levels. Recent research has shown that adverse health effects, particularly neurological, may occur at low blood lead levels previously thought not to result in adverse effects. Children are particularly susceptible to the toxic effects from exposure to chronic, low lead levels.

g) Mercury

Mercury is on the List of Toxic Substances (Schedule 1) of CEPA, and atmospheric emissions of mercury from chlor-alkali plants are regulated under CEPA. Because methylmercury biomagnifies in the aquatic food chains, mercury levels in freshwater fish taken from areas contaminated with mercury frequently render the fish unacceptable for human consumption. Exposure to methyl and ethyl mercuric salts has been associated with neurological effects in humans; the neurological effects of mercury vapour are well documented. Exposure to inorganic mercury has been associated with renal effects. Predators at the top of the aquatic food chain, which may consume large amounts of contaminated fish (*e.g.* mink, otter, eagles and loons), are at the highest risk of harm from mercury. Birds and mammals consuming foods containing elevated levels of mercury may experience nervous system damage (including poor coordination and tremors), weight loss, reproductive impairment, and ultimately death.

h) Trichloroethylene

Trichloroethylene has been declared toxic under Sections 11(a) and 11(c) of CEPA as it occurs at concentrations that may be harmful to the environment, and that may constitute a danger in Canada to human life or health. The estimated effects threshold for terrestrial plants, notably trees, exposed to trichloroethylene in the atmosphere is similar to rural air concentrations and mean concentrations in several cities in Canada. Maximum observed air concentrations in various urban locations, however, exceed the effects threshold. Trichloroethylene is classified as "probably carcinogenic to humans", i.e., as a substance for which there is believed to be some chance of adverse health effects at any level of exposure. A comparison of estimated exposure to quantitative estimates of cancer potency suggests that the priority for analysis of options to reduce exposure would be low to moderate.

i) Dichloromethane

Dichloromethane has been declared toxic under Sections 11(a) and 11(c) of CEPA as it occurs at concentrations that may be harmful to the environment, and that may constitute a danger in Canada to human life or health. Median levels of dichloromethane in Canadian surface waters exceeded the estimated effects threshold for the most sensitive aquatic species. Dichloromethane is classified as "probably carcinogenic to humans", i.e., as a substance for which there is believed to be some chance of adverse health effects at any level of exposure. A comparison of estimated exposure to quantitative estimates of cancer potency suggests that the priority for analysis of options to reduce exposure, based upon consideration of health risk only, would be low to moderate.

j) Benzene

Benzene has been declared toxic under Section 11 (c) of CEPA because it enters the environment in a quantity or concentration or under conditions that do not constitute a danger to the environment or to the environment upon which human life depends, but that may constitute a danger to human life or health in Canada. Benzene has been demonstrated to cause cancer in experimental animals and in humans. Benzene is, therefore, considered to be a "non-threshold toxicant", i.e., a substance for which there is believed to be some chance of adverse effects at any level of exposure. A comparison of estimated exposure to quantitative estimates of cancer potency suggests that the priority for analysis of options to reduce exposure is high.

k) Polyaromatic Hydrocarbons (PAHs)

PAHs have been declared toxic under Sections 11 (a) and 11(c) of CEPA because it has been concluded that 1) they are entering the environment in a quantity or concentration or under conditions that may have harmful effects upon the environment and 2) the PAHs benzo[*a*]pyrene, benzo[*b*]fluoranthene, benzo[*j*]fluoranthene, benzo[*k*]fluoranthene, and indeno[*1,2,3-cd*]pyrene may constitute a danger in Canada to human life or health. PAHs have been measured in water from railway and utility ditches at concentrations higher than those recognized to cause harmful effects under laboratory conditions. At several sites in Canada, populations of aquatic organisms have been adversely affected by contamination by PAHs. Moreover, PAHs in harbour sediments, have been associated with mortality of sensitive aquatic invertabrates under laboratory conditions. Under laboratory conditions, neoplastic effects such as liver tumours in aquatic organisms have been associated with exposure to PAHs. Five PAHs considered in a human health assessment have been classified as "Probably Carcinogenic to Humans", i.e., substances for which there is believed to be some chance of adverse effects at any level of exposure. Based on consideration solely of the potential effects of PAHs on human health by two limited approaches, the priority for analysis of options to reduce exposure would be moderate to high.

l) Inorganic nickel compounds

It has been concluded that dissolved and soluble forms of inorganic nickel compounds are toxic under Section 11(a) of CEPA in that they are entering or may enter the environment in a quantity or concentration or under conditions that are having or may have a harmful effect upon the environment, based upon sensitive pelagic organisms and terrestrial plants in the vicinity of major anthropogenic and natural sources. It has also been concluded that oxidic, sulphidic and soluble nickel compounds are toxic under Section 11(c) as they are entering the environment in a quantity or concentration or under conditions that may constitute a danger in Canada to human life or health. Oxidic, sulphidic and soluble nickel compounds have been classified as "Carcinogenic to Humans", i.e., substances for which there is believed to be some chance of adverse health effects at any level of exposure. Sensitivity to nickel from ingestion is commonly found in a portion of the general population. Based upon comparisons of estimated exposure to quantitative estimates of cancer potency, it is suggested that the priority for analysis of options to reduce exposure would be moderate to high.

m) Particulate matter

Respirable particulate matter, less than or equal to 10 micrometres in diameter, is one of 25 substances on Priority Substances (PSL 2) currently being assessed for toxicity under CEPA. Effects on soil-dwelling and aquatic organisms such as reduced growth and reproduction are partly attributable to the acidic nature and elevated metal contents of atmospheric particulate matter. Health effects believed to be associated with

exposure to ambient particulate matter include increases in school absenteeism and hospital admissions, decreased respiratory health/pulmonary function, and increases in cancer and mortality rates.

2.3 Estimated releases of SOP substances from the EPG Sector

Task Group 1 assembled the most up-to-date information on emissions by the electricity generating sector of the SOP substances listed in Section 2.1. This information is summarized in Table 2.3. Information on emissions from utility generators was provided by the utilities and reviewed by Environment Canada; information on emissions from non-utility generators (NUGs), other industrial sectors and, where available, natural emissions, were assembled by Environment Canada. The data are estimates for different years (between 1990 and 1995, depending upon the source), and for the plant operating in a steady-state condition. Emissions from most other sectors have not been subjected to the same degree of quality assurance as those of the utility sector. As a result, the comparison of electric utility emissions with those of other sectors could be misleading and should be considered for contextual purposes only.

A number of the key conclusions that were drawn from the work of Task Group 1 are noted below:

1. Information on releases via wastewater and solid waste streams is sparse for all industrial sectors.

2. Considerably more information is known about air emissions. Estimates of air emissions of metals and total particulate matter from coal-fired utility generators are complete. Generally, oil and gas steam-electric utility data are complete for total particulate matter but incomplete for metals. There is a reasonable degree of confidence surrounding these estimates and the utilities have provided documentation on them.[3]

3. Gas-fired generation contributes essentially none of the atmospheric releases shown in Table 2.3.

4. Utilities contributed less than originally estimated of the total Canadian industrial emissions of the inorganic substances considered by the Issue Table: 1.3 tonnes (or 3.7 %) of the mercury emissions, 0.6 tonnes (1.2%) of the cadmium, 7.8 tonnes (3.5%) of the arsenic and 7.6 tonnes (0.8%) of the lead emissions. The utilities contributed 125000 tonnes of particulate matter (about 13% of the total industrial emissions). As stated above, it should be noted that these percentages should be interpreted qualitatively because emissions from most other sectors have not been subjected to the same degree of quality

[3] The Canadian Environmental Network dissented with this conclusion. See Appendix C of this report for details.

assurance as those of the utility sector. As a result, the comparison of electric utility emissions with those of other sectors could be misleading and should be considered for contextual purposes only.

5. Within the utility sector, coal-fired generators contribute a large proportion of the atmospheric emissions of mercury, cadmium, arsenic, chromiumVI, lead and total particulate matter.

6. Utility emissions at one facility in western Canada contribute the majority of the particulate matter emissions from all Canadian utilities and a large proportion of the metals.

7. Total Canadian emissions of fluoride from utilities are not shown in Table 2.3 because provincial totals were available only for Ontario and Nova Scotia. (Data were available for 4 out of 7 stations in Alberta, however.)

8. Oil-fired steam generators contribute 45% of the atmospheric nickel emissions by the utilities.

9. With the exception of nickel and benzene, emissions from utility-owned diesel and distillate oil-fired generating units are believed to be insignificant and were deemed not to warrant further consideration by the Issue Table.

10. With the information available, releases of polychlorinated dibenzodioxins and polychlorinated dibenzofurans by this industrial sector appear to be relatively low. Measurements were made at five stations belonging to two utilities. However, Environment Canada believes that this amount of data may be insufficient to assess the releases of these substances from this industrial sector.

11. SOP-specific polycyclic aromatic hydrocarbon (see Table 2.1) emissions for Canadian coal-burning units are of the order of grams, not tonnes, based upon sampling carried out at Nova Scotia Power and Ontario Hydro stations.

12. Emissions from the EPG sector of the other organic SOP substances (trichloroethylene, dichloromethane) are believed to be insignificant and were deemed not to warrant further consideration by the Issue Table.

13. Estimates of releases of benzene and nickel from non-utility generators (NUGs) are not available due to a lack of reliable emission data. Further investigation of this issue, outside the scope of this Issue Table, is required.

14. Information on emissions of toxic substances from most other Canadian industrial sectors is incomplete; there is not a reasonable degree of confidence surrounding these data. Therefore, the percentage contribution of the EPG sector to total industrial emissions is shown in Table 2.3 for qualitative comparisons only.

Table 2.3

SUMMARY OF ATMOSPHERIC EMISSIONS OF INORGANIC TOXIC AIR POLLUTANTS FROM FOSSIL-FUELED ELECTRICAL GENERATORS AND INDUSTRIES IN 1990

SOURCE	EMISSIONS (tonnes/year) Hg	Cd	As	CrVI	Ni	Pb	F	TPM
UTILITY GENERATORS:								
British Columbia	NA	NA	NA	NA	NA	NA	NA	0
Alberta	0.3	0.2	0.4	0.1	1.3	0.7	572	10200
Saskatchewan	0.3	0.2	5.7	0.4	4.1	5.0	NA	102000
Manitoba	<0.1	<0.1	0.1	<0.1	0.1	0.3	NA	5600
Ontario	0.4	<0.1	0.3	0.1	1.4	0.4	285	3500
Quebec	0	<0.1	<0.1	<0.1	4.2	0.6	NA	15
New Brunswick	0.1	<0.1	0.1	<0.1	1.9	0.1	<0.1	700
Nova Scotia	0.2	0.1	1.1	0.1	2.6	0.4	3.1	2400
Newfoundland & Labrador	NA	NA	<0.1	NA	5.4	<0.1	NA	1400
TOTAL UTILITIES	**1.3**	**0.6**	**7.8**	**0.6**	**21.1**	**7.6**	**NA**	**126000**
TOTAL COAL-FIRED	**1.3**	**0.6**	**7.7**	**0.6**	**7.5**	**6.8**	**NA**	**123000**
TOTAL OIL-FIRED	**<0.1**	**<0.1**	**0.1**	**<0.1**	**9.5**	**0.2**	**NA**	**3500**
TOTAL GAS-FIRED	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL NUGs	**<0.1**	**0**	**0**	**NA**	**NA**	**0**	**NA**	**3200**
TOTAL SECTOR	**1**	**1**	**8**	**NA**	**NA**	**8**	**NA**	**127000**
TOTAL INDUSTRIAL	**36**	**52**	**227**	**NA**	**1355**	**986**	**6865**	**1003000**
UTILITY % OF TOTAL INDUSTR	**3.7%**	**1.2%**	**3.5%**	**NA**	**NA**	**0.8%**	**NA**	**12.5%**

Abbreviations:
Hg: mercury
Cd: inorganic cadmium
As: inorganic arsenic
CrVI: hexavalent chromium
Ni: oxidic, sulphidic, and soluble nickel
Pb: lead
F: inorganic fluorides
TPM: total particulate matter
NUGs: Non-utility generators

NOTES:

1. Emission estimates are for a range of years from 1990 to 1995. They are for plants in a steady-state operating condition; they do not represent emissions during startup or shutdown.
2. Because of the differences in the quality of the above estimates, comparisons of the emissions from the EPG sector with those from other sectors SHOULD NOT be made on a rigourous basis. These percentages could change as estimates of emissions from other sectors are improved.
3. The total utility emissions are not necessarily the sum of coal, oil and gas-fired emissions because of emissions from diesel generators, etc.
4. Fluoride emissions for Alberta are for 4 out of 7 stations reporting.

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15. Any information, from Environment Canada or elsewhere, on releases from natural sources is sparse.

2.4 Approaches of the Issue Table to the matter of incremental risks to human health and the environment posed by toxic substances emitted by the EPG Sector

Issue Table members had differing opinions on whether and how an assessment of the incremental risks to the environment and human health should be carried out in determining the substances and types of electric generating facilities for which management should be considered.

The key management objectives contained in the federal government's Toxic Substances Management Policy are as follows:

- virtual elimination from the environment of toxic substances that result predominantly from human activity and that are persistent and bioaccumulative. These are referred to in the TSMP as Track 1 substances. Virtual elimination will be achieved by addressing sources of release to the environment or by removing or managing the substance if it is already in the environment.

- management of other toxic substances and substances of concern throughout their entire life cycles, to prevent or minimize their release into the environment. These substances are referred to in the TSMP as Track 2 substances.

Environment Canada has identified the electricity generating sector as contributing to the presence of CEPA toxic substances in the Canadian environment. The assessments described in the Priority Substance List (PSL) reports, and which were summarized in Section 2.2, were made on a substance-specific basis rather than on a sector-specific basis. They cannot, therefore, be used to estimate the specific contribution of the electricity generation sector to the total human risk. This total risk originates from all of the sources. A specific sector may contribute different levels to the contamination of the environment in a given region.

The federal government members of the Issue Table contended that, because most of the toxic substances listed in Table 2.1 of this report are Track 2 substances, management strategies (including pollution prevention[4], pollution control, remediation and, in the case of sources outside of Canada, international action) will be based upon a life-cycle approach. Furthermore, the Toxic Substances Management Policy has

[4] ***Pollution Prevention*** is defined on Page 4 of *Pollution Prevention: A Federal Strategy for Action*: "The use of processes, practices, materials, products or energy that avoid or minimize the creation of pollutants and waste, and reduce the overall risk to human health or the environment."

adopted Principle 15 of the Rio Declaration on Environment and Development which states: "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation".

The utility members of the Issue Table felt strongly that it is essential that the management of the substances of concern be based upon quantitative assessments of incremental risks from sector-specific emissions of the substances. For that reason, the utilities employed a contractor, as part of the work of Task Group 2, to carry out, among other things, a review of available studies on the assessment of risk to human health resulting from emissions of the SOP substances from the EPG sector. This review is described in more detail in Volume 1 of the Technical Background Document; the contractor's report is included in full in Volume 2.

Task Group 2 concluded that the risk assessment studies that were reviewed concerning the electricity generating sector were performed by independent agencies or companies using the best available scientific knowledge and health risk assessment methodologies on a sector-specific basis. According to the utilities' review, a more detailed assessment will only reduce the estimated incremental health risk from the SOP substances emitted by the electric utility sector, except for mercury and particulate matter, for which there is insufficient information at this time to draw conclusions about the existence or non-existence of risk from sectoral emissions. Therefore, except for mercury and particulate matter, the Canadian utilities believe that incremental health risks posed by the SOP substances from the electric power sector are essentially negligible, or not an identifiable health problem. Health Canada believes that a *de minimus*[5] risk level cannot be established on a scientific basis alone. However, during the risk management phase a judicious balancing of technological, socio-economic and scientific information may allow the conclusion that some risks may be sufficiently small as to not warrant further action.

Task Group 2 suggested that it was essential that the results of these two risk assessment approaches (substance-specific and sector-specific) be used by the Issue Table in identifying and optimizing the number of substances on which cost-effective management options would be pursued during the management assessment phase of its work.

The Canadian Environmental Network (CEN) in a letter dated 21 November 1996 to the Issue Table Chair stated that they "recognize that scientific uncertainty is a customary and unavoidable factor that influences each and every phase of scientific research. All of the scientific disciplines that are used to characterize risk are subject to uncertainties due to theoretical and practical limitations in scientific knowledge, data collection, and interpretation of analytical methodologies. Compounding these uncertainties are difficulties in understanding the complex web of interactions within and amongst

[5]*De minimus* risk is a level of risk at or below which no action is deemed necessary to further protect health or the environment.

ecosystems, in determining levels of exposure to specific chemicals, and in determining the significance of and effective management options for substances released by human activity. Formalized risk assessment also involves complex ethical issues surrounding trans-generational impacts for certain substances and the ability of individuals to understand and voluntarily assume the risks associated with exposure to certain substances. Therefore, because of the scientific uncertainties and ethical issues, the CEN does not support risk assessment as a useful tool to help the Issue Table in its decision-making process."

The CEN tabled a document *Making Good Decisions* in which it is concluded that risk assessment is not necessarily the best or the only way of making environmental decisions. This document can be found in Volume 1 of the Technical Background Document.

The above differing points of view were thoroughly debated by the members of the Issue Table and resulted in the scoping decisions that are described in the next chapter.

In October 1996 the utilities made available to the Issue Table the executive summary of a new assessment of emissions from power plants carried out by the U.S. Environmental Protection Agency (EPA)[6] . This document may be found in Volume 2 of the Technical background Document. The study contained information on hazards and risks due to inhalation exposures to numerous hazardous air pollutants (e.g., arsenic, nickel, chromium), an assessment of risks due to multipathway (inhalation plus non-inhalation) exposure to radionuclides, and a general discussion of the fate and transport of mercury through environmental media. Table 2.4 summarizes the findings of the interim final EPA report. (It should be noted that, within the Strategic Options Process, Health Canada does not concur with the approach taken by the EPA.)

Table 2.4: Summary of findings in the EPA interim final report.

Number of utility plants studied -->	Coal-burning 426	Oil-burning 137	Burning natural gas 267
Cancer risks due to inhalation of HAP emissions -->	Majority of plants: less than 1 in a million	Two coal plants and up to 22 oil-fired plants (1): above 1 in a million due to Ni, As, radionuclides, Cr, Cd. (2): below 1 in a million for other HAPs	
EPA estimate of cancer risks per year in US due to inhalation exposure to HAP emissions from utilities. ---------->			0.5 to 6 persons per year
Non-cancer effects from inhalation exposure --->	Not expected to exceed RfC (inhalation reference concentration).		
Mercury --->	EPA has not yet determined whether the mercury emissions from utilities are a concern for public health.		

[6] "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units, Executive Summary, Interim Final Report", October 1996 (EPA-453/R-96-013abc)

3. Scoping the Work of the Issue Table

3.1 Substances and electric generating facilities to be further considered by the Issue Table

Based on the various approaches to risk assessment described in the preceding section, the rates of release of the toxic substances described in Section 2.3 and subsequent consideration of control technologies, the Issue Table decided to focus its work as shown below in Tables 3.1 and 3.2.

Table 3.1: Aspects not to be considered further by the Issue Table

NO FURTHER CONSIDERATION BY ISSUE TABLE	*RATIONALE*
facilities	
gas-fired facilities	They contribute almost no releases of the SOP substances.
media	
water and solid waste[7]	Releases of the SOP substances to solid and liquid waste are controlled by provincial regulations and permits. Environment Canada will follow up on these issues.
SOP substances	
dichloromethane trichloroethylene PAHs	There are very low emissions of these substances (based upon the present inventory).
dioxins & furans	Emissions appear to be very low (based on the present inventory).
fluorides from oil-fired facilities	Emissions are very low, based upon present inventory.

[7] The Canadian Environmental Network dissented with this conclusion. See Appendix C of this report for details.

benzene from coal-and heavy fuel oil-fired facilities	there are very low emissions, based upon the present inventory
benzene from diesel-fired facilities (NUGs and utilities)	there are very low emissions, based upon the present inventory

Table 3.2: Aspects to be further considered by the Issue Table

FURTHER CONSIDERATION BY ISSUE TABLE	*RATIONALE*
facilities	
size ranges	All size ranges for commercially-sized units would be included in the Issue Table deliberations.
SOP substances	
total particulate matter	There is increasing concern about the health effects of respirable particulate matter.
cadmium arsenic hexavalent chromium lead nickel	These substances have been found to be toxic under Sections 11(a) and 11(c), or are on Schedule 1 of CEPA; they are emitted by this sector. *Note: The utilities only supported the consideration of management options for nickel from certain oil-fired facilities on a local basis*
fluorides from coal-fired facilities	There are no demonstrated environmental effects resulting from emissions of fluorides by the sector; however, because of the magnitude of the emissions, further work on management options was recommended by Environment Canada and Health Canada. *Note: The utilities felt that this was unnecessary.*
mercury	There are uncertainties regarding the extent to which emissions from the EPG sector pose a risk to health or the environment; further research is needed.

3.2 Goals for the management of toxic substances

The federal government and ENGO members of the Issue Table supported the consideration of management options for **total particulate matter, cadmium, arsenic, lead, nickel, hexavalent chromium.** The members from utilities supported the consideration of management options for **total particulate matter and for nickel (from oil-fired facilities on a local basis only).**

The goal is to minimize environmental and health risks by reducing exposure to, and/or the release of, total particulate matter, cadmium, arsenic, lead, hexavalent chromium, and nickel[8] emitted by the Fossil Fuel Electric Power Generation Sector.

The long-term goal for the management of these substances is consistent with that found in the federal government's *Toxic Substances Management Policy* for Track 2 substances (i.e., to minimize environmental and health risks by reducing exposure to, and/or the release, of these substances). The management of these substances throughout their entire life cycle and in a manner promoting sustainable development and pollution prevention was considered. This goal is also consistent with the goal established in *Carcinogen Assessment* (Health and Welfare Canada, 1991) for human carcinogens or probable human carcinogens.

The determination of what is required in terms of reductions in exposure and/or releases and of what is possible given existing technical and socio-economic constraints will change over time. The Issue Table members recognized that it will therefore be important to monitor and assess new information.

8 The utilities supported including nickel only for oil-fired facilities, on a case-by-case basis.

3.3 Targets for the management of toxic substances

As part of the Strategic Options Process, the Issue Table is to develop targets that will be measurable steps along the path to the goal. The recommendations pertaining to regulatory or non-regulatory tools made by the Issue Tables to Ministers will set out the targets. In developing these targets, the Issue Table is to take into account the following:

- The targets will be *quantifiable* (i.e., they will deal with release reductions and/or appropriate measures, such as a reduction of risk achieved via a reduction in the levels of human exposure).

- The targets will be *time-limited* (i.e., they will be the milestones for measuring and monitoring progress towards achieving the goal).

- The targets will be *"science-based".*

- The targets will be *practicable*, i.e., they will take into account technical, scientific (including environmental quality objectives and guidelines, and health objectives and guidelines) and socio-economic considerations.

In Section 5 of this Report there are a number of targets set out for the consideration of Ministers. Four proposals for the management of toxic substances of concern to the EPG Issue Table, which cover the range of views held by Issue Table members, have been developed. The targets identified in each of these proposals reflect the different beliefs on the need for emission reductions and, where appropriate, the amount of reduction required or possible (given technical, socio-economic and economic factors), the preferred management option(s) and the recommended timeframe for implementing the management program and for achieving the reductions.

4. Screening of Management Options

Task Group 3 was charged with 1) providing the Issue Table with information to finalize, if required, the scoping portion of the process and the setting of appropriate targets for the management of the toxic substances of concern and 2) identifying the management option or combination of options that would provide industry and government with approaches for ensuring that these targets are met in a manner that is environmentally effective and cost efficient, etc. Environment Canada hired consultants to assist in the evaluation and screening of technical response measures and options for managing the SOP substances[9]. The information presented in this section is based on the consultants' work which was reviewed by all members of the Task Group. Inclusion of this information in this report does not, however, indicate its acceptance by all members of the Task Group.

4.1 Industry response measures

To meaningfully assess targets and management options, the first step was to assess the costs (cents per kWh and dollars per unit mass of substance removed) of the technological measures that could be adopted by industry in response to the management requirements. This first step was taken with the clear understanding that industry may choose any management approach in response to a management requirement.

The following industry response measures were evaluated:

- fuel selection measures, including fuel switching and fuel blending.
- on-site fuel preparation measures, including on-site coal washing and augmentation of fugitive dust controls. (Fugitive dust is dust which emanates from sources such as fuel piles and the ground.)
- combustion stage modifications, including conversion to alternative combustion technologies and the use of natural gas-fired burners; and
- post-combustion treatment technologies, including:
    - electrostatic precipitators
    - fabric filters
    - venturi and moving bed scrubbers
    - mechanical collectors

[9] Reference: *Evaluation of Technical Control Options for Toxic Releases from the Fossil Fuel-fired Electric Power Sector.* Phase I and Phase II reports, Resource Futures International (RFI). Note: RFI uses "cost per unit mass of material removed" as the definition for "cost-effectiveness"; there was disagreement within the Issue Table about this definition.

- acid gas scrubbers
- NOx reduction technologies
- carbon injection systems

The above industry response measures were assessed on the basis of:

- effectiveness in removing substances of concern
- cost (cents per kWh, and dollars per unit mass of substance removed)
- commercial status and proven capability
- availability of information on effectiveness and costs

On the basis of the above criteria, the following industry response measures were selected for further screening:

- coal washing
- natural gas burners (for varying degrees of replacement of coal)
- electrostatic precipitator (ESP) upgrades
- fabric filters
  - reverse air baghouse
  - pulse jet baghouse
- combination of ESP and fabric filter
- acid gas scrubbers
- carbon injection to control mercury emissions

4.2 Results of further screening of industry response measures

Arsenic, cadmium, chromium, lead, and nickel are emitted primarily as particulate matter. Respirable particulate matter with diameters less than or equal to 10 micrometres is on Priority Substance List 2 and is currently being assessed for toxicity under CEPA. Because the most effective measures for particulate matter control will also bring about substantial reductions in emissions of several heavy metals, the Issue Table decided to examine the effectiveness of the above industry response measures with respect to their effectiveness in controlling particulate matter emissions.

Mercury and fluoride were excluded from further screening for the following reasons:

- there are uncertainties regarding the extent to which mercury emissions from the EPG Sector may pose a risk to health or the environment; further research is needed.

- there are no demonstrated environmental effects resulting from emissions of fluorides by the EPG sector

- there are no demonstrated add-on (efficient and cost-effective) technological control systems for mercury or fluoride

- there is an inability to establish targets and control levels for these substances.

Table 4.1 shows the three mean annual emission levels for particulate matter used by the Issue Table in the further assessment of technological measures.

Table 4.1: Mean annual particulate matter emission levels used in the assessment of industry response measures

Mean annual emission level	lb/million BTU	nanograms/Joule
Level 1	0.1	43
Level 2	0.03	12.9
Level 3	0.01	4.3

As shown in Figure 4.1, these three annual levels were chosen because they bound the Canadian "Thermal Power Generation Emissions - National Guidelines for New Stationary Sources" which is equivalent to 0.1 lb/million BTU[10] and the U.S. Environmental Protection Agency New Source Performance Standard of 0.03 lb/million BTU. Compliance or non-compliance with the Canadian guideline or the U.S standard, which are "never to be exceeded" limits, is determined by source testing using approved standard reference methods. Level 3 represents an annual emission rate that might be attainable through state-of-the-art emission control or prevention technologies[11].

It is important to realize that standards based upon compliance source testing (which measures the mean hourly rate of emission) would result in a lower annual emission rate because emissions would usually be lower than the compliance guideline or standard. This is illustrated by Figure 4.1

[10] The Canadian "Thermal Power Generation Emissions - National Guidelines for New Stationary Sources" specifies a limit of 160 milligrams per cubic metre in the stack, corrected to 3% oxygen and measured dry at a temperature of 298 Kelvin and a pressure of 101.3 kiloPascals.

[11] *Controlling Particulate Matter Under the Clean Air Act: A Menu of Options*. Report of the State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO), 444 North Capital St. N.W., Washington DC 20001, pp. 143-154. This report states the following: "Upgrades of existing controls to below the New Source Performance Standards (NSPS) level, and often to 0.01 lb/MMBTU or less, are possible through precipitator rebuilding or replacement, augmentation or replacement of precipitators with new fabric filters, or the use of technologies such as flue gas conditioning, which improve collection efficiencies."

Figure 4.1: Relationship between annual mean emission levels used in the analysis of industry response measures, and published emission guidelines and standards, i.e., "never to be exceeded" limits.

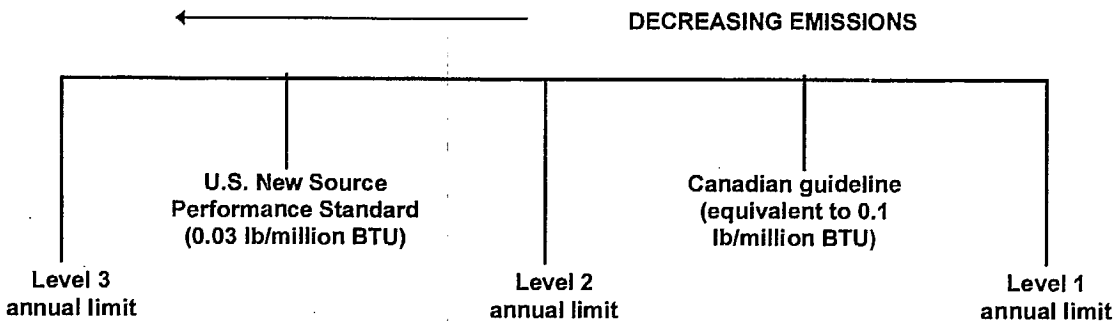

Figure 4.1 shows that a Level 1 annual average emission is, therefore, not as stringent as the Canadian guideline equivalent to 0.1 lb/million BTU and that a Level 2 annual limit is not as stringent as the U.S. standard of 0.03 lb/million BTU.

The reason that it is important to understand the difference between mean annual levels and "never-to-be-exceeded" compliance limits is that the analysis shown in Tables 4.2 to 4.6 were for mean annual emission limits, *not* "never-to-be-exceeded" compliance limits, whereas the proposals from various groups in the Issue Table to be described in Section 5 are expressed as compliance limits.

A detailed analysis of the technological control measures that might be applied to meet each of the three levels of mean annual particulate matter emissions was carried out on a plant-by-plant basis. The technological control measure that would achieve the specified level of control at lowest cost (in terms of annualized cents per kilowatt-hour) was identified. For particulate matter control, the preferred measure at all levels was either an upgrade of the electrostatic precipitator or a combination of an electrostatic precipitator and a baghouse.

Table 4.2 shows the percentage of **oil-fired** plants in Canada presently achieving each of the above three mean annual emission levels, and the costs for achieving these levels at all remaining oil-fired plants through adoption of lowest cost technological measures.

Table 4.2: Percentage of oil-fired plants in Canada currently achieving the three annual emission levels, and the costs for the remaining plants to achieve these levels.

	<---------	MEAN ANNUAL EMISSION LEVEL	--------->
	Level 1	**Level 2**	**Level 3**
Percent of plants currently achieving mean annual emission level	40%	40%	20%
Percent of generating capacity currently achieving mean annual emission level	66%	66%	46%
Average minimum cost (cents/kWh, weighted by plant size) to achieve mean annual emission level	0.069	0.069	0.16
Total annual cost in Canada (million $) to achieve mean annual emission level	3.1	3.1	7.1

NOTE: It should <u>not</u> be construed from Table 4.2 that, because 40% of the plants meet the Level 1 annual emission level of 0.1 lb/million BTU, 40% of the plants will also meet the Canadian guideline equivalent to 0.1 lb/million BTU. As demonstrated in Figure 4.1 and accompanying text, the Canadian emission guideline is a more stringent limit than the Level 1 mean annual level. Therefore, <u>fewer</u> than 40% of the plants will meet the Canadian guideline. Similar arguments would apply to Level 2 and the U.S. New Source Performance Standard, and to Tables 4.3 and 4.4.

Because of the limitations of the available data, it was not possible to calculate the values in Tables 4.2 to 4.6 for a "never to be exceeded" limit such as the Canadian guideline or the U.S. New Source Performance Standard.

Table 4.3 shows the percentage of **coal-fired** plants in Canada that are currently achieving each of the three mean annual emission levels, and the costs for all coal-fired plants to achieve these levels.

Table 4.3: Percentage of coal-fired plants in Canada currently achieving the three annual emission levels, and the costs for the remaining plants to achieve these levels. (see note following Table 4.2)

	<----------	MEAN ANNUAL EMISSION LEVEL	---------->
	Level 1	**Level 2**	**Level 3**
Percent of plants currently achieving mean annual emission level	87%	51%	13%
Percent of generating capacity currently achieving mean annual emission level	93%	47%	4%
Average minimum cost (cents/kWh, weighted by plant size) to achieve mean annual emission level	0.0086	0.037	0.080
Total annual cost in Canada (million $) to achieve mean annual emission level	7.5	32	69

In Table 4.4 below, the information for oil and coal-fired plants has been combined.

Table 4.4: Percentage of oil and coal-fired plants in Canada currently achieving the three annual emission levels, and the costs for the remaining plants to achieve these levels. (See note following Table 4.2)

	<---------	MEAN ANNUAL EMISSION LEVEL	--------->
	Level 1	**Level 2**	**Level 3**
Percent of plants currently achieving mean annual emission level	79%	61%	18%
Percent of generating capacity currently achieving mean annual emission level	86%	56%	14%
Average minimum cost (cents/kWh, weighted by plant size) to achieve mean annual emission level	0.011	0.039	0.084
Total annual cost in Canada (million $) to achieve mean annual emission level	10	35	76

In Table 4.5, the total cost of achieving the three mean annual emission levels by technological measures at **both coal and oil-fired** plants in each province is presented.

Table 4.5: Annual costs by province of achieving the three mean annual emission levels (thousands of dollars). Note: totals may not add due to rounding.

Province	Level 1	Level 2	Level 3
British Columbia	0	0	0
Alberta	770	17,000	27,000
Saskatchewan	6,000	6,000	13,000
Manitoba	720	720	720
Ontario	-	8,700	18,000
Québec	0	680	1,200
New Brunswick	-	0	6,000
Nova Scotia	840	840	7,300
Prince Edward Island	0	0	0
Newfoundland and Labrador	1,600	1,600	2,100
Yukon	0	0	0
Northwest Territories	0	0	0
CANADA	**10,000**	**35,000**	**76,000**

The effects of achieving the three levels of particulate matter control on emission reductions of selected SOP substances are given in Table 4.6 below.

Table 4.6: Percentage reductions in annual average emissions of selected SOP substances through achieving each particulate matter control level (coal and oil-fired plants combined). Levels 1, 2 and 3 are illustrated in Figure 4.1.

	Estimated Reductions in Annual Emissions of Substances		
SOP substance	**Level 1**	**Level 2**	**Level 3**
Arsenic	65%	68%	79%
Cadmium	22%	30%	63%
Hexavalent chromium	49%	53%	74%
Lead	69%	74%	86%
Mercury	5%	12%	39%
Nickel	42%	61%	81%
Inorganic fluorides[12]	0%	0%	0%
Particulate matter	81%	86%	96%

4.3 Description of management options

The 15 management options that were initially evaluated are briefly described below. More detailed descriptions may be found in Volumes 1 and 2 of the Technical Background Document.

- ***Status quo***. The control measure(s) that currently exist at the federal and/or provincial levels could be sufficient for the management of some or all of the toxic substances of concern.

- ***Quantity controls***. Limits are set on the quantity of an input used (e.g., on the metal content of fuels) or on the quantity of goods or services produced, imported or consumed (e.g., on the power produced using a certain class of input). These controls are usually implemented through a quota system.

- ***Performance standards***. The results or objectives to be achieved by individual sources or facilities are prescribed, but the means of compliance are not specified. Limits to the release of pollutants are typically applied in terms of concentrations of releases or in terms of the mass of pollutant released per unit of time, production or input.

[12] There may be significant retention of fluoride in alkaline flyash; therefore, control of particulate matter emissions may result in greater than a 0% reduction of fluoride emissions in specific cases.

- ***Air quality standards with permits***. The maximum allowable concentrations of a specified substance in the ambient air are specified. The regulatory body (usually provincial) then specifies, in a facility-specific permit, the requirements to ensure that the maximum concentration is not exceeded.

- ***Specified technological controls.*** The application of a particular technology or operating practice with a known environmental performance is required to limit releases.

- ***Emission "caps" or "bubbles"***. A limit on the total emissions of a given pollutant (or group of pollutants) released per unit of time from a group of facilities in a defined geographical area is set.

- ***Emission trading systems***. Control programs may include an emission trading component to cost-effectively limit emissions in a defined geographical area. Such programs may set a limit on the total release of a pollutant, allocate this limit among sources using a permit system, and then allow these allocations to be traded among sources. A wide range of trading variants is possible.

- ***Emission taxes and/or charges***. Fees are levied on inputs, processes, products or releases that are linked to environmental and/or health problems.

- ***Financial incentives***. Tax concessions or subsidies for adopting specific technologies or support research and development, etc., are used to reduce the costs to industry of meeting emission reduction targets.

- ***Demand side management***. Decreasing the demand for electric energy will result in reductions in emissions of toxic substances. Utilities could be encouraged to invest in customers' energy conservation efforts, or required to make least-cost planning decisions (e.g., to support energy conservation efforts or expand power generating capacity, whichever imposes the least cost).

- ***Feebates***. A combination of a charge or tax and the return of the revenue generated in the form of subsidies for pollution prevention measures or energy efficiency initiatives is used.

- ***Covenants***. Agreements for the management of each of the substances of concern are negotiated. These agreements could range from general undertakings to share information and work toward a general objective of reducing emissions, to the articulation of specific targets, timetables and grounds for government intervention.

- ***Mandatory public reporting.*** The federal government applies strengthened National Pollutant Release Inventory (NPRI) authorities to all significant emitters of toxic air pollutants, including power producers. It could require public reporting of past, current and projected fuel use and rates of emissions, and current and planned pollution prevention activities.

- ***Pollution prevention plans.*** Emitters of toxic substances, including those in the electric power sector, are required to produce pollution prevention plans.

- ***Voluntary and challenge measures.*** Instruments such as codes of practice, emission guidelines and industry standards are used to structure voluntary or challenge measures. Alternatively, individual emitters and their associations develop their own informal voluntary reduction and challenge plans.

4.4 Screening criteria for management options

Each of the above management options was evaluated against 13 groups of criteria.

1. **Environmental Effectiveness**
   To what extent can reductions in releases of toxic substances be achieved and ensured with the use of this management option? Both the magnitude of reductions and the degree to which all toxic substances of concern for the sector are addressed must be considered.

2. **Cost-Effectiveness and Competitiveness**
   Will this option minimize the financial burden to industry and to government in reducing releases of toxic substances? What impact on the international competitiveness of Canadian industry will result from the use of this option to achieve reductions in releases?

3. **Comprehensiveness**
   To what extent will releases of pollutants other than toxic substances be affected? Both increases and decreases in releases of pollutants such as sulphur dioxide, nitrogen oxides and greenhouse gases must be considered.

4. **Incentives**
   Does the option directly or indirectly stimulate creativity and innovation through some form of incentive acquired by decision-makers to develop and implement cleaner technologies and ways of operation?

5. **Enforceability and Compliance**
   How easily will it be to enforce and monitor compliance with this tool?

6. **Growth**
Can the option be structured in such a way as to allow for economic growth (entry of new producers into an industry, for example) while still meeting environmental requirements and/or Canadian commitments?

7. **Speed**
How quickly will reductions in releases be achieved with this tool?

8. **Fairness**
Does this option impose an unfair burden on certain individuals or sectors in the market?

9. **Intrusiveness and Flexibility**
What level of government knowledge and involvement will be required to effectively apply this tool? To what extent does this tool leave to producers and consumers the specific decisions about how to achieve reductions in releases?

10. **Data Requirements**
What will be the data requirements for the use of this tool (including monitoring data) in terms of quality, intensiveness and availability?

11. **Compatibility**
Will the application of this option support or be in conflict with established jurisdictional responsibilities, existing regulations and/or self-regulation initiatives?

12. **Mandate**
Is the enabling legislation for this tool available or being considered?

13. **Public Acceptability**
Will the use of this management option be readily accepted by the public?

4.5 Screening decisions for the management options

A preliminary screening of the 15 management options led to the selection of a smaller number for more detailed assessment. These options, and the reason for their selection, are summarized in Table 4.7. (A more detailed discussion of the selection process may be found in Volume 1 of the Technical Background Document and in the report of Task Group 3 in Volume 2 of the TBD.)

The management options that were selected for further assessment were re-grouped as noted below. The rationale for focusing on each of these management options is briefly summarized.

- ***Regulatory performance standards.*** Performance standards can be very effective in controlling releases of pollutants. They do not, however, create a significant incentive for continually reducing emissions.

- ***Emission caps/bubbles and emission trading.*** Emission trading has the potential to be an environmentally effective and cost-effective management tool. This option would allow power producers the flexibility to choose how best to respond to emission reduction requirements.

- ***Agreements***. Negotiated agreements such as covenants and memoranda of intent or voluntary commitments would give the utilities and the federal and the provincial governments maximum flexibility to manage the SOP substances in a cost-effective manner. The need to harmonize requirements/environmental quality across Canada could be addressed in the agreement.

The above three groups of management options provide a wide range of possible instruments for addressing the substances of concern. They are not mutually exclusive. For example, it would be perfectly consistent to have negotiated agreements that specify or include emission caps or emission trading. Similarly, a regulatory performance standard might be included in a cap or bubble program to ensure that emissions in all areas remain below a specified upper bound.

Table 4.7: Results of preliminary screening of management options

MANAGEMENT OPTION	SELECTED FOR DETAILED ASSESSMENT	NOT SELECTED FOR DETAILED ASSESSMENT	REASONS / COMMENTS
1. Status quo		√	However, used as a benchmark against which other options could be assessed.
2. Quantity controls		√	Effectiveness uncertain, provides little flexibility for power producers to select cost-effective options.
3. Performance standards	√		May not create a significant incentive for continually reducing emissions but can be effective in controlling releases of pollutants.
4. Air quality standards with permits		√	Public support would be high, but entails significant administrative burden for separate analysis and permit process for each facility. Enforcement may also be difficult.
5. Technological controls		√	Relationship between specific technology and emissions may be weak. Power producers may not have flexibility to choose least-cost method. No incentive for continuous improvement. (However, further analysis was carried out of certain technologies that could be used in support of other management options - see text.)
6. Emission caps or bubbles	√		Allows power producer flexibility to choose how best to respond to emission reduction requirements.
7. Emission trading systems	√		Experience has shown that trading can be environmentally effective and cost-effective.
8. Emission taxes and/or charges		√	Taxing utilities, which are primarily provincial crown corporations, would be too difficult.
9. Financial incentives		√	Not acceptable to government or the public. May be used as a complement to other options, e.g., feebates.
10. Demand side management		√	Can be very expensive to administer, difficult to ensure predictable emission reductions.
11. Feebates		√	See comments on emission taxes and/or charges.
12. Covenants	√		Has been successfully used elsewhere.
13. Mandatory public reporting		√	Could serve as accountability mechanism for other options but would not on its own ensure required emission reductions.
14. Pollution prevention plans		√	Will not, on its own, ensure that a targeted level of emission reductions is achieved.
15. Voluntary and challenge measures	√		Success has been highly variable; however, there are examples where such programs have been successfully implemented in the electric power sector.

ELECTRIC POWER GENERATION (FOSSIL FUEL) SECTOR ISSUE TABLE
STRATEGIC OPTIONS REPORT

5. Proposals submitted to the Issue Table

The initial phase of the Issue Table deliberations focused on information gathering and defining the need for further assessment of the release of toxic substances from the fossil fuel power generation sector. For those substances for which sufficient information existed, the next phase of the process was to identify those substances emitted by the sector that require reduction (i.e., require management). The final phase of the process was to assess and recommend how the substances should be managed (i.e., to assess and recommend reduction targets and the preferred management option). The best information available on emission inventories, costs, technologies and impacts was used in this assessment.

The federal government and ENGO members of the Issue Table supported the consideration of management options for total particulate matter, cadmium, arsenic, lead, nickel and hexavalent chromium. The members from utilities supported the consideration of management options for total particulate matter and nickel (the latter on a local basis only). It was clear that no consensus would be reached because opinions differed on the accuracy of release data[13], and on the role of sectoral risk assessment. However, both of the above positions required that the Issue Table focus on management options to address particulate matter emissions.

The utility representatives sought direction from their members regarding possible approaches to manage emissions of particulate matter from their sector. They subsequently developed and submitted a proposal to the Issue Table, authorized by the CEOs of the 12 utilities who own and/or operate fossil-fuel electric generation.

Although the utilities' proposal was judged by other members of the Issue Table (i.e., ENGO and federal government members) to be moving in the direction of emission reductions, not all aspects of the proposal were acceptable to them. Subsequently the two ENGO groups each submitted a proposal for the consideration of the Issue Table. Environment Canada members of the Issue Table then submitted a fourth proposal. It was agreed that all four proposals would be open to comment but not subject to changes within the Strategic Options Process.

From the outset of the work of the Issue Table, it was agreed that minority or divergent opinions would be recorded in the Strategic Options Report. The following four proposals represent the various divergent positions of Issue Table members. Essentially, the Environment Canada proposal falls within the spectrum of options presented in the other three proposals. It must be noted that there are some areas of consensus and similarity within the four proposals.

[13] The Canadian Environmental Network dissented with this conclusion. See Appendix C of this report for details.

Each proposal is presented below as received by the Issue Table and in the order that they were received. A comparison of the proposals is given in Section 5.5.

It should be noted that, although the following proposals address only utility emissions, the Issue Table did consider non-utility generators (NUGs) during their deliberations (see Table 3.2). However, no decision was made on the minimum size to which management options should be applied. This issue needs to be considered in future discussions of management options for this sector.

5.1 Canadian electrical utilities' proposal

The Canadian electrical utilities' proposal was submitted to the Issue Table on 17 September 1996.

PROPOSAL FROM

CANADA'S ELECTRICAL UTILITIES

TO

THE ISSUE TABLE

FOR

THE STRATEGIC OPTIONS PROCESS

FOR THE

ELECTRIC POWER GENERATION (FOSSIL) SECTOR

96 09 17

Background

Representatives of the fossil fuel generation sector of Canadian electric utilities have participated in the Strategic Options Process review. The substances reviewed were:

- mercury
- inorganic arsenic
- hexavalent chromium
-dibenzodioxins
- hexavalent chromium
- lead
- trichloroethylene
- benzene
- inorganic cadmium
- inorganic fluorides
- dibenzofurans
- dichloromethane
- oxidic, sulphidic and soluble nickel
- polycyclic aromatic hydrocarbons (PAHs)
- particulates

As members of each of the work groups reporting to the Issue table, utility representatives have contributed to the compilation of emissions inventories, the assessment of risk from the incremental emissions from utilities, and the evaluation of options and costs associated with the reduction of emissions of certain substances.

The mandate of each task group was as follows:

Task Group 1

To develop inventories of releases of the above toxic substances by the electric generating sector, other industrial sectors and natural sources to the atmosphere, wastewater streams, and solid waste.

Task Group 2

To provide the Issue Table with information on risks to health and the environment associated with releases by the electric generating sector of the toxic substances listed under the SOP, so that the Issue Table can determine which substances it should focus on in the management assessment phase.

Task Group 3

To finalize, if required, the scoping portion of the process and the setting of appropriate targets for the management of these toxic substances and, to establish the management option or combination of options that will provide industry and government with approaches for ensuring that these targets are met in a manner that is environmentally effective, cost efficient, etc.

Task Group 1 produced a utility inventory of SOP substances based upon accepted Quality Assurance methods. This utility inventory showed that utilities are a much smaller contributor to the environment of the substances being reviewed under the SOP than had been earlier estimated by Federal Government agencies. The inventory for other industrial sectors was based on best available information but it did not undergo a Quality Assurance review. No inventory was produced for natural sources. The utilities are of the view that the production of an inventory of natural emissions is essential if the management of toxic substances is to be implemented in a cost-effective manner which produces environmental benefits.

Under Task Group 2, the utilities retained the services of Bio-Response Systems Limited (BRSL):

1. to record the nature of the risk assessment process which was used in the selection of the electricity generation (fossil fuel) sector for an SOP review;
2. to review two recent Canadian (Ontario Hydro 1995; Hydro Québec 1991), and two recent American (USEPA 1995; EPRI 1994) risk assessment studies concerning various toxic substances emitted to the atmosphere by the utilities using fossil fuels (coal, oil or gas) for electricity generation.
3. and finally to provide a model which would allow the assessment of risks from the utility (fossil fuel) sector, based on available scientific information.

The BRSL report concluded that for the substances being reviewed within the utility SOP, with the exceptions indicated below, *"there will not be an identifiable public health problem from their potential cancer and non-cancer effects as a result of emissions from fossil fuel-fired electricity generation facilities. The boundaries on the calculated risks are also at levels that may have not traditionally been considered to warrant management intervention, either to conduct further risk assessment or to reduce risks. More-detailed assessment will reduce the risk assessment."*

It also concluded that for nickel emissions from oil-fired power plants, further assessment might be recommended on a case-by-case basis, and that taking into account the present uncertainties in estimating human exposure to mercury, further evaluation of risk is indicated for this substance.

Finally, it concluded that considering the lack of information to define a level of risk for respirable particulates, if any, particulates should remain a substance for further risk evaluation.

Following the completion of the BRSL report, Task Group 2 issued its final report in which it made a number of suggestions to the Issue table for further discussions. Two of the suggestions are particularly useful in presenting the context of emissions from electric utilities versus those from other sources, the inherent toxicity of a substance versus its specific contribution to human risk, and risks which may or may not warrant further action. The two Task Group 2 suggestions, on page 16 of their final report, are as follows:

> "Environment Canada has identified the electricity generation sector as contributing to the presence of CEPA toxic substances in the Canadian environment. **The assessments reported in the PSL reports were made on a substance-specific inherent human[14] toxicity basis rather than a sector-specific basis. Therefore, they cannot be used to estimate the specific contribution of the electricity generation sector to the total human risk.** A

[14] The Issue Table agreed that the term "toxicity" would replace "human toxicity".

specific sector may contribute different levels to the contamination of the environment in a given region."

"The Risk Assessment Studies presented here, concerning the electricity generation sector, were performed by independent agencies by using best available scientific knowledge and health risk assessment methodologies on a sector-specific basis. According to this approach, the incremental health risks evaluated for SOP substances emitted by the electric utility sector, except for mercury and particulates will not be improved through further assessment. Except for mercury and particulates, CEA believes that incremental health risks posed by the SOP substances from the electric power sector are essentially negligible or not an identifiable health problem. Health Canada believes that a *de minimus* risk level cannot be established on a scientific basis alone. **However, during the risk management phase a judicious balancing of technological, socio-economic and scientific information may allow the conclusion that some risks may be sufficiently small as to not warrant further action.**"

Proposal

Whereas

- the actual emissions of substances reviewed by the SOP for the electric power sector are substantially lower than originally estimated

- an exposure and risk evaluation of incremental emissions from the fossil fuel utility sector, based on extensive emission, exposure and risk information from the fossil fuel utility sector of the United States, risk assessment studies conducted by two Canadian utilities, and an emission inventory of all fossil fuel utilities of Canada found that all substances reviewed under the SOP, with the three qualifications outlined above, do not pose an identifiable public health problem from their potential cancer and non-cancer effects

- the above-noted exposure and risk evaluation concluded that present uncertainties, as well as the lack of information on which to define a level of risk from mercury and particulate emissions, do not permit a determination of risk or no-risk;

- there is growing concern for the impacts of respirable sized particulate matter on human health;

- Canadian electric utilities are major contributors to the competitiveness of the Canadian economy and are cognizant of the trade advantages of good environmental performance;

- Canadian electric utilities share the objective of pollution prevention as a means to maintain the quality of the environment, and support the objectives of the Accelerated Reduction of Elimination of Toxics (ARET) program by reducing emissions of toxics in a cost-effective manner, when there is an opportunity and where there is a benefit to the environment and public health;

Therefore, the Canadian electric utilities identified below propose to enter a covenant with the Government of Canada, with the participation of the provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland, to:

1. cooperate in the further assessment of potential risks, if any, associated with emissions of mercury and particulate matter from fossil fuel electric utilities. This assessment will be a mutually agreeable effort of the Government of Canada and Canadian electric utilities, and any determinations will be based on a rigourous, science-based approach that will include current knowledge, complete risk assessment information, and characterization of uncertainty in management decisions. This determination will also include full knowledge and understanding of the contribution of emissions from all sectors of the economy, and a rigourous inventory of naturally occurring substances which will assist in the assessment of cost-effectiveness and benefits to the environment of any proposed action. The information used for the determination will be reviewed by a Science Advisory Panel acceptable to both Government and utilities, and it will form part of the information used in any future initiatives pertaining to these substances.

2. reduce the particulate emission rate guideline to 0.03 pounds per million BTU of heat input (12.9 nanograms/Joule) for new fossil-fired units commencing first commercial operation after December 31, 1997. Emission rate to be calculated from the average of two valid particulate emission stack tests.[15]

3. review particulate emissions from existing units with their respective Province and reach an agreement on an appropriate plan of action by December 31, 2000 based upon specific priorities, the need to apply limited resources to these priorities and to obtain the best environmental benefits from these resources. Otherwise, the utility will commit to meeting particulate emission rates as follows:

   - 0.1 pounds of particulates per million BTU (43 nanograms/Joule) by December 31, 2005 for all facilities expected to be used for base load generation (greater than 20% annual capacity factor) after December 31, 2010. Emission rate to be calculated from the average of two valid particulate emission stack tests.

[15] Note: Units which have commenced first commercial operation before December 31, 1997 are not affected by this proposal.

- 0.2 pounds of particulates per million BTU (86 nanograms per Joule) by December 31, 2005 for all facilities expected to be used for peaking generation (less than 20% annual capacity factor) after December 31, 2010. Emission rate to be calculated from the average of two valid particulate emission stack tests.[16]

The proposal from Canadian utilities does not include any type of performance reporting to the Government of Canada. Harmonization and the reduction of duplication is a key part of the proposal. Therefore, participation by the provinces is an essential component of the proposal as progress on utility performance is expected to be tracked by the provincial regulatory agencies.

In response to these commitments by Canadian utilities, the Government of Canada will commit that information leading to any future initiatives regarding the emissions of CEPA-toxic substances from the electric utility fossil fuel sector will include a rigourous, science-based approach which will encompass current knowledge, complete risk assessment information, characterization of uncertainty in management decisions, and utility emission inventories which have been reviewed and approved by both utilities and the Government of Canada. This information will also include full knowledge and understanding of the contribution of emissions from all sectors of the economy, and a rigorous inventory of naturally occurring substances which will assist in the assessment of cost-effectiveness and benefits to the environment of any proposed action. The information will be reviewed by a Science Advisory Panel acceptable to both Government and utilities. Appendix 1 to this proposal shows guidance provided in various Government documents which will form the basis for the scientific review of the issue in question.

BC Hydro	Alberta Power
Edmonton Power	TransAlta Utilities
SaskPower	Manitoba Hydro
Ontario Hydro	Hydro Québec
NB Power	Maritime Electric
NS Power	Newfoundland & Labrador Hydro

16 Note: Units which will not be in operation after December 31, 2010 are not affected by this proposal.

APPENDIX 1 TO THE UTILITIES' PROPOSAL

Government of Canada Approach to the Management of Toxic Substances

Review of Government Documentation

- "In scientific parlance, toxicity is the inherent capability of a substance to cause harm which does not take into account exposure."

  Health Canada 1994. Human Health Risk Assessment for Priority Substances. Minister of Supply and Services, Canada

- "The Government of Canada considers inherent toxicity to be the intrinsic ability of a substance to cause harm."

  CEPA Review: The Government Response. p 70, 1995.

- " All things are poisons, there is nothing without poisonous qualities. It is only the dose that makes a thing a poison."

  Paracelus, 1493-1541

  Health Risk Determination: The Challenge of Health Protection, Minister of Health. 1993

- "Inherent toxicity plays a very significant role in establishing the levels of exposure at which adverse effects occur and, when coupled with exposure information, forms the basis for assessing risk."

  CEPA Review: The Government Response. p 70, 1995.

- "The Government of Canada is committed to a risk-based approach to decision-making."

  CEPA Review: The Government Response. p. 70, 1995.

- "Risk assessment estimates the degree and likelihood of adverse effects resulting from exposure to a substance in the environment. Risk management is a process of selecting and implementing management actions on an assessed risk, taking into account a wide range of legal, economic and social factors."

  Toxic Substances Management Policy - Government of Canada. p.6, 1995.

- "Elements and naturally occurring substances that are used or released as a result of human activity may be targeted under Track 2 for reduction to naturally occurring levels."

  Toxic Substances Management Policy - Government of Canada. p.7, 1995.

- Risk Management Approach

  Health Canada, Health Protection Branch. A Policy Framework. 1994.

  It is the policy of the Health Protection Branch, in fulfilling its mandate:

  a) To follow a structured process of risk determination for the assessment and management of health risk.

  b) To identify and define risks to the health and well-being of Canadians through:

  - multidisciplinary, population or incidence-based investigations;
  - monitoring and evaluation of products and production processes;
  - research and laboratory investigations; and
  - evaluation, synthesis and interpretation of evidence-based information.

  c) To quantify the relationship between health outcomes associated with the hazard, and exposure to the hazard and the level of risk involved.

  d) To identify various courses of action that could potentially address health issues under review.

  e) To assess possible risk management options in a consistent manner, taking many factors into consideration, including health benefits

  f) To select, implement and monitor appropriate courses of action.

- ".....we propose to incorporate in the Preamble a reference to the inter-relationship of economic and environmental principles and acknowledge the role of such economic considerations as the benefit-cost approach and flexible economic decision-making."

  CEPA Review: The Government Response. p. 15, 1995.

APPENDIX 2 TO THE UTILITIES' PROPOSAL

Clarification of Terms as Requested at the 1996 09 17 Montreal SOP Meeting

- **Complete Risk Assessment Information**

  As outlined by item c) above in Appendix 1, which is extracted from "Health Canada, Health Protection Branch, A Policy Framework, 1994"

  > "To quantify the relationship between health outcomes associated with the hazard, and the exposure to the hazard, and the level of risk involved."

- **Partnership**

  A working collaborative between the Government of Canada and utilities which identifies the scientific research issues, develops the scope of work, and coordinates/funds the work execution. Level of funding to be mutually agreed and shared between the Government of Canada and the utilities.

- **Science Advisory Panel**

  To provide independent third party advice to the Government/Utility partnership, including review of information to be used in toxic substance management initiatives. Panel membership to be acceptable to both the Government of Canada and the utilities.

5.2 Canadian Environmental Network's (CEN) Proposal

The CEN proposal was submitted to the Issue Table on 4 October 1996 by Great Lakes United on behalf of the CEN.

Montréal, October 4, 1996

To: Mr Joe Kozak
Chair of the Electric Power Generation Issue Table
By fax:

Dear Mr. Kozak:

This letter is to inform you about CEN's position regarding the EPG IT and the SOR. First we would like to reiterate our fundamental disagreement with the industry position in regards to their interpretation of the risk assessment study that was done and paid by their consultant as well as the reliability of data on toxics emissions from that sector. Their interpretation is not scientifically sound because it does not take into account the uncertainties surrounding emission data and consequences of exposure to the EPG toxic releases in the context of cumulative effects and combined effects on human health and the environment. Having said that, we would also like to denounce the process into which these interpretations were constantly used by industry to block any constructive discussions to address the problem of toxic contamination from that particular industry sector.

These industry's interpretations have constantly side-tracked the debate of the IT which should have been focused on *how do we all work together for a less polluted environment in Canada*. Moreover, the industry proposal presented at the last meeting in Montréal, by dumping the problem of enforcement and control into the provincial backyard in even more side-tracking than the previous debate.

For all of the above reasons and *because of the obvious lack of willingness of this industry sector to show real commitments to address toxic pollution in Canada*, we believe this industry should be regulated under CEPA for particulates to a 0.03 pound/MMBTU produced at the stack level for existing and new facilities. The implementation of this standard for particulates would also address some level of toxic emissions as well by capturing most of the particulates.

We also strongly suggest that a multimedia, mandatory pollution prevention planning system included in a federal permit system be implemented for coal and oil fired plants. These pollution prevention plans should take into account the demand for energy by proposing good energy efficiency programs thereby reducing the need for fossil fuel burning. They should look at technological good housekeeping measures for such facilities. Not only should these plans address the CEPA toxic substances but they should also address greenhouse gas and acid gas emissions. These permit / P2 plans

should be completed in two years after which time the permit would be given or not given to a specific facility. These plans should be revised by a public consultation process under which the Canadian public could comment and suggest modifications to the proposed plans. The implementation of these plans could be done through a legally binding agreement between the federal government and the facilities/companies under which financial penalties could happen if a company does not fulfil its commitment under the P2 plan.

Finally, we also believe that it is obvious that the lack of good emission data from that sector was and still is a major problem throughout this process. Consequently, we strongly recommend a mandatory reporting system for that sector under NPRI.

These constitute the core of our recommendations for the SOR. We are hopeful that our contribution will be included in the final report. We are also thankful to Environment Canada and Mr. Kozak for letting us participate and hopefully influence the outcome of this process.

Stéphane Gingras
Field Coordinator
Great Lakes United

5.3 STOP's Proposal

The proposal from STOP was received by the Issue Table on 7 October 1996.

Brief to Environment Canada

regarding the Electric Power Generation Issue Table

of the Strategic Options Process

STOP is a non-profit citizens' environmental organization incorporated in the Province of Québec in 1970. STOP deals with a wide range of environmental issues. Since 1990, STOP volunteers have participated actively on numerous multi-stakeholder advisory committees at the national and local levels. STOP has been particularly involved in the development of several Guidelines and Codes of Practice under the NOx/VOC Management Plan of the Canadian Council of Ministers of the Environment.

With respect to the Government of Canada's Strategic Options Process (SOP) under the Canadian Environmental Protection Act (CEPA), STOP has been an active member of three multistakeholder Issue Tables: dry cleaning, degreasing, and electric power generation (fossil fuel).

STOP believes strongly that emissions of respirable particulate matter and mercury from the existing twenty-three coal-fired power plants in Canada need to be better controlled. With respect to mercury emissions, STOP acknowledges the lack of reliable data at this time and the need for further research. STOP urges the Government of Canada to put a high priority on applied research in this area (monitoring, emission inventories, and control strategies). The U.S. Environmental Protection Agency is currently undertaking a similar exercise. Mercury emissions from U.S. coal-fired power plants are known to have a significant impact on the Great Lakes basin.

With respect to respirable particulate matter (RPM) emissions, the time to act is now. Several recent Canadian studies indicate a correlation between RPM ambient air concentrations and excess mortality and morbidity. The economic impact of these health effects has been estimated in the billions of dollars.

The technology to reduce particulate matter emissions from coal-fired plants is well-known and is readily available in the environmental industry marketplace. Electrostatic precipitators (ESP), which can remove particulate matter at efficiencies exceeding 99.9%, were patented in the U.S. in 1907. Most coal-fired utility boilers currently operating in Canada are equipped with ESPs or equivalent technology, although not currently at such high removal efficiencies. A notable exception is the Boundary Dam

power station in Saskatchewan. Operated by SaskPower, five of its six units do not have ESPs.

STOP strongly disagrees with the views of Canada's electric utilities that each power plant should be free to negotiate dust removal requirements with each provincial environmental regulatory agency. While STOP does not dispute provincial jurisdiction in this area, the result has been a very uneven playing field.

In order to achieve a "level playing field" STOP recommends that Environment Canada and Health Canada adopt regulations under the Canadian Environmental Protection Act. The question then becomes which level of control is appropriate. With the help of a consultant, the Issue Table developed three possible levels of control

Level 1
0.1 lb PM/million BTU
current Canadian emission Guideline for new plants;
87% of plants in Canada currently achieve this level[17]

Level2
0.03 lb PM/million BTU
current U.S. EPA standard for new plants;
65% of plants in Canada currently achieve this level[18]

Level 3
0.01 lb PM/million BTU
level cited by U.S. EPA as representing the upper limit of emission reduction from new plants

At the third meeting of the Electric Power Generation Issue Table in Halifax in July 1996, STOP's representative put the following proposal on the table:

> **Every existing coal-fired utility boiler in Canada shall emit no more particulate matter than 0.03 lb PM/million BTU, by no later than January 1, 2000.**

STOP stands by its earlier proposal, and reiterates it today. The consultant's revised cost estimates indicate that the Level 2 particulate matter control, if implemented across the country, would incur a total cost (including capital and operating costs) of $32 million per year. Level 1 control, which STOP deems inadequate, would incur total annual costs of $7.5 million. Level 3 control would incur total annual costs of $69 million.

17 Note from the Issue Table Chair: For clarification, this percentage represents the plants meeting the mean annual emission value of 0.1 lb/million BTU. Consequently, fewer than 87% of the plants would meet the "never-to-be-exceeded" limit of 0.1 lb/million BTU.

18 As in preceding footnote, but for a value of 0.03 lb/million BTU.

STOP supports the regulatory option at the Level 2 control for particulate matter. In recent years environmental regulation has been treated as a four-letter word in Ottawa. As there is clearly a lack of consensus with respect to the Electric Power Generation Issue Table, Canada's Ministers of Environment and Health will have to make some hard decisions. That is why they were elected. STOP believes its proposal would help to protect the health of Canadians at very reasonable cost to Canadian society. The purchase of new and/or retrofit of air pollution control equipment would also provide economic benefits to the Canadian environmental industry sector.

Bruce Walker
Research Director
STOP

5.4 Proposal submitted by the Environment Canada members

The proposal from the Environment Canada members of the Issue Table was first available for review by the Issue Table in the 17 December 1996 draft of the Strategic Options Report. Environment Canada members requested that it be noted in the SOR that a decision by them to include a proposal was made only following the last meeting of the Issue Table on 27 November 1996 when a final attempt to reach a set of consensus recommendations did not succeed.

PROPOSAL FROM
ENVIRONMENT CANADA MEMBERS OF THE ISSUE TABLE
WITH RESPECT TO THE MANAGEMENT OF TOXIC SUBSTANCES RELEASED BY THE ELECTRIC POWER GENERATION (FOSSIL FUEL) SECTOR

The following approach builds on several elements contained in the proposals submitted to the Issue Table by the Canadian electric utilities and by two ENGO organizations, STOP and CEN.

It is recognized that the Canadian utilities' proposal moves in a positive direction and is proactive in terms of particulate matter reductions. However, there is considerable uncertainty with respect to the level of emissions reductions that would result from the utilities' proposal. This stems in part from the pivotal role assigned in the proposal to the provinces, most of which have not participated in the SOP. Also, there remained significant concerns to the Government of Canada representatives with respect to the onus placed on the government by the proposed science advisory panel, and the other commitments, in relation to future air quality initiatives and issues.

The ENGOs' proposals recommend the development of federal regulations and more stringent standards for emissions of particulate matter from existing plants. This would provide greater certainty of outcome but would not provide flexibility to respond in the most cost-effective manner. Also, our analysis suggests that the more stringent standard may result in relatively small incremental reductions in emissions but at significantly increased costs. Regulation may be a more attractive alternative in the future if other measures are unsuccessful and if respirable particulate matter is deemed to be toxic under CEPA.

The following approach proposed by Environment Canada will result in estimated minimum emission reductions, from existing plants in the range of 100,000 tonnes (85%) per year for particulate matter, 5% for mercury, 25% for cadmium and 40 - 70% for arsenic, chromium, nickel and lead. It is estimated that the cost for this approach will be between $11 and $26 million per annum. The foregoing estimated emission reductions and costs are based upon an analysis carried out under contract for

Environment Canada (see Tables 5.2, 5.3 and 5.4). The majority of the emission reductions and associated costs would occur at a plant in Saskatchewan.

Whereas:

- the fossil fuel-fired electric utility sector is a contributor to releases of a number of substances deemed toxic under CEPA;
- information on releases of toxic substances from this sector is incomplete;
- information on risks specific to releases from this sector is incomplete;
- many of the CEPA-toxic substances addressed by the Issue Table are associated with emissions of particulate matter;
- there was general agreement at the Issue Table on limits to emissions of particulate matter from new sources and for some form of proactive action to reduce particulate matter emissions for existing sources;
- Of the 15 management options examined by the Issue Table, the two management options preferred by various stakeholders were negotiated agreements or regulatory performance standards;
- Environment Canada and Health Canada have a responsibility under CEPA to manage toxic substances entering the environment;
- Environment Canada and Health Canada are supportive of the concepts of pollution prevention, precautionary approach and continuous improvement;
- there is a need to set a standard for the release of toxic substances that will result in a harmonized level of environmental performance requirements across Canada, and to consider requirements for control of toxic substances being taken in the United States and the Economic Commission for Europe (ECE).

Although the following proposal deals with particulate matter and its associated heavy metals, it should be recognized that there is the possibility that, following assessment under Priority Substances List 2 (PSL 2), examination of the management of particulate matter with diameters less than 10 micrometres (PM_{10}) may be required.

Environment Canada proposes the following actions:

a) New plants

It is recommended that the present Thermal Power Generation Emissions - National Guidelines for New Stationary Sources (CEPA, 1993) be revised so that the particulate matter emission limit for new plants commencing commercial operation after 31 December 1997 will be equivalent to 0.03 lb per million BTU heat input (12.9 nanograms per Joule).

b) Existing plants

It is recommended that the Government of Canada (led by Environment Canada) and each of the major electric utilities, with input from the respective provinces,

enter into a framework agreement on a process to reduce emissions of particulate matter and associated metals from coal and oil-fired power plants. The discussions of this framework agreement should begin as soon as possible and be completed by 31 December 1997. An opportunity for public comment will be provided.

It is envisaged that the framework agreement will lead to the development of action plans by the utilities and their respective provincial governments and that the action plans will incorporate the following elements:

- Targets: The action plans should contain quantitative targets that result in an emission rate equivalent to 0.1 lb/million BTU heat input (43 nanograms per Joule) or lower. Targets expressed as mass limits (tonnes per annum) and flexible provisions such as emission averaging and trading should be considered as means to achieve comparable emission reductions at a lower (lowest practical) cost.

- Timelines: The action plans should contain clear timelines for achievement of emission reductions.

- Reporting: The action plans should include an open, transparent and uniform mechanism for public reporting of progress on implementation of the action plans.

The finalization of action plans between utilities and their respective provincial governments should be completed by no later than 31 December 1998. Environment Canada will review these action plans and they will be made available to the public.

An assessment of progress in terms of reductions and impacts, and the need for further actions, will be completed by Environment Canada, with participation of utilities and provinces by 31 December 2003.

Environment Canada should, at the outset of discussions on the framework agreement, indicate to all parties its intention to use regulatory powers under CEPA to achieve emission reductions if it appears that there is little or no progress being made on or under the framework agreement.

c) Further collaborative studies

It is recommended that the Government of Canada (led by Environment Canada) and electric utilities, with participation of provinces, and possibly private sector research organizations and academia, enter into further collaborative research on releases of toxic substances from the fossil fuel-fired electric utility sector. Key elements of this work, in order of priority should be:

- emissions of mercury and particulate matter from coal and oil-fired plants and nickel from oil-fired plants: links to health and the management of exposure;
- improvements in inventories of releases to all media (air, water, solid waste) of particulates, arsenic, cadmium, chromium, lead, mercury and nickel from this and other sectors, and natural sources. This would include improved quality assurance/quality control procedures and protocols;
- clarification of the environmental impacts of fluoride emissions from coal-fired electric utilities;
- further information on emissions of dioxins, furans and polycyclic aromatic hydrocarbons (PAHs) from the electric utility sector, including analytical protocols and inventories.

5.5 Comparison of the four proposals

The work of Task Group 3 was completed with the presentation of recommendations on scoping (with respect to substances and management options to be considered) at the September meeting of the Issue Table. The decision not to continue the work of the Task Group was in response to the decision of the utility members of Task Group 3 not to participate in the analysis of the proposals (and specifically of the utility proposal). Responsibility for the comparison reported in this section was then left to the federal government, in particular to Environment Canada.

a) Key features

The key features of the four proposals are summarized in Table 5.1. There are both areas of agreement, and areas where the scope, targets and management approaches diverge.

All four proposals indicate that **further collaborative work and research** is needed. In the utilities' proposal this would be done through cooperative assessment between the federal government and the utilities and in the CEN proposal through the preparation of pollution prevention plans. The STOP proposal focuses responsibility on the federal government, though only research on mercury is addressed. Environment Canada proposes that this work be done by the utilities and the federal government (led by Environment Canada), with the participation of the provinces and the possible involvement of the private sector and academia.

The **management options** or approaches to implementing the proposals vary significantly. The utilities recommend the use of a binding covenant or negotiated agreement between the federal government and the utilities, with the participation of the provinces. In addition to a proposed emission guideline for new plants, this agreement would be supplemented by action plans, developed by the utilities and their respective provinces, to address particulate matter emissions from existing plants. Commitments to reduce these emissions, if the action plans are not developed with the provinces by the end of 2000, have also been included in the utilities' proposal.[19] **(Note that it is these commitments that are used to compare the utilities' proposal with the other three proposals.)** The STOP and CEN proposals specify federal regulations.

19 Note that the utilities have made their proposal conditional on the formation of a Science Advisory Panel and the use, for future CEPA initiatives, of sectoral risk assessment.

Table 5.1: Key features of the four proposals submitted to the Issue Table.

Proposal feature	Utilities' proposal[1]	STOP proposal	CEN proposal	Environment Canada proposal
Who is involved?	Federal government, provincial governments and utilities	Federal government and utilities	Federal government and utilities	Federal government, provincial governments, utilities and the public
Scope	Coal and oil-fired utility plants	Coal-fired utility plants only	Coal and oil-fired utility plants; pollution prevention plans cover greenhouse gases and acid gas emissions	Coal and oil-fired plants; agreement could involve other media and issues
Emission limits - existing plants	Negotiated with provinces or, failing that, utilities will commit to standards of: a) 0.1 lb particulate matter/million BTU for base load plants and 0.2 lb particulate matter/million BTU for peaking plants, by 31 December 2005	Regulated limit of 0.03 lb particulate matter/million BTU after 1 January 2000	Regulated limit of 0.03 lb particulate matter/million BTU (no date for implementation)	Actions, targets and schedules to be established in utility-specific plans based on framework agreement. The equivalent of 0.1 lb particulate matter per million BTU will be applied by the year 2003. Flexibility may be provided by trading and/or emission averaging.
Emission limits - new plants	Agreement of 0.03 lb particulate matter/million BTU for new plants commencing first commercial operation after 31 December 1997.	Not specified	Regulated limit of 0.03 lb particulate matter/million BTU (no date for implementation)	Guideline equivalent to 0.03 lb/million BTU for new plants starting operation after 31 December 1997
Research	Cooperative assessment by the utilities and the federal government of risks associated with mercury and particulate emissions.	Applied research on mercury by the federal government	Addressed through pollution prevention plans	Four areas for collaborative research are recommended in order of priority
Reporting	No direct reporting to federal government; provincial regulatory agencies to track performance		Mandatory reporting under National Pollutant Release Inventory	Public reporting on progress on action plans
Other actions	Federal government to commit that future initiatives on CEPA-toxic substances from the power sector will include a "rigourous, science-based approach", and sectoral risk assessment		Mandatory pollution prevention planning linked to federal permit for each facility	Review by federal government of progress under the action plans by 31 December 2003, and determination if further action is needed.

[1] All aspects of the utilities' proposal are conditional upon the acceptance of the Science Advisory Panel, as outlined in the proposal.

For **new plants** the utilities, CEN and Environment Canada proposals specify an emission limit of 0.03 lb particulate matter/million BTU. The effective date is the end of 1997 in the utilities' and Environment Canada proposals. The CEN proposal does not specify an implementation date. The STOP proposal does not specifically refer to new plants. **It is assumed that the emission limits specified in the three proposals are "never to be exceeded" values based upon standard source testing procedures.**

There are a number of differences among the proposals with respect to recommended emission limits for **existing plants**. The CEN proposal recommends the same limit for existing plants as it does for new plants - 0.03 lb/million BTU. The STOP proposal recommends this limit (i.e., 0.03 lb/million BTU) for existing coal-fired plants. The emission limits for existing plants in the utilities' proposal are less stringent than those in the two ENGO proposals - 0.1 lb/million BTU for base load plants and 0.2 lb/million BTU for peaking plants. Environment Canada recommends an emission rate equivalent to 0.1 lb/million BTU or lower for all existing plants.

The STOP, CEN and Environment Canada proposals for emission limits on existing plants will result in significant emission reductions if implemented. With a fully implemented utilities' proposal, however, there are several possible outcomes. These are:

a) agreement is reached between the utilities and provinces which may result in significant reductions in emissions;

b) agreement is reached between utilities and provinces that other priorities should be addressed with the limited resources available in the pursuit of the best environmental benefits from these resources, and no emission reductions are made; and

c) no agreement is reached between the utilities and the provinces and the utilities adopt the fallback emission limits specified in their proposal, which will result in significant emission reductions.

The proposals also differ with respect to the requirement for the **reporting of emissions**. The utilities' proposal offers no *direct* reporting to the federal government; it is expected that the provinces will track the performance of the plants. The CEN proposal specifies reporting under the National Pollutant Release Inventory. Environment Canada recommends that an open, transparent and uniform mechanism for reporting be adopted. The STOP proposal does not address the issue of reporting.

b) Estimated emission reductions

Environment Canada estimated the emission reductions and associated impacts including costs which could result from the implementation of the various proposals.

To allow for the difference between mean annual limits and compliance limits (as was discussed in Section 4.2), it was assumed that the target annual emissions rate will likely fall between the compliance rate and 50% of the compliance rate. For example, a suggested compliance rate of 0.1 lb/million BTU would lead to target annual emission rates between 0.1 and 0.05 lb/million BTU.

Table 5.2 summarizes, by province, the estimated reductions in emissions of particulate matter resulting from each of the proposals. It is assumed that the technological option with the minimum cost (in terms of cents/kWh) would be selected. Environment Canada's cost analysis indicated that, in nearly all cases, this would be either an upgrade of the electrostatic precipitator or a combination of an electrostatic precipitator and a baghouse. (Other options may be available.)

Table 5.2: Estimated reductions (from present values) in particulate matter emissions for each proposal, by province.[20]

Province	Present emissions (tonnes)[21] (see Table 2.3)	Percent reductions in emissions			
		Utilities' proposal[22]	STOP proposal	CEN proposal[23]	Environment Canada proposal
Alberta	10200	0-5	35-66	35-66	16-24
Saskatchewan	102000	0-98	98-99	98-99	96-98
Manitoba	5600	0	87-94	87-94	0-80
Ontario	3500	0-5	32-51	32-51	0-7
Québec	15	0-22	0	79-89	29-65
New Brunswick	700	0	0-8	0-23	0
Nova Scotia	2400	0-52	0-5	63-75	33-55
Newfoundland & Labrador	1400	0-74	0	84-92	47-74
CANADA	**126000**	**0-85**	**88-92**	**90-94**	**84-87**

Table 5.2 shows that each of the proposals, if implemented, could lead to substantial reductions in total emissions of particulate matter from utility generators (i.e., reductions of 83% to 94% from present values). In terms of quantity of particulate matter removed, the estimated reductions range from 103 to 118 kilotonnes per year. Based on the information available, the utilities' proposal would result in 98% of these kilotonnes being removed at a plant in Saskatchewan. According to the STOP proposal, from 91% to 94% would be removed at this plant and according to the CEN proposal, from 89 to 92%. The Environment Canada proposal would result in 96-97% being removed at the plant.

It is possible that agreements between the provinces and the utilities may lead to larger reductions than those shown in Table 5.2 where more stringent limits are set or where action by utilities results in larger emission reductions than required as a result of cost-effectiveness considerations. Alternatively, these agreements may result in no emission reductions or in reductions much less than those indicated in Table 5.2 where it is

20 Emission reductions are expressed as percentage reductions from present emissions. Estimated emission reductions in Table 5.2 and costs in Table 5.4 are based upon a forecast of electricity demand provided by staff of Natural Resources Canada (personal communication between D. Rose, Environment Canada, Hull, Québec and Hy-Hiên Tran, Natural Resources Canada, Ottawa, Ontario, September 1996). It is anticipated that electric utilities will undergo significant changes required by a move to deregulation of the industry. These estimated emission reductions and costs are based on one scenario only, and they could change based on industry restructuring.

21 Values my not add up to total due to rounding.

22 Estimated emission reductions in Table 5.2 and costs in Table 5.4 associated with the utilities proposal are based on the assumption that the utilities, after discussions with the provinces, implement emission reductions by 31 December 2005 as outlined in their proposal. The zero values indicate the extreme case that the implementation plans formulated with the provinces result in no emission reductions, or that the utilities in question already meet the targets outlined in their proposal.

23 As an implementation schedule is not addressed in the CEN proposal, the 1 January 2000 implementation date specified in the STOP proposal is assumed to apply.

agreed that no action is required by specific utilities or where the provinces have other priorities. Nevertheless, the utilities' proposal could, over time, lead to a substantial reduction of emissions as old units are retired and new ones are built if the emission limit of 0.03 lb/million BTU for new plants is adopted.

Table 5.3 presents the estimated minimum reductions in annual emissions in Canada of other substances that could result from reductions in emissions of particulate matter. Significant reductions in the emissions from utilities of other toxic substances, especially arsenic, hexavalent chromium, lead and nickel, are indicated. For the utilities' and Environment Canada proposals, this table assumes that the emission limits for existing plants that are shown in Table 5.1 will be applied.

Table 5.3: Estimated ranges in reductions in mean annual emissions in Canada of pollutants other than particulate matter resulting from the four proposals (in tonnes and in percent from present values)

	Estimated emission reductions			
Substance of concern	Utilities' proposal[24]	STOP proposal	CEN proposal	Environment Canada proposal
Arsenic	0, 5.1 to 5.2 tonnes (0, 66 to 67%)	5.4 to 5.9 tonnes (70 to 76%)	5.4 to 5.9 tonnes (70 to 76%)	5.1 to 5.3 tonnes (66 to 68%)
Cadmium	0, 0.1 to 0.2 tonnes (0, 22 to 26%)	0.2 to 0.3 tonnes (31 to 51%)	0.2 to 0.3 tonnes (32 to 53%)	0.1 to 0.2 tonnes (23 to 27%)
Hexavalent chromium	0, 0.3 tonnes (0, 48 to 50%)	0.3 to 0.4 tonnes (53 to 61%)	0.3 to 0.4 tonnes (54 to 64%)	0.3 tonnes (49 to 51%)
Lead	0, 5.3 to 5.5 tonnes (0, 71 to 73%)	5.6 to 6.3 tonnes (75 to 83%)	5.7 to 6.3 tonnes (76 to 84%)	5.3 to 5.5 tonnes (71 to 73%)
Mercury	0, 0.1 tonnes (0, 5 to 7%)	0.2 to 0.4 tonnes (12 to 29%)	0.2 to 0.4 tonnes (13 to 30%)	0.1 tonnes (5 to 7%)
Nickel	0, 8.6 to 11.2 tonnes (0, 41 to 53%)	5.5 to 6.8 tonnes (26 to 32%)	13.5 to 15.8 tonnes (64 to 75%)	8.9 to 11.6 tonnes (42 to 55%)

c) Costs of emission reductions

The estimated **costs to the utilities** to achieve the reductions associated with each of the four proposals are given in Table 5.4. The CEN proposal is the most expensive (36 to 71 million dollars per year) because it applies a relatively stringent emission limit (0.03 lb/million BTU) to all plants. The STOP proposal is slightly less expensive (33 to 65 million dollars per year) because it applies the same limit but only to coal-fired plants. The Environment Canada proposal is less expensive (9 to 26 million dollars per year) than either of the ENGO proposals because it applies a less stringent emission limit (0.1 lb/million BTU instead of 0.03 lb/million BTU), albeit to both existing base load and peaking plants. The utilities' proposal is slightly less expensive (8 to 19 million dollars per year) than the Environment Canada proposal because it applies the same emission

[24] The zero values reflect the possibility of agreements between the provinces and the utilities that result in no required action; the higher values reflect the implementation of the utilities' 'fallback' commitment if no action plans are developed.

limit to existing base-load plants but a less stringent limit (0.2 lb/million BTU) to existing peaking plants.

Table 5.4: Estimated costs of the four proposals submitted to the Issue Table, by province[25]

	Annual costs (million dollars/year)			
Province	Utilities' proposal	STOP proposal	CEN proposal	Environment Canada proposal
Alberta	0-4.6	17.6-28.6	17.6-28.6	0.8-7.9
Saskatchewan	6.0	6.0-10.7	6.0-10.7	6.0
Manitoba	0	1.1	1.1	0.7
Ontario	0-5.4	8.4-18.0	8.4-18.0	0-8.4
Québec	0-0.5	0	0.7	0.7
New Brunswick	0	0-3.0	0-6.0	0
Nova Scotia	0.6	0-3.2	0.8-4.1	0.8
Newfoundland & Labrador	1.6	0	1.6	1.6
CANADA	**8.2-18.7**	**33.1-64.7**	**36.2-70.8**	**10.6-26.0**

When comparisons among the proposals of this sort are made, it is important to ensure: a) that the assumptions behind the estimates are understood and b) that other features of the proposals that could have a significant impact on the outcome of the initiative are not overlooked. For example, the reduction and cost estimates for the utilities' proposal are based on the assumption that the target is 0.1lb/million BTU for base loaded plants and 0.2 lb/million BTU for peaking plants (i.e. the utilities' 'fall-back' commitment/recommendation with respect to existing plants). The other features of the proposals that must be recognized include 1) timing with respect to implementation of the recommendations, 2) certainty with respect to achieving the reductions, 3) openness at the implementation stage (e.g., openness and transparency in the development of the framework agreement and action plans, and in the reporting of progress towards the goal), and 4) commitments attached to the proposal (e.g., commitments with respect to undertaking joint initiatives in the future).

In addition to the costs identified in Table 5.4, there may be additional costs for the utilities associated with the various proposals including the cost for negotiation, research, sampling and reporting. These costs may be significant, depending on the level of effort; it was suggested by some utility members of the Issue Table that a rough estimate of 5% of the associated capital cost be used.

25 Annualization is done with a 7% interest rate following the U.S. Environmental Protection Agency costing methods.

The utilities recommend that there be less stringent emission limits set for peaking plants (i.e. plants operating at less than 20% capacity). The utility members explained that the dispatch of units in a competitive market will be based strictly on the cheapest available energy and that, therefore, high-cost, inefficient units which have been assigned a peaking role will not be more dispatchable because of a lower standard for emissions. They will continue to be expensive units, low on the dispatch order with very low emissions due to their infrequent use. Other members of the Issue Table believe that a less stringent emission limit for peaking plants may result in the utilities keeping these old plants in operation longer. Neither the ENGOs nor Environment Canada have distinguished between peaking and base-loaded plants in their recommendations with respect to existing plants. The ENGO proposals may create a situation where a plant soon to be decommissioned would be required to install new pollution control equipment. The Environment Canada proposal appears to take the middle path. The negotiation of action plans, and provisions for alternatives which achieve comparable emission reductions (e.g., mass limits, averaging, trading) provide flexibility to reduce overall economic impact; however, the shorter implementation deadlines than those found in the utilities' proposal would reduce this flexibility somewhat.

Environment Canada's comparison of the key financial indicators for the major utilities potentially affected by the proposals suggests that, even for the ENGO proposals, changes in the utilities' financial positions would be marginal. Though in the past it has been possible to pass cost increases on to the consumers of electricity, given the status of most utilities as regulated monopolies, it is likely that, under current conditions, a utility may now have to absorb some or all of the increase in cost through reduced net revenues. (The utility members of the Issue Table wished to have it recorded that, in their opinion, the sector may not be able to pass these costs on through prices given the new competitive environment, and that a trade-off with other program expenditures, including other environmental programs, would be required.)

Information on cash flow conditions for the utilities was not available. Though the requirement to install pollution control equipment could potentially create cash flow difficulties, this is unlikely to be a major concern given the relatively long planning horizons explicit in or assumed for all of the proposals[26].

26 It was estimated that if the capital expenditures for any of the proposals were subtracted in a single year from the net earnings of the utility, all of the utilities would maintain positive net earnings.

Environment Canada's comparison of the key financial indicators for the major utilities potentially affected by the proposals suggests that, even for the ENGO proposals, changes in the utilities' financial positions would be marginal. It was estimated, for example, that if the control cost increases were passed on through an even rate increase to all electricity consumers in a given province, the impact on electricity rates would be small (i.e. 1.6% or less for all provinces) [27]. As a basis for comparison, between 1985 and 1994 the lowest annual rate increase was 0.08% and the largest was 7.2%; these increases have however been smaller in recent years. Environment Canada also noted that (1) these rate increases would likely not occur immediately but would be tied to increases in spending on pollution control measures; and (2) though in the past it has been possible to pass cost increases on to the consumers of electricity given the status of most utilities as regulated monopolies, it is likely that under current conditions a utility may now have to absorb some or all of the increase in cost through reduced net revenues.

The utility members of the Issue Table wished to have it recorded that, in their opinion, the sector may not be able to pass these costs on through prices given the new competitive environment, and that a trade-off with other program expenditures, including other environmental programs, would be required. It was felt that even with an increase in the price of electricity as low as 2%, the competitive nature of the business will affect decisions regarding the location and relocation of new and existing industry with the consequent impact on employment. The utilities also believe that these added costs will put provinces heavily dependent on fossil fuel electricity generation at a disadvantage.

The **federal government** would, under the utilities' proposal, play a fairly limited role, participating only in the development of the initial covenant. For the two ENGO proposals, the normal regulatory development, implementation and enforcement processes would be followed. The more open and inclusive process described in the Environment Canada proposal would impose additional costs on the federal government (e.g., participating in the development of the framework agreement, reviewing and monitoring progress on the action plans, revising guidelines). There was not sufficient information to estimate the impact on the federal government that would result from the research recommendations attached to the various proposals.

The utilities' proposal and the Environment Canada proposal could impose some additional costs on **provincial governments** to negotiate, monitor and enforce the emission limits. No role for the provinces was identified in either of the ENGO proposals.

It was the opinion of Environment Canada that the **broader macroeconomic impacts** are very difficult to predict. If competitive pressures force the utilities to absorb the increased costs associated with the management of the substances of concern, there will be no inflationary effects. If, on the other hand, all of these costs are passed on to

27 These estimates do not take into account the anticipated increase in demand over the next decades, possible consumer response to increased prices or the effects on electricity prices of increased competition in the industry.

consumers (in the manner assumed above), the effect on inflation was estimated to be 0.05%, a magnitude that is probably not detectable in practice. [28] The net export of electricity has fluctuated dramatically from year to year and, according to a 1995 report[29], is expected to decline by approximately 56% between 1994 and 2010. It was also Environment Canada's opinion that the effect of the increased costs associated with the management of the substances of concern would probably not be detectable in the normal fluctuations in Canada's economic growth or in its balance of payments.

It was the opinion of the utilities that, given the evolution of the Canadian electricity sector from monopolies to a competitive market, the consequences of increasing electricity prices for Canadian utilities will be a reduction in opportunities to export electricity south of the border, additional risk on their ability to retain their current customer base, and increased vulnerability to U.S. plants taking away domestic market share.

d) Benefits of emission reductions

The possible **health and environment** effects of each of the substances of concern (i.e. the key concerns associated with each substance) have been summarized in Section 2.2. The goal for the management of these substances, as set out in Section 3.2, is to minimize environmental and health risk by reducing exposure to and or release of these substances.

Although an attempt was made by Environment Canada[30] to develop estimates of the benefits to health and the environment of reducing emissions of the SOP substances from this sector, it became evident that the benefits could not be quantified with any precision. Environment Canada concluded that, as it was only possible to estimate some of the potential benefits associated with controlling the substances of concern, and as there was considerable uncertainty associated with each step in this analysis, a comparison of the benefit estimates and the technical control costs would not be meaningful. Details on the estimates of emission reductions, costs and benefits associated with each proposal may be found in the report *Review of Proposals to the Power Sector Strategic Options Process Issue Table* prepared for Environment Canada

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28 Given the maximum increase of electricity rates of 1.6% and the contribution of electricity prices to the change in the Consumer Price Index of 3.13% averaged over the years 1988-1995, the maximum net effect on inflation would be 0.05%.

29 *Electric Power in Canada.* Report by Energy Resources Branch, Natural Resources Canada, 1995. (Available from Ministry of Supply and Services.)

30 Estimates of increases in long-term ambient concentrations of the substances of concern were based on the results of modelling the dispersion of pollutants around most of the power plants addressed through the SOP. This information was then linked to the distribution of human population densities in the vicinities of the plants making possible crude exposure estimates. Finally, the results of this modelling exercise were combined with information on dose-response relationships and economic values from the PSL Assessment Reports and the Cleaner Vehicles and Fuels Study (Report to the Canadian Council of Ministers of the Environment by the Task Force on Cleaner Vehicles and Fuels, 23 October 1995.)

by Resources Futures International, March 1997. This report may be found in Volume 3 of the Technical Background Document.

The utilities' view is that estimating health and environmental benefits from a sector of the economy is a complex matter even when a clear risk from the sector is identified. In the case of this SOP review, a risk from emissions of SOP substances from utilities was not identified. Therefore, the utilities' opinion is that the lack of an identified risk is the main reason for being unable to identify the benefits.

Health Canada stated that estimating the health risks from a sector of the economy is a complex matter because analyses and assumptions about human exposure are often incomplete and our understanding of the relevant biological, chemical and physiological processes are limited. In the Priority Substances Risk Assessment Documents, it was concluded that several substances, including a number of carcinogens, known to be emitted by this and other sectors, pose a health risk to the general public in Canada. In the case of the review within this SOP, the utilities concluded that the incremental health risks posed by some of the substances emitted from the electric power sector are essentially negligible, or not an identifiable health problem. Health Canada has countered that individual contributions to risk for specific substances may be negligible for many individual sectors; however, when taken together, the sum total of "negligible" risks may not be negligible.

It was, however, agreed by members of the Issue Table that the control of particulate matter emissions would be a proactive step in environmental management.

Other benefits related to the construction, installation and operation of the pollution control systems, including employment effects and the impacts resulting from the purchase of material and other services, were estimated to be small. In addition, it is not clear what percentage of these benefits would accrue in Canada and what percentage elsewhere.

ELECTRIC POWER GENERATION (FOSSIL FUEL) SECTOR ISSUE TABLE
STRATEGIC OPTIONS REPORT

6. Conclusions and Recommendations

The Electric Power Generation (Fossil Fuel) Sector Issue Table faced a number of significant challenges. There was a tight timetable to complete its task, a large number of toxic substances to evaluate, many uncertainties related to release estimates to resolve, a significant divergence of opinions on risk assessment as it relates to this sector to accommodate, and there was limited participation from the provinces. Given these challenges, members of the various stakeholders' groups actively participated in the Issue Table discussions and worked in a spirit of cooperation.

The conclusions and recommendations of the Issue Table are summarized below. In Section 6.1, conclusions respecting the scope of the Issue Table work, preferred management options, background information developed on the EPG Sector (including emission inventories) and the role of risk assessment are recorded. In Section 6.2 the minority recommendations for targets and management options are summarized. Finally, consensus recommendations on further collaborative investigations are presented in Section 6.3

6.1 Conclusions

a) Scope of Issue Table work

- The original 6 substances being considered under the Strategic Options Process were expanded to 13. After the problem definition phase of the process, the list for the further assessment of management options was narrowed to 7 CEPA PSL 1 /Schedule 1 toxic substances, plus particulate matter. The utilities supported the further evaluation under the SOP only of particulate matter and mercury, with nickel from oil-fired stations suggested for evaluation on a local basis as required.

- Management options would be focused on atmospheric emissions. Releases of the SOP substances to solid and liquid waste are controlled by provincial regulations and permits. (Environment Canada will follow up on issues of solid and liquid waste.)

- Management options would focus on coal and oil-fired steam plants. Gas-fired plants contribute almost no releases of the SOP substances.

- It was agreed that a reduction of emissions of particulate matter from this sector would be a proactive and positive step forward, in view of the growing concern about the possible health effects of respirable particulate matter emissions. Reductions in particulate matter emissions would also result in reductions in emissions of associated metals.

- Mercury was excluded from consideration for management options because there are uncertainties regarding the health impacts of mercury emissions from the EPG sector which require further research. Furthermore, there are no demonstrated add-on (efficient and cost-effective) technological control systems for mercury at this time.

- Fluoride was excluded from consideration for management options because there are no demonstrated environmental effects resulting from emissions of fluorides by the EPG sector. As well, there are no demonstrated add-on (efficient and cost-effective) technological control systems for fluoride at this time.

The focus of the Issue Table was on controlling emissions of particulate matter. This was considered to be a proactive step with respect to particulate emissions because respirable particulate matter with diameters less than or equal to 10 micrometres (PM_{10}) will be assessed under CEPA for toxicity. Furthermore, many of the substances under this SOP are bound to particulate matter emissions. The utilities believe that there are no identifiable health risks from the substances under consideration emitted by the sector, with the exception of mercury and particulate matter where they have concluded that information available at this time is insufficient to decide on the existence or non-existence of risk. The electricity generation sector has been identified as contributing to the presence of CEPA-toxic substances in the Canadian environment. As stated in the Problem Definition Statements (Appendix C in Volume 1 of the Technical Background Document), many of these substances are carcinogens for which there is believed to be some degree of risk at any level of exposure. For these substances, Health Canada maintains that effort should be directed towards reducing human exposure to the extent possible. In view of the fact that mercury and lead have been shown to cause serious adverse health effects, Health Canada believes that effort should be directed to minimizing exposure to these substances.

It should be noted that all the proposals submitted to the Issue Table provide the potential for significant reductions of particulate matter, and associated metals, on a national basis.

b) Background information on the EPG Sector

An improved and updated emission inventory for the utility sector was completed[31]; emissions from this sector are significantly smaller than originally estimated.

31 The Canadian Environmental Network dissented with this conclusion. See Appendix C of this report for details.

c) Emission limits for new plants

There was consensus on the application of an emission limit equivalent to the US New Source Performance Standards for particulate matter emissions to new utility units across Canada commencing first commercial operation[32] after 31 December 1997.

d) Benefits of emission reductions

It was not possible to quantify the benefits to health or the environment resulting from reductions in emissions of SOP substances from this sector.

e) Management options

Four management options appear to be preferable for reducing the emissions of substances under consideration by the Issue Table: regulatory performance standards; emission caps, bubbles or trading; negotiated agreements; and voluntary measures.

6.2 Minority recommendations

Four proposals regarding the reduction of particulate matter emissions from the electric utility sector, one from the Canadian electrical utilities, two from environmental non-government organizations, and one from Environment Canada, were received by the Issue Table in the course of its deliberations. These proposals are provided verbatim in Chapter 5. Efforts by the stakeholders were re-focused on analyzing the proposals rather than continuing to evaluate and seek consensus on a management option and one single set of targets.

Of the four possible management options that resulted from the screening described in Chapter 4 of this report, there were two, negotiated agreements and regulatory performance standards, that were favoured by various members of the Issue Table. The utilities and Environment Canada preferred negotiated agreements, while the two ENGOs (environmental non-governmental organizations CEN and STOP) specified regulatory performance standards. However, it appeared that ENGOs would accept negotiated agreements if they were developed in a transparent process, and if they included firm targets, deadlines and penalties.

32 The utilities would agree to this emission limit for new sources on condition that a Science Advisory Panel be established, as outlined in Item 1 in their proposal in Chapter 5 of this report.

a) Recommendations of the utilities (for the complete proposal see Section 5.1)

It is recommended by the utility participants at the Issue Table that the utilities and the Government of Canada, with the participation of the provinces, enter into a covenant:[33]

1) for utilities and the Government of Canada to cooperate in the further assessment of potential risks, if any, associated with emissions of mercury and particulate matter from fossil fuel electric utilities. This assessment will be reviewed by an Expert Science Advisory Panel acceptable to both the Government and the utilities, and will form part of the information used in future initiatives related to utility sector mercury and particulate emissions. The results of the assessment and all supporting information will be available to the public.

2) for reducing the particulate emission rate for new plants starting first commercial operation after 31 December 1997 to 0.03 pounds per million BTUs of heat input (12.9 nanograms per Joule).

3) for utilities to review particulate emissions from existing plants with their respective province and to reach agreement by 31 December 2000 on an appropriate plan of action. If a utility fails to reach agreement with its provincial regulator, it will achieve the following emission rates by 31 December 2005 for all facilities to be in operation after 31 December 2010.

- 0.2 pounds per million BTU (86 nanograms per Joule) for facilities with annual capacity factors of less than 20%

- 0.1 pounds per million BTU (43 nanograms per Joule) for facilities with annual capacity factors of greater than 20%

4) for the Government of Canada to commit that information leading to any future initiatives regarding the emissions of CEPA-toxic substances from the electric utility fossil fuel sector will include a rigourous, science-based approach which will encompass current knowledge, complete risk assessment information, characterization of uncertainty in management decisions, and utility emission inventories which have been reviewed and approved by both utilities and the Government of Canada. The information will be reviewed by a Science Advisory Panel acceptable to both Government and utilities.

33 It must be stressed that all recommendations put forth by the utilities are conditional upon the acceptance of all parts of their proposal. The utility members stated that it was not possible to modify their proposal within the Issue Table.

b) Recommendation of the Canadian Environmental Network (for the complete proposal see Section 5.2)

It was recommended by CEN that:

- all new and existing plants meet by federal regulation a limit of 0.03 pounds per million BTU (12.9 nanograms per Joule). (No deadline was specified.)
- a multi-media, mandatory pollution planning system be established under a federal permit system, as well as a mandatory reporting system for this sector under the National Pollution Release Inventory (NPRI).

c) Recommendation of STOP (for the complete proposal see Section 5.3)

It was recommended by STOP that

- all existing coal-fired plants meet by federal regulation a limit of 0.03 pounds per million BTU (12.9 nanograms per Joule) by 1 January 2000. (Oil-fired plants were not specified in the STOP recommendation.)
- further research be done on mercury emissions from this sector.

d) Recommendation of the Environment Canada members of the Issue Table (for the complete proposal see Section 5.4)

Environment Canada proposes the following actions:

i) New plants

It is recommended that the present Thermal Power Generation Emissions - National Guidelines for New Stationary Sources (CEPA, 1993) be revised so that the particulate matter emission limit for new plants commencing commercial operation after 31 December 1997 will be equivalent to 0.03 lb per million BTU heat input (12.9 nanograms per Joule).

ii) Existing plants

It is recommended that the Government of Canada (led by Environment Canada) and each of the major electric utilities, with input from the respective provinces, enter into a framework agreement on a process to reduce emissions of particulate matter and associated metals from coal and oil-fired power plants. The discussions of this framework agreement should begin as soon as possible and be completed by 31 December 1997. An opportunity for public comment will

be provided. It is envisaged that the framework agreement will lead to the development of action plans by the utilities and their respective provincial governments. The action plans should contain quantitative targets that result in an emission rate equivalent to 0.1 lb/million BTU heat input (43 nanograms per Joule) or lower.

The finalization of action plans between utilities and their respective provincial governments should be completed by no later than 31 December 1998. Environment Canada will review these action plans and they will be made available to the public.

An assessment of progress in terms of reductions and impacts, and the need for further actions, will be completed by Environment Canada, with participation of utilities and provinces by 31 December 2003.

6.3 Recommendations of the Issue Table for further investigations

The members of the Issue Table were in agreement with respect to recommendations for further collaborative investigation among governments and the utilities of the following areas:

a) Mercury and particulate matter

1) It is recommended that industry and governments work together in an effort to improve the knowledge on emissions from this sector of mercury and particulate matter and determine to what extent these emissions may pose a risk to health or the environment.[34]

b) Inventories

2) It is recommended that up-to-date information on emissions from utilities be maintained as required by governments and/or industries. Releases to air, water and land will continue to be reported to provincial authorities as stipulated in the various jurisdictions.

3) It is recommended that the Government of Canada continue to strive for better information from all industrial sectors through improved procedures and protocols which meet Quality Assurance criteria, and continue to improve the inventory of natural sources.

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[34] The utilities agreed to this recommendation on condition that their proposal be adopted in its entirety.

c) Fluorides

4) It is recommended that the Government of Canada clarify potential risks to the environment from emissions of fluorides by the utility sector and, if any environmental risk is identified, that the appropriate course of action be discussed with the utilities.

d) Dioxins and furans

With the information available, releases of polychlorinated dibenzodioxins and polychlorinated dibenzofurans by this industrial sector appear to be relatively low. Measurements were made at five stations belonging to two utilities. However, Environment Canada believes that this amount of data may be insufficient to assess the releases of these substances from this industrial sector. If new information indicates that these emissions are in fact significant, it is recommended that:

5) the Government of Canada and the utilities review appropriate courses of action.

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APPENDIX A

TERMS OF REFERENCE

ELECTRIC POWER GENERATION (FOSSIL FUEL) SECTOR ISSUE TABLE - STRATEGIC OPTIONS PROCESS

The Strategic Option Process (SOP) is a time limited multistakeholder consultative approach to prepare recommendations to the accountable federal ministers to manage toxic substances, as defined by the first Priority Substances List (PSL 1) risk assessments completed by the federal Departments of Environment and Health. The process is based on the following principles: open and transparent; inclusive; timely and disciplined; cost-effective; defensible and predictable; flexible; harmonized; and equitable.

The Electric Power Generation (Fossil Fuel) Sector Issue Table was formed in response to the decision to proceed under the SOP by the Federal/Provincial Advisory Committee on CEPA. In general, a sector approach is recommended for CEPA toxics whose entry into the environment is predominantly the result of identifiable industrial processes. Based on preliminary information developed by Environment Canada, it is believed that the sector contributes to the releases of a number of PSL 1 and Schedule 1 toxic substances associated with this sector, and requires an assessment under the SOP.

It should be noted that the designation of a substance as toxic under CEPA does not necessarily mean that controls will be imposed. Such decisions can only be made in the risk management phase that includes a judicious balancing of the risks and benefits associated with the continued use or release of the substances(s), that is, based on subsequent analysis of social and economic as well as scientific factors.

The concepts of the precautionary approach[35] and pollution prevention[36] must be considered in evaluating and developing the appropriate and needed management options for the selected toxic substances and their release from the electric power generation sector. It must be recognized that the application of these concepts are consistent with the *Federal Toxic Substance Management Policy*. In addition, any options developed should be consistent with other Federal regulatory activities, policies or approaches, and provincial activities.

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35 ***Precautionary Approach*** as defined by Principle 15 of the Rio Declaration on Environment and Development: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

36 ***Pollution Prevention*** as defined in *Pollution Prevention: A Federal Strategy for Action*: "The use of processes, practices, materials, products or energy that avoid or minimize the creation of pollutants and waste, and reduce the overall risk to human health or the environment."

The *Terms of Reference* for the multistakeholder Issue Table for this sector are as follows:

- to ensure that stakeholders from the provinces, territories, industry, relevant associations, environmental and health non-government organizations, and other key federal departments are invited to participate in the Strategic Options Process (SOP);

- to hold the Chair responsible for the management of the Issue Table, including secretariat support, and the Issue Table members responsible for seeking to represent the views of their respective organization or constituency;

- to define the scope of the issues related to toxics and to analyze the technical and socio-economic characteristics of the sector;

- to undertake the gathering and, where necessary, the analysis of the relevant technical, scientific and economic information from which recommendations can be drawn;

- to analyze relevant management options and their attendant socio-economic impacts, where required;

- to prepare the Strategic Options Report (SOR) and attendant recommendations, which may include management options;

- to consult with stakeholders before finalizing the SOR and attendant recommendations;

- to seek consensus on the scope, targets, and management options relevant to the work of the Issue Table and to ensure that divergent opinions will be reflected in the SOR;

- to complete the SOR for presentation to the federal Ministers of Environment and Health by December 1996.

APPENDIX B

ISSUE TABLE MEMBERS

ELECTRIC POWER GENERATION (FOSSIL FUEL) SECTOR STRATEGIC OPTIONS PROCESS

Name	Organization
Osmundo Betancourt	Nova Scotia Power, Halifax NS
Angello Castellan	Ontario Hydro, Toronto, ON
Randy Dobko	Alberta Environmental Protection, Edmonton, AB
Anne Douglas	Ontario Hydro, Toronto, ON
Elaine Easson	Health Canada, Ottawa, ON
Stéphane Gingras	Great Lakes United, Montréal, QC
Judith Hull	Environment Canada, Hull, QC
Les Johnston	EPCor, Edmonton, AB
Joseph Kozak (Chair)	Environment Canada, Atlantic Region, Dartmouth NS
Bob Lomas	Natural Resources Canada, Ottawa, ON
Denis Marquis	New Brunswick Environment, Fredericton, NB
Don Rose	Environment Canada, Hull, QC
Peter Telford	Ontario Ministry of Environment and Energy, Toronto, ON
Gerald Ternan (Secretariat)	Environment Canada, Atlantic Region, Dartmouth, NS
Louis Varfalvy	Hydro-Québec, Montréal, QC
Bruce Walker	STOP, Montréal, QC

CORRESPONDING MEMBERS:

Name	Organization
B. Arsenault	Maritime Electric Company Limited, Charlottetown, PE
Jane Barton	Environment Canada, Hull, QC
Debora Toll	Industry Canada, Ottawa, ON
Jake Brooks	Independent Power Producer Society of Ontario, Toronto, ON
Bill Brown	Manitoba Hydro, Winnipeg, MB
Leo Burns	New Brunswick Power, Fredericton, NB
Dave Campbell	Environment Canada, Hull, QC
Arun Chatterjee	Nova Scotia Dept. of the Environment, Halifax, NS
Bob Clapp	Canadian Petroleum Products Institute, Ottawa, ON
Pat Doyle	Environment Canada, Hull, QC
Don Edgecombe	National Defence Canada, Ottawa, ON

Name	Organization
Todd Fraser	PEI Environment, Charlottetown, PE
Rod Frith	Environment Canada, Prairie and Northern Region, Edmonton AB
Alain Gosselin	Environment Canada, Québec Region, Montréal, QC
John Nwoke	Newfoundland and Labrador Environment, St. John's, NF
John Kelly	British Columbia Hydro, Burnaby, BC
Rob Kent	Environment Canada, Hull, QC
Jennifer Keyes	Canadian Gas Association, North York, ON
Cliff Barua	Environment Canada, Ontario Region, Toronto, ON
Gordon Lambert	TransAlta Utilities, Calgary, AB
Jean Lavergne	Environnement Québec, Sainte-Foy, Québec
Bryan Levia	Government of the Yukon, Whitehorse, YT
Stephen MacDonald	Health Canada, Ottawa, ON
Patrick McNeil	Canadian Electricity Association, Ottawa, ON
Raouf Morcos	Environment Canada, Hull, QC
Renata Mortazavi	Environment Canada, Ottawa, ON
Paul Nolan	Babcock & Wilcox, Barberton, OH (USA)
N. Papadopoulos	ABB Incorporated, Gloucester, ON
Kash Ram	Environment Canada, Hull, QC
Geoff Ross	Environment Canada, Hull, QC
Howard Samoil	Environmental Law Centre, Edmonton, AB
Po-chih Lee	Natural Resources Canada, Ottawa, ON
Bob Ruggles	Saskatchewan Environment, Regina, SK
R.J. Stedwill	SaskPower, Regina, SK
Dick Stephens	Manitoba Environment, Winnipeg, MB
Michel Taché	Natural Resources Canada, Ottawa, ON
Kelly Thambimuthu	Natural Resources Canada, Ottawa, ON
Kathryn Tregunna	Canadian Public Health Association, Ottawa, ON
Frank Witthoeft	British Columbia Environment, Victoria, BC
Ed Wituschek	Environment Canada, Pacific and Yukon Region, North Vancouver, BC
Bill Peel	Alberta Power, Edmonton, AB

APPENDIX C

MINORITY VIEWS

Minority view of the Canadian utilities, received 7 October 1996

The Strategic Options Process Experience: The Utilities' View

Utility participation in the work of the Issue Table has provided a unique opportunity for improving information about our sector, and for both utilities and regulators to discuss complex issues from different points of view. There were successes which can serve to arrive at cooperative efforts in the future, and there were shortcomings which will remain to be overcome for future undertakings.

Successes

Issue Table Hands-On Approach

The early decision to establish three Task Groups to do the work of the Issue Table resulted in an increased accountability of participants for the quality of the information developed, and more in-depth knowledge of issues. The use of consultants was limited to specialized skills not readily available among Issue Table members.

Utility Inventory

The verified inventory of emissions provided by utilities was the most comprehensive compiled to date, and it established an emissions baseline for the sector, which had been assumed to be much higher at the beginning of the process.

Options and Cost

The consideration of options and costs was very productive, with valuable information being developed on the feasibility, or lack of it, of implementing certain options. The use of covenants or negotiated agreements was generally regarded very positively.

Sectoral Risk

From the beginning of the work of the Issue Table, it was important to utilities to have a good understanding of any potential risks arising from emissions from the sector. An assessment of incremental risk that may be associated with emissions from the utility sector concluded that there was not an identifiable risk from the sector's emissions of the substances evaluated by the Issue Table, with the exception of mercury and particulates for which there was insufficient information to conclude whether there was or was not an identifiable incremental risk.

Utility Proposal

Despite the lack of information to suggest that emissions from the utility sector present an identifiable incremental health or environmental risk, twelve utilities with fossil fuel generation joined in a proposal which promotes pollution prevention at new generation facilities, offers an opportunity for pollution prevention and emission reductions from existing facilities, and supports the principle of risk assessment as an integral part of decision-making in the cost-effective management of toxic substances.

Conduct of the Work of the Issue Table

While disagreements were profound at times, the discussion and information exchange was open, with respect shown to all participants while presenting their points of view. A large part of the credit goes to the capable chairmanship of the Issue Table.

Shortcomings

Problem Definition

Significant resources were committed to the SOP review without a clear understanding of what problems (or risk), if any, were being addressed. For the most part, this arose from the two radically different views of Government representatives at the Issue Table on the one hand, and the Utility Sector on the other, on how to assess the risk.

Inventories

While the best information available at the time was presented, emission inventories of non-utility sectors were not subjected to Quality Assurance verification. Further, information on emissions from natural sources were not sufficient to allow for cost-effective decision-making. This is one area which needs significant improvement if the management of toxic substances in Canada is to be efficient and cost-effective.

Hazard Versus Risk

A fundamental difference which remained unresolved throughout the work of the Issue Table was the approach employed:

- Substance specific identification of a hazard which can cause an adverse health or environmental impact.
- Sector specific determination of risk based on human or environmental exposure to the hazard.

Utilities advocated the latter, and offered that, in a real world where resources are limited, priorities must be established. Utilities supported a risk management approach based on *quantifying the relationship between health outcomes associated with the hazard, and exposure to the hazard and the level of risk involved.*

The italicized section above was extracted from the document "Health Canada, Health Protection Branch. A Policy Framework. 1994" However, despite this being the stated policy of Government, no agreement was reached on its use for Issue Table deliberations.

Throughout the discussions, the substance-specific hazard information available came, for the most part, from the Priority Substance List Assessment Reports, and the sectoral risk assessment information came from a report prepared by Bio-Response Systems Limited based on risk assessment studies conducted by the US Environmental Protection Agency, the Electric Power Research Institute, Ontario Hydro, and Hydro Quebec.

Despite the disagreement on approach, however, Government and utilities were able to agree that "the assessment reported in the PSL reports were made on a substance-specific inherent human toxicity basis rather than a sector-specific basis. Therefore, they cannot be used to estimate the specific contribution of the electricity generation sector to the total human risk".

Provincial Participation

The participation of provincial authorities was very limited throughout the SOP review. The provinces must play a role if the management of toxic substances is to be efficient and cost-effective. When resources are limited, action based on priorities is a must. The input of the provinces, harmonization of initiatives, and commonality of priorities on both the federal and provincial side would be very valuable in this area. For example, the Ontario Ministry of Environment and Energy is developing a standard-setting plan which would identify priorities and use risk assessment which includes hazard identification, dose-response assessment, exposure assessment, and risk characterization. The Government of Quebec has also developed criteria for identifying priorities through risk assessment. Incorporating these principles will be very valuable.

Summary

Using the information that became available from discussions at the Issue Table, and based on the strengths and weaknesses of the process, twelve Canadian utilities with fossil fuel generation have presented a proposal which will, over time, significantly reduce emissions of particulate matter, and with it, emissions of some of the substances identified for review under SOP. The proposal constitutes a very progressive step in pollution prevention. Maximizing its benefits will depend on the degree of cooperation that will exist between the federal and provincial governments.

Minority view of the Canadian Environmental Network (CEN)

Montreal, November 21, 1996

To: Mr. Joe Kozak
Chair of the EPG
Issue Table
By Fax: 1 902 426-6745

Dear Mr. Kozak,

I am unable to participate in the next Issue Table meeting in Ottawa on November 27th. However, I would like to take this opportunity to make some comments on the SOR received last week. First I am glad that you have put our proposal in the recommendation section without any changes and I want to thank you for that. Second I have a couple of editorial changes to propose and position on the quality of the release data provided by industry to include in Section 2.3 page 16.[37] I hope that these changes can be included in the final draft of the report.

So, on page 16, CEN wishes to add the following bullet after bullet number 2:

Considering that only four out of twelve utilities provided complete reports for the purpose of the data review by Environment Canada.
Considering that some utilities have refused to provide any data on their air emissions and others have provided limited data.
We question the validity and the quality of the data provided by industry and therefore their conclusions and recommendations.

On page 19 (paragraph 4) we want to propose rewording of our statement which should read as follows:
CEN recognizes that scientific uncertainty is a customary and expected factor that influences each and every phase of any scientific research and procedure. In brief, all of the science disciplines used to characterize risk are quantified by uncertainties due to theoretical and practical limitations in scientific knowledge, data collection and interpretation of analytical methodologies. Compounding these uncertainties are difficulties in understanding the complex web of interactions within and amongst ecosystems, in determining levels of exposure to specific chemicals, and determining the significance, and effective management options for substances that are released through human activity.

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37 Note that the references to sections and pages in this letter refer to an earlier draft of this Strategic Options Report dated 12 November 1996.

Formalized risk assessment also involves complex ethical issues surrounding trans-generational impacts for certain substances and the ability of individuals to understand and voluntarily assume risks associated with exposure to certain substances. Therefore and in regards to these scientific uncertainties and ethical issues CEN does not support risk assessment as a useful tool to help the IT in their decision making process. The CEN tabled a document *Making Good Decisions* by Peter Montague, Ph.D, of the Environmental Research Foundation.

On page 21, we want to register an official dissent on recommendation number 2. We cannot agree with that recommendation about releases in water and solid waste since we don't have valuable data to confirm that these releases are non-existent or properly controlled.

On page 21, we want to register an official dissent to recommendation number 5. We question the quality of the data provided by industry and therefore we cannot agree with the recommendation.

On page 53, bullet number 2, we don't agree with that statement. We believe that the industry data are not reliable (see comments on page 16).

On page 53, bullet number 5, we don't think that further risk assessment is needed and don't support any further initiative that would result in doing more risk assessment studies for that sector.

These are the principal modifications that we propose to the SOR. Please make sure that they are included. We would like to thank again Mr. Kozak and Mr. Ternan for their real and obvious commitment to this IT. Going through this exercise made us realize that some industry sectors are much more progressive and pro-active than others.

Sincerely,

Stéphane Gingras

c.c. James Riordan
c.c. Bruce Walker
c.c. Paul Muldoon

APPENDIX D: PUBLIC FILE

All correspondence and records of meetings related to this Issue Table are contained in a hard copy file No. 4133-8 at Environment Canada. Members of the public may request access to this file by contacting the following office:

Environment Canada
Atlantic Region
5th floor, Queen Square
45 Alderney Drive
Dartmouth, Nova Scotia B2Y 2N6

Contact:	Joseph Kozak	Telephone: (902) 426-3664
	Gerald Ternan	Telephone: (902) 426-1631