



House of Commons
Canada

THE STANDING COMMITTEE ON ENVIRONMENT

Out of Balance The Risks of Irreversible Climate Change

Part III of "Our Changing Atmosphere" Series



"This is simply a matter of where all the individual small contributions add up. There is simply no way one country or a small group of countries can solve this problem. We are all into it, and we all have to make our own contribution."

March 1991

The Honourable David MacDonald, P.C., M.P.
Chairperson

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This is simply a matter of degree. The individual and collective actions we take today
simply are necessary to avert a global climate system that would be catastrophic. We are all
responsible for it and we must act now to prevent it.

The Honourable David Crombie, M.P.
Chairman



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HOUSE OF COMMONS

Issue No. 72

Thursday, March 14, 1991

Chairperson: David MacDonald

CHAMBRE DES COMMUNES

Fascicule n° 72

Le jeudi 14 mars 1991

Président: David MacDonald

Minutes of Proceedings and Evidence of the Standing Committee on

Procès-verbaux et témoignages du Comité permanent de

Environment

l'Environnement

RESPECTING:

In accordance with its mandate under Standing Order 108(2), a study of global warming

INCLUDING:

Seventh Report to the House

CONCERNANT:

Conformément au mandat que lui accorde l'article 108(2) du Règlement, une étude du réchauffement de la planète

Y COMPRIS:

Le Septième rapport à la Chambre

Second Session of the Thirty-fourth Parliament,
1989-91

Deuxième session de la trente-quatrième législature,
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CHAPTER 1 – BASIC ISSUES

- A. Global Warming Is Real And Serious
- B. We Must Consider All Greenhouse Gases, Not Just Carbon Dioxide
- C. Canadian Greenhouse Gas Emissions Are a Major Concern
- D. Global Warming Is Much More Than An Environmental Problem
- E. Tackling The Growing Problem Of Global Warming Requires A Fairly Swift Policy Response
- F. The World Is Challenged With Dealing With The Risks Of Global Warming

The Standing Committee on Environment has the honour to present its

SEVENTH REPORT

Pursuant to Standing Order 108(2), the Standing Committee on Environment undertook a study on global warming. The Committee has agreed to the following **Final Report**.

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- B. The Need For Better Information
- C. Energy Efficiency: Significant Potential
- D. We Can Make Significant Progress Reducing Greenhouse Gas Emissions If We Understand How People Behave
- E. Canada's Evolving International Role: The International Centre Is Threatened By An Apparent Preference For A Carbon Credit Exchange

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- D. Prospects For The Next 10-15 Years
- E. The Need For A Global Commitment
- F. Stake Issues

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Dr. J. B. Anderson, M.D. - Chairman

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CHAPTER 1

BASIC ISSUES

A. GLOBAL WARMING IS REAL AND SERIOUS

1.1 Our report is based on three main premises:

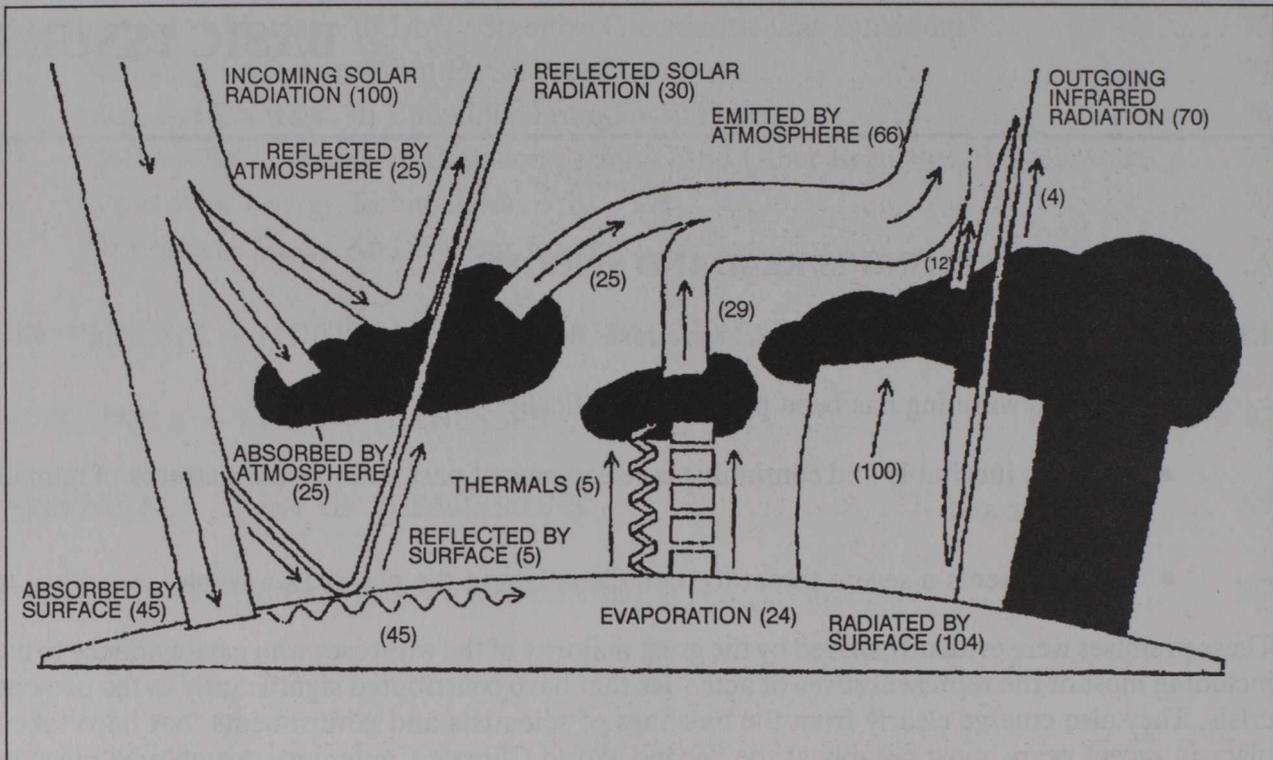
- global warming has been proved scientifically;
- it is an inevitable and continuing consequence of past and present patterns of human activity; and
- it represents a severe threat to both Canada and the planet as a whole.

These premises were evidently shared by the great majority of the witnesses who gave evidence to us, including most of the representatives of activities that have contributed significantly to the present crisis. They also emerge clearly from the meetings of scientists and governments that have taken place in recent years, most notably at the Second World Climate Conference, which took place in Geneva late in 1990.

1.2 The “greenhouse effect” is the result of a very complex chain of scientific processes in the atmosphere and at the earth’s surface, and it is not yet fully understood in quantitative terms. In principle, however, the effect is straightforward and easy to understand. The earth’s atmosphere, like the glass of a greenhouse, is highly transparent to incoming radiation from the sun, most of which is at very short wavelengths (including what we call visible light). The atmosphere is, however, less transparent to the heat energy that is radiated from the earth’s surface at longer (infrared) wavelengths (Fig. 1). Eventually a balance is struck between incoming radiation and outgoing radiation, but the temperature of the earth and its atmosphere at which the balance is struck depends on the amount of the gases in the atmosphere that can absorb this infrared radiation: the so-called “greenhouse gases”. The greater the amounts of these gases in the atmosphere, the higher will be the temperature at which the earth and its atmosphere will be in equilibrium.

1.3 It has long been recognized that one consequence of the burning of fossil carbonaceous fuels (such as coal, oil and natural gas) is a gradual increase in the amount of carbon dioxide (CO₂) in the atmosphere, and therefore an increase in what we now refer to as “global warming”. Humanity is also adding other greenhouse gases to the atmosphere, some of which are very much more effective than CO₂ in absorbing radiation (Figs. 2 and 3 and Table A).

FIGURE 1

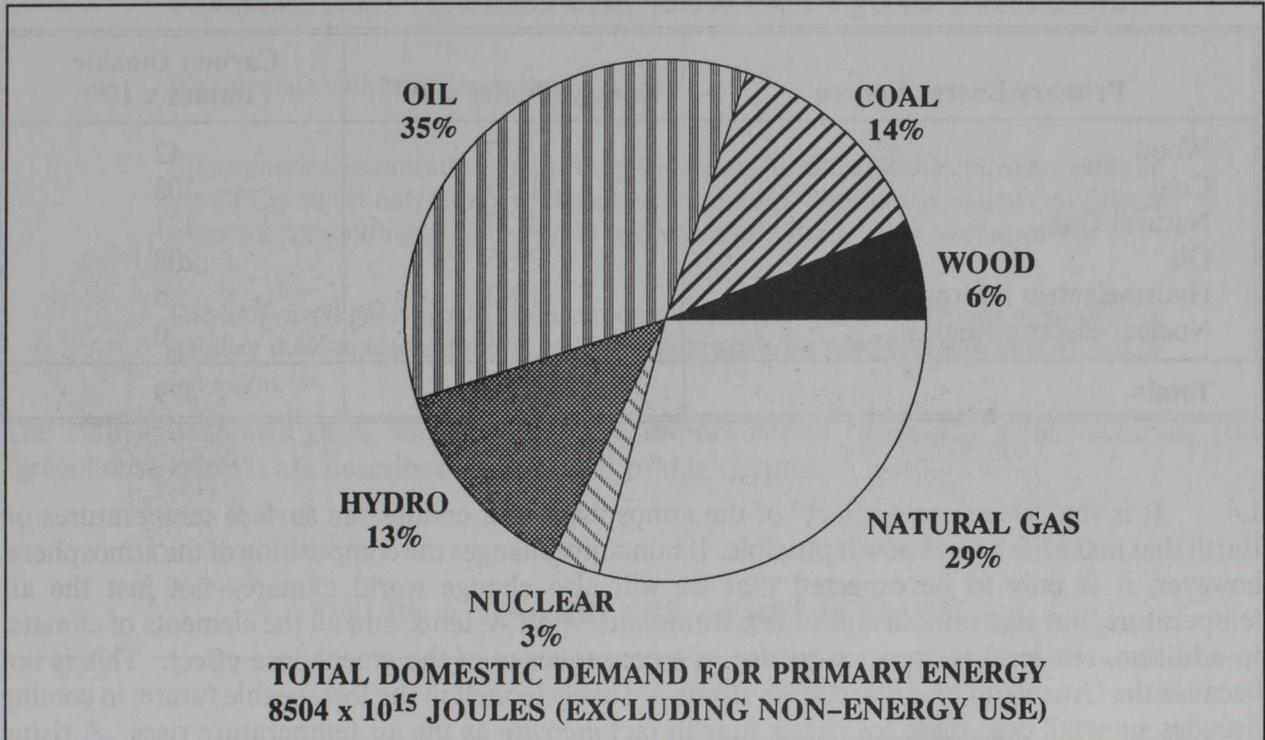


GREENHOUSE EFFECT arises because the earth's atmosphere tends to trap heat near the surface. Carbon dioxide, water vapour and other gases are relatively transparent to the visible and near-infrared wavelengths that carry most of the energy of sunlight, but they

absorb more efficiently the longer, infrared wavelengths emitted by the earth. Most of this energy is radiated back downward; hence an increase in the atmospheric concentration of greenhouse gases tends to warm the surface.

Source: Evidence to the Committee from Mr. Henry Hengeveld (Atmospheric Environment Service, Environment Canada)

**FIGURE 2:
PRIMARY ENERGY DEMAND IN CANADA 1988, BY FUEL**



**FIGURE 3:
CO₂ EMISSIONS BY PRIMARY FUEL IN CANADA, 1988**

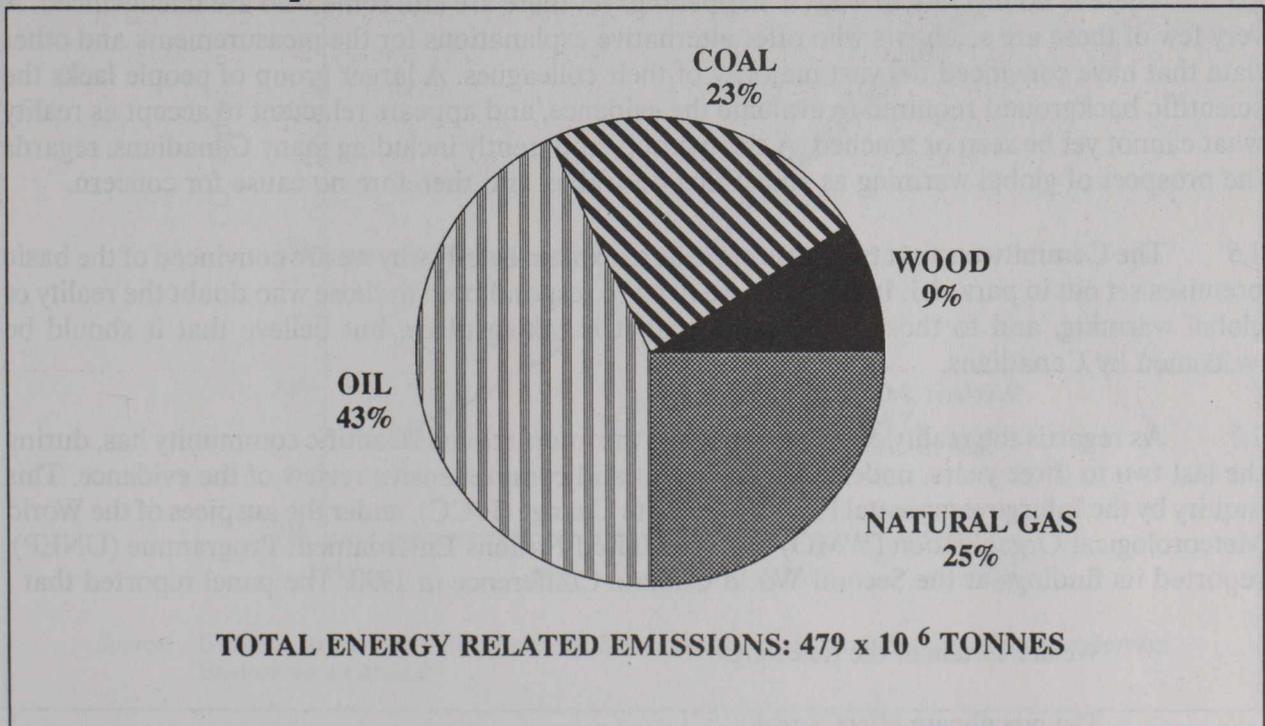


TABLE A: DOMESTIC DEMAND FOR PRIMARY ENERGY IN CANADA BY FUEL AND RELATED CARBON DIOXIDE EMISSIONS (1988)

Primary Energy Source	Energy (Joules x 10 ¹⁵)	Carbon Dioxide (Tonnes x 10 ⁶)
Wood	517	42
Coal	1191	108
Natural Gas	2427	121
Oil	2995	208
Hydro-electric Energy	1093	0
Nuclear-electric Energy	281	0
Totals	8504	479

1.4 It is the “greenhouse effect” of the atmosphere that creates the surface temperatures on Earth that make life as we know it possible. If humanity changes the composition of the atmosphere, however, it is only to be expected that we will also change world climate—not just the air temperature, but also rainfall and snowfall amounts, wind systems, and all the elements of climate. In addition, sea-level is expected to rise as a consequence of the greenhouse effect. This is not because the Greenland or Antarctic ice sheets are likely to melt in the foreseeable future; in coming decades snowfall over these ice sheets may in fact *increase* as the air temperature rises. A rising sea-level is expected because the world’s oceans will be warmed by the atmosphere above them, and as water gets warmer it expands in volume.

1.5 There is no mystery to what is happening, yet there are still some who are unconvinced. A very few of these are scientists who offer alternative explanations for the measurements and other data that have convinced the vast majority of their colleagues. A larger group of people lacks the scientific background required to evaluate the evidence, and appears reluctant to accept as reality what cannot yet be seen or touched. A third group, apparently including many Canadians, regards the prospect of global warming as something desirable, and therefore no cause for concern.

1.6 The Committee’s first task, therefore, is to explain briefly why we are convinced of the basic premises set out in para. 1.1. In doing so, we need to respond both to those who doubt the reality of global warming, and to those who accept that it is taking place, but believe that it should be welcomed by Canadians.

1.7 As regards the reality of global warming, the international scientific community has, during the last two to three years, undertaken an urgent and comprehensive review of the evidence. This inquiry by the Intergovernmental Panel on Climate Change (IPCC), under the auspices of the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), reported its findings at the Second World Climate Conference in 1990. The panel reported that

We are certain of the following:

The greenhouse effect is real....

Man made emissions are substantially increasing the atmospheric concentrations of the greenhouse gases: carbon dioxide, methane, the chlorofluorocarbons, nitrous oxide and tropospheric ozone. These increases will lead to a warming of the Earth's surface...

We calculate with confidence that:

Atmospheric concentrations of the long-lived gases (carbon dioxide, nitrous oxide and the CFCs) adjust only slowly to changes in emissions. Present day emissions of these gases are committing us to increased concentrations for decades to centuries....

The long-lived gases would require reductions in man-made emissions of 60-80% to stabilize their concentrations at today's levels; methane would require only a 15-20% reduction.¹

The main greenhouse gases, and their relative importance in producing global warming (the "greenhouse effect") are described in section B of this chapter.

FIGURE 4: CO₂ TRENDS — LAST 30 YEARS

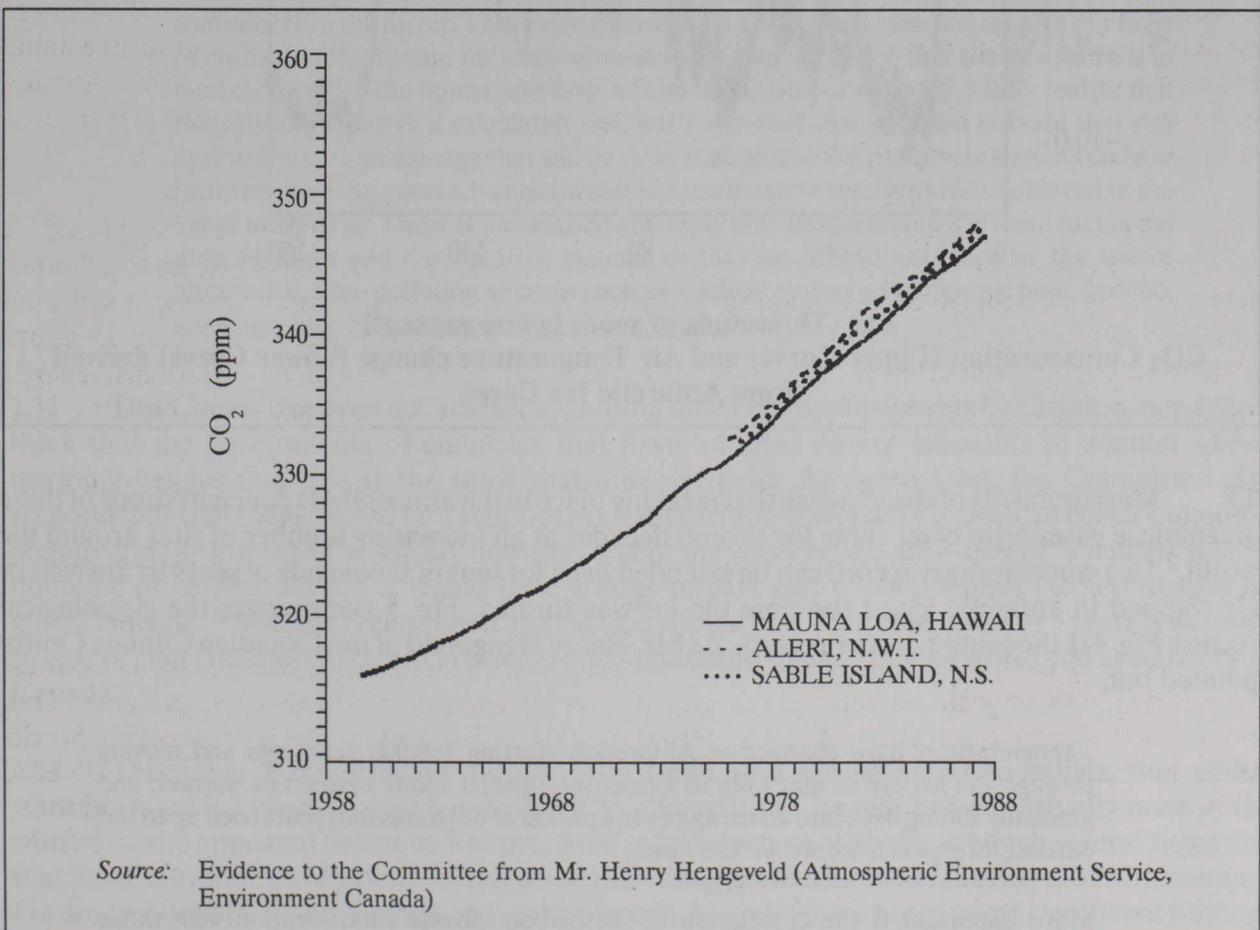
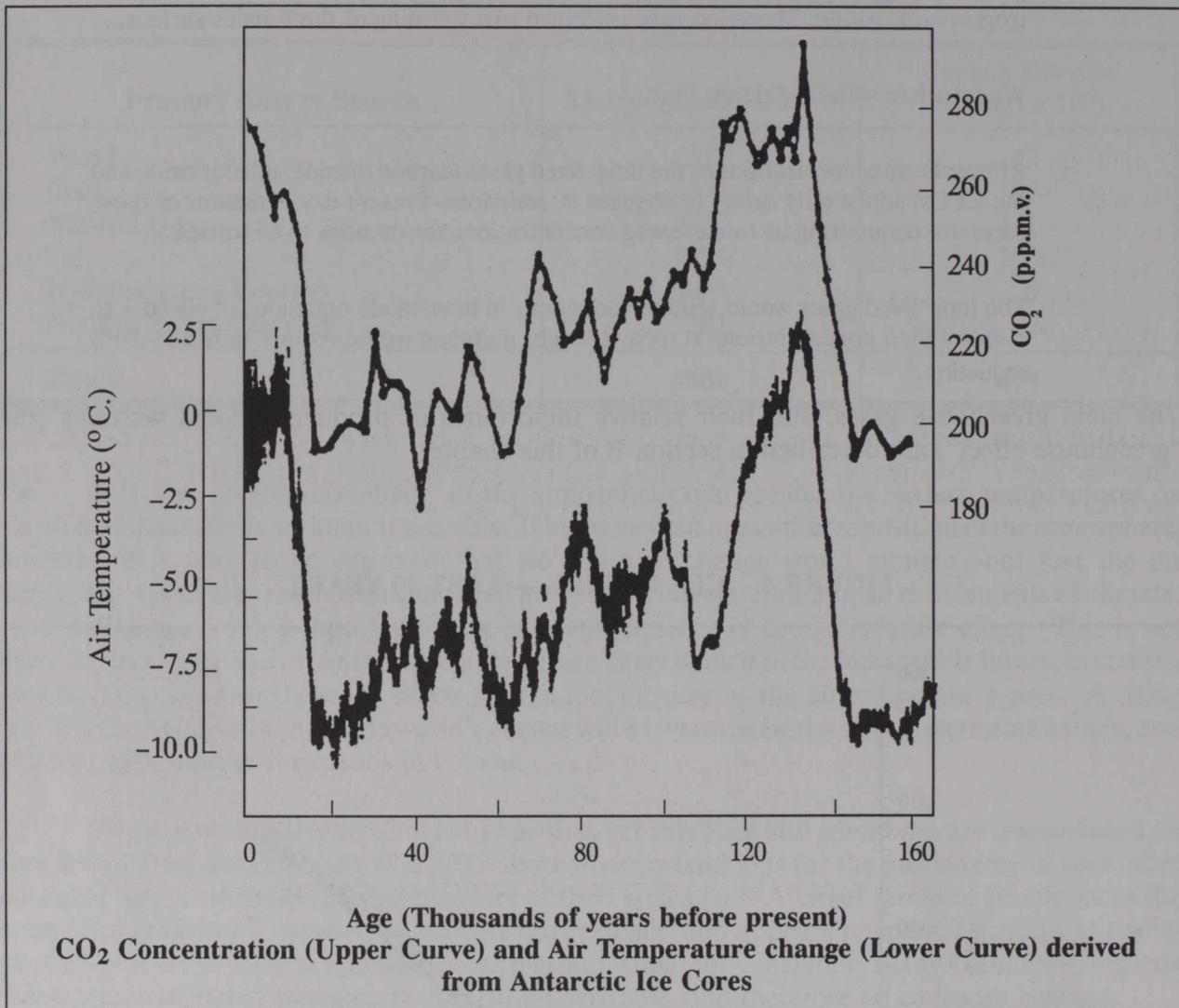


FIGURE 5: HISTORICAL TEMPERATURE AND CO₂ CORRELATION



1.8 Measurements of the increase that is taking place in the atmospheric concentrations of these greenhouse gases have been made for several decades at an increasing number of sites around the world.² This contemporary record can be extended back for tens of thousands of years by analysis of air trapped in antarctic ice at the time the ice was formed. Fig. 5 summarizes the glaciological record; Fig. 4 is the contemporary record. As Mr. Henry Hengeveld of the Canadian Climate Centre pointed out,

...temperatures have changed in Antarctica, starting 160,000 years ago and moving through the ice age at that time to a peak interglacial about 10 degrees warmer, and gradually sliding back into an ice age over a period of 80 [thousand] years back up to the current interglacial where we are now...

More important is the correlation of the carbon dioxide concentration with those changes in temperature. They are almost one on one...

We can see that the concentrations today are about 350 parts per million, which is about 25% higher than the highest values of the last 160,000 years... The trend is equally evident in Hawaii, as it is in Alert in the Northwest Territories or off the coast of Nova Scotia.³

1.9 And yet there are still some who doubt. Among the witnesses that appeared before the Committee were representatives of the George C. Marshall Institute of Washington, D.C. The Marshall Institute's report⁴ has probably been the most influential document of its kind in casting doubt on the reality of the greenhouse effect, because of the scientific credentials of those who prepared it. It is, nevertheless, the view of a very small minority in the scientific world. The Committee accepts the view of the vast majority of atmospheric scientists, expressed in the report of the Intergovernmental Panel on Climate Change: "The greenhouse effect is real".

1.10 In any case, it is clear from the evidence it provided to us, and from its report, that the Marshall Institute is mainly urging expanded research on global warming in a 3-5 year period, and the avoidance of drastic policy changes before that research is undertaken. As Dr. Seitz, a former president of the U.S. National Academy of Sciences, told us,

... I want to make it clear that I do not place those who express a word of warning in the same category as the boy who cried wolf too often, since there may indeed be a wolf somewhere in the forest. There is too much to be gained by continuing on with our form of civilization to deviate radically without more solid evidence that the biosphere is in mortal danger in the immediate future from uncontrolled warming. I fully realize that this attitude involves a calculated risk, but I also feel that we must balance that risk against the certain damage that will be done if we shut down our power stations and our factories, halt the great advances in communication and transportation achieved in the last century or so. These comments do not imply that we should not use fossil fuel in the most efficient and conservative manner or that we should not consider the use of alternative, non-polluting sources such as nuclear energy when appropriate. Indeed, economic factors alone may dictate such shifts.⁵

1.11 This Committee does not advocate shutting down our contemporary civilization, nor does it think that the governments of countries that have adopted strong measures to counter global warming believe that this is the price that must be paid. As noted later, the Committee also recommends that there should be a significant strengthening of climate research, to which Canada is already a major contributor. We do, however, accept the view of most atmospheric scientists that "a doubling of carbon dioxide ... would have a large impact and a likely unprecedented impact on global climate".⁶ We also **recommend** that action should be taken now, not 3 to 5 years from now, to reduce substantially the rate of greenhouse gas emissions throughout the world and specifically in Canada.

1.12 This latter view implicitly differs from those who are prepared to believe that global warming is taking place, but who welcome it as a benefit to Canada. In fact, virtually none of the witnesses who appeared before us was prepared to take such an attitude, although several suggested that the disadvantages of global warming had been exaggerated. However, during the Parliamentary Forum on Global Climate Change that took place in April 1990, we heard some significant findings from surveys of Canadian public opinion:

On the greenhouse effect side, we find from our research that 3 in 10 Canadians actually believe that global warming is going to be positive for Canada. There are going to be warmer winters, we are going to be able to grow more food—these are the reasons they give us in open-ended responses. So in terms of the public, there is a perceptual barrier here to serious efforts on global warming.⁷

1.13 Given the severity of the winter over much of Canada, and similar extremes, such an initial reaction to the term “global warming” may be understandable. It might be argued, for example, that even modest reductions in the length and severity of the snow season could have real benefits to the majority of the population, though not of course to ski resort operators and others who are economically dependent on the Canadian winter.

1.14 The evidence presented to us, however, suggests that global warming is likely to have significant negative effects in Canada, as elsewhere in the world. More important, perhaps, global warming seems certain to affect all aspects of weather and climate, in ways that are at present difficult to forecast for specific areas of the country. It is, for example, misleading to think in terms merely of rises in temperature. All aspects of the Canadian climate will be affected, and the economic and social consequences may be profound. In the southern prairie provinces for example, present indications are that there would be a substantial increase in summer evapotranspiration, with only a slight increase in summer rainfall. Consequently the frequencies of drought and severe drought may increase markedly.⁸ A similar increase in evaporation rates in the Great Lakes Basin could cause marked reductions in lake levels, and therefore severely affect navigation, hydro power generation and other activities.⁹

1.15 A recent scenario of ecoclimatic provinces in Canada in 2050, developed by Environment Canada, suggests that the boreal forest climate region could be virtually eliminated in all of Canada west of James Bay (see para. 4.45).¹⁰ What this would imply for the existing forest, and the forest economy, is difficult to foresee, but the evidence from Forestry Canada was not encouraging:

The total value of exports from forestry almost equals fisheries, mines, minerals, energy and agriculture put together....[A]nything that happens to this forest resource could have far-reaching social, economic, as well as environmental consequences....

I would say generally we would not expect a major increase in productivity of total forest land because of moisture as a limiting factor. There will not be enough water...

Overall, the consensus is that moisture is going to be a limiting factor. So at best we can hope to maintain our present productivity. At worst, it could decline.¹¹

1.16 At present, forecasts of the future climate of specific regions, such as the prairies or the Great Lakes Basin, are speculative rather than reliable. Atmospheric scientists are confident that the world climate (and sea-level) will change substantially as a result of global warming, but the present state of knowledge does not permit similar confidence at the regional or local level. Four general statements can however be made to support our belief that global warming offers few benefits to Canada, and that Canada should be as active as other nations in taking action to reduce or delay such warming.

1. **Practically every facet of Canadian economy, society and environment is intimately adjusted to the present climate.** This relationship to climate is sometimes obvious, more often subtle and complex. Changes in climate are likely to force changes in our way of life that are difficult to foresee, and that may well be unwelcome and expensive.

2. **The scientific evidence clearly indicates that the world is already committed to significant change, as the delayed effect of the substantial increases in greenhouse gases during the last two centuries.** If there are benefits to be obtained from global warming, they are probably already on the way. So also are the disadvantages and problems caused by greenhouse gas emissions of the past.
3. **Canada, like the rest of the world, is not faced with a change from our present climate to another that is also relatively stable. So long as greenhouse gases continue to increase in the atmosphere, global warming will continue progressively, and so will climate change and rising sea-level.** As the Minister of Energy, Mines and Resources told us,

Based on every information I have received in the department from the scientists and others who are working on global warming within the department, I am convinced that we have to reduce emissions, that they have negative effects on climate...¹²

4. **Even if global warming could be shown to benefit Canada, which is far from being the case, there is growing evidence of its potentially severe and even disastrous implications in other parts of the world, and especially in developing countries.** Canada cannot adopt a *laissez-faire* attitude to what is happening. Many millions of people live on the margin of survival not merely in terms of nutrition and similar measures; small changes of climate or of sea-level would make their physical environment uninhabitable.

B. WE MUST CONSIDER ALL GREENHOUSE GASES, NOT JUST CARBON DIOXIDE

1.17 Global warming is caused by a number of radiatively active “greenhouse” gases, i.e. gases that can absorb and radiate heat energy in proportion to their concentrations in the atmosphere. Four of these are dominant both in terms of their overall role in global warming and in terms of human influence on their concentration in the atmosphere. These gases are carbon dioxide (CO₂), methane (CH₄), halocarbons, and nitrous oxide (N₂O). The Intergovernmental Panel on Climate Change summarized the characteristics of these gases that are important for global warming:

Carbon Dioxide: The atmospheric CO₂ concentration, at 353 ppmv* in 1990, is now about 25% greater than the pre-industrial (1750–1800) value of about 280 ppmv, and higher than at any time in at least the last 160,000 years. Carbon dioxide is currently rising at about 1.8 ppmv (0.5%) per year due to anthropogenic emissions.... The time taken for atmospheric CO₂ to adjust to changes in sources or sinks is of order 50–200 years... Consequently, CO₂ emitted into the atmosphere today will influence the atmospheric concentration of CO₂ for centuries into the future.... [E]ven if anthropogenic emissions of CO₂ could be kept constant at present day rates, atmospheric CO₂ would increase to 415–480 ppmv by the year 2050, and to 460–560 ppmv by the year 2100. In order to stabilize concentrations at present day levels, an immediate reduction in global anthropogenic emissions by 60–80 percent would be necessary.

* parts per million by volume

Methane: Current atmospheric CH₄ concentration, at 1.72 ppmv, is now more than double the pre-industrial (1750–1800) value of about 0.8 ppmv, and is increasing at a rate of about 0.015 ppmv (0.9%) per year...[It has] a relatively short atmospheric lifetime of about 10 years. Human activities such as rice cultivation, domestic ruminant rearing, biomass burning, coal mining and natural gas venting have increased the input of CH₄ into the atmosphere... However, the quantitative importance of each of the factors contributing to the observed increase is not well known at present. In order to stabilize concentrations at present day levels, an immediate reduction in global anthropogenic emissions by 15–20 per cent would be necessary.

Chlorofluorocarbons: The current atmospheric concentrations of the anthropogenically produced halocarbons CCl₃F (CFC-11), CCl₂F₂ (CFC-12), C₂Cl₃F₃ (CFC-113) and CCl₄ (carbon tetrachloride) are about 280 pptv*, 484 pptv, 60 pptv, and 146 pptv, respectively. Over the past few decades their concentrations, except for CCl₄, have increased more rapidly (on a percentage basis) than the other greenhouse gases, currently at rates of at least 4% per year.... Future emissions will, most likely, be eliminated or significantly lower than today's because of current international negotiations to strengthen regulations on chlorofluorocarbons. However, the atmospheric concentrations of CFCs 11, 12 and 113 will still be significant (30–40% of current) for at least the next century because of their long atmospheric lifetimes.

Nitrous oxide: The current atmospheric N₂O concentration, at 310 ppbv**, is now about 8% greater than in the pre-industrial era, and is increasing at a rate of about 0.8 ppbv (0.25%) per year.... [It has] a relatively long atmospheric lifetime of about 150 years... Recent data suggest that the total annual flux of N₂O from combustion and biomass burning is much less than previously believed. Agricultural practices may stimulate emissions of N₂O from soils and play a major role. In order to stabilize concentrations at present day levels, an immediate reduction of 70–80% of the additional flux of N₂O that has occurred since the pre-industrial era would be necessary.¹³

1.18 The greenhouse effect produced by different gases depends not just on the amount of the gas in the atmosphere at present, expected future emissions, and the lifetime of individual molecules of the gas. It is also dependent to a very large extent on how effective the gas is in absorbing radiation. For example, methane is about sixty times more effective as a greenhouse gas than an equivalent amount of carbon dioxide; the chlorofluorocarbon CFC-12 is almost six thousand times as effective as carbon dioxide in such "radiative forcing" (Table B).

* parts per trillion by volume

** parts per billion by volume

TABLE B: SUMMARY OF GREENHOUSE GAS CHARACTERISTICS

Parameter	CO ₂ (carbon dioxide)	CH ₄ (methane)	CFC-11	CFC-12	N ₂ O (nitrous oxide)
Pre-industrial concentration (1750-1880)	280 ppmv	0.8 ppmv	0	0	288 ppbv
Current atmospheric concentration (1990)	353 ppmv	1.72 ppmv	280 pptv	484 pptv	310 ppbv
Current annual rate of accumulation	1.8 ppmv	0.015 ppmv	9.5 pptv	17 pptv	0.8 ppbv
Atmospheric life (years)	50-200	10	65	130	150
Carbon equivalent (CO ₂ = 1)	1	5.8	3970	5750	206

Abbreviations: ppbmv, ppbv, pptv – parts per million/billion/trillion by volume.

The “Carbon equivalent” row indicates that one metric ton of methane provides the same radiative forcing as about 60 metric tons of carbon dioxide; and one metric ton of CFCs provides the same forcing as several thousand metric tons of carbon dioxide.

Sources: Intergovernmental Panel on Climate Change, Working Group 1, *Report*, Table 1; World Resources Institute, *World Resources 1990-91*, p. 355.

Taking the properties and concentrations of the different gases into account, the relative contributions to global warming from increases in these major gases during the past decade are estimated to have been:

Carbon dioxide: 56%

Methane: 11%

Nitrous oxide: 6%

Chlorofluorocarbons: 24%.

1.19 Because of the significance of greenhouse gases other than carbon dioxide, and the need to have a method of comparing the global warming effects of the different gases, it is becoming customary to express the effect of the other gases in terms of carbon dioxide “heating equivalents”, or “carbon equivalents”. This follows the recommendation of the 1989 Noordwijk Declaration on Atmospheric Pollution and Climatic Change that

appropriate fora, including the IPCC, consider the necessity and efficiency of the introduction of the concept of CO₂-equivalence. This would provide a single parameter to describe the radiative effects of the various greenhouse gases, including CFCs.

1.20 Such a unit has, however, not yet become the normal parameter either at the international level or in Canada. The actual values to be used in determining the carbon-equivalents of other greenhouse gases remain inherently uncertain; those used in the preceding paragraphs are only

approximations. It will, for example, be necessary to have more precision if such "carbon equivalent units" are to be used in international negotiations and embodied in international (and national) agreements.

1.21 Nevertheless, it is evident to the Committee that considerable confusion exists in regard to what are often termed "carbon dioxide reductions". This phrase is used by many people with literal precision; to others, however, it implies "action to reduce global warming", including reductions in other greenhouse gases. The Committee believes that it would be desirable for Canada to adopt an approach based on carbon equivalents as soon as scientific definition of the conversion factors permits.

1.22 In the short term, and within national contexts, it may be wise to focus on each of the greenhouse gases separately, seeking substantial reductions in each of them. This is particularly so in regard to CFCs: the recent international agreement* to accelerate their phase-out was driven more by their serious effect on the stratospheric ozone layer than by their effect on global warming. Yet, for countries like Canada, it should be possible to achieve substantial overall reductions in contributions to global warming simply by phasing out CFCs. This will not, however, be sufficient, and it is necessary to look for all possible opportunities to limit emissions. (See also para. 1.34) The Committee also notes that there is need for careful assessment of the greenhouse gas characteristics of the substances that are anticipated as CFC-replacements.

1.23 By 2025, assuming broad compliance with the Montreal Protocol on chlorofluorocarbons, cumulative contributions to global warming were estimated by the IPCC to be:

Carbon dioxide: 63%

Methane: 15%

Nitrous oxide: 4%

Chlorofluorocarbons: 11%.

At that date, on this estimate, the carbon dioxide equivalent of the main atmospheric greenhouse gases would be twice the pre-industrial value (a situation usually abbreviated as "2 x CO₂").

However, as a result of the strengthening of the Montreal Protocol achieved in London in 1990, the relative role of chlorofluorocarbons can be expected to decline further. The other gases will therefore increase in relative significance, and the date when "2 x CO₂" is reached should be delayed.

1.24 It is clear from these estimates that the international agreements reached in recent years to control and then to eliminate production of CFCs are vital in reducing the impact of global warming, as well as in the protection of the stratospheric ozone layer. It is therefore essential that these agreements are implemented effectively. However, the major problems caused by carbon dioxide and the other principal greenhouse gases remain to be tackled in Canada and most other countries.

* The international Convention for the Protection of the Ozone Layer was adopted in Vienna in 1985. Subsequently a protocol to this convention, the Protocol on Substances that Deplete the Ozone Layer, was adopted in Montreal in 1987. In 1990 international agreement was reached in London to strengthen the provisions of the Montreal Protocol.

C. CANADIAN GREENHOUSE GAS EMISSIONS IN A WORLD CONTEXT

1.25 The World Resources Institute (WRI), an independent research body in Washington, D.C., published in 1990 its "Greenhouse Index": a list of the fifty countries with the highest greenhouse gas net emissions, based on the best data available for the year 1987. Three countries—the U.S.A., U.S.S.R. and Brazil—each contributed more than 10% of the world total; together they accounted for 40% of net emissions. Canada ranked 12th on the list, contributing an estimated 2.0% of the world total (Table C).

TABLE C: THE GREENHOUSE INDEX: 15 COUNTRIES WITH THE HIGHEST GREENHOUSE GAS NET EMISSIONS 1987
(CO₂ heating equivalents, thousands of metric tons of carbon)

Country	Rank	Carbon Dioxide	Methane	CFCs	Total	%
United States	1	540,000	130,000	350,000	1,000,000	17.6
U.S.S.R.	2	450,000	60,000	180,000	690,000	12.0
Brazil	3	560,000	28,000	16,000	610,000	10.5
China	4	260,000	90,000	32,000	380,000	6.6
India	5	130,000	98,000	700	230,000	3.9
Japan	6	110,000	12,000	100,000	220,000	3.9
West Germany	7	79,000	8,000	75,000	160,000	2.8
United Kingdom	8	69,000	14,000	71,000	150,000	2.7
Indonesia	9	110,000	19,000	9,500	140,000	2.4
France	10	41,000	13,000	69,000	120,000	2.1
Italy	11	45,000	5,800	71,000	120,000	2.1
Canada	12	48,000	33,000	36,000	120,000	2.0
Mexico	13	49,000	20,000	9,100	78,000	1.4
Mynamar	14	68,000	9,000	0	77,000	1.3
Poland	15	56,000	7,400	13,000	76,000	1.3

Source: World Resources Institute, *World Resources 1990-91*, Table 2.2.

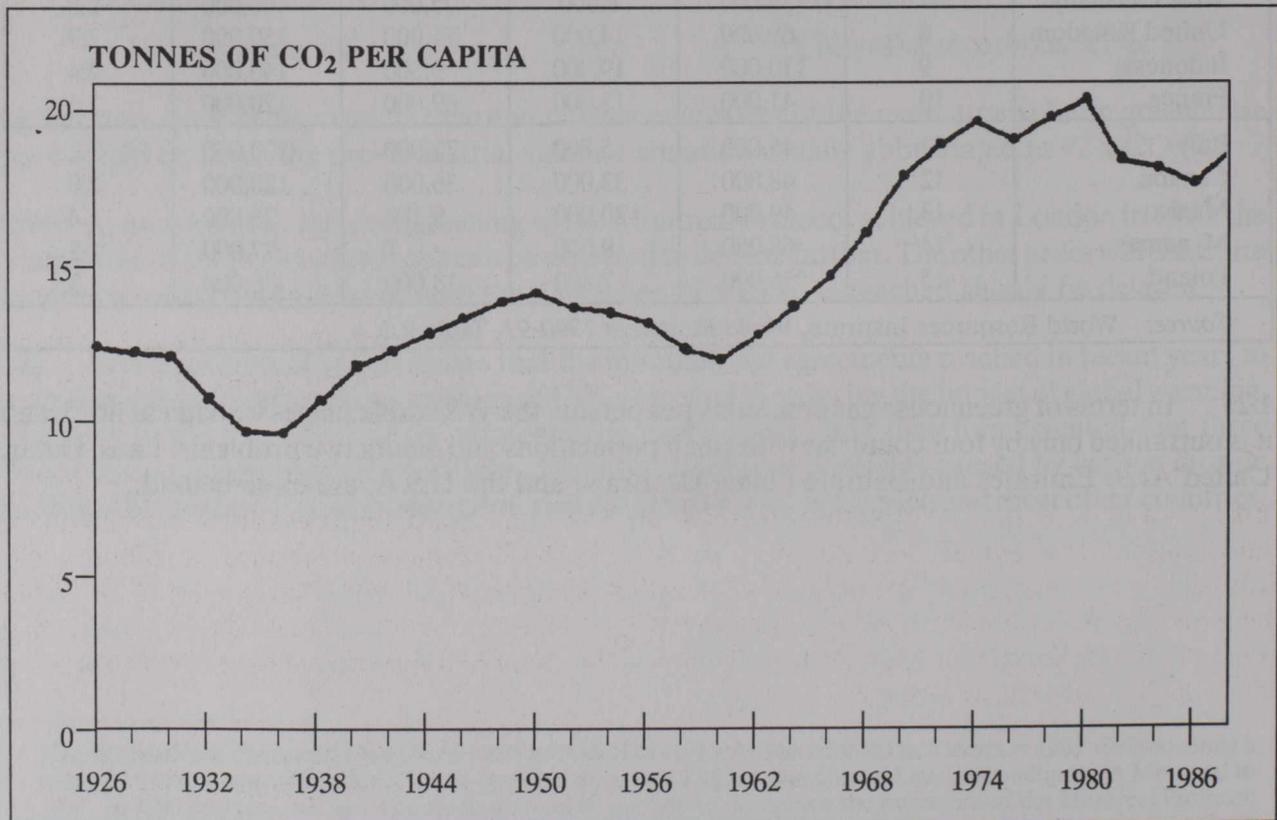
1.26 In terms of greenhouse gas emissions per person, the WRI table places Canada at no. 5, and it is outranked only by four countries with small populations and distinctive problems: Laos, Qatar, United Arab Emirates and Bahrain (Table D). Brazil and the U.S.A. are close behind.

TABLE D: PER CAPITA GREENHOUSE INDEX: 10 COUNTRIES WITH THE HIGHEST PER CAPITA GREENHOUSE GAS NET EMISSIONS 1987
 (CO₂ heating equivalents, thousands of metric tons of carbon)

Country	Rank	Metric Tons per Capita
Laos	1	10.0
Qatar	2	8.8
United Arab Emirates	3	5.8
Bahrain	4	4.9
Canada	5	4.5
Luxembourg	6	4.3
Brazil	7	4.3
Ivory Coast	8	4.2
United States	9	4.2
Kuwait	10	4.1

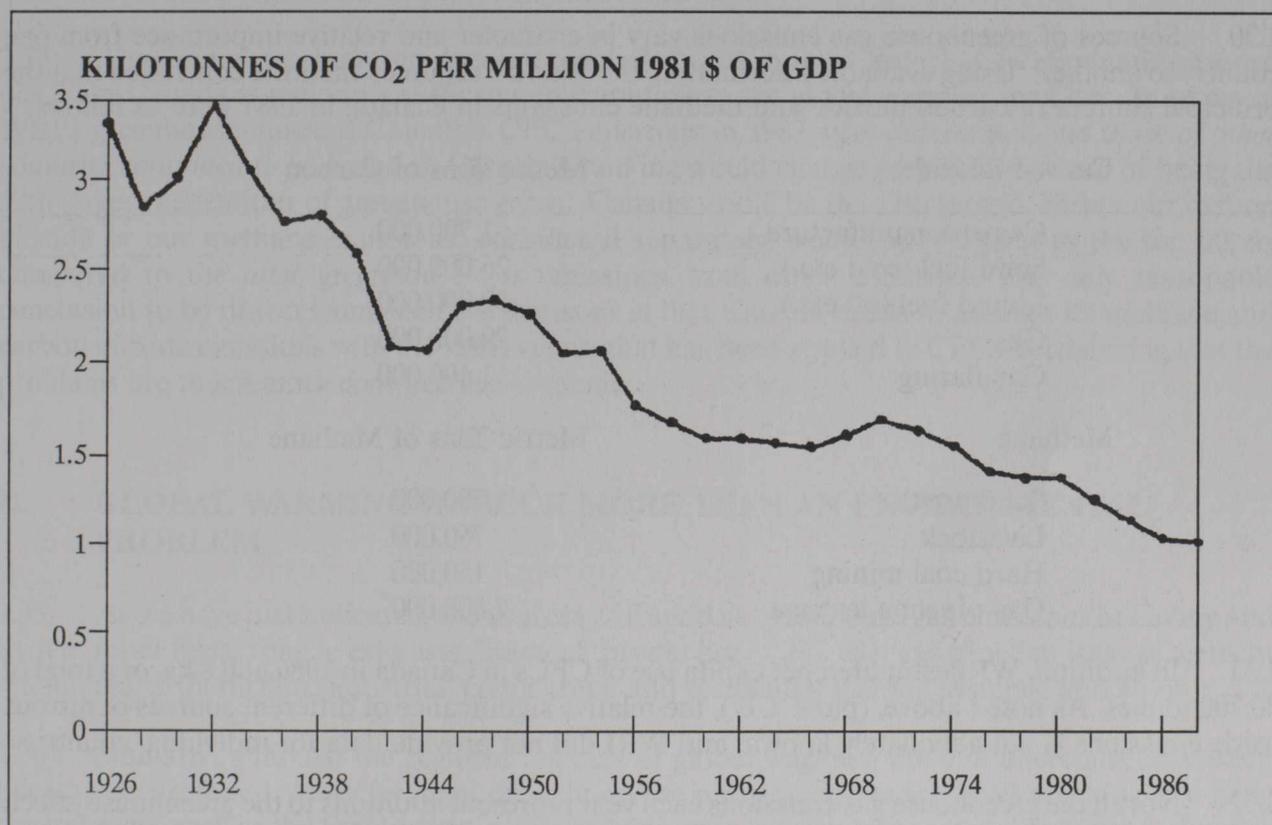
Source: World Resources Institute, *World Resources 1990-91*, Table 2.3.

FIGURE 6: PER CAPITA CARBON DIOXIDE EMISSIONS IN CANADA, 1926-1988



1.27 Only in terms of carbon emissions per unit of gross domestic product (Fig. 7) does Canada appear relatively efficient on the world scale, and then only because of the major inefficiencies encountered in most developing countries and a substantial number of economies that were centrally-planned in 1987 (e.g. China, Poland). When compared with “like” countries such as Japan, the Netherlands or even the U.S.A., Canada appears relatively inefficient in its use of energy.

FIGURE 7: CARBON DIOXIDE INTENSITY OF GROSS DOMESTIC PRODUCT IN CANADA, 1926-1988



1.28 In the evidence put before the Committee, Canada’s “2%” contribution was quoted several times. Sometimes it was used to urge the point that global warming is a global problem, and action by Canada alone can have little effect. The Committee agrees. Sometimes, however, the 2% figure seems to have been advanced to support the view that the proportion is trivial and that action by Canada is unnecessary. There are at least two answers to this. One is exemplified by the comment made by a representative of the Government of the Netherlands, who had described to us the strong and comprehensive measures adopted by the Dutch Parliament to reduce greenhouse gas emissions. In the same WRI table, the Netherlands ranks 24th, contributing only 0.7% of net emissions in 1987. When it was suggested to him that therefore “you would not have a great deal of sympathy for the argument that because Canada only produces 2% we do not have to worry about it that much”, the witness replied

This is simply a matter of where all the individual small contributions add up. There is simply no way one country or a small group of countries can solve this problem. We are all into it, and we all have to make our own contribution.¹⁴

1.29 The second argument is that if Canada used energy more efficiently than it does at present, this would be an economic benefit as well as a contribution to the reduction of greenhouse gas emissions. As a Task Force of the Federal-Provincial-Territorial Conference of Energy Ministers observed in 1989,

[T]here are substantial opportunities to reduce emissions of carbon dioxide in Canada. The potential reductions from improving efficiency of fossil fuel and electricity use are significant and many of these measures would be economically attractive for society solely on the basis of the energy savings to be realized.¹⁵

1.30 Sources of greenhouse gas emissions vary in character and relative importance from one country to another. Using available information, the World Resources Institute concluded that the principal sources of carbon dioxide and methane emissions in Canada in 1987 were as follows:

Carbon Dioxide	Metric Tons of Carbon
Cement manufacture	1,700,000
Solid fuel (coal etc.)	26,000,000
Liquid fuel (oil etc.)	52,000,000
Gas	29,000,000
Gas flaring	1,400,000
Methane	Metric Tons of Methane
Solid waste	1,700,000
Livestock	760,000
Hard coal mining	150,000
Gas pipeline leakage	7,800,000*

1.31 In addition, WRI estimated per capita use of CFCs in Canada in 1986 at 0.8 kg, or a total of 20,700 tonnes. As noted above, (para. 1.17), the relative significance of different sources of nitrous oxide emissions is not adequately known, and WRI did not provide data for individual countries.

1.32 Not all the greenhouse gas emissions each year represent additions to the greenhouse effect. For example, a substantial amount of carbon dioxide is absorbed by plants. WRI therefore estimated the *net* additions to the greenhouse effect, and then converted methane and CFCs to "carbon equivalents". For Canada the situation in 1987 was as follows:

Net Total Atmospheric Increase in Greenhouse Gases:

120,000,000 tons of carbon equivalent (2% of the world total of 5,900,000,000 tons), of which

Fossil fuels and cement manufacture:	48,000,000 tonnes (40%)
Methane emissions:	33,000,000 tonnes (25%)
CFC use:	36,000,000 tonnes (30%)

The remaining 5% is attributable to nitrous oxide, atmospheric ozone, and other greenhouse gases.¹⁶

* This figure is not consistent with estimates by the Canadian Gas Association; see paras. 4.9-4.16

1.33 We suggest that two important observations can be made on the basis of these data:

- (a) In Canada CFCs and (if the WRI's data are accurate) methane have been major sources of global warming, responsible for over half the net additions to the atmosphere from this country.
- (b) The vigorous action that is being taken, in Canada and internationally, to eliminate the use of CFCs is as important a contribution by Canada to solving the problem of global warming as it is to protecting the ozone layer.

1.34 The Committee, however, does *not* conclude from the above data that, by eliminating the use of CFCs, Canada is making a sufficient contribution to the global warming problem. In terms of WRI's greenhouse index, if Canada's CFC emissions in 1987 were eliminated, *and those of other countries continued to be included*, Canada's ranking would change very little. Instead of being the 12th largest net emitter of greenhouse gases, Canada would be the 13th largest. Either our carbon dioxide or our methane emissions, considered separately, would put Canada in the top 30, as compared to the *total* greenhouse gas emissions from other countries. The only reasonable conclusion to be drawn from such comparisons is that Canada needs to address its methane and carbon dioxide emissions with the same vigour that has been applied to CFCs, recognizing that the problems are much more complex and difficult.

D. GLOBAL WARMING IS MUCH MORE THAN AN ENVIRONMENTAL PROBLEM

1.35 As we have just indicated, the sources of Canada's greenhouse gas emissions are many and varied: fossil fuels, vehicle exhausts, livestock production, CFC use, gas pipeline leakage, cement manufacture, inefficient industrial, commercial and residential heating systems, and so on.

1.36 Similarly, although the regional impacts of global warming are still uncertain, they seem likely to be profound. More frequent drought on the prairies, rise in sea-level affecting low-lying coastal zones such as the Fraser delta, major reductions in sea-ice, severe stress on forest resources: these are just a few of the impacts on Canada that can be anticipated if available scenarios for "2 x CO₂" prove to be accurate.

1.37 It follows that policies and actions to counter the threat of global warming must be developed in a context that is as broad as the sources of emissions and the nature of the expected impacts. The Committee is concerned with the environment, but global warming is an issue that extends far beyond the usual definition of environment. This has already been recognized by Parliament in an imaginative and very rewarding way. Last April, Global Climate Change was the subject of a unique Parliamentary Forum in which eight Standing Committees participated: Agriculture; Energy, Mines and Resources; Environment; Forestry and Fisheries; Health and Welfare, Social Affairs, Seniors and the Status of Women; Industry, Science and Technology, Regional and Northern Development; Labour, Employment and Immigration; and Transport.¹⁷ This Committee welcomes the interest and concern in global warming shown by the other Standing Committees, and anticipates that their contributions to finding solutions will be maintained for a long time to come.

1.38 Our report on global warming therefore necessarily involves policy options and recommended actions in many diverse fields. It also involves consideration of Canadian life-styles, and our relationship with and policies towards other countries. Though the Committee cannot claim expertise in so many diverse areas, we did have the benefit of expert testimony from a wide range of witnesses with appropriate knowledge and experience.

1.39 There is little merit in solving one problem by creating others. The Committee has therefore endeavoured to be responsible in making recommendations that clearly have wider implications beyond the problem of global warming. At the same time, however, we need to insist that the character and importance of global warming will demand significant changes in the present situation. If we do not alter our "life as usual" to reduce the threat of global warming, changes of climate and rises in sea-level will force unpleasant consequences on us. In many cases, it seems that the action that is required involves better management and wiser use of our resources. "Life as usual" has been much less efficient, more wasteful and more expensive than it need have been to achieve our objectives and, incidentally, protect our environment.

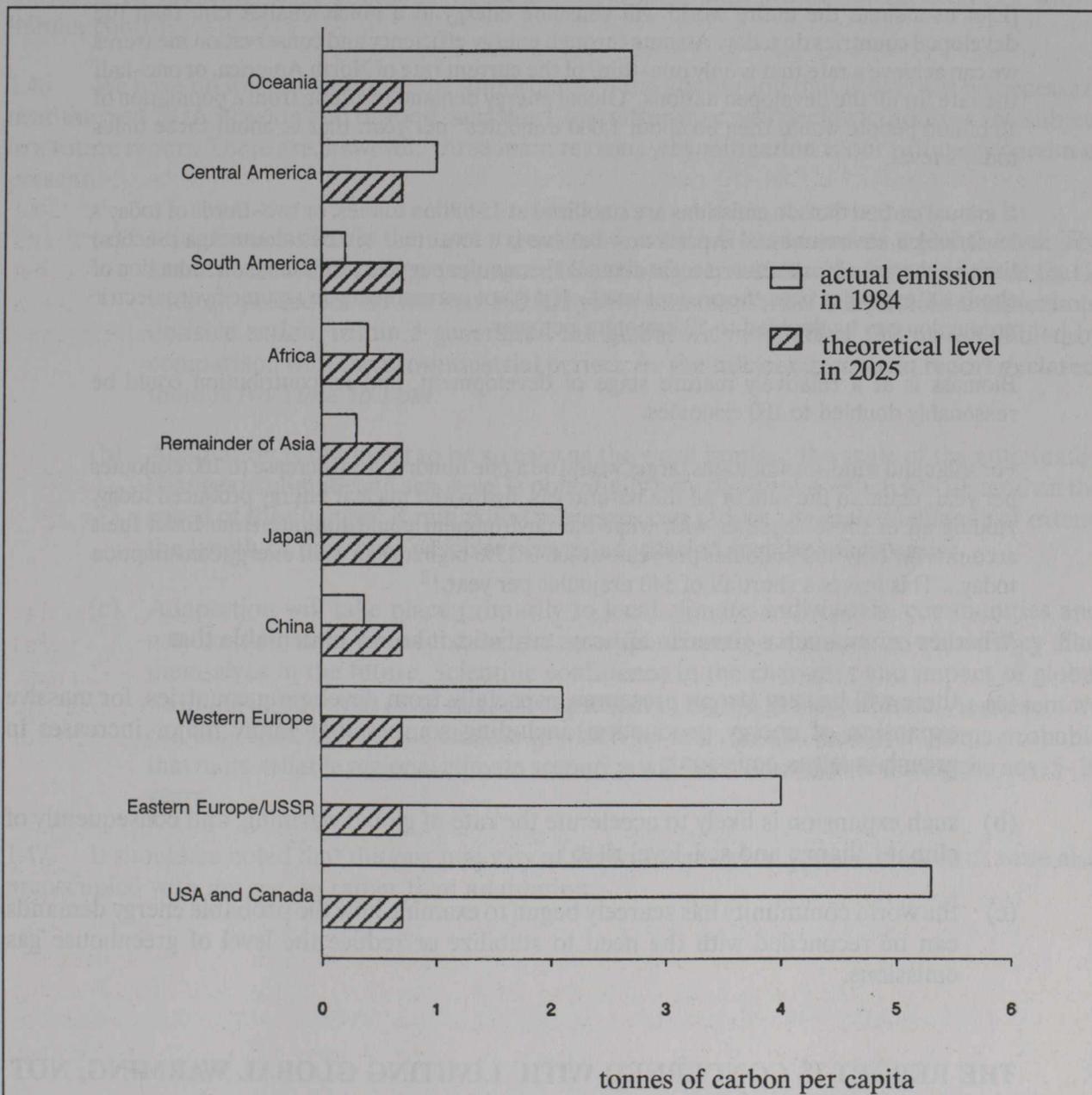
E. TACKLING THE GROWING PROBLEM OF GLOBAL WARMING REQUIRES A RECOGNITION OF FUTURE ENERGY AND DEVELOPMENT NEEDS, IN CANADA AND IN THE WORLD AS A WHOLE

1.40 Efforts to limit global warming inevitably focus on sources of greenhouse gas emissions that are linked to the activities of an expanding world population, especially in developing countries that are striving to reduce the economic disparities that separate them from countries such as Canada. Whether these efforts are expressed in increased methane emissions from feed-lots and rice paddies, or carbon dioxide emissions from the burning of larger amounts of fossil fuels, the task of reconciling emission limitations with future development needs is a daunting one.

1.41 It is clear, for example, that developing countries see increasing energy use as crucial to their development plans, as it has been and will be in the development of Canada. The problem is a global one, in that increased emissions anywhere in the world soon affect the global atmosphere and climate. The dilemma was vividly expressed to us, often in contrasting ways, by several witnesses. For example, in developing its own action strategy on global warming, the Dutch government considered the implications of limiting global carbon emissions at the 1984 level, and then allocating this level of emissions equitably among the world population as it might be in 2025. This amounts to 0.6 tonnes per capita, compared to the current emission level in North America of over 5 tonnes (Fig. 8).

1.42 Even if such reductions appear at present to be unrealistic, there can be little doubt that the world, and developing countries in particular, will seek to expand its use of energy to fuel the engine of development. The scale of the problem was sketched for us by a witness from Atomic Energy of Canada, Mr. W.T. Hancox. The following scenario can be challenged on many grounds, such as the anticipated future world population or the potential ability of different forms of energy to meet anticipated needs. Any scenario of this kind is nevertheless useful in indicating the scale of the long-term problem involved in limiting global greenhouse gas emissions, while encouraging global development.

FIGURE 8: EQUAL PER CAPITA CO₂ IN 2025



Theoretical distribution of the total carbon emission of 5.2 GtC (level 1984) to equal emissions per head of world population in 2025.

GtC: gigatonnes of carbon (1 gigatonne = 1x10⁹ tonnes)

Source: Evidence to the Committee from Dr. Bert Metz (Royal Netherlands Embassy)

To understand the size and nature of the challenge, I want to look briefly at a world population of 10 billion...

[L]et us assume the entire world will consume energy at a much smaller rate than the developed countries do today. Assume through energy efficiency and conservation measures we can achieve a rate that is only one-third of the current rate of North America, or one-half the rate for all the developed nations. Global energy demand resulting from a population of 10 billion people would then be about 1,000 exajoules* per year; that is, about three times today's level.

If annual carbon dioxide emissions are stabilized at 15 billion tonnes, or two-thirds of today's level, which environmental experts now believe is a level that can be tolerated, a practical limit on the use of fossil fuels is set at about 200 exajoules per year. This means a reduction of about 100 exajoules from the present level... [I]t is not unreasonable to assume hydroelectric production can be doubled to 50 exajoules per year...

Biomass is at a relatively mature stage of development, and its contribution could be reasonably doubled to 100 exajoules.

For solar and wind, an ambitious target would be a one hundredfold increase to 100 exajoules per year, equal to the sum of all the natural gas, hydro and nuclear energy produced today. Adding all of these together with what the environment could tolerate from fossil fuels accounts for only 460 exajoules per year, which is 35% higher than total energy consumption today... This leaves a shortfall of 540 exajoules per year.¹⁸

1.43 Whether or not such a scenario appears realistic, it seems undeniable that

- (a) there will be very strong pressures, especially from developing countries, for massive expansion of energy production, including sources that imply major increases in greenhouse gas emissions;
- (b) such expansion is likely to accelerate the rate of global warming, and consequently of climate change and sea-level rise;
- (c) the world community has scarcely begun to examine how the probable energy demands can be reconciled with the need to stabilize or reduce the level of greenhouse gas emissions.

F. THE REPORT IS CONCERNED WITH LIMITING GLOBAL WARMING, NOT WITH ADAPTING TO IT

1.44 We have observed already that the Earth is probably committed to a substantial amount of climate change and sea-level rise, as a consequence of the increase in atmospheric greenhouse gases that has already occurred. Since, in the foreseeable future, there seems no way of reversing such changes, it will therefore be necessary for Canadians and other inhabitants of the planet to adapt to these changes.

* 1 exajoule = 10^{18} joules

1.45 In this report, however, we are concerned overwhelmingly with *mitigation*, not with *adaptation*. Mitigation is the term used to cover measures that seek to avoid, reduce or delay global warming, by reducing those emissions of atmospheric gases that are of human origin or within human control.

1.46 We have no wish to minimize the importance of the adaptation that is likely to be necessary over the next 20 to 30 years and beyond, and this Committee may well decide to address the subject in a future report. There are, however, three main reasons why mitigation is our primary concern at present.

- (a) Mitigation is clearly the most urgent need, within Canada and at a global level. The atmospheric content of greenhouse gases already represents a carbon equivalent that is without precedent for the last 160,000 years or more, and it seems clear that, without decisive action, within a generation the global warming effect will have doubled by comparison with the pre-industrial period. As the title of our interim report declared, there is *No Time To Lose*.
- (b) Adaptation is not likely to be so easy as the word implies; the scale of the anticipated changes in climate and sea-level is potentially very disruptive. Much will depend on the speed of the changes; if mitigation measures can reduce the scale of change or extend the length of time over which it occurs, adaptation may be much easier.
- (c) Adaptation will take place primarily to local climate: individuals, communities and nations will need to adjust to the specific climatic situation in which they find themselves in the future. Scientific confidence in the character and impact of global warming is, however, at its weakest at present in regard to local climate. At present we can only speculate on the climate to which we must adapt, though it seems probable that more reliable regional climate scenarios will become available during the next 5-10 years.

1.47 It should be noted that the vast majority of the witnesses who appeared before us were also preoccupied with mitigation rather than adaptation.

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16. The preceding data are taken from Tables 24.1 and 24.2 in World Resources Institute, *World Resources 1990-91*, New York, Oxford University Press, 1990. (This source is hereafter cited as *World Resources 1990-91*.) The notes to these tables indicate the sources used, the methods used to estimate net atmospheric additions and carbon equivalents, and the reliability of the data.
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CHAPTER 2

POLICY CONSIDERATIONS

A. THE NEED FOR LEADERSHIP BY THE FEDERAL GOVERNMENT

2.1 In Toronto in June 1988, an international conference on "The Changing Atmosphere: Implications for Global Security" concluded that

Humanity is conducting an unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war.¹

To avoid such consequences, national and international, will be difficult and time-consuming, but that is no reason for further delay. The longest journey begins with a single step.

2.2 On several occasions during our hearings, it was emphasized to us in very plain terms that Canadians look to the federal government for leadership on environmental matters, and especially on global issues such as protection of the ozone layer and global warming. In the Parliamentary Forum on Global Climate Change last April, the Committee was shown the results of recent public opinion polls; as we heard from Mr Miller (Synergistics Consulting Ltd.), these expectations were in marked contrast to the constitutional allocation of jurisdiction on environmental matters:

... 3 in 10 Canadians assign primary responsibility to the federal government for environmental protection. Immediately following that, however, they assign primary responsibility for environmental protection to individual Canadians...

Increasingly, Canadians are recognizing that they have a share of this responsibility. However, they are looking to the federal government for some leadership on this issue.... [W]ay down at the end of the chart are provincial governments, where only 5% of Canadians assign primary responsibility for the environment to provincial governments...

This is not saying that Canadians are looking to the federal government to do it. It is clear from quite a lot of different questions that Canadians are looking to the federal government for leadership of a collective action that involves everyone, including individual Canadians, provinces, and industry.²

2.3 A similar report came from a body that is extremely well aware of the allocation of powers, but which also sees the need for national leadership: the Federation of Canadian Municipalities. From a nationwide sampling of municipal officials on the subject of global warming, the Federation found that

There are two overall concerns, one of which is that the available information is not very good... Whether it is because Environment Canada does not have the money, they do not feel certain enough about what is going on so they do not want to publicize it, or whatever, there is just a general lack of solid information and solid prediction....

The other point that comes across from a survey of municipalities across Canada... And I do not want to get into any kind of political argument. No particular government was singled out and they were often as unflattering about provincial governments [as about] the federal government. There was a feeling that there is just an incredible lack of leadership from the top on environmental matters. Again, that may be a matter of public relations. It may be a matter of information ... The general feeling is that people in government are just not responding with the speed, diligence and determination that at least a lot of the evidence suggests would be appropriate. The problem is that lack of application, that lack of determination, is infectious. If the federal government does not seem to care whether automobile use and airplane use is increasing like crazy, why should we care? That is the feeling.³

2.4 We endorse the need for greater evidence of leadership, and we also hope that this should not get obscured by political disagreement. The 1988 conference in Toronto recommended that, as an initial global goal, carbon dioxide emissions should be reduced by approximately 20% of their 1988 levels by the year 2005. Effective action to achieve such reductions needs to be global in scope, and international negotiations to develop an effective convention and CO₂ protocol are just beginning. Meanwhile, CO₂ emissions, in Canada and many other countries, are *increasing*, not decreasing.

2.5 Other evidence from public opinion surveys reported to the Parliamentary Forum reinforces our belief that stronger and more visible national leadership on the global warming issue will be generally welcomed:

[We asked] a related question, to show you that Canada is on the leading edge of concern and willingness to pay. Only 15% of Canadians are unwilling to pay more for environmental protection, and 42% identify a surtax or personal income tax as their preferred mechanism.

That is one indicator. We also find that Canadians are increasingly expecting major change in their own lifestyles. We asked them:

To what extent do you think the way that we as individual Canadians live will have to change in order to take a more environmentally sustainable track?

... 51% of Canadians expect major change in the way they live, in their lifestyle; 4 in 10 identify that moderate change is coming. These are significant findings.⁴

B. THE NEED FOR BETTER INFORMATION

2.6 In our interim report, this Committee urged that

If Canadians are going to accept far-reaching changes in the patterns of energy use that policies to combat global climate change will require over time, they must be well informed about the need for these changes and the benefits that can accrue from such policies. Communicating information to the public is a vital element of federal policy-making.⁵

2.7 It seems evident to us that good information is not being widely disseminated in Canada. Thanks to the media—and some unusual weather situations in recent years—we suspect that practically every Canadian has heard of the greenhouse effect and global warming. Yet there seems

to be a great gap between this superficial awareness and an adequate understanding of the causes and implications of global warming. For example, we were faced at the outset of this report by the surprising situation that 3 Canadians in 10 believe at present that global warming will be beneficial (para. 1.12).

2.8 How widely is it known that Canada contributes more greenhouse gases to the atmosphere *per capita* than any other major country? How many are aware of the major contributions to global warming from methane and CFCs in Canada? How many Canadians are aware of the natural and anthropogenic sources of methane: landfills, ruminant animals, gas pipelines, muskeg, etc.? How many appreciate that global warming involves changes in climate that go far beyond simple rises in temperature?

2.9 We do not wish to appear to be suggesting that all Canadians need to acquire some basic level of knowledge on the greenhouse effect: that they should achieve a passing grade in "Global Warming 101". It is however clear to us that there is a significant demand for information that is not being met adequately at present. If municipal officials complain that they cannot find the information and advice needed to guide their professional activities, then there is little likelihood that the general public is well served. We know that the Canadian Climate Centre of Environment Canada has been active in producing fact sheets and other material on global warming, but it seems clear that this material does not go far enough, especially in terms of its distribution.

2.10 It is, after all, only natural that Canadians should have a strong desire to know more about trends that could have significant social and economic implications within the space of a generation. In our interim report, we also pointed out that

[P]ublic information and education are not ends in themselves.... [P]ublic opinion is often well in advance of government policy. A better informed populace can become a strong advocate of new policy and can pressure governments to make changes that they might otherwise be reluctant to carry forward.⁶

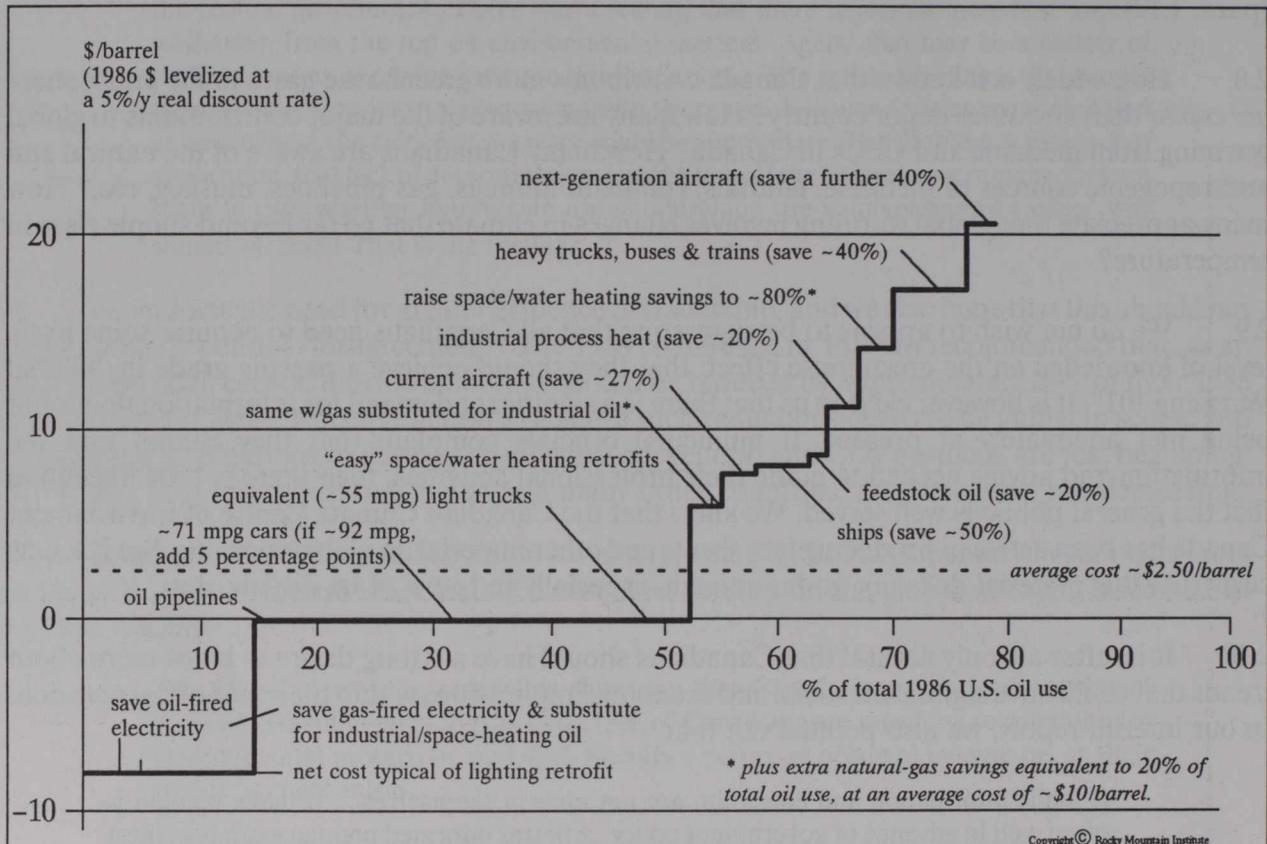
Therefore, as stated in our interim report,

The Committee recommends that Environment Canada, as the lead agency, coordinate the development by federal departments and agencies of comprehensive public information and advocacy programs directed to individual Canadians, to Canadian business and to other institutions, identifying the role that each can play in reducing greenhouse gas emissions. (Interim recommendation no. 4)

C. ENERGY EFFICIENCY SHOULD BE MORE IMPORTANT IN CANADA THAN IN OTHER COUNTRIES, AND MUST BE OUR FIRST PRIORITY

2.11 On several occasions during our hearings, witnesses suggested to us that, although Canada's *per capita* energy consumption is very high when compared to other countries, this is understandable and necessary because of Canada's geography and climate. In other words, more energy is required than in other countries to heat our buildings, and in travel across the huge distances that separate Canadian towns and cities.

FIGURE 9: OIL EFFICIENCY SUPPLY CURVE
An estimate of the technical potential to displace U.S. oil consumption



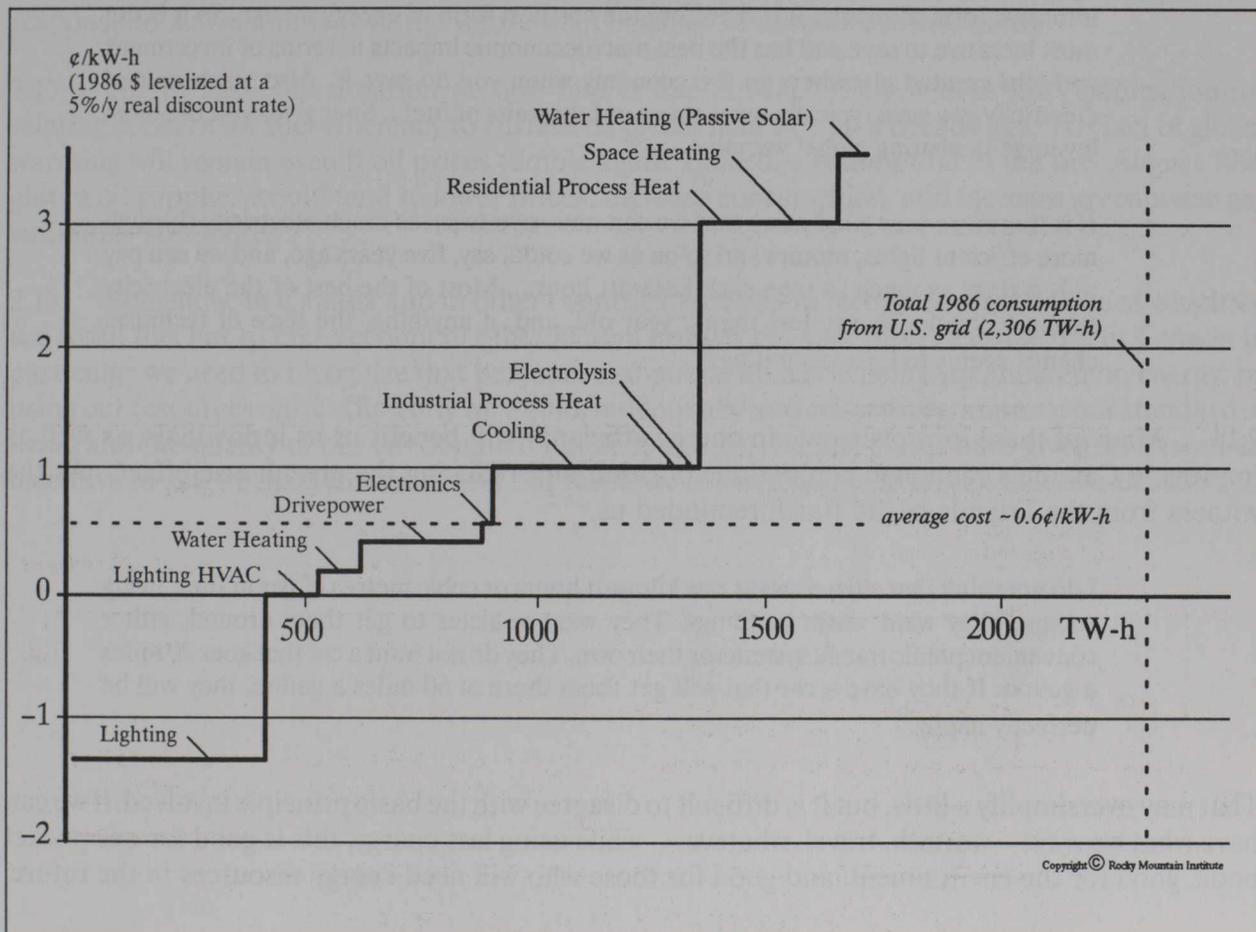
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HOW TO READ A SUPPLY CURVE

In these stairstep-like graphs, derived from detailed RMI analyses of energy-saving technologies, each rectangle represents a way or package of ways to save energy. Its height shows the saving's cost, its width shows how much can be saved, and its area shows how much money would have to be invested to capture that saving completely. The savings shown assume *full* practical use of those technologies; how much of that potential is actually captured depends on effort. Notice that half the electricity and two-thirds of the oil savings have a net cost of *zero*. This is because efficient lighting systems more than pay for themselves by their lower maintenance cost. The resulting negative-cost saving of oil- and gas-fired electricity can then be used to buy other oil savings.

Source: Rocky Mountain Institute, *Newsletter*, Fall 1989

FIGURE 10: ELECTRICAL EFFICIENCY SUPPLY CURVE
 An estimate of the full practical potential for retrofit savings of U.S. electricity



Source: Rocky Mountain Institute, *Newsletter*, Fall 1989

2.12 There is clearly some truth in this proposition, but it seems to the Committee that it obscures a much more important truth. It is precisely because of these climatic and geographical constraints that Canadians should have a strong desire to get the most use out of each unit of energy consumed: to “get the biggest bang for the energy buck”. Our attempts to do this in the past have been half-hearted and intermittent. As Mr. Eric Haites told us,

Canada will need stronger and more comprehensive efficiency standards for vehicles, appliances, buildings and energy-using equipment. Canada’s vehicle emission standards are below those of the United States, and Canada has not yet adopted appliance efficiency standards. Our past efforts to stimulate adoption of energy efficient facilities and equipment have not been notably successful, with the possible exception of automobiles.⁷

2.13 This view was reinforced by another witness, Mr. Amory Lovins.

I want to emphasize electricity..., because electricity is an extraordinarily capital intensive form of supply. It is therefore the costliest form of energy we use. So it is the most lucrative to save and has the best macroeconomic impacts in terms of investment and jobs created elsewhere in the economy when you do save it. Also, each unit of electricity you save typically saves three or four units of fuel... So it gives you the most leverage in abating global warming...

It is therefore very good news that we can now save twice as much electricity through more efficient lights, motors and so on as we could, say, five years ago, and we can pay only a third as much to save each kilowatt hour.... Most of the best of the electricity saving technologies are less than a year old, and, if anything, the pace of technical change seems to be accelerating.⁸

2.14 Many of these improvements in energy efficiency will benefit us as individuals, as well as improving Canada's economic competitive position and reducing the greenhouse effect. As the witness from the Friends of the Earth reminded us,

I do not think that citizens want raw kilowatt hours or cubic metres of gas in their living rooms. They want warm buildings. They want vehicles to get them around, either convenient public transit systems or their own. They do not want a car that goes 20 miles a gallon. If they have a car that will get them there at 60 miles a gallon, they will be perfectly happy.⁹

That may oversimplify a little, but it is difficult to disagree with the basic principle involved: if we can have what we want—warmth, travel, whatever—while using less energy, this is good for our pocket book, good for the environment, and good for those who will need energy resources in the future.

2.15 This principle has, however, clearly been subordinated to the price of energy in shaping Canadian behaviour. Long accustomed to ample supplies of all forms of energy at low prices, Canadians protected themselves from the first “oil shock” of the 1970s, and only gradually responded to its implications by developing a strong focus on using energy more efficiently. Ten to fifteen years ago there was a strong desire in Canada to improve our energy efficiency: we insulated our houses, insisted on more fuel-efficient cars and installed solar panels on our roofs. Then the price of oil fell, and we lost interest. We also lost a decade.

Ten years ago we were world leaders in energy efficiency in certain sectors. People came from all over the world to look at subdivisions of houses being built in Saskatoon that required 15% of the typical amount of energy of conventional mid-1970s housing. Construction of office buildings was going on that was at the leading edge world-wide in terms of energy efficiency. We had a lot of momentum and we lost it all.

We are now worse off than we were ten years ago because others have caught up and moved ahead ... We dropped the ball in energy efficiency and in reduction of energy intensity, and that correlates rather closely with the 75% reduction in federal spending on energy efficiency between 1984 and 1988. We have some catching up to do.¹⁰

2.16 Recently, energy conservation and energy efficiency have become priorities once again. This revival of interest may however be even more fragile and ephemeral than that of a decade ago, since there is no global shortfall in oil production at present, and oil prices rose during 1990 more in response to alarm and fear of the future than because of normal market forces.

2.17 In any case, the situation we now face is one in which there is even less justification for relating concern for fuel efficiency to current oil prices than existed a decade ago. The fact of global warming will remain even if oil prices tumble again. Indeed, a resumption of the pre-August 1990 glut in oil supplies would tend to lower prices, increase consumption, and increase greenhouse gas emissions still more.

2.18 Somehow, in Canada and in other countries, we need to recognize that the rate at which we use fossil fuel has to take account of other factors besides the spot price of crude oil. In Canada in particular we need to recognize that personal and public money is being squandered on energy: by using our resources more efficiently we would, individually and collectively, improve our standard of living and the quality of our environment (Table E and F). Recent events have given us a renewed incentive to act; we need to ensure that our response is more permanent than that of a decade ago.

TABLE E
Some Key Areas of Potential for Increased
Energy Efficiency in Canada

Sector	End-Use	Measures	Sample Technologies	Efficiency Potential*
RESIDENTIAL	Space Heating & Cooling	- building shell improvements - heating system efficiency improvements	- insulation - seating - superwindows	53%
	Appliances	- more efficient appliances	e.g.- insulation - bulbs - motors	30%
COMMERCIAL	Space Conditioning	- building shell improvements - better controls	- insulation - seating - integrated control systems	53%
	Lighting	- improved lighting systems	- bulbs	60%
	Motors	- improved motors	- drives, controls efficient motors	35%
INDUSTRIAL	Process Heat	- heat recovery - improved heating systems	- insulation - cascading - advanced heating systems - cogeneration	32%
	Mechanical Drive	- improved motors	- variable speed drives - linkage systems - more efficient motors	22%
TRANSPORTATION	Auto/Bus		- weight and size reductions	45%
	Trucks		- improved aerodynamics	35%
	Rail	- vehicles efficiency	- improved engine efficiency	38%
	Air	- higher load factors	- reduced rolling resistance	40%
	Marine		- variable speed transmissions	35%
* Rough estimates, averaging across new and existing buildings, processes and activities				

Source: Evidence to the Committee from Prof. John Robinson (University of Waterloo)

TABLE F
Energy Efficiency and CO₂ Reduction in Canada

Sector	End-Use	Efficiency Potential (%)	Contribution to CO ₂ Emissions (%)	Weight	Weight as Percentage
RESIDENTIAL	Space Heating and Cooling	53%	20%	11	26
	Appliances	30%	2%	1	1
COMMERCIAL	Space Conditioning	53%	11%	6	14
	Electricity Specific*	48%	1%	0	1
INDUSTRIAL	Process Heat	32%	26%	8	21
	Mechanical Drive	22%	9%	2	5
TRANSPORTATION	Auto/Bus	45%	19%	9	21
	Trucks	35%	7%	2	6
	Rail	38%	1%	0	1
	Air	40%	2%	1	2
	Marine	35%	1%	0	1
TOTAL			100%	40	100

Notes 1. Weight = Efficiency Potential x Sectoral Contribution to CO₂ Emissions x 100.

2. Excludes energy supply sector.

Source: Evidence to the Committee from Prof. John Robinson (University of Waterloo)

D. IN ASSESSING EXISTING ENERGY AND ENERGY ALTERNATIVES, KNOWLEDGE OF THE FULL COSTS INVOLVED IS ESSENTIAL

2.19 One of the significant changes that has taken place during the last decade or so, apparent in much of the evidence presented to the Committee, has been a growing confidence that new and sustainable energy systems, like energy conservation, can compete successfully with traditional forms of energy based on fossil fuels. This confidence is, however, matched by a widespread recognition that successful competition is prevented by an array of visible and hidden subsidies to traditional energy systems.

2.20 There is no doubt that proponents of alternative energy technologies, and organizations that see these technologies as environmentally desirable, have a much greater confidence in market forces than was evident in the past. As one of our witnesses, Amory Lovins, has written,

[T]he biggest evolution in my thinking over the fifteen years since the first modern oil shock has been an increased respect for how well even very imperfect markets can work. Efficiency and renewables have swept the U.S. energy market *despite* a formidable array of officially erected obstacles meant to achieve the opposite result...

Today... it is we former "technological pessimists" who are pointing out that new technologies ...have indeed proven far more powerful than anyone, including us, thought possible.¹¹

And, as one of the witnesses from Friends of the Earth told us,

... in the area of energy supply I think you would find that environmentalists are very much in favour of the free market. We would like energy to be provided at the least cost to society.¹²

2.21 Unfortunately, we heard much evidence which indicated that alternative energy systems, which could contribute to reducing global warming, are at a disadvantage in the present situation in Canada. There seem to be at least five different types of inequity.

- (a) *Encouragement of major fossil fuel developments through federal and other subsidies.* The consortium of environmental, conservation and aboriginal groups which prepared the *Greenprint for Canada* document urged that existing and proposed subsidies to such projects as Hibernia, Lloydminster Upgrade and OSLO (Other Six Leases Operation) should be reconsidered:

On the one hand they are environmentally destructive in numerous ways, not just contributing to the global warming problem but in other ways as well, and in addition they are basically unfair from a free market point of view. They are unfair to energy conservation corporations that want to achieve energy efficiency but cannot because the supply side is being so heavily subsidized.¹³

2.22 Several witnesses who commented on subsidization of these supply megaprojects recognized that they had regional development and other implications as well. However, as Professor Robinson observed,

I do not have a lot of trouble with a strategic decision by the government that a certain project should be supported for a whole bunch of non-economic reasons. I do have trouble when it is combined with an adherence to a kind of market-based philosophy used to exclude the same kind of treatment for other options, like demand side...

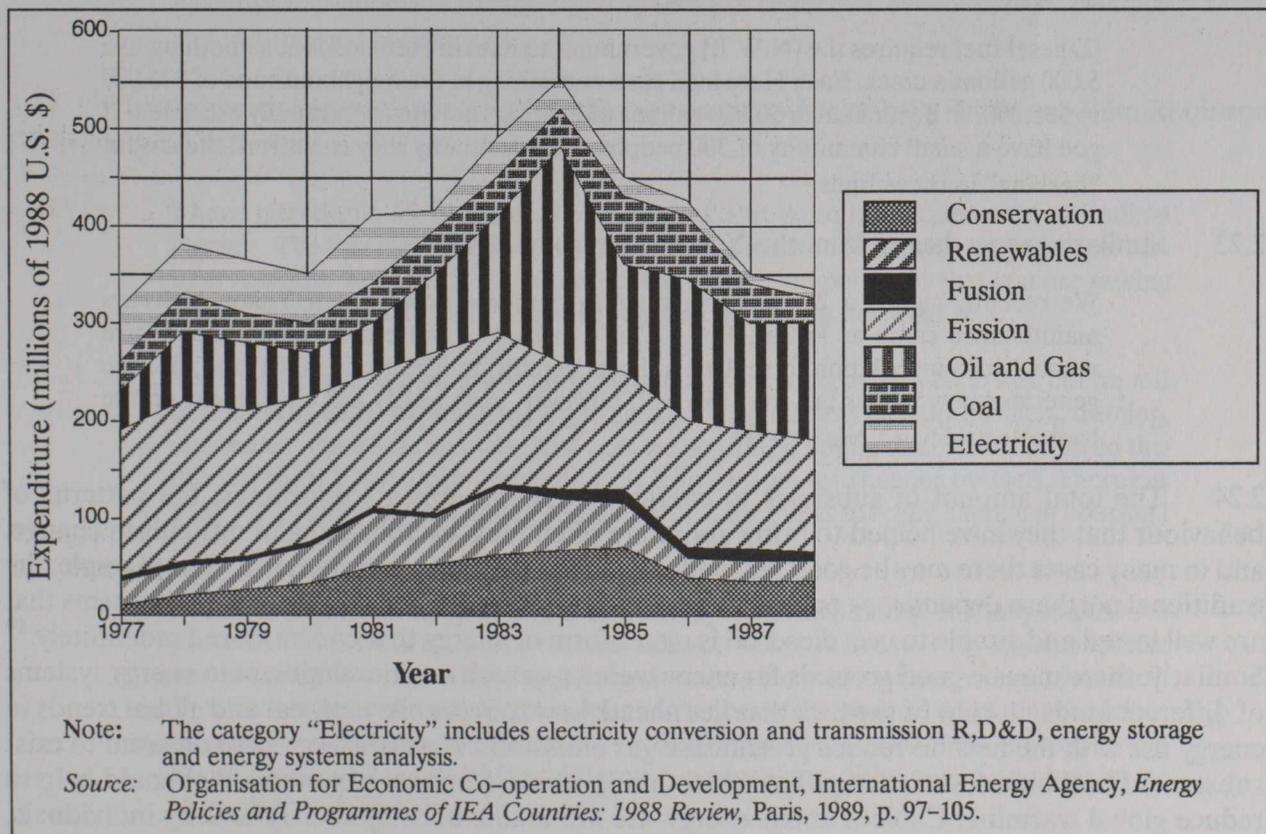
I would just like to see a little more symmetry.... We know the demand side will be faster, cheaper, easier and better for the environment. So it is the asymmetry that bothers me more than the mere fact of subsidization.¹⁴

(b) *Hiding the true cost of energy decisions by the consumer.* It was argued, for example, by a witness from the Solar Energy Society of Canada that a 20-kilowatt electric system for domestic heating would cost a Nova Scotia homeowner about \$2000, but that this will necessitate a much greater expenditure by the electricity utility at the margin to provide the supply capacity needed. In contrast, those who heat by oil or by solar systems pay all or most of the costs associated with the provision of these systems.

(c) *Attitudes and managerial decisions that favour fossil fuels.* As Mr. Jeff Passmore told us,

If a utility is going to build a power plant, the power plant is financed publicly. If an individual wants to put energy efficiency into his home, he is expected to pay for it himself. Simultaneously, the power plant is depreciated over 40 years, but Ontario Hydro, for example, depreciates energy conservation initiatives over 5 years.... So there are all kinds of areas where the incentives—and I am not talking about financial incentives here, I am just talking about institutional incentives—are contrary to going the efficiency route.¹⁵

FIGURE 11: GOVERNMENT EXPENDITURES ON ENERGY R,D&D IN CANADA BY TYPE, 1977-1988, MEASURED IN CONSTANT 1988 U.S. DOLLARS



- (d) *Declining support for energy research, development and demonstration (R,D&D) in general, and proportionately greater cuts in support for conservation and renewables.* As indicated in Figure 11 reproduced from our interim report, governmental support for conservation and alternative energy R,D&D in Canada waned after the mid-1980s, as the price of oil fell. As we stated in our interim report, this complacency was short-sighted; it stemmed from a failure by policy-makers to take a strategic, long-term and holistic view of the environmental, economic, social and political impacts of global energy development. The need to restore a vigorous R,D&D program in energy conservation and alternative energy development remains manifest.
- (e) Finally, there are inequities that seem *accidental or inexplicable*. Two of the examples offered to us concerned the high energy costs facing northern communities and activities. Mr. Passmore again:

Solar electricity goes head-to-head with diesel fuel in remote communities in northern Canada. Diesel fuel is tax exempt for the generation of electricity and photovoltaics is not. Automatically photovoltaics in 13.5% more expensive.¹⁶

This occurs in situations where (as we were told by the witness from the Government of the Northwest Territories), the price paid by northern residents may bear no relation to the cost of getting the diesel fuel to them. Some communities are inaccessible by road or sea, and airlifts by Hercules freighters are needed.

[D]iesel fuel requires the [N.W.T.] government to haul in Herc loads at something like 5,000 gallons a crack. Each Herc load costs something in the neighbourhood of \$25,000 to \$35,000, so if you haul in 50,000 gallons of heating fuel the costs rapidly escalate... If you have a small community of 300 people, there is no way they can afford the cost of "herking" in these fuels.¹⁷

2.23 Similarly, as we heard from the Yukon Government witness:

We recently signed a 2-year agreement to purchase power for a Yukon highways maintenance camp at Fraser, B.C. This .. project .. will enable construction of a micro-hydro installation to replace a diesel generator. The irony is that the fuel the generator now uses is tax-free. We will, however, have to pay a B.C. sales tax on the hydroelectricity we purchase.¹⁸

2.24 The total amount of subsidies to energy in Canada appears enormous; the patterns of behaviour that they have helped to bring about are often long-established and difficult to change; and in many cases there may be good reason for caution in seeking their removal. For example, the traditional northern dependence on diesel fuel is clearly related to the need for heating systems that are well tested and simple to use; diesel oil is also a form of energy that can be stored indefinitely.¹⁹ Similarly, there may be good grounds for encouraging research and development in energy systems of different kinds, in view of the task that lies ahead: how to reconcile national and global trends in energy use with the need to reduce greenhouse gas emissions. Nevertheless, there do seem to exist substantial and unnecessary inequities which hinder the use of energy systems that could help to reduce global warming. Choices about energy use are made, both by society and by individuals, without taking into account the full costs of those decisions on either the economy or the environment. There is an obvious need for energy accounting that recognizes both internal and external costs of different systems.

E. WE CAN MAKE SUBSTANTIAL PROGRESS IN REDUCING GREENHOUSE GAS EMISSIONS IF WE UNDERSTAND HOW PEOPLE BEHAVE

2.25 A large number of witnesses, with very different interests and experience, concurred in the view that public responses to incentives to reduce greenhouse gas emissions (e.g. by reducing residential energy consumption) could not be estimated using normal cost-benefit methods. Even when non-economic considerations, such as comfort and convenience, are taken into account, consumer behaviour may appear irrational or perverse. Our witnesses were extremely helpful in explaining the logical reasons that frequently shape such behaviour, and in showing how novel approaches could satisfy the consumer and achieve environmental objectives.

2.26 The broad problem was identified early in our hearings by Mr. Eric Haites, the author of an influential study on opportunities for controlling carbon emissions in Canada. When asked why few people chose to benefit from the experience already gained in building low-energy houses, he replied:

The phenomenon of those demonstration projects not being adopted more widely is one that has been studied in some depth. The main conclusion I am aware of is that people are somewhat reluctant to change unless they are forced to change or they have some strong incentives to change. We are still in that situation where the energy prices and the regulations regarding buildings are not sufficiently stringent to provide the incentive for builders to change either in terms of residential dwellings or commercial and institutional buildings.²⁰

2.27 The residential energy aspect was developed very convincingly by Professor John Robinson (University of Waterloo):

I have talked to a lot of builders in Waterloo, and there is a sequence of attitudinal barriers. The first response always was that it does not work. That was ten years ago. The next response was that it was too expensive. Then you point out that you are talking about 5% to 7%. The third response was that people do not want it.

The most recent response was that in 20 years we are going to have to do this, but we will be retired by then. We are not going to change our whole way of doing business, training, our trades, the whole sequences of how we do things, telling the electrician to do this differently. It is just too much hassle..... It is just not going to happen by itself. There has to be the push in terms of codes, standards, etc., for things to really happen in housing I think...

Let me give you an example. If you build energy-efficient housing, basically you have to use 2x6 studs instead of 2x4s or two sets of 2x4s. You have to use 6 mil vapour variance instead of 2 mil and you have to overlap from stud to stud and use acoustic [sealant]. You have to put in special outlet vapour barrier boxes and so on. This means that all of your trades have to be re-educated. The electricians have to do things differently; the drywall guys have to do things differently—everything. Why would any builder go through that if he does not have to?²¹

2.28 It is not merely a problem of the suppliers of housing being unwilling to supply a more energy-efficient product. There is also good evidence that the purchaser is often reluctant to pay the additional 5% to 7% required to cut energy consumption down to 10% to 20% of what is typical at present. As the witness from the Department of Finance pointed out

One of the things we know about private consumers—it is different with companies and with larger users who are more skilled at doing the analysis on the real economics of their purchases—who are buying cars, building houses and so on, is that they typically give far too much emphasis to the up-front capital cost of something as opposed to its lifetime cost. So people will tend to underinvest in insulation, energy efficiency, or lighting systems even if the message is there...²²

2.29 As Amory Lovins reminded us, the consumer is not necessarily being illogical in this decision. Buying a house is typically an occasion when personal finances are stretched to the limit, and making an additional investment in energy saving can well be considered “a difficult, risky use of very scarce discretionary capital.”²³

2.30 Our witnesses also indicated ways in which this apparent *impasse* could be circumvented. Professor Robinson pointed out that it was normal in Canada for mortgage payments to include PIT—principal, interest and local taxes. A mortgage that also included energy payments—PITE—would mean only a small addition to the mortgage payments in an energy-efficient home, and a much smaller payment each year than the homeowner would pay for PIT plus energy costs in a typical residence today.

2.31 Several witnesses also drew the Committee’s attention to recent experience in the United States, where it has been recognized that electrical utilities have a strong financial incentive to reduce the growth in energy demand. The utility can then become the agent for retrofitting, and not just in regard to electricity use.

I wonder how you would feel if your utility company...came in and said not to worry about what switch you should have on your furnace, not to worry about whether you should put more insulation in the walls or in the ceiling or if you should be sealing your windows, just leave it to them. They will install it all; you do not have to pay a penny. They will monitor it afterwards and will provide some follow-up guarantee: we are your utility company; we are not a fly-by-night operation; we are going to be around. Now that is a fairly big incentive because your bill goes down next year and you do not pay a penny. That is exactly the kind of program that a bunch of utilities are already doing around North America. That is the kind of program that is irresistible.²⁴

2.32 There are, of course, significant differences between Canadian and United States electricity utilities, especially in regard to the sources of energy used to generate electricity, and their costs. As indicated later (paras. 5.13–5.14) there are also substantial differences within Canada. Nevertheless, the suggestion that electrical utilities could play a much greater, and more comprehensive, role in energy conservation does seem “irresistible”, and the Committee returns to this suggestion in the context of its own recommendations (paras. 4.35–4.40).

2.33 The Committee is more doubtful about whether electric utilities and other energy suppliers in Canada have reached a similar stage in re-evaluating their contemporary role as those in the United States that were mentioned by witnesses. The electric utilities that gave evidence to us seemed to see their mandates as limited primarily to providing supply adequate for demand:

The philosophy that gears the company is still one that says when someone goes to the light switch and turns it on, the lights will come on. It is one of meeting customer needs and we do not have any control over those...²⁵

The Committee recognizes that Ontario Hydro, the utility just quoted, does nevertheless have an expanding demand management program. However other utilities seemed to doubt both the desirability or potential effectiveness of demand management, and they would have liked to doubt the reality of global warming.

2.34 Mr. Haites is clearly correct: people are reluctant to change unless forced to do so or unless they have some strong incentives. What this Committee finds disturbing is that what seems to be required most is not a change in the lifestyles of all Canadians, but a change in the way that some key sectors and institutions—such as energy suppliers, mortgage institutions, builders—interpret their missions. Meanwhile, in the words of Professor Robinson,

We are building sieves. They are going up, and the day they are built they are obsolete from an energy point of view.²⁶

F. CANADA'S ENVIABLE INTERNATIONAL REPUTATION ON ENVIRONMENTAL ISSUES IS THREATENED BY AN APPARENT RELUCTANCE TO ACT ON CARBON DIOXIDE EMISSIONS

2.35 Canada has long been a vigorous and respected advocate of action on international environmental issues, especially since the Stockholm Conference on the Human Environment in 1972. On issues such as marine pollution, acid rain, ozone layer protection and urbanization, Canada has taken strong and enlightened positions, and has backed them up with national action.

2.36 In regard to global warming, our role has seemed less consistent. In terms of research, especially on the potential impacts of global warming and through the development of Environment Canada's global climate model, our national effort has more than matched those of other countries. The 1988 international conference in Toronto drew national and worldwide attention to the problem, and gave strong encouragement to the subsequent work of the Intergovernmental Panel on Climate Change. And yet, faced with the uncomfortable fact that Canada's *per capita* contribution to greenhouse gas emissions is higher than that of any other major country, the national action that has been taken so far is widely perceived to be tentative and inadequate. Our Committee was told this in fairly blunt terms by two Canadians who have recently returned from international vantage points. First, the former secretary-general of the Brundtland Commission, Jim MacNeill:

I attend a lot of international meetings. I am often reminded by my foreign friends that we are the energy guzzlers of the world. North Americans consume more than twice as much energy per capita and per unit of product than Japan and most west European countries. In the process, we produce more acid rain and more global warming. On atmospheric pollution ... we are the environmental bad boys of the industrialized world, and the rest of the world knows it. When I hear statements that we in Canada are world leaders on the environment, I cringe with embarrassment.²⁷

Secondly by Jim Bruce, recently returned from the World Meteorological Organization in Geneva:

Canada has for a number of years been a respected international leader on environmental issues...

What made us leaders on these issues? I think there are two main factors. First of all we had excellent science.... We brought to the table the best scientific understanding based on sound environmental measurements and research, and practical solutions for addressing the issues....

Secondly, we had wise and defensible policies at home to address the issues....

On the issue of global warming and the protection of the global atmosphere how does Canada stand?...

On the scientific side we are in a respectable but, I would think, underfunded position, with some excellent work going on, but generally inadequate support and inadequate contributions internationally. But we are not in too bad shape.

On the second requirement, having wise and defensible policies at home, my impression is that we are in serious disarray. The trends are ominous. First of all, we have no target or commitment to CO₂ emission reductions; secondly we seem to be pursuing policies leading to ever-increasing wasteful burning of hydrocarbons, with our industry becoming less and less energy efficient and competitive. We are followers and not leaders on auto emission controls; we appear to have turned our backs on supporting promising technologies for alternative renewable energy sources, and in doing these things are essentially ignoring our responsibility to protect the planet's atmosphere and planet for ourselves and future generations.²⁸

2.37 Foreign witnesses conveyed a similar message, although in more diplomatic language. The representative of the Government of the Netherlands has already been quoted (para. 1.28); the following comments are those of the witness from the Worldwatch Institute in Washington, D.C.

I do know that in Canada as well as in the United States, many of the very good energy conservation and renewable energy programs during the 1970s and 1980s have dwindled or in some cases disappeared. As I have already indicated, that is definitely turning around in the United States. We will in a period of two years see a 30% to 50% increase in budgets for both renewables and energy conservation in the United States....I would hope to see Canada moving in that direction as well. I realize it may be politically uncomfortable to revive something so soon after you have eliminated it, but I just do not see how you are going to develop energy efficiency and renewable energy sources without getting those kinds of programs going and indeed making them even stronger than they were during their peak period in the 1980s....

The reason I say that Canada has apparently sat on the sidelines is that I do not see either in the internal cable traffic that I have seen or certainly in any public pronouncements by key Canadian officials any indication that Canada has firmly joined one camp or another. Maybe there is one foot in each camp.²⁹

2.38 If that is how Canada appears at present from an international perspective, there are some other considerations that need to be kept in mind. The Committee emphasized in Chapter 1 that effective action on global warming involves much more than adoption of a specific target; it will

involve substantial commitments across Canada's economy and society and at all levels of government, especially in regard to energy use. The work currently being undertaken, through federal, provincial and territorial consultative mechanisms by both energy and environmental ministries, may appear time-consuming, but it is unavoidable.

2.39 Another reason for linking Canada's commitments to those achieved internationally was provided by the representative of the Government of Sweden:

In environmental policy I think for many years it has been thought that before we go out internationally we have to do something ourselves, otherwise not very many people will believe in this policy. That was done when it came to sulphur dioxide, nitrous oxides, and in other areas. So we were prepared to take action in Sweden before we advised somebody else to do something...

The issue of global warming is somewhat different.... You have to do it together with other people. To do something on your own just for show, I do not think that would have any meaning. In my view at least, you must say that you are prepared to do it, but it has no meaning if nobody else does it.³⁰

2.40 The moment when Canada must make clear which camp it belongs to is now at hand. International negotiations have begun on an international convention on global warming, and on the protocols to make it effective. Canada's delegates need to say what Canada is prepared to do.

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TARGETS FOR EMISSIONS REDUCTIONS

A. THE NEED FOR EFFECTIVE, REALISTIC, AND SPECIFIC TARGETS

3.1 The Committee believes that it is self-evident that Canada needs to adopt specific targets for limitation and reduction of greenhouse gas emissions by specific dates. One target, or set of targets, should be determined in terms of what can feasibly be achieved on a short- to medium-term perspective: say, 10 to 15 years into the future. A second set of targets should be determined in terms of what is needed in the long term to arrest or reverse the process of global warming. In this report the Committee is primarily concerned with targets and strategies for the next 10–15 years; however, we recognize that these must contribute effectively to achieving the long-term goal.

3.2 The targets that Canada adopts should therefore be *effective, realistic, and specific*:

- effective, in that the emission limitations adopted by Canada must make a significant and appropriate contribution to solving the global problem;
- realistic, in that there are grounds for believing that the targets adopted by Canada can be achieved within the period specified;
- specific, in that they are defined in unambiguous and quantitative terms, so that progress can be monitored and eventual success or failure can be clearly determined.

3.3 A prerequisite for targets that meet these criteria is a system of measurement that is accurate, unambiguous, and adequate in terms of both spatial coverage and time series. The need for this might seem to go without saying; it is, however, easy to forget that discovery of the “ozone hole” in the antarctic stratosphere was almost accidental. Similarly, much of the incentive to investigate global warming came from observations of atmospheric CO₂ concentrations at only two sites, in Hawaii and the Antarctic. As the Committee notes later (paras. 4.9 – 4.16) there is a major discrepancy in estimates of methane emissions by the Canadian oil and gas industry that has substantial implications for Canada’s strategy to limit greenhouse gas emissions. The Committee strongly **recommends** that Canada implement immediately a National Program of Greenhouse Gas Emissions Measurement and Source Identification, and that the data be tabled annually in Parliament.

B. TARGETS FOR ALL GREENHOUSE GASES

3.4 Another source of ambiguity was identified in Chapter 1 (paras. 1.19 to 1.21); it was latent in much of the testimony that the Committee received and is also evident in much of the literature on proposed targets, in Canada and elsewhere. Frequently it is not easy to determine whether a proposed target refers to reductions in carbon dioxide emissions, or to reductions in carbon equivalents, i.e. considering all major greenhouse gases.

3.5 The Committee has no doubt that targets should be set in terms of carbon equivalents. Carbon dioxide is only one of the main greenhouse gases, although at present it is the largest single contributor to global warming, both in Canada and worldwide. Efforts to limit global warming should be directed at all the greenhouse gases that cause this warming. Successful measures in response to one or more gases should not be used as a reason for reduced efforts in regard to other emissions.

C. DEFINING THE TASK: A CHOICE AMONG SCENARIOS

3.6 Before considering possible targets for Canada, it is necessary to define the scale of the effort required, globally and during the next 30–50 years, if the atmospheric concentrations of greenhouse gases are to be stabilized and then perhaps to be reduced. The Intergovernmental Panel on Climate Change (IPCC) reported to the World Climate Conference in 1990 that:

Even if we were able to stabilise emissions of each of the greenhouse gases at present day levels from now on, the temperature is projected to rise by about $0.2^{\circ}\text{C}/\text{decade}$ for the first few decades.

The rates of change of global temperature predicted from a Business-as-Usual case is in the range $0.2 - 0.5^{\circ}\text{C}/\text{decade}$. These are global mean estimates; on a regional level, changes could be substantially larger (and smaller) than this. In addition, the natural variability of climate could considerably enhance or reduce this rate of change.¹

3.7 A report prepared by the U.S.A. and the Netherlands for the Response Strategies Working Group of IPCC contained five scenarios for the future, based on various economic, demographic and emissions control assumptions.

(a) The 2030 High Emissions Scenario*

... depicts a world in which few or no steps are taken to reduce emissions... [I]ncreases in emissions yield increases in atmospheric concentrations of greenhouse gases with an equivalent greenhouse effect of a doubling of CO_2 concentrations from pre-industrial levels by 2030 and continued increase throughout the rest of the century.

(b) The 2060 Low Emissions Scenario

... portrays a world in which a number of environmental and economic concerns result in steps to reduce the growth of greenhouse gas emissions.... These steps reduce growth in emissions by 50 to 75 per cent and significantly slow down the growth in atmospheric concentrations of greenhouse gases. CO_2 emissions do not double until 2100, but the equivalent greenhouse effect of a doubling of CO_2 concentrations over pre-industrial levels is achieved by 2060 and continues to grow, albeit at a slower rate than in the first scenario.

* In the IPCC reports, this scenario is also referred to as the "Business-as-Usual" situation (see, for example, the quotation in para. 3.6 above).

(c) The Control Policies Scenario

... reflects a future where concern over global climate change and other environmental issues, such as stratospheric ozone depletion, motivate steps over and above those taken in the 2060 Low Emissions Scenario.... As a result, emissions of CO₂, N₂O, and CH₄ grow slowly through the middle of the next century, then start to decline. Emissions of CO and NO_x* decline sharply along with emissions of CFCs. These emission trends yield increases in atmospheric concentrations of greenhouse gases equivalent to slightly less than a doubling of CO₂ from pre-industrial levels by 2090 with concentrations stable after 2090.

(d) Two Accelerated Policies Scenarios

...are similar to the Control Policies Scenario but feature much more rapid development and penetration of renewable energy sources ... The results of these two scenarios differ only in emissions of CO₂ and primarily in the short run.... In both scenarios, atmospheric concentrations of greenhouse gases continue to increase but stabilize by the middle of the next century at levels 25 per cent greater than current levels but well below an equivalent doubling of CO₂ over pre-industrial levels.²

3.8 These of course are only scenarios, based on present knowledge of the relationship of greenhouse gas emissions to global warming, and on assumptions about future world population and economic growth. They are, however, the most authoritative and generally accepted perspectives that are available.

3.9 It is clear that the world has already begun to move away from a situation leading to the 2030 High Emissions Scenario. That scenario does not contemplate the strengthening of the Montreal Protocol on CFCs that took place in 1990. Nor does it include the growing international consensus that collective action must be taken to limit global warming.

3.10 In both Canada and the world as a whole, our present attitudes—not our actions—seem to lie somewhere between the 2060 Low Emissions Scenario and the Control Policies Scenario. For example, the need to stop tropical deforestation and begin a global reforestation effort is generally accepted (2060 Low Emissions requirement), and most countries have accepted the need for a complete phase-out of CFCs (Control Policies requirement).

3.11 It is clear, however, that neither of these is likely to be sufficient. The 2060 Low Emissions scenario still envisages that greenhouse gas concentrations in the atmosphere will continue to increase after 2060, and even the Control Policies scenario does not envisage stabilization until the carbon equivalent has doubled by comparison with pre-industrial levels, a century from now.

3.12 Apart from the phase-out of CFCs, which Canada plans to achieve by 1997³, most of the elements of the strategy that the Committee suggests in Chapter 4 are relevant only to achieving the 2060 Low Emissions Scenario. The Committee does not believe that Canadians, or the world community as a whole, will be prepared to accept such a modest effort, although there is no doubt that it is with these improvements in energy efficiency that we and many other countries have to begin. We **recommend** that Canada, together with other countries, should make a major effort to

* Carbon monoxide and nitrogen oxides.

achieve the goal of the Accelerated Policies Scenarios, i.e. stabilization of greenhouse gases by the middle of the next century, at levels that may be higher than at present but will be "well below an equivalent doubling of CO₂ over pre-industrial levels." We **recommend** also that the Government of Canada develop and publish a strategy for the Canadian component of such a global target. In our interim report, we suggested that the federal government should consider adopting a 50% reduction of CO₂ emissions from 1988 levels by the year 2020. This may appear a more stringent target than indicated by the Accelerated Policies Scenario. Figure 8 is however a reminder that major efforts will be required by countries like Canada, if global warming and economic development are to be reconciled.

D. PROSPECTS FOR THE NEXT 10-15 YEARS

3.13 In the short-term, several actual and possible targets exist that are relevant to Canada, including the following:

- The 1988 Toronto Conference recommended that Canada and other countries should "Reduce CO₂ emissions by approximately 20% of 1988 levels by the year 2005".⁴
- At the Second World Climate Conference, the federal government committed Canada to stabilize emissions of CO₂, and other greenhouse gases not controlled by the Montreal Protocol, at 1990 levels by the year 2000.⁵ This commitment is consistent with the draft "Recommendations for National Action Strategy", circulated for discussion in November 1990 by federal and provincial environment and energy ministers.

3.14 In the Committee's interim report, we expressed our belief that "Canada's support of the objective of stabilizing carbon dioxide emissions at 1990 levels by 2000 is not a sufficient response." If, as appears to be the case, the Canadian commitment is to stabilize emissions of methane, carbon dioxide and perhaps also nitrous oxide and other minor greenhouse gases, and at the same time to phase out the production and new consumption of CFCs by 1997, then a start will have been made.

3.15 This start will, of course, not be sufficient to achieve the type of long-term goals suggested in para. 3.12. Indeed, it is our view that, well before 2000, Canada should have revised its own short-term target and most members of the Committee continue to believe that the Toronto target—a 20 per cent reduction in 1988 CO₂ emissions by 2005 — is feasible without disruptive effects on the Canadian economy or lifestyles. We note that other countries are committing themselves to this target. Australia, for example, aims to reduce emissions of all greenhouse gases not controlled by the Montreal Protocol by 20%, based on 1987 levels, by the year 2005. Like Canada, Australia will phase out CFCs and halons by 1997.⁶ Therefore, as stated in our interim report,

The Committee recommends that the Toronto target of a 20% reduction in human-sourced CO₂ emissions by the year 2005, compared to the 1988 level of emissions, be adopted by the federal government as its minimum interim objective in reducing Canadian CO₂ emissions. (Interim recommendation no. 2)

The Committee recognizes that there is an urgent need in Canada for quantitative analysis of the economic and social implications of this and the other targets that have been recommended. Such studies are particularly needed because the regional incidence of reduction measures across Canada could be very uneven.

E. THE NEED FOR A GLOBAL COMMITMENT

3.16 Canada's targets need to be viewed in a wider international context. On the one hand, Canada needs to be seen to be acting as vigorously as other nations in tackling what is a planetary problem: Canada's targets therefore need to measure up to those of other comparable countries. On the other hand, if there is no general agreement to take coordinated and vigorous action, strong action by Canada, or even by Canada in concert with a number of similar countries, would have little significant effect on global emissions of greenhouse gases. Some countries, such as the Netherlands and Germany, have already adopted strong and unilateral commitments to reduce emissions. Others, such as the United Kingdom and Australia, echo the Swedish witness to our Committee quoted in para. 2.39: they define targets that they will adopt if other countries take similar action. Australia, for example, has said that

While recognising the need to restrict emissions and to aim for a 20% reduction, the Government will not proceed with measures which have net adverse economic impacts nationally or on Australia's trade competitiveness in the absence of similar action by major greenhouse gas producing countries.⁷

3.17 The crucial period for gaining this international commitment is during the next 12-15 months. The negotiations on an international convention to limit greenhouse gases (other than those covered by the Montreal Protocol) that have just begun are designed to have the convention ready for signature by national governments at the World Conference on Environment and Development in 1992. In the Green Plan, the federal government has declared that

Canada will aggressively pursue an International Framework Convention on Climate Change and development of any necessary protocols. The Government will also press for the conclusions on the Framework Convention and appropriate binding protocols by 1992. In pursuing the Convention, Canada will be seeking a comprehensive international agreement on targets and schedules for the reduction of CO₂ and other greenhouse gas emissions.⁸

3.18 The Committee **recommends** that, in implementing this commitment, the federal government should accept the Toronto Conference target of a 20% reduction from 1988 levels of CO₂ emissions by 2005. At present, the federal government has undertaken only to examine the feasibility and implications of this target.⁹ However, not merely is it desirable that Canada show strong leadership in action on global warming, it evidently makes good economic sense to do so. As Mr. Haites told us,

If Canada were to implement the most cost-effective measures to achieve the Toronto Climate Conference targets, we would achieve a net benefit of \$100 billion to \$150 billion in energy savings alone.¹⁰

After reviewing the study from which this estimate was derived, the federal-provincial-territorial Conference of Energy Ministers agreed that

... by implementing measures which would not entail major economic costs under current economic conditions, Canada could move a long way in the direction of meeting this illustrative target [20% reduction in CO₂ emissions from 1988 levels] but could not fully achieve it.¹¹

F. START NOW

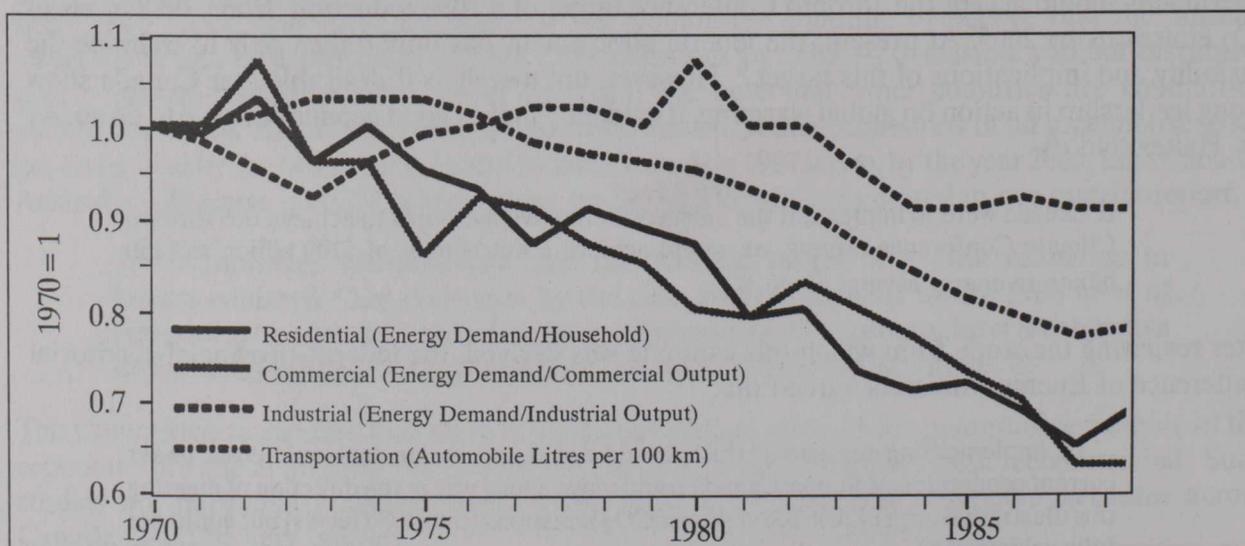
3.19 In our interim report, the Committee recommended that

Canada adopt the target of reducing the intensity of energy use in the Canadian economy by 2% annually, until our emissions of carbon dioxide are reduced to a level which does not contribute to the further accumulation of CO₂ in the atmosphere.¹² (Interim recommendation no. 3.)

3.20 In reiterating this target, the Committee emphasizes that it is particularly important in the very short run: right now. More than a year and a half has elapsed since the “20% reduction by 2005” target was proposed by the Toronto Conference. It is more than a year since the Committee began its hearings on the subject of global warming. Meanwhile, the situation continues to deteriorate rapidly. According to the report published in August 1990 by the Carbon Dioxide Information Analysis Center, total CO₂ emissions (other greenhouse gases not included) in Canada increased by 4.6% in 1987 and 6.6% in 1988.¹³ There seems no reason to doubt that emissions have continued to increase in 1989 and 1990. If Canada is to be serious about achieving either the 2000 target already adopted by the federal government, or the Toronto Conference target that we recommend, action must be immediate, not in another year or two. In a recent discussion paper on “Energy Use and Atmospheric Change”, the Department of Energy, Mines and Resources (EMR) noted that

Energy consumption per dollar of GDP dropped about 18 per cent between 1973 and 1988 with much of the improvement coming in the 1980s. During the 1970s, the residential, commercial and transportation sectors experienced modest reductions in energy intensity. These improvements were in response to rising energy prices and the implementation of information and incentive programs. In the industrial sector, energy intensity rose slightly (see figure 12). Since 1980, there have been marked energy intensity improvements in the transportation sector—reflecting improved vehicle design and changes in purchasing habits; in the residential sector—reflecting better insulation and more efficient furnaces, water heaters and windows; and in the commercial sector—reflecting better automatic heating, ventilation and air conditioning controls and lighting systems.¹⁴

FIGURE 12: CANADIAN ENERGY INTENSITY BY SECTOR



The discussion paper noted, however, that a reference projection of energy demand developed by EMR and Environment Canada in 1990 suggested only “a moderate decline in energy intensity of about 0.5 per cent per year... between 1990 and 2010.”¹⁵ “Life as usual” is evidently not good enough.

3.21 What is implied for Canada in the interim targets that we recommend—2% annual improvement in energy efficiency and a 20% reduction on 1988 CO₂ emission levels by 2005—ought to be the easier to achieve because Canada’s use of energy is so wasteful by comparison with other advanced industrial countries. Yet several of these countries have set themselves much more ambitious targets than those suggested for Canada by the Committee. In the Netherlands, for example, the 1989 National Environmental Policy Plan adopted a target of stabilizing CO₂ emissions by 2000 at the average level of 1989 and 1990: i.e. a target comparable to that adopted by the federal government in Canada. As the representative of the Netherlands Government told us,

Given the already modest CO₂ emission per capita in Holland compared to other countries... this implies already a major effort, since the CO₂ emissions are currently growing at a rate of about 2% per year.¹⁶

However, the Dutch government has already accelerated this rate of reduction, so that

... stabilization at 1989/1990 levels will be reached by 1994/1995, with additional potential for reductions after that... Assuming a real 1% reduction after 1994, a 5% reduction in the year 2000 might be reached.¹⁷

3.22 The Committee suggests that Canada should not be in the position of studying and debating whether significant reductions in greenhouse gas emissions can be achieved, at the same time as other countries with similar problems are actually achieving such reductions.

NOTES AND SOURCES

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2. *Emissions Scenarios*, Report of the Expert Group on Emissions Scenarios, Intergovernmental Panel on Climate Change, pp. E2 - E4.
3. Canada, *Green Plan*, Ottawa, 1990, p. 114. Hereafter cited as "*Green Plan*, p. 114", etc.
4. *Proceedings of the World Conference on The Changing Climate: Implications for Global Security*, WMO 710, World Meteorological Organization, Geneva, 1988, p. 296.
5. *Green Plan*, p. 100.
6. *Climate Change Newsletter*, 2, 4, November 1990, Australian Department of Primary Industries and Energy.
7. *Ibid.*
8. *Green Plan*, p. 111.
9. *Green Plan*, p. 101.
10. Vol. 22, p. 33.
11. Federal-Provincial-Territorial Conference of Energy Ministers Briefing Book, 28 August 1989, p. 8.
12. *No Time To Lose*, p. 6.
13. *Trends '90*, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Tennessee, 1990, p. 110.
14. Energy, Mines and Resources Canada, "Energy Use and Atmospheric Change, A Discussion Paper", 10 August 1990, pp. 13-14.
15. *Ibid.*, p. 17.
16. Vol. 29A, p. 4.
17. *Idem.*

ACHIEVING THE TARGETS: A STRATEGY FOR THE 1990S

A. INTRODUCTION

4.1 In this chapter the Committee expresses its views on the priorities and means that should be adopted in Canada during the next decade, in order to make substantial progress in achieving the targets identified in the previous chapter. Many of the Committee's suggestions appeared as recommendations in our interim report, *No Time To Lose*. As promised in that report, we now explain in more detail the bases for those recommendations.

4.2 Our focus in this chapter is on the next 10 years. It seems to us that the term "strategy" becomes almost meaningless if it is extended beyond that time-frame. The strategy for succeeding decades will need to be developed in the light of experience during the 1990s, and even during the present decade it can be anticipated that new needs and opportunities will be identified, requiring modifications to the strategy. In the next chapter, we deal with options and approaches that do not yet appear ready for incorporation into a strategy for the 1990s, or that seem unlikely to have a significant impact on greenhouse gas emissions during this decade. They nevertheless need to be investigated and developed urgently, if they are to be useful in maintaining progress after the turn of the century.

4.3 At the beginning of Chapter 3, we suggested that one test of a proposed target is whether it is likely to be effective: will it make a significant and appropriate contribution to solving the problem? This is clearly also a valid question to be raised about the components of our proposed strategy. In making its recommendations, the Committee cannot affirm from its own knowledge that the strategy will be effective. We are not meteorologists expert in the relationship of emissions to global warming, nor are we energy experts. Similarly, we cannot be definitive about the costs and other implications of the measures that we propose. We have heard from a large number of witnesses who do possess the necessary expertise and experience in these matters, and in other relevant considerations such as the acceptability of various emissions reductions options by the Canadian public. We have confidence in their testimony. The Committee also believes that the alternative of "doing nothing until we can be certain about everything" is quite unacceptable. We do however return to a specific problem concerning effectiveness at the end of this chapter.

4.4 In the previous chapter, we also noted the confusion that exists at present about whether official or recommended targets for emissions reductions concern the combined effect of all greenhouse gases, or just carbon dioxide: "20% reduction in what?" The Committee assumes in this chapter that Canadians should be seeking significant reductions as soon as possible in all the major greenhouse gases. We recognize the federal government's intention, as expressed in the Green Plan¹, to phase out CFCs by 1997, and to stabilize ("cap") emissions of each of the other main greenhouse

gases at its 1990 level by the year 2000. The Committee's proposed target is more ambitious, but we also believe that the strategy during the 1990s should include all greenhouse gases. Now that decisive action has been taken in regard to CFCs, the Committee believes that the main emphasis should be on carbon dioxide, and it is to reductions in CO₂ emissions that we devote most of this chapter. We begin, however, with brief comments on how limitations or reductions in emissions of the other gases are likely to be achieved during the 1990s.

B. CHLOROFLUOROCARBONS AND HALONS

4.5 *Deadly Releases: CFCs*, our report on chlorofluorocarbons and similar substances such as halons was presented to Parliament and published in June 1990. Most of the recommendations made in that report, which focused on stratospheric ozone depletion, are relevant also to the pernicious effects that CFCs have on global warming. The Committee reaffirms its recommendations on CFCs and welcomes the announcement by the federal government that production and new consumption of CFCs in Canada will be phased out by 1997.² This is consistent with our recommendation 1(a) in *Deadly Releases: CFCs*. We also welcome the statement that the use of CFCs in car air conditioners will be phased out by the 1995 model-year, although we **recommend** that this provision should apply to all vehicles, not just to cars, and that, as Recommendation 6 in our earlier report suggested, air conditioning units in vehicles should be required to be leak-proof by model-year 1992.

4.6 The Committee does wish to refer again to the need for adequate and effective means of removing CFCs from existing installations: the so-called "vampire units". Large amounts of CFCs at present exist in refrigerating and other units; they will remain as a potential threat to the atmosphere long after production of new CFCs ends in 1997. If effective substitutes are not readily available, there will be a demand for vampire units that can extract and recycle existing CFCs. If, however, adequate substitutes are readily available, as seems very probable, market-driven interest in extracting and recycling old CFCs is likely to diminish.

4.7 The latter situation would be similar to that at present, when new supplies of CFCs are readily available, and there is little incentive to recycle. By the end of January 1991, only two provinces, Ontario and Nova Scotia, had issued regulations requiring the recovery and recycling of CFCs. The Committee is therefore concerned that there appear to be both regulatory gaps and bureaucratic barriers that are unnecessarily deterring the safe extraction of used CFCs at present. Until recently, the problem appeared to be primarily technical in character: we heard evidence that portable recovery pumps were not commercially available. That situation has now changed, and it is now up to regulatory bodies to ensure that CFCs are routinely extracted from refrigerators and other appliances before these are discarded or replaced.

4.8 Meanwhile, the ozone layer continues to deteriorate and global warming is accelerated. The Committee **recommends** that the Government of Canada, in co-operation with provinces and municipalities, strongly encourage the introduction of a requirement that CFCs be removed from used equipment before disposal.

C. METHANE

4.9 As indicated in para. 1.30, the World Resources Institute data suggest that, in carbon equivalent, methane accounts for one quarter of net greenhouse gas emissions by Canada, or 33 million tonnes of carbon equivalent in 1987.³ Of Canada's total emissions of methane (excluding gas combustion or flaring) the WRI estimates that three-quarters (74.9%) is due to leakage from natural gas transmission and distribution pipeline leaks.⁴ If this proportion is anywhere near correct, it suggests strongly that Canadian efforts to stabilize or reduce methane emissions should focus on pipeline leakage.

4.10 In its evidence to the Committee, the Canadian Gas Association did not address the WRI data directly. However, the president of the association commented that

We have carried out a study within the Canadian gas industry which ... concludes that an estimate of methane emissions from gas industry operations in Canada is about 0.3% of gas produced...

Our estimate is that on the transmission side ... the range would be from 0.018% to 0.082%; on the distribution side, ..., it would be 0.03%; and on the production side 0.25% is the range.⁵

4.11 In a subsequent communication to the Committee, the Canadian Gas Association indicated that the 1989 total of 3.3 trillion cubic feet was equivalent to 92.4 billion cubic metres, or 66 million tonnes of methane. Using the Association's figure of 0.3% for total leakage, the CGA estimates that leakage in Canada amounted to 198,000 tonnes of methane.

4.12 This CGA estimate is so different from the WRI estimate for 1987 of 7,800,000 tonnes that the Committee believes it needs further investigation. The WRI estimate, for Canada and other countries, is based on U.S. Government sources⁶; in his evidence to our Committee the president of the Canadian Gas Association commented that

Recently there have been some quite misleading and inaccurate assertions made about the extent of methane leakage from natural gas operations. Figures as high as 4% to 10% of produced gas have been suggested, and in the extreme there have been allegations that the further use of natural gas would have a negative rather than positive effect on the greenhouse effect because of this leakage. Fortunately, a number of studies are correcting these inaccuracies.⁷

4.13 The Committee cannot resolve these disparities, but it does emphasize that this is not simply a case of "my numbers are better than your numbers". The difference has important implications for Canada's position as an emitter of greenhouse gases, for its stance in international negotiations to limit emissions, and for its domestic policies and actions.

4.14 The WRI tables, and its "greenhouse index" are the most widely available, comprehensive and up-to-date comparative analysis of greenhouse emissions by all countries: they are widely used throughout the world. The Committee relies on the data in *World Resources 1990-91*, which was published by WRI in collaboration with the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP). Yet the difference between WRI's view of leakage losses and that of the industry itself in Canada alters significantly the total net emissions of greenhouse gases by Canada and the relative significance of the different greenhouse gases, as the following comparison⁸ indicates:

	WRI Tables	CGA Methane Data
	(tonnes of carbon equivalent)	
Fossil Fuels & Cement	48,000,000 (40%)	48,000,000 (50%)
CFC Use	36,000,000 (27.5%)	36,000,000 (38%)
Methane	33,000,000 (30%)	8,700,000 (9%)
Other sources	3,000,000 (2.5%)	3,000,000 (3%)
TOTAL	120,000,000	95,700,000

This change would not alter Canada's position at no. 12 on WRI's global "greenhouse index", since total emissions from the 13th ranked country (Mexico) are estimated at 78 million tonnes of carbon (Table C). It would, however, alter Canada's position in terms of *per capita* emissions, from 4.5 tonnes to 3.6 tonnes (Table D).

4.15 Such alterations in comparative tables are not significant, especially as it may well be the case that similar leakages are overstated for other countries besides Canada. It is, however, a matter of considerable significance that:

- (a) a major source of Canada's contribution to global emissions of greenhouse gases may be seriously overstated, and the industry concerned may be much more efficient than the WRI tables make it appear;
- (b) national priorities on actions to reduce greenhouse gas emissions are likely to be substantially different if methane losses from anthropogenic sources represent less than 10% of net emissions, instead of 30% as indicated by WRI.

4.16 The Committee **recommends** therefore that the federal government investigate urgently the data offered to us by the Canadian Gas Association, preferably through an independent survey of the leakage problem. In addition to clarifying important problems of domestic priorities, we believe that independent evidence on this issue will materially assist Canada in international negotiations on a global warming convention.

D. CARBON DIOXIDE

4.17 Many of the following strategy recommendations were included in our interim report *No Time To Lose*, and are so identified. In this report we indicate in more detail the reasons why these recommendations were made, and some additional recommendations are also added.

4.18 Given that human-sourced carbon dioxide emissions are the principal contributor to increasing atmospheric levels of greenhouse gases, and given that society's use of energy is the largest factor in this CO₂ generation, the Committee

concludes that Canadian energy policy-making must have as its most immediate focus the more efficient and conserving use of energy. Coupled with the more effective use of energy is the need for fuel substitution away from high-carbon fuels and for the commercial availability of technologies for exploiting carbon fuels with less environmental impact. (Interim recommendation no. 1)

4.19 Not surprisingly, organizations and individuals concerned with environmental protection focused on the need for greater energy efficiency and energy conservation. As the *Greenprint for Canada* document submitted on behalf of a large number of environmental, conservation and aboriginal organizations urged

Canadians produce a lot of carbon because Canada's economy is the most energy intensive in the world, using the most energy to produce a dollar's worth of goods and services... We recommend a new national energy conservation program to reduce Canada's energy use and, along with it, carbon emissions.⁹

4.20 The view from environmental organizations was echoed by experts from the academic community, as for instance during the Parliamentary Forum on Global Climate Change:

We must develop a viable, long-term energy policy that is not only technically and economically efficient, but also socially acceptable.

For several years now, analysts have started looking at the energy issue by examining both sides of the equation, not just an increase in the supply of megawatts, but also demand management, expressed as negawatts. Thanks to this approach, analysts determine the famous potential for improving energy efficiency. The approach has also led us to least-economic-cost planning, including tendering mechanisms, which allows us to have a freer energy market and has produced very encouraging results where it is already in use.¹⁰

4.21 It was also reassuring to learn from witnesses in energy-consuming industries that efficiency and conservation are effective, realistic and timely priorities. Here, however, there were obvious differences in attitude. From electricity utilities, for example, we heard enthusiasm from Alberta:

In summary ... we would like to see means come forward that Canada can maximize its contribution globally [to emissions reductions]. In that respect, we see conservation and efficiency improvement as key, and technological development to apply within the globe as key...

On the conservation side, ... I believe the company has been very effective in demand-side management of the load-shifting kind...

However, I think it is very important for us to recognize environmental costs in the future, and they have to be incorporated into our cost structure... As we do that, that will mean our marginal cost, our incremental cost of new capacity, will become greater than the average embedded cost our rates are set upon.... Right now in Alberta the reality is that our marginal cost is pretty much equal to our embedded. So to get into a demand-side management program such as B.C. Hydro and Ontario have started, where rebates and money or cash are actually given to customers to buy reductions in load, would put a burden on our other customers...

... The one thing we are missing in our marginal cost is the degree to which we recognize real environmental costs.¹¹

This enthusiasm did not appear to be evident in the utility serving the neighbouring province of Saskatchewan:

[D]emand-side management, as we see it, is not a solution to this problem, and we firmly believe that...

If the decision is that we in Canada want to change our lifestyle—and I mean a significant change in lifestyle—then, yes, you can do this. But the assumption we at Saskatchewan Power make is the only assumption we believe we can make. We have a mandate to serve our customers. That is what our job is. Our job is not to change the lifestyle of our customers. And we believe we must meet the load-growth. As industry develops, energy is required. If we want to stop development in the country, then in our view the solution of conservation is the one you look to.¹²

4.22 Similarly, a marked lack of enthusiasm for new vehicle fuel-efficiency (CAFE) standards in the evidence from the Motor Vehicle Manufacturers' Association was countered by the consumer view presented by the Canadian Automobile Association:

[W]e should really give motorists the tools they need and want, automobiles which run on lower polluting energy... There are several options now available, many of which may become practical over the next few years.... The federal government in particular should show the leadership necessary not only to develop alternate fuel technology but equally to develop markets and distribution infrastructure...

[I]n Canada we do not have ... formalized CAFE standards. What we would suggest is we do have voluntary standards that industry has agreed to live by. If those are not being lived up to, then we would recommend formalizing the standards...

Without qualification, we have a consumer base out there willing to contribute significantly to environmental preservation, conservation and protection...

You can also go one step further and suggest that experience has shown... that people have downsized their vehicles. People have driven less as a result of their ecology-mindedness. It certainly has a relationship also to economic-mindedness as well as social-mindedness.... There is a willingness on the consumer's part to be environmentally conscientious to the point of paying more for a vehicle that is more environmentally friendly.¹³

4.23 In the Green Plan, the federal government has accepted that

The immediate emphasis ... must be on improving energy efficiency across a broad spectrum of uses, from consumer products to buildings, transportation and our major industrial sectors.¹⁴

The government also plans to introduce a National Energy Efficiency and Alternative Energy Act, to raise the fuel-efficiency targets for new vehicles, and to take other steps in the direction of our recommendation. The Committee welcomes these initiatives, and attaches importance to the fact

that they are set within an environment and sustainable development context, rather than in response to short-term rises in fossil fuel prices as was the case a decade ago. We hope that this will ensure that energy efficiency and conservation remain continuing commitments. Canada's standards certainly should be no weaker than those required in other comparable jurisdictions. The evidence presented to our Committee makes it clear that such initiatives are necessary, are achievable, will be welcomed by the Canadian public, and will be welcomed also by the most forward-looking and vigorous elements of Canadian industry and business.

4.24 The Committee recommends that federal and provincial strategies to combat human-induced global climate change combine strong regulatory systems with a careful utilization of market forces to develop economically efficient programs for reducing greenhouse gas emissions in Canada. (Interim recommendation no. 5)

4.25 There seemed general agreement that both market forces and government regulation will be necessary if the targets for emission reductions are to be achieved. Understandably, there is debate on where the emphasis should be, and the extent to which government actions should be prescriptive, rather than providing a set of requirements that industry and business can satisfy by means that they determine. We have already quoted the confidence in market forces expressed by Friends of the Earth and by Amory Lovins (para. 2.20). It is relevant also to mention that a blend of regulatory and market forces is considered desirable by important elements of the private sector. The Canadian Gas Association told us that:

In general we believe that after consultation with all the stakeholders the government has the responsibility, of course, to set overall standards and emission limits and then to establish the new playing field and to keep it as level as possible, with penalties and rewards if that is appropriate. But we believe that it should be left to the private sector and the marketplace to develop the most cost-effective way of meeting those standards; in other words, that government should not mandate the precise means of solution, in our opinion, but set the standards.¹⁵

4.26 The witness from the Institute for Research on Public Policy looked back to the experience of a decade ago in the U.S.A. and Canada:

The fact is that when we actually had major increases in energy prices in the mid to late 1970s we got an enormous explosion of technological innovation in the private sector....[W]e reduced energy use substantially during that period; we got all sorts of new ways of doing things, and the market, to an extent, worked well.

On the other hand, the market is not a perfect instrument...

If it [were], it would obviously be levying a much higher charge on energy production, particularly on coal use, because in fact coal use is costing us an enormous amount in terms of air pollution, in terms of sulphur dioxide and in terms of carbon dioxide. The market does not adequately levy that charge, so we have to find a way to help the market to levy that sort of charge.¹⁶

4.27 Mr. Eric Haites, the author of a study for federal and provincial energy ministers that took an optimistic view of the benefits to society from energy savings, reminded us that the market did not necessarily act in the interests of society as a whole, and that incentives might be needed:

By doing everything technically possible to reduce CO₂ emissions without regard to cost, the Toronto Climate Conference goals can just be achieved. The measures economically attractive to society achieve only about 75% of the target. Market penetration alone achieves less than 15% of the CO₂ emission goals.¹⁷

4.28 These conclusions accord with common sense: let the market do as much of the task as possible, but do not expect the market to define a task like reduction of greenhouse gas emissions, and do not expect that the market is all that will be necessary. At present Canada and other countries appear to be entering a period of partnerships rather than ideologies, and the Committee believes that federal and provincial emission reduction strategies should be based on a framework of partnership.

4.29 The Committee believes also that successful implementation of this recommendation requires federal and provincial governments to ensure that the playing field occupied by competing energy systems is as level as possible. Markets may never be perfect, but strongly asymmetrical markets are no basis on which to rely in achieving emission reduction and similar targets. It may well be that some of the complaints we heard were unjustified or of minor significance; in the absence of hard evidence on the true costs of different energy forms (see para. 2.22), this is difficult to determine. We recommend that the federal government sponsor such a study. We also suggest that the proposed National Energy Efficiency and Alternative Energy Act should incorporate provisions that eliminate many of the existing inequities and that ensure a level playing field is maintained in the future.

4.30 The Committee recommends that all federal departments and agencies, as part of their budget submissions, report on the direct and indirect impacts of their operations on global warming, and set annual targets for reductions in greenhouse gas emissions. (Interim recommendation no. 17)

4.31 This recommendation needs little justification: the Green Plan states the situation very clearly:

The federal government is the largest single "business" in Canada, with expenditures of \$125 billion and over 585,000 public servants and employees of Crown corporations. As the largest commercial landlord, it owns or leases 25 million square metres of office space. There are more than 50,000 buildings and facilities in its inventory, ranging from office buildings to laboratories, parks and military bases. Government purchases from the private sector total more than \$9 billion each year from thousands of consumer, commercial and industrial goods...

[T]he Government of Canada is ready to move as quickly as possible to ensure that it becomes one of the most environmentally sensitive jurisdictions in the developed world.¹⁸

4.32 The opportunity in regard to greenhouse gas emissions is here and now; as the Committee keeps insisting, there is "No Time To Lose". Clearly the main burden is on the Department of Public Works (DPW), which is responsible for most of those 50,000 buildings and facilities, and the energy they consume. The Committee also suggests that departments such as DPW and Supply and Services Canada should have the additional responsibility of identifying emission reduction strategies relevant to typical government activities that are beyond their direct control, but that can be adopted by individual departments and agencies.

4.33 The enthusiasm expressed in the Green Plan is welcome. However, the Committee notes that some of the evidence it heard indicated that in the past the federal government has been neither enthusiastic nor innovative in regard to energy efficiency. It appears to us that the federal government should be in the vanguard of efforts to improve energy efficiency and reduce emissions. In this context, we suggest action of the kind that we were told was taken a few years ago by the Toronto District Heating Corporation:

[W]e had a funny kind of auction. We went out to the engineering community and said we want you to bid on energy improvements on our main heating plant for \$1 million; what are you going to give us for \$1 million. We will give you \$1 million... If you do not meet what you say you are going to do, there will be a penalty.

The best one, and the one that was awarded the contract, came in with a \$980,000 per year saving in energy use in that main plant. Actually by the time it was implemented natural gas prices went down and it finished up—it has been in place now for three years—with an average of over \$800,000. It did not quite meet the target, but the energy price went down, which is stupid in this day and age...

It is enormously easy, really, compared with other things, to reduce the energy use for buildings and for building systems. All you need is for someone to take charge and do it.... That is a good role for the federal government—cut energy use in Canada's buildings by 60% in the next 10 years. It is achievable.¹⁹

4.34 The Committee concludes that Canada's electric utilities are a key element in reducing greenhouse gas emissions and urges provincial, territorial and municipal governments to direct utilities to take the lead in developing programs for electricity demand management and for introducing new technologies which improve—in both an energy and an environmental sense—the production, transmission and consumption of electricity. (Interim recommendation no. 9)

4.35 On the evidence presented to us, the most urgent need is for new attitudes in many of the electricity utilities themselves. This may require a formal change in their mandates, but the Committee doubts this. What seems more relevant is for senior management to take a new and expanded view of their existing mandates. Members of the Committee, like other Canadians, expect that when we turn the switch, the light will come on, but we do not think this is incompatible with a strong interest in demand management by electric utilities. It seems clear that attitudes are changing, but apparently not fast enough. As Mr. Lovins commented,

Most Canadian hydros—and I think in terms of senior management I would say all of them except B.C. Hydro—are still at an early stage of reforming their mission and culture to reflect the realities of the competitive energy service marketplace. That is, most of them still believe they are in the business of selling kilowatt hours...

But we are now in an era of relatively costly electricity and relatively very cheap efficiency ... It is therefore logical to expect that customers want to buy less electricity and more efficiency...

I therefore suggest it is high time to redefine the hydros' mission not as the production and sale of kilowatt hours, but as the production—I hope profitable—of customer satisfaction, delivering the energy services customers want, such as hot showers and cold beer, reliably and at least cost, whether that means investing in supply or on the customer's side of the meter.²⁰

4.36 The Committee, indeed, would like to go beyond the recommendation that we made in our interim report, which was limited to the electricity utilities' role in electricity supply and demand. We believe that the structure of electricity supply in Canada, and the examples in the United States that were drawn to our attention, suggest that electricity utilities have a broader role to play in promoting energy efficiency, especially in regard to individual consumers and residences.

4.37 Canadians have several choices in home heating, the main ones being natural gas, oil, and electricity. Oil is typically supplied by small retailers, whereas natural gas and electricity are supplied by regulated monopolies. However, whereas not everyone has an oil or gas furnace, essentially every Canadian has an electricity supply, whether or not it is the primary form of home heating. Electricity utilities are therefore well-positioned to provide the type of energy efficiency retrofitting suggested by Dr Robinson (para. 2.31), i.e. the utility assesses the opportunities, undertakes the work, and monitors and guarantees the results. In the situation suggested by Dr Robinson, there need be no financial outlay by the consumer, since the marginal cost of supplying unnecessary energy is greater than the cost to the utility of carrying out the work. Both utility and consumer benefit. However, it is easy to envisage a pricing mechanism that would allow the utility to be reimbursed for its expenditures in a house that used another form of heating.

4.38 Such a pricing mechanism should not involve a substantial upfront payment by the consumer: the Committee heard a good deal of evidence which emphasized that this is exactly the situation that will not lead to widespread improvement. Individuals typically and logically attach a much lower present value to future benefits than businesses and money markets. What the Committee has in mind is a version of the PITE mortgage payments advocated by Dr. Robinson (para. 2.30). The PITE type of mortgage incentive makes excellent sense in regard to new construction, and the Committee **recommends** that Canada Mortgage and Housing Corporation should take the lead in introducing it in Canada. In regard to retrofitting a gas- or oil-heated residence, the Committee could similarly envisage the electricity utility being repaid over time from the money saved by the consumer in energy costs.

4.39 It may reasonably be asked: why should this task be undertaken by a public utility? Why not by specialist firms that can also be repaid through a portion of the energy savings to the consumer? The prospects for this were examined in 1988 in a report for the International Energy Agency, entitled *Contracts for Energy Management: A New Approach to Energy Efficiency*. This report concluded that, although energy performance contracting was developing in the U.S.A. and Canada, and the Government of Canada was "playing an exemplary role" in communicating its advantages,

The **residential sector** is unlikely to form a significant market for energy performance contracting...[T]he concept is not likely to make a major impact in single family dwellings because [of] the importance of lifestyle and behaviour in determining energy use, and thus the difficulty of predicting and attributing savings.

4.40 We recognize such difficulties, but we believe that the possibility of such a program should be actively explored by electricity utilities. The type of improvements we have in mind should not lead to significant changes in lifestyle or behaviour; in Canada, for example, there is much less chance than there is in some European countries that improvements in insulation, etc. will be taken in the form of higher indoor temperatures rather than energy savings.²¹

4.41 The Committee recommends that fuel efficiency standards be legislated for cars and trucks. (Interim recommendation no. 10)

4.42 Since, in the Green Plan, the federal government has indicated its intention to act on this recommendation, little comment is necessary here. The Committee believes, however, that these standards should be set in more ambitious terms than in the past, and that Canada should not necessarily continue to follow the overall vehicle fuel-efficiency standards adopted in the United States. We were encouraged, for example, by the general support expressed by the Canadian Automobile Association for adoption in Canada of the stringent vehicle emission standards now being introduced in California.²² The Committee recognizes that the market in new cars is a global one, and that the market share of the U.S.A. will always be much larger than that of Canada. We suggest, however, that Canada should take the initiative in proposing higher standards; we believe that this would be welcomed and supported by many Americans.

4.43 Recognizing that Canada's forests are a major reservoir for atmospheric carbon and that the losses of forest stands through commercial harvesting, wildfire, insects and disease have resulted in a rate of harvesting of Canada's commercial forests and wild lands exceeding the rate of restocking, the Committee recommends that:

- (a) the federal government expedite negotiations with the provinces on federal-provincial agreements for the management of Canada's forests;**
- (b) provincial governments be urged to ensure that NSR ("not sufficiently or satisfactorily restocked or revegetated") lands are adequately forested through replanting programs or through natural regeneration of the forest cover, and in a reasonable period of time;**
- (c) the losses to wildfire, insects and disease be reduced wherever possible; and**
- (d) future forest resource development agreements be linked to prompt regeneration and protection of all deforested areas, whether harvested commercially or depleted naturally. (Interim recommendation no. 12)**

4.44 The vast forested areas in Canada are a significant element of the global carbon balance. It is difficult to provide accurate estimates of the balance, especially on a year to year basis. Insects, disease and wildfires are responsible for the removal of about 4 million hectares per year, compared to a commercial harvest of about 1 million hectares. These natural removers are, however, extremely variable from one year to the next: in 1989, for example, over 7 million hectares were lost to fire alone. The most recent estimate by Forestry Canada is that there is a net carbon accumulation over emissions of 116 million tonnes. However, since the carbon accumulated in Canada's forests is estimated at 226 billion tonnes, the net accumulation is relatively small.²³ Reductions in wildfire and other losses could make a substantial contribution to carbon storage.

4.45 In January 1990, Environment Canada published maps of the ecoclimatic provinces of Canada as they are at present and as they may be by the middle of the next century, only 60 years from now, if global warming proceeds at the present rate (Figs. 13 and 14).²⁴ They show a boreal forest zone reduced from 29% of Canada's land area at present to only 15% in 2050. Still more important, the maps suggest that the boreal forest zone west of James Bay practically disappears by 2050; it is reduced to three small and widely separated remnants.

FIGURE 13: ECOCLIMATIC PROVINCES OF CANADA 1990

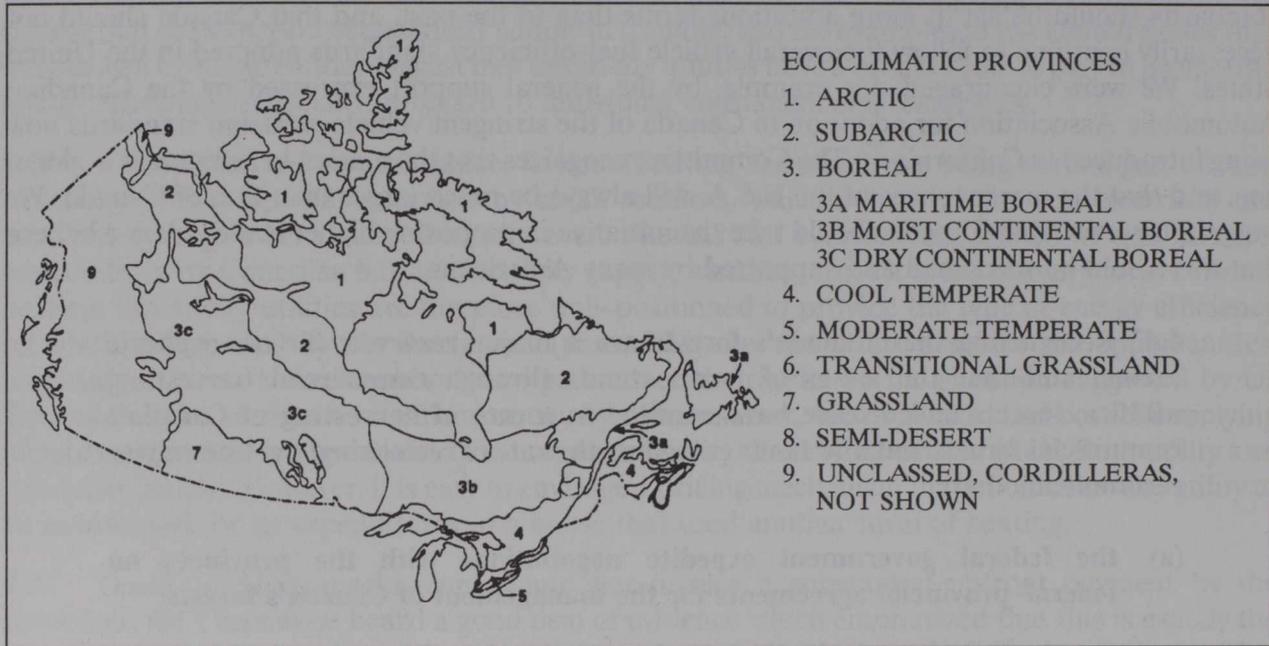
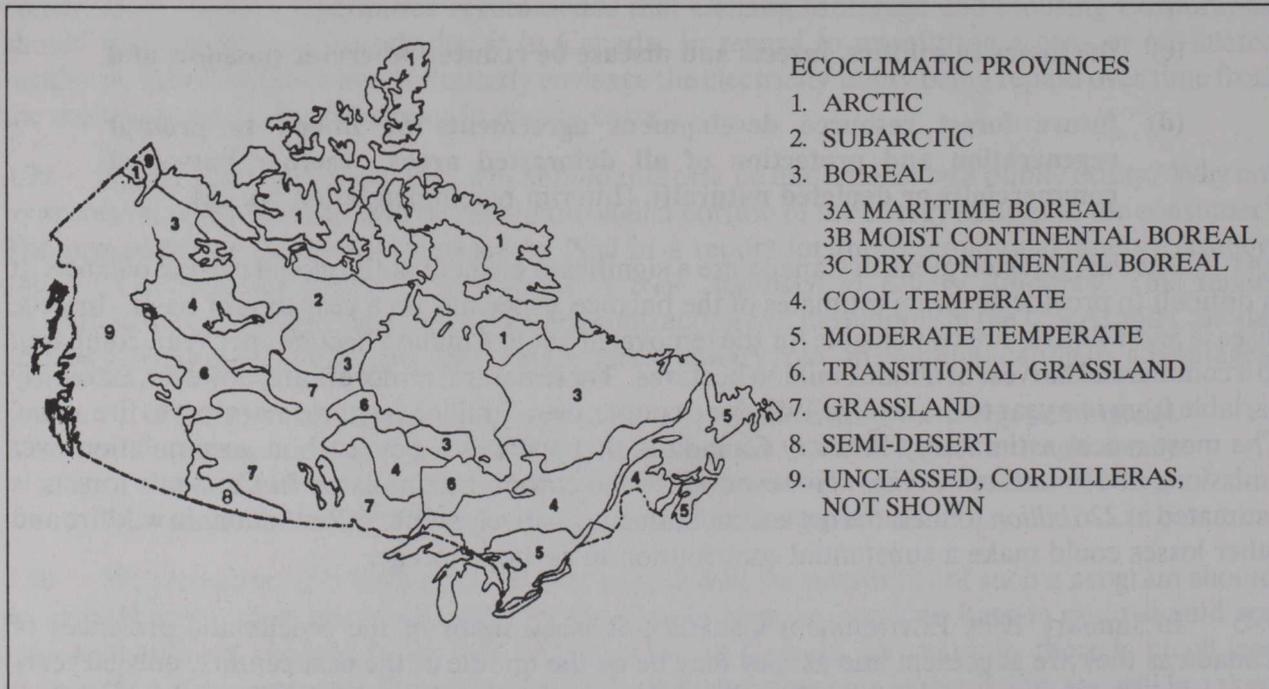


FIGURE 14: ECOCLIMATIC PROVINCES A 2050 SCENARIO



4.46 There can be few more graphic illustrations of the potential impact of global warming on Canada. In economic terms, the forest products industry is the largest single industrial sector in Canada. Canada accounts for 21% of total world trade in forestry, producing an annual trade surplus of \$20 billion a year. As Dr. Maini of Forestry Canada reminded the Committee,

The total value of exports from forestry almost equals fisheries, mines, minerals, energy and agriculture put together.²⁵

4.47 Of course, a significant part of the Canadian forest industry does not depend on the boreal forest, and the Environment Canada maps do not suggest that the boreal forest will have been eliminated from these areas by 2050, merely that the climate will have changed to one favouring another type of climax vegetation. Neither of these considerations provides much basis for reassurance, however. It has also been pointed out that the productive Douglas fir stands below 300 m in southern British Columbia are vulnerable to a warming of climate, since it may be difficult to meet the winter "chilling requirement" of the species.²⁶ In the boreal forest, a working group of the Intergovernmental Panel on Climate Change noted that

[C]limate will probably change faster than tree species can naturally respond (eg through migration). Second, new sites may not be edaphically hospitable, having evolved over thousands of years under other climatic and vegetative regimes.... Forests in areas of large climatic changes over the next 50 years will likely display massive readjustments, with concomitant large reductions in the area of healthy forests...²⁷

4.48 The Committee believes, therefore, that Dr. Maini was being very conservative when he told us that

... at best we can hope to maintain our present productivity. At worst, it could decline.²⁸

4.49 It seems clear that both the threat of global warming and the demands of sustainable development will force major changes in the way that Canada administers its vast forest areas. In 1990 the Green Plan announced Canada's intention to manage our forest resource "without prejudice to its future productivity, ecological diversity and capacity for regeneration": i.e. for sustainable development rather than merely for sustained yield.

4.50 The specific items indicated in our recommendation would contribute to improved management of Canada's forests and at the same time make a significant contribution to fixing carbon dioxide in growing trees. As Dr. Maini commented, "Forests can be an important part of developing a balanced carbon budget"²⁹, and nowhere more so than in Canada.

4.51 Given that vigorously growing trees are an effective means for extracting CO₂ from the atmosphere, the Committee recommends that the federal government take the lead in establishing federal-provincial-municipal programs to encourage development of forests on otherwise unused lands, dedicated to sequestering atmospheric carbon as an intermediate term strategy for reducing CO₂ levels in the atmosphere. (Interim recommendation no. 13, slightly amended)

4.52 In the Green Plan, the federal government has announced that it will initiate a community tree-planting program, designed to plant 325 million trees in the period 1991-1996.

One hectare of forest can absorb and store between 150 and 300 tonnes of carbon. In addition, in urban areas, trees can lower peak energy demands by 20 to 40 per cent simply by providing shade and windbreaks.³⁰

4.53 In addition to conventional approaches, the Committee heard evidence on a more novel approach:

Tree farming ... using rapid growing trees having a two- to five-year maturity. They might be planted on marginal farm land... This is by far the fastest and most efficient way to remove carbon dioxide. We in Canada can grow trees significantly more rapidly than natural trees can be grown in the tropics....

These rapid-growing trees have been growing on the basis of pulling carbon dioxide out of the atmosphere and are extremely efficient in doing so. They grow something in the order of 10 times faster than natural trees in Canada.³¹

4.54 But what happens to the trees, and the carbon they contain, when they reach maturity? Our witnesses (from Techrol Inc. and Iogen Corporation) saw this resource as the basis of an ethanol-from-biomass program, substituting for fossil fuels. The implications of this (not least for the vast areas of planting that are envisaged) go well beyond the 1990s that are the focus of this chapter. Nevertheless, the Committee feels that experiments may be encouraged during the 1990s using such fast-growing species, within the context of the tree-planting program announced by the federal government.

4.55 The Committee recommends that the federal government use environmental considerations as a filter for its foreign aid and trade initiatives, encouraging programs and technologies which convey environmental benefits and ending or modifying those that are environmentally unacceptable. (Interim recommendation no. 8)

4.56 This is clearly an issue that goes well beyond the subject of global warming and the reduction of greenhouse gas emissions. Nevertheless, it is difficult to ignore the significance of global warming, since so many of Canada's aid and trade initiatives have greenhouse implications (e.g. coal exports, power development, assistance for agriculture, forest product industrial development in the tropics.)

4.57 The Committee observed a clear distinction between the witnesses who gave evidence from a foreign trade perspective and those who represented Canadian aid channels. The witness from the Canadian International Development Agency (CIDA), although she recognized the need to respect the sovereignty of the countries with which Canada has dealings, made it clear that the type of filter the Committee has in mind is already in place in the Agency:

Since 1986 the Canadian International Development Agency has been conducting an environmental assessment on all projects that we have abroad. This is a commitment we will pursue, and we have definitely made environment a top priority...

We are basically, in most of these projects, but a tiny participant in an activity. Very often that activity is being funded by a great number of nations, or partly by the recipient countries. We are requested to join in a project. Before we join in the project, we do an environmental assessment to determine whether we want to associate ourselves with that project.³²

4.58 That is not the situation which exists in regard to Canada's international trade, when CIDA is not involved. The Committee was told by the witness from the Export Development Corporation (Mr. R.L. Richardson) that a requirement for such an assessment would seriously damage the ability of Canadian business to compete in the international market:

Mr. Fulton: ...Do you not think we should in fact be enacting amendments to the legislation under which you operate that do provide direction not only to the EDC, not only to those Canadian firms who are using you as a financial instrument, but also to the buyers so that they know we are involved in some kind of screening, be it related to the best available technology or serious global environmental protection?

Mr. Richardson: No. My answer is "definitely not". To notify our buyers in other countries that we have a constraint placed upon us that will prevent us from offering similar financing to that which all the other major creditor countries offer would be a signal to all the buyer countries not to consider Canadian exporters for their products and services. I think it would be an announcement to the world that Canada wishes to be left aside in the international trade business.³³

4.59 The Committee recognizes that it is one thing to have such a filter in regard to public funds used as development assistance, and perhaps something else when it is a matter of supporting Canadian entrepreneurial activity. We recognize also that, even in the aid context, environmental considerations such as global warming may be evaluated differently in regard to a situation of abject poverty or ill-health in the recipient country. Nevertheless, it seems neither morally right nor in Canada's own self-interest that we should turn a blind eye to one set of activities while at the same time we insist on a more rigid set of standards in regard to activities that differ primarily in regard to the method of financing. If, for example, Canada found it impossible on environmental grounds to provide aid for the construction of a mill that would devastate an area of tropical forest, is it acceptable for a similar mill to be financed with Canadian entrepreneurial capital? And should the Canadian government provide export guarantees for the latter enterprise?

4.60 These are hard questions, but ones which the fact of global warming is forcing us to face as a nation. More positively, the Committee suggests that more could be done, in both trade and aid contexts, to "encourage programs and technologies which convey environmental benefits." This leads to our next recommendation.

4.61 The Committee recommends that the federal government develop policies and programs which encourage Canadian companies to commercialize and export technologies and equipment that are effective in reducing greenhouse gas emissions, particularly to developing countries which are striving to build their domestic economies. (Interim recommendation no. 7)

4.62 This is clearly a matter of Canada's own self-interest, not merely in terms of trade development opportunities but because of the global threat represented by the potential growth in fossil fuel emissions as developing countries industrialize rapidly. China and India are already among the largest emitters of CO₂ from coal burning and their development plans envisage enormous expansion of coal use. The need for environmentally-benign alternatives to present energy use will be immense. As Mr. Haites noted in his evidence,

Resources that are currently available include hydro and nuclear electricity generation. Resources currently under development, such as thermal and photo-voltaic solar, wind, tidal, geothermal and biomass move more quickly into the marketplace if they are competing against higher priced fossil fuels.³⁴

4.63 Meanwhile, Canada is among those industrialized countries that are attempting to develop such alternatives, and to improve its use of carbonaceous energy sources. In Alberta, for example, TransAlta Utilities Corporation is attempting to adapt the integrated gasification combined cycle (IGCC) process to achieve substantial reductions in CO₂ emissions. As the Corporation's witness pointed out,

If we can develop technology that means China and India will burn coal more efficiently in the future, because they surely will burn coal, then we can make a greater contribution to the globe that way. They will burn vast quantities compared to us.³⁵

4.64 Given the interconnectedness of the global environment and the necessity of assisting the developing world in protecting our common environmental heritage, the Committee recommends that the federal government, through its own agencies and through Canada's membership in multilateral organizations, advocate programs to reduce deforestation and to encourage reforestation and the planting of forests in developing countries. Support for these activities by the federal government must not reduce current and planned Canadian support for other development assistance programs. (Interim recommendation no. 14)

4.65 The Green Plan commits Canada

to participate actively in the development of the proposed international convention on forests... This will help to promote the sustainable development and conservation of the world's forests.³⁶

4.66 Canada, we were told by the CIDA witness, is already active in regard to our recommendation:

We are involved in a number of projects that are trying to enhance the management of the tropical forests. We have been leaders in trying to regroup donor countries to address the entire issue of the management of the tropical forests...

We require replantation programs for projects with which we are associated. I cannot say... that always might have been the situation in the past, but it was not in Canada as well. We are all learning. The practices of the past should not be the practices of the future ...³⁷

4.67 The Committee supports such initiatives, although we wonder whether Canada's activities in this area are at all commensurate with the scale of the problem, whether that problem is considered from a development or a global warming perspective.

E. CAN THESE SHORT-TERM OBJECTIVES BE ACHIEVED?

4.68 At the beginning of this chapter, the question was raised: will this strategy for the 1990s be effective? Is it likely to achieve the federal government's goal of capping greenhouse gas emissions at their 1990 level by the end of the century, or keep Canada on target to meeting the Toronto Conference target of a 20% reduction from 1988 emission levels by 2005?

4.69 The Committee cannot guarantee success, nor can it predict failure: we do not have either the competence or the chutzpah to make such an assessment. It is clear, however, that success or failure will depend to a very large extent on "the more efficient and conserving use of energy" and we heard from both Canadian and foreign witnesses who had grounds for believing that the target could be achieved. Mr. Haites, for example, suggested that the Toronto Conference target could be achieved through

... 75% conservation – improved efficiency is a more accurate term – and 25% switching fossil generation effectively to hydro.³⁸ (See also para. 5.8)

4.70 It was disturbing therefore to learn from a senior official of Environment Canada, Mr. Robert Slater, that there appears to be a significant division of opinion about the efficacy of such measures between Canadian experts on the one hand and European experts on the other.

[T]he sorts of [energy efficiency] measures ... listed... are exactly the same sorts of measures contained in the German proposals that are working their way through the system, the same sorts of measures the Swedes.. Netherlands.. and Norwegians have talked about. The big difference is in the results people expect to achieve from what seem like very similar sets of measures they propose to take....[T]he Germans believe they could achieve a 25% reduction in energy consumption by the year 2005 based on 1990 emission levels.

[O]ur colleagues in the Department of Energy, Mines and Resources .. have taken that same array of measures and have said it would give rise to somewhere between a 10% and 12% reduction in the growth rate by the year 2005, but still implying a substantial growth...

So we are clearly faced with a huge difference in our forecasting...

Quite frankly, we do not understand why that should be the case...

One final point is the Germans told us, when we met with them in the last few days, that during the last year they achieved a 4.4% increase in gross national product and a 1.9% reduction in energy consumption. I am equally advised that in Canada, since 1988, our carbon dioxide emissions have gone up by some 10% or 11% or so.³⁹

In its August 1990 discussion paper on "Energy Use and Atmospheric Change", Energy, Mines and Resources Canada suggests that a broad package of efficiency and alternative energy initiatives ("intended to achieve energy savings at no net economic cost to society") would reduce Canadian carbon emissions by 35 to 50 megatonnes in 1990. Since "life as usual" was expected to lead to emissions of 596 megatonnes by 2000, an additional reduction of 38 to 53 megatonnes would be required if total emissions in 2000 were to be stabilized at the expected 1990 level of 508 megatonnes.⁴⁰

4.71 The Committee believes that this is an issue that should be resolved as decisively and as rapidly as possible. In principle, since Canada is more profligate in energy use than the European nations mentioned, efficiency measures should be quantitatively more effective, not less. Certainly, it would be difficult to envisage success in such measures, or their vigorous prosecution, if the federal department that would be most concerned with implementation is convinced that their effect will be modest.

4.72 In his evidence on this matter, Mr. Slater suggested that the International Energy Agency might be asked to convene a technical workshop so that those responsible for evaluating the measures in the various countries could compare their assumptions and methods, and if possible reconcile their differences. The Committee would endorse such an initiative by Canada, and any other necessary action. We reiterate that this issue is both urgent and of vital importance.

NOTES AND SOURCES

1. *Green Plan*, p. 100.
2. *Green Plan*, p. 108.
3. *World Resources 1990-91*, Table 24.2.
4. *Ibid.*, Table 24.1.
5. Vol. 38, pp. 36, 42.
6. *World Resources 1990-91*, p. 352.
7. Vol. 38, p. 36.
8. WRI data have been used throughout, except that the value for Canadian "pipeline leakage" in the WRI Table 2.1 (7,800,000 tonnes of methane) has been changed to 198,000 tons (CGA estimate). WRI methods of calculating the *net* emissions to the atmosphere, and the carbon equivalent, have been followed (see notes to Table 24.2 in the WRI volume).
9. Vol. 24A, p. 24.
10. *Parliamentary Forum*, pp. 109-110.
11. Vol. 28, pp. 11, 13.
12. Vol. 30, pp. 10, 16.
13. Vol. 38, pp. 14, 15-16, 22.
14. *Green Plan*, p. 103.
15. Vol. 38, p. 41.
16. Vol. 19, p. 56.
17. Vol. 22, p. 32.
18. *Green Plan*, p. 159.
19. Vol. 41, pp. 28-29.
20. Vol. 38, pp. 54-55.
21. See the discussion on this topic in Jackson, C.I., ed., *Human Settlements and Energy*, Pergamon Press, Toronto, 1977, pp. 97-98.
22. Vol. 38, p. 15.

23. Forestry Canada, personal communication, March 1991.
24. Rizzo, Brian, "The Ecosystems of Canada in 2050: A Scenario of Change", *State of the Environment Reporting*, newsletter no. 5, Environment Canada, January 1990.
25. Vol. 22, p. 7.
26. Lavender, Denis P., "Predicted Global Warming and the Chilling Requirement of Conifers", pp. 30-32 in Spittlehouse, D.L. and D.F.W. Pollard, eds., *Climate Change in British Columbia - Implications for the Forest Sector: Developing a Framework for Response*, FRDA report no. 075, Forestry Canada, Victoria, B.C. 1989
27. Intergovernmental Panel on Climate Change, draft report of Working Group 2 (*Likely Impacts of Climate Change*), Chapter 2, sect. 3.4.1.
28. Vol. 22, p. 13.
29. Vol. 22, p. 12.
30. *Green Plan*, p. 107.
31. Vol. 27, pp. 10-11.
32. Vol. 39, pp. 6, 9.
33. Vol. 46, p. 51.
34. Vol. 22, p. 35.
35. Vol. 28, p. 11.
36. *Green Plan*, p. 65.
37. Vol. 39, pp. 9, 10.
38. Vol. 22, p. 41.
39. Vol. 41, pp. 64-65.
40. "Energy Use and Atmospheric Change, A Discussion Paper", 10 August 1990, Chapter 6.

BEYOND 2000: STABILIZING GLOBAL GREENHOUSE GAS EMISSIONS AT A SUSTAINABLE LEVEL BY 2050

A. WHAT DO WE HAVE TO DO TO STABILIZE GREENHOUSE GAS EMISSIONS?

5.1 In our discussion of targets (para. 3.12), the Committee suggested the basic global objective should be to achieve stabilization of greenhouse gases by the middle of the next century, at levels that are well below the equivalent of doubling atmospheric carbon dioxide by comparison with the situation before the industrial era. Canada intends to stabilize its emissions by the year 2000, but we need to remember that this will only be a partial solution to what is a global problem. It is unreasonable to expect developing countries to place similar limits on their current emissions. This would be tantamount to saying: "We in Canada and other industrialized countries have achieved our level of development by a heavy reliance on fossil fuels for the last two centuries or more. But this has caused the crisis of global warming, and therefore the developing countries must not anticipate similar use of their energy resources."

5.2 Fig. 8 can be regarded as an "equity graph": it takes the total estimated carbon emissions throughout the world in a recent year (1984), and then allocates this on an equal *per capita* basis over the expected world population in 2025. It says, in other words, "Let us agree to limit global carbon emissions at their 1984 level, and accept that every human being in 2025 has an equal right to emit his or her share of this total." It is evident that this would mean an enormous reduction by those parts of the world that are already industrialized. The graph was prepared to assist in developing a national strategy for the Netherlands, and the Dutch government's witness remarked to our Committee that

[T]he target I initially mentioned of 80% reduction from a sustainability point of view was derived simply from looking at what the world emissions are, assuming you have to achieve an equitable distribution amongst the citizens of this world. If you do it at a level that is a little bit higher than what we have today, then you see that western Europe has to go back to 0.6 tonnes of carbon per capita. Given the fact that we [in Europe] are somewhat up to 2.6 or so, for us it would mean 80% reduction. I am afraid for Canada it would mean more.¹

Indeed it would.

5.3 In any case, limitations on emissions do not equate to a limitation on concentrations in the atmosphere. As the Intergovernmental Panel on Climate Change reported,

Atmospheric concentrations of the long-lived gases (carbon dioxide, nitrous oxide and the CFCs) adjust only slowly to changes in emissions. Present day emissions of these gases are committing us to increased concentrations for decades to centuries. The longer emissions continue at present day levels, the greater reductions would have to be to stabilise at a given concentration.

The long-lived gases would require reductions in man-made emissions of 60-80% to stabilise their concentrations at today's levels; methane would require only a 15-20% reduction.²

5.4 Capping Canada's greenhouse gas emissions at the 1990 level will therefore not be an adequate contribution to the ultimate solution of the global warming problem. Nor will achievement of the Toronto Conference target of a 20% reduction from 1988 levels by 2005. The Conference itself recognized that the latter could only be "an initial global goal".³ The IPCC working group's assumptions in regard to stabilization of greenhouse gases by the middle of the next century included the following:

- Full phase-out of CFCs throughout the world and freezes on methyl-chloroform and carbon tetrachloride.
- Reductions in emissions of greenhouse gases from enteric fermentation in domesticated animals, rice paddies and fertilizer.
- Annual rate of improvement in energy intensity declines from an initial value of between 1.5% and 2.5% to a range of 1.1% to 1.8% during the last quarter of the next century; the average rate from 1985 through 2100 ranges between 1.2% and 1.9% per annum.
- Rapid development and penetration of renewable energy sources, encouraged in part by the global adoption of "carbon fees". Biomass energy represents 10 to 25 per cent of primary energy supply by 2025, depending on economic growth assumptions.
- Tropical deforestation ends by 2025, and about 1,000 million ha are reforested by 2100.⁴

5.5 These scenarios and assumptions are of course highly speculative. The indications of what may be required are nevertheless useful in guiding the research, development and policy formulation that will be needed in Canada and other countries in the years ahead.

B. REDUCING EMISSIONS FROM FOSSIL FUEL USE

5.6 It is evident that, in the words of the Green Plan,

Canada's ability to meet its longer-term goal to reduce greenhouse gas emissions depends upon our ability to move to less carbon-intensive fuels.⁵

Canada needs to do this for other reasons as well: to reduce air pollution and, in the longer perspective, to move towards a sustainable pattern of resource use.

5.7 In achieving such changes, Canada is unlikely to "go it alone". For example, the Canadian Automobile Association's objective (para. 4.22) of automobiles that use alternate fuels is likely to involve vehicle fleets in the United States and the world as a whole. But Canada, as a major developed nation and also a major source of greenhouse gas emissions, has to be one of the pacesetters in altering our dependence on fossil fuels. We also have some problems in this regard that other countries do not share to the same extent, and that need to be addressed.

5.8 In the evidence given to us, the Committee heard much about the prospects for alternative energy sources that was visionary, exciting, and potentially very relevant. It is clear to us that most of these sources are unlikely to make a significant contribution to reducing greenhouse gas emissions before the turn of the century. But vigorous pursuit of such options is essential if Canada is to be ready for the next phase of emissions reductions. As noted in para. 4.69 we learned from Mr. Haites that in order to achieve the Toronto target of a 20% reduction from 1988 levels by 2005, energy efficiency and conservation could get us three-quarters of the way, and alternative fuels the rest. After 2005, however, to achieve a 50% reduction from 1988 levels, more than half the task may need to be accomplished by alternative fuels.⁶

5.9 What we do during the next decade to research, evaluate and develop new and sustainable energy technologies will be crucial for Canada's future. In view of the anticipated growth in global energy demand, they may also be crucial for developing countries' needs, and in the achievement of sustainable development throughout the world.

5.10 As stated in our interim report

The Committee recommends, for the purpose of attaining integrated environmental and economic objectives, that the federal government considerably increase its support for research, development and demonstration directed to:

- (a) the more efficient and conserving use of energy;**
- (b) fuel substitution leading to reduced greenhouse gas emissions; and**
- (c) technologies for producing and using fossil fuels in less environmentally-damaging ways. (Interim recommendation no. 6.)**

5.11 This clearly involves a reversal of the trend during the last ten years. As our witness Mr. Passmore reminded us, the signals given by declining expenditures, termination of programs, research centres and delivery mechanisms, and similar actions may be as important as the loss of research funding:

Basically the signal to official Ottawa was that efficiency and renewable energy is an area that this government is not interested in...

[S]ignals are important, and basically that signal to the Canadian private sector is this: well, okay, this is not an area we should be doing R & D in, this is not an area the private sector should be actively involved in....

The level of contribution of efficiency, renewables... it does not matter what technology you choose — fossil fuels, nuclear — the level of contribution of these sources is not policy independent. In fact, policy is far more important than programs, and indeed, far less expensive for governments.⁷

The signals that were given by government policy and research expenditures during the last decade need to be changed, for the sake of the global environment, global sustainable development, and Canada's own economic self-interest.

C. REGIONAL CONTRASTS IN EMISSIONS FROM FOSSIL FUELS

5.12 In a nation as vast as Canada, it is scarcely surprising that there are huge differences in the levels of greenhouse gas emissions from one part of the country to another. The most obvious contrasts depend on population density. As the witness from the Government of the Northwest Territories reminded us, in the Territories

[O]ur annual per capita production of CO₂ from the combustion of fossil fuels was estimated at 26.1 tonnes, relatively high in comparison with southern Canada. This is primarily a reflection of the distance between our communities, our long, cold winters, and our reliance on diesel fuel to produce electricity...

Although our per capita production of greenhouse gases is high, our total contribution is low.....[I]f a national carbon dioxide emission reduction target is established, we would like to see options developed to determine what share of such a market would be the responsibility of each jurisdiction.⁸

5.13 If the North emits disproportionate amounts of CO₂ from diesel fuel, it avoids the urban smog associated with nitrous oxide and other greenhouse gases in the Windsor-Quebec axis. Less apparent, but perhaps even more important, are the potential problems arising from the major differences in electricity generation across the country. Figure 15 summarizes the main forms of electricity generation, by percentage of total gigawatt hours (GWH) generated in 1986 in each province and the territories.

5.14 The potential differences in impact of efforts to limit global warming on the individual Canadians who are served by the electrical utilities is considerable. Newfoundland, Quebec, Manitoba and British Columbia are all heavily reliant (>90% of electricity consumption) on hydropower. Alberta generates over 90% of its electricity from coal, and Nova Scotia and Saskatchewan are also heavily coal-dependent. New Brunswick (and therefore Prince Edward Island which imports its electricity from New Brunswick) and Ontario depend on nuclear sources to meet a substantial proportion of their electricity needs (more than half in Ontario in the near future).

5.15 It is easy to see from Figure 15 why the prospects of strong policies to shift Canadian energy use away from fossil fuels get a different reaction in different parts of the country, and it is also easy to see that the issue could be a divisive one. As the president of TransAlta noted

[W]e are very concerned about talk of a carbon tax because it could fall disproportionately on Alberta. .. We would think that taxes, if introduced, should be applied to all greenhouse gas emissions and perhaps to waste from other energy forms as well, including perhaps even spent uranium fuel, to keep the total social costs in front of utility managers.⁹

5.16 It is clear that, in regard to electricity generation, a carbon tax would indeed fall disproportionately on Alberta, and on the other provinces that rely heavily on coal as a source of electricity. How is this dilemma to be resolved equitably? TransAlta's recommended approach, a much more enlightened one than we heard from other fossil fuel users in similar positions, put heavy stress on technical methods, but also envisages tradeable emission permits and emission taxes.

5.17 Another regional contrast that needs to be considered in developing global emission policies is that between Alberta and Nova Scotia. Both are heavily coal-dependent in electricity generation, but whereas electric residential heating is common in Nova Scotia, it scarcely exists in Alberta.¹⁰

5.18 The Committee is not in a position to evaluate the implications of these and other regional contrasts for emissions reductions policy. We suspect indeed that many Canadians are unaware that the contrasts are as great as they are. We note that “due recognition [of] the importance of *regional differences*” is one of four basic principles underlying the National Action Strategy on Global Warming,¹¹ but it is not clear to us how this is reflected in the strategy itself. The Committee **recommends** that a study of the regional implications of proposed greenhouse gas limitation measures be included as a vital part of the National Action Strategy on Global Warming. This does not, of course, mean that we recommend preservation of the status quo: quite the opposite. It is evident, however, that some measures may be vital in one part of the country and irrelevant in another. What is economically attractive may also have significant social costs in certain parts of the country, and these costs need to be known.

D. CARBON TAXES, TRADEABLE EMISSION PERMITS, AND OTHER REGULATORY MECHANISMS

5.19 Perhaps understandably, the evidence we heard on the subject of carbon taxes as a means of reducing fossil-fuel emissions seemed more reactive, “knee-jerk”, than informed. Several environmental organizations expressed themselves in favour; most larger users of fossil fuel, such as TransAlta, were anxious to avoid the imposition of such taxes. The organizations responsible for producing the *Greenprint for Canada*, for example, agreed on a recommendation

That by 1991 the government introduce a national carbon tax on fossil fuels to raise up to \$40 billion over 15 years to fund a national energy conservation program to reforest two million acres of NSR lands and to complete the national parks system.¹²

5.20 We also heard two witnesses who, while endeavouring to be less dogmatic on whether or not a carbon tax would be good or bad, nevertheless doubted that it would have the desired effect. First, the witness from the Department of Finance:

We are somewhat sceptical about the use of the tax system. The history of using the tax system on the incentive side is that it has not always been very effective, and if you look at it in terms of creating penalties, you want to choose very carefully where you put your penalties...

Let me give you an example of the sort of thing I am talking about. The IEA [International Energy Association] did a study recently of a hypothetical carbon tax. It is just a first cut, ...but at a carbon tax equivalent to \$8 a barrel of oil, which is a fairly significant rise, they found we would reduce the growth in emissions in the OECD countries to the year 2005 only from 25% to 13%, so you do not get a great response to that particular message going through the price system...

Let us assume there was an objective of reducing CO₂ emissions. The question is, how do you go about it? The regional implications of trying to dramatically change our energy consumption will be the same, whether you do it through taxation or regulation or any other method....[I]t is not obvious that the tax system is the best way to do it.¹³

5.21 A rather similar view had been expressed earlier by an independent consultant, Mr. Ralph Torrie.

One of the ideas for dealing with global warming is to put a tax on carbon-burning fuels. On the surface this would seem to make sense, but I have just finished a comprehensive analysis of what has really happened to energy demand in Canada since the early 1970s. The central finding ... is that the price impact on energy demand has been grossly over-estimated.

It is understandable why it happened. Prices went up at the same time demand went down, and that was enough for the economists to conclude there was a causal relationship...

[However] we estimated that somewhere between 40% and 50% of the improvement in energy efficiency that took place in this country between 1973 and 1987 would have happened anyway due to structural changes in the economy characteristic of all advanced industrial economies....

Quite frankly, whether or not the money is raised by a carbon tax or another point on the GST really is not going to affect the overall level of energy demand in this country very much. This energy demand, per dollar of GDP, has dropped over 30% since 1973 and it is still going down, and it is going down in all the industrial economies.¹⁴

5.22 In our view the case for a carbon tax has not yet been proved, but neither has it been disproved. In regard to the findings just quoted, it is not the overall level of energy demand that needs to be affected to reduce greenhouse gas emission, what is needed is a shift in the forms of energy used. The Committee would be against the imposition of a carbon tax (or similar device) in the present state of knowledge of its potential direct and indirect effects. The Committee believes that it would be worthwhile for Canada to acquire that knowledge, and to monitor carefully the effects of such taxes in those countries that are imposing them.

5.23 The Committee takes a similar view of tradeable permits on greenhouse gas emissions, such as those suggested by the TransAlta witness. In principle these represent assets that can be used as a market-driven incentive to industrial firms, electricity utilities, and other major emitters to reduce their emissions, and sell the unneeded portions of their permits. Again we believe that this option merits serious study, especially as a potential way of reducing the regional disparities in emission patterns that we have emphasized. The Committee regards it as axiomatic that any permit system should provide for a declining total level of emissions over time, consistent with the need to achieve substantial reductions from contemporary levels. The Committee notes that, in the Green Plan, the federal government anticipates the introduction of emissions trading as a means of reducing urban smog.¹⁵ We think this will be a valuable and relevant pilot for the possible use of such permits in regard to greenhouse gas emission limitations.

5.24 More broadly, it seems evident to the Committee that the time is ripe for some new thinking, and especially some new Canadian thinking, on novel mechanisms to achieve the emission reduction targets that we seek. Some of these will be technical, others will involve taxation, regulation, incentives, and the like. There is much we can learn from other countries, and especially the innovations taking place in United States energy supply and demand management. But, as we have endeavoured to show, the Canadian situation is distinctive, and more specific attention to the Canadian situation seems to be needed.

E. ALTERNATIVE ENERGY TECHNOLOGIES

5.25 Through many months of hearings, members of the Committee gained an acquaintance with alternative energy technologies, and consequently the possible shape of Canada's energy future, that we value highly. We recommend the minutes of the evidence presented to us to all those who share our concern for our energy future, and who have a desire to see Canada move into a sustainable development pattern. We heard from experts on hydrogen, fast-growing trees, fuel cells, integrated gasification combined cycle systems, and several others. Our witnesses communicated their enthusiasm as well as their expert knowledge, and we are grateful.

5.26 However, as with regional issues and carbon taxes, the Committee cannot make a judgement as to the efficacy of these systems or their long-term prospects. In most cases, we believe that no one is able to make that type of judgement, since the technologies are still in the development stage and their economic and social implications have scarcely been examined. In this respect they differ substantially from the methods of improving energy efficiency and conservation that we believe will dominate the 1990s. The next decade will be crucial in bringing these systems and technologies to the stage where they can make a significant contribution to meeting Canada's energy needs. We will need them very quickly if atmospheric greenhouse gas concentrations are to be stabilised by the middle of the next century; many people would say that their introduction is already overdue. In reiterating both the recommendation in para. 5.10 and the following one, we have these alternative energy technologies particularly in mind:

5.27 The Committee recommends that the federal government introduce a major research, development and demonstration program with its objective being the commercial development of transportation fuels and systems that result in the lowest economically and technically feasible emissions of greenhouse gases.
(Interim recommendation no. 11)

F. GREENHOUSE GASES AND NUCLEAR ENERGY

5.28 Although nuclear power represents a major source of electricity for a large number of Canadians, its future expansion, in both Canada and the world, is uncertain, and it arouses strong passions, both pro and con, among many members of the public. These differences of view exist also within the Committee.

5.29 The Committee recognizes that energy conservation is the most rewarding strategy to reduce greenhouse gas emissions for the near-term future, and must represent the first line of attack. It is clear that in limiting or reducing emissions between now and the end of the century, nuclear power will have little role to play. To quote Prof. Robinson once more:

[I]f you want to spend a buck on reducing carbon dioxide emissions, and you do a conservation supply curve, nuclear power is way up at the expensive end of the options. It gets relatively little carbon dioxide abatement per dollar spent. By spending all that money there, you do not have that money to spend on the really cheap conservation that would be very profitable in a financial sense and that would get you much larger amounts of efficiency.¹⁶

My own view is that given scarce resources, what you should be spending your money on is what is giving you the most bang for the buck. Right now, that is not any new supply source. We could afford to divert all our marginal investment capital and energy onto

the demand side for some time to come, and we would be better off for it socially. That is not going to happen, of course. We are not going to simply stop investing in energy supply, but we should at least redirect as much as we can at the margin.... Whether in the end we have to go nuclear or not, I think, is essentially a political question that will have to be faced, but we do not have to now. Global warming does not provide a rationale for a massive nuclear expansion. It provides a rationale for a massive increase in efficiency, and then we can decide the nuclear case on its own merits later.¹⁷

5.30 The question nevertheless arises as to whether increased use of nuclear energy should be included as part of Canada's longer-term strategy to reduce greenhouse gas emissions after the turn of the century. This is a question that does not at present arise in most other "like" countries; as we were told by our final witness, a Canadian who serves on the International Energy Agency in Paris:

Canada is one of three countries in the OECD that still has a nuclear program. It is probably the only country that is proposing to go ahead and continue to build nuclear, along with aggressive energy efficiency programs in the Canadian utilities....

The CANDU technology is excellent, and it is the only technology out there in the world other than the American PWR system.¹⁸

5.31 A dispassionate view of the role of nuclear energy in global warming control was provided by a witness with impeccable environmental credentials, Dr. James Bruce:

Instead of policies leading to ever more hydrocarbon use Canada must reduce energy demand and must change fuels to use more renewables, more natural gas, and, yes, where economically warranted, more nuclear...

Where the nuclear option looks to be a reasonable option from the economics of the situation, then I think it is probably preferable from the point of view of the world's atmosphere to building a fossil fuel plant.¹⁹

5.32 The costs of nuclear energy are still in dispute, as we were told by Mr. Haites:

There was an independent review done in Ontario that said the costs of nuclear, including the environmental cost of disposal and decommissioning, are quite competitive with thermo generation. Then, when you look at cost estimates produced in the States, they are three times as high. Frankly, that puzzles me as a non-expert. I do not know what the resolution is there.²⁰

5.33 Other reservations about nuclear energy aside, when new energy supply must be considered, nuclear energy may or may not prove to be much more expensive than alternative fuels that can also reduce greenhouse gas emissions substantially. Some members of the Committee believe that nuclear power will be essential in meeting the world's future energy needs while limiting emissions, and that Canada's CANDU technology may have a major role. Other Committee members endorse the view expressed by witnesses that nuclear power will remain a high-cost mechanism for reducing greenhouse gas emissions.

5.34 Obvious questions still arise, in both national and international contexts, concerning site safety and security, proliferation, and waste disposal at all stages, including decommissioning of nuclear plants. If these concerns can be effectively addressed, in the continuing development of the CANDU system, and if similar encouragement is given to alternative energy sources over the next decade, Canada will be then able to choose its future forms of energy supply on an adequate basis of knowledge about the economic, environmental and other criteria involved in the choice.

NOTES AND SOURCES

1. Vol. 29, p. 49.
2. Intergovernmental Panel on Climate Change, Working Group 2, Policymakers Summary, p. 1.
3. *Proceedings of the World Conference on The Changing Climate: Implications for Global Security*, WMO710, World Meteorological Organization, Geneva, 1988, p. 296.
4. Based on *Emissions Scenarios*, Report of the IPCC Expert Group on Emissions Scenarios, pp. E3 - E4 and Table 5.
5. *Green Plan*, p. 105.
6. Vol. 22, p. 47.
7. Vol. 23, pp. 8, 14.
8. Vol. 42, pp. 7, 9.
9. Vol. 28, p. 10.
10. Vol. 28, p. 23.
11. *Green Plan*, p. 102.
12. Vol. 24, p. 7.
13. Vol. 42, pp. 43, 44, 45.
14. Vol. 23, p. 18.
15. *Green Plan*, pp. 54-55.
16. Vol. 24, pp. 18-19.
17. Vol. 24, p. 58.
18. Vol. 51, p. 28.
19. Vol. 30, p. 39, 41.
20. Vol. 22, p. 40.

CHAPTER SIX

MONITORING PROGRESS AND REVISING THE STRATEGY

6.1 Our final chapter is brief but, the Committee believes, essential and important. Efforts to reduce greenhouse gas emissions, such as those embodied in the National Action Strategy on Global Warming, must be sustained over several decades. Priorities, and public and governmental attention, are apt over time to move to other issues. We have the "lost decade" of the 1980s as evidence of this in regard to energy conservation. Not merely is the present concern over global warming likely to diminish, especially if initial efforts appear to be bearing fruit, the strategies and options themselves will necessarily vary over time. In the Committee's view, an essential ingredient of success will be the existence of a continuing mechanism (or, preferably, several mechanisms) for monitoring the progress that is made and the opportunities that will arise for revising and improving the strategy for limiting greenhouse gas emissions.

6.2 To some extent this need has already been recognized and accepted by the federal government. The Green Plan indicates that the Action Strategy will include the following:

- an annual report to Parliament on progress in meeting energy efficiency objectives
- publication of detailed information on Canadian energy consumption by end-use
- publication of a discussion paper in spring 1991 on the use of economic instruments to achieve environmental objectives, including tax and emissions-trading options
- an inquiry into the environmental impact of electricity generation options
- annual reports on the state of the Canadian climate, beginning in 1991
- a volunteer network across the country to detect climate change, in place by 1996.¹

6.3 The relevance of, and need for, these commitments should be evident from the preceding chapters of our report. They do not, however, go far enough. It is not difficult, for example, to envisage a situation in which, whatever political party is in power, the enthusiasm of Environment Canada for an effective limitation strategy is not shared equally by other key departments. It was with this in mind that we made, and now reiterate, two recommendations in our interim report. The Committee believes that they have a wider relevance beyond the immediate issue of global warming, as Canada endeavours to move to a sustainable development path. Global warming is, however, by its diversity and enduring character an excellent demonstration of the need for these recommendations.

6.4 The Committee recommends that the Minister of Environment have the responsibility and authority to develop policies, programs and regulations that span the full range of activities of the federal government, analogous to the

Minister of Finance for financial and economic affairs, and that the Environment Minister report to Parliament annually on the environmental impact of all federal activities. (Interim recommendation no. 15.)

6.5 The Committee recommends that the Auditor General, working in conjunction with the Departments of Environment and Finance, establish an environmental audit function to assure that all federal departments and agencies have implemented environmental assessment processes, and to monitor the effectiveness of environmental programs. Specifically, the Auditor General should monitor the progress of all federal departments and agencies in setting and attaining targets for greenhouse gas emissions. (Interim recommendation no. 16)

6.6 The National Action Strategy on Global Warming is being developed on a federal-provincial basis; it will depend for its success, however, on action by municipalities, by the private sector, and by individuals, as well as by senior governments. Yet, more may be needed.

6.7 In order to develop a truly comprehensive response to global warming, a long-term energy policy is needed as a framework for the wide array of necessary initiatives. The policy would give priority to energy efficiency (from transportation to buildings to electricity generation to agriculture to manufacturing and production), and to alternative or renewable energy sources. In addition, such policy would provide a means of ensuring that all government actions and policies — fiscal, taxation, regional development, forestry, foreign aid, trade, agriculture, etc. — are coordinated towards the single goal of reducing the emission of greenhouse gases, particularly CO₂, and slowing the rate of global warming.

“But the threat to our world comes not only from tyrants and their tanks. It can be more insidious though less visible. The danger of global warming is as yet unseen, but real enough for us to make changes and sacrifices, so that we do not live at the expense of future generations.”

— Margaret Thatcher, then Prime Minister of the United Kingdom,
Geneva, 6 November 1990.

NOTES AND SOURCES

1. Green Plan, pp. 107, 109, 110.

WT Harrell, Vice President, Technology and Planning
AM Cahill, Director, Environmental
Romer, Green Plan

City of Santa Barbara
Department of Planning

James Pease, Environmental Consultant

Ray Thompson, Vice President, Planning

Bill G. Smith, Manager, Planning

John Anderson, Manager, Planning

City of Santa Barbara, Department of Planning

Michael Mitchell, President

David Lombard, Manager, Public Affairs

California Association of Governments

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Gene E. Donohue, Manager, Technology Transfer and

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California Association of Governments

J.R. Smith, President

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Shell Chemical Division

J. Douglas Bryant, Director, Safety, Health and

Environment

California Association of Governments

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APPENDIX A

LIST OF WITNESSES

	Issue	Date
W.T. Hancox, Vice-President, Technology and Planning; R.V. Osborne, Director, Health Sciences, <i>Atomic Energy of Canada.</i>	35	March 27, 1990
Erik Haites, Principal, <i>Barakat and Chamberlin.</i>	22	November 23, 1989
James Bruce, Environmental Consultant.	30	January 25, 1990
Ray Thompson, Vice-President, Marketing Bill Bender, Manager, Advance Technology Bill Smithers, Manager, Consumer Services <i>CAMCO Inc. - Canadian Appliance Manufacturing Company</i>	13	June 26, 1989
Michael McNeil, President; David Leonhardt, Manager, Public Affairs, <i>Canadian Automobile Association.</i>	38	April 5, 1990
Ian C. MacNabb, President; Pierre E. Dumouchel, Manager, Technology Transfer and Development, Union Gas Limited; Robert Cumming, Manager, Natural Gas Vehicle Development, <i>Canadian Gas Association.</i>	38	April 5, 1990
Danielle Wetherup, Vice-President, Professional Services Branch; André Levasseur, Senior Policy Advisor, Policy Branch; Gilles Lamoureux, Special Advisor, Environment, Professional Services Branch, <i>Canadian International Development Agency.</i>	39	April 10, 1990
I.R. Smyth, President; Peter Dickey, Manager, Safety and Environmental Affairs, Shell Canada Limited; P. Douglas Bruchet, Director, Safety, Health and Environment, <i>Canadian Petroleum Association.</i>	35	March 27, 1990

	Issue	Date
Jim Johnson, President; Terry Daynard, Executive Vice-President, <i>Canadian Renewable Fuels Association.</i>	27	December 12, 1989
Arthur C. Eggleton, Mayor; Glen Gormick, Transportation Consultant, <i>City of Toronto.</i>	49	May 23, 1990
Gary Livingstone, Chairman of the Board; Dick Marshall, President; John Railton, Director, Research and Development, <i>Coal Association of Canada.</i>	28	December 14, 1989
Dr. Arthur Olson, Assistant Deputy Minister, Research Branch; Dr. Laure Benzing-Purdie, Research Coordinator (Environment), Research Branch; George Pearson, Director, Ottawa Affairs, Prairie Farm Rehabilitation Administration (PFRA); Dr. Valerie Stevens, Research Coordinator, (Animals) Research Branch; Cathie Lesslie-Jeffery, Senior Advisor, Policy/Communications Research Branch, <i>Department of Agriculture.</i>	47	May 15, 1990
M. D. Everell, Assistant Deputy Minister, Mineral and Energy Technology Sector; Ken Babcock, Assistant Deputy Minister, Geological Survey of Canada Sector, <i>Department of Energy, Mines and Resources.</i>	26	December 11, 1989
David Reeve, Director, Energy Research Laboratories; A.C. Skip Hayden, Head, Energy Conservation; George K. Lee, Senior Scientist, <i>Canada Centre for Mineral and Energy Technology (CANMET), Department of Energy, Mines and Resources.</i>	28	December 14, 1989
George Anderson, Assistant Deputy Minister, Economic Development Policy Branch; Ron Edwards, Director, Energy and Resource Policy Division; David Holland, Director, Business and Resource Tax Analysis Division, Tax Policy and Legislation Branch; Brian Willis, Assistant Director, Sales and Excise Tax Division, Tax Policy and Legislation Branch; Glen Hodgson, Chief, International Development Finance Division, International Trade and Finance Branch, <i>Department of Finance.</i>	42	May 1, 1990

	Issue	Date
Bill Barley, General Manager, Fluorocarbon Products; J. A. Walsh, Vice-President, Government Affairs; G. Mouton, Marketing Manager, Fluorocarbon Products, <i>Du Pont Canada.</i>	29	January 23, 1990
A.K. Stuart, Chairman, <i>Electrolyser Corporation Ltd.</i>	37	April 3, 1990
Honourable Lucien Bouchard, Minister of the Environment Lee Clark, Parliamentary Secretary to the Minister of the Environment Michael Owens, Legal Counsel Glenn Allard, Director, Commercial Chemicals Branch, Conservation and Protection Peter Higgins, Director General, Environmental Protection, Conservation and Protection <i>Environment Canada</i>	13	June 26, 1989
Glenn Allard, Director, Commercial Chemicals Branch, Conservation and Protection Alex Chisholm, Science Advisor Vic Buxton, Chief, Chemicals Control Branch, Conservation and Protection <i>Environment Canada</i>	20	November 7, 1989
Robert Slater, Assistant Deputy Minister, Policy, <i>Environment Canada.</i>	18	October 26, 1989
Elizabeth Dowdeswell, Assistant Deputy Minister, Atmospheric Environment Service; Kirk Dawson, Director General, Canadian Climate Centre; Henry Hengeveld, Advisor, Carbon Dioxide Related Matters, Canadian Climate Centre; Peter Higgins, Director General, Environmental Protection, Conservation and Protection, <i>Environment Canada.</i>	19	October 31, 1989
Len Good, Deputy Minister; Kirk Dawson, Director General, Canadian Climate Centre; Robert Slater, Assistant Deputy Minister, Policy; Peter Higgins, Director General, Environmental Protection; Elizabeth Dowdeswell, Assistant Deputy Minister, Atmospheric Environment, <i>Environment Canada.</i>	41	April 26, 1990

	Issue	Date
G.V. Buxton, Chief, Chemical Controls Division, Commercial Chemicals Branch; A. Stelzig, Acting Chief, Chemical Industries Division, Industrial Programs Branch, <i>Environment Canada.</i>	49	May 23, 1990
R.L. Richardson, President; Rolfe Cooke, General Manager, Corporate Coordination and Evaluation Division, <i>Export Development Corporation.</i>	46	May 10, 1990
Richard Gilbert, Metropolitan Councillor, Toronto; George Brown, Alderman, Ottawa; Denis Goulet, Alderman, Laval, <i>Federation of Canadian Municipalities.</i>	41	April 26, 1990
Jag S. Maini, Assistant Deputy Minister, Policy; John Forster, Director, Forestry Development, <i>Forestry Canada.</i>	22	November 21, 1989
Robert Hornung, Ozone Campaign Coordinator <i>Friends of the Earth.</i>	20	November 7, 1989
Kai Millyard, Policy Director; Phillip Jessup, Energy Policy Advisor, <i>Friends of the Earth.</i>	24	December 5, 1989
James J. Frelk, Executive Director; Frederick Seitz, President Emeritus, Rockefeller University, <i>George C. Marshall Institute (Washington, D.C.).</i>	43	May 3, 1990
Rolf Annerberg, Under-Secretary of State for Ministry of Industry, <i>Government of Sweden.</i>	44	May 7, 1990
Bob McLeod, Assistant Deputy Minister, Department of Renewable Resources, <i>Government of the Northwest Territories.</i>	42	May 1, 1990
John Lawson, Director, Federal Relations, <i>Government of Yukon.</i>	42	May 1, 1990
John Bennett, Atmosphere Campaigner <i>Greenpeace</i>	13	June 22, 1989
Stephen Hazell, Chairman, <i>Greenprint for Canada Committee.</i>	24	December 5, 1989

	Issue	Date
Warren Heeley, President; Garry Stroud, Secretary-Treasurer and President, Copeland Refrigeration of Canada Limited, <i>Heating, Refrigerating and Air Conditioning Institute of Canada.</i>	34	March 8, 1990
Esmat Macramalla, President; George Ferris, Vice-President, Research and Development, <i>Incendrex International Inc.</i>	32	February 20, 1990
David Runnalls, Associate Director, Environment and Sustainable Development Program, <i>Institute for Research on Public Policy.</i>	19	October 31, 1989
David Brooks, Director, Environmental Affairs, <i>International Development Research Centre.</i>	23	November 28, 1989
Ivan L. Head, President; Geoffrey Hawtin, Director, Agriculture, Food and Nutrition Sciences Division; Anne Whyte, Director, Social Sciences Division, <i>International Development Research Centre.</i>	39	April 10, 1990
Robert Skinner, Director, Long-Term Co-operation and Policy Analysis, <i>International Energy Agency OECD</i>	51	June 7, 1990
Brian Foody, President, <i>Iogen Corporation.</i>	27	December 12, 1989
The Honourable Jake Epp, <i>Minister of Energy, Mines and Resources.</i>	26	December 11, 1989
The Honourable Lucien Bouchard, <i>Minister of the Environment.</i>	18	October 26, 1989
Marc Nantais, Executive Director, Committees; J.E. Elliott, Director of Engineering, Chrysler Canada Limited, <i>Motor Vehicle Manufacturers' Association.</i>	27	December 12, 1989
Darrell Bishop, Senior Director, Planning and Environment; Leo Burns, Senior Technical Specialist, Meteorology and Air Quality; Heather Connors-Dunphy, Manager, Energy Conservation and Customer Service, <i>New Brunswick Power.</i>	36	March 29, 1990

	Issue	Date
Carole Burnham, Director, Environment Division; June Bassu-Roy, Supervising Planner, System Planning Division; Gerry Crown, Section Head, Government Relations, <i>Ontario Hydro.</i>	25	December 7, 1989
Jeff Passmore, <i>Passmore Associates International.</i>	23	November 28, 1989
Amory Lovins, Director of Research, <i>Rocky Mountain Institute.</i>	38	April 5, 1990
Bert Metz, Counsellor for Health and Environment;	29	January 23, 1990
Mieke Bos, Third Secretary, <i>Royal Netherlands Embassy.</i>		
Bob Lawrence, Senior Vice-President, Operations;	30	January 25, 1990
Tony Harras, Vice-President, Planning, <i>Sask Power.</i>		
Raye E. Thomas, President; Peter L. Allen, Vice-President; Douglas P. Lorriman, Director, <i>Solar Energy Society of Canada Inc.</i>	25	December 7, 1989
Patrick Foody, President, <i>Techtrol Inc.</i>	27	December 12, 1989
Ralph Torrie, <i>Torrie, Smith and Associates.</i>	23	November 28, 1989
Ken F. McCready, President and Chief Executive Officer; Edward J. Barry, Vice-President, Research; Jim Leslie, Senior Vice-President, Corporate Services, <i>TransAlta Utilities Corporation.</i>	28	December 14, 1989
Chris Holloway, National Director; David Jeanes, National Treasurer, <i>Transport 2000.</i>	36	March 29, 1990
William E. Rees, Associate Professor, Planning and Resource Ecology, School of Community and Regional Planning, <i>University of British Columbia.</i>	43	May 3, 1990

	Issue	Date
David Scott, Professor of Mechanical Engineering and Integrated Energy Systems, <i>University of Victoria.</i>	25	December 7, 1989
John Robinson, Professor, Department of Environment and Resource Studies, <i>University of Waterloo.</i>	24	December 5, 1989
Christopher Flavin, Vice-President and Senior Researcher, <i>Worldwatch Institute (Washington).</i>	31	February 1, 1990

The Hon. Rick Oman
Alberta Minister of Energy

The Hon. Ralph Klein
Alberta Minister of Environment

J.R. Gray
Executive Vice-President and General Manager
Alberta Power Limited

F.D. Donald Barlow, Research Scientist
Alberta Research Council

Jury Chynowski, President
Glen Chynowski, Director
Alberta & Saskatchewan Energy Program

Betty S. Larkman
Energy Market Research Ltd.

M. Michalski, Vice President
Energy Projects
Energy Services and Training and Consulting Ltd.

Angus J. Fryer
Ballard Institute of Oceanography

T. Callahan
Northwest International Energy Company

The Hon. John Reynolds
British Columbia Ministry of Environment

Del E. Baker (Dixon)
Energy Market
British Columbia Ministry of Energy

APPENDIX B

LIST OF SUBMISSIONS

ORGANIZATIONS

David R. Guy, President,
Advanced Power Systems Canada Inc.

The Hon. Rick Orman,
Alberta Minister of Energy.

The Hon. Ralph Klein,
Alberta Minister of Environment.

J.R. Frey,
Executive Vice-President and General Manager,
Alberta Power Limited.

F.D. (Rick) Barlow, Research Scientist,
Alberta Research Council.

Jorg Ostrowski, President;
Helen Ostrowski, Director,
Alternative & Conservation Energies Incorporated.

Barry S. Larkman,
Aqua Delphini Research Ltd.

M. Mirkin, Vice-President,
Energy Projects,
Basic International Training and Consulting Ltd.

Angus J. Fraser,
Bedford Institute of Oceanography.

P. Cathcart,
Blankevoort International Dredging Company.

The Hon. John Reynolds,
British Columbia Minister of Environment

Ted E. Baker, Director,
Research Branch,
British Columbia Ministry of Forests.

Fikret Berkes,
Institute of Urban and Environmental Studies,
Brock University.

J. Poscente, Chairman of the Board,
Canada Northwest Energy Limited.

Kelvin Doyle, Chairman,
Canadian Aerosol Information Bureau.

Al Cerilli, Regional Vice-President,
Canadian Brotherhood of Railway, Transport and General Workers.

Rick Williams, Chairman,
Environmental Steering Committee,
Canadian Cattlemen's Association.

Hans R. Konow, Director,
Public Affairs,
Canadian Electrical Association.

Kathy Cooper, Researcher,
Canadian Environmental Law Association.

Jack Gibbons,
Senior Economic Adviser,
Canadian Institute for Environmental Law & Policy.

J.H. Cayford, Executive Director,
Canadian Institute of Forestry.

Paul D. Scholfield, Chairman,
Canadian Nuclear Association.

R. Colledge, Chairman,
Canadian Oxygenated Fuels Association.

Merv Hey, Chapter Chair,
Canadian Parks and Wilderness Society.

Anothy R. Raab, Chairperson,
*Canadian Remote Sensing Society and
Canadian Aeronautics and Space Institute.*

Carl Shaykewich, President,
Canadian Society of Agrometeorology.

John Lilley, President,
Canadian Society of Environmental Biologists.

A. Cormier, Executive Vice-President,
Canadian Urban Transit Association.

Dan Ray, Research Director,
Centre for the Great Lakes.

J.B. Fogg, Marketing Manager,
Cornwall Chemicals Limited.

Susanne Hare,
Council for International Rights and Care for Life on Earth.

Ghislain Daigle, President,
Daigle Consultants - Combustion Inc.

Raymond Poisson, Manager,
Government Affairs,
Dow Chemical Canada Inc.

Kent Goodwin,
East Kootenay Environmental Society.

Russ Pratt, HSIRTF Co-ordinator,
Energy and Chemical Workers Union.

R.J. Dubey,
Geological Survey of Canada Sector,
Energy, Mines & Resources Canada.

George R. Stewart, Chairman,
Public Advisory Committees,
Environment Council of Alberta.

R. Stace-Smith, Chairman,
Federation of British Columbia Naturalists.

Hubert Coutu, Assistant Regional Director,
Fédération de l'Union des producteurs agricoles de Lanaudière

W.G. Doubleday, A/Assistant Deputy Minister,
Fisheries and Oceans Canada.

A.K. Ray, Consultant and Advisor,
Fundamental Research Institute.

John Bennett, Atmosphere Campaigner,
Greenpeace.

Philip Lucima,
External Relations Coordinator,
(The) Hunger Project.

R.P. Delaney, Manager,
Government Affairs,
Imperial Oil Ltd.

Ronald J. Cargo, Chairman,
Independent Petroleum Association of Canada.

John R. Miller, General Manager,
Krestew & Associates Inc.

The Hon. Harold J. Neufeld,
Manitoba Minister of Energy and Mines.

The Hon. J. Glen Cummings,
Manitoba Minister of Environment.

Anne Marie Lappano, Co-facilitator,
Mitchell and Area Environmental Group.

M.W. Waldner, Manager, Projects and Analysis,
Mohawk Oil Ltd.

Jean Boutet, Director,
Mouvement pour l'agriculture biologique.

Doreen Kissick, President,
National Council of Women of Canada.

Laverne Dalglish, Secretary-Treasurer,
National Energy Conservation Association.

Robert Miles, Conservation Chair,
North Columbia Group.

John K. Poirier, Solicitor,
Nova Scotia Power Corporation

Cameron Campbell, Senior Analyst,
Federal/International Relations,
Government Relations Department,
Ontario Hydro.

Paul Pennington, President,
Ontario Natural Gas Association.

J. Stauder, President,
Orchard Geothermal Inc.

Hon. Gilbert Clements,
*Prince Edward Island Minister of the Environment and
Minister of Finance.*

William C. Thompson, President,
Private Sector Meteorology Association.

Warren Grapes, Provincial President,
Quebec Farmers' Association.

Stephen Piernitzki,
Red Mountain Residents Association.

D.R. Cullimore, Director, Professor of Microbiology,
Regina Water Research Institute.

H.J. Saaltink,
H.J. Saaltink & Associates Ltd.

Hon. Rick Swenson,
Saskatchewan Minister of Energy and Mines.

Elaine Wheaton, Climatologist,
Saskatchewan Research Council.

R.J. Bradshaw, Geologist,
Shield Geophysics Limited.

Bo Martin, Researcher,
Sierra Club of Western Canada.

Robert K. Swartman, President,
Solcan Ltd.

Heather Mizener, President;
P. Anne Bradley,
Chairman, Environment Committee,
South Shore University Women's Club (Montreal).

Eric Eberhardt, Co-Chairman,
Stratford Perth Environmental and Ecological Committee.

John Darvill, Director,
Technocracy Inc.

Gordon Cowie, General Manager,
Thermal Energy Systems G.T. Inc.

M.H. McGregor,
Senior Vice-President, Operations,
Union Gas Limited.

David Hallman, Programme Officer,
Environment and Energy Concerns,
United Church of Canada.

Derek Weisbeck,
University of Alberta.

Gordon A. McBean,
World Climate Research Programme,
Joint Scientific Committee,
University of British Columbia.

Ken Ashley,
Fisheries Branch,
University of British Columbia.

Mark Roseland,
School of Community & Regional Planning,
University of British Columbia.

William O. Pruitt,
Department of Zoology,
University of Manitoba.

Gary T. Whiteford,
Department of Geography,
University of New Brunswick.

Danny Harvey,
Department of Geography,
University of Toronto.

Henry A. Regier;
A.P. Grima;
D.W. Whelpdale;
R.E. Munn;
Institute for Environmental Studies,
University of Toronto.

Thomas F. Homer-Dixon,
Peace and Conflict Studies Program,
University College,
University of Toronto.

Timothy Ball,
Department of Geography,
University of Winnipeg.

David E. Todd, Staff Vice-President
Via Rail Canada Inc.

Michael J. Brown, President,
Ventures West Management Inc.

Fergus Watt, Executive Director,
World Federalists of Canada.

Serge Ducharme,
World Wide Contact Sales.

Hon. Piers McDonald,
Yukon Minister of Economic Development.

Hon. Art Webster,
Yukon Minister of Renewable Resources.

INDIVIDUALS

Michael Abel
Victoria, British Columbia.

Juli A. Abouchar
Westmount, Quebec.

Mary Aitken
Hinton, Alberta.

Dustin Anderson
Rock Creek, British Columbia.

George Atwell
Winnipeg, Manitoba.

Edward Bart
Gore Bay, Ontario

G. Bethlendy
Toronto, Ontario.

E.J. Bowser
Sackville, New Brunswick.

Brock Boyle
Abbotsford, British Columbia.

Jay Brellisford
New Denver, British Columbia.

John Broderick
Vancouver, British Columbia.

Michael J. Brown
Vancouver, British Columbia.

Stephen Burk
Calgary, Alberta.

Ross M. Cardiff
Brussels, Ontario.

Laylah Chappell
Vancouver, British Columbia.

S. Scott Coffen
Halifax, Nova Scotia.

Philip Coll
Guelph, Ontario.

Laurent Dubois
Ste-Sophie-de-Mégantic, Quebec

Janet Dysart
Vancouver, British Columbia.

Robert L. Ewing
St. John's, Newfoundland.

Rand Flem-Ath
Nanaimo, British Columbia.

Kelly Franks
Surrey, British Columbia.

Dan Garsonnin
St. Albert, Alberta.

A.J. Giguère
Boucherville, Quebec.

William R. Goddard
Winnipeg, Manitoba.

Ken W. Goodall
Sardis, British Columbia.

Robert and Helen Hansen
Willowdale, Ontario.

Cecile Helten
Delta, British Columbia.

Robert Hicks
Niagara Falls, Ontario.

Marcel Hill
Surrey, British Columbia.

Marcelle Hudon
Quebec, Quebec.

Birgit Isernhagen
Aylmer, Quebec.

Brian A. Jenkins
Montreal, Quebec.

Walter Kasyh
Edmonton, Alberta.

Sung-Yong Kil
Thornhill, Ontario.

Werner A. Kurz
Vancouver, British Columbia.

A.G.W. Lamont
Picton, Ontario.

Harvey Lavery
Winnipeg, Manitoba.

Claude Léger
Scoudouc, New Brunswick.

David Lewis
Crescent Valley, British Columbia.

Douglas H. Luttervelt
Chemainus, British Columbia.

Fred G. Marsh
Castlegar, British Columbia.

Geoffey May
Cape Breton Island, Nova Scotia.

Robert A. McGeachie
Willowdale, Ontario.

Caroline McLean
Red Deer, Alberta.

David Mondor
Kirkland, Quebec.

Andrew E. Nevin
San Francisco, California.

C.R. Nixon
Ottawa, Ontario.

Christopher O'Brian
Yellowknife, Northwest Territories.

Derek H. Parkinson
Vancouver, British Columbia.

Edward A. Parson
Cambridge, Massachusetts.

Paul Piehler
St. Lazare, Quebec.

Donald E.B. Pittis
Shatin, Hong Kong.

David Puzey
Red Deer, Alberta.

Dorene A. Rew
Rocky Mountain House, Alberta.

Garry F. Robin
Nanaimo, British Columbia.

Doug Small
Toronto, Ontario.

Stewart Smith
New Hamburg, Ontario.

Math Stepp
Moose Jaw, Saskatchewan.

Etienne Szekely
Rossland, British Columbia.

Richard Thomson
Nelson, British Columbia.

Dorothy Towns
Red Deer, Alberta.

Ron Tyler
Didsbury, Alberta.

Pierre Verville
Victoriaville, Quebec.

C. Robin Wall
Grand Manan, New Brunswick.

Phil Weir
Gloucester, Ontario.

Horst Zimmermann
Oshawa, Ontario .

James M. Smith
St. Louis, Missouri

James Smith
Victoria, British Columbia

John A. Smith
St. Louis, Missouri

John A. Smith
St. Louis, Missouri

John B. Smith
St. Louis, Missouri

John B. Smith
St. Louis, Missouri

John C. Smith
St. Louis, Missouri

John C. Smith
St. Louis, Missouri

John D. Smith
St. Louis, Missouri

John E. Smith
St. Louis, Missouri

John F. Smith
St. Louis, Missouri

John G. Smith
St. Louis, Missouri

John H. Smith
St. Louis, Missouri

John I. Smith
St. Louis, Missouri

John J. Smith
St. Louis, Missouri

John K. Smith
St. Louis, Missouri

John L. Smith
St. Louis, Missouri

John M. Smith
St. Louis, Missouri

John N. Smith
St. Louis, Missouri

John O. Smith
St. Louis, Missouri

John P. Smith
St. Louis, Missouri

John Q. Smith
St. Louis, Missouri

John R. Smith
St. Louis, Missouri

REQUEST FOR GOVERNMENT RESPONSE

Your Committee requests that the Government table a comprehensive response to this Report within 150 days of its tabling, in accordance with the provisions of Standing Order 109.

A copy of the relevant Minutes of Proceedings and Evidence (*Issues Nos. 18, 19, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 46, 47, 49, 50, 51, 52, 53, 54, 55, 56, 57 and 58 which includes the Fourth Report, and 66 to 72 which includes this Report*) is tabled.

Respectfully submitted

DAVID MacDONALD
Chairperson

REQUEST FOR GOVERNMENT RESPONSE

Your Committee requests that the Government table a comprehensive response to this report within 150 days of its tabling in accordance with the provisions of Standing Order 109.

A copy of the relevant Minutes of Proceedings and Evidence (Items 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100) and 10 which include the Fourth Report and 65 to 75 which include this Report is tabled.

Respectfully submitted

DAVID McDONALD
Chairman

