THE SENATE OF CANADA

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THE ENERGY EMISSIONS CRISIS:

A VIABLE

ALTERNATIVE

Report of the
Standing Senate Committee on
Energy, the Environment and Natural Resources

Chairman
The Honourable Daniel Hays

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January 1993

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ENERGY, THE ENVIRONMENT
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Line Gravel
Clerk of the Committee

ORDER OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Friday, February 28, 1992:

> Resuming the debate on the motion of the Honourable Senator Hays, seconded by the Honourable Senator Olson, P.C.,
>
> That the Standing Senate Committe on Energy, the Environment and Natural Resources be authorized to undertake a study of the policy options available to the government to achieve the objective of containing emissions associated with energy production and use in Canada with a view to improving the environment and to make recommendations thereon. Among these options are regulation; the use of economic instruments such as emission charges and taxes, subsidies and tradeable emisions permits; measures to enhance energy efficiency and conservation; and the promotion of energy alternatives; and
>
> That the Committee present its final report no later than 30 November, 1992.

After debate,

> The question being put on the motion, it was adopted.

Gordon L. Barnhart
Clerk of the Senate

• By order of the Senate dated October 15, 1992, the date of tabling the final report was extended to February 12, 1993.

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FOREWORD

The Standing Senate Committee on Energy, the Environment and Natural Resources has done several studies under both Senator Earl Hastings (my predecessor in the Chair) and my chairmanship (commencing June, 1989) on energy supply issues.

It was decided that we should spend some time on other aspects of our mandate. Two important contributors to the work of the Committee, Senator Duff Roblin, now retired, Senator Tom Lefebvre, who died on November 20th of last year, come to mind.

Both Senators attended the Vancouver Globe '90 Conference on the Environment in March, 1990, and, at their urging, we heard testimony from one of the presenters at that conference. On April 2, 1990, Mr. Amory Lovins, Director of Research at the Rocky Mountain Institute in Colorado, advised the Committee about the potential of energy efficiency in addressing both supply and demand-side concerns.

We are, as well, increasingly concerned about the necessity to identify and to act on unwanted environmental changes that occur as a result of the way humans exploit naturally occurring substances that we find at hand. Many of these unintended changes have the potential to threaten our, and future generation's, enjoyment of an environment of the same quality we have inherited.

Another motivator of this study has been the Committee's recognition of the importance of our relations with the United States in matters of energy and environmental policy. The Committee has made regular visits to Washington to discuss policy developments with a cross-section of political, regulatory and other Congressional/Governmental elements in the U.S. We have discovered, as a result of this work, that the U.S. has had some good results in achieving their environmental objectives by using market incentives in conjunction with government established objectives. The most ambitious of these is the scheme of trading in sulphur emission allowances in the electric power generation sector pursuant to the provisions of their Clean Air Act. Appendix B lists a number of relevant reports.

We accepted a reference from the Senate and held hearings on a difficult policy development challenge, namely how do we ensure that we do not exceed the assimilative capacity of the atmosphere as a repository of waste and the unwanted by-products of energy production and use. The context of the problem is regional, national and international and embraces ground level pollution in the

form of urban smog, acid rain and global climate change. The time for political decision on objectives and how to achieve them is now. Governments have made commitments to an improved environment and not said how they will make good on them.

Our purpose or goal in producing this report is to move decision-making forward by defining the issues as best and in as simple a way as we can. Our intention is to provide an opportunity for debate that will bring home the importance of the role that we must now play in listening to all those that will be affected and to all those setting policy. My impression is that industry, environmentalists, bureaucrats and the general public are anxious to have these important environmental issues addressed and the time has come for legislators, and in turn the governments that are responsible for them, to act.

This report is the result of a number of excellent presentations from the witnesses listed in Appendix A of the report. We thank them for their extraordinary effort in preparing written submissions and for appearing before the Committee.

Several background papers which were prepared by the Committee staff for our report served as important reference material. They are **a) A Primer on the Application of Economic Instruments to the Canadian Energy Sector; b) Energy Efficiency in Canada; c) Energy Efficiency: Future Improvements; and d) Solar and Wind Energy in Canada: Current Status and Future Potential.** These papers are available by contacting the Committee Clerk's office.

This report is also the result of many hours of work by Committee members and staff. On behalf of all Committee members, I would like to thank Lynne Myers and Peter Berg from the Research Branch of the Library of Parliament for their excellent research services; Ed Lauer for his quality consultative assistance; and our clerk, Line Gravel and her staff for their dependable efforts on our behalf. The Committee is also indebted to the assistance of translators and editors at Secretary of State and to Mario Pelletier, whose editing service ensured an accurate translation.

Senator Dan Hays
Chairman

Because there is no explicit price on pollution, we tend to regard the environment as free. And we abuse it.

The cost of that abuse is borne by society indirectly, through the retarded growth of forests, the loss of fish in acidified lakes, the intensification of health problems due to urban smog, and perhaps in the future, the multiple and potentially catastrophic impacts of global warming.

The Senate Standing Committee on Energy, the Environment and Natural Resources has recognized for some time that many of Canada's most pressing emissions problems arise from the production, transportation and use of energy. Indeed, energy is responsible for anywhere from 45 to 95 percent, depending on the case, of the acid rain, urban smog and greenhouse gas problems in Canada. Virtually all of these emissions relate to our use of fossil fuels: oil, natural gas, and coal. The sobering fact is that despite our much heralded hydroelectric developments, Canada still depends on fossil fuels for about 80 percent of its primary energy supply.

It is clear, therefore, that the energy sector must be part of the solution. Executives of the energy companies understand this, and accept their responsibility to find solutions. They worry, however, about the public perception that the answer to environmental problems is simply a matter of governments forcing industry to stop polluting. The truth is that the costs of environmental protection will flow back to society in one form or another. That is, through the inclusion of environmental charges in the price of the products and services that we acquire, or in higher taxes, or in the loss of jobs when companies are unable to pay for environmental controls.

The challenge therefore is to find better, more affordable ways to achieve environmental protection, so that the burden on consumers and our economy can be minimized. Key elements in this quest are a correct understanding of the problems, the consequences, and the alternative solutions that are available.

In recent years there has been growing unease over the shortcomings of the traditional approach to pollution control whereby government officials order companies to meet prescribed effluent limits regardless of cost, and in some instances to specify the control equipment that must be installed. This so called "command and control" (CAC) approach lacks flexibility, and in many instances results in high cost solutions. An alternative approach would be to employ market forces to bring about the desired results through the mechanism of the

price system. That is, to cause the environmental objectives to be pursued within a market framework, so that competitive forces and innovation can function effectively.

In May, 1992 Environment Canada published a discussion paper entitled **"Economic Instruments for Environmental Protection"**, which discussed a number of market-based approaches that could be considered in place of Command and Control measures. These included several types of environmental charges, product taxes, and incentives. The basic principles are that by incorporating environmental costs into prices, the correct signals would be sent to consumers, and that purchase decisions would favour the products or services that have the lowest relative environmental costs.

The Committee decided that it would be appropriate for the Parliament of Canada to involve itself in the consultation process called for in the paper. Accordingly, the Committee invited a cross section of manufacturers, environmental groups, research and policy agencies and consumers to address the potential for using market-based measures in the context of the production and use of energy. The Committee also heard from two federal Ministers (Environment; Energy, Mines and Resources) and officials from their departments, as well as officials from the Departments of Finance, Transport and Industry, Science and Technology. Points of view were expressed both through testimony before the Committee, and through a roundtable discussion.

Because the consideration of market-based measures (economic instruments) is at a relatively early stage, the hearings resulted in the articulation of a series of guiding principles as contrasted to support for specific measures. The principles, in summarized form, are:

- environmental costs to society should somehow be built into prices
- economic efficiency should be a fundamental tenet of environmental policy
- a full range of policy measures needs to be considered
- market-based measures require public education and support
- market-based measures must be assessed for cost/ benefit
- market-based measures should be "revenue neutral", in, terms of governments' current and future requirements for general revenues

. market-based measures should respect regional and sectoral impacts

. market-based measures will fail if they jeopardize international competitiveness

. action on global problems should be taken globally

. energy subsidies should be transparent and justifiable and subject to frequent review

. voluntary initiatives are preferable to imposed controls

As to specific conclusions and recommendations, there was a fair consensus that the concept of establishing a system of "tradeable" emissions permits, or reduction credits, is worth pursuing. It was suggested that there has been enough study on this measure to permit a pilot program to be launched, probably for acid gas emissions. If it proves to be practicable, the system could then be considered for the management of the urban smog precursors, NO_x and VOCs.

The Committee's recommendations, based on the information received and the roundtable discussion, are:

1. That the above guiding principles be adopted when considering the use of economic instruments.

2. That economic efficiency be the cornerstone of environmental policy-making.

3. That the federal government adopt a comprehensive environmental management process that would assure complete and balanced consideration of all relevant factors making policy decisions.

4. That the federal government establish a national advisory committee of involved stakeholders to assure effective consultation.

5. That the federal government encourage the establishment of pilot projects to evaluate the merits of tradable emissions permits.

6. That a particular analysis of the feasibility of using emissions trading for greenhouse gases be undertaken by the federal government.

7. That the federal government prepare a "layman's" version of the economic instruments approach so as to enable Canadians to understand the concepts and potential benefits.

MARKET SOLUTIONS TO ENERGY EMISSIONS: AN AFFORDABLE ALTERNATIVE

> The cost of pollution to society is a real number, and that number is not zero![1]
>
> The cost of dealing with pollution is also a real number, and that number is not zero either!

CHAPTER 1: INTRODUCTION

The two statements above capture the dilemma facing Canadian society today as we attempt to grapple with emerging environmental issues. Historically, the costs associated with environmental damage have usually not been taken into account in the production and pricing of goods and services. The environment has been treated as a freely available receptacle for waste; thus there is little wonder that this common resource has been abused.

There has been a growing recognition that some type of cost should be assigned to the use of the environment. The challenge for Canadian policy-makers lies in devising policy measures that would incorporate these currently external costs into the price of energy and the goods and services it helps to produce, by making us all pay for the environmental degredation caused by our activities. Policy-makers may also have to deal with the environmental damage that has accumulated over time.

As the second introductory statement notes, however, we must be aware that additional investment and operating expenditures will be required to protect the environment. Experience has shown that these investment costs are substantial, and there is every indication

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(1) Jeff Passmore, Passmore Associates, in testimony to the Committee, 21 October 1992.

that they will increase throughout this decade and beyond. This expected trend presents a second, formidable challenge to Canadian policy-makers: to find policies that achieve environmental objectives as economically as possible, having regard to our competitive position and the manner in which our major competitors approach the same problems. Reaching this goal will be difficult at a time when investment capital is decidedly limited and funds for increased operating costs are constrained.

There is no doubt that Canadians want clean air to breathe and clean water to drink. What is less certain is the amount of environmental protection required, its costs, how these should be allocated and the willingness of the public to bear them. Our geography, climate, resource endowment and industrial structure all combine to produce an economy that is highly energy-intensive. This reality, in turn, translates into high levels of airborne emissions with correspondingly high abatement costs. Future environmental policy-making must be considered in this context.

In light of this understanding, the Standing Senate Committee on Energy, the Environment and Natural Resources felt it was necessary to examine the potential use of environmental management tools that rely on the workings of the marketplace and, in particular, the important price signals upon which firms and consumers rely to make everyday decisions. The rationale for selecting this focus was the desire to achieve the goal of environmental protection in the most efficient and affordable way. Some early experience has shown that market-based measures offer significant advantages over the traditional regulatory or "command and control" (CAC) approach.

Canada has, in recent years, made numerous environmental commitments.[2] In May 1992 Environment Canada published a discussion paper entitled "Economic Instruments for Environmental Protection." The stimulus for that paper was the need to find the best way for Canada to fulfil its commitments. The paper describes in some detail a number of approaches to managing environmental protection through the use of market-based measures. It calls for consultations with Canadians on how market-based instruments might be adopted in actual practice.

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(2) See Appendix C for Canadian commitments.

This Committee concluded that it was appropriate to involve the Parliament of Canada in these consultations. Accordingly, in the fall of 1992, the Committee organized a series of hearings with government officials and Ministers. We also hosted a roundtable session which brought together a cross section of energy producers and users, and environmental groups, to examine how market-based measures could be applied to reaching environmental objectives associated with the production and use of energy in Canada.

The hearings revealed that Canada, like most other developed countries, is still at a relatively early stage in deciding on the most effective means of dealing with energy-related emissions. One complication is the fact that there is not yet a full scientific consensus on the magnitude of all of the environmental threats, especially those air emissions that are international or global in their impacts. Another is the uncertainty regarding the costs of achieving a given level of emissions, and the impact that these costs will have on domestic and international economic well-being.

The Committee's deliberations brought forth many questions and identified many important economic considerations. Although there were few firm conclusions, a number of important guiding principles were proposed. It would appear that industry, many environmental groups and governments find merit in the market-based approach, and it can be anticipated that policy will follow this direction.

This being the case, it is in Canadians' best interests to become more conversant with the nature and extent of the environmental problems facing the energy sector and the market-based policy tools available to deal with them. It is the Canadian consumer, after all, who will ultimately assume the costs and realize the benefits of an improved living environment associated with government policies aimed at protecting the environment. Through this report the Committee hopes to contribute to this educational process by bringing these issues to a wider public audience. We all want a cleaner, healthier adn esthetically pleasing environment and it is time to confront the issues involved in bringing this about.

The other major goal of the Committee's study was to bring representatives from industry, government and consumer and environmental groups together around the same table to further the discussion called for in the federal government's paper. While no detailed action plan emerged from the roundtable, it served as a forum for frank discussion about the means by

which we can achieve environmental protection in the most affordable way. We believe that attaining this objective is in the best interests of all Canadians.

CHAPTER 2: THE ENVIRONMENTAL CHALLENGES FACING THE ENERGY SECTOR

The energy sector faces a wide variety of environmental challenges, from radioactive waste management to ponds of oil sands tailings and sulphur dioxide emissions. In this study we have chosen to focus only on the emissions into the atmosphere that are related to the production, transportation, conversion and use of energy in Canada. This focus is in no way meant to imply that other energy-related pollution problems are not important. It is simply acknowledging the fact that energy use is heavily implicated in the production of a number of airborne emissions that are believed to cause environmental problems.

The importance of the energy sector in the production of airborne pollutants is illustrated in Table 1. Energy-related emissions are linked closely to what are generally considered to be the three most pressing environmental problems of the day: acid rain, urban smog and global climate change. Controlling these problems will be a major preoccupation for the energy sector in the coming years.

A. Acid Rain

Acid rain, which mainly results from the combination of airborne sulphur dioxide and water vapour, has been shown to produce elevated levels of acidity in soil and water, resulting in damage to fish and other aquatic species. Acid rain also retards forest growth, destroys the viability of agricultural crops, and causes damage to buildings, monuments and infrastructure such as bridges.

As Table 1 notes, the energy sector is responsible for about 45% of current SO_2 emissions. SO_2 emissions from the energy sector have their origin in the sulphur which is present as an impurity in primary fossil fuels. For example, the average sulphur content of crude oil refined in Canada in 1991 was 0.8%; however, some refined products such as heavy fuel oil, typically contain higher levels of sulphur, in the range of about 2.5%. This is the fuel

used in oil-fired thermal electric generating stations, in most cement kilns and in some industrial processes and furnaces.

TABLE 1

PROPORTION OF EMISSIONS ATTRIBUTABLE TO ENERGY SECTOR			
EMISSION	TOTAL QUANTITY kilotonnes	ENERGY kilotonnes	% FROM ENERGY
SO_2[a] (sulphur dioxide)	3,687	1,644	45
NO_x[a] (nitrogen oxide)	1,887	1,774	95
VOC[a] (volatile organic compounds)	1,782	957	54
CO_2[b] (carbon dioxide)	457,000*	455,000	97*
CH_4[c] (methane)	3,800	646	17
N_2O[c] (nitrous oxide)	108	59	55

[a] estimates for 1985, from Environment Canada, *Economic Instruments for Environmental Protection*, 1992, figures 8, 9.

[b] estimates for 1990, *Ibid.*, Table 2.

[c] estimates for 1987, from Environment Canada, *National Action Strategy on Global Warming*, (draft), November 1990, Annex 1, p. 3, and Tables A.1, A.2.

* does not include agriculture, wood burning. These non-energy sources are not readily measurable, and so are ignored in many Canadian analyses. Worldwide, these sources are estimated to comprise about 22% of total manmade CO_2 emissions.

Source: Peter Berg and Edward R. Lauer, "A Primer on the Application of Economic Instruments to the Canadian Energy Sector," Background Paper prepared for the Standing Senate Committee on Energy, the Environment and natural Resources, 15 September 1992, p. 23.

Underground natural gas formations also contain varying amounts of sulphur. When sulphur content is high, it is known in the industry as "sour gas". Virtually all of the sulphur is removed from the gas at the processing plant before it is sent to market. As a result, in terms of sulphur dioxide emission, natural gas is seen as a very clean-burning fuel. Nevertheless, some untreated gas, with its attendant sulphur emissions, can escape into the

atmosphere during exploration, development and processing. The quantities involved are typically not large.

In the case of coal, the content of sulphur varies widely. In Canada the lowest sulphur coals are found in Alberta, where sulphur contents as low as 0.2% are often found. Moving east, Saskatchewan lignite deposits typically exhibit sulphur contents in the 0.4% range, while some of the coals used in thermal generating plants in the Atlantic provinces are as high as 6%. Canada also uses U.S. coal, especially for steel making and electricity generation in central Canada. These coals are currently in the range of 1.0 to 1.5% sulphur.

It follows that the amount of SO_2 emitted in electricity generation or in industrial processes is mainly determined by the source of the coal used. Where higher sulphur coals are the most economical, technologies exist to remove up to 95% of the sulphur from combustion gases.

Fossil fuel producers and users in Canada are faced with the challenge of meeting their share of a federally established SO_2 cap of 2.3 million tonnes by 1994. The cap was established on the basis of what was thought to be the natural capacity of the soils, lakes and plant life in eastern Canada to neutralize the acid being deposited, and it represents a 50% reduction from the 1980 base year. Based on this emissions ceiling, the federal government has negotiated agreements with the governments of the provinces east of Saskatchewan on the share of the total reduction each will bear. Each province was left to decide where the reductions should be made and how to do it. In almost all cases, it is expected that each province will meet its agreed limit for 1994, mainly through the use of lower sulphur fuel. As well, scrubbers will finally appear on plants of Ontario Hydro and New Brunswick Power during the next three years. Nova Scotia Power has undertaken to pioneer a new technology and is building the world's largest (to date) commercial scale circulating fluidized bed boiler, a 150 MW unit at Point Aconi. Other utilities expect to rely more heavily on gas-fired generating units that can also produce by-product heat for nearby buildings or industrial processes.

More recently, under a revised Canada-United States agreement, the SO_2 cap for the seven eastern provinces was extended to the year 2000, with a new national cap of 3.2 million tonnes set for the same year. The way in which this new national cap will be apportioned has not yet been established, but western energy producers and consumers will be

brought into the system at that time. There is some concern in the west that the additional 0.9 million tonnes will simply be taken as the western limit.

B. Urban Smog

The major component of urban smog is ground-level ozone. It is formed by the interaction of nitrogen oxide (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. NO_x emissions are almost entirely the result of the combustion of fossil fuels, with exhausts from gasoline, diesel and propane powered vehicles accounting for about 56%, and power generation accounting for another 14%. VOCs, such as fuel gases and solvent fumes, are released through a number of energy-related or other industrial processes. Urban smog represents a health concern, especially to people with respiratory conditions, and has a minor acidic effect, although to a much lesser extent than SO_2.

Ground-level ozone is primarily a seasonal concern, peaking in most areas in the summer months. It is estimated that some 50% of the Canadian population is periodically exposed to concentrations of ground-level ozone which exceed the maximum target levels. The problem is particularly acute in three regions of the country, notably the Windsor-Quebec City corridor, the Lower Fraser Valley and the Southern Atlantic region, an area that receives considerable cross-border flows of pollutants.

A plan for the management of NO_x and VOCs has been developed by the Canadian Council of Ministers of the Environment. It proposes a three-phased approach which seeks to reduce emissions in the three regions noted above by 40% by the year 2000, and to fully resolve the problem of ground-level ozone in Canada by the year 2005. The plan depends heavily on measures to limit emissions from motor vehicles. It also includes many measures aimed at stationary sources such as power plants.

C. Global Climate Change

Unlike acid rain and urban smog, which tend to be local or regional in nature, climate change is a truly global issue. The greenhouse effect, by which certain gases in the atmosphere trap heat near the surface of the Earth, is not, by itself, the source of concern. It

is, after all, this effect that makes the planet habitable. The concern, instead, centres on the possible impact of the emission of increasing quantities of man-made greenhouse gases on the equilibrium of the heat flows into and out of the atmosphere.

The scientific theory suggests that there will be a trend towards a general, but not necessarily uniform, warming of the planet, combined with some shifts in climatic patterns. These climatic effects may produce a number of adverse consequences, such as a loss of arable land because of moisture and temperature problems; northward movement of agricultural land away from markets and transportation infrastructures; and accelerated melting of the ice-caps and resultant flooding of low-lying areas.

There has already been a great deal of international investigation of this problem. While there seems to be quite widespread agreement that it is important to reduce worldwide emissions of greenhouse gases, there is, as yet, no definitive estimate of the level of reduction required or of the urgency with which it should be pursued.

This uncertainty can be easily explained. Those seeking to define the magnitude and the timing of the problem still require basic scientific data and mathematical models that can more accurately predict the behaviour of complex natural systems. Still to be defined are the precise relationships between manmade and naturally occurring gas flows, the potential chemical interactions among the different gases and the earth's natural response mechanisms such as increases in water vapour flows into the atmosphere as warming occurs. For purposes of this study, we accept, as does the government of Canada, that the continued release of greenhouse gases into the atmosphere at current rates will have some type of unpredictable and disruptive effect.

The most common greenhouse gas of consequence to the energy industry is carbon dioxide (CO_2), the inevitable result of burning fossil fuels such as coal, oil and natural gas. Unlike sulphur dioxide and nitrogen oxide emissions, which occur because of impurities in the fossil fuels or from less-than-perfect combustion conditions, CO_2 formation is the inescapable result of the conversion of carbon to carbon dioxide to produce heat. In other words, no CO_2, no heat!

The transportation sector accounts for the largest share of Canadian CO_2 emissions at 28%, with power generation and industrial fuel burning following closely at 23% and 18%

respectively. The rest comes from the residential and commercial sectors and a number of other sources.

The direct emission of methane to the atmosphere is a second area of concern to the energy industry. Methane is a short-lived but potent greenhouse gas, being about 25 times more efficient at trapping heat in the atmosphere than is carbon dioxide. Fortunately, the quantities of methane released by the energy sector are relatively small, compared with CO_2 emissions, and there are fewer sources. The energy sector's contribution to methane release occurs during oil and gas exploration, processing and transportation and from seepage of the gas from coal deposits as they are mined.

Although it is believed to be a minor emission from fossil fuel combustion, nitrous oxide deserves to be mentioned, primarily because it is estimated to be some 230 times more efficient at trapping heat than carbon dioxide, and has a lifespan in the atmosphere of about 150 years. As with other oxides of nitrogen it is formed during the combustion process.

The challenge is to find cost-effective ways to reduce the emissions of all of these gases. In the case of CO_2, the federal government has undertaken in its Green Plan to stabilize carbon dioxide emissions at 1990 levels by the year 2000. This commitment means that we must attempt to hold CO_2 emissions to an estimated 467 million tonnes. The Department of Energy, Mines and Resources and Environment Canada have estimated that emissions would otherwise reach 547 million tonnes by 2000, leaving a gap of some 80 million tonnes to be reduced or avoided.

This gap represents a cutback of 15% over a "business as usual" scenario. Expressed another way, the 80 million tonnes is roughly equivalent to today's combined CO_2 emissions from all of the residences and commercial establishments in Canada. Although this appears to be a difficult target to meet, a number of energy management studies have shown that it is within the realm of technical and economic feasibility. Key obstacles to achieving this goal are the availability of up-front capital to fund efficiency improvements; useful, relevant information for consumers on cost-effective energy efficiency measures; and the public's willingness to accept changes.

CHAPTER 3: A PROFILE OF THE CANADIAN ENERGY SECTOR

Canada has the good fortune to be blessed with a wide array of energy sources with which to satisfy domestic demands. These sources range from the traditional fossil fuels - coal, oil and natural gas - to hydro and nuclear energy. We also have the possibility of developing renewable sources of energy in the future, and possess a significant untapped potential for energy efficiency and conservation.

Over the past 20 years, our energy consumption pattern has moved from being dominated by oil and gas to being much more diverse. Furthermore, the Canadian energy economy is now much more electricity-intensive than it was two decades ago, a trend that is expected to continue. Table 2 shows details of energy demand by sector and by source for the years 1970, 1980 and 1990, as well as projections for 2000 and 2010.

The energy sector is a vitally important part of the national economy in terms of employment, investment, trade, and income generation. It employs more than 300,000 Canadians and accounts for over 6% of our GDP (Gross Domestic Product) and slightly less than 20% of total investment in Canada. Energy is also a crucial input for a number of major natural resource industries, such as pulp and paper, iron and steel and petrochemicals. Any actions taken to limit emissions to improve air quality will exert measurable impacts on both the energy sector directly and on those industries that are highly energy-intensive.

Within the country there are marked regional differences in energy production and consumption. For example, Alberta produces about 80% of Canada's crude oil and 83% of our natural gas, while Ontario and Quebec together consume nearly 60% of the oil and 50% of the natural gas.[3] These regional differences present a significant challenge to federal policy-makers, in that actions taken at the federal level may not have a consistent effect or impact in all regions of the country.

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(3) Energy Council of Canada, "National Energy Data Profile: Canada," 15th World Energy Congress, Madrid, Spain, 1992, p. 2.

TABLE 2

TRENDS IN CANADIAN ENERGY DEMAND - 1970-2010					
5.1 FINAL ENERGY DEMAND BY SOURCE AND SECTOR (PJ)	1970	1980	1990	2000	2010
Coal					
Industry	267	235	164	255	289
Transport	9	-	-	-	-
Other	45	4	3	2	2
- of which: residential	45	3	3	2	2
- of which: commercial	-	1	-	-	-
Non-Energy Use (i.e., petrochemicals)	-	5	14	17	19
Total Coal	321	245	181	274	310
(MToe)(1)	8	6	4	7	7
Crude Oil, NGL and RPP					
Industry	483	648	562	706	855
- of which: Petrochemical	83	159	255	354	431
Transport	1,205	1,803	1,720	2,088	2,415
Other	969	709	457	374	398
- of which: residential	583	436	190	177	161
- of which: commercial	337	210	180	130	130
Non-Energy Use (i.e., petrochemicals)	166	233	192	290	325
Total Crude Oil, NGL and RPP	2,823	3,393	2,931	3,458	3,993
(MToe)(1)	67	81	70	83	95
Natural Gas					
Industry	376	678	840	1,051	1,206
Transport	-	-	2	6	11
Other	409	672	845	959	1,036
- of which: residential	228	366	475	542	563
- of which: commercial	182	295	349	374	422
Non-Energy Use	-	-	-	-	-
Total Natural Gas	785	1,351	1,687	2,016	2,253
(MToe)(1)	19	32	40	48	54
Other (Renewables - Primarily Forest Biomass)					
Industry	-	301	253	385	431
Other	-	80	90	105	117
- of which: residential	-	80	90	105	117
- of which: commercial	-	-	-	-	-
Total Other	-	381	343	490	546
(MToe)(1)	-	8	8	12	13
Electricity					
Industry	340	489	601	1,000	1,285
Transport	2	2	3	3	4
Other	315	595	885	1,051	1,298
- of which: residential	154	305	468	493	607
- of which: commercial	155	261	382	458	567
Total Electricity	657	1,085	1,489	2,054	2,587
(MToe)(1)	16	26	36	49	62
Heat					
Industry	-	42	21	42	51
Other	-	1	-	1	1
- of which: residential	-	-	-	-	-
- of which: commercial	-	1	-	1	1
Total Heat	-	43	21	43	52
(MToe)(1)	-	1	1	1	1
Total Final Energy Demand	4,586	6,498	6,652	8,335	9,743
(MToe)(1)	110	155	159	199	233
(1) MToe = metric tonnes of oil equivalent					

Source: Energy Council of Canada, *National Energy Data Profile: Canada*, 15th World Energy Congress, Madrid Spain, 1992.

Energy commodities have been an important part of Canada's export trade for many years, and these exports have been an important contribution to the health of the energy sector itself. In fact, since the late 1960s, Canada has been a net exporter of most energy commodities with, as one would expect, the vast majority going to our closest neighbour, the United States. Virtually all of our exports of oil, natural gas and electricity go to that country, along with more than 80% of our uranium exports. In 1990, the gross value of Canadian energy exports was some $15.7 billion. If the export of energy-intensive goods and equipment, which form a large part of industrial production, is also taken into account, the importance of energy to our trade balance is even greater. All of this is to say that Canadian authorities must remain mindful of the energy-intensive nature of our economy and of our international competitiveness when establishing environmental policy. Much could be lost if Canada took unilateral action that undermined the advantages that energy provides to our economy.

In terms of future supplies, Canada's energy resources are large and diverse. As new technologies are developed, and if and when energy prices increase, there are additional resources that could be developed. The exception to this promising scenario is conventional light crude oil, the production of which is expected to continue dropping as the western sedimentary basin matures as a producing region. Over time, we will either continue to increase imports of this commodity or turn to enhanced recovery methods, upgrading of heavy oil and exploiting our vast oil sands deposits.

While the energy picture in Canada seems very bright from the point of view of our natural resource base, the financial situation in the energy sector has been much less encouraging in recent years. In 1991, the Canadian Petroleum Association and the Independent Petroleum Association of Canada (now merged into one entity known as the Canadian Association of Petroleum Producers, or CAPP) commissioned a study on the profitability of the upstream oil and gas sector.[4] The study concluded that over the five years preceding the study the rate of return on capital invested in the upstream oil and gas industry was just 3.3%. This does not compare well to the cost of capital to the investors or to the rate of return from

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(4) "Canadian Upstream Oil and Gas Industry Profitability: Historical Review and Future Perspectives," PowerWest Financial Limited, September, 1991, 121 p.

other economic activities, where returns have averaged 8% since 1986. The situation has not improved materially in the period since the study's release.

The collapse of world oil prices in the mid-1980s, which resulted from a surplus of supply, caused a considerable decline in cash flow to the industry. Companies responded by restructuring their operations, sometimes by means of mergers and acquisitions. In the process they trimmed their operating costs and their debt loads, and increased productivity. The "oilpatch" experienced a significant number of layoffs during this time, as the need to trim costs coincided with the decline in conventional crude oil production. Despite all these efforts, the return on capital remains well below that of many comparable industries.

The natural gas industry does not face the problem of declining production. Rather it has been faced, until recently, with a long-term surplus of supply which depressed prices. It is difficult to predict long-term pricing trends and hence one cannot predict with certainty the prospects for an improvement in the financial performance of this sector. The financial situation in the coal and uranium sectors does not differ appreciably from that described for the oil industry. In the case of coal, companies have already rationalized their operations to a great extent by cutting costs and improving efficiency; nevertheless, this industry still faces financial hardship as a result of depressed commodity prices.

This poor financial situation explains why companies in the energy sector are concerned about the growing demands being placed on them and their customers to meet environmental challenges. The need to find policies that will allow Canada to meet its environmental objectives in the most cost-effective manner possible has never been greater. This report will explain the benefits which market-based measures (i.e., "economic instruments") appear to offer in this regard.

CHAPTER 4: INTEGRATING ENVIRONMENTAL COSTS INTO DECISION-MAKING

Historically, the cost of environmental damage in the form of air, land and water pollution has been largely treated as external to the economy, and therefore not directly reflected in the market price of various goods and service. Failure to capture these external, or social, costs directly in prices causes consumers to improperly assess their purchasing decisions and has, in turn, caused an over-consumption in polluting products.

Nowhere is this more prevalent than in energy markets. Energy resources are normally valued only at their private (out-of-pocket) cost of extraction, with pollution valued at zero. The social costs of energy production and use are passed on to society at large, and are not paid by either the producer or the consumer of the products in question. This is only gradually changing, as the costs of acid gas scrubbers, or low NO_x burners, for example, become reflected in the prices for heat and electricity. Yet, these increases are unlikely to comprise more than a small percentage of the true environmental costs, if those costs could be determined. Given that access to the environment as a receptacle for society's wastes is not restrained through a price mechanism, it is not surprising that the environment has been "consumed" to the extent that it has.

The problem is further aggravated by the historical tendency of governments to provide substantial subsidies to fossil fuel generating projects, thereby again introducing a distortion into the energy market. In many cases, the subsidies occur indirectly, through policies that seek to create regional economic benefits. The Hibernia development was one example often cited to the Committee.

It has been argued that the lack of full incorporation of environmental costs in the price of energy products, together with the traditional skewing of subsidy assistance towards hydrocarbon production, has provided an advantage to conventional, well-established energy producers. This tilt in the energy "playing field" has thus been seen as inhibiting the introduction of conservation strategies and renewable energy sources into the market place, thereby precluding the emissions reduction potential that these options offer.

If society is to make any tangible progress in its attempts to achieve environmental protection, Canadians must be encouraged to adequately justify the subsidy route (and in the process make these subsidies open and transparent) and to begin integrating environmental costs into their everyday decision-making. Only by assigning a recognizable value to what has generally been considered to be "free" access to the environment will the citizens and firms of this country begin to respect the environmental consequences of their activities and alter their consumption behaviour patterns so as to utilize environmental resources more efficiently. In order to obtain a much cleaner environment, the prices of all goods should include the cost to society of the pollution resulting from the production and consumption of these products. This should be done to the extent that is possible without jeopardizing the competitive advantages which lower cost or abundant energy provides.

It sounds easy enough: the polluter should pay for his polluting activity. There are several problems to deal with first, however. Society is far from having a precise grasp on the monetary values of even those adverse environmental impacts that have been identified. It is easier to place a value on some environmental impacts than on others. For example the long-term health effects of urban smog can at present be described only qualitatively, rather than quantitatively.

While there has been some discussion, no Canadian jurisdiction has yet attempted to assess the true environmental costs of competing energy forms. While estimates of environmental damage have been undertaken in other jurisdictions, these are simply that -- "ball park" estimates.

Does the lack of precision matter, when the value that society now assigns directly to pollution is zero? Many argue that the environmental costs of many forms of fossil-fuel activities are now so high that taking any action, no matter how modest, is preferable to taking no action at all. As the argument goes, the initial price chosen to represent the amount of environmental damage caused should be based on some estimate of this damage - not necessarily the best estimate. If the resulting reduction in pollution is not deemed to be sufficient, then prices can be raised until the more desirable response in the market place is attained.

Once policymakers have dealt with the value questions, the next problem is to devise a set of policies that will bring these (up to now) external costs into the price of energy without placing our competitiveness at risk. This is what is known as "internalizing the externalities." Since the free market by itself has no mechanism to initiate this step, government intervention is warranted.

The problem arises because there are so many different ways to assign a cost to the use of the environment. This is a principal focus of the remainder of the report. Suffice it to say that actions taken by governments can either influence prices directly, (eg. environmental charges); quantity-based, and thus only indirectly price influencing, (eg. emission permits or allowances); or implicit, (eg. regulatory restrictions placed on emissions). The next chapter discusses the various instruments that governments can use when formulating environmental policy.

CHAPTER 5: HARNESSING MARKET FORCES TO MAKE ENVIRONMENTAL PROTECTION BOTH MORE EFFECTIVE AND MORE AFFORDABLE

Governments have a host of policy tools with which to address energy-related environmental issues.[5] While the focus of the Committee's study is the greater use of market-based, or economic, instruments, it is important nonetheless to note that other forms of intervention have been and are being used with some success. In the future, solving our environmental problems will require a combination of various instruments.

One of these essentially non-market options is to provide information to businesses and consumers about energy conservation applications and about energy-using equipment. In this way, governments can help turn society's energy-use patterns towards less energy-consuming products. Today, a wide array of energy-saving products and technologies that are economic at current market conditions exist but are not used, simply because the public is not aware of them. Reductions in energy consumption translate into reductions in emissions.

There is also considerable merit in having governments provide funds to industry for research and development. Significant progress in environmental protection can be achieved if new energy-efficient technologies and industrial processes are developed to commercial readiness.

But new products and better information do not always lead to better decisions. Energy waste and environmental issues do not always command the attention that they deserve. Ultimately, as experience has shown, to bring about effective environmental responses governments need to turn to more active forms of intervention. Regulation has been the policy instrument most frequently used to generate the desired responses. There is no doubt that careful application of regulations can serve a useful function, particularly in localized situations where one must respect ambient standards. Another is the use of energy efficiency standards, designed to weed out less efficient equipment and appliances from the Canadian marketplace.

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(5) Energy, Mines and Resources Canada, Notes on slide presentation to the Standing Senate Committee on Energy, the Environment and Natural Resources, 14 October 1992.

As the federal government's recent report on prosperity suggests, regulation noticeably affects how efficiently Canada attains its environmental objectives.[6] This is because, historically, governments have tended to rely on a "command and control" (CAC) regulatory approach to limit pollutant emissions. Under this approach, a limit is placed on the rate of discharge of pollutants, and governments specify a certain technological route to achieve it. In many cases, a common regulatory standard, or limit, is applied to all firms, regardless of their individual economic situations and their financial ability to comply. CAC approaches make no direct use of the market at all.

The CAC approach may have been acceptable when environmental demands were fewer and less intense, and when investment capital was more readily available. Recent poor economic performance, however, combined with the increasing scope and scale of environmental issues, has led policy-makers to turn their attention to alternative approaches, and to the focus of this report, the greater use of market-based policy tools within the overall regulatory framework.

The recent movement to more flexible forms of regulation, in which governments establish overall performance standards without specifying the technologies to be adopted, represents an improvement over more traditional CAC forms of regulation. Nonetheless, even greater economic benefit can be achieved through increased efforts to harness market forces.

Economic instruments essentially engage the market to give producers and consumers a financial incentive to factor environmental considerations into their everyday decisions. While they cannot be viewed as a panacea to all our environmental problems, they may result in effective solutions (from both an environmental and a cost point of view) to problems in specific situations.

Some witnesses who appeared before the Committee felt a sense of urgency in moving quickly to this market-based approach. The following quotation captures this sense best:

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(6) Canada, Steering Group on Prosperity, *Inventing Our Future: An Action Plan For Canada's Prosperity*, p. 29.

> If the potential gains from the use of economic instruments are to be realized, it is important that the government introduce them as rapidly as possible in selected areas, to establish a base of Canadian experience that will permit the refinement of specific designs and their broader application. It is particularly important to implement emissions trading quickly as an alternative to ongoing expansion of a system of new source performance standards and on our reliance on concepts such as best available control technologies that will impose an unnecessarily restrictive and costly system of command-and-control regulations on the Canadian economy.[7]

A. Potential Advantages of a Market-Based Approach

Traditionally, the marketplace has been viewed as a significant adversary in the fight against pollution. This is unfortunate, given the power that can be harnessed, through adoption of market-based policies, to bring about environmental protection.

It is important to note that economic instruments exhibit a number of features that distinguish them from their CAC counterparts, the most important being that they are often more cost-effective. As stated above, the overriding aim when designing policy has to be the provision of effective environmental protection at a manageable cost to society.

Secondly, economic instruments are designed to achieve maximum flexibility. They do so by focusing on environmental results, rather than on a particular method or technology. By providing individual firms with the latitude to select an appropriate route to environmental protection, economic instruments enable market participants continuously to adapt their strategies to achieving environmental gains. In this way, their environmental responses can be optimized.

Finally, greater use of market-based policy tools can actually result in environmental performance which is superior to that achieved through the CAC approach and which can be achieved more quickly than if a set of technology-specific rules are developed. Economic instruments provide a continuing incentive to reduce pollution through the adoption

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(7) Canadian Electrical Association, "Roundtable on Economic Instruments for Environmental Protection," A Brief to the Senate Standing Committee on Energy, the Environment and Natural Resources, 20 October 1992, p. 1.

of new control technologies and processes. Requiring business to pay for its use of the environmental resource encourages managers to be constantly aware of changes in production methods in order to ensure that these additional environmental costs are minimized. Greater innovation is thus encouraged and in some cases competitive advantages may be realized.

The imposition of CAC regulatory requirements, on the other hand, do not encourage business managers to develop technologies to reduce pollution below prescribed levels; once a manufacturer or consumer has installed the prescribed equipment, there is little incentive to do anything further. In addition, the prescribed equipment may not be the best available, since government officials may not have the most recent and reliable information. In many instances, therefore, the use of economic instruments can bring about better environmental performance.

B. Different Forms Of Economic Instruments

Economic instruments come in various forms; a convenient way to subdivide them is to assess whether or not they impose a direct effect on the price of a given product. Instruments that do so include taxes, charges, incentives, or a combination of these two.

Let us first consider the use of charges, which the government's discussion paper breaks down into three types: emissions charges, input charges and product charges. Under the first option the government would place a direct charge on emissions from various sources. The Finance Department's presentation to the Committee noted that, while this approach would provide producers with flexibility in choosing how to reduce emissions, the emissions themselves could be difficult and expensive to measure.[8]

An alternative approach would involve the imposition of a charge on energy inputs that are the sources of the emissions. In the case of greenhouse gas emissions, this last option offers distinct advantages from an administrative point of view. It would be far less costly, for example, to administer an input charge such as a carbon tax, or a more broadly based energy input tax on fuels at the wholesale level, than an emissions charge on greenhouse gases from

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(8) Finance Canada, "Presentation on Economic Instruments: Opening Remarks," Presentation to Standing Senate Committee on Energy, the Environment and Natural Resources, 14 October 1992, p. 7-8.

many individual end users. One can imagine the difficulties inherent in trying to collect an emissions charge from eight million automobile owners. A carbon tax, while possibly achieving administrative efficiency, raises a number of other serious concerns. We will defer further treatment of the carbon tax to Chapter 6.

As opposed to an input charge like a carbon tax, environmental charges can take the form of charges placed on final products. For example, charges can be placed on automobiles that do not attain prescribed fuel efficiency standards. In this case, the effectiveness of the charge would be largely dependent on consumers' reaction to the increased cost. This reaction would, in turn, be based on the magnitude of the charge.

Incentives designed to support investments in the environment are another form of a price-based policy instrument. Incentives could be provided through such means as tax deductions, exemptions or credits for certain capital expenditures, and government subsidies provided to promote the use of cleaner and/or more energy-efficient sources and technologies. Despite their appeal in certain situations, tax incentives are not without problems. In an appearance before the Committee, for example, officials from the Department of Finance highlighted such potential difficulties as their relative lack of effectiveness; windfall gains that would go to those making investments that would have been made regardless of the incentive; and the impact of such incentives on the fairness of the overall tax system.[9]

Yet another approach is to develop policy instruments which bring together in one package both environmental charges and offsetting credits such as rebates or tax incentives. For example, one could envision a "feebate" scheme in which drivers of fuel-inefficient vehicles would face a product charge, whereas drivers of more energy-efficient cars could access a rebate from the government. In this situation, the charges from one could be used to pay for the rebates to the others.

So far we have been referring to policy tools whose impacts are directly price-related. There is also a set of market-based measures that affect the quantity of emissions. A tremendous amount of interest has been generated in the development of markets for access to

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(9) *Ibid.*

clean air, through the use of tradeable emissions permits or allowances,[10] for example. As the Committee's hearings pointed out, industry generally prefers policy instruments of this type to those like taxes or charges that impose a direct quantitative cost burden.

Under this approach, an overall cap for a given pollutant or group of pollutants, is determined by the regulatory authorities. A market is then established for these permits, which allow companies to emit only a certain amount over a specified period of time. These permits can then be bought and sold.

An effective system of tradeable emissions permits could achieve environmental protection at a reduced cost to society since it would concentrate the emissions reduction effort at the sources with the lowest abatement costs. CAC regulation, on the other hand, would have all sources, regardless of their reduction costs, undertake the same reduction effort.

The way such a permit system would function is illustrated in Figure 1. The diagram shows that, of the two emissions sources, the cost per tonne of reducing emissions for Source A is a mere $500, compared with $3,000 for Source B. If we as a society forced each source to cut back its emissions by the same amount, say one tonne, a total cost of $3,500 ($500 + $3,000) would be incurred. On the other hand, we could allow B to pay A for reducing its one tonne of emissions. Instead of incurring a $3,000 cost at its own source of emissions, B could pay A a negotiated sum to undertake an additional one-tonne reduction, say $2,000, the total cost of reduction would drop to $1,000 ($500 + an additional $500). As the illustration shows, there is a double benefit: B saves $1,000 ($3,000-$2,000) and A benefits, to the tune of $1,500 ($2,000 payment from B less the $500 it costs B to reduce its emissions by another one tonne). The total monetary gain to society in this simplified example is $2,500, while the basic environmental objective of eliminating two tonnes of emissions is still attained.

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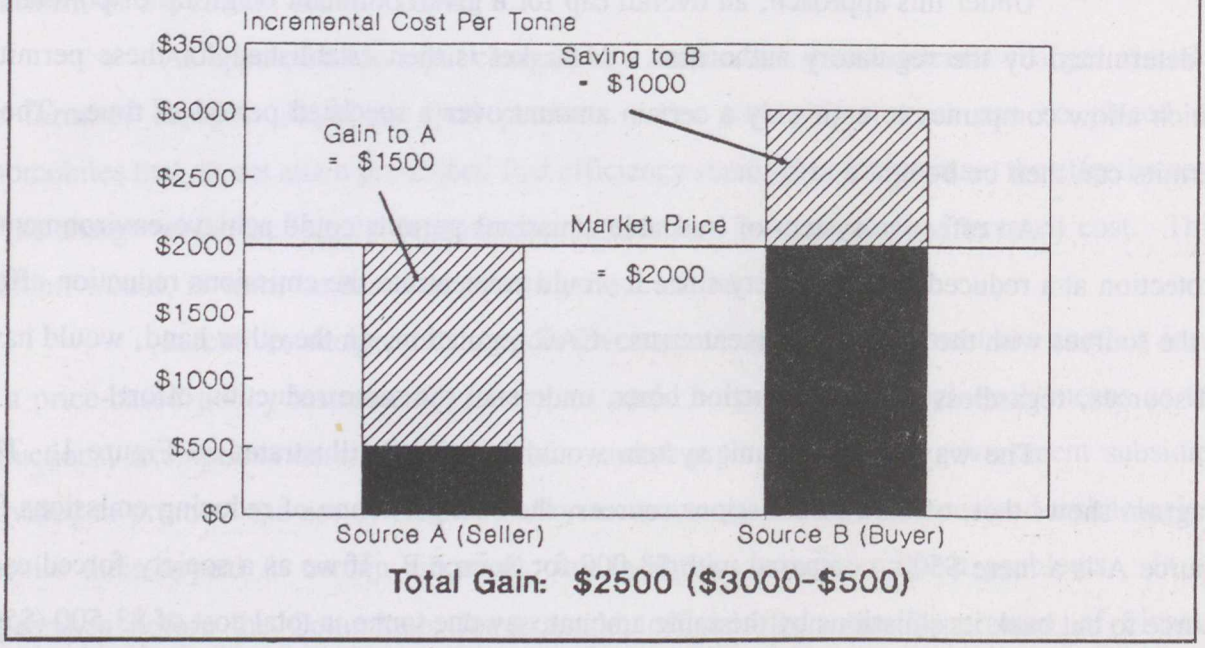
(10) There is not yet a convention on the use of the terms "permits" and "allowances". In this report, the terms are used interchangeably. It is recognized by some, however, that the term "allowances" infers a more permanent status.

FIGURE 1
POSSIBLE COST REDUCTION FROM USING ECONOMIC INSTRUMENTS



Source: Environment Canada, 1992.

In the above example, the high-cost source has been provided with an economic incentive to pay the least-cost source to undertake emissions reductions on its behalf. For the least-cost source, it makes sense to reduce emissions below the level authorized by its permits and to trade excess permits (and realize a profit) if, as in the example given, the price of these permits (the negotiated sum of $2,000) is greater than its own abatement costs. This would normally be the case for low-cost applications. When there are numerous emissions sources, the result can be an open market for permits, in which their price reflects their perceived market value. By having the lower-cost sources reduce their emissions by more than the higher cost sources, society will have reached its emissions target at less cost to the economy than if all sources had to meet the same reduction target, regardless of cost.

Over time, the emissions permits take on a value in the marketplace as the total emissions target is ratcheted downwards and it becomes increasingly costly to meet the new limits. The value of the permit would then represent a real cost to polluters and thus an

incentive to reduce pollution. Our objective is to let the marketplace function, so as to freely buy and sell emission permits. Government's role is to set the total annual limit, which artificially creates the initial value for the permits.

C. Design Concerns

A host of practical problems needs to be overcome before the full potential of various instruments can be developed. Not only must the individual policy tools be correctly matched with a particular problem, their program design must be appropriate.

Several complicating factors can be briefly mentioned. First, since the task of quantifying environmental costs is fraught with problems, it is often very difficult to establish an appropriate value for an incentive or disincentive. Even if this could be accomplished, different economic instruments can have varying effects on consumer prices. Second, for measures based on discharges, the administrative costs of accurately measuring and monitoring pollution flows will be high. Third, the introduction of a particular economic instrument, and its implications for energy production and consumption patterns, could impose disproportionate costs on certain regions and industries. Measures might have to be implemented to compensate those groups/industries hardest hit by the new policy. Fourth, the establishment of certain economic instruments might impose difficulties on the general economy during the transition period, and could also damage our international competitiveness.

Of course, many of these same criticisms can be levelled at government regulation. It is therefore important, when fashioning environmental policy, to examine carefully the costs and benefits, both environmental and economic, of alternative policy tools.

A number of additional important considerations can be mentioned. The ground rules establishing each form of economic instrument must be made clear, and there must be stability and certainty. Moreover, since environmental problems that can be addressed through the use of economic instruments do not always respect political borders, interprovincial, and/or international, coordination must be assured before these instruments can be put in place. It is important for all governments involved to agree on a common, coordinated approach to the use of these policy instruments.

On the specific issue of tradeable permits, several particular design concerns were raised before the Committee. We believe that these concerns are important enough to note, even though such concerns were not a primary focus of our deliberations.[11]

One problem was the initial allocation of permits. If these permits are provided to existing companies free of charge, a valuable asset will be created almost instantly. This will give emitters a distinct financial advantage over new firms, who would have to buy permits prior to beginning operations.

Another concern is that firms, anticipating a rapid appreciation in the value of the permits, could adopt a conscious strategy of hoarding them. The intent of these companies, it is argued, would not be to use the permits in the designed way, but rather to realize a financial windfall from their eventual sale.

One solution might be to implement an auction process whereby firms would be required to bid for permits if they wished to continue emitting. The payment for permits under this plan, however, could impose quite onerous costs on business. As well, requiring firms either to purchase permits or essentially to stop producing could likely set the tone for a furious bidding process, thereby likely raising the price of the trading allowances.

Perhaps a more effective and less costly alternative would be to retire, on a regular basis, a small proportion of existing permits in line with government plans to reduce emission targets. A scheduled depletion of this sort would tend to discourage hoarding of permits by making them less attractive as long-term assets.

Yet another concern that the Committee heard was the potential creation of pollution "hot-spots" in locations where pollution abatement is most expensive. In other words, firms in a region where abatement costs are low might sell their excess permits to firms in high-cost regions, with a resulting shift in net emissions towards the latter. This problem could be addressed by setting local ambient air quality standards at levels which protect human health. Alternatively, trades in certain directions between specified geographical areas could be prohibited.

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(11) For more detailed discussion see: Canadian Council of Ministers of the Environment, Emission Trading Working Group, *Emission Trading: A Discussion Paper*, May 1992, p. 25-47.

These are a few of the many design issues that are now being addressed by the various working groups in Canada and elsewhere. There is no question that the effectiveness of economic instruments in meeting environmental objectives will depend on careful attention to such design details.

CHAPTER 6: POTENTIAL APPLICATIONS OF MARKET-BASED MEASURES TO ENERGY-RELATED AIR EMISSIONS

During its hearings, the Committee was told that Canadians must acknowledge that there are real costs associated with fixing or preventing environmental problems. These costs will show up either directly, in the price of the products that they buy, or indirectly, through a reduction in the ability of Canadian businesses to continue to provide jobs and economic growth in an internationally competitive world. The issue is to achieve realistic environmental objectives at an affordable price.

This section of the report will review the opportunities to secure affordable environmental protection through mechanisms that use market forces. The market-force approach, either directly or indirectly, builds the cost of pollution or pollution control into the price of the goods and services that Canadians buy. Over time, Canadians will respond to these price signals and favour goods that have a lower environmental cost.

In this chapter, the market-based opportunities are discussed in relation to the three principal airborne emissions problems associated with energy use: acid rain, urban smog and global climate change.

A. Using Market-Based Measures To Control Acid Rain

Of the three issues noted above, the acid rain problem is the one on which Canada has worked the longest, and that has seen the most progress. Indeed, it is expected that, in eastern Canada at least, acid gas discharges will be reduced to nearly 50% of 1980 levels by the end of 1994. The 1994 levels are in most areas those that scientific evidence suggests can be accommodated by the natural neutralizing capacity of the soils and lakes. These reductions will be made without the use of market-based measures.

Several factors have contributed to the success of the acid rain program. First, most of the provinces allowed the companies themselves to decide the best way to meet their assigned portion of the provincial cap. Second, there was freedom within companies to choose which of their plants would be adjusted. Corporations such as Ontario Hydro, New Brunswick

Power, and Nova Scotia Power were permitted to make changes at those plants where the changes were the least costly, as long as the overall company limit was met, and the local ambient air standards respected. Third, there was a period of nine years in which to carry out the adjustments. Fourth, the SO_2 emissions are calculated from the sulphur content of the fuels rather than by difficult and expensive continuous monitoring of gas discharges. This approach was, in effect, a limited version of permit trading, and its success illustrates the advantages of using a more flexible approach than traditional CAC regulation.

Well, one might ask, if full blown market based measures were not needed for acid rain, why all the fuss? In response, we might point out that the costs of controlling acid rain might have been even lower, if a full market based program had been available. What would have been the compliance costs if there had been a mechanism to trade emissions permits among companies, rather than just within companies? For example, would it have been less expensive overall for Ontario Hydro and say, Falconbridge to trade credits? While testimony before the Committee did not address that question, one can assume that the existence of a large trading market would have resulted in more trade, and therefore additional savings.

As noted previously, in Chapter 2, the Green Plan reiterated the government's commitment, under the Canada-U.S. Air Quality Accord, to extend the 1994 cap on SO_2 emissions in the seven eastern provinces to the year 2000, at which time a national cap of 3.2 million tonnes would become effective. Meeting the national cap will, in all likelihood, bring western Canada into the picture. In Alberta, for example, there are many sources of SO_2 emissions, and CAPP testified that the estimated costs of reducing them will vary from about $400 per tonne to $19,000 among the various sites. This cost variation suggests, and a study undertaken by the Province of Alberta and the former CPA[12] confirms, that a system of emissions permit trading could help lower the average cost of achieving any required reductions. CAPP and the Alberta government are now planning multi-stakeholder negotiations on the design of a permit system for large stationary sources of SO_2 emissions. It might be noted, however, that to date no apportioning of the year 2000 national cap has been completed, and it may be that

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(12) Province of Alberta and Canadian Petroleum Association, "Market-Based Approaches to Managing Air Emissions in Alberta," 1991.

the national ceilings for the western provinces and the territories will not require significant reductions as a result.

It may be desirable to harmonize acid gas control measures in Canada and the U.S. This is because roughly half of the acid gas flows into eastern Canada originate in the U.S., while some border areas of the U.S. receive gas flows from Canadian metal smelters. The restrictions of emissions in the 1990 amendments to the U.S. *Clean Air Act* will take hold in two phases, in 1995 and 2000. As well, the U.S. legislation gives power plant operators the option of using permit trading to meet their targets in a more cost-effective manner. It may be prudent to provide a parallel regulatory regime in Canada, so that regional cross-border trading could be considered. Canada may thus wish to concede some of its independent decision-making in favour of achieving a better overall result.

In summary, the acid rain problem has been well researched, and existing targets for SO_2 emissions will be met using control measures already in place. The probability of still more stringent SO_2 emission requirements in the future have prompted interested parties to begin examining market-based approaches to achieve additional reductions. There is considerable interest on the part of organizations such as the CEA and CAPP to use acid gas emissions as a test case for the trading of emissions permits. The experience gained could also be valuable in designing similar programs for the control of gases that cause smog and potential global climate change.

B. Using Market-Based Measures to Control Urban Smog

As was noted in Chapter 2, urban smog is typically a summertime problem. It results from an interaction of oxides of nitrogen with volatile organic compounds (VOCs) in the presence of sunlight, to form ground level ozone. It is known that the dominant source of nitrogen oxides is the exhausts of gasoline and diesel powered vehicles and the exhausts of stationary boilers that burn oil, gas or coal. VOCs have a variety of origins, from vehicle exhausts to dry cleaning plants, from gasoline fuelling and transfer terminals to commercial bakeries. Smog is known as "urban" smog since it tends to be at a peak in urban areas where the component gases are concentrated. Thus, the problem is both seasonal and localized.

It follows that the measures needed to control the problem may have to deal with many thousands of emissions sources located in certain defined urban areas, and be in effect mainly during the long sunlight days of summer. This suggests that the control measures are likely to be much more complex and potentially more difficult and expensive to deploy than those required for the gases that cause acid rain.

The NO_x/VOCs Management Plan developed through consultations with officials from a national cross section of emission sources, and endorsed by the Canadian Council of Ministers of the Environment (CCME), calls for a multi-faceted approach to controlling both NO_x and VOCs. But the NO_x/VOCs Management Plan does not set priorities as to the sources to be addressed first, nor does it attempt to project the financial impacts of the control measures on different sectors of the economy or in the different regions. Market-based measures could prove useful in achieving the objectives set out in the Plan because of the flexibility they could introduce.

Developing appropriate policies to address NO_x/VOCs emissions is made difficult in part because the mechanism of smog formation is not completely understood. The exact chemistry of the interactions between the family of gases that are called "NO_x" and the broad range of volatile organic compounds is not yet firmly established. The CEA, for example, noted that the amounts of NO_x reduction and VOC reduction needed have not been well established. Other jurisdictions have been grappling with this issue as well. For example, in one smog-prone area of California, local air quality officials have decided to concentrate mainly on VOCs, since control of these gases can be accomplished more cost effectively than can control of NO_x. One question is whether, and in what circumstances, one unit of VOC could be equivalent to one unit of NO_x. The significance of the uncertainties lies in the great variation in the control costs among the hundreds of sources of both gases.

The Committee also heard that there are some lingering concerns about the "rightness" of our targets. For example, Canada's goal of 82 parts per billion of ground level ozone is about 50% lower than the US target. This presents a problem when one considers that a large portion of the smog-forming gases in southern Ontario and the southern Atlantic region come from across the border.

Any hesitation in moving to control NO_x and VOCs is not to deny the legitimacy of the problem. The issue is to make the right amount of reduction at the right place, at the right time, and at the lowest economic cost.

The evidence provided by the CEA clearly suggested that many of the stakeholders are examining the work underway in several jurisdictions to address the application of emissions trading to the smog problem.[13] In Ontario, a multi-stakeholder study has been assessing the feasibility of NO_x emissions trading. This study has concluded that allowing trading between the larger NO_x sources could realize a savings of 40%, or about $130 million per year, in the cost of complying with the NO_x/VOCs Management Plan, over the cost of traditional forms of compliance. The study also noted that if the objective was to reduce emissions even further than outlined in the Management Plan, an additional 33% cut in emissions could be achieved without increasing associated costs.

Similarly, a study was undertaken earlier this year by the CCME and the Province of B.C. of the merits of a trading system for NO_x and VOCs in the Greater Vancouver Regional District. The conclusion, again, is that substantial savings from traditional regulatory approaches are potentially available using emissions trading.

In addition, the Committee was advised that the Economic Instruments Collaborative, a national volunteer body composed of industry and environmental representatives, with government observers, has an active working group addressing the opportunities for market-based measures to be used in the control of urban smog. The results of all these efforts should sharpen the focus on what should be done, by whom, and when.

To conclude, a number of questions and issues await resolution before a concerted drive to control smog gases can begin. As noted, the scientific basis for an abatement program is incomplete, both with respect to the mechanisms of smog formation under a variety of gas concentrations and weather conditions, and the determination of which of the two gases would yield the greater benefit per unit of reduction. Questions remain about Canada's ground-level ozone goal, given the less stringent target adopted in the US, and the cross border flows of both NO_x and VOCs. Strong concerns exist among the affected industries as to the priorities, the

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(13) CEA, 20 October 1992, p. 2.

costs, and the equal sharing of the responsibilities for control. There is fear that the stationary sources will be selectively targeted because they are larger and less numerous than vehicles, even though they contribute less to the problem. Finally, CAPP repeated a recurring theme before the Committee: a call for review of air emissions control within a comprehensive environmental process based on a number of principles. These principles are discussed in more detail in Chapter 7.

Looking ahead, if one assumes that progress can be made in resolving the science questions, appropriate targets, and the need to follow a compressive environmental management process, is there in fact a place for market-based measures in controlling urban smog? The theories suggest there is and the Committee was advised, in general terms at least, that economic instruments will have a key role to play. The experience gained in the design of flexible measures such as trading in emissions permits to address the SO_2/acid rain problems suggests the use of trading could prove to be a viable option for smog control. These conclusions derive from the following:

- there are a large number of pollution sources
- the geographic areas of concern are well defined
- the technologies are relatively well known
- the costs to reduce any individual source can be computed, and are likely to vary considerably among the sources
- the costs of reducing via "command and control" are likely to be high and administratively difficult.

C. Using Market-Based Measures to Control Greenhouse Gases

From the certainties of controlling SO_2 gases, to the less certain approaches to dealing with urban smog, we come to the unsettling problem of deciding what Canadians can and should do about the potentially catastrophic effects of global climate change. The issue is at once both simple and complex.

We know that our planet is habitable because there is a "greenhouse" effect that keeps weather temperate enough to sustain life. We know that there is an equilibrium between

the mainly natural production of greenhouse gases and the takeup of those gases in plant life and the oceans. But we also know that the massive additional flows of greenhouse gases resulting from human activity will alter this equilibrium. Finally we know that the production and use of fossil fuels is the single largest contributor to those additional flows of greenhouse gases. That is the simple part.

The complex part is the uncertainties, and what to do about them. The climate change issue is made much more perplexing by the fact that we do not know what the rate, magnitude and impacts of the change will be. Neither do we have a good sense of the cost of a policy response. It is also impossible to determine with precision how our trading competitors will address this issue. The Committee heard strong testimony on these points. The environmental groups stressed that, in their opinion, the scientific evidence is already sufficient to compel us to act without delay to cut back drastically on the generation of greenhouse gases as we await refinement of the science. Others argued just as fervently that inappropriate responses, without better science, could be ineffective and potentially damaging to Canada, if not implemented around the world.

Given the uncertainties presented, the challenge for Canadians is to use policy instruments that will not impose undue economic costs but still achieve environmental benefits. Until the scientific and economic uncertainties are dealt with, prudence requires that Canada undertake control initiatives that would lead to no regrets, regardless of the eventual scientific conclusions.

The Committee heard, for example, of opportunities to reduce fossil fuel consumption through a continuation of energy efficiency measures such as the replacement of incandescent or mercury vapour streetlights by high efficiency low pressure sodium lamps (gold colour). Such measures are attractive even at current energy prices, and conversions could be accelerated by well-designed incentives to defray initial capital outlays.

Many witnesses spoke at length on incorporating the environmental costs of fossil fuels into the prices of energy. This was most often termed the "internalizing of the externalities" that we discussed in Chapter 4. Some participants argued that this could at least be done on a "notional" basis for planning purposes. That is, decisions on energy supply or use would be made "as if" the full environmental costs were included. To the Committee's

knowledge, only a few jurisdictions employ this approach, one of which is the public utilities board in Massachusetts.

Another mechanism to build in environmental costs, especially in the greenhouse gas context, would be via a so-called "carbon tax" on fossil fuels. This approach is, however, highly controversial. In some respects the idea is very logical-- it is a simple "polluter pay" mechanism. But some participants worried that such a tax would simply end up as another source of revenue for governments, and contribute little to reducing greenhouse gases. Other participants noted that the North American dependence on fossil fuels is so strong that a carbon tax would have to be relatively high in order to prompt behaviour changes. In that scenario, the tax would be extremely punitive, and even at a higher rate might not necessarily be related to the actual costs (if these could be computed) of the environmental damage.

The impacts of a high carbon tax, apart from being unevenly distributed among the regions of Canada, would be extremely harmful to Canadian industries, many of which use carbon-based energy very intensively. For example, making primary iron using a blast furnace requires carbon as a chemical reductant. A carbon tax of $100 per tonne of CO_2, if imposed unilaterally by Canada, would roughly double the price of primary iron. This would most certainly doom the Canadian primary steel industry, as there are yet no commercially available alternatives to blast furnaces. Calculations also reveal that a carbon tax of this magnitude would cause a doubling to tripling of electricity prices in provinces that are dependent on fossil fuels, especially coal, for a large portion of their generating capacity. These provinces include Alberta, Saskatchewan, and Nova Scotia. The above analysis suggests that Canada needs to tread cautiously when considering environmental charges, such as a carbon tax, and to move in step with our trading partners.

Several witnesses were convinced that a tax such as a carbon tax should be considered only in the context of a complete restructuring of the federal tax system, with the result that the overall tax take would not increase. As an example, governments could move to reduce other taxes in proportion to the increases in environmental taxes. Resource industry participants reminded the Committee that income tax reductions used to offset environmental charges, would be effective only when a company was in a taxable situation. Many companies are from time to time not profitable, thereby limiting the usefulness of this option.

Another option would be to recycle environmental tax revenues back into environmental protection initiatives. This approach has been rejected in the past, with successive governments resisting any type of earmarked or dedicated taxes because of the consequent loss of fiscal flexibility. The Committee heard from the Department of Finance that the current government continues to hold this view.

Numerous witnesses referred to the idea of using a system of trading of emissions permits for CO_2, but were not in a position to elaborate. The main appeal is that a trading system would at least offer the potential of reducing the average compliance cost. The Committee was, however, left with a strong impression that, given all of the scientific uncertainties surrounding the issue of global climate change, trading in permits for $C0_2$ is much less "ripe" for implementation than for either SO_2 or NO_x/VOCs.

Several witnesses took the tack that Canada cannot afford to be out in front on this issue, given its open economy, and that, in any event, little improvement in the global environment would result from unilateral Canadian action since we only emit 2% of the world's CO_2. They insisted that Canada pay heed to its competitive trade position by acting only in concert with international agreements. Perhaps a new body, such as the Multilateral Trading Organization (MTO), which may replace the General Agreement on Tariffs and Trade (GATT), could attempt to ensure that the two ideals of competitiveness and environmental protection are integrated.

Several witnesses also argued that the biggest threat to dealing with the climate change problem is mushrooming population growth, especially in developing countries. This creates a double kick -- the number of people is not only increasing, but is doing so most rapidly in the countries where per capita energy consumption will inevitably rise with increasing prosperity. It is generally acknowledged that investment in energy efficiency in developing countries represents a cost-effective approach to dealing with what is essentially a global issue.

In summary, the Committee received a clear message that policies designed to deal with greenhouse gas emissions must be very carefully thought out and implemented. There is an acceptance that Canada can and should do its share to reduce greenhouse gases where it is feasible and advantageous to do so. It bears repeating that the reduction of CO_2 emissions is quite a different issue from reductions in acid gases and smog gases. The latter can be

controlled by using lower sulphur fuels, or by pre- or post-combustion cleaning, or by improvements to combustion control and to the handling of volatile substances, all of which are technically feasible. The complications in dealing with fossil fuels is that CO_2 is an unavoidable product of combustion, and that there are no practical, economical methods of capturing and containing the large quantities of CO_2 now being produced.

For these reasons, the consensus was clear. All agreed that the potential for climate change exists, and that Canadians must do their part to reduce the threat. The preferred route would be to use "no regrets" initiatives first, including a more vigorous move to adopting higher efficiency energy processes. These will yield economic benefits in their own right that can help boost Canada's competitiveness, while reducing CO_2 emissions. There was an implied acceptance that some small environmental levies could be accommodated if these were recycled to help develop and finance more efficient processes or systems.

To move beyond "no regrets" actions, there was a general opinion that some other market-based measures, such as trading in emission permits, might also be employed. In addition, some witnesses did propose removal of energy subsidies, although the testimony did not quantify the possible impacts on energy prices. The idea of a carbon tax was the least acceptable market-based measure to most witnesses presenting evidence to the Committee. The reasons behind this opposition, as discussed, were the difficulties that such a tax would create sectorially, regionally and nationally. As well, respondents doubted that mechanisms to adjust the impacts of a tax, and to equalize its impacts, would be practicable under current fiscal policies.

CHAPTER 7: GUIDING PRINCIPLES EMERGING FROM THE COMMITTEE'S ROUNDTABLE

Given the early stages of the consultation process on market-based measures, and the as yet incomplete evaluations by several provincial and national working groups, it is not surprising that much focus was placed during the Committee's hearings on a number of principles to guide environmental policy formulation. Some of these were formally proposed, while others were introduced and gained a measure of consensus during the discussions. The Committee concluded that there are a number of guiding principles that should be followed by federal and provincial policy-makers.

- For real environmental progress, external environmental costs should be internalized to the extent that such moves do not threaten Canada's industrial competitiveness. The economic viability of energy efficiency activities and alternative energy sources would be considerably enhanced if the environmental costs of conventional energy production were internalized in the cost of energy.

- Economic efficiency should be adopted as a fundamental tenet of environmental policy-making. Market-based instruments, if introduced in a fair and administratively efficient way, can be useful in achieving Canada's environmental goals and targets in an economically effective and efficient manner.

- Decision-makers should consider the full range of policy measures rather than seek to apply a single approach to all of the problems.

- The use of economic instruments must be backed by strong public support. Achieving such backing may require substantial efforts in educating the public about the consequences of a variety of environmental policy initiatives. As an example, unless the public is educated on the advantages offered by such market-based measures as tradeable

allowances or permits, they may be reluctant to accept the idea of granting to industry what might otherwise be interpreted as a "licence to pollute."

- Any consideration of individual economic instruments should be subject to careful cost-benefit analysis.

- The use of economic instruments must be guided by the desire to achieve revenue neutrality. They must not become a "tax grab" by the government. A major restructuring of the existing tax system and our subsidy practices would almost certainly be required if tax instruments were to be used to internalize environmental externalities in the cost of energy.

- The use of economic instruments must respect the need to ensure fairness in terms of regional and industrial impacts. Those regions and industries seriously affected by certain government initiatives might require some form of compensation to accommodate the dislocations arising from changes in environmental policy.

- In setting environmental goals we must respect our international competitive position. Policy instruments that unilaterally impose onerous increases in firms' operating costs or restrict the ability of business to conduct its commercial affairs will fail. Canada depends heavily on its energy resources in a number of key industrial sectors, which, in turn, are heavily reliant on export activity. We must therefore not negate the comparative advantage that energy gives us. Our strength in energy and the need to maintain international competitiveness, behoove us to use economically-efficient environmental initiatives.

- Voluntary initiatives are preferable to imposed measures. If governments must intervene, non-tax measures should be pursued in preference to tax measures. CAC should be used mainly for highly toxic emissions, where certainty of result is paramount. The Committee observed a high degree of opposition to the implementation of a carbon tax.

- Action on global problems such as global climate change should be undertaken in a global context, perhaps under the auspices of a restructured GATT or its possible successor, the MTO.

- Energy subsidies must be made transparent, and following frequent review should be either justified or eliminated in order that market-based measures can function as intended. Government assistance to the energy sector, for example in the form of both direct and indirect subsidies, is hampering the market penetration of energy efficiency measures and renewable forms of energy.

We believe that these guiding principles form a sound basis on which to build in the ongoing consultations concerning the application of economic instruments to attaining environmental objectives. We therefore recommend:

Recommendation #1:

that the federal government adopt the above-noted principles as a guide during its consultations on the application of economic instruments, and the subsequent development of policies in this area.

We are of the view that one of these guiding principles stands out from the others: the need to respect economic efficiency when designing environmental policies. As the title of our report suggests, our aim, and that of most proponents of market-based measures, is to make environmental protection more affordable and therefore more likely to occur. This can be achieved if effective responses to environmental challenges are undertaken at the lowest possible cost to society. We therefore recommend:

Recommendation #2:

that in developing policies to achieve environmental goals, efficiency be the cornerstone of government policy-making.

CHAPTER 8: TAKING THE NEXT STEPS

During its study, the Committee was struck by the call for the establishment of an improved decision-making process so that necessary action could be taken more quickly and more effectively. We believe it is worth emphasizing a key point brought to our attention by CAPP.

CAPP's suggestion was that a more effective decision-making process could be achieved at all levels of government, particularly at the national level, by adopting a comprehensive environmental management process such as that displayed in Figure 2. It was argued that such a process would ensure an efficient use of resources, since it would allow environmental concerns to be priorized and scarce financial resources to be allocated to the most pressing environmental needs, using the most appropriate policy measures available. Rational decisions about the application of economic instruments could then be made within this broader framework. The Committee therefore recommends:

Recommendation #3:

> **that the federal government adopt a comprehensive environmental management process through which effective environmental decision-making can be achieved, with the process outlined in Figure 2 being considered as a model.**

The Committee also heard, from the CEA, that the consultation process set up by the CCME to examine economic instruments was not particularly open or transparent. We concluded that particularly on the subject of economic instruments, there is a need for an improvement in the way consultation and decisions are reached.

It is vital that input be solicited from interested parties, including those that represent broad public interests. The consultation process should involve stakeholders meeting together in various forums, such as the Roundtable hosted by the Committee. Only with the

cooperation of all critical stakeholders can environmental policy decisions be made most effectively and efficiently. We therefore recommend, that under the general decision-making framework outlined in Figure 2:

Recommendation #4:

> **the federal government establish a National Economic Instrument Advisory Committee to oversee the introduction of economic instruments, thereby assisting in a cost-effective implementation of the Green Plan. Membership of the Committee should include, at the minimum: key stakeholders from industry, consumer and environmental groups, together with representatives from Environment Canada; Energy, Mines and Resources Canada; Finance Canada; Industry, Science and Technology Canada; and representatives from the provinces and the territories.**

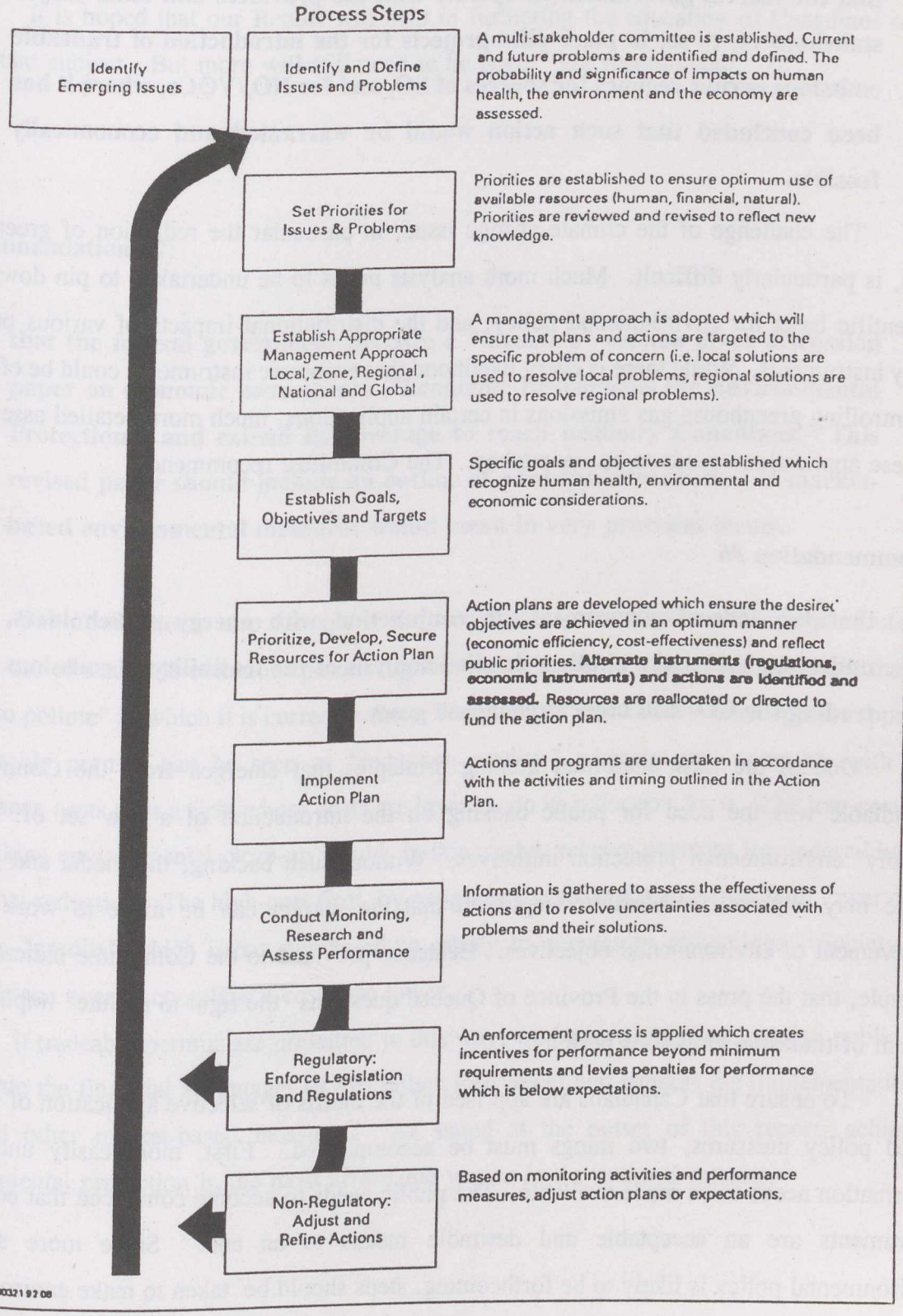
A number of groups participating in the Roundtable, particularly the Canadian Association of Petroleum Producers, Canadian Electrical Association and the representatives from the Economic Instruments Collaborative, were enthusiastic about getting tradeable permits schemes up and running to deal with acid deposition and ground-level ozone. They argued that since feasibility studies have been completed and preliminary indications are that these initiatives could be successful, it is time for action.

We also heard complaints that the federal government is behind industry in terms of planning for implementation. A considerable amount of work and discussion about market-based measures has indeed been undertaken at the provincial level, within business and within the environmental community. As was previously noted, a number of multi-stakeholder groups such as the Collaborative are also assessing the application of market-based tools to environmental problems.

We support the call to move quickly toward the design and implementation of trading permit schemes for SO_2 and NO_x/VOCs emissions, where trading is deemed to be warranted and environmentally justified. We therefore recommend:

Figure 2

A Management Process for Addressing Environmental Issues



Source: Canadian Association of Petroleum Producers' Response to Economic Instruments for Environmental Protection, Submission to the Standing Senate Committee on Energy, the Environment and Natural Resources, p. 8.

Recommendation #5:

that the federal government co-operate with the provinces and other major stakeholders, to set in place pilot projects for the introduction of tradeable emissions permit regimes for sources of SO_2 and for NO_x/VOCs, where it has been concluded that such action would be warranted and economically feasible.

The challenge of the climate change issue, in particular the reduction of greenhouse gases, is particularly difficult. Much more analysis needs to be undertaken to pin down both a scientific basis for environmental policy, and the distributional impacts of various possible policy instruments. While there is every likelihood that economic instruments could be effective in controlling greenhouse-gas emissions in certain applications, much more detailed assessment of these applications needs to be undertaken. The Committee recommends:

Recommendation #6

that the federal government, in conjunction with energy stakeholders, undertake and make public a detailed analysis of the feasibility of emissions trading for CO_2 and other greenhouse gases.

One of the most important guiding principles that emerged from the Committee's Roundtable was the need for public backing on the introduction of a new set of "market friendly" environmental protection initiatives. Without such backing, the media and general public may express considerable scepticism that the market can be made to work in the achievement of environmental objectives. Evidence provided to the Committee indicated, for example, that the press in the Province of Quebec questions "the right to pollute" implied by a system of tradeable emissions permits.

To ensure that Canadians are apprised of the merits of selective application of market-based policy measures, two things must be accomplished. First, more easily understood information needs to be made available. The public needs to become convinced that economic instruments are an acceptable and desirable means to an end. Since more stringent environmental policy is likely to be forthcoming, steps should be taken to make environmental

protection as affordable as possible. Market-based tools offer some potential for achieving this objective.

It is hoped that our Report will help in furthering the education of Canadians on this important subject. But more will still need to be done. We recommend:

Recommendation #7:

> **that the federal government prepare a "layman's" version of its discussion paper on economic instruments ("Economic Instruments for Environmental Protection") and extend its coverage to reach ordinary Canadians. This revised paper should include an outline of what the introduction of market-based environmental measures would mean in very practical terms.**

The Committee is also strongly of the view that economic instruments, in particular the greater use of tradeable emissions permit regimes, must be put in a more positive light than the "right to pollute" in which it is currently cast. The public is more likely to accept this approach if tradeable permits can be seen as "reduction credits," whereby one company with high compliance costs pays a firm whose costs are lower to do its reduction for it. The low-cost firm undertaking environmental clean-up would, in this model, receive payment for undertaking the additional reduction. The high-cost firm, by assigning the reduction to a firm with lower costs, uses the "credits" which it has purchased to satisfy its regulatory obligations. Society will benefit since overall compliance costs are lower.

If tradeable permits are presented in this way, we believe that the Canadian public will appreciate the financial advantages of this policy instrument and support the implementation of this and other market-based measures. As stated at the outset of this report, achieving environmental protection in the most affordable way is in the national interest.

APPENDIX A

List of Witnesses

WEDNESDAY, OCTOBER 14, 1992

Morning Meeting

From Environment Canada:
Penny Gotzaman, Chief, Economic Analysis;
Alex Manson, Director, Climate Response Strategies Branch; and
Wayne Draper, Associate Director, Industrial Programs Branch.

From Energy, Mines and Resources Canada:
David Oulton, Assistant Deputy Minister, Energy Sector; and
Sue Kirby, A/Director General, Energy Policy Branch.

Afternoon Meeting

From Transport Canada:
Robin Lewis, Senior Advisor, Intergovernmental Relations and Environmental Affairs; and
Malcolm McHattie, Chief, Advanced Engineering and Special Projects.

Evening Meeting

From the Department of Finance Canada:
Bill McCloskey, Director, Sales Tax Division;
Marilyn Knock, Senior Policy Analyst, Sales Tax Divison;
Dr. Munir A. Sheikh, Assistant Director, Economic Studies and Policy Analysis Division; and
Jerry Beausoleil, Chief, Environment Section, Environment, Energy & Resources Division.

From Industry, Science and Technology Canada:
Ron Harper, Director, Environmental Regulatory Affairs Directorate.

TUESDAY, OCTOBER 20, 1992

Morning Meeting

From the Canadian Gas Association:
Ian C. MacNabb, President;
M.H. McGregor, Senior Vice-President, Operations Union Gas Limited, Chatham, Ontario, and Chairman, CGA Environment Managing Committee; and
John S. Klenavic, Vice-President, Government Relations.

From the Canadian Association of Petroleum Producers:
Gerry Prodti, President;
Doug Bruchet, Vice President, Environment; and
Gordon Lambert, Imperial Oil.

From the Canadian Petroleum Products Institute:
David A. Stuart, Petro-Canada; and
Sheila Malcolmson, Energy Probe.

From the Mining Association of Canada:
Robert J. Keyes, Vice-President, Economic Affairs;
John Primak, A/Vice-President, Environment and Health; and
John Owen, Manager, Maintenance and Engigeering,
Falconbridge Limited, Kidd Creek Division, Timmons, Ontario.

Afternoon Meeting

From the Canadian Chemical Producers' Association:
David Goffin, Secretary-Treasurer; and
David J. Shearing, Ph.D, Project Manager, Business Development.

From the Canadian Steel Environmental Association:
H.H. Eisler, General Manager Environmental Affairs, Stelco Inc.; and
Dan Romanko, Managing Director.

From the Motor Vehicle Manufacturers Association:
Norm Clark, President.

From the Building Owners and Managers Association of Canada:
Wayne Smithies, President.

From the Canadian Electrical Association:
Hans R. Konow, Vice-President, Public Affairs; and
Dr. Carole Burnham, Director, Environment Division, Ontario Hydro.

From the Canadian Nuclear Association:
The Honourable John Reid, P.C., President;
Fred Belaire, Corporate Economic Advisor; and
Ian Wilson, Vice-President, Technology.

From the Consumers' Association of Canada:
Ruth Lotzkar, Chairperson, Consumers' Association of Canada Committee and National Board Member; and
Mark Haney, Director, Policy Research, National Office.

From Passmore Associates International:
Jeff Passmore, President.

From the Canadian Institute for Environmental Law and Policy:
Jack O. Gibbons, Senior Economic Advisor.

WEDNESDAY, OCTOBER 21, 1992

From the Canadian Gas Association:
Ian C. MacNabb, President; and
John S. Klenavic, Vice-President, Government Relations.

From the Canadian Association of Petroleum Producers:
Gordon Lambert, Imperial Oil.

From the Canadian Petroleum Products Institute:
David A. Stuart, Petro-Canada; and
Sheila Malcolmson, Energy Probe.

From the Mining Association of Canada:
John Owen, Manager, Maintenance and Engineering,
Falcon Bridge Ltd, Kidd Creek Division, Timmons, Ontario

From the Canadian Chemical Producers' Association:
David Goffin, Secretary-Treasurer.

From the Canadian Steel Environmental Association:
H.H. Eisler, General Manager Environmental Affairs,
Stelco Inc..

From the Building Owners and Managers Association of Canada:
Wayne Smithies, President.

From the Canadian Electrical Association:
Dr. Carole Burnham, Director, Environment Division, Ontario Hydro.

From the Canadian Nuclear Association:
The Honourable John Reid, P.C., President.

From Passmore Associates International:
Jeff Passmore, President.

From the Canadian Institute for Environmental Law and Policy:
Jack O. Gibbons, Senior Economic Advisor.

From the Sierra Club of Canada:
Louise Comeau.

WEDNESDAY, NOVEMBER 4, 1992

Appearing:
The Honourable Jean Charest, P.C., M.P.,
Minister of the Environment and President of the Canadian Council of Ministers of the Environment.

From Environment Canada:
Brian Emmett, Assistant Deputy Minister, Policy;
Penny Gotzaman, Chief, Economic Anasylis; and
Wayne Draper, Associate Director, Industrial Programs Branch.

WEDNESDAY, NOVEMBER 25, 1992

Appearing:
The Honourable Jake Epp,
Minister of Energy, Mines and Resources Canada

From Energy, Mines and Resources Canada:
David Oulton, Assistant Deputy Minister, Energy Sector;
Sue Kirby, A/Director General, Energy Policy Branch; and
W.D. (Bill) Jarvis, Director General, Efficiency and Alternative Energy Branch.

APPENDIX B

List of U.S. Reference Material

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- Goffman, J. ***Questions and Answers Proposed Acid Rain Rules***. Washington, D.C.

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- U.S. Department of Energy. Report to the Congress of the United States. ***Limiting Net Greenhouse Gas Emissions in the United States - Volume I - Energy Technologies***. No. DOE/PE-0101. September 1991.

- U.S. Department of Energy. Report to the Congress of the United States. ***Limiting Net Greenhouse Gas Emissions in the United States - Volume II - Energy Responses***. No. DOE/PE-0101. September 1991.

APPENDIX C

Canada's Energy - Related Environmental Commitments

Acid Rain

In 1985 the federal government committed itself to a comprehensive program, the Canadian Acid Rain Control Program. The plan's objective was to work with industries and the governments of the seven eastern-most provinces to reduce sulphur dioxide emissions to 50% of 1980 levels by 1994. This target will be met.

In the Green Plan the federal government committed to renegotiating agreements with the seven eastern provinces to cap SO2 emissions at 1994 levels until the year 2000.

The Green Plan further committed the country to a permanent national cap of 3.2 million tonnes of SO2 by the year 2000.

Urban Smog

The federal government has set a maximum acceptable concentration for ground level ozone (urban smog) of 82 parts per billion. A comprehensive, ten-year federal-provincial plan has been developed to address the problem of NOx and VOC emissions, which lead to the formation of smog. The objective of the plan is to reduce Nox and VOC emissions in problem areas by 40% by the year 2000, and to ensure that all of Canada's smog problems are fully solved by 2005.

Global Climate Change

Canada has pledged to stabilize emissions of CO_2 and other greenhouse gases not covered by the Montreal Protocol (which deals with CFCs) at 1990 levels by the year 2000.

APPENDIX D

Glossary

Command and control - Policy measures that "command" polluters to "control" specific polluting activities, often in a way that is clearly set out.

Economic instruments - Policy measures that use market signals to influence consumer behaviour in a manner that is consistent with environmental goals.

Emission permits - A policy measure which enables governments to establish a ceiling or limit on total allowable emissions of a given pollutant, and then distribute those emissions among the sources of that pollutant. The assigned emission permits authorize each source to emit a specified amount of a pollutant over a specified time period. The permits would be tradeable, providing incentive for permit holders with low abatement costs to reduce their emissions below their authorized limit and then sell the unused portion to other emitters whose abatement costs are higher than the market price for the permits.

Enhanced oil recovery - A technique for recovering additional oil from a petroleum reservoir beyond that economically recoverable by conventional methods. Heat, CO2, or certain chemicals can be injected into the well to allow for the extraction of additional oil.

Externalities - Benefits or costs incurred in the production or consumption of goods and services that are not reflected in the price of the final products.

Fluidized bed combustion - A combustion method in which a mass of small particles of solid fuel (such as coal), ash and limestone are kept in motion by the rapid passage of air and combustion gases. The velocity of the gas flow is such that the mass behaves like a circulating fluid, hence the name. During combustion, the limestone particles combine with the sulphur from the coal, capturing over 90% of it before it can escape into the atmosphere as SO2 (and add to the acid rain problem.)

Greenhouse gases - Those gases, such as water vapour, carbon dioxide, nitrous oxide and methane, that are transparent to solar radiation but opaque to longwave radiation. Their action is similar to that of the glass in a greenhouse. Increasing their presence in the atmosphere is thought to augment this greenhouse effect, upsetting the current temperature balance.

Oil sands tailings - The sediment and water mixture remaining after oil sands have been processed. When oil sands are processed the bitumen (heavy oil) and sand mixture is combined with hot water, steam and sodium hydroxide. The bitumen separates from the sand, floats to the top of the mixture and is removed. The water and remaining sediment, or tailings, are pumped into dyked ponds. The presence of the sodium hydroxide prevents the finer particles from settling and the long term handling of this material and of the sludge at the bottom of the tailings ponds are cause for environmental concern.