



NATIONAL ROUND TABLE ON THE ENVIRONMENT
AND THE ECONOMY

TABLE RONDE NATIONALE
SUR L'ENVIRONNEMENT
ET L'ÉCONOMIE

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CANADIAN
GLOBAL
CHANGE
PROGRAM



PROGRAMME
CANADIEN DES
CHANGEMENTS
À L'ÉCHELLE
DU GLOBE

Organized by:

The Canadian
Global Change Program
of the Royal Society of Canada

In Partnership with:

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The Faculty of Environmental
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Report to the NRTEE
on
Cross Canada Climate Change Briefings

by

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1. General overview

1.1. Background

There is a clear feeling that the climate change discussions in Canada have not engaged enough of those who will be called upon to play a role in the follow up to Kyoto. There is also a sense that a large number of people who know about the issue are not able to keep up with the flow of information produced to support the international negotiations.

These briefing sessions were intended to provide a larger segment of decision makers and members of the media with the information they would need to understand the Kyoto meeting and the position Canada will be defending there. They were also intended to prepare these people to play an active and informed role in the discussions and negotiations that will likely take place in Canada after Kyoto. The emphasis was on credible, well presented information assembled by an arms length, independent and non advocacy organization. The briefing sessions were also designed to provide useful insight into the kind of information participants might find useful to keep up to date in the post Kyoto period.

The main objectives of the Briefing Sessions were:

1. To provide a larger segment of the "decision makers community" with a clear and objective picture of the climate change issue and how it is likely to affect Canada by providing an overview of:
 - a. the science (scientific consensus; implications for Canada; nature of the remaining uncertainties and of the debates within the scientific community)
 - b. the international negotiation processes and dynamics
 - c. Canada's current position and how it was developed (including the interest groups involved) with special reference to Provincial positions and their input to the process
 - d. how different interest groups perceive the issue
 - e. future direction for Canada (how things are likely to evolve and how Canadians can take part in the discussions to come)
2. To provide an overview of key sources of information and how to best stay abreast of this complex issue as well as identifying information needs of participants;
3. To identify the key concerns or questions the participants have with regard to Canada's position and their possible participation in shaping it.

The sessions were intended for people who do not have advanced knowledge of the climate change issue or who only have expert knowledge in one area and would like to have a better sense of the "big picture". They include people who are coming to the realization that the issue of climate change is likely to affect them in one way or another and see the need for a credible,

short, well structured introduction to the issue. The intent was to target a broad audience that included:

- Decision makers from business, non-governmental organizations (including professional organizations), provincial, regional and municipal governments
- Media representatives
- Environment Canada's outreach partners

1.2. The Sessions

Three hundred and seventy five people registered representing a broad cross section of groups affected by climate change issues. As a pilot project it was very successful and the feedback from questionnaires will enable the CGCP to develop an even better product for awareness building post-Kyoto. Many persons commented on the quality, fairness and breadth of the presentations and the comprehensive briefing material that they were able to take away. The only major complaint was lack of adequate time for audience participation due to the large number of speakers presenting during the day. Some participants indicated a desire to hear views contrary to the generally accepted IPCC stance on the science and to have greater industry participation on the program. Most of the negative comments were directed towards the federal and provincial presenters who, through no fault of their own, were in the unenviable position of talking about positions on climate change that were not yet decided. [When planning the briefings we had assumed that within one month of the Kyoto negotiations, a Canadian position would have been available.]

1.3. Our Partners

The success of the briefings can be largely attributed to the development of highly effective partnerships at each location. Despite working at a distance all partnerships worked out well. [See list of partners at the beginning of this report]. Partners were in a better position than the CGCP to approach local and regional experts and also to contact media and potential registrants. As a result of working together the CGCP now has a network of partners in universities that are all keen to work with us either alone or with others on some form of post-Kyoto awareness building and debate of the resulting policy issues. We believe that these partnerships are extremely valuable and should be encouraged as we move forward to implement the decisions at Kyoto.

1.4. The Participants

The briefings were designed for those professionals who have a responsibility for, or an emerging professional interest in climate change but who, due to other work pressures, have difficulty keeping up to date with the breadth and complexity of climate change science, economics and policy issues. To reach these people the CGCP in collaboration with its partners, targeted industry groups, associations, academic institutes, municipalities and individuals.

Initially, we considered that 40 participants at each location would be satisfactory. We actually averaged 75 with a high of 91 and a low of 67. In Montreal and Halifax there was a predominance of government (provincial and federal) and "other" (mainly NGO and students) over business registrants. However, in the other locations 50% of the registrants were from business. Overall business participation was 38% of the registrants (low of 15% in Halifax and high of 70% in Calgary), or about 30 at each location on average. Government participants were, for the most part, actively involved in climate change issues, as were those from NGO's. We were therefore satisfied that our target audiences were reached. All considered that climate change was "very important" to them and their organization. It is clear that with the experience we now have and the contacts that we have made, any post Kyoto briefings would likely attract greater participation.

2. The Briefing Sessions

2.1. Calgary

About 70 people attended this session which was partnered with the McLeod Institute for Environmental Analysis and the Faculty of Environmental Design at the University of Calgary.

The morning session focused on Understanding Climate Change. **Jim Bruce** gave a concise overview of the science based on the IPCC consensus and also gave a brief presentation later on aspects of mitigation and the associated benefits. Regional impacts of climate change were covered by **James Byrne** of the University of Lethbridge. His presentation was somewhat academic and focused on his own research in the region with a perspective on global impacts. The focus of the talk was sensitivity of agriculture to climate changes. Impacts and Adaptation to Human Health were presented by **Sheldon Roth** who gave a balanced overview of possible health threats under a regime of increased temperatures associated with climate change. The morning session rounded out with a fascinating presentation by **Peter Dickey** of economic and social costs based in part on real life examples taken from TransAlta's joint implementation projects and from the world Resources Institute's recent analysis of economic modeling issues.

In the afternoon, **Doug Russell** gave a comprehensive overview of the negotiating process to date, some predictions for outcomes at Kyoto, a prescription for what needs to be done post-Kyoto and some inside observations on the unproductive tensions in Canada that are hampering progress towards an equitable outcome on moving forward to reduce greenhouse gases (GHG's). In particular, the development of policy "by press release" at environment and energy ministers' meetings came in for particular criticism.

Following this, the federal representative, **Tim Goos** gave a presentation on federal perspectives on the Framework Convention. He was not able to outline a federal position for Kyoto since this was yet to be announced. The Alberta representative, **Brent Lakeman**, presented Alberta's approach to the climate change issues that has been taken in federal-provincial discussions to date. Both presentations had the effect of enlightening the audience on the immense federal-

provincial divides that make consensus on complex issues difficult in Canada.

The panel discussion, for the most part, did not generate the kind of audience response and participation that we expected from the speakers who represented a variety of stakeholders. Nonetheless, the session served to emphasize the different perspectives of different stakeholders. **Gary Webster** from CAPP gave the perspective from the oil and gas industry. Emphasizing that this is a long term issue of 50 - 100 years, he stated that we should plan accordingly and see Kyoto as one step in the process. He emphasized that the voluntary approach is an important tool and that a Canadian plan should encompass flexible targets, credits for early action and improved understanding of climate change science. He envisioned greater efficiencies in the future and urged continued awareness, support and improvement of the voluntary challenge and registry program. His presentation concluded with the observation that GHG emissions are related to lifestyle and energy consumption and that everybody needs to understand how they contribute to the problem and how they need to contribute to the solutions. **Alan Wood** of the Insurance Bureau of Canada spoke from the perspective of property and casualty insurance. Losses have been mounting in recent years, some of which the insurance industry attributes to climate changes, although much uncertainty prevails. For the insurance industry, regardless of the uncertainties surrounding some of the science, precautionary actions are essential and one action has been to create an Institute for Catastrophic Loss Reduction. **Dan Smith** of the Pembina Institute felt that in Kyoto we needed to make sure that the emissions trends are changed, that a strong signal is sent to consumers, investors and developing countries. He felt that the Kyoto outcome would be inadequate from an environmental perspective and that we would be back at the table again soon after. Beyond Kyoto, he indicated that Canada would need to strengthen the voluntary challenge program and implement actions to take advantage of the economic opportunities in reducing GHG emissions. Energy efficiency and renewable energy will be important. Clearly, no single measure will do the job. A portfolio approach is essential for success as is public education.

Questioning was generally subdued, polite, and non controversial. Much of the questioning occurred in the breaks as industry members sought to get answers to questions on the science and economics in a less exposed environment. The clear issue for industry was the uncertainty surrounding what the federal government intends to do at Kyoto and beyond. Most identified the need to know what course of action will be required so that they can plan accordingly and receive credit for action. It was generally agreed that the debate had to move from a lose-lose situation to one where an equitable win-win scenario is worked out. Nobody mentioned the uncertainty of the science as a barrier to future action.

Media participation was considerable. In addition to the CBC National news crew with Eve Savory, there were CBC local news crews from Calgary and Edmonton, CBC Radio news, CHQR News and the Calgary Herald reporter who stayed all day. Many of the speakers were interviewed.

2.2. Vancouver

About 80 persons attended. Our partner was the Sustainable Development Research Institute of UBC.

For the morning session **Jim Bruce** once again covered the science and mitigation aspects of climate change.

Impacts were covered by **Stewart Cohen** who first focused on the large studies of the MacKenzie and St. Lawrence basins then went on to emphasize the potential impacts on B.C.. This presentation, although it included way too many slides for the time allotted, was enthusiastically received because of the clarity of the talk and the convincing results from the MacKenzie basin study.

Economic and social costs were presented by **Michael Margolick**. His presentation essentially summarized recent articles that he had prepared for the CERI Energy-Environment modelling Forum in Ottawa, October 15/16th and the Briefing Paper to Paul Martin "The Role of Government" published by the David Suzuki Foundation on September 29th, 1997. The limitations of economic models was outlined, as were the barriers that have resulted in inaction on Canada's part to date to limit greenhouse gas emissions. One dramatic example from the past that parallels today's foot dragging in certain quarters is worth repeating. In 19th Century France, when central sewers, garbage collection and clean water systems were being developed by a new class of government administrators the property owners vehemently opposed them. They argued that it would involve enormous cost, that many persons would lose their jobs (e.g night soil operators) and it was an intrusion to bring pipes into their property. "Put in contemporary terms, the market economy angrily and persistently opposed clean public water, sanitation and garbage collection and improved public health because they appeared unprofitable enterprises which, in addition, put limits on the individual's freedom" (Quote provided by Margolick from Voltaire's *Bastards*, John Ralston Saul; Penguin Books, 1993, pp. 238-240). As Margolick stated, who today would question the decision to have safe water and effective disposal of sewage and garbage, or the economic and health benefits as a result?

Doug Russell's presentation after lunch was identical to that in Calgary. The federal regional Director General, **Arthur Martell** gave an overview of the general situation in Canada and the principles on which a Canadian position would be made for Kyoto. This was essentially the same presentation given in Calgary. The provincial representative, **ADM Don Fast** gave an excellent presentation on BC's position, the process leading up to it and how they were ready to set the science debate aside and get on with serious action post-Kyoto. BC has engaged a wide variety of players from the start through their "Greenhouse Gas Forum" which has led them to their current position.

The panel lived up to its promise for spirited discussion with the presence of Michael Walker of the Fraser Institute on the one hand and Jim Fulton of the Suzuki Foundation on the other with

Robert Falls, ex West Coast Energy and now a consultant, in the middle.

Robert Falls provided an excellent overview of what needed to be done at Kyoto. First, he believed that the current lack of leadership pre-Kyoto will give us problems at Kyoto and unless fixed, will be a great barrier in advancing implementation post-Kyoto. He felt that a target of a reasonable emissions reduction figure that would get us to below where we are now is what we should strive for. He hoped we would explicitly support Joint Implementation and get non Annex I countries on board through Joint Implementation projects. It would be helpful, in his opinion, if Canada would "stop whining about being a northern country" and get on with positive action. Post Kyoto, he felt that we would need to get accountabilities and infrastructure in place to assist groups to move in a positive direction. There would be a great need to provide appropriate resources to get full participation and to move quickly to bring dissenters on side. He emphasized that this is a long term issue and a very serious challenge. Therefore a very serious national effort is required with a very clear position established by the federal government with the definite threat to regulate if adequate progress is not made. He also made a plea that organizations such as the CGCP and similar organizations must be funded adequately if they were to be able to do the independent and objective work that needed to be done post-Kyoto.

Michael Walker promoted the now familiar Fraser Institute view that government should stay out of the way and allow individuals and business the freedom to choose their own paths. He used the example of economic models that he had worked on with the Bank of Canada and other organizations to question the validity of the climate change models. He stated that climate modelers were "well meaning people" who must certainly "fudge the results" because they believe that "the ends justify the means". He referred to the Fraser Institute's survey of the scientific literature that led him to reject the "so called IPCC consensus" that climate change was influenced by human activity. Only one scientist was quoted (repeatedly), - Sallie Baliunas, an astrophysicist and Chair of the Science Advisory Board of the ultra conservative George. C. Marshall Institute. Walker's general conclusion was that action now will cause a global recession and that we should wait at least 20 years, by which time the science would be more certain.

Jim Fulton began by taking aim at Walker's presentation which he described as "disengenuous and false". He then went on to urge significant leadership and a position that called for significant reductions of greenhouse gases at Kyoto. He also urged a national effort to decide on a blueprint to achieve the actions needed post Kyoto.

The following discussion was almost exclusively targeted towards the comments of Michael Walker and was uniformly in condemnation of his presentation, especially from the economists and other modelers in the audience. The balanced viewpoint presented by Robert Falls was lost during this discussion, but notably remained in their minds, as indicated from the corridor talk afterwards.

Apart from one film maker from the NFB, who will be producing a film on climate change, the media were absent. Presumably, the UBC campus is too far away.

2.3. Montreal

The briefing was held at the Université du Québec à Montreal and 65 people attended. Partners were L'Institut des sciences de l'environnement, UQAM, and L'Association de climatologie du Québec.

Marc Lucotte opened the meeting and then went on to give an overview of the science of climate change. **Alain Viau** gave an explanation of the various models used in climate change and explained their limitations and strengths. **Jacinthe Lacroix** followed with a useful presentation on the impacts as they pertained to Quebec, drawing from various regional studies and focusing mainly on extreme events. **Maryse Labriel** outlined studies conducted on the contribution of the transportation industry in Quebec which contributes over 40% of the province's greenhouse gas emissions. Her main focus was on GHG reduction strategies. **Philip Waaub** explained how the MARKAL model has been used in Quebec and **Luc Gagnon** surveyed other socio-economic studies in Canada. Everyone was ready for lunch after this intensive menu of studies and reports had been presented!

The afternoon session also saw a change from other briefings in that the International aspects normally covered by Doug Russell were covered by **Sory Ibrahim Diabaté** who covered the international negotiating process up to Kyoto and the various positions of the negotiating blocs and by **Claude Lefrançois** who covered the national scene and how Canada has been performing and is likely to perform in relation to other countries in reducing its greenhouse gases.

The standard presentation of the federal perspective was presented by **Albin Tremblay**. This presentation elicited little comment but was generally well received.

The position of the Quebec government that was at that very moment being tabled in Regina was outlined by **Jean Rivet**. This position elicited a number of questions, predictably centering around whether other provinces would be willing to agree to Quebec's ambitious targets. It was clear that Quebec felt that its targets were achievable and therefore it was in a position to take the moral high ground in Regina. [NOTE: We now know the result of the Regina meeting whereby the agreement was significantly less than Quebec's position, resulting in Quebec's decision not to sign the Regina accord].

The panel discussion moderated by **Jean Pierre Révéret** provided a useful discussion of what might be done at Kyoto and beyond. **Manuel Dussault** took the conservative position, citing economic instability and special circumstances to justify a go slow approach. **Joanne Lalumière** spoke about the positive actions that Quebec Hydro has taken to reduce GHG's. **Jean-François Lefebvre** outlined numerous areas where it was economically reasonable to move ahead with measures for GHG reductions. Finally, **Steven Guilbeault** argued why Canada needs to take leadership on this issue and move the agenda ahead with some conviction in the post Kyoto years.

This was a very full agenda and the registrants were interested to the end. Discussion was most lively in the breaks since there was little time for questions from the floor due to the large number of speakers.

2.4. Toronto

This briefing was held in the Senate chamber at York University with 67 people attending. Our partner was the York Centre for Applied Sustainability in the Faculty of Environmental Studies. **Peter Victor**, Dean of the Faculty of Environmental Studies and CGCP Board member opened the meeting with a Climate Change clock challenge. Based on the "one hour to midnight" nuclear armageddon clock, the audience was asked to note the time according to their perception of the potential severity of the climate change issue then to reset the time at the end of the session. An analysis would then be done to see whether the audience's perceptions had changed.

Science and mitigation were once again covered by **Jim Bruce** in similar fashion as before. Questions came up about the satellite data that showed apparent cooling rather than warming. The questioner was referred to the "myths" section of the briefing book. Stephen Strauss of the Globe and Mail asked a deliberately provocative question - "who was the IPCC and why should one believe them?" An appropriate answer was given by Jim Bruce.

Linda Mortsch gave an overview of impacts and possible adaptations from the regional perspective using the Ontario report of the Canada Country Study as a basis. She indicated that water resources issues are likely to be the lynch pin for climate change in Ontario.

Eric Haites covered the economic and social costs segment and reinforced the IPCC conclusions that it is economically feasible to address climate change issues. Emissions trading offers the possibility of reducing by up to 50% the costs of stabilizing emissions at 1990 levels by 2010. Costs to the economy are not likely to be excessive with a prudently chosen portfolio of measures. Since the GDP is forecast to increase by over 30% to 2010, a cost of 2% of GDP would not seriously affect Canadians' lifestyle in the long run.

Brian Emmett, the Commissioner for the Environment and Sustainable Development gave a lunch time speech that focused on international environmental issues. He gave Canada a failing grade since over 70% of such agreements had not been lived up to. His office is about to release a study on how well Canada has dealt with the ozone issue and the climate change issues. He will also be looking at other international environmental agreements and reporting on these at a later date. A major point was the need for leadership to be shown by governments rather than the constant bickering that is the rule rather than the exception in Canada.

Doug Russell, with the agreement from the Regina JMM meeting in hand in the form of yet another press release, was able to postulate further on his contention that policy is by press release on the climate change issue. Once again, the press release was less than clear on what actually would be done in the form of positive action to address the issues. He reiterated that

tough decisions had to be made on regional and sectoral targets for Canada post Kyoto and that it would need the “best and the brightest” to roll up their sleeves in a non-threatening and arms length forum to come to grips with a plan of action for the future. To be successful required:

- ▶ political will and strong leadership
- ▶ accountability with a fair and equitable sharing of the burden
- ▶ flexibility for different players to meet the targets
- ▶ the vision to exploit opportunities

Rick Findlay presented the standard federal presentation of “Perspectives on climate change”. He was able at this meeting to present the results from the JMM at Regina but was not able to offer any inside interpretation of what it might mean with regard to a federal negotiating position at Kyoto. He felt that the key issues at Kyoto might be: flexibility; a multi-year approach; banking and borrowing emissions; and differentiation based on national circumstances.

Rick Jennings followed with a presentation on Ontario’s position on climate change. Ontario’s bottom line is that the USA must ratify the Kyoto agreement if Ontario is to sign on to the Canadian position. He cited the trade relationships with the USA as the major reason for this. He cited Ontario as one of the major players in Canada with 40% of the population and 30% of the emissions (just behind Alberta) and forecast to rise considerably. Questioners were somewhat severe in asking if Ontario is such a major player, where is its blueprint for action and why aren’t they getting on with the job and showing leadership? In general, the questions pointed to the lack of credibility of Ontario in the debate so far.

The panel session was reasonably lively with Ken Ogilvie of Pollution Probe, Angus Ross of Sorema and Jim Hughes of Imperial Oil presenting.

Ken Ogilvie stated that to get anywhere near the target that came out of Regina would require strong policy measures so we had better start right away. The problem as he sees it is that we have been operating on two disturbing principles:

1. The “you go first” principle and
2. The “don’t hurry” principle

To implement post-Kyoto, Ogilvie suggested a large list of measures that could be taken on the urban setting and the need to integrate other issues such as smog, toxics and acidifying emissions. He felt that transition support would be needed to push certain technologies and to change behaviour. Public education was emphasized, focusing on the risks of climate change, the costs of inaction and the benefits of action. He also emphasized the critical need for integrated research and for a far greater analytical capacity in Canada.

Angus Ross gave an impassioned presentation on the perspectives of the insurance industry concerning climate change and some of the initiatives that the industry is taking to counteract the perceived threats. For post-Kyoto he recommended better building codes to give safer cities, preparing the communities to be more aware of climate impacts and to target research on areas of greatest vulnerabilities.

Jim Hughes reduced the issue to one of risk management and balancing the risks. In terms of Kyoto and beyond he suggested that Canada should:

1. Avoid a rush to judgement
2. Recognize that stabilizing or reducing CO2 emissions sacrifices economic growth
3. Ensure equitable sharing of the economic burden
4. Promote voluntary, cost effective measures
5. Insist on developing country participation
6. Realize that the climate change debate is about trade, economics, competitiveness, living standards, jobs and social expectations
7. Have a long term flexible approach
8. Encourage flexible solutions for individual countries
9. Make no new commitments without an analysis of the consequences and through public debate
10. If the Kyoto agreement is not in Canada's interest it should be prepared not to sign

A number of persons questioned Hughes on the models used to base his conclusions indicating that his was a case of using the worst case scenario with no acknowledgment of additional benefits from action on greenhouse gas reduction.

Peter Victor closed the session with an analysis of the Climate Clock which had moved closer to midnight as a result of the revised views of the participants.

The major message in his view was that we had better wake up in Canada on the policy side and that each one of us has to answer serious questions at a personal level as to what action we are prepared to take.

2.5. Halifax

Over 90 people attended this briefing which was organized with our partner, the School for Resource and Environmental Studies at Dalhousie University.

The briefing was opened by the President of the University, Dr. Tom Traves.

Des O'Neil then took over as Chair for the day and introduced the morning session to the more than 90 registrants.

The science overview, mitigation and social and economic costs presentations were delivered by **Jim Bruce** and **Doug Russell** and covered essentially the same ground as in previous sessions. **Jim Abraham** covered the impacts segment, using the Atlantic Region part of the Canada Country Study as his material. The legal framework for the Climate Change Convention was explained by **David VanderZwaag**. His thesis was:

1. that the Convention really provides "no law at all" since it is only a framework agreement as yet and provides no hard law.

2. That it is “a legal lotto to Kyoto” because of the frailty of the Berlin Mandate and the uncertainty of what the developing country responsibilities will be beyond 2000.
3. That it will be “a long haul to Montreal” i.e. to get an agreement as good as the Montreal Protocol because of the greater uncertainty of the science; the human fear factor is less; there are more contributors to the problem; there are greater socio-economic impacts for certain sectors; and the Montreal Protocol did not need consensus to make amendments but rather a 2/3 majority.

The afternoon session began with **Doug Russell's** presentation which, as usual was received with great interest and prompted lots of questions on the negotiating process and how decisions are made. **Garth Bangay** delivered the standard federal perspective and it was well received. **Creighton Brisco** provided some detail on what Nova Scotia is doing to curb some emissions but cautioned, as did most other provincial representatives, that achieving reduced emissions was going to be extremely difficult.

The panel discussion started with **Dave Brickman** who focused on well known energy saving measures to reduce GHG's.

Owen Hertzman felt that we should focus on the individual and enable them to change their behaviour through governmental incentives. At Kyoto he believed that we should make clear to our trading partners that we would not abrogate our responsibilities post Kyoto, that we should take the moral high ground and that the delegation should be aware of Canadians' deep concern for the environment and therefore to represent us accordingly and not represent only powerful minority interests.

Osmundo Betancourt began by casting doubt on the reliability of the science, indicating that different interpretations of the science have been offered depending on who was presenting the science. However, he agreed that fuel use must be used responsibly. He believed though, that fiscal incentives were needed for both developers of energy and users. He felt that the real commitment at Kyoto should be to deal with the issue of wastage of energy.

A number of general questions were posed. One statement by Tony Charles of St. Mary's University should be noted. He stated “The lack of leadership on the climate change issue in Canada is an embarrassment.” He asked “why do we not say that we are embarrassed and commit to lead rather than follow, as we clearly are doing now?”

The question of lack of leadership came up frequently in corridor discussion and is clearly an issue that needs to be addressed post Kyoto.

3. Analysis of the Questionnaire

The questionnaire (see section 6) was used to determine, insofar as possible, how well we achieved our three main objectives.

3.1. General comments received

A number of people, while wanting to keep the balance of the day, would have liked the opportunity to have a discussion of the fact that there were still skeptics and how this is dealt with in finding a balance. To this end, it was clear that we could have included more industry representation for speakers with a module in the morning session on contrary views and how the IPCC consensus dealt with these views. It should be noted, however, that a section in the briefing materials provided to each registrant dealt with many of these issues.

Another suggestion was to include a private sector innovator to challenge the group on what could be done to reduce GHG's and make money. Also, there was a request to include more on the economic instruments for reducing GHG emissions. Participation from local groups on what can and has been done locally was also asked for, in particular municipalities and local environmental initiatives.

Since all impacts of climate change are not necessarily bad, it was suggested that a module on the positive side of the impacts would be useful.

It was suggested that the general public ought to be encouraged to participate, perhaps through a free evening session planned to increase public awareness and buy in.

Less extreme speakers, it was suggested, would provide better balance and a statement of bias from each speaker at the start would help the audience in understanding the context of the discourse.

It was also suggested that a greater selection of participants could have been attracted by advertizing through companies and Internet user groups.

We believe that these comments and many others included in the questionnaire responses are valuable and will assist as we plan other events of a similar nature.

3.2. Objective 1: Providing an objective picture of the climate change issue

Some of the above comments suggest that we could have improved the briefing slightly to give a more complete overview, and we agree. Time, however is a factor in trying to be totally comprehensive. Judging from the majority of the responses to questions 1 through 4 on the questionnaire, we believe that our purpose was achieved as well as could be expected with such a diversity of backgrounds in the audiences.

Those responding had a moderate to good understanding of climate change issues overall and came away from the sessions better informed. Most felt that they had learned more of the science and impacts of climate change. Little was learned of the federal or provincial positions with the exception of Quebec and Nova Scotia who had the fortune to present after the Regina meeting of

ministers. The panel discussions were moderately successful in giving the audience an appreciation of the perceptions of various interest groups and what they believed Canada should do beyond Kyoto, but this could have been better crafted to achieve the objective.

The most consistent positive response was to the national and international negotiating positions, how they were developed and what the likely outcomes would be. This segment was clearly provided considerable insight for people and contributed much to understanding the process pre Kyoto.

3.3. Objective 2: Providing an overview of key information sources and how to keep up to date

The briefing book was welcomed by most people. Some would have preferred to receive it ahead of the session but this would be difficult to do logistically.

Many people were interested in receiving climate change information regularly, mostly by e-mail or the Web and would be prepared to pay a reasonable fee for this service. However, most are unwilling to pay for information on the Web since, for some reason they believe it costs nothing to mount this information! Information is gathered at present mostly through industry association sources, government publications, newspapers, professional journals, various commercial newsletters and the Web.

A limited number of people felt that their organizations would welcome a briefing tailored to their sector. This will need to be explored further in order to determine whether customized briefings would be economically viable.

3.4. Objective 3: Identifying key concerns with Canada's position at Kyoto

This objective was not reached because there was no position to discuss at the briefings. However, the fact that Canada was so late in arriving at a position was cause for considerable discussion and concern in informal meetings during and after the sessions. So, the lack of a position was in some way useful in raising awareness among the registrants of the great difficulties surrounding the Kyoto negotiations.

4. List of registrants

Note that the total number of participants indicated in the summary table below is slightly greater than the number included in the lists due to unknown addresses, and last minute drop-in participants who did not provide any other information. Speakers, staff, or local assistants are not included in the lists.

REGION	TOTAL NUMBER OF PARTICIPANTS	SECTORAL BREAKDOWN		
		BUSINESS	GOVERNMENT	OTHER
CALGARY	70	54%	16%	30%
VANCOUVER	82	49%	15%	36%
MONTREAL	65	26%	35%	39%
TORONTO	67	47%	21%	32%
HALIFAX	91	15%	27%	58%
TOTAL	375	-	-	-
AVERAGE	-	38%	23%	39%

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6. Questionnaire**Participant Feedback Form
1997 Climate Change: Cross-Canada Briefings Before Kyoto**

Your feedback is important to us. Please fill out the form as completely as possible and feel free to write on an additional piece of paper if there is not enough space. We will be using your responses to improve any briefings that we design in the future and to assist us in the design of other climate change briefing services.

1. Identify three aspects of the briefings that you appreciated, or three things you have learned which are important to you.

2. Identify aspects of the briefings that you think should be modified.

3. Before attending this briefing, how would you have ranked your overall understanding of climate change? Please circle the corresponding number, from Expert (1) to minimal (5).

1 (Expert) 2 3 4 5 (Minimal)

4. As a result of attending this briefing session, indicate how much, on a scale of 1 to five - from a lot (1) to very little (5), your understanding of the climate change issue has improved in the following areas:

- a) Climate Science and IPCC Assessment Process: _____
- b) Social and economic costs of climate change: _____
- c) Impacts of climate change: _____
- d) National and international negotiation processes: _____
- e) Federal Position: _____
- f) Provincial Position: _____
- g) The debate over how Canada should respond to climate change: _____

5. Would you like periodical updates on climate change? Yes: _____; No: _____

- a) If yes, what topics would be most useful?

b) What format would you prefer for these updates? (Internet, printed newsletter, briefing session, other?)

c) How often would you like an update? (Monthly, semi-annually ...)

d) Based on your experience with other information products, how much would you be willing to pay for this service (please specify which one you are referring to)?

6. At the present time what are your sources of information on climate change?

7. We are considering the possibility of customizing briefing sessions to organizations or associations. Would this be of interest to your organization/association? Yes: ____; No: ____

Please comment (and if your answer is yes, include contact name or contact us!):

8. How did you hear about this briefing?

a) I received an invitation: by mail ____; by fax ____; by Email ____

b) Publicity in newspaper/newsletter (please specify): _____

c) Other: Please specify: _____

9. How important is the climate change issue to your organization? Please comment.

10. Affiliation:

a) Type of organization: _____

b) Size of organization: _____

c) Your level of responsibility: _____

11. Name, Email or fax (optional): _____

Thank you for taking the time to fill this questionnaire.

If you were not able to leave your completed form at the workshop, please fax it to (613) 991-6996

Appendix 1 - Briefing material and Program for each region

CANADIAN
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PROGRAM



PROGRAMME
CANADIEN DES
CHANGEMENTS
À L'ÉCHELLE
DU GLOBE

Organized by:

The Canadian
Global Change Program
of the Royal Society of Canada

In Partnership with:

The Macleod Institute for
Environmental Analysis at
University of Calgary
The Faculty of Environmental
Design, University of Calgary
The Sustainable Development
Research Institute, University of
British Columbia
L'Association de climatologie
du Québec
L'Institut des sciences de
l'environnement, Université
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Nova Scotia Power Inc.
Kimberly-Clark Nova Scotia

Climate Change: Cross-Canada Briefings Before Kyoto

Calgary – Vancouver – Montreal – Toronto – Halifax

**Calgary Session: Wednesday, November 5, 1997, Blue Room
The Dining Centre, 2500 University Drive NW
University of Calgary**

Program

8:30	Registration and coffee
9:00	Welcoming Remarks: Elaine McCoy, President, Macleod Institute for Environmental Analysis
9:05	Introduction to the Session: Hugh Morris, President, Canadian Global Change Program (CGCP)
9:15	Understanding Climate Change, Jim Bruce, IPCC WG3, CGCP Board member • General overview: Jim Bruce • Impacts: a regional perspectives: James M. Bryne, Water Resources Institute, University of Lethbridge • Impacts and adaptation on human health: Sheldon Roth, Director – Environmental Research Centre, University of Calgary • Mitigation: Jim Bruce • Economic and social costs: Peter Dickey, TransAlt Utilities
12:00	Lunch (included with registration fee)
13:00	The International and National Negotiation Process, by Doug Russell, Global Change Strategies International Inc. (GCSI)
14:15	The position of the Federal Government, by Tim Goos, Chief, Atmospheric and Hydrological Sciences Division, Prairie and Northern Region, Environment Canada
14:45	The position of the Provincial Government, by Brent Lakeman, Senior Advisor, Environmental Affairs, Planning and Development Division, Alberta Department of Energy
15:15	Pause
15:30	Panel: What should Canada do in Kyoto and beyond? • Chair: Elaine McCoy, President, The Macleod Institute • Panel: Gary Webster, Canadian Association of Petroleum Producers; Alan Wood, Insurance Bureau of Canada; Dan Smith, Pembina Institute
16:45	Conclusion of the Session: Hugh Morris
17:15	End of the Session

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L'Association de climatologie
du Québec

L'Institut des sciences de
l'environnement, Université
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Nova Scotia Power Inc.

Amberly-Clark Nova Scotia

Climate Change: Cross-Canada Briefings Before Kyoto
Calgary – Vancouver – Montreal – Toronto – Halifax

Vancouver Session: Friday, November 7, 1997
Upper Lounge, International House
1783 West Mall, Vancouver, BC
University of British Columbia

Program

- 8:30 Registration and coffee
- 9:00 Welcoming Remarks, by John Robinson, Director, Sustainable Development Research Institute (SDRI)
- 9:05 Introduction to the Session, by Hugh Morris, President, Canadian Global Change Program (CGCP)
- 9:15 Understanding Climate Change, Jim Bruce, IPCC WG3, CGCP Board member
- General overview: Jim Bruce
 - Impacts: Stewart Cohen, SDRI, Environment Canada
 - Mitigation: Jim Bruce
 - Economic and Social Costs: Michael Margolick, The ARA Consulting Group
- 12:00 Lunch (included with registration fee)
- 13:00 The International and National Negotiation Process, by Doug Russell, Global Change Strategies International Inc. (GCSI)
- 14:15 The position of the Federal Government, by Arthur Martell, Regional Director General, Pacific and Yukon Region, Environment Canada
- 14:45 The position of the Provincial Government, by Don Fast, Assistant Deputy Minister, BC Ministry of Environment, Lands and Parks
- 15:15 Pause
- 15:30 Panel: What should Canada do in Kyoto and beyond?
- Chair: John Robinson, SDRI
 - Panel: Robert Falls, RWF Consulting;
Jim Fulton, David Suzuki Foundation;
Michael Walker, The Fraser Institute
- 16:45 Conclusion of the Session: Hugh Morris
- 17:15 End of the Session



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Le Programme Canadien des
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Les changements climatiques: séances d'information en vue de la réunion de Kyoto

Calgary – Vancouver – Montréal – Toronto – Halifax

Séance de Montréal: mercredi le 12 novembre 1997, Salle DR 200

Pavillon Athanase-David, UQAM

1430 rue St-Denis, Montréal (Métro Berri-UQAM)

Programme

- 8:30 Inscription et café
- 9:00 Introduction et mot de bienvenue: Marc Lucotte, Directeur, Institut des sciences de l'environnement, Université du Québec à Montréal
- 9:15 Comprendre les changements climatiques
- Survol des connaissances scientifiques: Marc Lucotte
 - Impacts: Jacinthe Lacroix, Présidente, Association de climatologie du Québec; Alain Viau, Professeur, Université Laval
 - Moyens de contrôle des Gaz à effet de serre: Marc Lucotte
 - Le cas du transport: Maryse Labriel, Chercheure, GREIGE, UQAM
 - Coûts sociaux et économiques:
 - Application du modèle MARKAL, Jean-Philippe Waaub, UQAM
 - Survol des études réalisés au Canada, Luc Gagnon, Hydro-Québec
- 12:00 Lunch (inclu dans le prix d'inscription)
- 13:00 Les processus national et international de négociation: Sory Ibrahim Diabaté, Responsable du programme environnement, Institut de l'énergie des pays ayant en commun l'usage du français, et Claude Lefrançois, Coordonnateur, PCCEG
- 14:15 La position du gouvernement fédéral, Albin Tremblay, Directeur Régional, Direction de la protection de l'environnement, Environnement Canada, Région du Québec
- 14:45 La position du gouvernement du Québec, Jean Rivet, Directeur des politiques du secteur industriel, Ministère de l'environnement et de la faune
- 15:15 Pause
- 15:30 Panel: quelle devrait être la position du Canada à Kyoto et après?
- Président du Panel: Jean-Pierre Revéret
 - Panel: Manuel Dussault, Directeur de la recherche et de l'analyse, Alliance des manufacturiers et des exportateurs du Québec
Joanne Lalumière, Directrice principale, Communication et Environnement, Hydro-Québec
Jean-François Lefebvre, Groupe de recherche appliquée en macro écologie
Steven Guilbeault, Greenpeace Québec
- 16:45 Conclusion de la séance: Marc Lucotte, Jacinthe Lacroix, Claude Lefrançois
- 17:15 Fin de la séance

CANADIAN
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la Faune du Québec

Hydro-Québec

Nova Scotia Power Inc.

Kimberly-Clark Nova Scotia

Climate Change: Cross-Canada Briefings Before Kyoto
Calgary – Vancouver – Montreal – Toronto – Halifax

Toronto Session: Monday, November 17, 1997
Senate Chamber (Room N940 Ross Building)
York University, 4700 Keele Street, Toronto

Program

8:30	Registration and coffee
9:00	Welcoming Remarks: Peter Victor, Dean Faculty of Environmental Studies York University, CGCP Board member
9:15	Understanding Climate Change, Jim Bruce, IPCC WG3, CGCP Board member - General overview: Jim Bruce - Impacts: Linda Mortsch, Environmental Adaptation Research Group at the University of Waterloo, Environment Canada; Jamie Smith, Smith & Lavender Environmental Consulting - Mitigation: Jim Bruce - Economic and social costs: Erik Haites, Margaree Consultants
12:00	Lunch (included with registration fee) Brian Emmett, Commissioner of the Environment Office of the Auditor General of Canada
13:00	The International and National Negotiation Process, by Doug Russell, Global Change Strategies International Inc.
14:15	The position of the Federal Government, by Rick Findlay, Manager, Climate Change Air Issues Branch, EPS, Environment Canada
14:45	The position of the Provincial Government, by Rick Jennings, Director, Economic Services Branch, Ontario Department of the Environment
15:15	Break
15:30	Panel: What should Canada do in Kyoto and beyond? - Chair: David Bell, Director, York Centre for Applied Sustainability, Faculty of Environmental Studies, York University - Panel: Ken Ogilvie, Executive Director, Pollution Probe Angus Ross, President, Sorema Management Inc. Jim Hughes, Manager, Energy Analysis, Imperial Oil Limited
16:45	Conclusion of the Session: Peter Victor
17:15	End of the Session

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Environment Canada - Ontario
Region

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Hydro-Québec

Climate Change: Cross-Canada Briefings Before Kyoto

Calgary – Vancouver – Montreal – Toronto – Halifax

Halifax Session: Wednesday, November 19, 1997
University Club, Upper Campus
Dalhousie University, Halifax

Program

8:30	Registration and coffee
9:00	Welcoming Remarks: Tom Traves, President, Dalhousie University
9:05	Introduction to the Session: Desmond O'Neil, Donmec Consulting
9:15	Understanding Climate Change, Jim Bruce, IPCC WG3, CGCP Board member • General overview: Jim Bruce • Impacts: Jim Abraham, Manager of Atmospheric Science, Environment Canada, Bedford • Mitigation: Doug Russell, Global Change International Inc. • Legal Framework: David vanderZwaag, Dalhousie University • Economic and social costs: Jim Bruce
12:00	Lunch (included with registration fee)
13:00	The International and National Negotiation Process, by Doug Russell, GCSI Inc.
14:15	The position of the Federal Government, by Garth Bangay, Regional Director General, Atlantic Region, Environment Canada
14:45	The position of the Provincial Government, Creighton Brisco, Director, Resource Management and Environmental Protection Division, Nova Scotia Department of the Environment
15:15	Break
15:30	Panel: What should Canada do in Kyoto and beyond? • Chair: K. Scott Wood, Director, School of Resource and Environmental Studies, Dalhousie University • Panel: - David Brickman, Ecology Action Centre, Halifax - Owen Hertzman, Department of Oceanography, Dalhousie University - Osmundo Betancourt, Director, Environmental Policy and Programs, Nova Scotia Power
16:45	Conclusion of the Session: Desmond O'Neil
17:15	End of the Session

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Climate Change



Cross-Canada Briefings Before Kyoto

Presented by:

The Canadian Global Change Program of The Royal Society of Canada

In partnership with:

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The Faculty of Environmental Design, University of Calgary
The Sustainable Development Research Institute, University of British Columbia
L'Association de climatologie du Québec
L'Institut des sciences de l'environnement, Université du Québec à Montréal
The York Centre for Applied Sustainability, Faculty of Environmental Studies, York University
The School of Resource and Environmental Studies, Dalhousie University

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Environment Canada - Ontario Region
BC Ministry of Environment, Lands and Parks
Ministère de l'Environnement et de la Faune du Québec
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Cross-Canada Climate Change Briefings: Partners

The York Centre for Applied Sustainability

The Centre is an Organized Research Unit of York University that is based in the Faculty of Environmental Studies (FES). The Centre serves as a University-wide focus for activities that foster the application of sustainability practices and procedures, drawing on the substantive strengths of the Faculty of Environmental Studies, the Erivan K. Haub Business and the Environment Programme, the Faculty of Pure and Applied Science, the Faculty of Education and other faculties at York. The mandate of the Centre is to work in partnerships with organizations, businesses, governments, communities, First Nations, and educational institutions to help develop their own policy and programs for sustainability.

When the Ontario Round Table on Environment and Economy (ORTEE) was disbanded in 1995, the Centre assumed some aspects of its mandate. The Centre carries out work at the national, international and local levels.

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The Macleod Institute for Environmental Analysis

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Faculty of Environmental Design

The Faculty's educational mandate is a dual one; to offer a learning environment that prepares individuals for interdisciplinary collaboration and action; and to ensure that its graduate are competent practitioners in the professional specialties they individually elect to develop through studies in one of the five programs. Students and members of the faculty frequently collaborate in research including outreach projects. Students can obtain credits to their programs of study through participation in research.

In the twenty-five years since the founding of the Faculty, the nature and scope of its activities have developed widely and deeply, in concert with the growing concerns about the environment and its qualities, and with the extended complexity of environmental issues. Attention is being increasingly given to the appropriate ends, the just and equitable modes of intervention, and the qualitative character of environment to be achieved when management, planning and design projects are undertaken. In these respects, the Faculty's research, educational programs, and outreach services variously touch on natural, social, cultural and built environments. Its ultimate concerns are for the quality of human life and sustainability.

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The School for Resource and Environmental Studies

The School for Resource and Environmental Studies is the centre for environmental scholarship and research at Dalhousie University. It is a leading institution in environmental management and capacity-building in Canada and abroad. At the core of the School is a graduate, interdisciplinary teaching and research program. The program emphasizes rigorous inquiry and ethical practice as the foundation of responsible environmental and resource management which leads toward sustainable development. Efforts are devoted to addressing causes, rather than symptoms, of environmental problems.

The School draws its strength from an extended network of faculty, students, research associates, alumni and project partners. It is a dynamic community with diverse skills, interests and experience in natural sciences, policy, management and development. The bond which links this network is a shared interest in seeking innovative and appropriate solutions to critical environmental and resource problems.

The School demonstrates its commitment to society through many community service and international development initiatives. Enhancing environmental management capacity through institutional strengthening and human resource development are primary goals of activities which extend beyond the University community.

The School for Resource and Environmental Studies

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Institut des sciences de l'environnement

The prime directive of the Environmental Sciences Institute of the Université du Québec à Montréal as an organization is to foster the development of environmental education and research. It offers a common ground where all the units and individuals working in this field have the opportunity to meet and better coordinate their efforts, and provides a meeting place for the various disciplines pertinent to the development of environmental sciences. As such, the Institute especially encourages the involvement of new research units and new human resource to this field.

With the creation of the Institute in May 1990, UQAM wished to address the need to identify its various resources at work in the environmental sciences, and to offer its external partners a unique and clearly visible access to these resources. The university also wanted to improve the quality of its services, and increase its involvement potential in environmental issues so as to respond more efficiently to the community's needs

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Sustainable Development Research Institute

The Sustainable Development Research Institute (SDRI) was established in April 1991 as a vehicle to encourage interdisciplinary collaboration among the faculty, departments and centres at UBC, as well as other provincial institutes undertaking environmental research. SDRI represents a concerted attempt to break away from the restrictions imposed by the traditional compartmentalization of research, aiming to transcend disciplinary boundaries in its search for solutions.

The Institute fosters research on sustainable development issues that is policy-relevant, interdisciplinary and involves non-academic partners. In its research, the Institute recognizes the linkages between environment and development issues, the increasing importance of environmental issues in the decisions of governments and industry, and that the concept of sustainable development implies the need to connect environmental imperatives directly to economic and social priorities. SDRI focuses on these linkages, seeking ways to integrate the environment, the economy and social institutions.

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Quebec Climatology Association

Quebec climatology association (ACLIQ) is a non-profit organization established in october 1982, with the mandate to promote climatology and its uses in Quebec. The current membership is about 100 persons (individuals, corporate members, institutions) coming from universities, government agencies (federal and provincial) and the private sector. Many of the members also come from outside Quebec, mainly Ontario, Alberta and France.

Since the beginning, ACLIQ encourages research and links and exchanges between different people and groups working in the climatological or related fields. To this end, the association organizes every year at least one scientific meeting for its members and different groups of users. Those meetings are generally held within the climatology/meteorology session or an independant conference at the annual congress of the *French canadian association for the advancement of sciences* (ACFAS). When there is an opportunity, like in 1992 in Quebec City, the meeting is held within the *Canadian meteorological and oceanographic society* (CMOS)'s congress. On every of those occasions, series of papers on actual topics regarding climatology and related fields are presented.

Association de climatologie du Québec (ACLIQ)

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CANADIAN
GLOBAL
CHANGE
PROGRAM



PROGRAMME
CANADIEN DES
CHANGEMENTS
À L'ÉCHELLE
DU GLOBE

The **Canadian Global Change Program** was founded in 1985 under the auspices of the Royal Society of Canada to bring together scientists and other specialists from many disciplines in the sciences and humanities to plan interdisciplinary research, assess the significance of this research in the policy context, and communicate the implications to its target audiences. The Canadian Global Change Program is characterised by its independent, non-governmental status, its combination of the natural and human dimensions of global change, its access to world-wide networks of collaborating organisations, its emphasis on global issues that have relevance to Canada, and its access to Canadian and international capability that can be brought to bear on these issues.

THE ROYAL SOCIETY OF CANADA is an independent, non-profit organization that was incorporated by an act of Parliament in 1883. Its primary objective is to promote learning and research in the arts, letters and sciences in Canada. It draws on the knowledge and expertise of its Fellows to recognize and honour distinguished accomplishments, to promote public understanding of scholarly, scientific, technical and cultural issues, and to foster the free circulation of ideas through international exchanges and participation in scientific and cultural programs.

Acknowledgments

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Briefing Book

The briefing book was created using a number of published sources as well as original material. The published materials include products of the CGCP, the United Nations Framework Convention on Climate Change, and the IPCC. This briefing book is not meant to be a stand-alone product—it was prepared to be used in conjunction with the briefing session. It has not been formally reviewed by the CGCP Board or the Royal Society of Canada.



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1 Introduction

In less than a month Canada will be sitting down with other countries of the world to hammer out agreements on reduction of greenhouse gases that contribute to climate change. Since these agreements are likely to be binding on all parties, Canadian society will need to be well informed of the implications of such agreements. Much of the information surrounding the climate change issue is complex and many of the interpretations of the causes and effects reflect entrenched positions and are often contradictory. As a result of all the complexity and the claims and counter claims, the Canadian public is justifiably confused. For an informed debate to take place and for sensible decisions to be made, Canadians need to have a balanced overview of the science, economics and possible impacts of climate change, and need to understand the national, regional and international context in which the climate change issues are being played out.

This series of briefings is targeted to leaders in business, professional, university, non-profit, municipality, environmental and public interest organizations. The objective is to provide an independent and objective overview of the science, economics and impacts of climate change. In one day we can only cover the highlights of such a broad topic as climate change. The briefing book is designed to supplement the day's discussions and to lead you to areas for further study. There will no doubt be areas that we have not covered in enough detail and some that we may have left out. However, we hope that you will leave with a better understanding of climate change, the possible technical and policy responses nationally and internationally, the key issues to be faced by Canada, and how these issues could affect the various regions of Canada. We also hope that the briefings will give you the stimulus to increase further your understanding of the issues and to become involved as an informed participant in the decisions that have to be made to help us address the issue of climate change and the other global change issues with which it is linked.

The Canadian Global Change Program (CGCP) is lodged within the Royal Society of Canada. We attempt to bring together the best qualified people in Canada to address global environmental issues. Our current major area of focus is climate change. We draw on people in all sectors of inquiry: the natural sciences, economics, social sciences and the humanities. Our main objective is to provide a balanced analysis of global change science and to bring this analysis to the policy making level of organizations. Our point of departure and reference point for choosing the balance point for the climate change debate is the second assessment report of the Intergovernmental Panel on Climate Change (IPCC). Our concept of balance is based on the consensus of the great majority of the world's scientists including economic and social scientists, who have studied climate issues. We do not give equal weight to minority views on either side of this balance point.

Much of the legitimate concern of business interests in Canada centres around potential economic losses to our natural resource based industries and on competitiveness issues. Environmental and other concerned citizen groups mostly fear that the environment and human health and security will be severely harmed if greenhouse gas emissions are not reduced at a faster rates than currently planned. There is an increasing consensus among the scientific community that humans, by emitting increasing amounts of greenhouse gases are having a discernable influence on global climate and that the resulting climate change will have serious impacts both economic and environmental. Yet a vocal minority refutes the

science as uncertain and uses this as a basis for inaction. More research with an appropriate focus will reduce these uncertainties but how much certainty is required before action is taken? Regardless of areas in the science that still remain uncertain - and there will never be absolute certainty - the current evidence should be of enough concern to policy makers for rational, precautionary steps to be taken now. One of these steps will be taken at Kyoto. However, federal and provincial governments, faced with widely different regional pressures have found it difficult to find an acceptable middle ground that will allow Canada to make good on its promises at Rio in 1992 and define an acceptable negotiating position for Kyoto. There is agreement that voluntary measures to reduce greenhouse gas emissions should be implemented but these have yet to show significant results.

Canada will go to Kyoto with emissions up to 13% higher than agreed to at Rio and an as yet unknown negotiating position (although at the time of writing, October 29th, there are indications that public notice of Canada's position is imminent). European nations are calling for a 15% reduction in emissions from 1990 levels by 2010. Japan is arguing for a 5% reduction between 2008-2012. The USA's position is less ambitious - stabilization of emissions at 1990 levels between 2008-2012. The developing countries are calling for even more stringent emission reductions from the rich industrialized countries.

Climate change is a global issue that requires international response for the long term and will require behaviour modifications from all sectors of society and all countries if we are to counter its threats. It is an issue that requires attention at the highest levels. It is not simply an energy/environment problem, although that would be large enough. Much of the current debate promoting inaction in reducing greenhouse gas emissions reflects reaction to the potential short term negative effects as opposed to the long term responsibilities and the possible opportunities that might be seized by adopting long term response strategies.

Achieving appropriate measures that give incentives to actually change behaviour of manufacturers, producers and consumers will not occur overnight. There are many steps that will have to be taken beyond the Kyoto meetings before the threats of climate change can be countered. Sensible steps towards policy making on climate change will only be made by those with the broadest possible base of understanding based on a full exposure to all aspects of the issues. We hope that this briefing session and its accompanying materials will play a significant part in providing some of that understanding.

Jeffrey Watson,
Executive Director,
Canadian Global Change Program



2 Understanding Climate Change



2.1 Greenhouse Effect and Greenhouse Gases



2.1.1 Greenhouse Effect

- The earth's climate is driven by a continuous flow of energy from the sun. About 30% is immediately scattered back into space, but most of the 70% which is absorbed passes down through the atmosphere to warm the earth's surface.
- The earth must send this energy back out into space in the form of infrared radiation to maintain a temperature balance. Being much cooler than the sun, the earth does not emit energy as visible light. Instead, it emits infrared, or thermal radiation.
- Greenhouse gases in the atmosphere block some of the infrared radiation from escaping directly from the surface to space. Infrared radiation cannot pass straight through the air like visible light. Instead, most departing energy is carried away from the surface by air currents and clouds, eventually escaping to space from altitudes above the thickest layers of the greenhouse gas blanket.
- The main greenhouse gases are water vapour, carbon dioxide, ozone, methane, nitrous oxide, and the chlorofluorocarbons (CFCs). Apart from CFCs all of these gases occur naturally. Together, they make up less than 1% of the atmosphere. This is enough to produce a natural greenhouse effect that keeps the planet some 30°C warmer than it would otherwise be - essential for life as we know it.
- Levels of all key greenhouse gases are rising as a result of human activity. Emissions of carbon dioxide (mainly from burning coal, oil, and natural gas), methane and nitrous oxide (due to agriculture and changes in land use), ozone (generated by the fumes in automobile exhausts) and CFCs (manufactured by industry) are changing how the atmosphere absorbs energy. Water vapour levels are also rising because of a positive feedback. This is all happening at an unprecedented speed. The result is known as the enhanced greenhouse effect.
- The climate system must adjust to rising greenhouse gas levels to keep the global energy budget in balance. In the long term, the earth must get rid of energy at the same rate at which it receives energy from the sun. Since a thicker blanket of greenhouse gases helps to reduce energy loss to space, the climate must change somehow to restore the balance between incoming and outgoing energy.
- This adjustment will include a global warming on average of the earth's surface and lower atmosphere. But this is only part of the story. Warming up is the simplest way for the climate to get rid of the extra energy. But even a small rise in temperature will be accompanied by many other changes: in cloud cover and wind patterns, for example. Some of these changes may act to enhance the warming (positive feedbacks), others to counteract it (negative feedbacks).

- Meanwhile, industrially-generated sulphate aerosols can have a local cooling effect. Sulphur emissions from coal- and oil-fired power stations produce clouds of microscopic particles that reflect sunlight back out into space. This partly compensates for greenhouse warming in some regions. These sulphate aerosols, however, remain in the atmosphere for a relatively short time compared to the long-lived greenhouse gases. They also cause problems, such as acid rain. This means we should not rely on sulphate aerosols to keep the climate cool indefinitely.



2.1.2 Greenhouse Gases and Aerosols

- Greenhouse gases (GHGs) control energy flows in the atmosphere by absorbing infra-red radiation. Their levels are determined by a balance between sources and sinks. Sources are processes that generate greenhouse gases; sinks are processes that destroy or remove them. Humans affect greenhouse gas levels by introducing new sources or by interfering with natural sinks.
- The largest contributor to the natural greenhouse effect is water vapour. Its presence in the atmosphere is only marginally affected by human activity. Nevertheless, water vapour matters for climate change because of an important positive feedback. Warmer air can hold more moisture, and models predict that a small global warming would lead to a rise in global water vapour levels, further adding to the enhanced greenhouse effect. On the other hand, it is possible that some regions may become drier. Because modelling climate processes involving clouds and rainfall is particularly difficult, the exact size of this crucial feedback has some uncertainty.
- Carbon dioxide is currently responsible for over 60% of the enhanced greenhouse effect, which is responsible for climate change. This gas occurs naturally in the atmosphere, but burning coal, oil, and natural gas is releasing the carbon stored in these fossil fuels at an unprecedented rate. Likewise, deforestation releases carbon stored in trees. Current annual emissions amount to over 7 billion tonnes of carbon, or almost 1% of the total mass of carbon dioxide in the atmosphere.
- Carbon dioxide produced by human activity enters the carbon cycle. Many billions of tonnes of carbon are exchanged naturally each year between the atmosphere, the oceans, and land vegetation. The exchanges in this massive and complex natural system are precisely balanced; carbon dioxide levels appear to have varied by less than 10% during the 10,000 years before industrialization. In the 200 years since 1800, however, levels have risen by almost 30%. Even with half of humanity's carbon dioxide emissions being absorbed by the oceans and land vegetation, atmospheric levels continue to rise by over 10% every 20 years.
- A second important human influence on climate is aerosols. These clouds of microscopic particles are *not* a greenhouse gas. In addition to various natural sources, they are produced from sulphur dioxide emitted mainly by power stations, and by the smoke from deforestation and the burning of crop wastes. Aerosols settle out of the air after only a few days, but they are emitted in such massive quantities that they have a substantial impact on climate in some regions.
- Aerosols cool the climate locally by scattering sunlight back into space. Aerosol particles block sunlight directly and also provide seeds for clouds to form, and often these clouds also have a cooling effect. Over heavily industrialized regions, aerosol cooling may counteract nearly all of

the warming effect of greenhouse gas increases to date.

- Methane is a powerful greenhouse gas whose levels have already doubled. The main new sources of methane are agricultural, notably flooded rice paddies and expanding herds of cattle. Emissions from waste dumps and leaks from coal mining and natural gas production also contribute, especially in Canada. The main sink for methane is chemical reactions in the atmosphere.
- Methane from past emissions currently contributes 15-20% of the enhanced greenhouse effect. The rapid rise in methane started more recently than the rise in carbon dioxide, but methane's contribution has been catching up fast. However, methane has an effective atmospheric lifetime of only 12 years, whereas carbon dioxide survives much longer. This means that the relative importance of methane versus carbon dioxide emissions depends on the time horizon. For example, methane emitted during the 1980s is expected to have about 80% of the impact of that decade's carbon dioxide emissions over the 20-year period 1990-2010, but only 30% over the 100-year period 1990-2090.
- Nitrous oxide, chlorofluorocarbons (CFCs), and low level ozone contribute the remaining 20% of the enhanced greenhouse effect. Nitrous oxide levels have risen by 15%, mainly due to more intensive agriculture. CFCs increased rapidly until the early 1990s, but levels of key CFCs have since stabilised due to tough emission controls introduced under the Montreal Protocol to protect the stratospheric ozone layer. Ozone is another naturally-occurring greenhouse gas whose levels are rising in some regions in the lower atmosphere due to air pollution, even as they decline in the stratosphere.



2.1.3 Trends in Emissions

- Future greenhouse gas emissions will depend on global population, economic, technological and social trends. The link to population is clearest: the more people there are, the higher emissions are likely to be. The link to economic development is less clear. Rich countries generally emit more per person than do poor countries. However, countries of similar wealth can have very different CO₂ emission rates depending on their geographical circumstances, their sources of energy, and the efficiency with which they use energy and other natural resources.
- As a guide to policymakers, economists produce scenarios of future emissions. A scenario is not a prediction. Rather it is a way of investigating the implications of particular assumptions about future trends, including policies on greenhouse gases. Depending on the assumptions, a scenario can project growing, stable, or declining emissions.
- Most scenarios suggest that future growth in emission rates will be dominated by what happens in developing countries. The bulk of emissions to date have come from industrialized countries. However, most future growth is likely to come from emerging economies where economic and population growth is fastest - and for which projections are most uncertain.
- In a typical non-intervention scenario, carbon dioxide emissions rise from 7 billion tonnes of carbon per year in 1990 to 20 billion in 2100. Non-intervention means that no new policies are

adopted to reduce emissions in response to the threat of climate change. It does not mean that nothing else changes: in this particular IPCC scenario (known as IS92a), world population doubles by 2100 while economic growth continues at 2-3% per year. (Remember that scenarios are based on assumptions, which are simply that, assumed futures of the world)

- This scenario leads to the equivalent of a doubling of pre-industrial CO₂ concentrations by 2030, and a trebling by 2100. This includes the effects of other greenhouse gas emissions, translated into their carbon-dioxide equivalents. Even the present 30% of pre-industrial carbon dioxide takes levels of this long-lived greenhouse gas higher than they have been for at least 160,000 years.
- Different assumptions about sources and sinks give very different results. Future emissions are uncertain, and they have to be translated into future atmospheric concentrations using models of the carbon cycle and atmospheric chemistry. This introduces more uncertainty, since it is unclear how key sinks (processes that absorb greenhouse gases) will respond to a changing climate. Rising carbon dioxide levels, for example, cause plants to grow faster (the CO₂-fertilisation effect) and absorb more carbon dioxide through photosynthesis. CO₂ fertilisation, together with forest re-growth in northern countries, may be absorbing up to 25% of the carbon dioxide currently produced by human activity. No-one knows how this sink will behave in the future: if more land is required for food production or more forest fires occur, the trend may reverse.
- Intervention scenarios are designed to examine the impact of efforts to reduce greenhouse gas emissions. They depend not only on assumptions about population and economic growth, but also about how future societies will respond to the introduction of policies such as taxes on carbon-rich fossil fuels or regulation of greenhouse gas emitting products.
- Existing international commitments could slightly reduce the rate of growth in emissions through the 21st century. Under the Climate Change Convention, developed countries are aiming to return their greenhouse gas emissions to 1990 levels by the year 2000. If they were to succeed, the date of CO₂ doubling would be postponed by less than five years. A goal of making more substantial reductions in atmospheric concentrations would clearly require all countries to make stronger cuts in their emissions.
- Freezing global emissions at current levels would postpone CO₂ doubling to 2100. This still would not be enough to prevent greenhouse gas concentrations from continuing to rise far beyond the year 2100. Stabilising carbon dioxide at double its pre-industrial concentration sometime in the future would require emissions to fall eventually to less than 50% of their current levels, despite growing populations and an expanding world economy.
- Reducing uncertainties about climate change impacts and the costs of various response options is vital for policymakers. Stabilising or reducing emissions world-wide would have an impact on almost every human activity. To decide if it is worthwhile, we need to know how much it would cost, and how bad things will get if we let emissions grow. There are tough moral questions too: how much are we prepared to pay for the climate of the future, which only our children and their children will see?

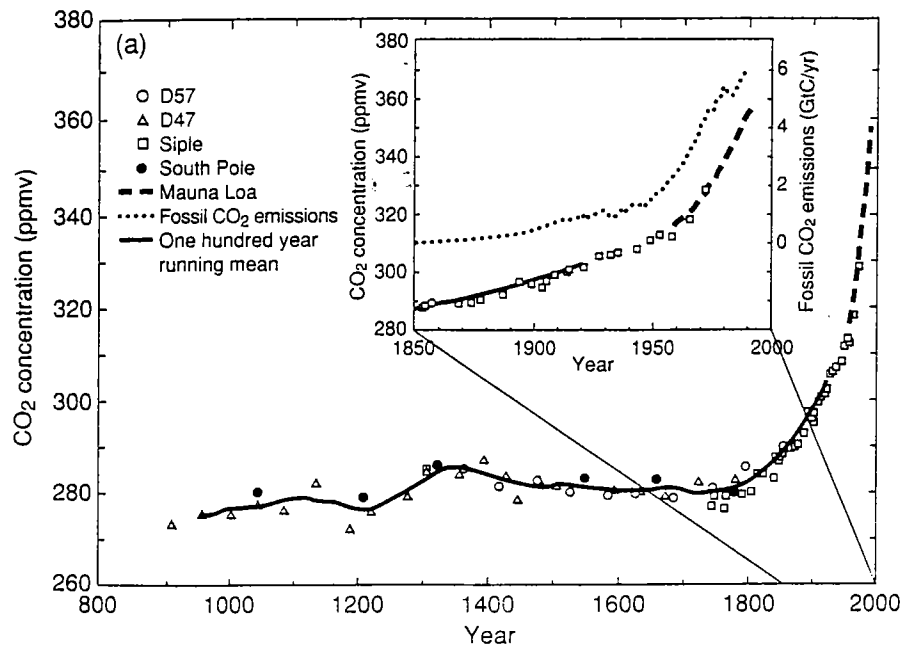


Figure 1: CO₂ concentration (ppmv) / year, from 800 - 2000

Source: Climate Change 1994, Reports of Working Groups I and III of the IPCC, 1995

2.2 Climate System Science

In many countries research on climate - the atmosphere, oceans, hydrological and terrestrial systems, has been conducted for many years. Much of that research has been conducted since 1980 in the framework of the World Climate Research Program (WCRP), and since 1986 in the International Geosphere Biosphere Program (IGBP). WCRP has focussed mainly on the physical aspects of the ocean-atmosphere system and climate system modeling. IGBP concentrates on the biogeochemical aspects, but close collaboration has brought the programs ever more closely together to understand better the whole climate system. The key international agencies involved are the World Meteorological Organization, the Intergovernmental Oceanographic Commission of UNESCO and the nongovernmental International Council of Scientific Unions. In Canada, the Canadian Global Change Program has coordinated the important Canadian IGBP efforts and liaison with the international program. The Canadian Climate Program Board has served a similar function for Canada's active participation in the WCRP. Science assessments of IPCC are based upon the research results from these international programs as well as national research effect on climate.

2.2.1 The IPCC Assessment Process

The Intergovernmental Panel on Climate Change's assessments are relied on to a considerable extent in

these briefing notes. This is because they are widely recognized as the most thorough and balanced assessments of available published knowledge on climate system science, the likely impacts of change, and the socio-economic dimensions of the climate change issue.

The IPCC was formed as a Panel open to all countries in 1988 by the World Meteorological Organization, (WMO), a United Nations specialized agency, and the United Nations Environment Program (UNEP), at the request of governments. Its first assessment report was completed in 1990 and was endorsed at the Second World Climate Conference, Geneva, Nov. 1990 by some 800 scientists and Ministers. This provided much of the impetus for negotiation by countries of the Framework Convention on Climate Change initially signed in 1992 at the Earth Summit in Rio. The IPCC Report writing and review procedures have nine steps, and are the most elaborate ever attempted by the global community on a science-environment issue.

The steps are as follows:

1. Governments decide in plenary sessions on the overall scope of issues to be addressed, assign the topics to three Working Groups and elect a Bureau for each group. For the 1992 to 1995 assessment, these Working Groups were on:

Working Group I	The Science of Climate Change,
Working Group II	Impacts, adaptation and mitigation, and
Working Group III	Economic and Social Dimensions.
2. Each Working Group in Plenary Session, usually involving more than 100 country representatives and business and environmental NGOs, decides in more detail on the topics to be covered in their part of the overall assessment.
3. Countries are then asked to nominate qualified authors and reviewers for the various topics. They may be experts drawn from government agencies, universities, the business sector and scientific or environmental non-governmental organizations. Writing teams are selected from these nominees by the Working Group Bureaux ensuring inclusion of developing countries' specialists and a range of the expertise needed for the topic.
4. The Writing Teams, led by one or several Lead Authors, then prepare first drafts of assessments of published, peer reviewed, scientific and economics literature.
5. These drafts go to a large number of expert reviewers around the world, and reviews and comments are carefully considered to produce a second draft report.
6. The second draft goes to governments for review by whoever they wish to designate, often including business groups and environmental NGOs. After incorporation of the relevant review comments, the Technical Reports are essentially complete. They remain the responsibility of the Authors.
7. Based on these technical assessments (which have ranged from 420 to 830 pages), each Working Group Bureau then prepares a draft Summary for Policy Makers (SPM). This summary is intended to reflect the key findings of the assessments, cast in a form that would be useful to governments and others concerned with climate change policy.

8. A government review by correspondence is conducted of this SPM and amendments are made by the WG Bureau of the draft, to take into account the comments received.

9. A Working Group Plenary session reviews and approves the text of the SPM line by line, and accepts the underlying technical report.

Thus the IPCC Assessments of 1990 and 1995, consist of three authored technical assessment reports containing 11 to 28 Chapters each, and 3 government approved Summaries for Policy Makers. As there are different perspectives from countries ranging from oil producers to small island states concerned about sea level rise, the SPM's usually involve carefully phrased, balanced statements, based upon the underlying technical reports. The whole process in the 1995 assessments involved upwards of 3,000 scientists and other specialists from around the world. It is undoubtedly the most thorough, authoritative, global assessment of a science-environment issue that has ever been produced.

Most of the IPCC material in this briefing kit is drawn from the Summaries for Policy Makers. The complete 1995 Assessment was published by Cambridge University Press, in 3 Volumes under the general title, Climate Change, 1995 and is available through bookstores. The Summaries for Policy Makers are also available from WMO, Case Postale 2300, CH 1211 Geneva in several languages. The documents are also available on the Web (see resources section at the end of the binder for the Web addresses).

The next section of the briefing binder provides the entire text of Working Group I Summary for Policymakers.



2.2.2 Summary for policy makers: WGI¹

Considerable progress has been made in the understanding of climate change science since 1990 and new data and analyses have become available.

1. Greenhouse gas concentrations have continued to increase

Increases in greenhouse gas concentrations since pre-industrial times (i.e. since about 1750) have led to a positive radiative forcing of climate, tending to warm the surface and to produce other changes of climate.

- The atmospheric concentrations of greenhouse gases, inter alia carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) have grown significantly: by about 30%, 145%, and 15%, respectively (values for 1992). These trends can be attributed largely to human activities, mostly fossil fuel use, land-use change and agriculture.
- The growth rates of CO₂, CH₄ and N₂O concentrations were low during the early 1990s. While this apparently natural variation is not yet fully explained, recent data indicate that the growth

¹ excerpt from: IPCC Second Assessment: Climate Change 1995. Intergovernmental Panel on Climate Change. World Meteorological Organization and United Nations Environmental Program, pg 21-24

rates are currently comparable to those averaged over the 1980s.

- The direct radiative forcing of the long-lived greenhouse gases (2.45 Wm⁻²) is due primarily to increases in the concentrations of CO₂ (1.56 Wm⁻²), CH₄ (0.47 Wm⁻²) and N₂O (0.14 Wm⁻²) (values for 1992).
- Many greenhouse gases remain in the atmosphere for a long time (for CO₂ and N₂O, many decades to centuries), hence they affect radiative forcing on long time-scales.
- The direct radiative forcing due to the CFCs and HCFCs combined is 0.25 Wm⁻². However, their net radiative forcing is reduced by about 0.1 Wm⁻² because they have caused stratospheric ozone depletion which gives rise to a negative radiative forcing.
- Growth in the concentration of CFCs, but not HCFCs, has slowed to about zero. The concentrations of both CFCs and HCFCs, and their consequent ozone depletion, are expected to decrease substantially by 2050 through implementation of the Montreal Protocol and its Adjustments and Amendments.
- At present some long-lived greenhouse gases (particularly HFCs (a CFC substitute), PFCs and SF₆) contribute little to radiative forcing but their projected growth could contribute several per cent to radiative forcing during the 21st century.
- If carbon dioxide emissions were maintained at near current (1994) levels, they would lead to a nearly constant rate of increase in atmospheric concentrations for at least two centuries, reaching about 500 ppmv (approaching twice the pre-industrial concentration of 280 ppmv) by the end of the 21st century.
- A range of carbon cycle models indicates that stabilisation of atmospheric CO₂ concentrations at 450, 650 or 1000 ppmv could be achieved only if global anthropogenic CO₂ emissions drop to 1990 levels by, respectively, approximately 40, 140 or 240 years from now, and drop substantially below 1990 levels subsequently.
- Any eventual stabilised concentration is governed more by the accumulated anthropogenic CO₂ emissions from now until the time of stabilisation, than by the way those emissions change over the period. This means that, for a given stabilised concentration value, higher emissions in early decades require lower emissions later on. Among the range of stabilisation cases studied, for stabilisation at 450, 650 or 1000 ppmv accumulated anthropogenic emissions over the period 1991 to 2100 are 630 GtC, 1030 GtC, and 1410 GtC respectively (approximately 15% in each case). For comparison the corresponding accumulated emissions for IPCC IS92 emission scenarios range from 770 to 2190 GtC.
- Stabilisation of CH₄ and N₂O concentrations at today's levels would involve reductions in anthropogenic emissions of 8% and more than 50% respectively.
- There is evidence that tropospheric ozone concentrations in the Northern Hemisphere have increased since pre-industrial times because of human activity and that this has resulted in a

positive radiative forcing. This forcing is not yet well characterised, but it is estimated to be about 0.4 Wm^{-2} (15% of that from the long-lived greenhouse gases). However the observations of the most recent decade show that the upward trend has slowed significantly or stopped.

2. Anthropogenic aerosols tend to produce negative radiative forcings

- Tropospheric aerosols (microscopic airborne particles) resulting from combustion of fossil fuels, biomass burning and other sources have led to a negative direct forcing of about 0.5 Wm^{-2} , as a global average, and possibly also to a negative indirect forcing of a similar magnitude. While the negative forcing is focused in particular regions and subcontinental areas, it can have continental to hemispheric scale effects on climate patterns.
- Locally, the aerosol forcing can be large enough to more than offset the positive forcing due to greenhouse gases.
- In contrast to the long-lived greenhouse gases, anthropogenic aerosols are very short-lived in the atmosphere, hence their radiative forcing adjusts rapidly to increases or decreases in emissions.

3. Climate has changed over the past century

At any one location year-to-year variations in weather can be large, but analyses of meteorological and other data over large areas and over periods of decades or more have provided evidence for some important systematic changes.

- Global mean surface air temperature has increased by between about 0.3 and 0.6°C since the late 19th century ; the additional data available since 1990 and the re-analyses since then have not significantly changed this range of estimated increase.
- Recent years have been among the warmest since 1860, i.e., in the period of instrumental record, despite the cooling effect of the 1991 Mt. Pinatubo volcanic eruption.
- Night-time temperatures over land have generally increased more than daytime temperatures.
- Regional changes are also evident. For example, the recent warming has been greatest over the mid-latitude continents in winter and spring, with a few areas of cooling, such as the North Atlantic ocean. Precipitation has increased over land in high latitudes of the Northern Hemisphere, especially during the cold season.
- Global sea level has risen by between 10 and 25 cm over the past 100 years and much of the rise may be related to the increase in global mean temperature.
- There are inadequate data to determine whether consistent global changes in climate variability or weather extremes have occurred over the 20th Century. On regional scales there is clear evidence of changes in some extremes and climate variability indicators (e.g., fewer frosts in several widespread areas; an increase in the proportion of rainfall from extreme events over the contiguous states of the USA). Some of these changes have been toward greater variability; some

have been toward lower variability.

- The 1990 to mid-1995 persistent warm-phase of the El Niño -Southern Oscillation (which causes droughts and floods in many areas) was unusual in the context of the last 120 years.

4. The balance of evidence suggests a discernible human influence on global climate

Any human-induced effect on climate will be superimposed on the background noise of natural climate variability, which results both from internal fluctuations and from external causes such as solar variability or volcanic eruptions. Detection and attribution studies attempt to distinguish between anthropogenic and natural influences. Detection of change is the process of demonstrating that an observed change in climate is highly unusual in a statistical sense, but does not provide a reason for the change. Attribution is the process of establishing cause and effect relations, including the testing of competing hypotheses.

Since the 1990 IPCC Report, considerable progress has been made in attempts to distinguish between natural and anthropogenic influences on climate. This progress has been achieved by including effects of sulphate aerosols in addition to greenhouse gases, thus leading to more realistic estimates of human-induced radiative forcing. These have then been used in climate models to provide more complete simulations of the human-induced climate-change 'signal'. In addition, new simulations with coupled atmosphere-ocean models have provided important information about decade to century time-scale natural internal climate variability. A further major area of progress is the shift of focus from studies of global-mean changes to comparisons of modelled and observed spatial and temporal patterns of climate change.

The most important results related to the issues of detection and attribution are:

- The limited available evidence from proxy climate indicators suggests that the 20th century global mean temperature is at least as warm as any other century since at least 1400 AD. Data prior to 1400 are too sparse to allow the reliable estimation of global mean temperature.
- Assessments of the statistical significance of the observed global mean surface air temperature trend over the last century have used a variety of new estimates of natural internal and externally-forced variability. These are derived from instrumental data, palaeodata, simple and complex climate models, and statistical models fitted to observations. Most of these studies have detected a significant change and show that the observed warming trend is unlikely to be entirely natural in origin.
- More convincing recent evidence for the attribution of a human effect on climate is emerging from pattern-based studies, in which the modelled climate response to combined forcing by greenhouse gases and anthropogenic sulphate aerosols is compared with observed geographical, seasonal and vertical patterns of atmospheric temperature change. These studies show that such pattern correspondences increase with time, as one would expect as an anthropogenic signal increases in strength. Furthermore, the probability is very low that these correspondences could occur by chance as a result of natural internal variability only. The vertical patterns of change are also inconsistent with those expected for solar and volcanic forcing.

- Our ability to quantify the human influence on global climate is currently limited because the expected signal is still emerging from the noise of natural variability, and because there are uncertainties in key factors. These include the magnitude and patterns of long term natural variability and the time-evolving pattern of forcing by, and response to, changes in concentrations of greenhouse gases and aerosols, and land surface changes. Nevertheless, the balance of evidence suggests that there is a discernible human influence on global climate.

5. Climate is expected to continue to change in the future

The IPCC has developed a range of scenarios, IS92a-f, of future greenhouse gas and aerosol precursor emissions based on assumptions concerning population and economic growth, land-use, technological changes, energy availability and fuel mix during the period 1990 to 2100. Through understanding of the global carbon cycle and of atmospheric chemistry, these emissions can be used to project atmospheric concentrations of greenhouse gases and aerosols and the perturbation of natural radiative forcing. Climate models can then be used to develop projections of future climate.

- The increasing realism of simulations of current and past climate by coupled atmosphere-ocean climate models has increased our confidence in their use for projection of future climate change. Important uncertainties remain, but these have been taken into account in the full range of projections of global mean temperature and sea level change.
- For the mid-range IPCC emission scenario, IS92a, assuming the best estimate value of climate sensitivity and including the effects of future increases in aerosol, models project an increase in global mean surface air temperature relative to 1990 of about 2 °C by 2100. This estimate is approximately one third lower than the best estimate in 1990. This is due primarily to lower emission scenarios (particularly for CO₂ and the CFCs), the inclusion of the cooling effect of sulphate aerosols, and improvements in the treatment of the carbon cycle. Combining the lowest IPCC emission scenario (IS92c) with a low value of climate sensitivity and including the effects of future changes in aerosol concentrations leads to a projected increase of about 1 °C by 2100. The corresponding projection for the highest IPCC scenario (IS92e) combined with a high value of climate sensitivity gives a warming of about 3.5 °C. In all cases the average rate of warming would probably be greater than any seen in the last 10,000 years, but the actual annual to decadal changes would include considerable natural variability. Regional temperature changes could differ substantially from the global mean value. Because of the thermal inertia of the oceans, only 50-90% of the eventual equilibrium temperature change would have been realised by 2100 and temperature would continue to increase beyond 2100, even if concentrations of greenhouse gases were stabilised by that time.
- Average sea level is expected to rise as a result of thermal expansion of the oceans and melting of glaciers and ice-sheets. For the IS92a scenario, assuming the best estimate values of climate sensitivity and of ice melt sensitivity to warming, and including the effects of future changes in aerosol, models project an increase in sea level of about 50 cm from the present to 2100. This estimate is approximately 25% lower than the best estimate in 1990 due to the lower temperature projection, but also reflecting improvements in the climate and ice melt models. Combining the lowest emission scenario (IS92c) with the low climate and ice melt sensitivities and including aerosol effects gives a projected sea level rise of about 15 cm from the present to 2100. The

corresponding projection for the highest emission scenario (IS92e) combined with high climate and ice-melt sensitivities gives a sea level rise of about 95 cm from the present to 2100. Sea level would continue to rise at a similar rate in future centuries beyond 2100, even if concentrations of greenhouse gases were stabilised by that time, and would continue to do so even beyond the time of stabilisation of global mean temperature. Regional sea level changes may differ from the global mean value owing to land movement and ocean current changes.

- Confidence is higher in the hemispheric-to-continental scale projections of coupled atmosphere-ocean climate models than in the regional projections, where confidence remains low. There is more confidence in temperature projections than hydrological changes.
- All model simulations, whether they were forced with increased concentrations of greenhouse gases and aerosols or with increased concentrations of greenhouse gases alone, show the following features: greater surface warming of the land than of the sea in winter; a maximum surface warming in high northern latitudes in winter, little surface warming over the Arctic in summer; an enhanced global mean hydrological cycle, and increased precipitation and soil moisture in high latitudes in winter. All these changes are associated with identifiable physical mechanisms.
- In addition, most simulations show a reduction in the strength of the north Atlantic thermohaline circulation and a widespread reduction in diurnal range of temperature. These features too can be explained in terms of identifiable physical mechanisms.
- The direct and indirect effects of anthropogenic aerosols have an important effect on the projections. Generally, the magnitudes of the temperature and precipitation changes are smaller when aerosol effects are represented, especially in northern mid-latitudes. Note that the cooling effect of aerosols is not a simple offset to the warming effect of greenhouse gases, but significantly affects some of the continental scale patterns of climate change, most noticeably in the summer hemisphere. For example, models that consider only the effects of greenhouse gases generally project an increase in precipitation and soil moisture in the Asian summer monsoon region, whereas models that include, in addition, some of the effects of aerosols suggest that monsoon precipitation may decrease. The spatial and temporal distribution of aerosols greatly influence regional projections, which are therefore more uncertain.
- A general warming is expected to lead to an increase in the occurrence of extremely hot days and a decrease in the occurrence of extremely cold days.
- Warmer temperatures will lead to a more vigorous hydrological cycle; this translates into prospects for more severe droughts and/or floods in some places and less severe droughts and/or floods in other places. Several models indicate an increase in precipitation intensity, suggesting a possibility for more extreme rainfall events. Knowledge is currently insufficient to say whether there will be any changes in the occurrence or geographical distribution of severe storms, e.g., tropical cyclones.
- Sustained rapid climate change could shift the competitive balance among species and even lead to forest dieback, altering the terrestrial uptake and release of carbon. The magnitude is uncertain,

but could be between zero and 200 GtC over the next one to two centuries, depending on the rate of climate change.

6. *There are still many uncertainties*

Many factors currently limit our ability to project and detect future climate change. In particular, to reduce uncertainties further work is needed on the following priority topics:

- Estimation of future emissions and biogeochemical cycling (including sources and sinks) of greenhouse gases, aerosols and aerosol precursors and projections of future concentrations and radiative properties.
- Representation of climate processes in models, especially feedbacks associated with clouds, oceans, sea ice and vegetation, in order to improve projections of rates and regional patterns of climate change.
- Systematic collection of long-term instrumental and proxy observations of climate system variables (e.g., solar output, atmospheric energy balance components, hydrological cycles, ocean characteristics and ecosystem changes) for the purposes of model testing, assessment of temporal and regional variability and for detection and attribution studies.

Future unexpected, large and rapid climate system changes (as have occurred in the past) are, by their nature difficult to predict. This implies that future climate changes may also involve surprises. In particular these arise from the non-linear nature of the climate system. When rapidly forced, non-linear systems are especially subject to unexpected behaviour. Progress can be made by investigating non-linear processes and sub-components of the climatic system. Examples of such non-linear behaviour include rapid circulation changes in the North Atlantic and feedbacks associated with terrestrial ecosystem changes.



2.2.3 *Changes in Climate Extremes*

By all measures there has been an alarmingly rapid increase in world-wide losses from natural disasters over the past three decades. The problem facing design engineers, water managers, insurance companies and society as a whole, is whether the exponential trend in increased losses is likely to continue, or will the damages subside in future decades? To answer requires analysis of the likely causes of the increases. The rise in disaster damages could be due to three main factors:

- 1) increases in infrastructure and human activities exposed to natural hazards,
- 2) changes in land use in river basins affecting floods and droughts, and
- 3) increases in the frequency of extreme climatic events.

This section of the briefing book examines these three factors, with special emphasis on the question of changes in climate-related hazards, and considers the implications for future disaster losses. Many in the insurance and re-insurance industry, in particular, believe that the increased losses cannot be attributed entirely to growing economic development and populations exposed to the hazards. Munich Re's 1996 press release was headed by newspapers, Insurance: Biz Blames High Costs Partly on Climate Change.

The report goes on to say, The cost of natural disasters, some caused by global warming, surged to a record \$180 billion last year, three times the previous high reached in 1994, according to Munich Re, world's largest re-insurance group. In Canada, the Insurance Industry has reported a similar rapid rise in losses - reaching \$900 million in 1996, which many in the industry ascribe in part to climate change.

Do the records of disaster losses, and of frequency and severity of climate-related hazards - storms, floods and droughts, support the contention of a linkage to anthropogenic climate change made by some insurance companies? Can anything be inferred from projections of future climate, under forcing by greenhouse gases and aerosols, about future trends in natural hazards?

WORLD-WIDE DISASTER LOSS TRENDS

There are several sources of disaster data, the large re-insurance companies, some government agencies (especially in U.S.A. and Japan), and university groups such as the Centre for Research on Epidemiology of Disasters (CRED) University of Louvain, Belgium. While there are differences in the data sets, several general conclusions can be reached from compilations by these agencies and summaries of their data made for the Yokohama U.N. Conference on Natural Disaster Reduction 1994. These are that:

1. Losses have increased enormously since the 1960s - from an average of about \$1 billion/year in the 1960s to an average of more than \$50 billion/year in the 1990s - in constant dollars (Munich Re and Japan Land Agency)

Most recent annual global loss estimates were \$65 billion (1995), \$150 to \$180 billion (1996 - about half from the Great Hanshin - Kobe earthquake, Japan), and \$60 billion (1997).

2. From 1965-92 data, about 70% of economic losses were due to climate related disasters (storms, floods, droughts) and 97% of people affected were from extreme climatic and hydrologic events.
3. The number of deaths from natural disasters has increased at a slower rate than economic losses. In significant measure, this is attributable to improved warning and preparedness systems, stronger building codes and other measures reinforced through the U.N.'s International Decade for Natural Disaster Reduction (1990-99). Most deaths (88%) from 1985-92 were in low income countries in which these disaster loss prevention measures have been less vigorously pursued.

One analysis for the 1994 Yokohama Conference provides data on numbers of major disasters from 1963-1992. Major is defined as:

- a) damages of more than 1% of annual GNP of the affected country,
- b) number of affected people exceeding 1% of the population, and
- c) number of deaths greater than 100.

Over the period the number of earthquake disasters, exceeding the 1% of GNP threshold, doubled or tripled but drought numbers on this criterion showed a 5 to 7 fold increase, floods were up 8 - 12 times and tropical storms about 4 times. Floods and droughts also showed the greatest rate of increase for the persons affected criterion, more than twice as rapid as the doubled number of disastrous tropical cyclones.

POSSIBLE CAUSES OF OBSERVED TRENDS

Global economic development from 1965 to 1990 is illustrated by about a 3-fold increase in world GNP and total world population has nearly doubled over this period. However, these are far from the 50 fold increase reported in disaster losses. Undoubtedly populations in hazardous areas, especially coastal zones, have increased more rapidly than the general population, but only in a few locations (e.g. Florida) has this increase been sufficient to explain much of the disaster loss rise. Flood frequency has increased in a number of river basins because of reduction of forested area. Increases in surface areas impermeable to rain water has accelerated runoff and raised flood peaks because of urban and suburban development in many watersheds. Reduction of woody vegetation in semi-arid countries has intensified desertification and drought. These forces have been undoubtedly at work, but it is difficult to assess their global magnitude.

What of the third possible factor, increased frequency of climate extremes? Is there evidence of this in climatic records and what do climate research results suggest for the future?

The 1995 IPCC Report concluded that "there are inadequate data to determine whether consistent global changes in climate variability or extremes have occurred over the 20th century". Nevertheless, the Report cites a number of regions in which increased frequency of certain extreme events has been observed. At the same time, the IPCC reports that, "With increasing greenhouse gas concentrations, many models suggest an increase in the probability of intense precipitation". This follows from the IPCC's 1992 conclusion "that a warmer climate will be one in which the hydrologic cycle will in general be more intense leading to more heavy rain events". Various classes of climate extremes need to be considered since the evidence of changes and projections of future change differ for different types of hazards.

Heavy Rains

As suggested in the quotations from the IPCC report, this is the class of extreme events for which climate change evidence is most compelling. Among the regionally observed trends, well confirmed by long term reliable data, are increases in the frequency of extreme rainfall events in U.S.A., Japan, northern Australia, and the north-west coast of India. For example, Tom Karl of U.S. National Oceanographic and Atmospheric Administration and colleagues, found a highly significant (20%) increase from 1911 to 1992 over U.S.A. in the proportion of rain occurring in heavy rain days (>50.8mm) in summer. Karl and his colleagues also showed that the area of the U.S.A. that has had a greater than normal amount of precipitation in heavy one day events (>50.8 mm) has steadily increased over the century. They calculate that this result has a less than 1 in 1000 chance of occurring in a quasi stationary climate, and is a manifestation of a changing climate. However, these analysts found no similar detectable trend in records for a short period to 1989, in China or the former Soviet Union. The changes over North America are related to a significant increase in moisture content in the lower layers of the atmosphere observed over the past 30 years. In southern Canada, while the average amount of water vapour for precipitation has increased in the past 30 years, in some cases significantly, the frequency of very heavy rains is unchanged or only slightly greater. Total rainfall has also increased over much of the U.S.A. and parts of Canada but this has occurred mainly in heavy falls on rainy days rather than more days with rain.

A number of different models of the climate system driven by increasing greenhouse gases indicate that a generally warmer world in future will see rain intensities increase at most latitudes, with the heaviest rain

events increasing the most. The latter would rise by more than 50% according to the U.K. Meteorological Office model in a doubled CO₂ world. Under similar changes in the atmospheric composition, the Canadian Climate model projects heavy rains occurring once in 20 years to become once in 10 year events.

Tropical Storms

Data compiled by the World Meteorological Organization suggest that there has been no world-wide significant change observed in frequency or intensity of tropical cyclones, variously called, typhoons, hurricanes, cyclones in different tropical regions. Regional fluctuations have been strong on a decade to decade basis, and these appear to be closely related to the El Nino - Southern Oscillation (ENSO) events involving abnormally warm surface water in the equatorial Pacific. The warm El Nino years depress hurricane activities in the Caribbean and North Atlantic and enhance cyclone frequency in parts of the Pacific. Some studies, but not all, suggest an increasing frequency, intensity and length of warm El Nino events in a greenhouse gas-enhanced world.

At the same time, present climate models do not have a fine enough scale to provide any confident indication of tropical cyclone activities in a future changing climate. It has been argued on physical grounds that there will likely be little change in numbers or average intensities of tropical cyclones but there could be an increase in intensity of the most severe storms.

Extra-tropical Storms

There is evidence in some published reports of increases in the past few decades in frequency of the most severe northern hemisphere storms, especially in winter, and of increased significant wave heights in the North Atlantic. On the other hand, some analysts argue that the data sets available are not consistent enough for determination of long term trends.

Modeling of possible future changes with increased greenhouse gases has also been limited. However, several studies suggest that recent observed trends towards more intense extra-tropical storms (cyclones) in the northern hemisphere may be a part of human induced climate change. For example, from the Canadian Climate-model runs, it was concluded that although the total number of winter cyclones would decrease with increased greenhouse gases there would be an increase in frequency of very intense storms. This suggests that more of the precipitation (snow and rain) would occur in intense bursts, and there would be more frequent wind damages. The U.K. Meteorological Office model suggests a poleward shift and intensification of Northern Hemisphere storm tracks with the most spectacular increase in intensity in eastern Atlantic and western Europe. These results are consistent with observed increase in Northern Hemisphere severe storms and North Atlantic significant wave heights over the past 3 decades.

Sea Level Rise

Exacerbating coastal and estuarine flooding, along with any change in intensity or location of storms, is an increase in mean sea level. IPCC indicates that mean sea level has risen between 10 and 25 cm over the past century. The rise in average sea level is mainly due to expansion of water in a warming world but also in part to melting of land based ice and glaciers, evident in recent decades. Projections of future rates of sea level increase in a warming world are 2 to 5 times the past rates with a mid-range projection of a ½

metre rise by 2100. IPCC estimates that the world population exposed to coastal flooding would double from 46 to 92 million with a ½ metre sea level rise, with many low lying islands and estuaries seriously affected.

Droughts

Statistical evidence for systematic changes to date in drought frequency is not consistent or convincing. Drought frequency and severity in many countries is very closely tied to the ENSO phenomenon, which appears to be a more important factor at this stage than any global climate trend. The question of the interaction between ENSO events and climate change is a field of very intensive research. Over the past 80 years the intensity of both warm water El Nino events and cold water La Nina occurrences has apparently increased. Some models of the interaction of global warming and ENSO suggest that the warming could worsen drought conditions in those regions subject to ENSO induced droughts.

Other investigators find that their model outputs indicate not only heavier one-day rains in future, but also longer dry spells between rains. IPCC suggests also that dry days may become more frequent in those tropical regions where mean precipitation is expected to decrease in a warmer world. Taken together, there may then be an increase in the length of dry periods, i.e. a tendency towards more and longer dry spells in many regions.

Recent modeling work at the Geophysical Fluid Dynamics Lab. (Princeton) examined effects of greenhouse gas increases on soil moisture, and investigated the mechanisms responsible for mid-continent summer dryness. The analysis used 4 x CO₂ forcing to exaggerate the mechanisms and effects although the exaggeration may not be too great since without additional limitation policies, a 3 x CO₂ world is quite plausible before the end of the next century. This study showed largest increases in evaporation minus precipitation in summer in the band 40 to 50° North, suggesting a tendency towards more severe droughts in major cereal growing regions of North America and Asia.

Floods

Several climatic trends may have been affecting flood frequency and severity. The observed increase in large one day rainfalls in some regions outlined above are one factor especially in small river basins. In zones where floods often result from snowmelt, there is evidence that earlier spring melt, with recent warming trends, has resulted in more rapid melt of the winter snow pack and higher peak flows. These factors combined with changes in land use in many river basins is likely to continue to increase flood disaster losses, unless strong damage reduction measures are implemented.

Other Climate Related Hazards

There are indications from both France and Canada that increased summer temperatures of the past few decades especially warmer nights, have been related to more frequent severe thunderstorms, hail and tornado events. Warm summers will be more frequent in a greenhouse enhanced world.

Wildfires in remote forest areas are a result of dry periods and lightning strikes. Both have been observed to increase as has area burned, in recent decades in boreal forests of central and western Canada and parts of Russia. This is likely to increase with further greenhouse gas forcing of climate.



2.3 Impacts and Adaptation



2.3.1 Introduction

The following text is adapted from *Implications for Canada of Recent IPCC Assessment Reports*, a joint Canadian Global Change Program/Canadian Climate Program publication released in 1995. References to the Mackenzie Basin Impact Study, the Great Lakes-St. Lawrence River Basin Study and to the Canada Country Study have been incorporated into this briefing book.

SECOND ASSESSMENT REPORT — IMPACTS, ADAPTATIONS AND MITIGATION OPTIONS

Background

The IPCC Working Group II Draft Second Assessment Report provides a wealth of detail on potential impacts and adaptation and mitigation responses all over the world. The report contains 28 chapters, numbers over 800 pages and has a list of some 550 lead and supporting authors (dozens of whom are Canadians). While it provides an excellent global inventory of potential impacts, it does not, provide a direct national assessment of impacts on Canada.

The first and foremost implication of the IPCC work is, therefore, to suggest an urgent need for a national impacts and adaptation assessment for Canada.

The impacts of climate change on Canada are of two kinds: the direct impacts upon the Canadian environment and society, and indirect effects that will be felt by Canada as a result of impacts elsewhere in the world. Because Canada and Canadians may have a greater capacity to adapt than most other regions of the world, these indirect effects are particularly significant.

A number of detailed impact studies of sectors and regions have been made in Canada, but significant gaps in research exist and the existing studies have not been synthesized into an integrated picture, nor have concerted attempts been made to evaluate impacts in monetary forms. The Canada Country Study (see box below) was launched in 1996 to address this important gap in our knowledge. However, since the study will only be released at the end of November, it was not used for this briefing book.

Background information, Canada Country Study

The Canada Country Study (CCS) was officially launched in the early summer of 1996. In Phase I, the focus was placed on assessing current levels of understanding and identifying major gaps in knowledge via a review of the scientific literature. Intended to be a basis for the Canadian contribution to the North American chapter of the Intergovernmental Panel on Climate Change (IPCC) Special Report on Regional Impacts being prepared for COPIII in Kyoto, the assessment process has resulted in the production of eight volumes. These include:

- ▶ Six regional volumes (British Columbia and Yukon, Arctic, Prairies, Ontario, Quebec, Atlantic)
- ▶ A national volume with twelve sectoral studies (agriculture, built environment, energy, fisheries, forestry, human health, insurance, recreation and tourism, transport, unmanaged ecosystems, water resources, wetlands)
- ▶ A national volume with eight cross-cutting issues papers (changing landscapes, costing, domestic trade and commerce, extra-territorial issues, extreme events, integrated air issues, sustainability, two economies)

From these 26 component reports, a series of bilingual summaries are being produced including a National Summary for Policy Makers, a National Plain Language Summary, and six Regional Plain Language Summaries.

More information regarding the Canada Country Study or the National Symposium is available through its website (<http://innova.tor.ec.gc.ca/ccs/>).

Mackenzie Basin Impact Study

This regional comprehensive study has been widely recognized as a model for climate change impact studies. It was led by Stewart Cohen of Environment Canada and University of British Columbia but involved a large number of partners. First of all, it was conducted in a region where temperatures have already risen an average of 1° to 2° C over the past three decades and so can be thought of as a fore taste of impacts to come in a more widespread and intense warming. Secondly, it engaged directly the indigenous people of the basin, many of whom still live off the land in a society based mainly on hunting and trapping.

Physical impacts of observed and projected changes include:

- a) melting of permafrost as the line of permanently frozen ground retreated northward - resulting in land slides and failures in building foundations, roads, pipelines, etc.,
- b) lowering of water levels in some deltas and marshes important for fur-bearing animals,
- c) observed and potential adverse effects on caribou herds with deeper winter snows and warming summer with more biting insects,
- d) increased area burned by forest fires in boreal forest regions of the basin, at times threatening communities,
- e) altered spring flood regimes affecting navigation, silt deposition, etc.
- f) rising sea level affecting coastal settlements.

One general conclusion was that impacts of an increasingly rapid climate change would have major

impact on indigenous people and their means of subsistence.

Great Lakes - St. Lawrence River Basin Study

A regional study similar to the MBIS project is also underway in the Great Lakes - St. Lawrence River basin, in a bilateral project between Canada and U.S.A. Preliminary results indicate that projected climate change would result in significant lowering of lake levels with adverse effects on shipping, hydro-power production, municipal water supply and water quality.

Vulnerabilities, Selected Impacts

The IPCC Working Group II report shows that human-induced climate change will be a major additional stress in a world where the environment is already being seriously damaged and depleted by increasing resource demands and non-sustainable management practices:

Human health

There is a serious threat to human health in high-latitude countries such as Canada through increased exposure to heat stress in very hot weather events and more frequent weather hazards (e.g., droughts, floods, wildfires and severe storms) with resulting injuries, deaths and damage to infrastructure that supports public health.

From a global perspective, the most alarming threat is an increase in transmission of vector-borne infectious diseases as the vector organisms spread and extend their range from equatorial regions. Major increases are likely in the range and incidence of malaria, dengue, yellow fever, schistosomiasis and river-blindness, events which are likely to compound conditions of poor environmental health conditions in many countries. Public health preventative programs need strengthening. The problem could be further exacerbated by regional food shortages and consequent undernutrition. In a smaller world with rapid air travel and mass tourism and migration, a deterioration in health levels in developing countries would also pose a threat to Canada.

Water systems

Major impacts are expected in regional water supplies and demands, resulting in chronic shortages where water supply is already limited.

The quality and quantity of fresh water for domestic water supply, agriculture, hydroelectricity, thermal power generation, municipal and industrial water supply, water pollution abatement and inland navigation is already insufficient in many regions of the world, especially the arid and semi-arid areas. With the expected growth in population by 2025, the 8% of the world's people already without water will increase to 25%, even without climate change. Even in North America, periodic water shortages in the United States have resulted in calls for increased diversions southward from the Great Lakes. With climate change, these stresses will extend to other areas, resulting in hardship, threats to health and, most serious to contemplate, strong competition for control of sources among competing users both within and between countries. Such competition is often a contributing cause of armed conflict.

Canada has a well-recognized interest in international law and order and plays a major peacekeeping role. The necessity for such actions on a much larger scale is a probable outcome of the impact of climate change on water systems.

Natural ecological systems

Aquatic and terrestrial ecosystems provide food, transportation, timber, flood control, water supplies, recreation and biodiversity, all of which are sensitive to climate change.

Natural ecological systems are now under heavy stress from human resource demands. Wildlife and fish stocks are endangered, with serious economic and sociocultural consequences. Climate change will add a major additional stress factor.

The boundaries of ecosystem regions are likely to move a lot faster than most species can migrate, resulting in significant species loss and decline in biodiversity. Such dangers will have a direct impact on Canada. The most outstanding concern is for the future of the great boreal forest, which could be reduced to a mere remnant of the present size, or undergo major changes in species.

Forests

Between 14% and 65% of the world's forested areas would undergo major changes in vegetation type, with implications for management and commodities. Large forested areas that now provide a large and varied supply of forest products are under threat from climate change because, like natural ecosystems, they cannot move (or be moved) rapidly enough to adapt to the poleward shift of temperate bands. A poleward shift in the range of 160 to 640 km over the next 100 years is expected, while the historical migration rates for many species are in the range of 4 to 200 km per century.

Boreal forests (including Canada's) are particularly vulnerable: in addition to direct effects on growth, indirect effects such as increased forest fire frequency and pest outbreaks are likely to decrease average forest age, biomass and carbon storage.

Coastal ecosystems and coastal zones

The median projection of sea level rise of 1/2 meter is estimated by IPCC to about double the world population subjected to coastal flooding from 46 to 92 million. Saltwater marshes, mangroves, wetlands, coral reefs and atolls together provide a wide range of goods and services and play a vital role as habitats and nurseries (breeding grounds and safe places for young fish).

Projected sea level rise threatens to destroy many of these sensitive natural areas and terminate their key role in ecosystems. Sea level rise will have a number of negative impacts on tourism, ports, harbours, human settlements, agriculture, the insurance industry and cultural systems and values. There is serious risk of permanent loss of land — some of which is densely populated in countries where available land for alternate development is in short supply or non-existent. High-cost options to protect coastal areas from sea level rise do exist, but they are likely to be prohibitively expensive for all except the most committed governments. The largest impacts on Canada are likely to be experienced in the lower Fraser delta lands in British Columbia and in a few coastal cities in eastern Canada, including Charlottetown, Prince Edward

Island.

Agriculture

In aggregate, it seems that the gains and losses may average out globally, such that there will not be a major threat to world food production, assuming suitable and cost-effective adaptation measures can be implemented and trade in food is efficient and meets the needs of countries with reduced production. On the other hand, the lesser ability to adapt agriculture to changed climate in some regions, especially the poorer regions of the planet, will have a potentially large regional impact, including security of food. There may be significant new opportunities for Canadian agriculture in a warmer world, provided sufficient precipitation occurs or irrigation water is available in food-producing areas, which is by no means certain in a changing climate. Other regions are likely to be adversely affected. In Canada, northward expansion of cultivation could also lead to conflict with existing land use and the stakeholders in forestry, wildlife habitat and hunting. This could pose an additional threat to aboriginal lifestyles.

Adaptation

Adaptation will be important to limit losses or take advantage of changing climatic conditions. While considerable adaptation potential does exist in Canada, no systematic efforts have yet been made to estimate the costs of adaptation. The following Table summarizes the major threats and adaptation potential for natural, agricultural and socioeconomic systems:

System	Consequence	Adaptation Potential
Natural Ecosystems:		
Forests	Loss of species and goods and services	Limited and potentially costly
Montane	- same -	Non-existent
Coastal Marshes	- same -	Very limited and potentially costly
Coastal Reefs	- same -	Non-existent
Cryosphere	Loss of glaciers, reduced snowpack	Non-existent
Agriculture	Redistribution, reduced yields in developing countries	High but potentially costly
Water Resources	Changes in quantity and quality	High and potentially costly
Human Settlements	Coastal and river flooding threatening human habitat, causing deaths and displacement of people	High and potentially costly
Human Health	Loss of life, increased diseases	High and potentially costly

It seems that agriculture, forests, water resources, human settlements and human health can all be protected from the worst impacts of climate change by a strategy of adaptation, but at high cost.

In the case of natural ecosystem, the ice world (cryosphere) and high mountains, there are few or no possibilities for adaptation, and major losses can be expected. In cold mountain climates and in the Canadian Arctic, major losses of habitat and existing species of wildlife can be expected. Over the longer term these are likely to be replaced by other species to the extent that biodiversity could be increased.

A major conclusion of IPCC Working Group II is that the impacts of climate change will vary considerably from region to region. Impacts will be less where socioeconomic systems and institutional response capacity are strong. Consequently, the poor and less-developed regions and populations living close to the land or the sea are most at risk.



2.4 Social and Economic Costs of climate change and mitigation measures: Highlights from IPCC Working Group III - Climate Change 1995 Economic and Social Dimensions of Climate Change

Incurring costs to mitigate climate change is economically justified

- The risk of aggregate net damage due to climate change, consideration of risk aversion and the precautionary principle, provide rationales for greenhouse gas mitigation actions beyond no regrets. The literature indicates that significant no regrets opportunities for greenhouse gas mitigation are available in most countries
- No regrets measures are those for which benefits, such as reduced energy costs and reduced emissions of local/regional pollutants equal or exceed their cost to society, excluding the benefits of climate change mitigation. They are sometimes known as measures worth doing anyway
- Note: This definition of no regrets has two aspects. There is a component of no regrets which benefits the company or individual undertaking the measure, with reduced fuel costs offsetting initial investment. The IPCC definition also includes a second component - non-climate benefits to society or the country as a whole. These arise in part because of environmental and health benefits from reducing local and regional air pollution through reduction in use of fossil fuels.

How much to limit emissions is a policy judgement

- Energy efficiency gains of perhaps 10% to 30% below baseline trends over the next two to three decades can be realized with net economic benefits to zero net cost. (an example of no regrets measures).
- Estimates of (aggregate annual) damages from a 2-3° C global warming tend to be a few percent of world GDP, with, in general, considerably higher estimates of damage to developing countries as a share of their GDP. Small islands and low lying coastal areas are particularly vulnerable to projected sea level rise accompanying global warming, and damages may be as high as 9% of GDP.
- Attitude towards risk aversion will influence the extent of mitigation measures. The IPCC 1995 Assessment of the Science states, "Future climate changes may also involve "surprises". In particular, these arise from the non-linear nature of the climate system. When rapidly forced, non-linear systems are especially subject to unexpected behaviour".

The costs of action depends in significant measure on the policies adopted

- Two main types of models have been used to analyze costs of greenhouse gas mitigation. These are referred to as top-down models of the large scale economy, and bottom-up models which incorporate more detailed studies of engineering costs.

- In the specific case of stabilizing emissions at 1990 levels, most top-down studies estimate annual costs in the range of -0.5 % of GDP (equivalent to a gain of about \$60 billion in total for OECD countries at today's GDP levels) to 2 % of GDP (equivalent to a loss of about \$240 billion) could be reached over the next several decades.
- Although it is difficult to generalize, top-down analyses also suggest that the costs of substantial reductions below 1990 levels in OECD countries could be as high as several percent of GDP. However, studies also show that appropriate timing of abatement measures and the availability of low-cost alternatives may substantially reduce the size of the overall bill. Realization of economic double dividends (below), and secondary environmental benefits through reduction of local and regional air pollution, can also significantly offset costs of mitigation.
- Bottom-up studies are more optimistic about the potential for low or negative cost emission reductions, and the capacity to implement that potential. Such studies show that the costs of reducing emissions by 20 percent in developed countries within two to three decades are negligible to negative (i.e. economically beneficial). Other such studies suggest that there exists a potential for absolute reductions in excess of 50 percent in the longer term, without increasing and perhaps even reducing total energy system costs.
- A number of studies indicate that global emissions reductions of 4 to 18 percent, together with increases in real incomes are possible from phasing out fuel subsidies world-wide.
- Economic instruments, such as emissions trading and carbon taxes can reduce significantly the costs of achieving a given target. If a carbon or carbon-energy tax or sale of permits is used as a policy instrument for reducing emissions, this could raise substantial revenues, and how the revenues are distributed could dramatically affect the cost of mitigation. If the revenues are distributed by reducing distortionary taxes in the existing system, they can potentially yield an additional economic benefit (economic double dividend).
- Appropriate long run signals are required to allow producers and consumers to adapt cost-effectively to constraints on greenhouse gas emissions and to encourage research and development. Failure to adopt policies as early as possible to encourage efficient replacement investments at the end of the economic life of plant and equipment (i.e. at the point of capital stock turnover) impose an economic cost to society. Implementing emissions reductions at rates that can be absorbed in the course of normal turnover are likely to be cheaper than enforcing premature retirement now.
- Studies suggest that as much as 15-30% of 1990 global energy-related emissions could be offset by additional carbon sequestration in forests for a period of 50-100 years. Costs of carbon sequestration, which are competitive with source control options, differ among regions of the world, particularly in relation to land costs.

A prudent strategy

- A prudent way to deal with climate change is through a portfolio of actions aimed at mitigation, adaptation and improving our knowledge. The appropriate portfolio will differ for each country.

The challenge is not to find the best policy for the next 100 years, but to select a prudent strategy and to adjust it over time in the light of new information.

Mitigation measures (in addition to adaptation) can be grouped in three broad categories:

1) Reduction of anthropogenic emissions. This reduction of GHG's can typically be achieved by improving energy efficiency; by changing consumption and production patterns; and by fuel substitution (from carbon rich fuel such as coal or petroleum to low carbon or carbon-free fuel).

2) Sequestration and removal. In this case the GHGs are captured where they occur (using scrubbers for example) or removed from the atmosphere by increasing the intake from biomass (reforestation, changes in agriculture practices, etc.). The possibility of increasing the carbon uptake of ocean by fertilizing them with iron has also been discussed. However the large environmental uncertainties associated with this measure raises serious doubts concerning its possible use.

3) Compensation. These measures have been suggested as a way to compensate the enhanced greenhouse effect by reducing, for example, the solar radiation reaching the earth. They involve various geo-engineering measures such as the use of orbiting mirrors to reflect incoming solar radiation. The technical complexity and high costs associated with these measures have prevented them from being considered in the current discussions over mitigation measures.

- Individual countries that seek to implement mitigation policies can choose from among a large set of potential policies and instruments, including carbon taxes, tradable permits, deposit refund systems as well as technology standards, performance standards, product bans, direct government investment, and voluntary agreements. Public education on the sustainable use of resources could plan an important part in modifying consumption patterns and other human behaviour. The IPCC report analyzes available information on the applicability of each of these instruments in various situations and regions.
- The (economic) value of better information and predictions of climate change and its impacts are likely to be great. Research and development on energy efficiency technologies and non-fossil energy options also offer high potential value.



2.5 Myths and Misinterpretations about Climate Change Due to Human Activities

In the recent preparations and debate concerning the world negotiations on Climate Change, a number of statements have been made in advertisements, editorials, articles and speeches that are scientifically incorrect, or at least misleading. There are many, but some of those arising most frequently are addressed here.

1. Observed Temperature Trends:

The theory and models of enhanced greenhouse gas forcing of climate indicates that temperatures in the upper atmosphere, above clouds, should cool, mid-troposphere layers should warm somewhat and the surface layers, where we live, warm significantly.

1.1 Myth: Observed cooling of the upper atmosphere negates climate change theory.

Fact: It helps confirm both the theory and the conclusion that the changes are now occurring.

1.2 Misinterpretation: The Multi-spectral Scanning Unit (MSU) observations from satellites show a cooling trend since observations began 18 years ago.

Facts: An 18-year period is too short to ascertain trends without adjusting the record for known unusual influences. In addition, combining data from eight different satellites, as was done, introduces errors. The satellite record begins about the time of the longest warm El Nino on record, and moves to the period affected by the temporary cooling of 1992 to 1994 induced by the ash particles from the volcanic eruption of Mount Pinatubo. When these events are taken into account, an underlying warming trend of 0.06 to 0.09°C is seen. This corresponds well with a 0.1°C warming over these 18 years for this layer, as observed by conventional balloon soundings.

1.3 Myth: Often cited trends in temperature near the surface are unreliable because observation stations in and near cities show higher temperature than they should because of the growing city "heat island" effect.

Fact: The data sets used to determine global mean warming trends of 0.17°C in the period of the satellite record, and about 0.5°C over the past century have been adjusted to remove the well known "heat island" effects.

2. Myth: Global Climate Models (GCMs) are as inherently unreliable as macro-economic models so projections of future climate cannot be trusted.

Fact: There are major differences between climate and economic models:

- e) the former are based on well founded equations derived from fundamental physical laws describing atmospheric circulation and energy exchanges in the atmosphere and between the earth, sun and space. This is unlike econometric models of human and economic behaviour, based on past behaviour, which is constantly changing.
- b) the GCMs showing climate forced by greenhouse gases and aerosols are tested against observed past climate variations and changes to ensure reliability. For example, once the volume of ash particles from the Mt. Pinatubo eruption was known, the GCMs accurately predicted the temporary cooling effect.

3. Misinterpretation: Warming would only be about 1.2°C with a doubled CO₂ concentration if the theory and models did not predict an uncertain increase in water vapour (a greenhouse gas) to augment the CO₂ effect.

Fact: Models project greater concentration of atmospheric water vapour as the CO₂ induced warming proceeds, which causes more evaporation and a warmer atmosphere which holds more water vapour although the magnitude of this effect is still under scientific debate. In the past 30 years statistically significant increases in atmospheric water vapour have been observed over North America and elsewhere, consistent with model predictions and augmenting the CO₂ effect.

4. Misinterpretation of Uncertainty: Oceans and vegetation could absorb more CO₂ as atmospheric concentrations increase.

Fact: On average over the past decade, about half of the CO₂ emissions emitted by human activities are retained in the atmosphere and about half goes into oceans, soils and trees. There is, indeed, uncertainty about whether this will change in futures, but some recent studies suggest that it is more likely that climate changes will result in changed ocean circulations that will reduce CO₂ absorption, leaving a greater percentage in the atmosphere to affect climate. Increases in vegetation growth with more CO₂ in the air are already taken into account in climate models, but this could be offset by more frequent forest fires not factored into the models.

5. Correct Statement Misinterpreted: Contrary to popular belief tropical cyclones (hurricanes) have not increased, and models do not indicate global increases in frequency and intensity in a warmer climate.

Fact: The observed record and model projections confirm that this is correct. However, the damages and loss of life due to storm surges accompanying tropical cyclones are increasing and will continue to increase with rises in mean sea level in a warming world. Other extreme climatic events such as heavy one-day rainfalls causing floods and intense winter storms are both projected to increase and have already been observed to do so in a number of regions which have reliable records. Climate related disaster losses are rising rapidly, more rapidly than losses due to earthquakes and volcanos.

6. Misinterpretation: The Conference Board of Canada's review of the economic effects of stabilization or 5 to 10 % reductions in emissions indicate that they would be costs 0.5 to 2.3 % of GDP by 2010, giving a small reduction in projected GDP growth of 30% by that time.

Fact: The Conference Board's report reviewed 16 studies of net economic effects in Canada of emission limitations on GDP which ranged from strongly positive to minus 2.3%. The variations depend largely on the assumptions made in the economic models used. The Conference Board chose in its Executive Summary to cite "One possible outcome is" and proceeded to select the most negative one, fed by the most pessimistic assumptions.

They did not include in their Summary "Other possible outcomes" which are given in the body of the report and which show negligible or positive impact on GDP. Most economists think that a well chosen set of limitation policies will have negligible net effects, positive or negative on the economy.

None of the models reviewed consider the benefits of reduced fossil fuel use on local air pollution are their contribution to reducing rates of climate change.



3 The International Response



3.1 The United Nations Framework Convention on Climate Change



3.1.1 History

- **Climate change was recognized as a serious problem by the First World Climate Conference in 1979.** This scientific gathering explored how climate change might affect human activities. It issued a declaration calling on the world's governments "to foresee and prevent potential man-made changes in climate that might be adverse to the well-being of humanity". It also endorsed plans to establish a World Climate Programme (WCP) under the joint responsibility of the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP), and the International Council of Scientific Unions (ICSU). A number of intergovernmental conferences focusing on climate change were held in the late 1980s and early 1990s.
- In 1988 the UNEP and the WMO established the **Intergovernmental Panel on Climate Change (IPCC)** with a mandate to assess the state of existing knowledge about the climate system and climate change; the environmental, economic, and social impacts of climate change; and the possible response strategies. In 1990, the IPCC published its First Assessment Report (vetted by experts and government officials) which confirmed the scientific evidence for climate change. The report provided the basis for negotiation of the Climate Change Convention.
- **The 1990 Second World Climate Conference called for a framework treaty on climate change.** Ministerial-level negotiations among 137 states plus the European Community did not at the time produce any international targets for reducing emissions. However, the following principles were supported, and later included in the Climate Change Convention. These were: climate change as a common concern of humankind, the importance of equity, the common but differentiated responsibilities of countries at different levels of development, sustainable development, the precautionary principle, that the lack of full scientific certainty should not be used as an excuse to postpone action when there is a threat of serious or irreversible damage.
- **In December 1990, the UN General Assembly approved the start of treaty negotiations via the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC/FCCC).** The Framework Convention on Climate Change was adopted in New York on 9 May 1992 and was signed by 154 states (plus the EC) at the Rio de Janeiro Earth Summit in June, 1992. The Convention entered into force on 21 March 1994, 90 days after the receipt of the 50th instrument of ratification (after signing a convention a state must also ratify). The Convention enters into force for a state 90 days after that state ratifies it. As of September, 1997, 169 nations were party to the Convention.



3.1.2 Provisions of the Framework Convention on Climate Change

Commitments Under the Framework Convention

- **The Climate Change Convention seeks to stabilize atmospheric concentrations of greenhouse gases "at a level that would prevent dangerous anthropogenic [human-induced] interference with the climate system".** There are three requirements: (1) this ultimate objective should be achieved early enough to allow ecosystems to adapt naturally to climate change; (2) food production should not be threatened; and (3) efforts to minimize greenhouse gas emissions and climate change should be consistent with sustainable economic development.
- **There is no agreed definition of what is meant by dangerous.** Individuals and cultures differ in their understanding of what is safe and what is dangerous. In addition, some people and countries are more vulnerable to the expected consequences of climate change than are others. While science can provide a useful basis for decision-making, determining how much climate change is safe or how much risk is acceptable is essentially a political judgment. The judgment of the international community is expressed through the Conference of the Parties to the Convention.
- **The Convention requires policymakers to decide on concrete actions.** The Parties to the Convention must come to some consensus on the changes that could be considered dangerous. They must choose the level at which they want to stabilize atmospheric concentrations, a schedule for limiting greenhouse gas emissions over time, and appropriate technologies and policies for meeting this schedule.
- **The Convention sets out some guiding principles.** The precautionary principle says that the lack of full scientific certainty should not be used as an excuse to postpone action when there is a threat of serious or irreversible damage. The principle of the common but differentiated responsibilities of states assigns the lead in combating climate change to developed countries. Other principles deal with the special needs of developing countries and the importance of promoting sustainable development.
- **Both developed and developing countries accept a number of general commitments.** All Parties will develop and submit national communications containing inventories of greenhouse-gas emissions by source and greenhouse-gas removals by sinks. They will adopt national programmes for mitigating climate change and develop strategies for adapting to its impacts. They will also promote technology transfer and the sustainable management, conservation, and enhancement of greenhouse gas sinks and reservoirs (such as forests and oceans). In addition, the Parties will take climate change into account in their relevant social, economic, and environmental policies; cooperate in scientific, technical, and educational matters; and promote education, public awareness, and the exchange of information related to climate change.
- **Industrialized countries undertake several specific commitments.** Most members of the Organization for Economic Cooperation and Development (OECD) plus the states of Central and Eastern Europe - together known as Annex I Parties - are committed to adopting policies and measures aimed at returning their greenhouse-gas emissions to 1990 levels by the year 2000.

They must also submit national communications on a regular basis detailing their climate change strategies. Several states may together adopt a joint emissions target. OECD countries should take the strongest measures, while the countries in transition to a market economy are granted a certain degree of flexibility.

- **The richest countries shall provide new and additional financial resources and facilitate technology transfer.** These so-called Annex II countries (essentially the OECD) will fund the agreed full cost incurred by developing countries for submitting their national communications. These funds must be new and additional rather than redirected from existing developmental aid funds. Annex II Parties will also help finance certain other Convention-related projects, and they will promote and finance the transfer of, or access to, environmentally sound technologies, particularly for developing country Parties. The Convention recognizes that the extent to which developing country Parties implement their commitments will depend on financial and technological assistance from the developed countries.



3.1.3 Negotiation Processes under the Convention

- **The supreme body of the Convention is the Conference of the Parties (COP).** The COP comprises all the states that have ratified the Convention (some 169 by September 1997). It held its first meeting (COP-1) in Berlin in 1995 and will continue to meet on a yearly basis unless the Parties decide otherwise. The COP's role is to promote and review the implementation of the Convention. It will periodically review existing commitments in light of the Convention's objective, new scientific findings, and the effectiveness of national climate change programmes. The COP can adopt new commitments through amendments and protocols.
- **The COP comprises all the states that have ratified the Convention (some 169 by September 1997).** The COP's role is to promote and review the implementation of the Convention. The COP meets annually and its subsidiary bodies (ad hoc groups) meet more frequently.
- **The Convention also establishes two subsidiary bodies.** The Subsidiary Body for Scientific and Technological Advice (SBSTA) provides the COP with timely information and advice on scientific and technological matters relating to the Convention. The Subsidiary Body for Implementation (SBI) helps with the assessment and review of the Convention's implementation. Two additional bodies were established by COP-1: the Ad hoc Group on the Berlin Mandate (AGBM) and the Ad hoc Group on Article 13 (AG13).
- **A financial mechanism provides funds on a grant or concessional basis.** The Convention states that this mechanism shall be guided by, and be accountable to, the Conference of the Parties, which shall decide on its policies, programme priorities, and eligibility criteria. There should be an equitable and balanced representation of all Parties within a transparent system of governance. The operation of the financial mechanism may be entrusted to one or more international entities. The Convention assigns this role to the Global Environment Facility (GEF) on an interim basis; this status was extended by COP-1 for four years.

- **The COP and its subsidiary bodies are serviced by a secretariat.** The interim secretariat that functioned during the negotiation of the Convention became the permanent secretariat on 1 January 1996. The secretariat arranges for sessions of the COP and its subsidiary bodies, drafts official documents, services meetings, compiles and transmits reports submitted to it, facilitates assistance to Parties for the compilation and communication of information, coordinates with secretariats of other relevant international bodies, and reports on its activities to the COP.
- **The COP will periodically review existing commitments in light of the Convention's objective, new scientific findings, and the effectiveness of national climate change programmes.** The COP can adopt new commitments through amendments and protocols. Policies, programme priorities, and eligibility criteria for the finance and technology transfer mechanisms are decided by the COP. Based on the information about policies and emissions that the Parties share with each other through their national communications, the COP assesses the Parties' efforts to meet their treaty commitments and adopts and publishes regular reports.

The following subsections relate highlights of the COP meetings.

COP-1 Berlin

The Conference of the Parties held its first session in Berlin, in spring 1995. Delegates from 117 Parties and 53 Observer States agreed that the commitments contained in the Convention for developed countries were inadequate and launched the Berlin Mandate talks on additional commitments. They also reviewed the first round of national communications and finalized much of the institutional and financial machinery needed to support action under the Convention in the years to come.

A new subsidiary body, the Ad hoc Group on the Berlin Mandate (AGBM), was established to draft "a protocol or another legal instrument" for adoption at COP-3 in 1997. The Berlin Mandate process is to consider all greenhouse gases. It is also to consider setting quantified objectives for limiting and reducing emissions within specified time-frames such as 2005, 2010, and 2020. It is not to introduce any new commitments for developing countries.

COP-1 also gave guidance to the GEF on financing and technology transfer. It stated that projects funded by the GEF should be cost-effective, supportive of national development priorities, and focused on enabling activities that would assist developing countries to implement the Convention. A pilot phase was launched for activities implemented jointly (AIJ) between two Parties, an investor and a recipient. Details of this issue are discussed in a later section. COP-1 agreed that any country can participate in the pilot phase if it so chooses; during this phase the investing country could not claim credit for reduced emissions in the recipient country. A system of regular reporting will monitor the activities and the pilot phase will be reviewed no later than the end of 1999.

COP-2 Geneva

The second session of the COP (Geneva, July 1996) took stock of progress on the Berlin Mandate, the review process for national communications, and endorsed the 1995 Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) "as currently the most comprehensive and

authoritative assessment of the science of climate change, its impacts and response options now available". The Geneva Declaration further stated that the Report "should provide a scientific basis for urgently strengthening action at the global, regional and national levels, particularly action by Annex I (industrialized) countries to limit and reduce emissions of greenhouse gases".

COP-2 also adopted an agreement on the contents of the first national communications that developing countries began to submit in April, 1997. Their due date is 36 months after becoming a Party or having access to the necessary financial resources. Parties that are least developed countries may make their initial communications at their discretion. Other decisions concerned technology transfer, financial support for Convention-related activities in developing countries, and the pilot programme for AIJ.

COP-3 Kyoto

The third session of the Conference of the Parties will be held from 1-10 December 1997 in Kyoto, Japan. In addition to adopting the results of the Berlin Mandate process, this meeting will consider funding, technology transfer, the review of information, and the many other issues that together constitute the international response to the threat of climate change. It is expected to adopt a protocol or another legal instrument committing developed countries to limiting their greenhouse gas emissions after the year 2000. It will also continue to review national communications, which will provide another update on implementation.



3.1.4 Financing and technology transfer

Developing countries need financial resources and access to climate-friendly technologies if they are to limit emissions from their growing economies. The Climate Change Convention therefore states that developed countries should provide new and additional funds to help developing countries meet their treaty commitments and "take all practical steps to promote, facilitate, and finance, as appropriate, the transfer of, or access to, environmentally-sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the Convention".

The Convention's financial mechanism is a major source of funding. Its role is to transfer funds and technology to developing countries. Countries with economies in transition (Central and Eastern Europe and the former Soviet Union) are eligible for technology only. The mechanism must be guided by, and accountable to, the COP, which decides on policies, programme priorities, and eligibility criteria. The Convention states that the operation of the financial mechanism can be entrusted to one or more international entities with "an equitable and balanced representation of all Parties within a transparent system of governance". It gives this responsibility to the Global Environment Facility (GEF) on an interim basis and calls for this arrangement to be reviewed at the first session of the COP (held in 1995).

The GEF was launched in 1990 with the World Bank, the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP) as the implementing agencies. The available funds are based on voluntary contributions from governments. During the pilot phase of 1991-94, the GEF trust fund contained some \$800 million from participating governments. When the GEF was later restructured to make it more universal, democratic, and transparent, it was replenished with \$2 billion.

Projects must be country-driven and based on national priorities that support sustainable development. The GEF covers four focal areas: climate change, biological diversity, international waters, and protection of the ozone layer. At the end of 1996, climate change activities accounted for about 38% of the gross funds allocated in the GEF portfolio. Projects are carried out by a wide range of executing agencies, such as government ministries, non-governmental organizations (NGOs), UN bodies, regional multilateral institutions, and private firms. GEF funds normally cover only a portion of a project's entire costs, for example, the added cost of introducing a climate-friendly technology in place of a more polluting one.

In addition to technical assistance and investment projects, the GEF supports various enabling activities. These activities help countries to develop the necessary institutional capacity for developing and carrying out strategies and projects; they can also involve the development of information and plans that are required by the Convention. Projects relating to grassroots action sponsored by non-governmental organizations are supported through a Small Grants Programme managed by UNDP. Besides directly providing grants, the GEF facilitates other bilateral, co-financing, and parallel financing arrangements. It also promotes the leveraging of private-sector participation and resources.

In 1995 the COP reviewed the interim arrangements with the GEF. The COP decided to extend the interim arrangements whereby the GEF operates the financial mechanism and to review the situation again within four years. It emphasized that GEF projects should focus, at least initially, on enabling activities that help developing countries prepare and submit information about their implementation of the Convention.

Technology can be transferred through several different channels. The traditional channel has been bilateral and multilateral development assistance in the form of export credits, insurance, and other trade support. Incorporating climate change considerations into the programmes of national development offices and multilateral development banks would greatly increase the transfer of low-emissions technologies. The Convention also provides for two new channels. The first is the GEF. The second is Activities Implemented Jointly, or AIJ, which seeks to attract private sector funds for the transfer of technology and know-how to developing countries and countries with economies in transition. The Convention emphasizes that these two new channels must add to, rather than replace, traditional development assistance.

Activities Implemented Jointly has been conceived as one way of channeling private-sector money into climate change activities. If successful, AIJ could promote the co-development of advanced technologies and their transfer from developed countries to other parts of the world. These technologies would need to be appropriate to local circumstances, environmentally sound, and economically competitive. AIJ is carried out through partnerships between an investing company in a developed country and a counterpart in a host country (which could be developed, developing, or in transition to a market economy). The investing partner is expected to provide most of the required technology and financial capital. The host-country partner may provide the site, the principal staff, and the organization needed to launch and sustain the project.

AIJ is currently being tested through a pilot phase that will end by 1999. Proponents argue that AIJ can reduce global emissions cost-effectively, as reducing a given quantity of emissions may be cheaper in many developing and transition countries than in some developed countries. Skeptics are concerned that

AIJ will not only transfer technology but - contrary to the spirit of the Convention - the responsibility for combating climate change from developed to developing countries. Under the pilot phase, the investing country does not receive credits for the emissions it helps to reduce in another country, although supporters of the concept emphasize the importance of a credit system if AIJ is to achieve its full potential. Other issues include how to structure the reporting and regulatory regime and how to prevent the transfer of uncompetitive and inappropriate technologies.

Technology transfer must be accompanied by capacity building. The delivery of new hardware alone rarely leads to "real, measurable and long-term environmental benefits" in the host country. In many cases it is absolutely essential to strengthen existing local institutions. This includes building managerial and technical skills and transferring the know-how for operating and replicating new technological systems on a sustainable basis.



3.1.5 Negotiating Blocs

As in all international negotiations, there are groups of negotiating blocs that represent the various common views of countries. The climate change negotiations are no different. The developed countries of the world (OECD) and the Economies in transition (EIT) countries all have emissions limitation commitments as "Annex I" countries in the UN FCCC. The developing world is represented by the "Group of 77 and China" which is a recognized UN bloc. Within the G-77 group there are numerous sub-blocs each of which are discussed below.

I. ANNEX I countries: OECD countries

A. JUSSCANNZ

Canada is a member and current chair of the JUSSCANNZ group. Others include: Japan, the USA, Switzerland, Australia, Norway, New Zealand, Iceland, and Mexico. This group's genesis came in the run up to Rio in other environmental negotiations, beginning with a core of Japan, USA, Canada, Australia, and New Zealand. Its purpose was, and continues to be, to share information. Members are free to voice their own sovereign views on any issue. The group does not participate in the negotiations as a bloc (i.e. no one country speaks on behalf of JUSSCANNZ), although often share similar views on key issues.

In the climate change negotiations, JUSSCANNZ members are generally in support of the following:

- need to have realistic and achievable emissions targets
- flexibility should be provided in meeting the targets, including joint implementation with credits and emissions trading
- coverage should include all sources and sinks of GHGs
- need to have developing countries, particularly those with high emissions, take on emissions limitation commitments.

Differences occur on the issues of differentiated commitments for Annex I countries and on the level of emissions limitation and reduction targets that should be established in Kyoto.

B. European Union (EU)

The EU comprise 15 sovereign states, who speak as a bloc in the negotiations with one common position. Because they are a recognized legal entity as a regional economic cooperation group, they also have been able to set the precedent of taking on a joint commitment under the Convention. The EU is chaired on a 6-month rotational basis. Luxembourg will be in the chair for the Kyoto meeting. The EU has developed a scheme for allocation of their overall emissions reduction targets which allow some members' emissions to rise (e.g. Portugal, Spain, Ireland) while others reduce further, based partially on their own unique circumstances (e.g. Germany, United Kingdom). For Kyoto, the EU members have proposed reduction targets of 7.5% from 1990 levels by 2005 and 15% by 2010. Influential members of the EU in these negotiations are Germany, the Netherlands, France and the United Kingdom.

EITs (Economies in Transition)

This group includes Central and Eastern European countries and countries who were once part of the Soviet Union, all of whom are undergoing a transition from a centrally planned to a market based economy. This group of countries all have seen their emissions decrease since 1990 because of their economic crises. While these countries have emissions limitation commitments equivalent to the OECD countries, they do not have commitments to help finance the climate change initiatives of developing countries.

Like JUSSCANNZ, this group does not speak as a bloc in the actual negotiations. Each member of the group is free to voice its own position on any given issue. Typically, the group wants recognition of their economic transformation in the form of flexibility in end points and starting points for emissions targets. As well, the group are very interested in the potential that joint implementation and international emissions trading may have for providing them with private sector capital investment. Depending on the level of an Annex I target from Kyoto, EIT countries could find themselves as being major sellers in an emissions trading system.

II. Non Annex I countries: Group of 77 (G-77) and China

The chairman of this group (currently Tanzania) speaks on behalf of the more than 120 developing nations of the world. The G-77 and China is a well established group in all UN negotiations. Although they manage to speak with one voice most of the time in the negotiations, the many competing factions within the group cause coordination difficulties for the member states. The dominant common theme for the G-77 and China in the climate change negotiations is the consistent call for developed countries to assume responsibility for the historical build-up of greenhouse gases in the atmosphere, and to demonstrate leadership first by reducing their emissions before asking developing countries to take on emission limitation commitments of their own.

Sub-groups/negotiating blocs within the G-77:

Alliance of Small Island States (AOSIS)

This group is comprised of more than 40 developing island nations who are threatened by the prospect of rising sea levels. Some of their members are only a meter above sea level at their highest point. They

typically speak as a bloc and have, since the outset of the negotiations, had an official seat on the Bureau of the Negotiating Committee. They advocate more aggressive CO₂ reduction targets for developed countries, and have had an official proposal for a draft Kyoto Protocol on the table since 1994. It calls for developed countries to make a 20% reduction in CO₂ emissions from 1990 levels by 2005.

AOSIS members are also members of the UN recognized Group of 77 and China, which speaks on behalf of developing countries in UN Negotiations.

Organization of Petroleum Exporting Countries (OPEC)

The oil producing and exporting countries of the world feel threatened by any potential actions taken by countries to reduce their emissions, since such actions are likely to reduce the demand for oil and hence affect the economies of these countries. OPEC countries include, to name a few, Saudi Arabia, Kuwait, Iran, Iraq, Venezuela, Nigeria, Jordan, Qatar, United Arab Emirates, and Oman. In the negotiations their tactics have been to grind talks to a slow pace using procedural tactics. As a result of OPEC efforts, there are still no agreed rules of procedure to govern the meetings of the Conference of the Parties (e.g. there is no agreement on putting matters to a vote).

Members of OPEC are members of the G-77 and China group of developing countries.

China and India

Both China and India are influential members of the G-77 and China group of developing countries. In addition, they often speak in their own sovereign right at the negotiating sessions. They are also numbers 2 and 5 respectively, on the global list of highest annual CO₂ emitters, and as such are viewed by many developed countries as being prime candidates for measures designed to limit their emissions. China and India argue, however, that their per capita rates of CO₂ emissions are among the lowest in the world (2.66 tons per person in China, 0.90 in India) and therefore they should be allowed to pursue their economic development without limitations placed on their emissions.

Newly Industrialized Countries (NICs or "Asian Tigers")

These countries are among the fastest growing economies in the world today. Included, among others, are Thailand, Malaysia, Indonesia, Singapore and South Korea (number 11 on the list of top CO₂ polluters in the world). As members of the G-77 and China, they are happy to side with the developing countries' position that only developed countries should have emissions limitation and reduction commitments. Under this current arrangement, they gain an economic competitive advantage by attracting polluting industries to their countries and allowing their growth to continue unabated. As with China and India, these countries are high on the list of countries that OECD members would like to see taking on emissions reduction commitments.

Africa

The nations of Africa are among the poorest in the world. In the United Nations, Africa is considered a regional group and as such, has a seat on the Bureau of the negotiations. African nations are all members of the G-77 and China group. The concerns of most African nations relate to the potential effects of

climate change (drought, desertification, agricultural damage, etc.). As with other members of the G-77 and China, they argue that the problem has been caused by developed countries and should be solved by developed countries. African nations steadfastly refuse to limit their emissions growth.

Latin America

The Latin American countries are one of the five regional subgroups which make up the United Nations. Like Africa, this group has a seat on the Bureau of the negotiations. Latin American countries are all members of the G-77 and China. The overall chairman of the Climate Change Negotiations comes from Argentina, a member of the Latin American group. Typically moderate in their stance on climate change, individual members of this group have been responsible for providing solutions to potential and real negotiating impasses.



3.2 The USA Response

The USA is Canada's largest trading partner and as such their decisions on any given issue exert a large amount of influence in Canadian policy decisions. This briefing book therefore includes a detailed description of the US position as well as an overview of the US policy context.

Overview

Current Commitment: Return GHG emissions to 1990 levels by 2000 - Political commitment, not legally binding.

The Clinton Administration has embraced climate change as a major environmental issue, but like Canada, is having great difficulty in stabilizing its greenhouse gas emissions at 1990 levels by 2000. The 1993 plan tabled by President Clinton forecast that the USA would be on track to return their emissions to 1990 levels by 2000. Their July 1997 report to the UN cites two reasons why they now will miss their target by 12.9%:

- the original analysis used to develop their 1993 plan overestimated fuel prices and underestimated economic growth and electricity demand; and,
- the US Congress has not fully funded the programs in the 1993 Program.

Measures that are in place will reduce emissions by 279 megatonnes, or about 29% of what is needed to deliver on stabilization by 2000. The Report now admits that even the most draconian measures would be insufficient to reverse the growth in greenhouse gases to return them to 1990 levels by 2000 and goes on to state that new efforts are focusing primarily on post-2000 initiatives.

In thinking ahead to what those measures might be, it is useful to consider elements of the USA market economy. It is a system based on property rights and a reliance on the market as a means of allocating resources. The government plays a role in addressing market failures and promotion of social welfare, although in the current political climate, interventions are made cautiously. The USA say outright in their report to the UN that "...the strong political and economic preference is to undertake such [greenhouse gas limiting] controls through flexible and cost-effective programs, including voluntary

programs and market instruments, where appropriate." One demonstration of this approach is the USA's aggressive pursuit of international and domestic emissions trading schemes as one of the key means for dealing with climate change after 2000.

It is likewise important to understand the system of governance in the USA. Like Canada, the political and institutional systems participating in the development and implementation of climate protection policies span federal, state and local governmental jurisdictions. Federally, the US Government is divided into three separate branches: the executive branch which includes the Office of the President and the departments and independent agencies, the legislative branch or Congress which includes the Senate and House of Representatives, and the judicial branch, comprising the US court system. The Executive Branch speaks for the country in international matters and sets domestic policy direction. However, when it comes to ratifying treaties and delivering on international commitments that have budgetary implications, the Congress has a major say as evidenced by the approximate 45% budgetary reductions suffered by the 1993 Clinton Climate Change Program. Finally, the judiciary branch, which is often overlooked in the climate debate, provides the legal recourse if the country fails to live up to its commitments. The individual's freedom to legally challenge the government in these cases makes it necessary for the executive branch and Congress to be very certain that they can deliver on a legally binding commitment before signing on the bottom line. It is partly for this reason that the President's call in July 1996 for a legally binding emissions limitation and reduction target at Kyoto was seen as a major decision on behalf of the Administration.

State and local governments also exert influence over the passage, initiation, and administration of environmental, energy, natural resource, and other climate-related programs, with each of the States having significant autonomy in its approach to implementation of environmental regulation and management activities. For example, responsibility for regulation of electricity production and distribution lies with state and local public utility commissions and regulation of building codes and hence energy efficiency of buildings, are also controlled at state levels. While the federal government has not required state governments to adopt a climate change mitigation target, twenty states have completed or are developing climate action plans. In addition, forty one cities have joined the Cities for Climate Protection Campaign. None of these plans have been explicitly reflected in the final calculations of US emissions reductions, although many of the emission reductions likely to be achieved are captured in assumptions about the adoption of federal initiatives at the state and local level.

On October 28th, President Clinton announced the US negotiation position - the following White House announcements provide some of the highlights:

U.S. PRESIDENT'S FIVE CLIMATE CHANGE PRINCIPLES

October 22, 1997

Global climate change is the premier environmental challenge and opportunity of the 21st century, and the risks it poses justify sensible preventive steps. Addressing this issue is one of the United States' greatest imperatives, for this and future generations. Recognizing the solid foundation of climate science, President Clinton is committed to strong and sensible action to reduce greenhouse gas emissions -- including realistic and binding emissions targets.

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President Clinton's climate change plan is based on five key principles:

- Guided by science. The vast majority of the world's scientists have concluded that if the countries of world do not work together to cut greenhouse gas emissions, temperatures will rise and disrupt the global climate. Indeed, most scientists say this process has already begun. But there is much we still don't know about how the climate and human health will react to increased greenhouse gas concentrations. That's why the President's plan includes regular science reviews, to ensure that our policies are guided by the best science available.
- Market-based, common-sense tools. We have learned that the costs of protecting the environment is substantially lower if we harness the power of markets to do so. That's why the President's plan emphasizes flexible and market-based mechanisms. His plan includes a domestic and international permit trading system for greenhouse gas emissions, similar to the highly successful permit trading system that has dramatically cut acid rain at a fraction of the predicted cost.
- Seek win-win solutions. There are a multitude of win-win solutions to reducing carbon emissions, that can improve our energy efficiency and save consumers money. For example, a breakthrough in fuel cell technology announced yesterday will clear the way toward developing cars that are twice as efficient as today's models -- cutting pollution while also cutting driving costs. The President believes that we must seek such win-win solutions to addressing climate change.
- Global participation. Climate change is a global problem, and requires a global solution. A ton of carbon emitted in Argentina has just as much effect on the global climate as a ton of carbon emitted in the United States -- and within the next few decades, emissions from developing countries are expected to exceed those from developed countries. And many win-win opportunities exist to reduce greenhouse gas emissions in developing countries. That's why the United States has spear-headed joint implementation projects and the President has committed that the United States will not adopt binding obligations without developing country participation.
- Common-sense economic reviews. Our knowledge of the challenges and opportunities we face will grow over time. Therefore, the President is calling for regular 5-year economic reviews and updates, to ensure that policy-makers, both in the Administration and in Congress, have the best possible information on how the economy is responding to the effort to address climate change, how other countries are performing relative to their own commitments, and how the climate is changing in response to human activities.

U.S. COMPREHENSIVE FRAMEWORK FOR EFFECTIVE, SENSIBLE ACTION

October 22, 1997

GREENHOUSE GAS EMISSION REDUCTION TARGET

Under the current international climate change agreement (signed in Rio de Janeiro in 1992), industrialized countries accepted a non-binding emissions reduction goal. Most nations, including the United States, will fall short of meeting it. This fact, coupled with better scientific evidence on the seriousness of the climate change threat, led the U.S. to propose last year that a new agreement set binding limits on emissions. The proposed U.S. emissions target is designed to provide important environmental gains while maintaining strong economic growth. It is:

- **Realistic.** Seeks to return U.S. emissions to 1990 levels in the period 2008-2012 and reduce them further thereafter. Rejects European proposal for more stringent early reductions, as well as the "do-nothing" approach of some interests.
- **Achievable.** By providing incentives for early action to reduce emissions, attacking domestic energy inefficiencies, securing flexible international implementation mechanisms, and putting in place a market-based domestic emissions trading system, the U.S. can reach 1990 levels in the proposed time frame with minimal economic costs.
- **Meaningful.** Achieving 1990 levels in the period 2008-2012 would amount to almost a 30 percent reduction off a business-as-usual path, an important first step on the road toward stabilizing concentrations of greenhouse gases in the atmosphere. Emissions accounting will include all greenhouse gas sources and sinks (including reforestation).

FLEXIBLE, MARKET-BASED IMPLEMENTATION

Just as the effects of climate change will be felt globally, so too are the causes of climate change global in nature. Greenhouse gas emissions do equal harm to the atmosphere whether they come from a coal plant in China or a bus in Boston. For this reason, any regime to reduce greenhouse gases must be global. It must also allow all nations the ability to seek out the most efficient way of reducing emissions so that the greatest gains are achieved at the least cost. For these reasons, the United States strongly supports the inclusion in a new climate change agreement of two innovative, flexible mechanisms for reducing emissions:

- **International Emissions Trading --Using Markets to Lower Costs.** The principle of emissions trading is to use the efficiency of the market place to achieve environmental objectives at the lowest possible cost. Under an international emissions trading regime, a country (or firm) would be able to meet its emissions reduction target by reducing pollution itself, purchasing reductions from another country (or firm) that was able to achieve excess gains, or some combination of both.
- **Joint Implementation --A Global Solution to Low-Cost Reductions.** Joint Implementation (JI) is an innovative, market-based approach for addressing global climate change that uses international partnerships to achieve low-cost reductions in greenhouse gas emissions. Under JI, a company in the United States invests in a project which reduces emissions in another country and uses those reductions as a less expensive means of meeting its own target.

PARTICIPATION OF DEVELOPING COUNTRIES

In addition to its non-binding emissions reduction aim for developed countries, the Rio climate change agreement

required all countries to take policies and measures to reduce emissions. Many developing countries have made real strides, through, for example, reducing energy subsidies. Nevertheless, given that developing country emissions will eclipse those from the developed world within several decades, these countries need to do more. Accordingly, the U.S. calls on developing countries to strengthen their existing commitments and to agree that their obligations must increase over time to include binding emissions limits. Our principles include:

- **Global Participation.** All countries must participate. Every nation would be required to take meaningful actions to limit emissions. The U.S. will not assume binding obligations until developing countries agree to participate meaningfully in the challenge of addressing climate change.
- **Equity.** The obligations of poorer and less developed countries should take into account their state of economic development and their relative contribution to the climate change problem.
- **Assistance.** While insisting that developing countries take meaningful actions to address climate change, the U.S. recognizes that many of these countries face significant development challenges that hamper their ability to reduce emissions. President Clinton is reemphasizing his commitment to working with these nations to help build more sustainable energy futures. This includes a \$1 billion package of assistance from USAID and a renewed commitment to provide financial assistance through the Global Environment Facility, as well as our pathbreaking joint implementation proposals.

THE U.S. PRESIDENT'S THREE-STAGE PLAN ON CLIMATE CHANGE

October 22, 1997

Reflecting his five key principles, the President's plan will proceed in three stages:

- **Stage 1: Priming the Pump Through R&D, Tax Incentives, Incentives for Early Action, Federal Leadership, and Industry Consultations.** The first stage of the President's package includes a 9-point action plan -- including \$5 billion in tax incentives and spending for R&D; and energy efficiency, incentives for early action, a set of Federal government energy initiatives, and industry-by-industry consultations to explore their best ideas on how to reduce emissions in a cost-effective manner (including market-oriented standards for energy efficiency). The first economic review would occur near the end of Stage 1.
- **Stage 2: Review and Evaluation.** The second stage, which would begin around 2004, will build upon the programs adopted in Stage 1, by including a review of our progress and an evaluation of next steps as we move toward a market-based permit trading system for carbon emissions. During this second stage, the details of the permit system would be refined and perhaps tested. Such a permit system is similar in concept to the one that dramatically cut acid rain emissions -- although the scale would be significantly larger than the current acid rain program. The second economic review would occur near the end of Stage 2.
- **Stage 3: Meeting Binding Targets Through Domestic and International Emissions Trading Program.** In the third stage, we would reduce emissions to 1990 levels by 2008-2012, and below 1990 levels in the 5-year period after that, through a market-based domestic and international emissions trading system. Before beginning this third stage, the second economic update and review would allow Congress and the President to evaluate how the economy had responded to a decade's worth of experience in the first two stages of the President's plan. The President is committed to working with labor and Congress to insure that we give proper assistance to any workers dislocated by the changes in energy usage inherent in any

climate change plan.

This three-stage program recognizes the long-term nature of the effort to address climate change in three ways:

- By adopting a graduated approach to emissions reductions, it allows us to exploit the tremendous opportunities for win-win reductions first.
- By adopting a system of regular scientific and economic updates and reviews, it allows us to monitor our progress and re-assess our success in reducing emissions, the state of scientific knowledge, and how the economy is responding to our efforts. Only after we have accumulated ten years of experience with the first two stages of the program would we enter the internationally binding period.
- By insisting that the United States will not adopt binding obligations without developing country participation and by emphasizing the importance of an international trading system and joint implementation, we take advantage of low-cost reduction possibilities wherever they occur -- either here or abroad.



3.3 Canadian Overview

Commitment: Stabilize emissions of greenhouse gases at 1990 levels by 2000. A political commitment made in 1990. Ministers of Energy and Environment noted in 1996 that Canada would not meet its goal for 2000. No goals have been set for beyond 2000 at this time.



3.3.1 National Circumstances

As a northern latitude country, Canada is particularly vulnerable to the potential impacts of climate change. At the same time, Canada's northern and diverse climate, sparsely populated land mass, regional differences, high rate of population growth, resource-based and export-oriented economy, lifestyles, and high standard of living all serve to create a high demand for energy, with its associated greenhouse gas emissions.

Canada has the second highest population growth rate among developed countries (due mainly to immigration). During the period 1973-1993, Canada's population grew at an annual rate of 1.22%, compared with 0.98% for the United States, 0.14% for the United Kingdom and Germany, and 0.69% for Japan. This population growth puts a demand on the production of goods and services and on energy for infrastructure and transportation. It is expected that Canada's population will continue to grow at an annual rate of 0.9% for the next 25 years, reaching approximately 37 million by 2020.

Canadians, in general, enjoy a high quality of life, as measured on a variety of social and economic scales. Gross domestic product (GDP) is a measure of a country's ability to generate wealth. From 1990-1995, Canada's GDP rose by 8.2% and its population rose by 6.5%. Associated with these rises was a rise in energy use of 9.2%.

During the past 40 years the Canadian economy has diversified to a point where less than 10% of our economic growth is attributable to the energy sector. In 1995 the energy sector contributed \$50.1 billion or 7.5% of Canada's GDP and accounted for 9.5% of the value of Canadian exports. Yet our perception

of ourselves remains one of an energy-based economy, when in reality the fastest growing sectors are high technology and services. This shifting of economic drivers is important to consider when interpreting results of various economic models as related to climate change.



3.3.2 Canada's Greenhouse Gas Emissions Inventory

Overview for Canada

The following figures and tables provide a breakdown of Canada's 1995 greenhouse gas emissions by sector, gas and fuel/sources. The information comes from Canada's Second National Report on Climate Change that was prepared to provide an update of Canada's situation and response to Climate Change, as required by the FCCC. The document *Trends in Canada's Greenhouse Gas Emissions 1990-1995*, prepared by Environment Canada (April 1997), also provides a wealth of information on GHG emissions.

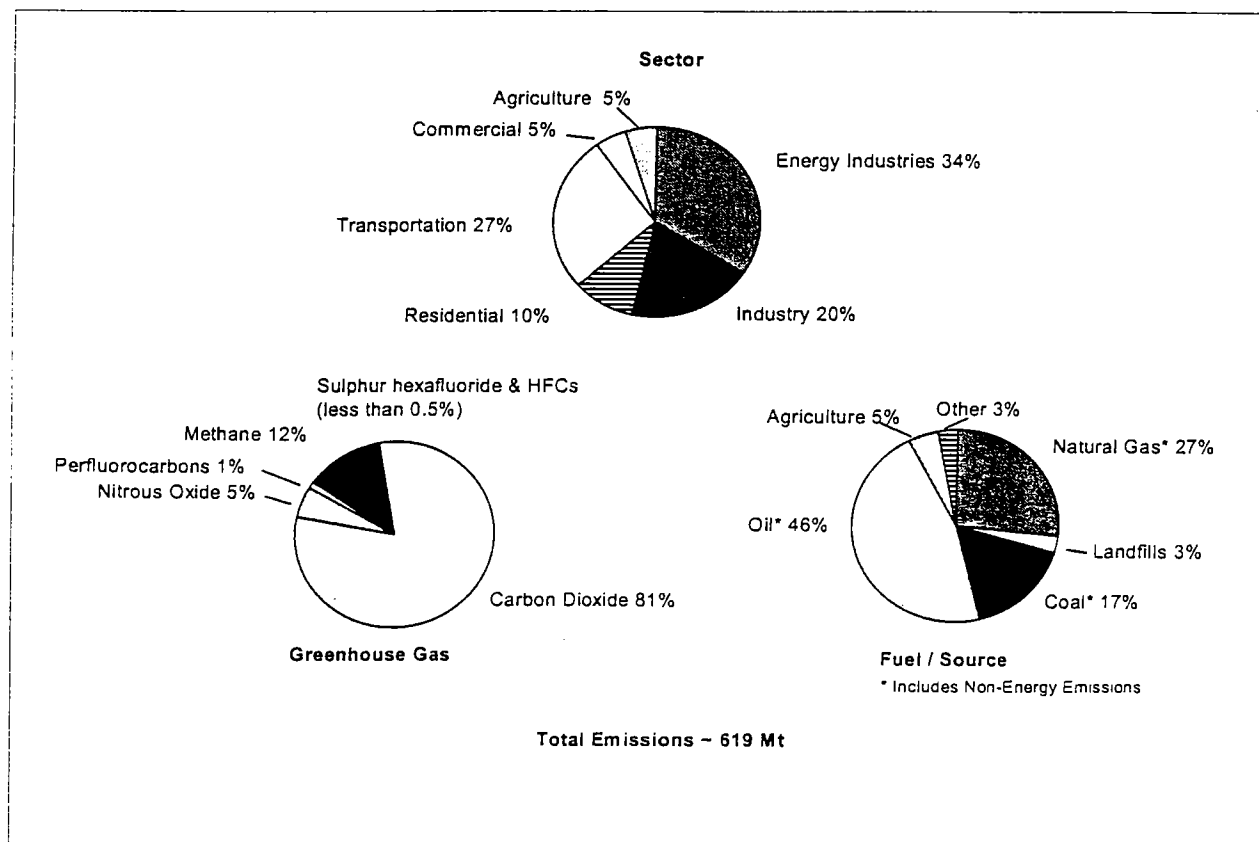


Figure 2: Canada's Greenhouse Gas Emissions, by Gas, by Sector, and by Fuel/Source, 1995

(Source: Environment Canada, Canada's Second National Report on Climate Change, 1997, p. 20)

CLIMATE CHANGE BRIEFINGS

Source	Emission Estimates (kt CO ₂ equivalent)					
	1990	1991	1992	1993	1994	1995
Global Warming Potential Multiplier						
Industrial Processes						
Natural Gas Distribution	2 200	2 400	2 600	2 800	3 000	3 200
Upstream Oil and Gas	31 600	33 000	36 600	38 400	41 100	43 600
Cement/Lime Production	7 720	8 570	6 180	6 580	7 220	7 350
Undifferentiated Industrial Processes	23 100	25 600	25 100	27 800	27 300	25 700
Coal Mining	1 900	2 100	1 800	1 800	1 800	1 700
Chemical Production	11 000	11 000	11 000	9 900	12 000	12 000
Subtotal	78 000	80 900	82 500	87 400	92 400	93 400
Fuel Combustion — Stationary						
Power Generation	94 800	96 100	104 000	93 300	94 800	103 000
Industrial	75 700	73 500	71 700	72 900	73 800	77 400
Pulp and Paper and Sawmills	11 500	11 700	11 200	11 000	11 200	10 200
Iron and Steel	14 100	15 200	15 600	15 200	14 500	15 000
Other Smelting and Refining	3 470	2 880	3 070	3 060	2 960	2 790
Cement	3 790	3 330	2 880	2 720	3 090	3 690
Petroleum Refining	3 290	3 620	2 950	2 470	2 640	2 070
Chemicals	7 830	7 740	7 560	8 160	8 800	7 580
Commercial	24 100	23 900	24 300	26 600	25 300	27 200
Residential	40 800	39 000	38 600	42 900	43 500	42 000
Agriculture	2 480	2 700	5 170	2 950	2 400	2 580
Public Administration	2 060	2 000	2 130	2 150	2 820	2 780
Steam Generation	379	309	256	369	666	656
Producer Consumption	40 300	38 800	41 000	41 800	42 700	44 000
Other	6 850	7 560	9 740	10 200	10 600	11 800
Firewood (Residential) ^a	760	820	760	750	700	700
Fuel Wood (Industrial)	372	362	372	330	372	489
Spent Pulping Liquors	0	0	0	0	0	0
Subtotal	289 000	285 000	298 000	295 000	298 000	313 000
Fuel Combustion — Mobile						
Automobiles	56 100	55 100	56 100	59 600	61 600	62 000
Light-Duty Gasoline Trucks	23 000	23 000	24 800	24 600	26 100	26 900
Heavy-Duty Gasoline Trucks	2 370	2 250	2 280	2 170	2 140	2 050
Motorcycles	179	177	182	184	189	187
Off-Road Gasoline	5 380	4 610	4 000	3 840	3 940	3 960
Light-Duty Diesel Automobiles	839	841	856	861	892	898
Light-Duty Diesel Trucks	952	904	928	941	1 020	1 090
Heavy-Duty Diesel Vehicles	24 300	23 500	24 100	25 400	27 800	29 900
Off-Road Diesel	11 500	10 300	9 610	10 800	12 400	13 900
Air	10 600	9 570	9 720	9 030	10 100	10 800
Rail	6 610	6 130	6 410	6 380	6 610	5 980
Marine	5 990	6 440	6 390	5 550	5 850	5 600
Other	1 680	1 870	1 890	2 090	2 290	2 360
Subtotal	149 000	144 000	147 000	151 000	161 000	165 000
Incineration						
Municipal Solid Waste	749	759	770	777	786	796
Subtotal	749	759	770	777	786	796
Agriculture						
Livestock/Manure	19 000	19 000	19 000	20 000	20 000	21 000
Fertilizer Use	3 300	3 400	3 700	4 000	4 100	4 100
Soils (Net Source)	7 090	5 820	5 000	3 940	3 490	2 480
Subtotal	29 400	28 200	27 700	27 900	27 600	27 600
Miscellaneous						
Prescribed Burning ^a	1 160	1 480	1 160	1 050	400	400
Wastewater/Compost	361	361	371	381	391	411
Landfills	17 000	17 000	17 000	18 000	18 000	18 000
Anaesthetics/Propellants	420	420	430	440	440	470
HFCs in Refrigeration/ Air Conditioning/Foam	0	0	0	0	0	500
Subtotal	18 800	18 900	19 800	19 800	19 600	20 100
National Totals^a	567 000	559 000	575 000	581 000	599 000	619 000

^aNote: Individual values may not add up to totals owing to rounding.

^aNational totals do not include carbon dioxide from the combustion of biomass.

Figure 3: Greenhouse Gas Emission Estimates in Canada by Sector, 1990-1995
(Source: Environment Canada, Canada's Second National Report on Climate Change, 1997, p. 19)

Provincial Contribution and Trends

Figures 4 and 5 illustrate the relative contribution of each province to Canada's overall GHG emissions. Projected numbers for 2000 and 2010 are also provided.

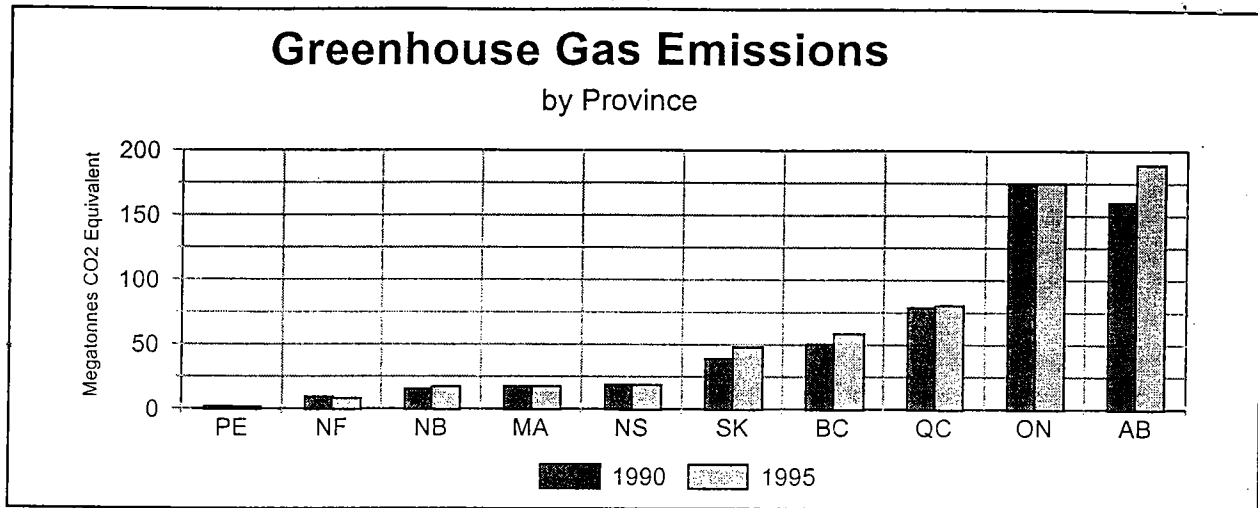


Figure 4

(Source: Trends in Canada's GHG Emissions 1990-1995, Environment Canada, 1997)

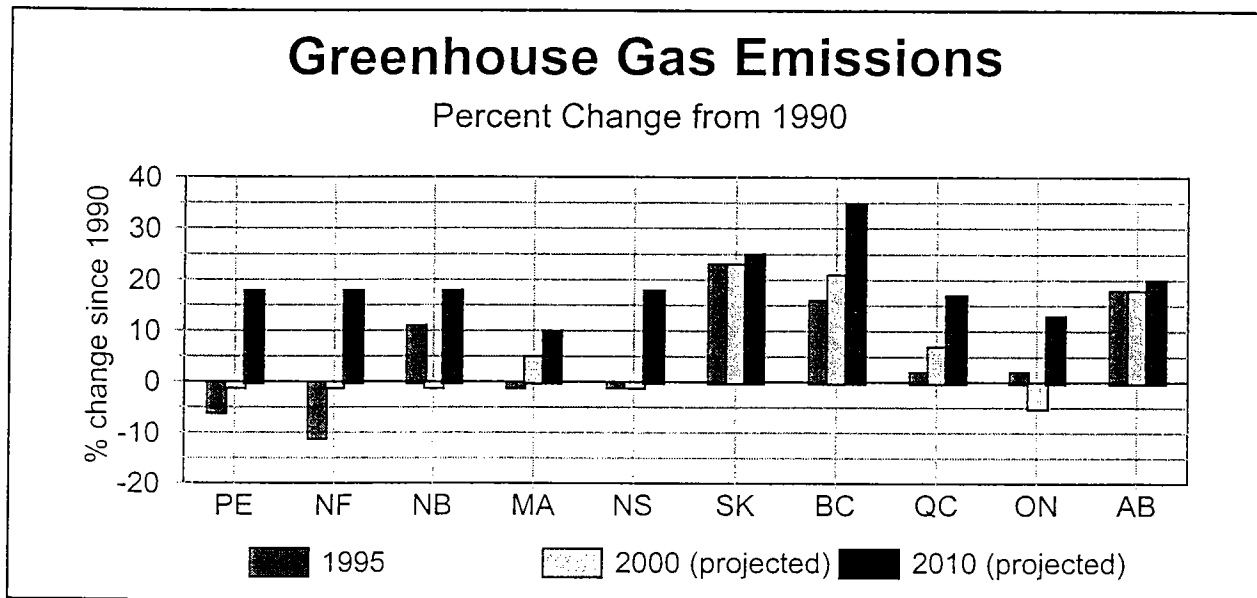


Figure 5

(Source: Canada's Energy Outlook 1996-2000, Natural Resources Canada, 1997)



3.3.3 Policy Process in Canada

Domestic policy

The Canadian Constitution assigns different powers to each of the federal and provincial governments. Dealing effectively with climate change dictates the necessity to carefully recognize the jurisdictional responsibilities within the country. With twelve provinces and territories, each having varying economic and social priorities, finding a solution to climate change means balancing the full spectrum of development concerns of each region of the country. To that end, domestic climate change policy is currently in the hands of a joint federal-provincial council of energy and environment ministers who meet annually to review progress on Canada's climate change commitments and to make adjustments as required. The meetings of these 26 Ministers aim at reaching a consensus. Federal Ministers who participate include the Minister of the Environment and the Minister of Natural Resources, who share the federal responsibility for domestic climate change policy.

Also supporting policy development is a federal-provincial coordinating committee that deals with all air issues, including climate change, ozone depletion, smog, acid rain and hazardous airborne pollutants. Consultations are also held regularly with environmental groups and major industry and business associations.

International Policy

Canada's international positions on climate change are determined by the federal government following extensive consultation with the provincial and territorial governments as well as the major stakeholders who will be affected by either climate change itself or by policy responses designed to mitigate climate change. The Federal Minister of Environment and the Minister of Foreign Affairs and International Trade share the responsibility for Canada's international climate change policy.

Decisions within the federal government on both domestic and international climate change policy are made by Cabinet, supported by interdepartmental committees involving a wide array of ministries including Environment, Natural Resources Canada, Foreign Affairs and International Trade, Finance, Industry, Privy Council Office, Transport, Agriculture, International Development, and Fisheries and Oceans.



3.3.4 Canada's Emission Limitation Efforts

Canada's Second Report to the UN Framework Convention catalogues close to 200 initiatives underway or planned by various levels of governments in the country. Most are difficult to quantify because they are directed towards raising public awareness and increasing research and development.

Canada's overall approach towards meeting its stabilization target has been to adopt a series of measures that also produce economic efficiencies, with the centerpiece being the Canadian Voluntary Challenge and Registry Program. Education, research and development and energy efficiency regulations supplement the voluntary measures. Aside from a few small taxes on new vehicles, in some provinces, there is little use made of economic instruments.

Canada's National Action Program on Climate Change (NAPCC) of 1995 sets out the strategic directions Canada will pursue towards meeting its national goal of stabilizing emissions of greenhouse gases at 1990 levels by 2000. It embraces a number of principles including:

- A lack of scientific certainty should not be used as a reason for postponing mitigative actions that are cost effective or justified for other reasons.
- Actions to address climate change should be a shared responsibility across all sectors of society. No one region or economic sector should be unduly disadvantaged by actions to address climate change.
- Must involve all gases, their sources and sinks and focus on early actions with long term results
- Actions must be emphasized which are cost effective, enhance employment, and maintain or improve Canada's competitiveness abroad.
- Clear accountability should be established regarding who will be responsible for taking action, what actions are being undertaken, the expected impact of measures, and how well the measures performed
- The NAPCC must be flexible to adjust for new scientific and technological finding
- Canadian actions on climate change should be part of an overall global effort.

The NAPCC set out four strategic directions:

- Canada is committed to a dynamic *Action Program*, which incorporates an open and transparent review mechanism to assess progress
- Canada will build on its previous successes, identify new avenues and opportunities for program development, and remove barriers where applicable;
- Canada supports the implementation of voluntary actions, and will encourage the development of technologies and expertise to reduce greenhouse gas emissions
- The NAPCC will cover a wide range of opportunities to address climate change, including actions related to energy efficiency, renewable energy sources, carbon sinks, research and development, education, and international cooperation.

The centre piece of the NAPCC is the Voluntary Challenge and Registry Programme. Despite the fact that more than 600 companies are participating, a recent independent review of the results found that only 73 participants had developed a greenhouse gas inventory and made a commitment to implement at least one action in the future to reduce greenhouse gas emissions. Most registrants at this stage have only made pledges to undertake unspecified actions sometime in the future. Although it is still early days for the Voluntary Challenge and Registry Programme, there is no doubt that calls will mount for demonstrable results in the coming years.

There are also no real back-ups or threats to impose regulations or taxes should the Voluntary Challenge fail to deliver results. As for the Voluntary Challenge, there have been few positive incentives for companies to participate, despite continued calls by industry for governments to tangibly recognize early actions to reduce greenhouse gas emissions. Provision of early credits against future regulatory or economic instruments would send a positive signal to the business community that early action on climate change has a pay off. This is not to say that voluntary measures are not helping to reduce Canada's greenhouse gas emissions nor that they don't have potential to contribute further. In its

Voluntary Challenge and Registry (VCR) submission, the Canadian Electricity Association announced that actions by its members would reduce greenhouse gas emissions by approximately 3 megatonnes by 2000. Natural Resources Canada believes that initiatives being considered by upstream oil and gas producers will hold levels of CO₂ emissions stable at 75 megatonnes per year after 2010, despite considerable increases in production. Such examples are, however, the exception. It is clear that Canada will have to go beyond voluntary action if it is to meet its emission reduction objectives.

In its 1995 National Action Program on Climate Change (NAPCC), Canada was one of a handful of countries to signal its intention to develop indicators of progress in meeting its climate change goals. Broadly speaking, these were to include comparisons of how Canada is stacking up against other countries, participation rates in climate change initiatives, energy intensity per unit of output, shifts in public attitudes and behaviour, and technological uptake. Specific, quantitative benchmarks were promised such as decreases in the number of vehicle miles traveled, the number of zero or low emission vehicles, market penetration by alternative fuels, levels of retrofits for energy efficient buildings, etc. To date, few, if any, targets along these lines have been set.

At the individual provincial level, British Columbia and Quebec have plans aimed at stabilization of emissions at 1990 levels by 2000 but each have reported increases in emissions in 1995 (16 % for BC and 2% for Quebec). Other provinces whose economies are based on fossil fuel exploration and development are arguing for a go slow approach both domestically and internationally.

Numerous municipal governments have demonstrated leadership by adopting specific reduction targets and mobilizing public action at a grass roots level. Thirty seven Canadian municipalities are profiled in the July 1997 Interim Report by the International Council on Local Environmental Initiatives (ICLEI) as having begun work on climate change, with 15 of the municipalities signed on to reduce emissions by 20% from 1988 levels by 2005. Progress has been slow, partly due to the air of political uncertainty surrounding the climate change issue. Toronto, for example, is cited by ICLEI as having mounted an ambitious plan to reduce CO₂ emissions with actual results being "modest to date".

The following graphs are included to illustrate Canada's relative position with regard to CO₂ emissions among selected OECD countries:

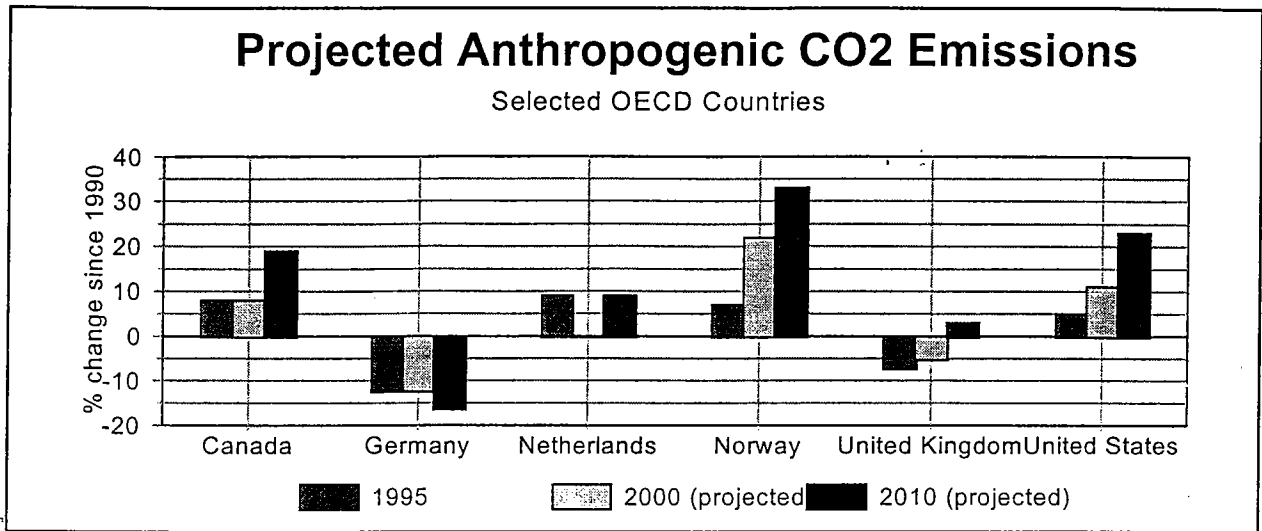


Figure 6

(Source: Data taken from UN FCCC report FCCC/SBI/1997/19, September 30, 1997)

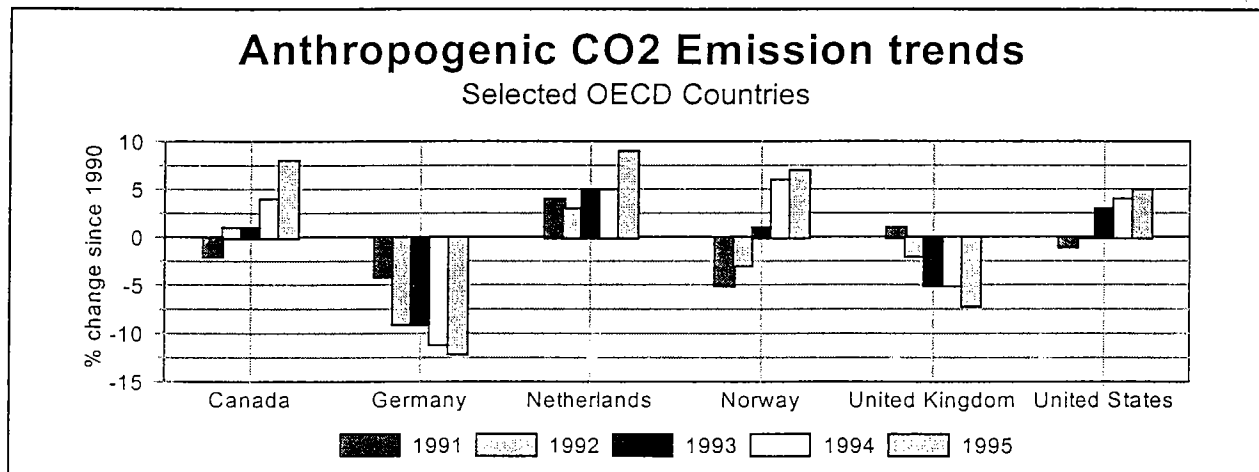


Figure 7

(Source: Data taken from UN FCCC report FCCC/SBI/1997/19, September 30, 1997)

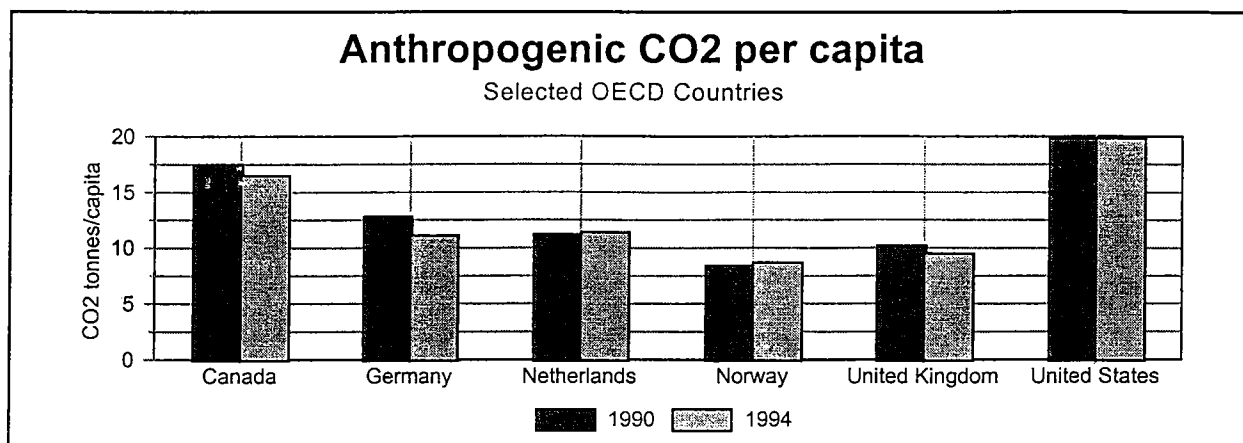


Figure 8

(Source: Data obtained from UN FCCC Secretariat, October 17, 1997)



3.3.5 Canadian cost estimates

A number of the studies of economic impacts on Canada of greenhouse gas reductions have been summarized by the Conference Board of Canada. The comparison tables in this report include macro-economic (top-down) model results and technology-based (bottom-up) model findings. Most of the studies have been based on stabilization of emissions at 1990 levels to 2010 or 2020, and in some cases 10% emission reductions by 2010.

Macro-economic Results

Top-down results are consistent with the international study outcomes cited by IPCC. That is, net economic effects range from slightly positive, to the order of 2% (~ \$26 billion) below the projected economic growth of 30% from 1997 to 2010. For a 20% emission reduction by 2010, two studies showed a GDP loss of 0.6% and 2.3%. Several studies suggest that in the longer run while there would be some costs in the target year (2010 or 2020) the measures would later yield an economic gain.

Some Cautionary Notes

1. The larger GDP loss estimates mostly reflect an assumed loss in trade as a result of loss of GDP, particularly in U.S.A., for emission reduction programs. Some have questioned this assumption since:
 - a) some studies suggest that U.S. emission reductions might be achieved with little or no GDP loss, and
 - b) in order to achieve emission reductions, U.S.A. would probably wish to import natural gas and hydro-electricity from Canada, offsetting other trade losses.

2. These studies mostly assumed a carbon tax, or similar economic instrument to reduce emissions, and estimated the effect of this on the economy. In most cases they did not consider the economic benefits that can be obtained by using carbon tax revenues to reduce more distortionary taxes (e.g. payroll taxes).
3. None of the greenhouse gas emission reduction cost estimates take account of economic and health benefits of reduced regional smogs, acid rains and toxic metals which would occur with less fossil fuel consumption.

Comparative Costs

Several studies cited by the Conference Board show Canada's costs of emission reductions as higher than EU countries and U.S.A., because of greater trade dependency and an energy-intensive economy. However, a DRI/McGraw Hill and Marbek Resource Consultants study (1993) of stabilizing emissions at 1990 levels by 2000 and to 2010, with measures carefully selected "to meet the stabilization goal without compromising Canada's competitiveness", showed competitiveness (total factor productivity) would rise 0.2% in 2000 and 0.6% in 2010 while GDP declines relative to the growth trend were estimated at 0.4% in 2000 and 0.7% in 2010. Also, a recent analysis (August 1997) by International Energy Agency and OECD show costs of 20% or greater emission reductions in Ontario and Quebec as less than in nine other developed countries analyzed, because of availability of substitutes for coal and oil for electricity generation (i.e. hydro, nuclear, natural gas). [All of Canada was not included in the study.]

It is probably reasonable to conclude that the economic impact of emission reduction actions depends very greatly on the measures selected (and how they are implemented.). In particular, domestic and international emissions trading (and actions implemented jointly), can reduce net costs substantially. Significant offsets to emissions of carbon dioxide in Canada are available through taking measures to increase sequestering in forests and in agricultural soils.

Factors Affecting Economic Model Cost Estimates

Variations in net cost estimates by macroeconomic models are dependent on eight main assumptions that enter into the calculations.

1. Does the model assume that the economy adjusts efficiently in the long-run, or is it a macroeconomic model that assumes the economy suffers persistent transitional inefficiencies?
2. How much scope for inter-fuel and product substitution does the model assume, as indicated by the number of different energy sources and industrial sectors in the model?
3. Does the model assume that one or more backstop non-fossil energy sources are available at some constant cost?
4. How many years does the model assume to be available to achieve the specified CO₂ reduction target, expressed as a percentage reduction from projected baseline emissions in the final year?

5. Does the model assume that reducing CO₂ emissions would avoid some economic costs from climate change, or that no such costs exist?
6. Does the model assume that reducing fossil fuel combustion would avoid some damages from air pollution, or not?
7. Does the model assume that carbon tax revenues are returned to the economy through the reduction of a distorting tax rate, or through lump-sum rebates?
8. Does the model assume that international emissions trading and joint implementation options are available, or not?

For a 50% reduction of CO₂ from baseline in 2020 for U.S.A. the predicted economic impacts range from a loss of almost 6.0% from baseline GDP in that year under the worst case assumptions, to a gain of about 4.5% under the best case assumptions. The range clearly illustrates the importance of these assumptions and, in particular, of the four assumptions (1, 8, 7 and 6) which have the largest impact on the results.

Technology-based Model Results

Technology-based models or bottom-up analyses for Canada give similar results to international results assessed by IPCC and are much more optimistic about low costs or benefits of emission reductions. They suggest in one case that cost-effective technological opportunities could yield 20 to 44% emission reductions by 2020 with no GDP loss. In two studies of costs of stabilization at 1990 levels by 2000 or 2010 estimates ranged from net savings of \$150 billion (11% of GDP) to losses of 0.2% of GDP.

Some Cautionary Notes: These models typically do not incorporate a full range of economic interactions or international trade effects.

Regional and Sectoral Impacts

Several models indicate that impacts on regions and industrial sectors would be uneven. While some economic sectors would gain, coal producers in particular would experience sharp reductions in demand; the oil industry would experience a loss in well-head revenues; and regions with substantial oil development (Alberta, Newfoundland) would experience higher losses in economic activity. (Conference Board Report). Canada-wide policies and programs should take into account these distributional effects.

Economists' Summary Statement

In attempting to provide a perspective on the, at times, bewildering range of conflicting results, 2800 economists including 8 Nobel Prize winners issued a statement as follows:

"As economists, we believe that global climate change carries with it significant environmental, economic, social, and geopolitical risks, and that preventative steps are justified. Economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total

benefits outweigh the total costs. For the U.S. and Canada, sound economic analysis shows that there are policy options that would slow climate change without harming North American living standards, and these measures may, in fact, improve productivity in the longer run. The revenues generated from such policies can effectively be used to reduce the deficit or lower existing taxes."



3.3.6 Mobilizing Canadians to Take Action - Post Kyoto Challenge

Whatever level of commitment Canada and other developed countries take at the Kyoto Conference of Parties, December 1997, there will be a need to strengthen Canada's Action Plan on Climate Change. This becomes especially clear when one considers that total Canadian GHG emissions are projected to increase by 19% in 2010 and by 36% in 2020 from 1990 levels (Source: Canada Second National Report, p. 47). This section introduces a number of key issues that will have to be dealt with if Canada is to successfully address the post Kyoto Challenge. Panelists who have been invited to each Briefing Session to contribute their own views on *What should Canada do in Kyoto and beyond?* will undoubtedly add other issues to this list as well as new perspectives on the issue of climate change itself.

Mobilizing Canadians to Take Action

If Canada is to meet an emissions target, the public has to become engaged. However, the *1996 Review of Canada's National Action Program on Climate Change* (National Air Issues Coordinating Committee, November 1996) notes that while a significant number of the NAPCC actions involve making information available to the public or raising awareness about climate change and energy issues, as yet, an action-oriented public education campaign on climate change, as outlined in the NAPCC, has not been launched. Clearly there is an urgent need for action on this front. What can be done to clarify and promulgate the messages needed to convince Canadians that actions taken now to reduce emissions are a good investment? How best to go about getting these messages out? What are the respective roles of the three levels of government as well as the corporate sector?

Ensuring a Fair and Equitable Sharing of the Burden in Canada

Assuming there is enough political agreement to deal seriously with the issue of climate change, a fundamental challenge will be to determine the relative responsibilities of each of the major economic sectors and each province. To date, Ministers of energy and environment have been unable or unwilling to enter into such a discussion. Canada's commitment remains a national one with no regional or sectoral targets. Given that most of the levers for policy action on emissions limitation rest with the provincial governments, forging some sort of agreement on the allocation of targets (or the distribution of burden) will be essential. The overall goal is to change the nature of the climate change debate from being a win-lose polemic pitting one region of the country against another, to one of shared responsibility and a search for win-win solutions. To do so, the debate must be broadened from an energy-environment focus to one that involves all sectors of the economy and engages a wider range of ministers, notably finance ministers.

Determination of a burden sharing agreement essentially becomes a federal-provincial negotiation, the

political spectre of which may be seen by some as too daunting at this time. But, in all likelihood, if an international target emerges from Kyoto, there will be a two to four year period before the agreement would enter into force; a time for Canada to work towards a consensus on the need for a formula that spreads the economic burden and opportunities equitably across the country.

Providing Canadian companies with the flexibility needed to undertake further actions

One of the key messages from Canadian industry has been the need for clear policy direction coupled with the provision of flexibility for individual companies to choose how they will most cost effectively reduce their emissions. This explains the underlying popularity of the Voluntary Challenge and Registry (VCR). However, in a regime whereby a legally binding target is the goal for Canada, ways must be found to make the VCR more effective, including providing recognition for early actions, for offset projects and for activities implemented jointly with other countries.

Internationally, there are a number of flexibility provisions likely to be included, at least in principle, in the Kyoto deal. These include joint implementation (JI) and emissions trading and possibly differentiation of targets based on individual national circumstances. Is Canada positioned to take best advantage of JI and emissions trading? There is a JI office established in NRCan but to date the number of projects registered with the group is small, primarily because potential investors have no guarantee that the credits resulting from the projects they are sponsoring abroad will have any value in Canada. Emissions trading is at its inception, with an international pilot trading regime planned to be in place by 2000 involving a few interested countries (Canada included). In general, a dialogue should be established with industry leaders to learn what they feel would be cost effective and innovative means of achieving internationally agreed targets. Their views would be helpful as well on what Canadian initiatives would be required to create the optimal policy environment to provide industry the flexibility it needs to achieve meaningful reductions. As noted earlier, engagement of other ministries, notably the finance ministry, will likely be needed to provide the best policy setting.

New markets for Canadian Products and Knowledge

One of Canada's key negotiating objectives has been to engage developing countries, particularly large emitters, in taking steps to reduce their emissions. The UN FCCC has failed to make progress in this regard, with a highly divisive North-South polemic dominating the discussions. Developing countries feel that the industrialized world is shirking its responsibilities for emissions limitation while at the same time calling for poorer countries to shoulder their part of the burden. A lack of trust has been established that will make diplomatic breakthroughs slow and difficult.

However, at the same time there are opportunities to build trust in the developing world through wise investment choices. As sustainable development principles become implemented, new markets will be created. For Canada, it will be important to identify promising market niches and choose policies and programs aimed at fostering development and export of selected, high potential greenhouse gas reducing and energy efficient technologies. Opportunities also exist in developed countries where the market for innovative energy efficiency technologies and for alternative energy sources is very large.

The Transportation Sector

Figure 9 shows the projections for greenhouse gas emissions by the end-use sectors. The emissions portrayed are those associated with the direct combustion of fossil fuels (principally refined petroleum products and natural gas). The relative contribution of four sectors are provided with transportation and industrial being the most important. These two sectors may provide some excellent opportunities for reducing emissions without sacrificing living standards.

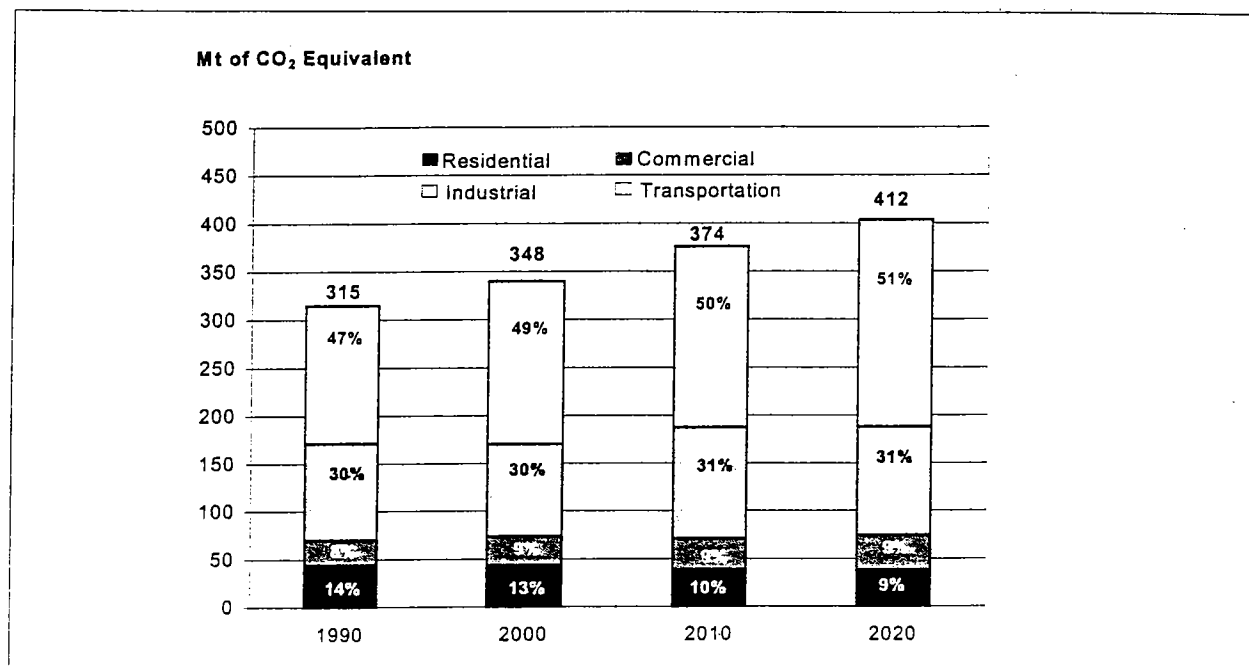


Figure 9: Greenhouse Gas End-use Emissions; 1990-2020

(Source: Environment Canada, Canada's Second National Report on Climate Change, 1997, p. 37)

In the transportation sector, the fuel consumption per km of private vehicles (cars, vans, light trucks) was reduced significantly in the late 70s and early 80s. Since then all the innovative engineering has gone into more power and heavier vehicles because there has been no price or regulatory incentive for manufacturers to reduce vehicle fuel consumption. However, there are many opportunities available to reduce emissions per km. driven which would not only reduce the greenhouse gas burden but would also help solve regional smog and other local air pollution problems. It is estimated that just a moderate re-design of present vehicles would yield a 20% improvement (Scientific American Dec. 1994), and newer technologies, such as hybrids (combined battery and small gasoline engine) or hydrogen fuel cells could cut emissions drastically. Ballard Fuel Cells of Vancouver is a leading player world-wide in fuel cell development and one manufacturer expects to have fuel cell vehicles on the market by 2004. Regulatory or economic measures by government would speed up this process. As the IPCC 1995 report put it, Greenhouse gas emission reductions per unit of transport activity could be reduced 20 to 50% by 2025 if there were no changes in vehicle performance and size. If changes in performance and size were accepted, the reductions could be 60 to 80%. At the same time, other transportation sector policies, such

as improved public transportation, greater use of rail and ships, more energy efficient urban planning, and vehicle inspection programs could help to keep the number of kilometres driven from rising rapidly.

4 Additional Sources of Information

Climate change is a complex issue involving large numbers of individuals and organizations engaged in a wide variety of activities. The amount of information available on the different dimensions of the issue covered during the Cross-Canada Briefing Session you attended is simply staggering. While the issue is being covered more and more by the mass-media, it is not clear that they provide an adequate coverage for those who want to keep a watching brief on this critical issue or for those who want to become more actively involved in the debate at the regional, national or international level.

This section was assembled to serve as an extension to the Briefing Sessions. It offers some general references, contacts at both the Federal and Provincial levels as well as a number of useful Internet based resources. It is by no means exhaustive and the intention of the CGCP is to secure funds to maintain and develop this initial list on its Web site (<http://www.cgcp.rsc.ca>).

4.1 Federal

Many federal government departments are involved in the climate change issue, however, for the purpose of this briefing binder, we are providing contacts for the departments that are leading the federal government effort.

4.1.1 Environment Canada

Enquiry Center

Telephone: 1-800-668-6767 or 819-997-2800

Fax: 819-953-2225

Internet: [Http://www.ec.gc.ca](http://www.ec.gc.ca)

In Ottawa:

Rick Findlay

Manager, Climate Change

ENVIRONMENT CANADA

Global Air Issues Branch

351 St. Joseph Blvd., 11th floor

Hull, Québec K1A 0H3

Telephone (819) 997-1977, Fax (819) 994-0549, Internet: Rick.Findlay@ec.gc.ca

Robert Audet

Policy Advisor, Climate Change

ENVIRONMENT CANADA

Global Air Issues Branch

351 St. Joseph Blvd., 11th floor

Hull, Québec K1A 0H3

Telephone (819) 953-6014, Fax (819) 994-0549, Internet: Robert.Audet@ec.gc.ca

In Different Regions of Canada

Jim Abraham
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ENVIRONMENT CANADA
Atmospheric Science Division - Bedford
1496 Bedford Hwy.
Bedford, Nova Scotia B4A 1E5
Telephone (902) 426-9134, Fax (902) 426-9158, Internet: Jim.Abraham@EC.GC.CA

Alain Gosselin
Head
ENVIRONMENT CANADA
Air Pollution and Toxic Substances Control Section
105 McGill Street, 4th floor
Montréal, Quebec H2Y 2E7
Telephone (514) 283-4110, Fax (514) 496-6982, Internet: Alain.Gosselin@EC.GC.CA

Terry Allsopp
Manager
ENVIRONMENT CANADA
Atmospheric Environment Issues
4905 Dufferin Street
Downsview, Ontario M3H 5T4
Telephone (416) 739-4291, Fax (416) 739-4379, Internet: Terry.Allsopp@ec.gc.ca

Tim Goos
Chief, Atmospheric and Hydrological Sciences Division
ENVIRONMENT CANADA
Atmospheric and Hydrologic Sciences Division
Room 200, 4999 98th Avenue
Edmonton, Alberta T6B 2X3
Telephone (403) 951-8844, Fax (403) 951-8916, Internet: Tim.Goos@EC.gc.ca

Eric Taylor
Regional Climatologist
ENVIRONMENT CANADA
Atmospheric Science Section
430, 1200 West 73rd Ave.
Vancouver, British Columbia V6P 6H9
Telephone (604) 664-9123, Fax (604) 664-9195, Internet: Eric.Taylor@ec.gc.ca



4.1.2 Natural Resources Canada

Voluntary Challenge Program
Natural Resources Canada
580 Booth Street, 19th floor
Ottawa, Ontario K1A 0E4
email: vcr.info@nrcan.gc.ca
Web site: <http://www.vcr-mvr.ca/>

Energy Efficiency Branch
Natural Resources Canada
580 Booth Street
Ottawa, Ontario K1A 0E4
Fax: 613 947-4120
Web site: http://eeb-dee.nrcan.gc.ca/home_e.html



4.2 Provincial

Please note that this section included specific provincial contacts relevant to each region where the briefings took place. The CGCP plans to consolidate of all the provincial contacts into a more generic list which will be useful to a broader audience, which will be posted on our web site (www.cgcp.rsc.ca).



4.3 Other Information Resources



4.3.1 Internet Sites

Governments, International Organizations and Academic Sources

The Royal Society of Canada's Global Change Program maintains a web site which contains several climate change publications. This briefing binder will also be poste on the site in the near future - please consult the site at <<http://www.cgcp.rsc.ca>> for updates.

Environment Canada (federal Government)

Issues and Topics: Atmosphere and Climate http://www.ec.gc.ca/atmos_e.html
- climate change information, Canada's National Report

Natural Resources Canada (federal government)

Energy Efficiency http://eeb-dee.nrcan.gc.ca/home_e.html
Voluntary Challenge and Registry <http://www.vcr-mvr.ca/>

CLIMATE CHANGE BRIEFINGS

International Energy Agency <http://www.iea.org>
Policy evaluations, i.e. Voluntary action options

International Institute for Sustainable Development
Linkages <http://www.iisd.ca/linkages/>
Journal: See October 1997 edition for discussion of Kyoto options
- See pages on climate change convention. Also hosts listserv discussion group

Union of Concerned Scientists's Sound Science Initiative
www.ucsusa.org/ucs.globalresources.html#ssi
- Periodic update service available on scientific and political news (US based)

United Nations (and agencies)
Climate Change Secretariat <http://www.unfccc.de/index.html>
- the Convention, climate change information kit, national emissions inventories, IPCC
scientific assessment reports
IPCC Second Assessment report <http://www.ipcc.ch/>
Common Questions about Climate Change <http://www.gcrl.org/ipcc/qa/cover.html>

US EPA "Global Warming" Site <http://www.epa.gov/globalwarming/>
- general information, US emissions inventory, media clippings

USI Initiative on Joint Implementation. JI Online. <http://www.ji.org/>
- information and discussion group

Atmospheric Research and Information Centre (ARIC) based at the Manchester Metropolitan University,
<http://www.doc.mmu.ac.uk/aric/gcciphm.html>.
- Good internet links on variety of environment and sustainability issues.

IGC Climate and Atmosphere <http://www.igc.org/igc/issues/ac/or.html#TOP>
- scientific information and good links to other internet resources



4.3.2 Periodicals

Climate Alert. The Climate Institute, Washington, D.C. (Non-profit) Plain language reporting. \$US95/6
issues/year. (202) 547-0104. Climateinst@igc.apc.org

Global Environmental Change Report. Cutter Information Corp. Policy, science and industry news;
international. 2 issues/month. \$US457/year. 1-800-964-5125; dcrowley@cutter.com

Global Warming Today. Month-in-Review or Daily Internet E-Mail. Environmental Information
Networks. International media clippings on policy, industry initiatives, science and technology.
\$US540/year. 1-800-726-6898.

United Nations Climate Change Bulletin. Secretariat of the UN Framework Convention on Climate Change. IPCC information. FREE. Quarterly.



4.3.3 *Books and Reports*

Canada and the State of the Planet. Michael Keating and the Canadian Global Change Program. Oxford University Press. To order call (416) 441-2941.

Canada's Second National Report on Climate Change. Environment Canada, 1997. Cat. no. En21-125/1997E. To order call 1-800-668-6767.

Climate Change Information Kit. United Nations Environment Programme's Information Unit for Conventions. Tel(+41-22) 979-9244/9196/911; fax (+41-22) 797 3464; e-mail iuc@unep.ch

• IPCC Second Assessment: Climate Change 1995. Intergovernmental Panel on Climate Change. World Meteorological Organization and United Nations Environmental Program

Implications for Canada of IPCC Assessments Reports. An Overview (8p) or Long Version (22p) . Canadian Climate Program Board and Canadian Global Change Program, 1995. Both free. (613) 991-5639; cgcp@rsc.ca

Houghton, John T. Global Warming: the Complete Briefing, Second Edition, Cambridge University Press, 251 pages, 1997

Appendix 2 - Overhead slides/speaking notes



Climate Change Policy

Presentation for CGCP Seminars
Doug Russell
November 1997



Climate Policy Overview

- ◆ UN FCCC - what is it?
- ◆ Commitments internationally
- ◆ Negotiating history
- ◆ Negotiating blocs
- ◆ The USA
- ◆ Canada's performance
- ◆ Canadian plan and process
- ◆ Post-Kyoto challenges



The United Nations Framework Convention on Climate Change

- ◆ signed in 1992 - Rio
- ◆ entered into force 1994
- ◆ more than 168 countries
- ◆ divides the world into 3 groups :
 - ◆ OECD
 - ◆ Economies in transition
 - ◆ Developing countries
- ◆ differentiated commitments -what are they?
- ◆ review process
- ◆ economic and technological assistance



Commitments under the UN FCCC

- ◆ OECD: report on measures aimed at returning GHG emissions to 1990 levels by 2000, finance developing countries' efforts
- ◆ EITs - report on efforts aimed at returning to 1990 levels by 2000 - plus additional flexibility
- ◆ G-77: general commitments - inventories, public awareness, scientific cooperation
- ◆ Commitments judged inadequate - Berlin, April 1995
- ◆ New commitments in Kyoto??



Negotiating History

- ◆ 1980 - First World Climate Change Conference
- ◆ 1988 - Toronto conference (20% reduction by 2005)
- ◆ 1990 - Second World Climate Conference - Canadian stabilization pledge
- ◆ 1991 - Launch of UN FCCC negotiations - Chantilly, VA
- ◆ 1992 - May- Convention adopted for signature
- ◆ 1992 - June - Rio: opened for signature
- ◆ 1995- 1st meeting of COP = Berlin Mandate
- ◆ 1996- Geneva - COP2 - Ministerial Declaration
- ◆ 1997 - Kyoto- COP3 - outcome?



1997 - Kyoto- COP3 - outcome?

- ◆ **Deal** : Stabilization to 5% reduction by 2010 - legally binding + mandate for further negotiations regarding developing country commitments
- ◆ **Deal**: "Soft target" with further negotiations to differentiate legally binding targets and commitments for developing countries
- ◆ **No Deal**: Talks collapse over developing country commitments and lack of movement by industrialized world.



Negotiating Blocs

- ♦ JUSSCANNZ
- ♦ European Union
- ♦ Russia
- ♦ EITs
- ♦ AOSIS
- ♦ OPEC
- ♦ China, India
- ♦ NICs (Asian Tigers)
- ♦ Africa
- ♦ Latin America



European Union "Bubble"

STATE	% Target by 2010	STATE	% Target by 2010	STATE	% Target by 2010
Belgium	-10%	France	0%	Austria	-25%
Denmark	-25%	Ireland	+15%	Portugal	+40%
Germany	-25%	Italy	-7%	Finland	0%
Greece	+30%	Luxembourg	-30%	Sweden	+5%
Spain	+17%	Netherlands	-10%	U.K.	-10%



The USA

- ♦ Policy stance: Market - based and voluntary
- ♦ White House and Congress
- ♦ Kyoto Proposal

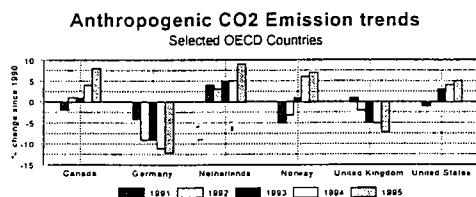


Canadian Overview

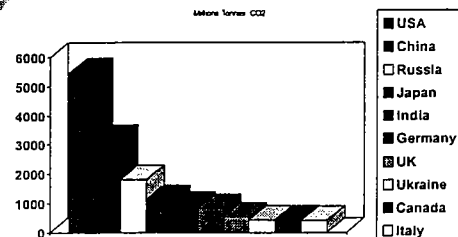
- ♦ drivers of economic growth:
 - ♦ in 1950
 - ♦ in 1995
 - ♦ in 2020
- ♦ physical circumstances - climate and geography
- ♦ political circumstances - jurisdictional



Canada's Performance 1990-1995

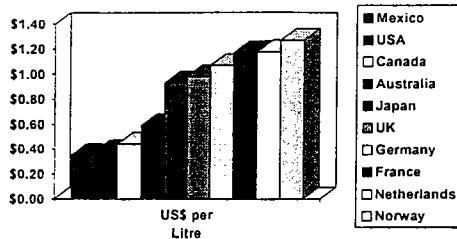


Top 10 CO₂ Emitters Globally 1995

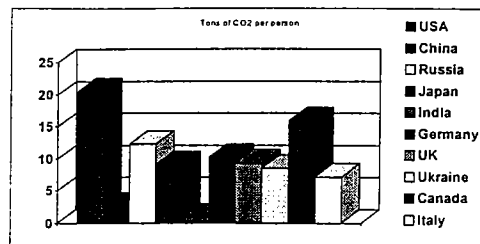




Gasoline Prices in Selected Countries 1996

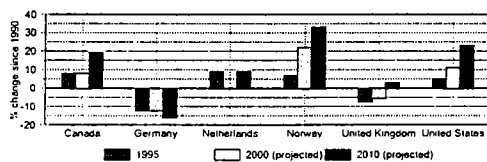


Per Capita Emissions - Top 10 Total Global Emitters (1995)

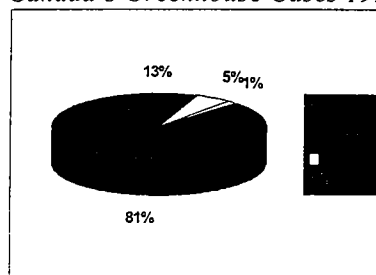


Canada's Performance - Projections

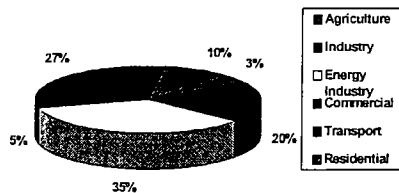
Projected Anthropogenic CO2 Emissions Selected OECD Countries



Canada's Greenhouse Gases 1995

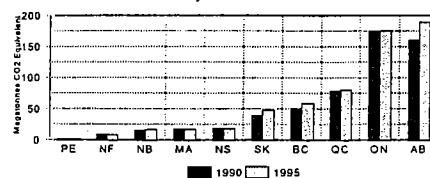


Canada's Greenhouse Gases 1995



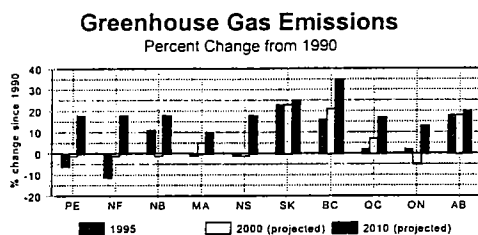
GHG Profile Province by Province 1995

Greenhouse Gas Emissions by Province





GHGs -% Growth Province by Province



Canada's National Action Program

- ◆ Elements:
 - ◆ Voluntary Challenge
 - ◆ Performance measurement
- ◆ NAPCC Review 1996
- ◆ Next steps?



Policy Process in Canada

- ◆ Role of Federal Government - International
- ◆ NAICC process
- ◆ Stakeholder involvement

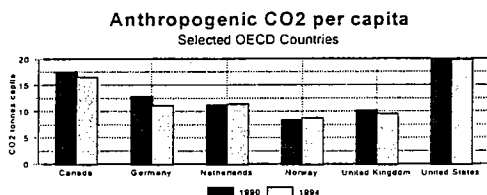


Post Kyoto Challenges for Canada

- ◆ Political will
- ◆ Ensuring accountability and a fair and equitable burden
- ◆ Providing flexibility to meet target
- ◆ Exploiting opportunities



Canada's Performance 1990-1994



GREENHOUSE GASES AND CLIMATE CHANGE:

CANADIAN GLOBAL CHANGE PROGRAM - PRE KYOTO BRIEFINGS

(BASED MAINLY UPON IPCC'S CLIMATE CHANGE 1995 REPORT)

1. **THE CLIMATE SYSTEM: - atmosphere, oceans, land processes.**
 - **Natural Greenhouse effect - water vapour CO₂, methane, keep Earth at liveable temperatures, by letting sun's heat and energy reach the surface, but prevent some of earth's radiation back to space.**
 - **acts like a blanket or glass in greenhouse.**
 - **enhanced greenhouse effect due to human activity - like putting on another blanket**
2. **CO₂ INCREASES - Now much higher concentration than in last 160,000 years on earth, due to fossil fuel burning and removal of a good portion of the world's forests. Both still going on at accelerating rates. Methane more than doubled.**
3. **CHANGES IN RADIATIVE FORCING from 1850 to now**
 - **aerosols regionally important, short lived**
 - **GHG's globally distributed, some very long lived: CO₂ - 150 years**
4. **HOW THIS AFFECTS CLIMATE IS VERY COMPLEX:**

There are many feed-backs in the system, e.g. melting ice, clouds, etc. Need complex models to assess.

Canadian Climate Model - University of Victoria - taking into account greenhouse gas and sulphate aerosols, and a doubling of CO₂ radiative forcing from 1910-2040.

Much warmer in Canada (3 to 5 °C) : Cooler N.E. of Labrador.

5. WHAT HAS BEEN THE OBSERVED CHANGES IN TEMPERATURE?

1961 - 1990 - Northern Hemisphere, centred on Canada
- yellow and orange warmer, greater in N.W. Canada and Siberia,
- cooler N.E. Labrador (similar pattern to projection.

6. GLOBAL MEAN TEMPERATURE - up about $\frac{1}{2}$ °C

7. HOW WELL ARE THE GLOBAL MEAN INCREASES SIMULATED BY CCCma (Canadian) MODEL. - reasonably well.
Also departure from natural climate variations now becoming apparent.

8. IPCC SCIENTISTS examined the ever-closer parallel between projected and observed regional patterns of change and global changes and concluded in a cautious statement:

“The balance of evidence suggest a discernible human influence in global climate”.

9. THESE WARMING RATES projected ($1\frac{1}{2}$ °C to $3\frac{1}{2}$ °C by 2100) are faster than earth has experienced in the past 10,000 years. The range is mainly influenced by range of estimates of future world population growth and industrial development.

10. AS THE EARTH WARMS, so do the oceans and they expand as they warm - also glaciers world wide are melting. Thus the rise in mean sea level is accompanying warming. - at 2 to 5 times as fast as in future the 10 to 25 cm observed this past century. Projections depend on future emissions - range 15 cm to almost 1 metre 2100. Most probable $\frac{1}{2}$ metre by 2100. (In most likely case, 20 cm before 2050.) I just came from a country - the Maldives, in the Indian Ocean, where 80% of their land is lower than 1 metre above sea level. With sea level rise the slightest storm will inundate them.

11. IMPACT OF 20 cm RISE: on land with high dykes (3m) - 1 in 10 year flood becomes 1 in 9 years, and low lying delta -10 year flood becomes 2 or more per year.

How safe is Richmond B.C. or some east coast estuaries?

12. But we probably will not feel climate change mainly through a gradual warming, but through extremes of climate and weather. **HEAVY RAINFALLS** - CSIRO Australia model for 40°N - heavy rains up, light rains down.
13. **OBSERVED IN U.S.A.** - more of rain in heavy falls, > 50 mm/day up 20%, - more flash floods.
14. **WATER VAPOUR IN ATMOSPHERE OVER U.S.A. AND SOUTHERN CANADA** significantly higher in past 30 years, available for heavier rains.
15. **CANADIAN CLIMATE MODEL** suggests fewer winter **STORMS** overall but more very severe winter storms in northern hemisphere with increased forcing by CO₂ and other GHGs. Here is the pattern of frequency of intense winter storms - significant increases 1980s and 1990s.
Canada's insurers say climate related losses increasing rapidly to \$900/mill last year and attribute this partly to a changing climate.
16. We have heard a lot lately about the **EL NINO (ENSO)**, probably the most intense on record, now in progress. More than 5 °C departure from normal surface water temperatures - Equatorial Pacific. Causes more storms in some areas - droughts in others.
17. **INTENSITY OF WARM AND COLD ENSO INCREASING**
- last major warm one in 1982-3 estimated to do \$13 billion damage world-wide.
18. **DROUGHT INTENSITY** would be greatest about 50°N in Canada, near the border according to Geophysical Fluid Dynamics Lab/Great Lakes and Prairies affected.
19. **CARBON EMISSIONS PER CAPITA AND POPULATION**
- Canadian emissions next to U.S. - twice as much as Japan and Europe and 20 times greater than India and much of Asia, most of historical emissions from developed countries still about 60%, developing countries gaining.

**20. ANALYSES OF COSTS OF EMISSION REDUCTIONS
by macro-economic models and technology driven models
- ALTERNATIVE VIEWS:**

- a) Perfect market and carbon tax : - costs go up as amount as
amount of reduction goes up.**
- b) Some energy efficiency measures are cost-effective - i.e. energy
savings offset initial costs: - also if carbon or energy tax is used
to offset more distortionary taxes, e.g. payroll taxes - net
economic benefit.**

**21. IN ADDITION THERE ARE ENVIRONMENT DOUBLE
DIVIDENDS**

**- reduce precursors of urban smog, acid rain and toxic metals releases
by reducing fossil fuel use. Economic analyses suggest at least 30% of
costs of emission reductions can be attributed to the health and
economic benefits of reducing these other pollution problems.
Measures where costs of implementing them are less than benefits of
reduced energy costs and non-climate environmental benefits are often
called "no regrets" measures or "worth doing anyway".**

22. Summary of Mitigation Cost Literature

**23. Economists' Statement from 2800 Canadian and U.S. Economists
including 8 Nobel Laureates.**

**"As economists, we believe that global climate change carries with it significant
environmental, economic, social, and geopolitical risks, and that preventative steps are
justified. Economic studies have found that there are many potential policies to reduce
greenhouse gas emissions for which the total benefits outweigh the total costs. For the U.S.
and Canada, sound economic analysis shows that there are policy options that would slow
climate change without harming North American living standards, and these measures
may, in fact, improve productivity in the longer run. The revenues generated from such
policies can effectively be used to reduce the deficit or lower existing taxes."**

**---Statement signed by 2800 Leading American
and Canadian Economists, including 8 Nobel Laureates**

24. **WHAT MEASURES CAN WE TAKE IN CANADA:**
Some suggestions:

PARTIAL PORTFOLIO OF MEASURES - FEDERAL
FOR
GREENHOUSE GAS EMISSION REDUCTIONS

FOR NEW VEHICLES, INCREASED FUEL EFFICIENCY AND INNOVATIVE TECHNOLOGIES (HYBRID, FUEL CELLS), THROUGH NATIONAL STANDARDS OR AGREEMENTS WITH MANUFACTURERS.

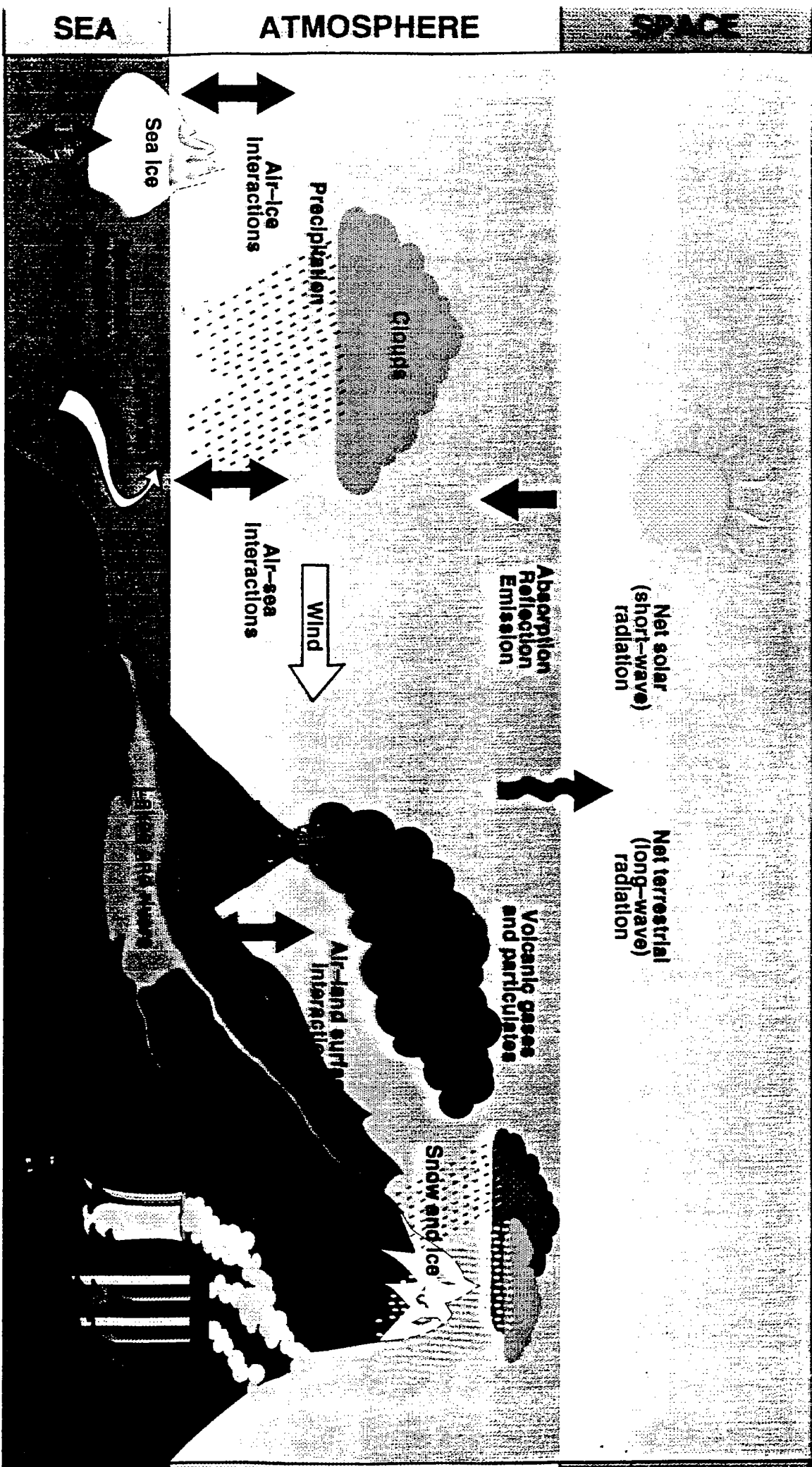
STABILIZATION OR REDUCTION TARGETS FOR INDUSTRIES, TO STRENGTHEN "VOLUNTARY" PROGRAMS. BEGIN EMISSION PERMIT TRADING TO MINIMIZE COSTS AND PUBLICIZE RESULTS.

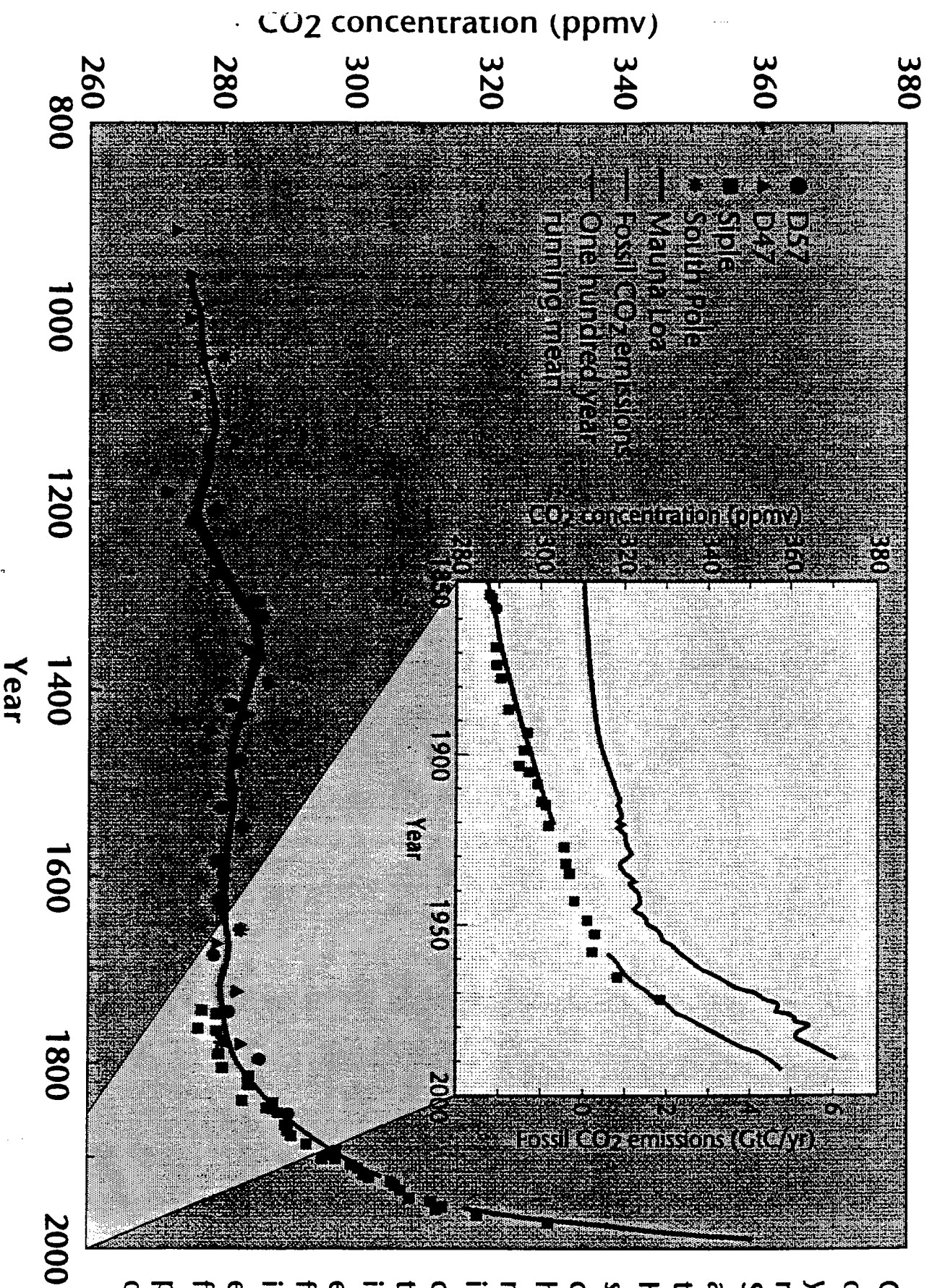
DEVELOP A STRATEGY, WITH THE PROVINCES, TO MOVE FROM: COAL AND OIL FOR ELECTRICITY PRODUCTION TO: HYDRO, NATURAL GAS, COGENERATION OPTIONS, AND/OR NUCLEAR.

25. **Reason for suggesting TRANSPORTATION SECTOR for attention:**
- Transportation now 48% of end-use emissions projected to rise to 51% of much larger total emissions by 2020.
26. **WHAT HAPPENS IF WE DO NOTHING?**
CO₂ emissions - 3 to 7 times, more likely 5 to 7 times, those of this past century in the next 100 years.
27. **CONCLUSION**
WE ARE IN THE MIDST OF AN UNINTENDED, UNPRECEDENTED EXPERIMENT ON PLANET EARTH. THE FULL CONSEQUENCES CAN ONLY BE PARTIALLY PERCEIVED.

The recent ad of the Canadian Association of Petroleum Producers put the Canadian situation very well:

"Together we can control emissions and help clear the air, without slowing our economy. It takes imagination and determination. Here in Canada we've got a lot of both."





CO₂ concentration over the past 1000 years from ice-core records (D47, D57, Siple and South Pole and (since 1958) from the Mauna Loa, Hawaii measurement site. The smooth curve is based on a hundred year running mean. The rapid increase in CO₂ concentration since the onset of industrialisation is evident and has followed closely the increase in CO₂ emissions from fossil fuels (see inset of period from 1850 onwards).



Fossil fuels contain no ^{14}C because of their age.

rate of atmospheric CO_2 concentration slowed

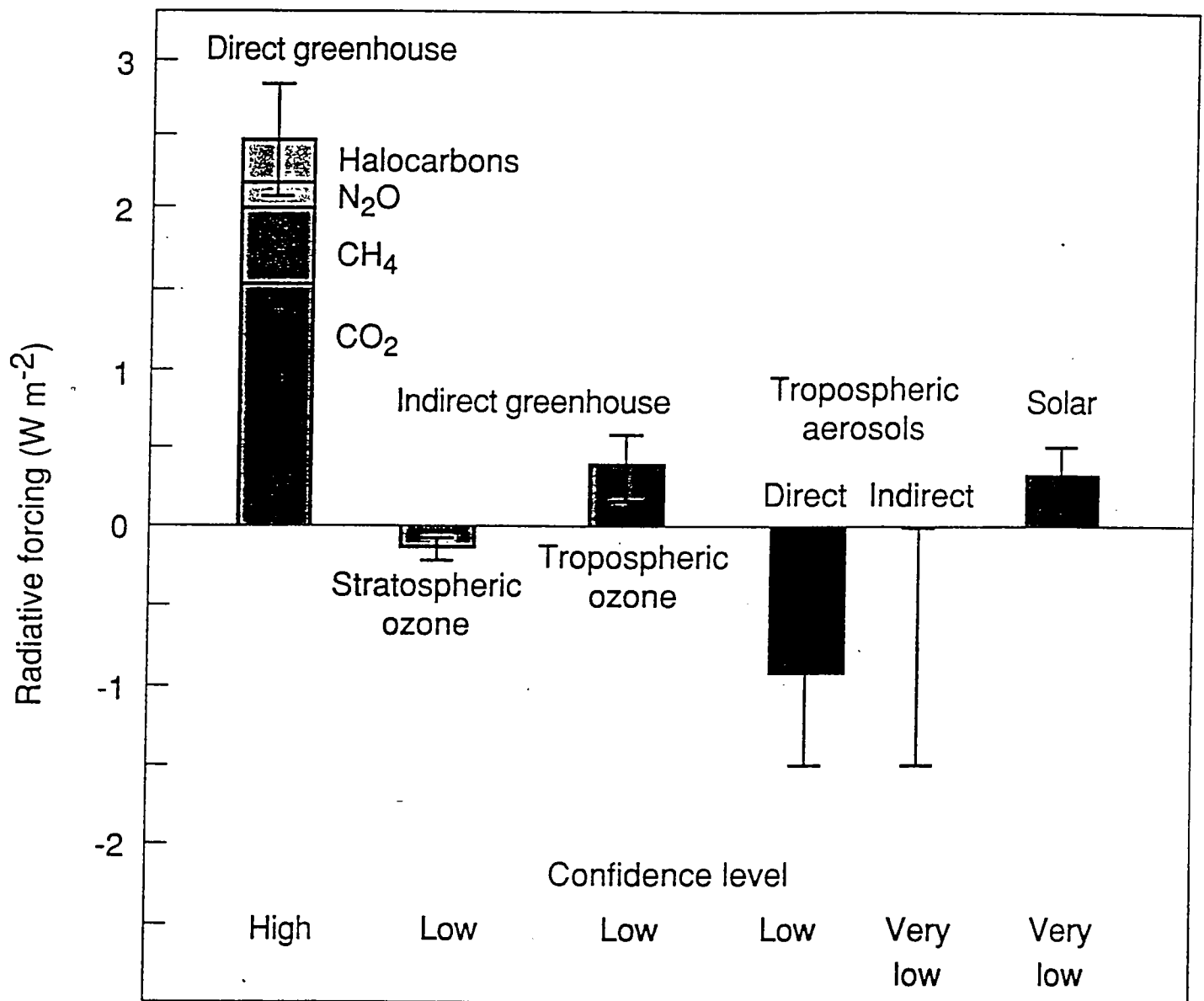
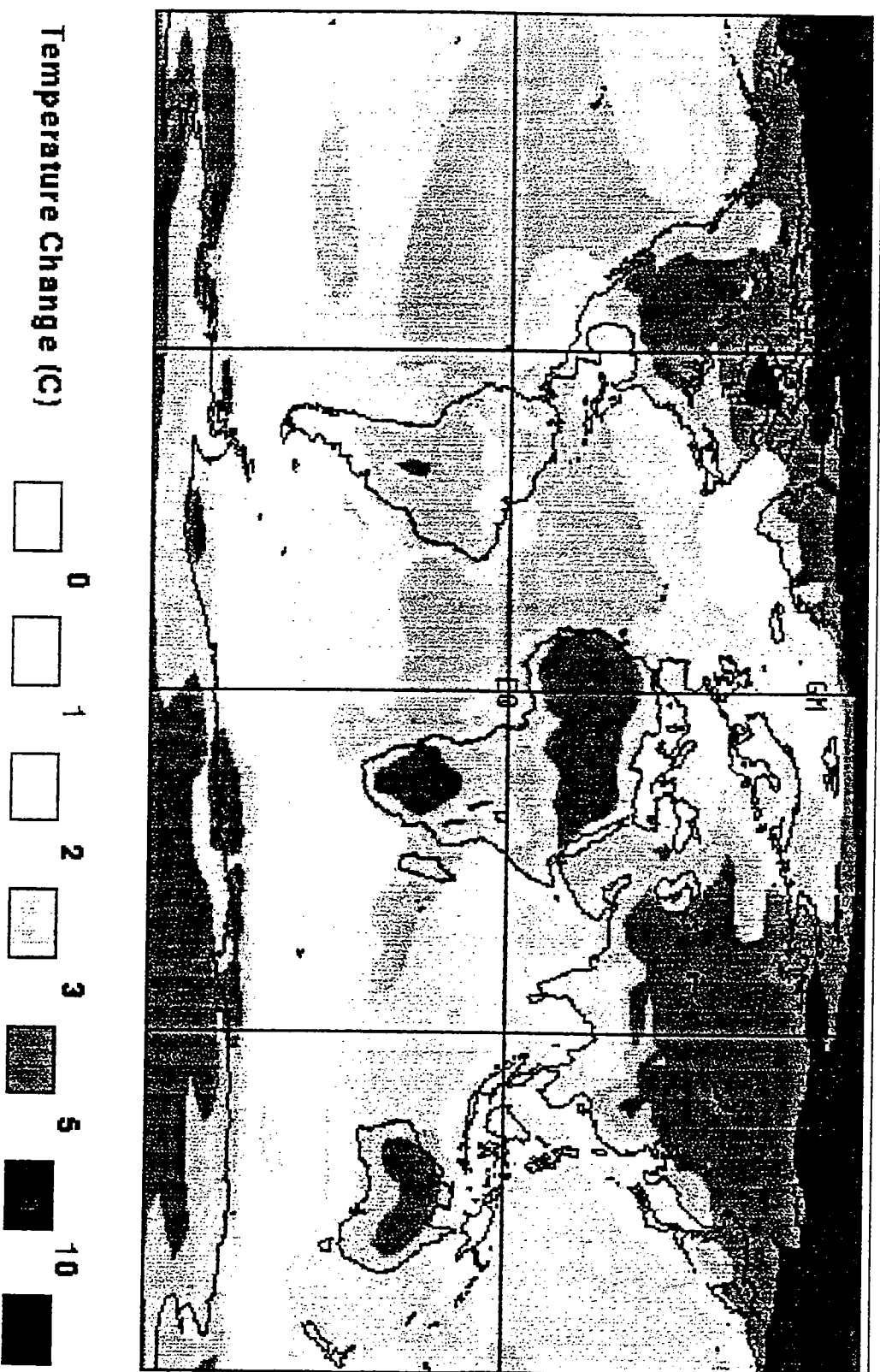


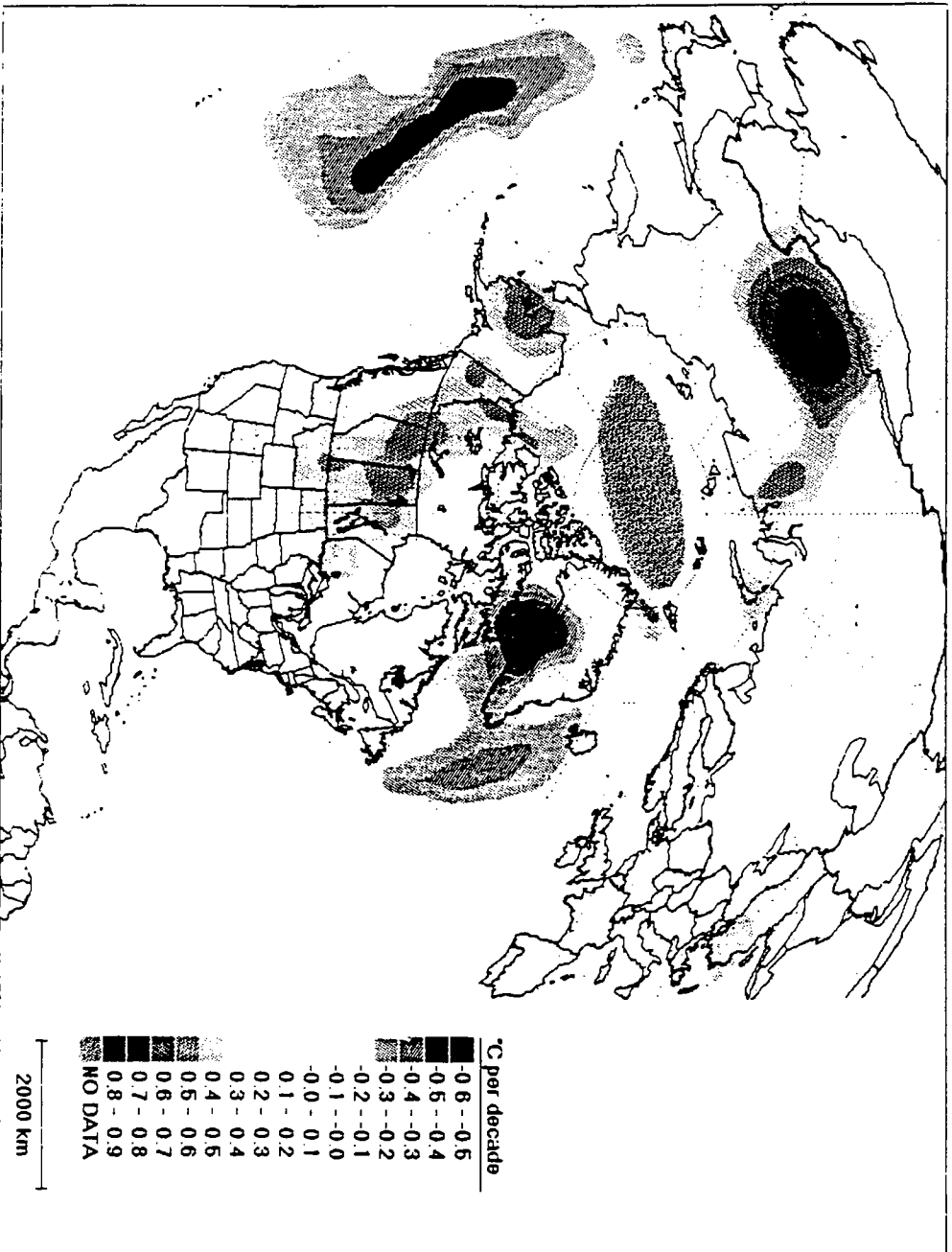
Figure 3. Estimates of the globally averaged radiative forcing due to changes in greenhouse gases and aerosols from pre-industrial times to the present day and changes in solar variability from 1850 to the present day. The height of the bar indicates a mid-range estimate of the forcing whilst the lines show the possible range of values. An indication of relative confidence in the estimates is given below each bar. The contributions of individual greenhouse gases are indicated on the first bar for direct greenhouse gas forcing. The major indirect effects are a depletion of stratospheric ozone (caused by the CFCs and other halocarbons) and an increase in the concentration of tropospheric ozone. The negative values for aerosols should not necessarily be regarded as an offset against the greenhouse gas forcing because of doubts over the applicability of global mean radiative forcing in the case of non-homogeneously distributed species such as aerosols and ozone (see Section 1 and Section 7).

Projected Temperature Change between 1910 and 2040 AD



Combined Effect of Projected Greenhouse Gas and Sulphate Aerosol Increases.- Canadian Model

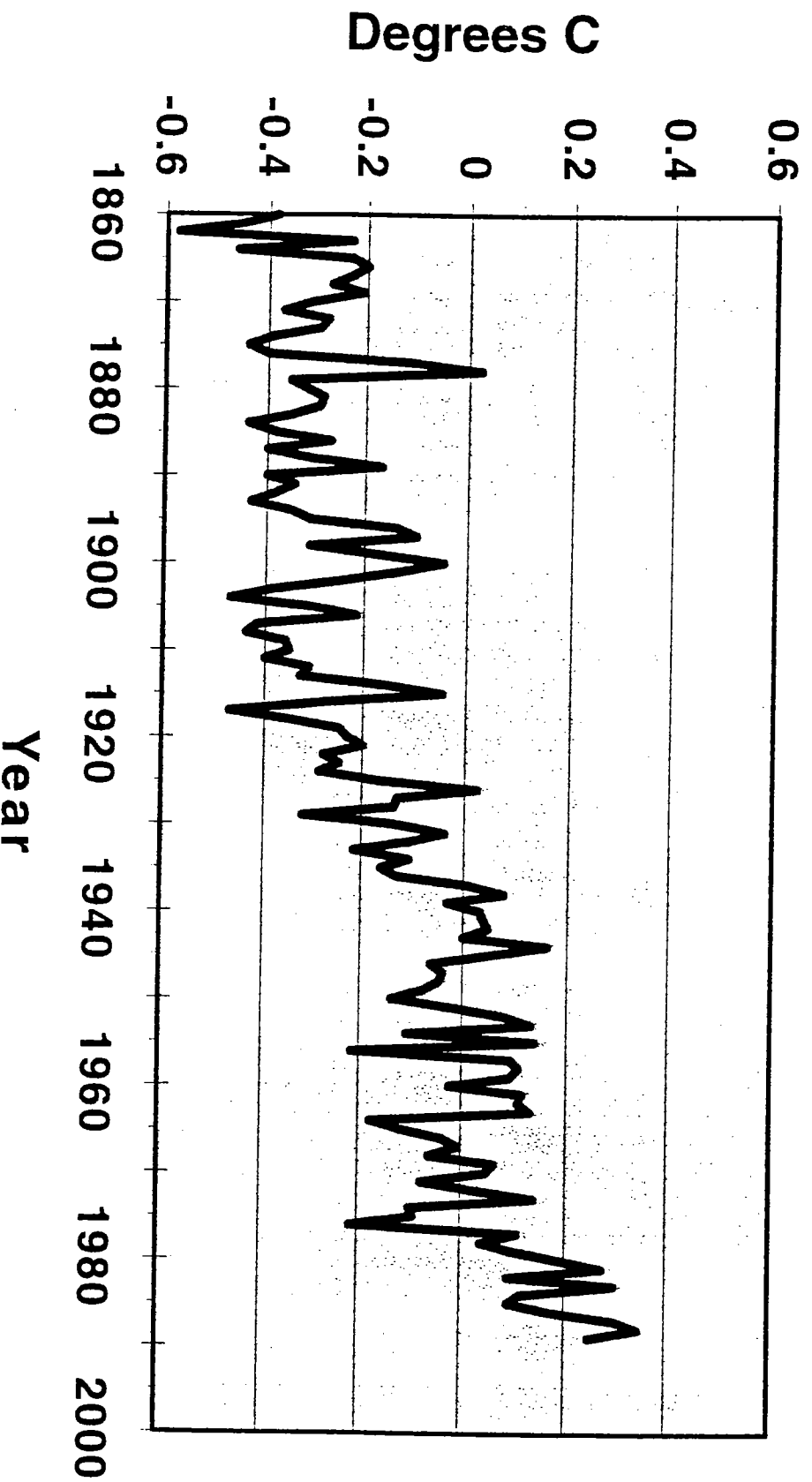
ANNUAL SURFACE TEMPERATURE TRENDS 1961 TO 1990



Climate Change Detection Division
Atmospheric Environment Service
Environment Canada

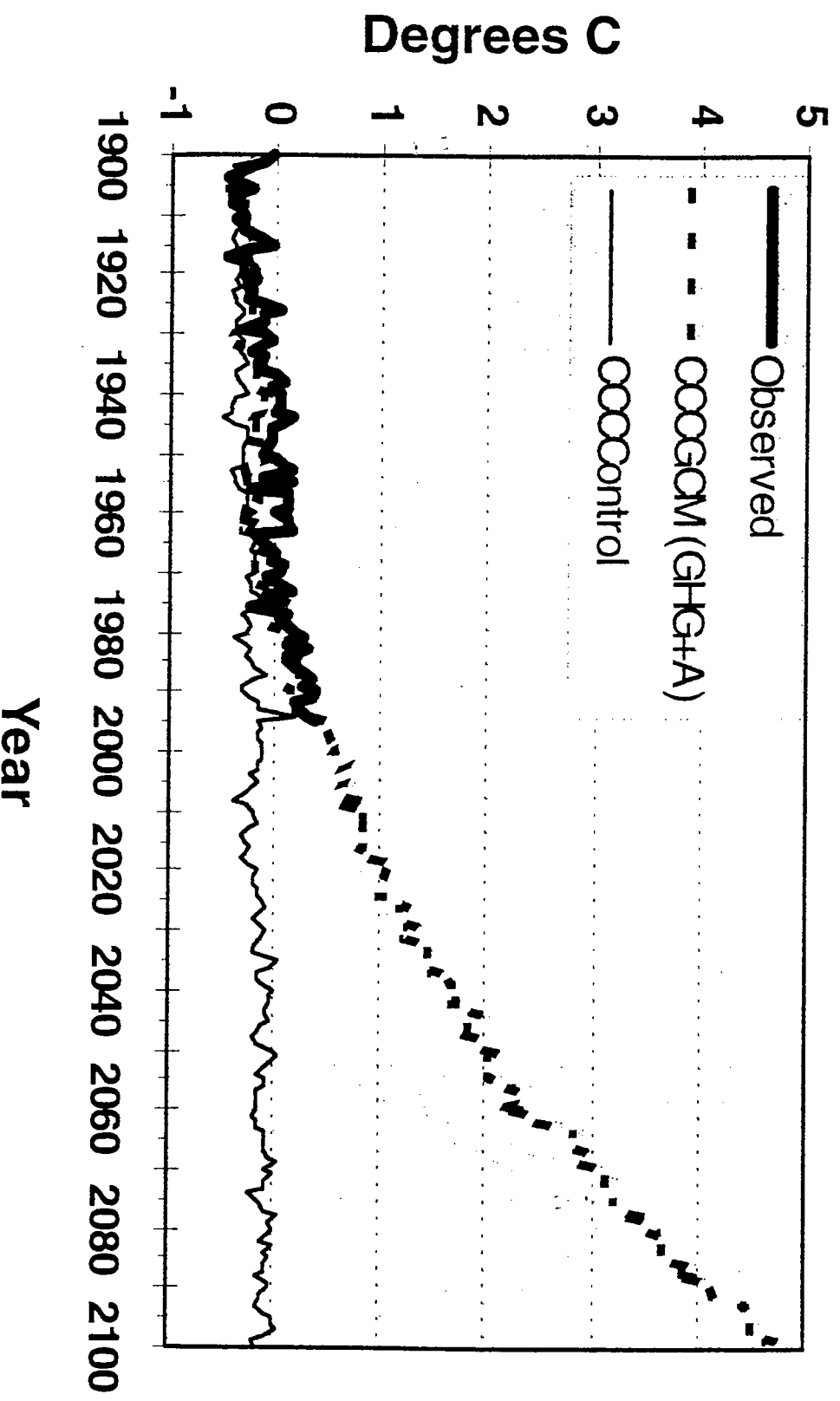
Draft Map of Climate Research Unit
Grid-Box Data (June, 1993)

Global Temperature Change 1860-1996



Relative to 1951-80 average temperature

Observed and Modeled Global Temperature Change



Departures from 1951-80 average

**“THE BALANCE OF EVIDENCE
SUGGESTS A DISCERNIBLE
HUMAN INFLUENCE ON
GLOBAL CLIMATE.”**

IPCC - Second Assessment Report 1995

CLIMATE CHANGE UNDER BUSINESS-AS-USUAL

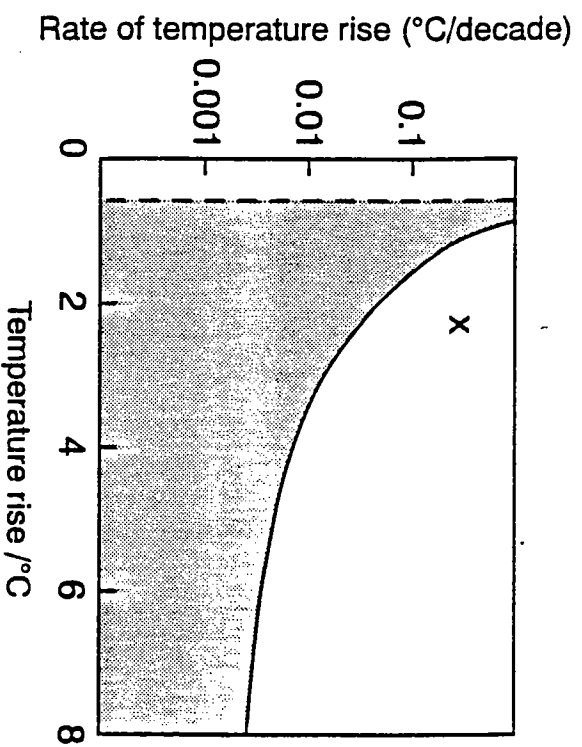


Fig. 6.3

Within the shaded region are typical rates of climate change during the past 10,000 years, over periods up to about a century, plotted against actual change deduced from climate records and paleoclimate data⁸. Also plotted (X) is the projected rate of change next century due to a business-as-usual increase of greenhouse gases – well outside the shaded region.

1990-2100 sea-level rise for scenario IS92a

(see Chapter 7, Changes in Sea Level, of the Working Group I, IPCC Second Assessment Report 1995)

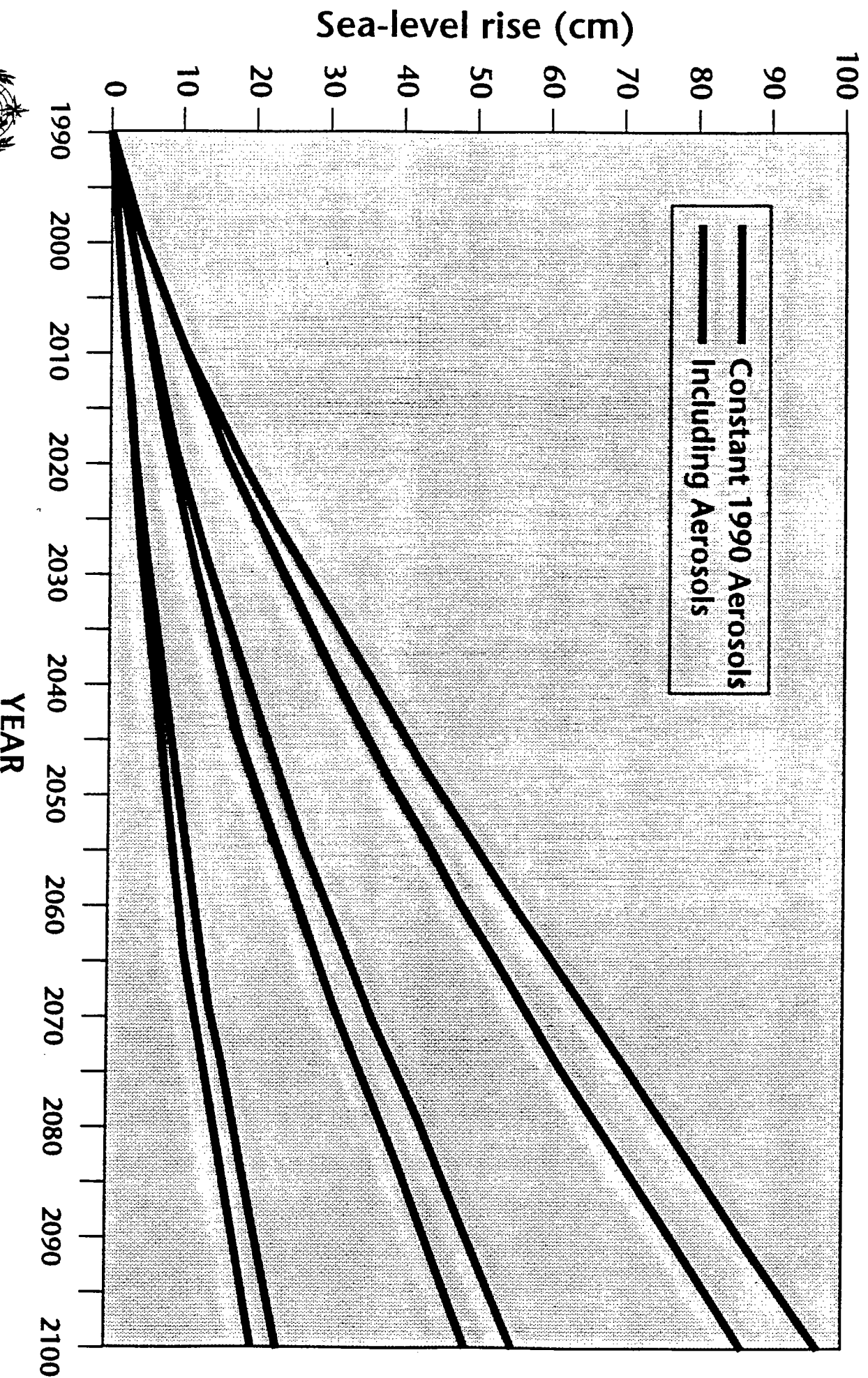
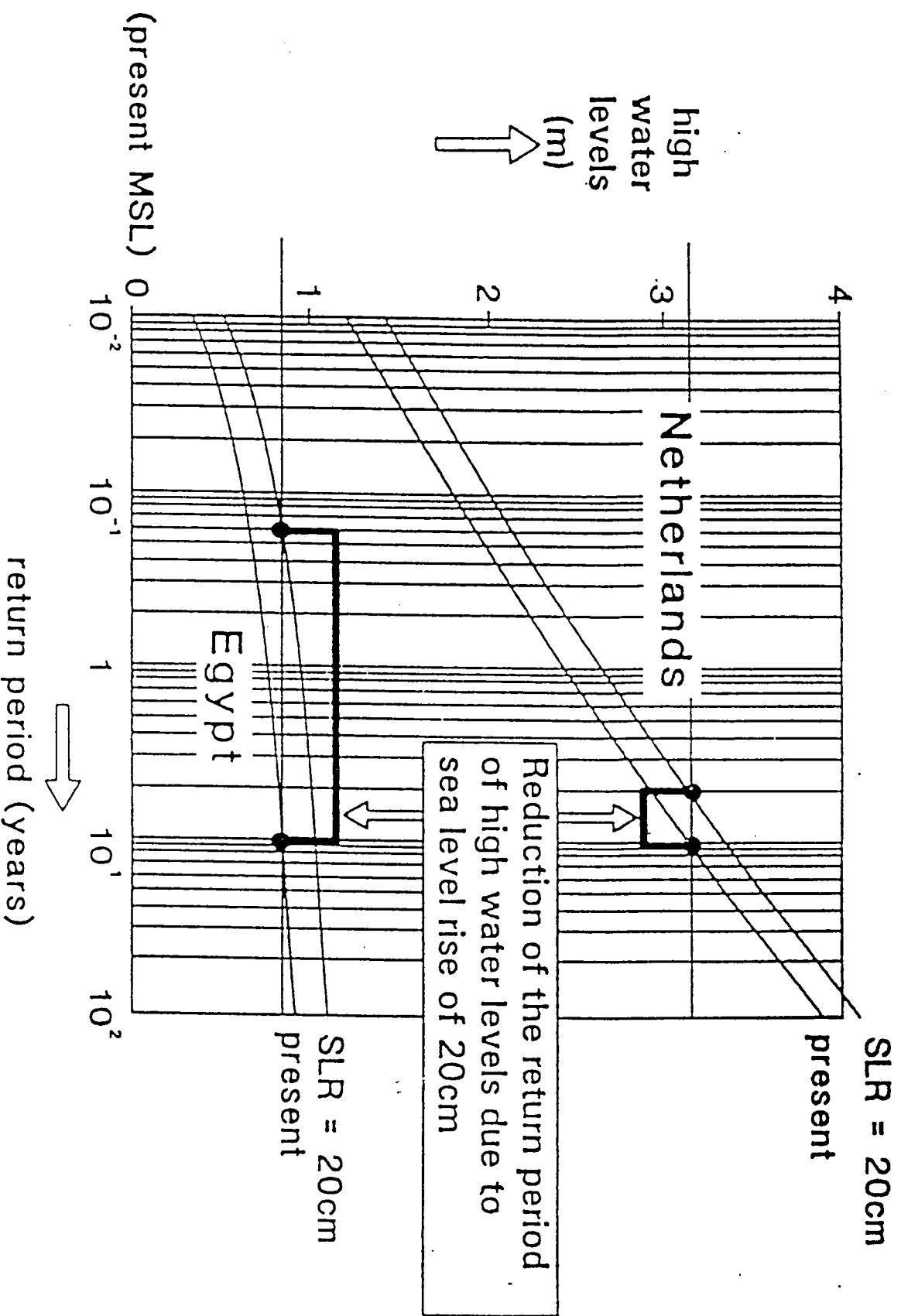


Figure 3.4 Return period of surge heights



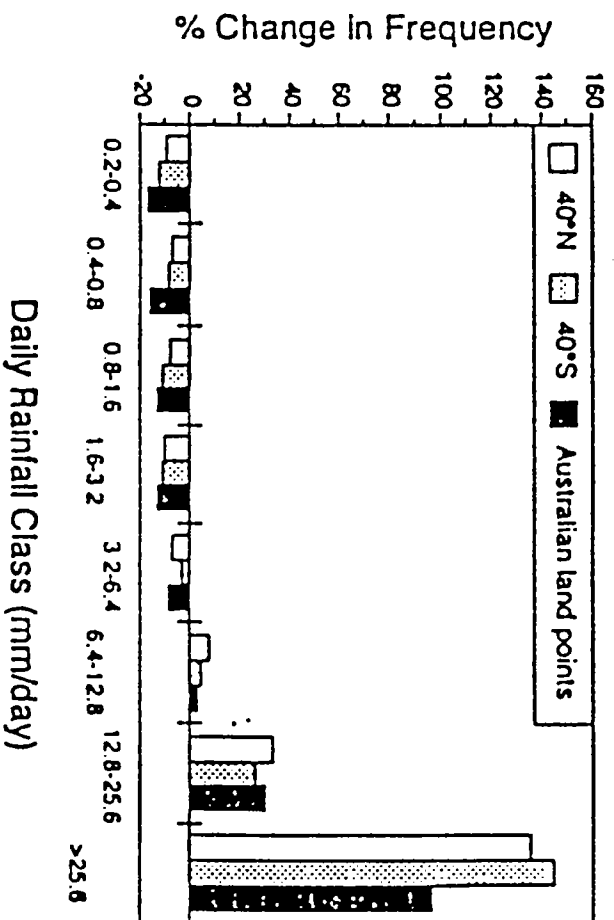
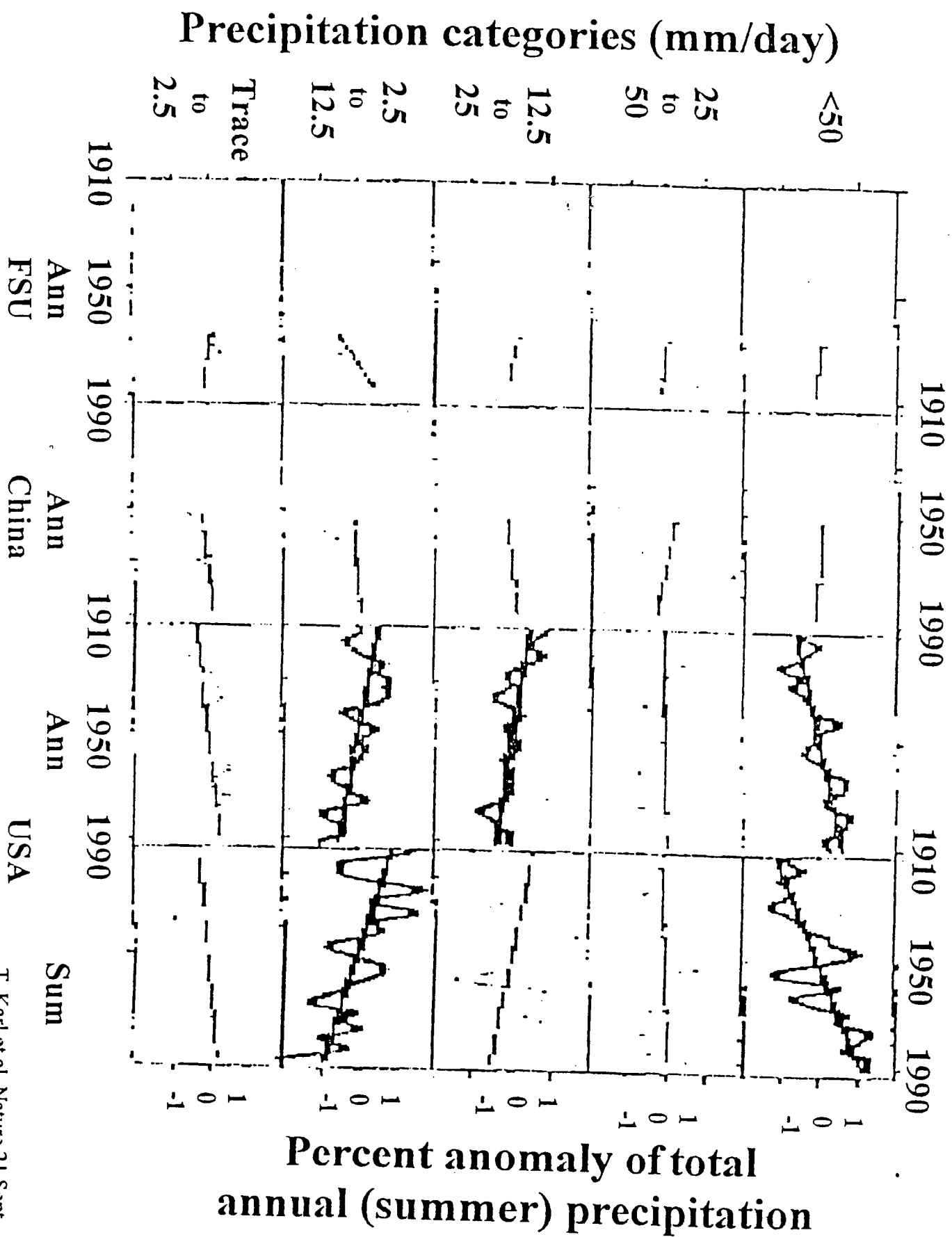


FIG 6

Fig. 6. Percentage change in the frequency of CSIRO4 simulated daily rainfall (mm/day) at latitudes 40°N and 40°S, and for Australian land points. Results are for raindays (≥ 0.2 mm) and are combined for all gridpoints.

P. H. Whetton et al CSIRO Climate Change 1992

TRENDS IN PRECIPITATION



Annual 700mb Dewpoint Trends (0.1°C/decade)

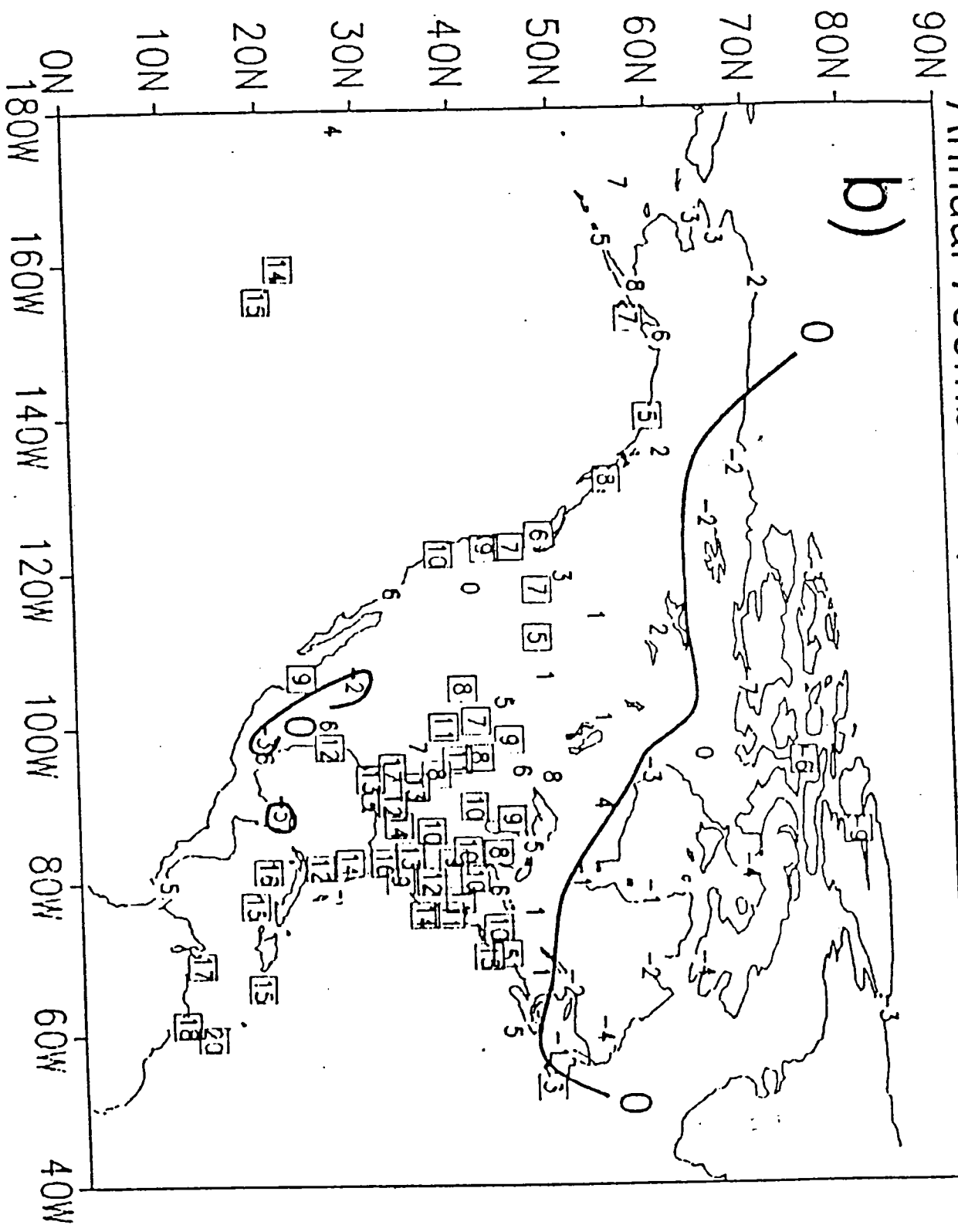
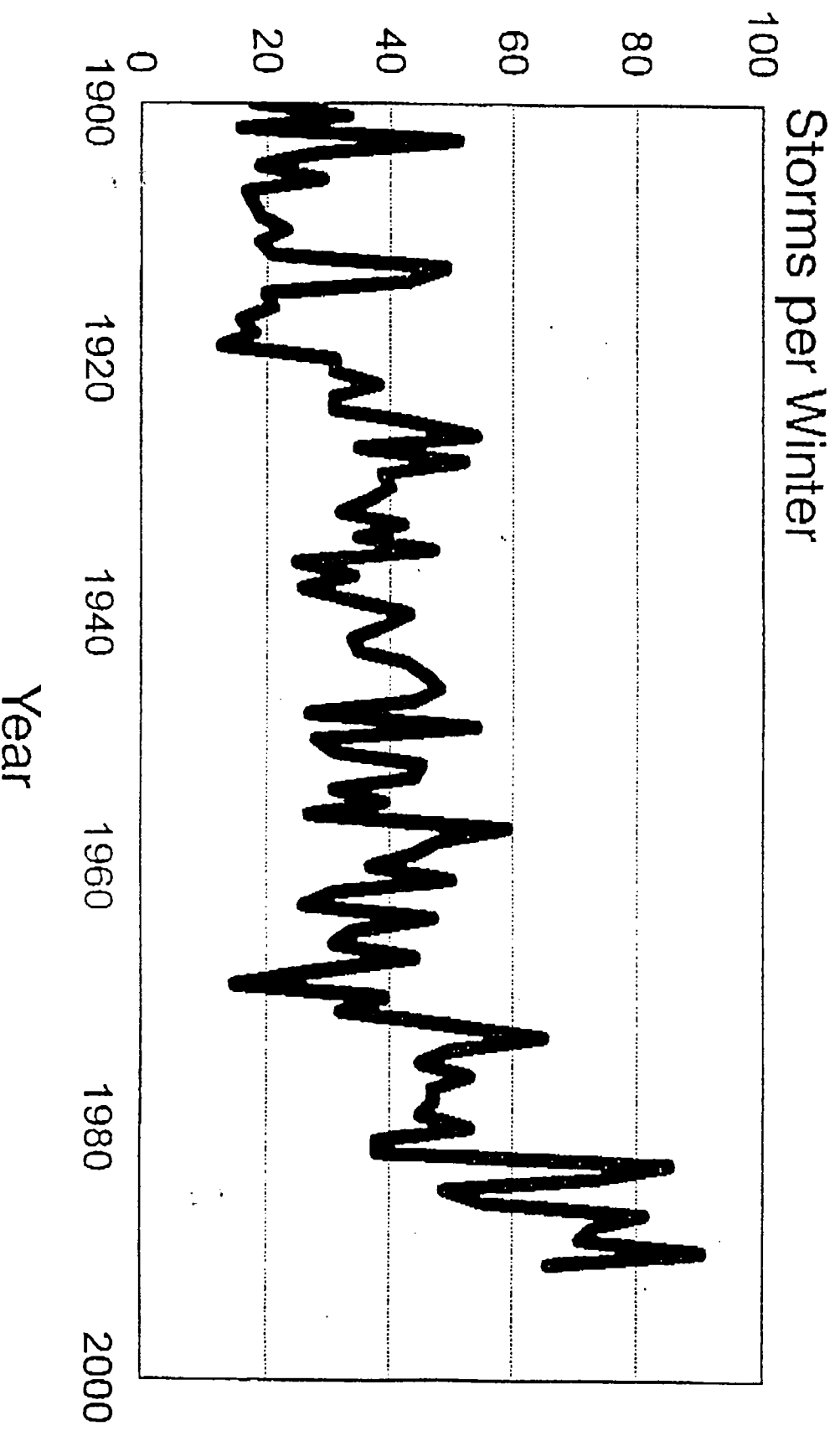


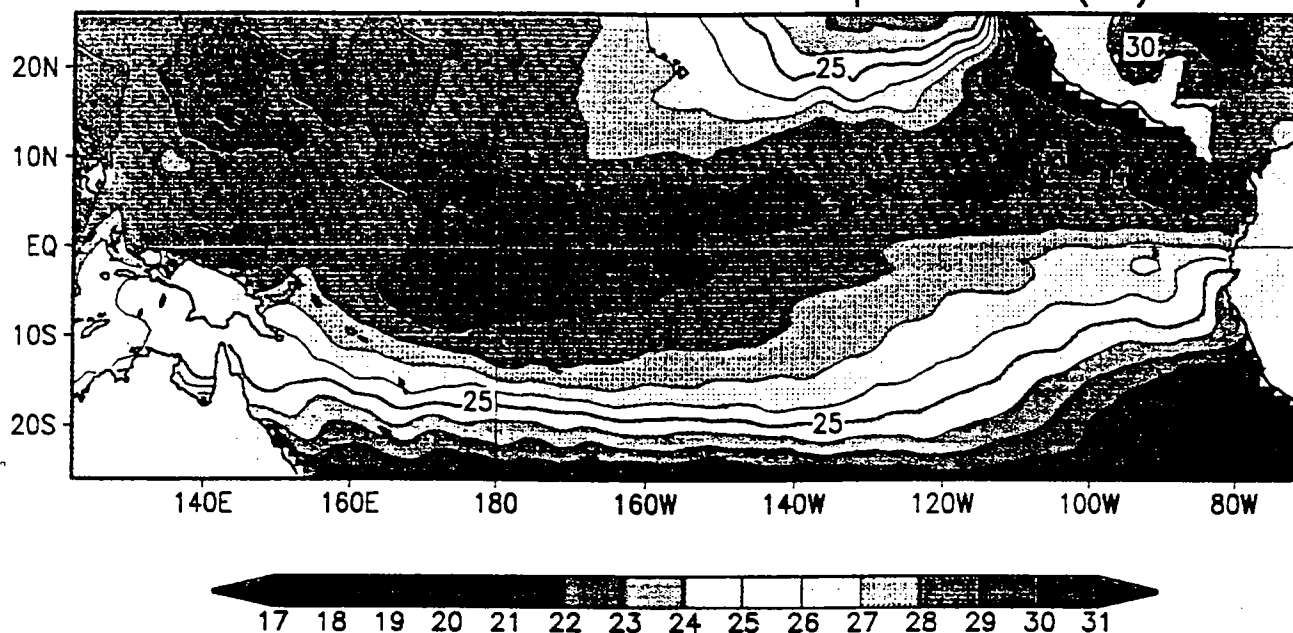
FIG. . Annual trends of (a) 700-mb temperature ($0.1^{\circ}\text{C decade}^{-1}$) and (b) 700-mb dewpoint ($0.1^{\circ}\text{C decade}^{-1}$). Trends outlined with a black square exceed the 95% confidence level.

Frequency of Intense Winter Storms

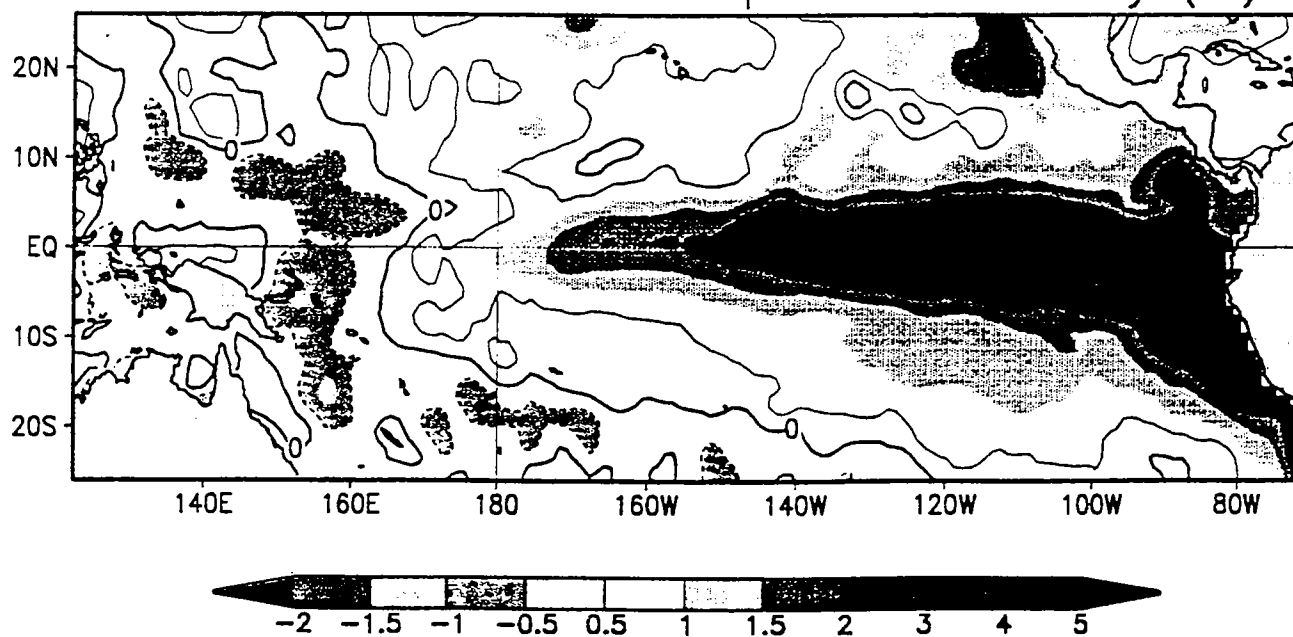
Northern Hemisphere



Observed Sea Surface Temperature (°C)

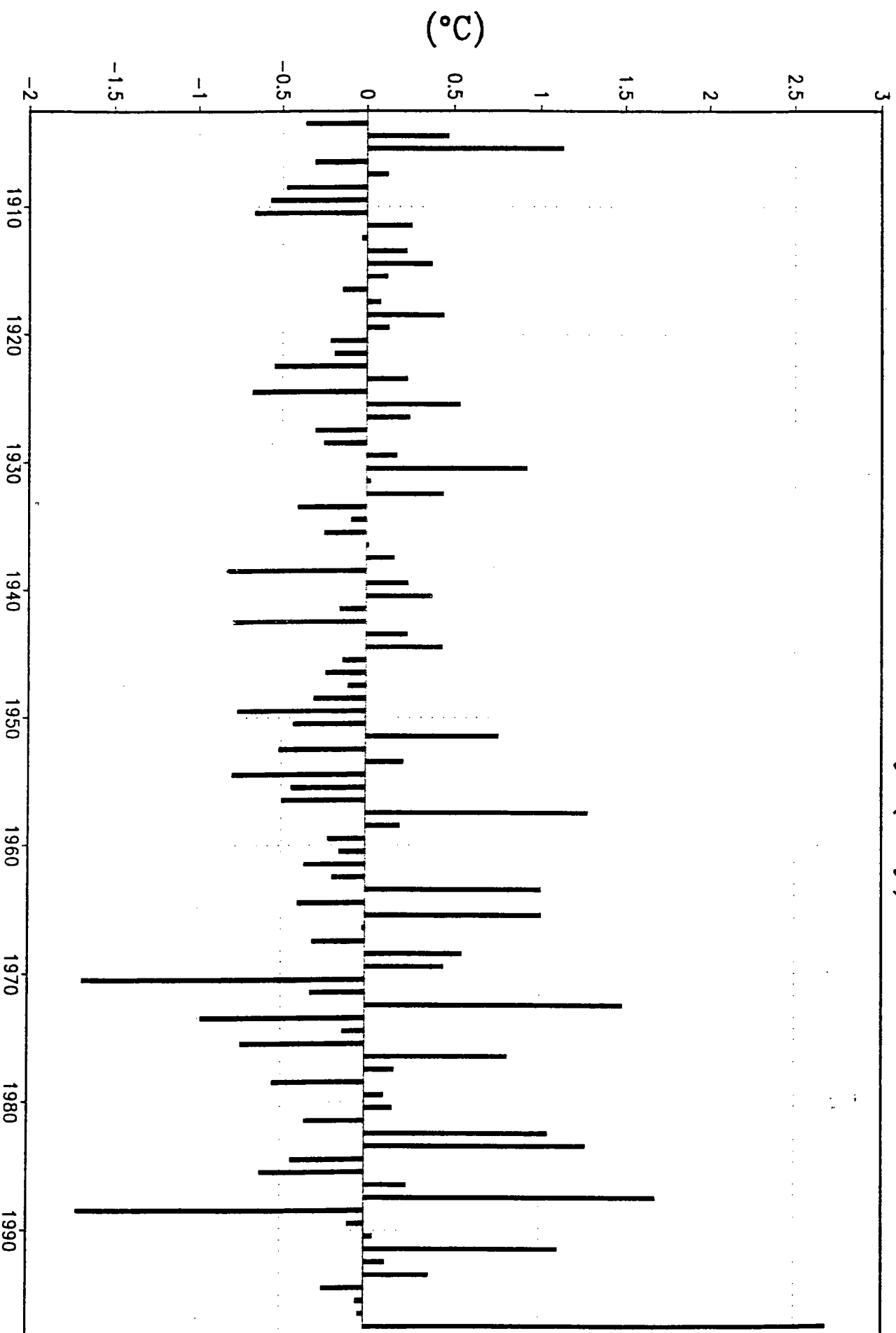


Observed Sea Surface Temperature Anomaly (°C)



7-day Average Centered on 13 August 1997

Equatorial Pacific (NINO3: 5°N–5°S, 150°W–90°W)
SST Anomaly (July)



GISST2.2 (1903–81), OISST (1982–97) using GISST2.2 1951–80 as an

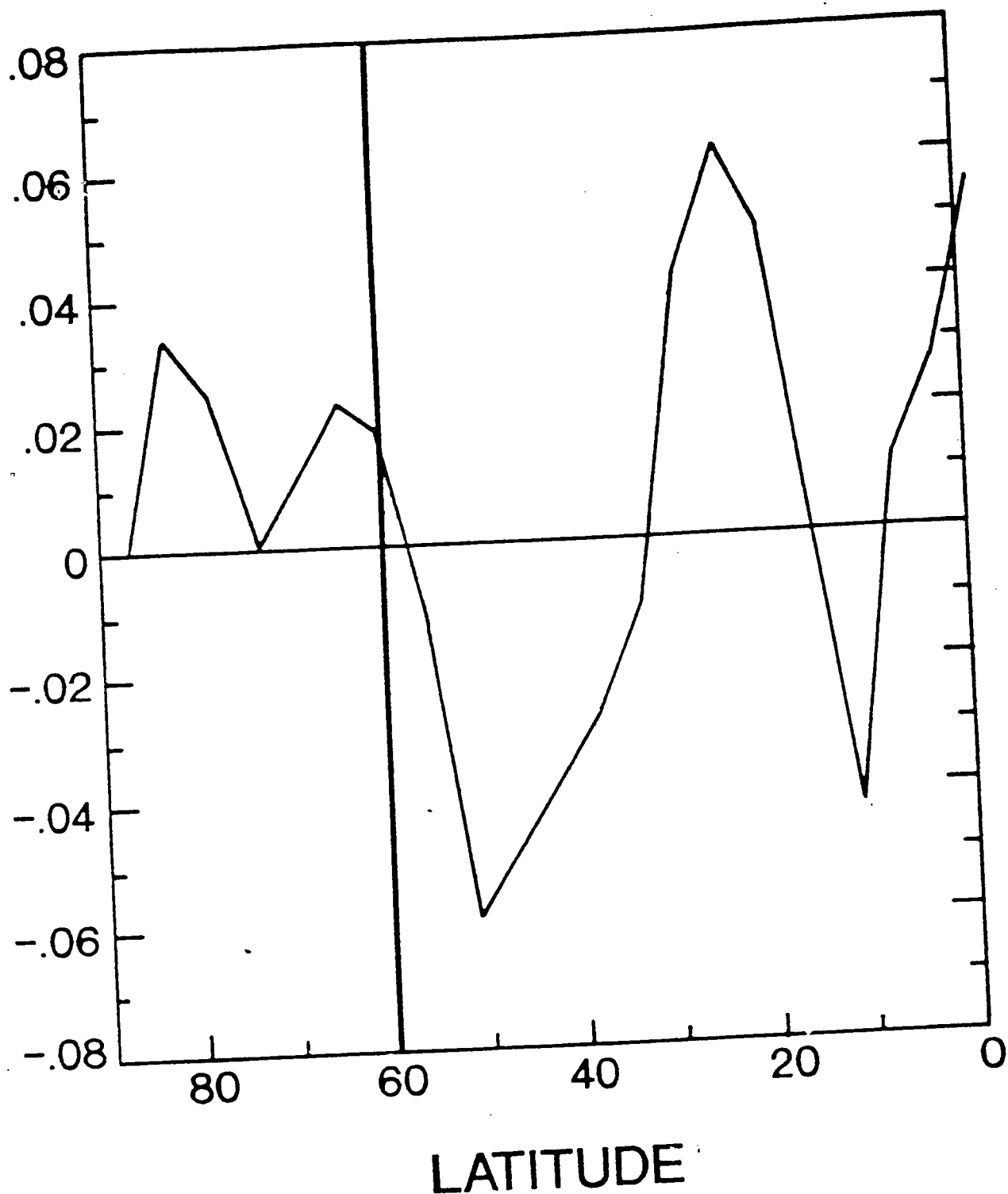
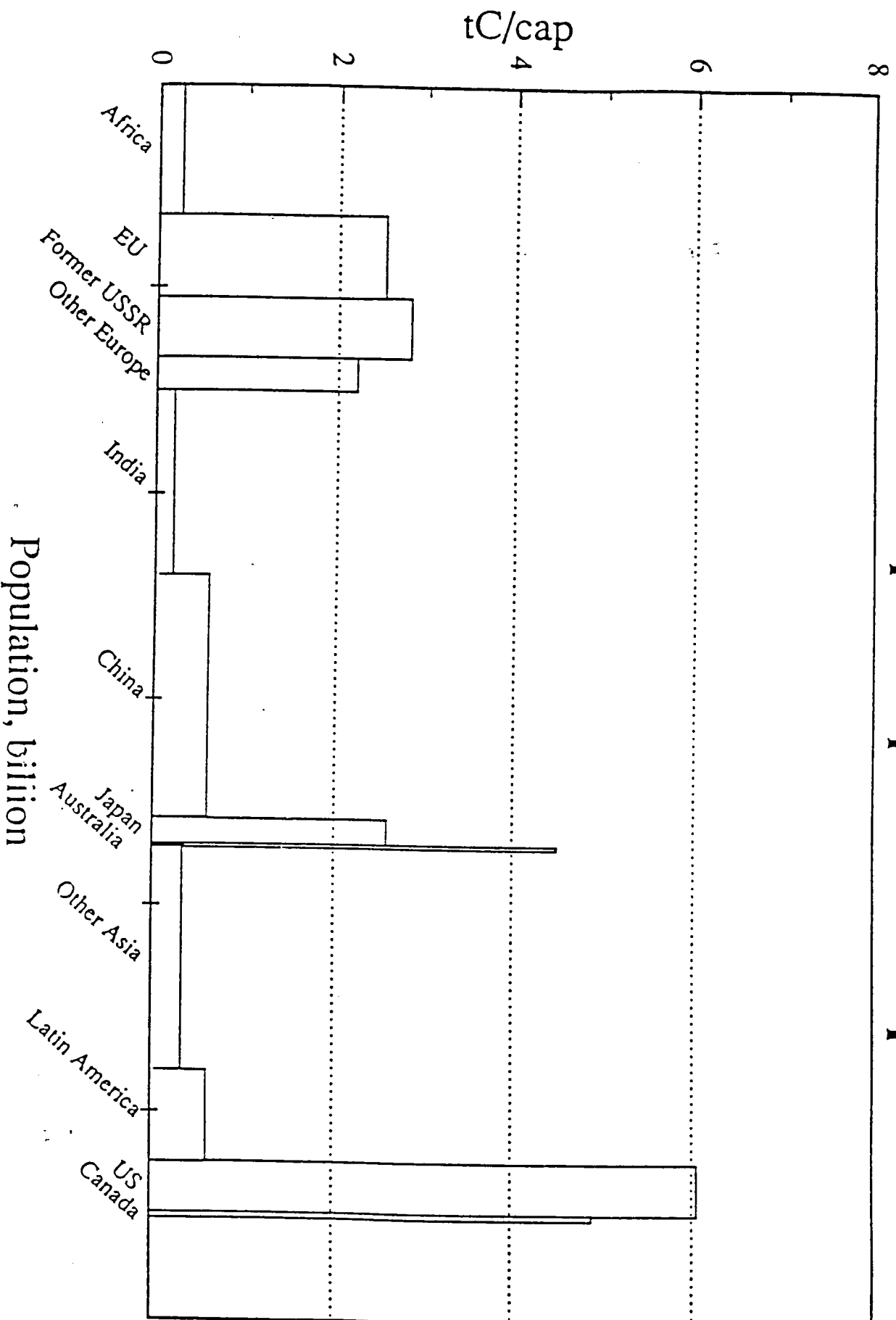


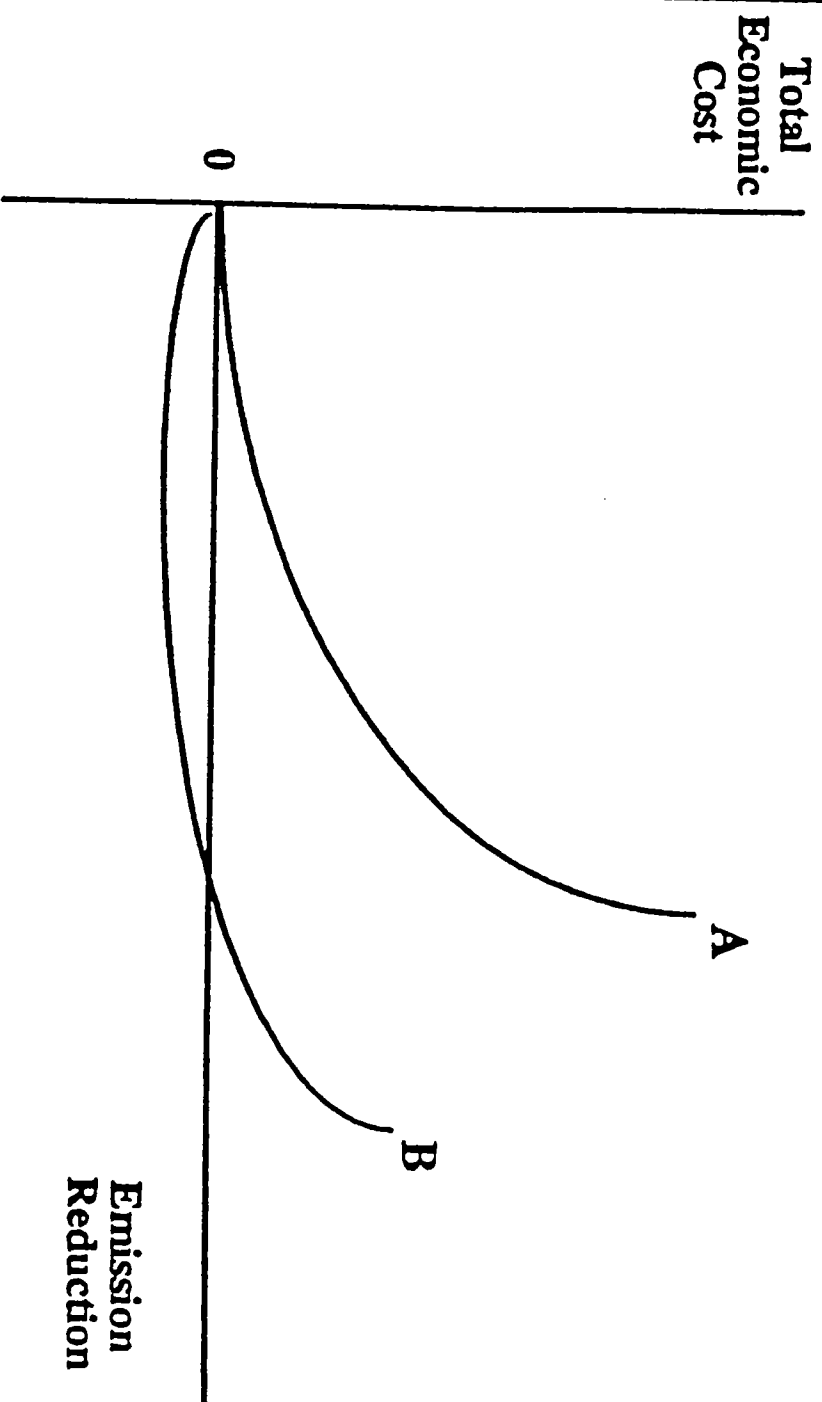
FIG. 7. Latitudinal distribution of zonal mean difference of precipitation minus evaporation ($P-E$) rate, over the continent, between the $4\times$ and $1\times$ integrations of the PW experiment averaged over the months of June to August. Units are in cm day^{-1} .

Carbon Emissions per Capita and Population



Source: M. Grubb, *Energy Policies and the Greenhouse Effect*, Vol. I: Policy Appraisal, 1990; updated for IPCC by the author using energy data from BP Statistical Review of World Energy, 1994.

Figure 8.3
Alternative Views on
Cost of Emissions Reductions



Key:

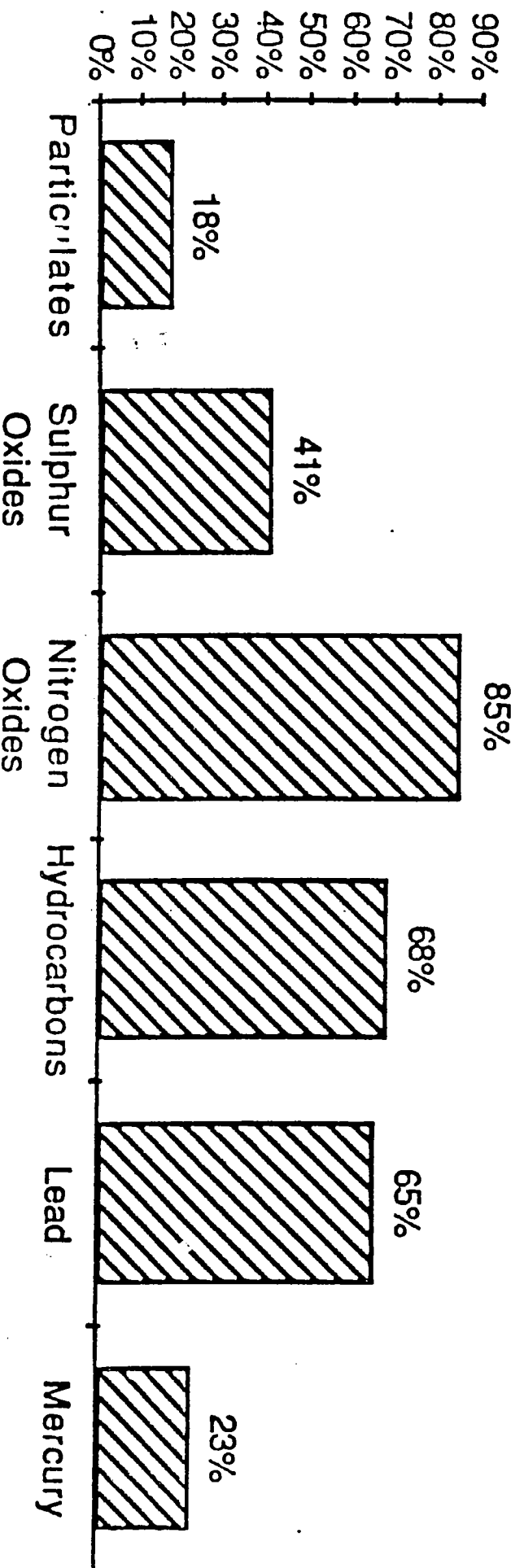
A - no market imperfections, no economic double dividend

B - negative cost potential plus economic double dividend

Note: A & B do not include environmental double dividend

FIGURE 1

**Contaminants from Energy Production
and Consumption in Canada
(as percentage of total pollution)**



Source: Energy, Mines and Resources Canada (1989)

Summary of Mitigation Cost Literature

Substantial “no regrets” opportunities are available in most countries

— 10% to 30% of current emissions over 1 to 3 decades

Stabilizing global emissions at 1990 levels for the next several decades could cost 0.5% to 2.5% of GDP

Stabilizing atmospheric concentrations at levels above 400 ppmv of CO₂ could cost approximately the same

ECONOMISTS' STATEMENT ON CLIMATE CHANGE

As economists, we believe that global climate change carries with it significant environmental, economic, social, and geopolitical risks, and that preventive steps are justified.

Economic studies have found that there are many potential policies to reduce greenhouse gas emissions for which the total benefits outweigh the total costs.

PARTIAL PORTFOLIO OF
MEASURES - FEDERAL
FOR
GREENHOUSE GAS EMISSION REDUCTIONS

1. FOR NEW VEHICLES, INCREASED FUEL EFFICIENCY AND INNOVATIVE TECHNOLOGIES (HYBRID, FUEL CELLS), THROUGH NATIONAL STANDARDS OR AGREEMENTS WITH MANUFACTURERS.
2. STABILIZATION OR REDUCTION TARGETS FOR INDUSTRIES, TO STRENGTHEN "VOLUNTARY" PROGRAMS. BEGIN EMISSION PERMIT TRADING TO MINIMIZE COSTS AND PUBLICIZE RESULTS.
3. DEVELOP A STRATEGY, WITH THE PROVINCES, TO MOVE FROM: COAL AND OIL FOR ELECTRICITY PRODUCTION TO: HYDRO, NATURAL GAS, COGENERATION OPTIONS, AND/OR NUCLEAR.

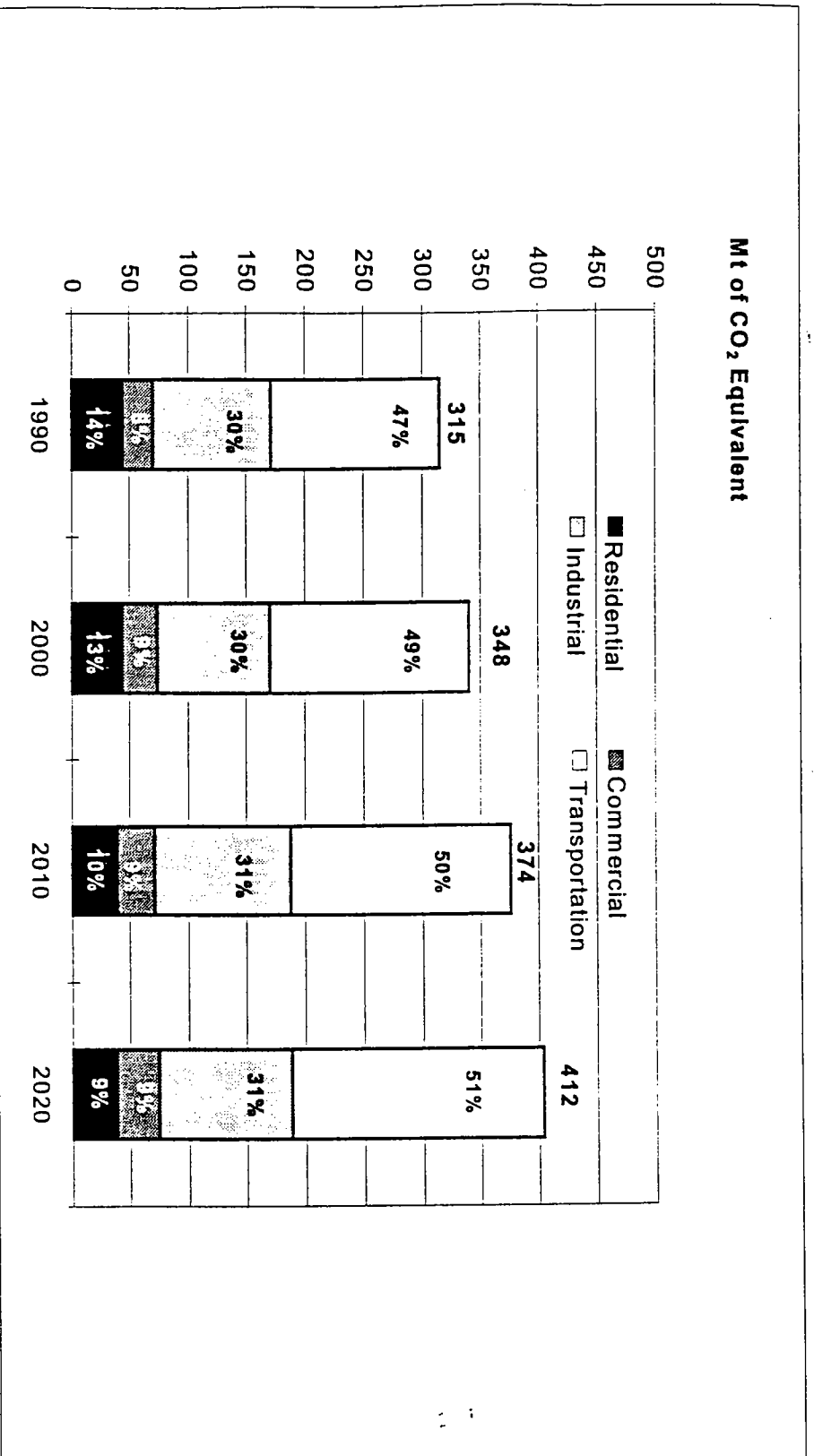
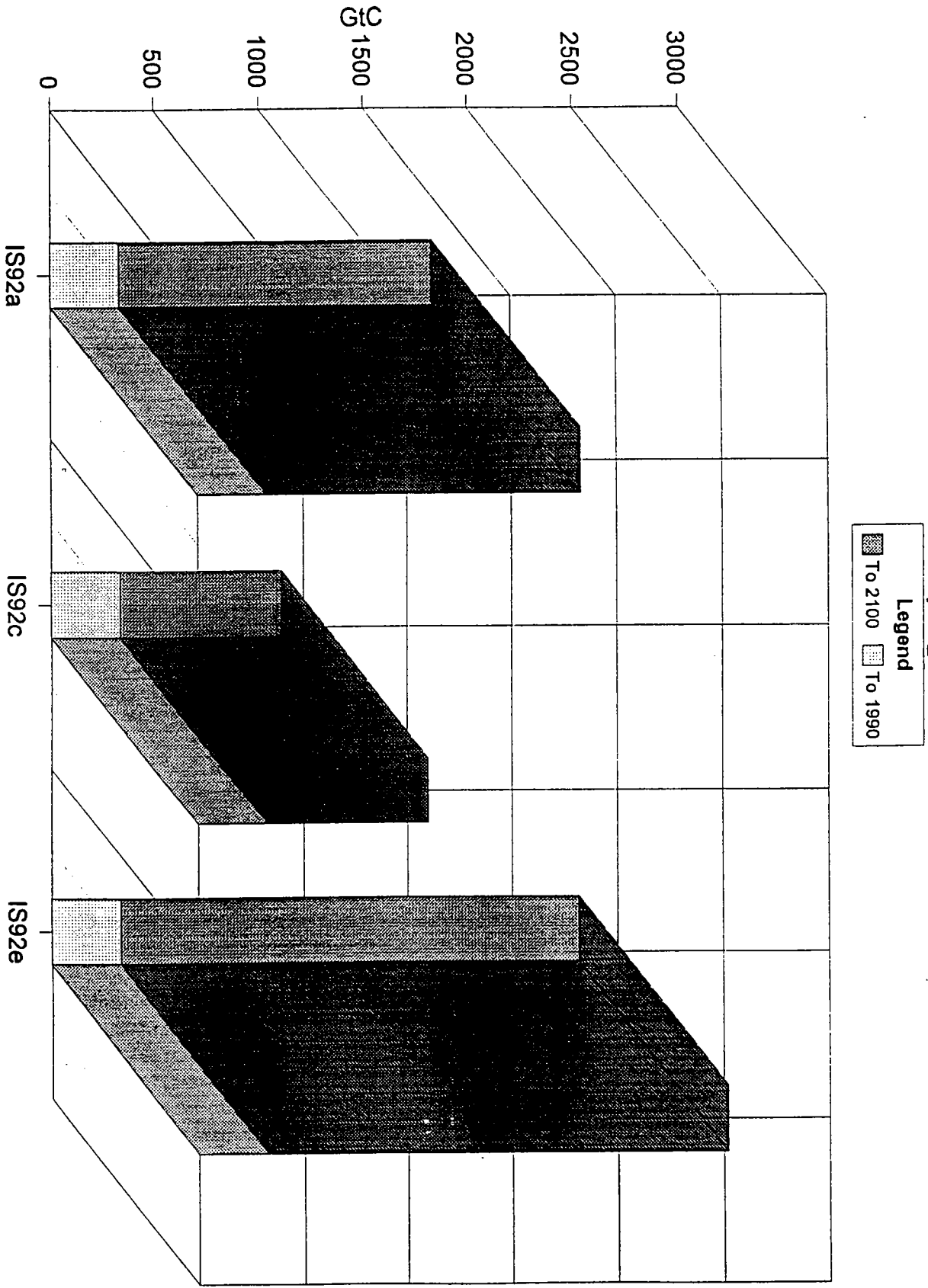


FIGURE 4.1 GREENHOUSE GAS END-USE EMISSIONS, 1990-2020

Total CO2 Emissions from Anthropogenic Sources



**TOGETHER WE CAN CONTROL
EMISSIONS AND HELP CLEAR THE AIR.
WITHOUT SLOWING THE ECONOMY.
IT TAKES IMAGINATION AND
DETERMINATION. HERE IN CANADA,
WE'VE GOT A LOT OF BOTH.**

BETTER GLOBAL RULES



SOLID LOCAL ACTION



Canadian Association of Petroleum Producers

IPCC - 1995: MAJOR INSIGHTS

- 1. HUMAN IMPACTS ON CLIMATE NOW DISCERNIBLE.**
- 2. WITHOUT MAJOR INTERVENTION, WORLD WILL BE WARMING IN NEXT CENTURY AT A GREATER RATE THAN AT ANY TIME IN PAST 10,000 YEARS.**
- 3. MAJOR IMPACTS WOULD BE ON:**
 - 3.1 NATURAL ECOSYSTEMS: BOREAL FORESTS, CORAL REEFS.**
 - 3.2 HUMAN HEALTH: HEAT STRESS, SPREAD OF TROPICAL DISEASES.**
 - 3.3 SEA LEVEL RISE: FOR 1/2 METRE RISE AN INCREASE FROM 46 TO 92 MILLION PEOPLE SUBJECT TO INUNDATION.**
 - 3.4 PROBABLY MORE SEVERE NATURAL DISASTERS.**

IPCC - 1995: MAJOR INSIGHTS

- 4. INEQUALITY BETWEEN COUNTRIES IN CAUSES OF PROBLEM AND IMPACTS.**
- 5. MEASURES FOR WHICH FUEL SAVINGS, AND NON-CLIMATE ENVIRONMENT BENEFITS EXCEED COSTS ARE CALLED “NO REGRETS” MEASURES OR WORTH DOING ANYWAY.**
- 6. ACTIONS ARE ECONOMICALLY JUSTIFIED BEYOND “NO REGRETS” TO:**
 - AVERT NET DAMAGE**
 - AVOID CLIMATE SURPRISES (RISK AVERSION INSURANCE)**
- 7. ADOPT A PORTFOLIO APPROACH**
- 8. WITHOUT VIGOROUS ACTION HUGE INCREASES IN CUMULATIVE CO₂ EMISSIONS NEXT CENTURY - AND MAJOR CLIMATIC IMPACTS WITH “SURPRISES” INCREASINGLY LIKELY.**

Calgary - Alberta

Wednesday, November 5th, 1997

Understanding Climate Change Impact & Adaptation on Human Health

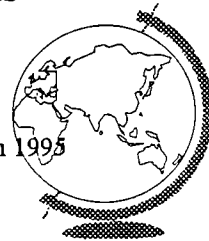
Sheldon H. Roth
Director, Environmental Research Centre
Professor, Faculty of Medicine
University of Calgary



Impact of Global Change on Human Health

- ♦ global warming
- ♦ ozone (stratospheric) depletion & ultraviolet irradiation
- ♦ environmental pollutants
- ♦ population pressures and movements

Health Issues Panel
Canadian Global Change Program 1995



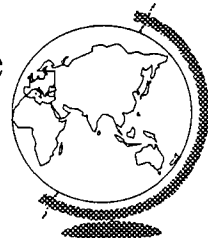
The Greenhouse Effect

- ♦ natural process
- ♦ prevents escape of radiant heat into space
- ♦ stabilizes earth's temperature
- ♦ maintains ideal temperatures to sustain life



Global Warming

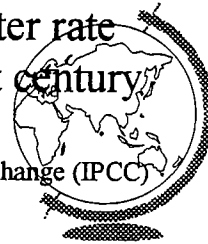
- ♦ anthropogenic greenhouse gas emissions alter earth's climate
- ♦ CO₂ major contributor (~50%)
- ♦ exponential increase in CO₂ concentrations (highest in 160,000 years)
- ♦ large contribution by methane (more effective than CO₂)



Global Warming

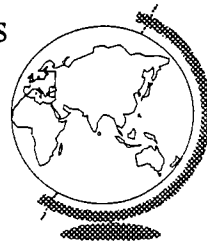
- ♦ earth's average surface temperature increased by $0.3 - 0.6^{\circ}\text{C}$ over last century
- ♦ average global temperatures projected to rise by $2.0 - 2.5^{\circ}\text{C}$ (range $1.5 - 4.0^{\circ}\text{C}$) in next 50 years
- ♦ temperature rise represents 5 X faster rate of warming than observed over past century

UN Intergovernmental Panel on Climate Change (IPCC)



Global Warming - Climate Change

- ♦ due to enhancement of greenhouse effect
- ♦ produces complex trends in weather
- ♦ more frequent extremes in weather conditions
- ♦ less increase in average temperature at equator & high altitudes
- ♦ rapid change disrupts intricate systems (agriculture, trade, communication)



Global Warming

- ◆ affects all aspects of human life (health)
- ◆ local, regional & global ecosystems
- ◆ agriculture and forests
- ◆ food & water supplies
- ◆ sea level, ocean currents, fisheries
- ◆ weather, heat effects
- ◆ infectious diseases
- ◆ industry & transport
- ◆ population migration
- ◆ urban planning & demographics



Climate Change and Human Health

HEALTH

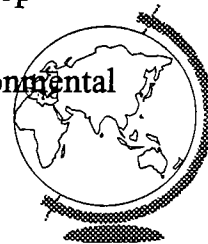
“the extent to which an individual or group is able to realize aspirations and satisfy needs and to change or cope with the environment”.

WHO, 1984



Climate Change and Human Health

- direct effects:
 - death due to increases in the frequency and intensity of heat waves
- indirect effects:
 - changes in vector-borne diseases or crop production
 - social and economic impacts of environmental refugees
 - conflict over fresh water supplies



Infectious Diseases

- ◆ increase in geographic distribution of disease vectors (e.g. malaria, dengue fever, yellow fever, encephalitides, schistosomiasis, diphtheria, TB)
- ◆ changes in life-cycle, dynamics of vectors & pathogens
- ◆ increase transmission of vector borne disease
- ◆ greater abundance of insect vectors of disease
- ◆ emerging / re-emerging of infectious diseases
- ◆ elimination of some vectors and/or pathogens



Heat Effects

- ♦ increased illness & mortality
- ♦ exacerbation of existing medical problems in the old, young and chronically ill
- ♦ gradual adaptation
- ♦ elevated perinatal death & pre-term birth
- ♦ violent & antisocial behaviour
- ♦ increased air conditioning produces greater emissions



Agriculture

- ♦ altered patterns of food production
- ♦ regional impacts
- ♦ severe shortages of food supplies
- ♦ decline in soil moisture
- ♦ loss of topsoil
- ♦ uncertain crop yields
- ♦ altered pest distribution
- ♦ plant migration - increase allergens - asthma



Future Research

- ◆ develop research models related to global change
- ◆ foster communication
- ◆ establish surveillance systems
- ◆ encourage multidisciplinary studies
- ◆ assess effects of industrial/agricultural pollution on susceptible groups
- ◆ study changes in global environment
- ◆ evaluate human behavior to global change
- ◆ address issues of public health policy and action

Some of the Recommendations of the Health Issues Panel of the Canadian
Global Change Program 1995



Economic Considerations

Economic Efficiency

Domestic and International Offsets

Capital Stock Turnover

Model Results

Impact of Assumptions

Greenhouse Gas Offsets

- ◆ Actions or projects that reduce, avoid or absorb greenhouse gases
- ◆ Technical or biological
- ◆ Implemented independent from source of emissions

Types of Carbon Offsets

AVOIDANCE

(Eliminate or reduce GHG emission)

TECHNICAL

CO₂

- *Energy Conservation*
- *Eff-Improvement*
- Combined Cycle
- *Renewable Energy (Wind-Hydro)*
- Fuel Switching Coal - Oil - Gas
- *Co Generation*
- Recovery from stacks for storage
- Recovery from vents for storage

CH₄

- Recovery from oil and gas operations
- Recovery from landfills
- Coal Bed Methane

N₂O

- Fertilizer process vent treatment

ABSORPTION

(Recover GHG from the atmosphere and sequester)

BIOLOGICAL

CO₂

- Renewable Fuels Biomass (Transportation)
- *Renewable Fuels - Biomass (Stationary)*

CH₄

- *Cattle Feed*
- *Composting to avoid production of CH₄ - diversion from landfills*

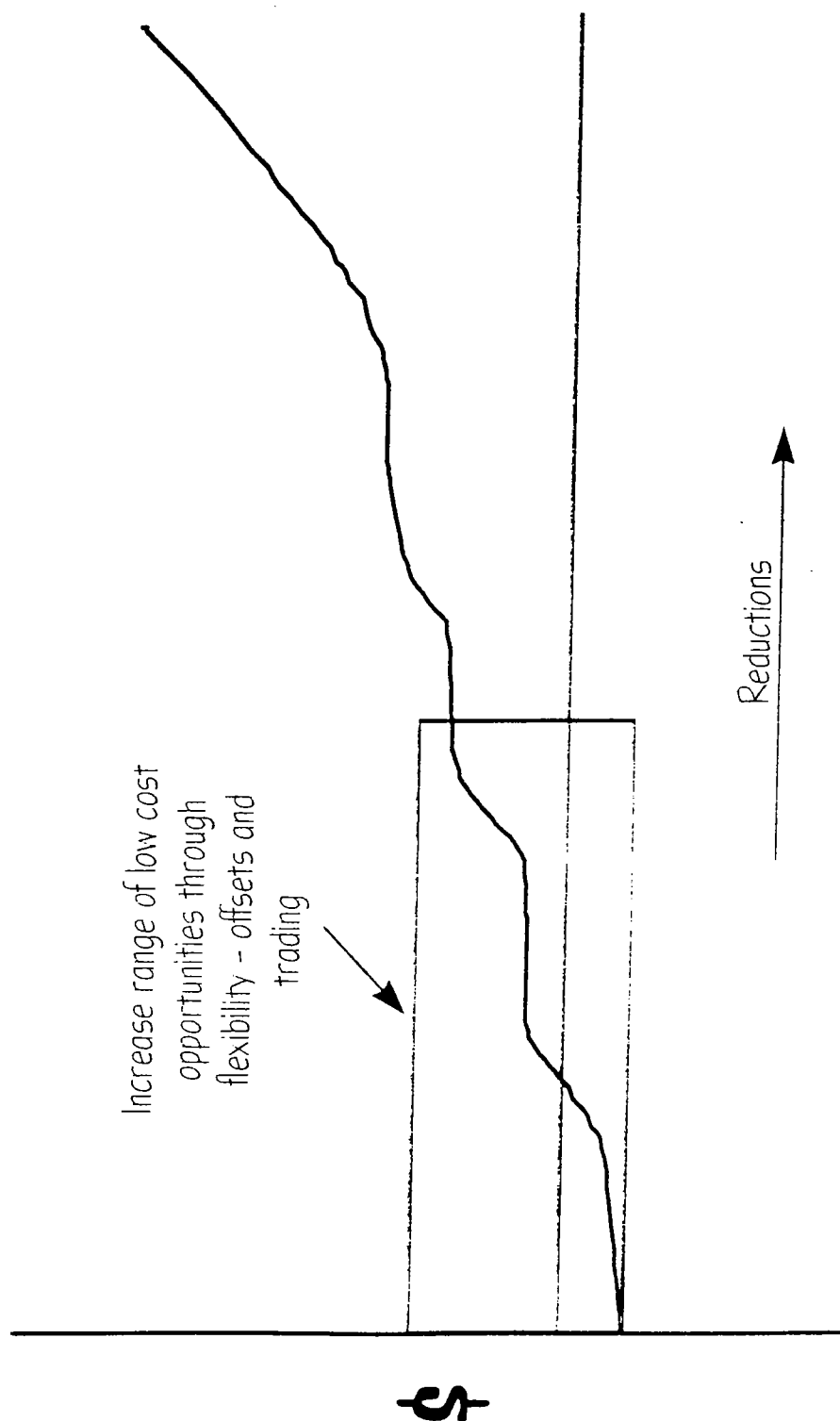
N₂O

- Type and method of fertilizer used

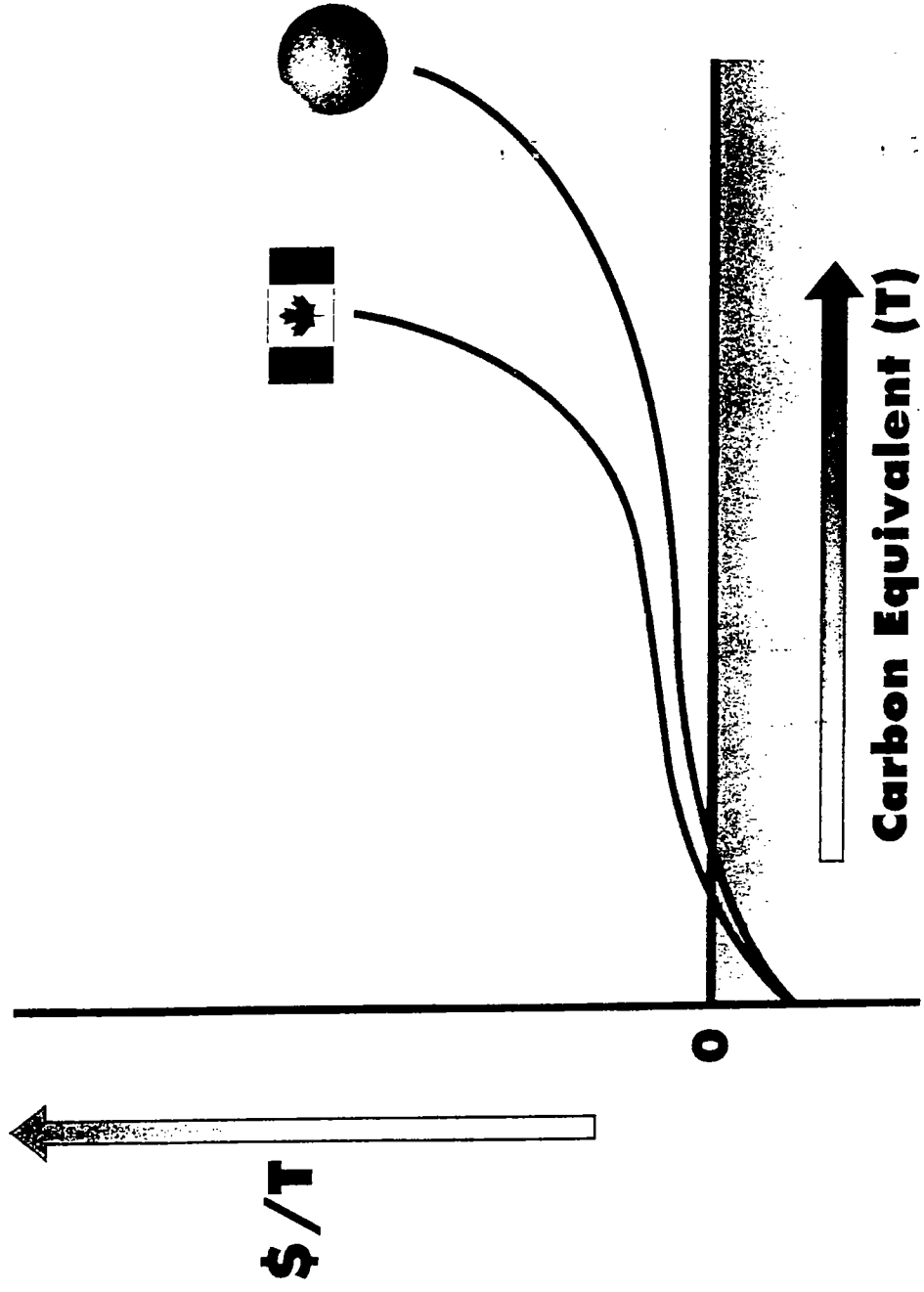
CO₂

- *Sustainable Forestry*
- *Sustainable Agriculture*
- *Conservation or restoration of natural areas*

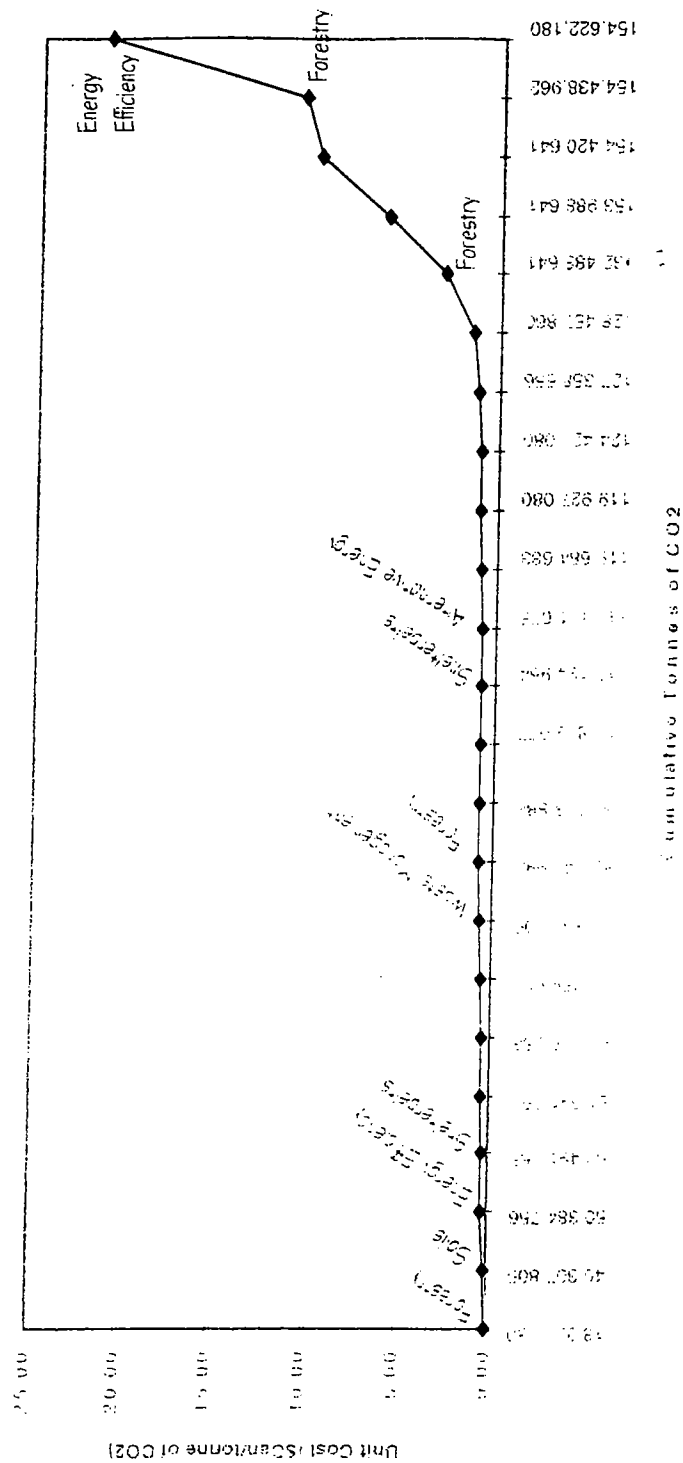
Typical Cost Curve



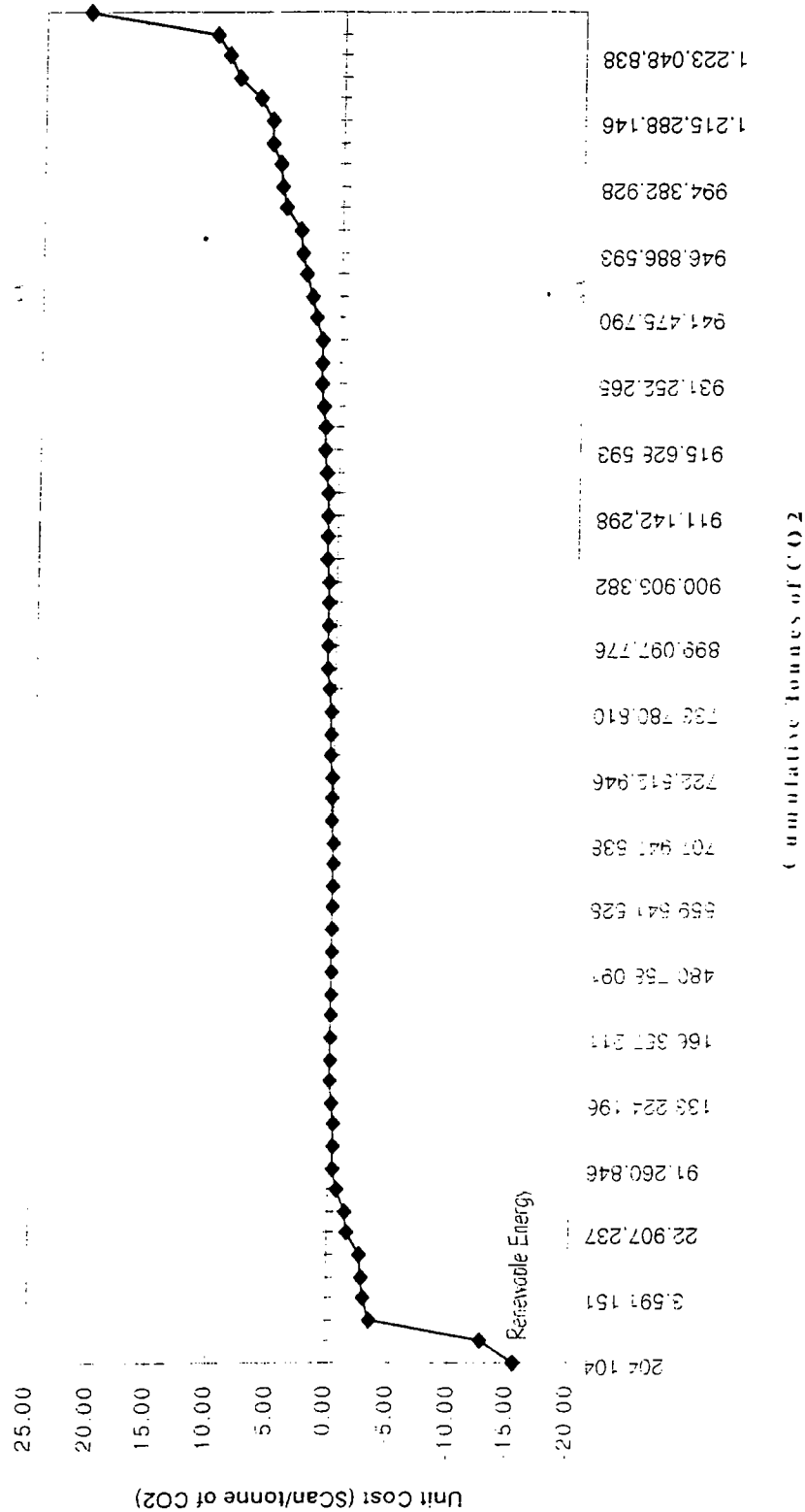
Cost Curves



Domestic Offset Cost Curve



Domestic & International Offset Cost Curve



Assumptions:

1. No weighting for risk;
2. Streams of carbon and cash undiscounted.

Data sources:

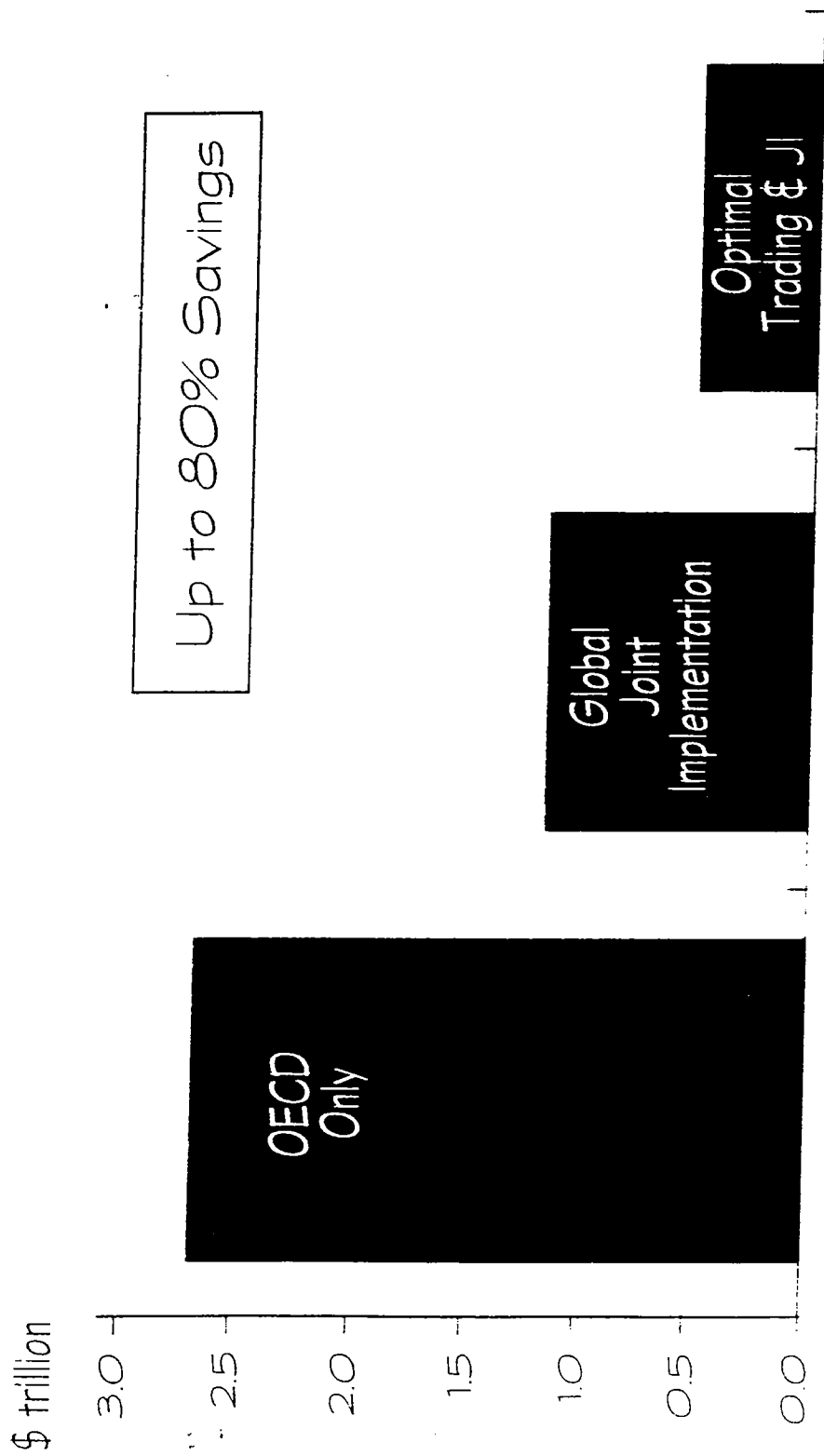
1. WBCSD;
2. Trexler and Associates;
3. USJI;
4. TransAlta RFP, NOVA, and AES.

Offsets - Benefits

- ◆ cost-effective
- ◆ scientifically sound approach
- ◆ local economic, social and community development
- ◆ other environmental benefits
- ◆ private/public/stakeholder partnerships
- ◆ encourage creativity and innovation
- ◆ economic and environmental win-win solutions
- ◆ domestic and international (J.I. Actions)

--- Very Important for Canada ---

Flexibility = Savings



World Compliance Costs

Capital Stock Turnover

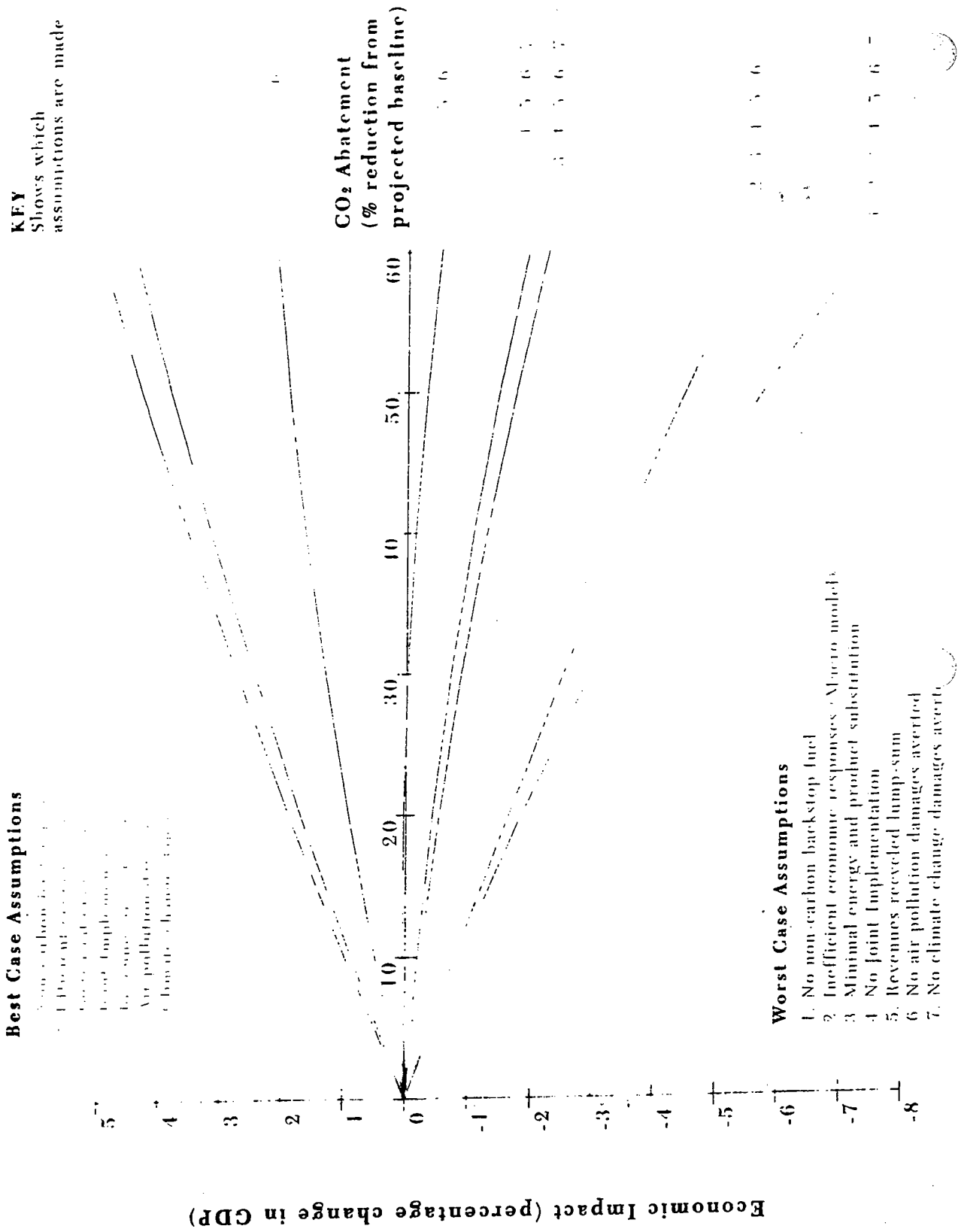
- ◆ Capital investment in replacement equipment
- ◆ Normal investment cycle
- ◆ Drivers (examples)
 - age of plant
 - obsolete technology
 - changing demand
 - changing conditions

Economic Models

- ◆ Basis for different results
- ◆ WRI study "A Guide for the Perplexed"
- ◆ Doesn't show regional or sectoral impacts
- ◆ Economic impacts will vary much as climate impacts are predicted to vary

FIG. 2

PREDICTED IMPACTS ON GDP OF VARIOUS CO₂ ABATEMENT TARGETS IN 2020
THE EFFECTS OF CHANGING KEY ASSUMPTIONS ONE-BY-ONE



Federal Government Perspectives – The Road to Kyoto



Climate Change: Cross-Canada Briefings

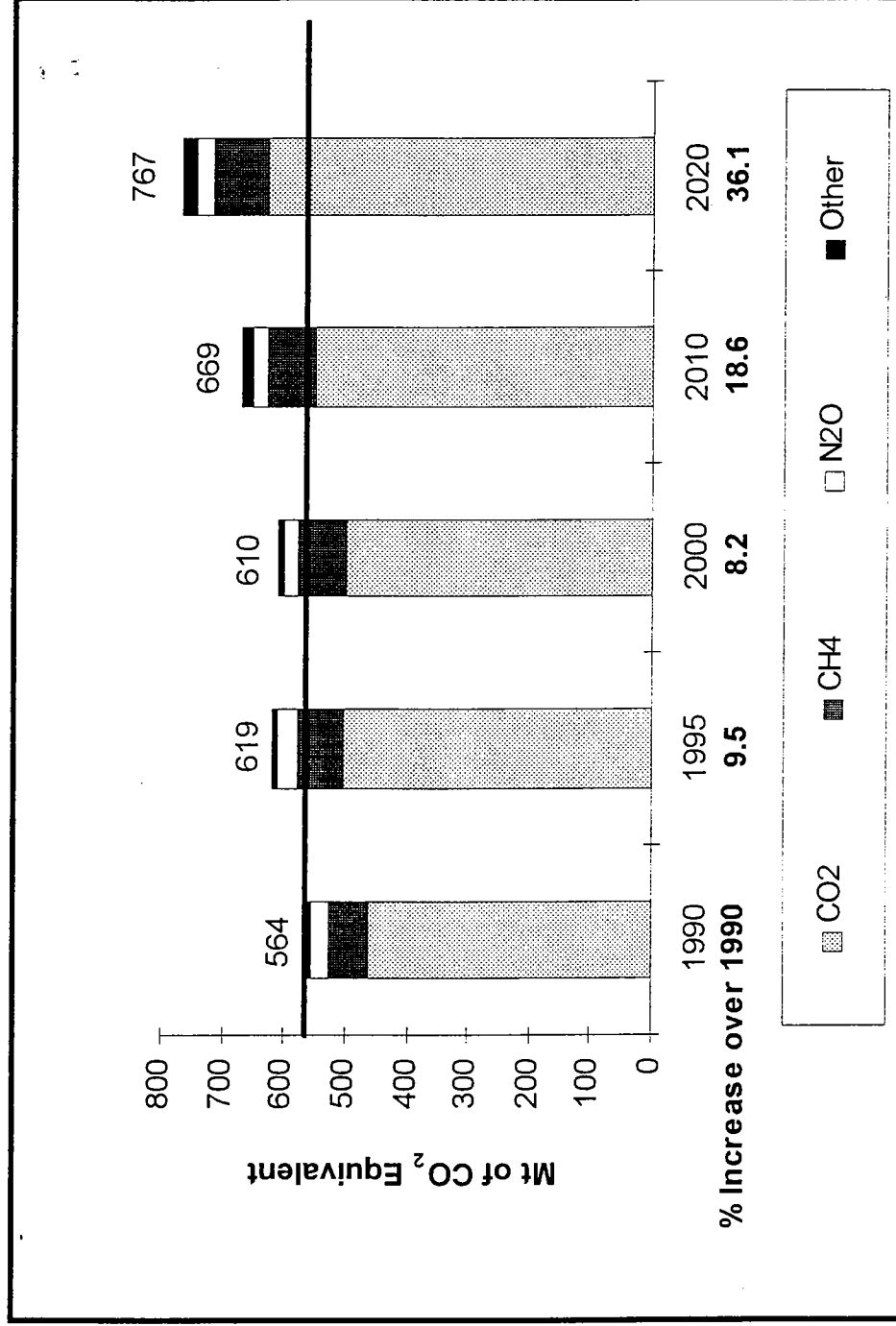
Environmental Considerations

- **International consensus on the science**
 - discernible human influence
- **Greenhouse gases increasing**
 - burning fossil fuels linked to economic growth
- **Unprecedented global climate change projected**
 - environmental, geopolitical and economic implications
 - northern latitude countries most sensitive
- **Impacts on Canada predicted to be large**
 - severe weather, human health, environment, natural resource base

History

- **1992 Framework Convention - Rio**
 - Ultimate objective – prevent dangerous anthropogenic interference with the climate system
 - Initial commitment – developed countries aim to return emissions to 1990 levels by 2000
- **1995 Conference of Parties - Berlin**
 - Current commitments insufficient to meet objective
 - Agreement to conclude new obligations for post 2000 by December 1997 (Berlin Mandate)

Domestic Context - Emissions



Source: NRCan

Economic Studies - Findings

- **Impact on 2010 GDP is likely to be in the range of +0.2% to -2.5%**
 - **GDP is expected to grow between 40% to 45% (1995 to 2010) under the business as usual case**
- **Economic impact on Canada is in the same range as in US, but greater than those on the EU**
- **Policy choices make a difference**
- **Economic studies do not include the cost of inaction or multiple benefits (toxins, acidic and smog emissions)**

Implications for Canada

- Significant economic implications
 - Must make major changes in the ways we produce and use energy and transport people and goods
 - Over 40% of the economic impacts will come from the actions our trading partners take to reduce their emissions
- Some Opportunities to develop and market new technologies and know-how

Why are projected emissions increasing?

- **There are four main reasons why emissions are expected to rise:**
 - **the strong linkage between economic (GNP) growth and emissions growth**
 - **increasing population**
 - **low and stable energy prices**
 - **increasing carbon intensity of the energy mix in electrical generation**

At Kyoto

(December 1 – 10, 1997)

- **New meaningful, realistic and equitable legally binding targets**
- **Practical, step-by-step approach**

Key Issues at Kyoto

- **Targets and Time Tables**
- **Flexibility Elements**
 - **Differentiation**
 - **Emissions Trading**
 - **Joint Implementation (JI)**
- **Policies and Measures**
- **Greenhouse Gas Coverage**
- **Developing Countries' Participation**

Process for the Ratification of an International Agreement

- 1. Adoption of the Kyoto Agreement by
the Parties to the FCCC.**
- 2. Signature of the Agreement by
Canada**
- 3. Ratification of the Agreement by
Canada**
- 4. Entry into Force internationally**

Process for the Ratification of an International Agreement (Cont'd)

1. Adoption

- At the third CoP to FCCC this December, Canada and other Parties will indicate if they support adopting the final text**

2. Signature with a view to ratification

- After the Kyoto meeting, there will be federal / provincial / territorial discussion of the outcome through the National Air Issues Coordinating Mechanism (NAICM).**
- Cabinet will then decide if they wish to sign.**

Process for the Ratification of an International Agreement (Cont'd)

3. Ratification

- A national implementation plan needs to be developed in conjunction with the provinces and territories prior to the ratification of the Kyoto agreement.
- Full federal / provincial / territorial collaboration will be pursued too identify appropriate policies and measures by all orders of government.
- The federal government would not ratify an agreement without broad-based support

4. Entry into Force (under negotiation)

- Kyoto agreement would enter into force once a prescribed number of Parties (likely 50) have ratified which constitute a stated amount of global emissions.

National Framework for Collaboration

- **The provinces and territories are key partners in the development and implementation of a national implementation plan.**

Key Considerations – Implementation Principles

- NAPCC described a set of principles to guide domestic implementation of a climate change action plan in Canada.
- The evolution of these principles have been the subject of extensive federal / provincial / territorial discussion.

The principles are:

- Precautionary Principle
- International Cooperation
- Shared Responsibility
- Equitable Burden Sharing
- Competitiveness
- Effectiveness
- Flexibility
- Emitter Responsibility
- Transparency and
- Accountability

Key Considerations Implementation Principles (Cont'd)

- **No single jurisdiction or government has full responsibility for efforts to reduce emissions; responsibilities of and actions by all our governments will be required.**
- **Provincial and territorial jurisdiction (e.g. electricity generation, urban transportation and infrastructure) and constitutional responsibilities will be respected.**
- **Canada's national economic and environmental interests and well as differing regional and sectoral circumstances and opportunities will be taken into consideration**
- **The national approach will recognize provincial actions and decisions and should be reflected in the implementation plan.**

Implementation Plan

Implementation should:

- **build on existing initiatives such as the VCR**
- **use a phased approach for new measures**
- **consider the actions of our trade partners and market opportunities that exist**
- **recognize the need for sequencing decisions to maintain flexibility, and to take advantage of new information on effectiveness and costs**
- **use existing and new consultative/discussion mechanisms as appropriate**

Stakeholder Involvement

- **Stakeholders, municipal levels of government, First Nations, industry, ENGOs and others will have an important role in the development of Canada's implementation plan.**
- **Either through new fora (yet to be identified), or existing mechanisms, opportunities will be identified to consult with stakeholders on an implementation strategy**

A Provincial Perspective on Climate Change

Brent Lakeman
Environmental Affairs Branch
Planning and Development Division
Alberta Department of Energy

A Provincial Perspective on Climate Change

Outline of Presentation

- **Alberta Role**
- **Challenge of Berlin Mandate**
- **Responding to the Challenge**
- **A Suggested Approach**
- **Conclusions**

Alberta Department of Energy

Alberta Role

Current Focus of Canadian Governments

- **Jobs and economy**
- **Getting government house in order**
- **Making governments more effective**
- **Avoid commercial undertakings**
- **Accountability**
- **People, prosperity, preservation**
- **Cooperative, effective, flexible federalism**

Alberta Department of Energy

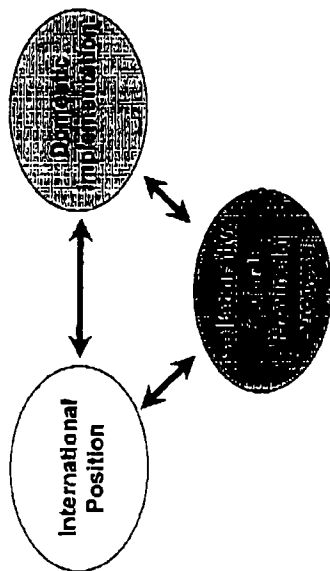
Alberta Role

Cooperative, Flexible Federalism

- **Environment is shared jurisdiction**
- **Provincial jurisdiction over management of renewable and non-renewable natural resources**
- **Commitment to demonstrating effectiveness of federalism**

Alberta Department of Energy

Canadian Climate Change Policy



Alberta Role

Laying the Groundwork for Action by Others

- Proponent of National Action Program and Voluntary Challenge and Registry
- Strong record of Alberta participation in Voluntary Challenge
- Alberta Government activities provide framework for action by others

Alberta Department of Energy

Alberta Role

- Partner in collaborative decision-making
 - ➔ Clean Air Strategic Alliance
 - ➔ National Air Issues Coordinating Mechanism
 - ➔ National Action Program on Climate Change
- Clear role in developing position, ratifying and implementing agreement

Alberta Department of Energy

Alberta Role

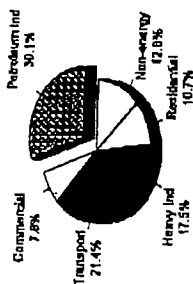
Alberta Climate Change Principles

- Shared Responsibility
- Maximum Flexibility
- Comprehensive Integrated Approach
- Equity
- Prosperity
- Precautionary Approach
- Global Perspective
- Partnership
- Sustainability

Developed by CASA and adopted by Government of Alberta in 1994

Alberta Department of Energy

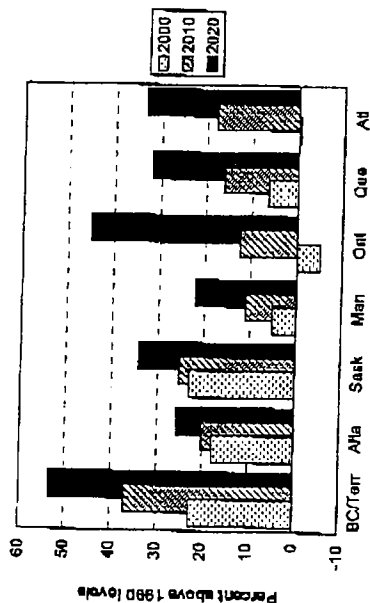
Growth in Canadian Emissions 1990-1995



- 72% increase in oil exports
- 94% increase in gas exports
- but for growth in exports, petroleum emissions would have been stable.
- Alberta emissions increased by 19% from 1990 levels

Alberta Department of Energy

Provincial Emissions Growth 1990-2020



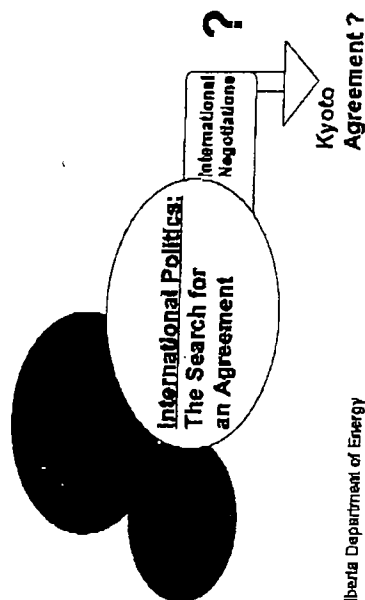
Alberta Role

Proponent of Voluntary Challenge and Registry Program

- Over 640 organizations participating
- Over 360 Action Plans
 - Over 100 from Alberta
- 48 new Progress Reports in 1997
 - 42 from Alberta organizations
- Independent office being established
- More rigorous reporting being encouraged

Alberta Department of Energy

Challenge of the Berlin Mandate Integration of Three Fields



Alberta Department of Energy

Challenge of Berlin Mandate

- Understanding economic implications of new commitments
- Justifying costs of action
- Recognition of national circumstances

Alberta Department of Energy

Challenge of Berlin Mandate

"The benefits of climate protection are very difficult to quantify ... if anybody tells you that he or she has the definitive answer to the costs and benefits of particular climate change policies, I would suggest that you raise your collective eyebrows"

Dr. Janet Yellen
Chair, President Clinton's Council of Economic Advisors

Alberta Department of Energy

Challenge of Berlin Mandate

Understanding the Benefits of Action
Few immediate benefits from action



Benefits require coherent global strategy



Coherent global strategy minimizes costs



Framework Convention advocates least cost-strategy (geographic and temporal flexibility)

Alberta Department of Energy

Challenge of Berlin Mandate

Understanding Risks and Costs of Protection

- "Negligible costs" -- assumptions about efficiency of economy
- Risks and costs vary across nations and regions
- Yardsticks for "realistic and achievable"
- Iterative process required

Alberta Department of Energy

Responding to the Challenge

Alberta's Approach

- "Realistic and achievable" commitments
- Account for national circumstances
- Protect Canada's national interests
- Managing uncertainty

Alberta Department of Energy

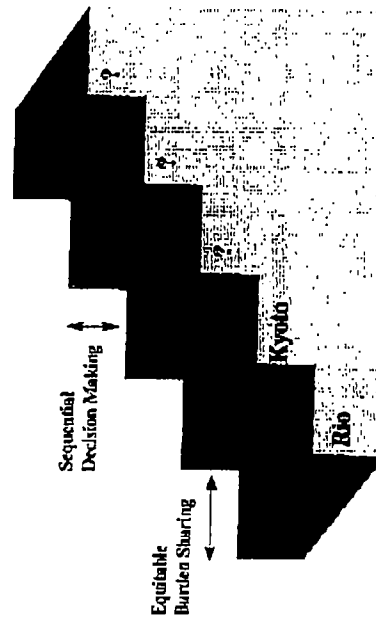
Responding to the Challenge

Managing Uncertainty

- Taking action in face of scientific, technological, demographic and economic uncertainties
- Need to know objective, timing, method of engaging all nations
- Design the "staircase" before the building the "step"

Alberta Department of Energy

Sequential Decision Making on Climate Change



A Suggested Approach

Building the "Steps"

- Key Principle: Equitable Burden Sharing
- Question: How much to invest in addressing risks of climate change?
 - ➔ Will others make similar investment?
 - ➔ Will we suffer competitive disadvantage?
 - ➔ What is the economic target?

Alberta Department of Energy

An Alberta Approach

- What is "realistic and achievable"?
 - Reflect national circumstances
 - Risk management approach
 - Equitable burden sharing
- Canada's diversity means provinces must be full partners

Alberta Department of Energy

BY GARY WESTER

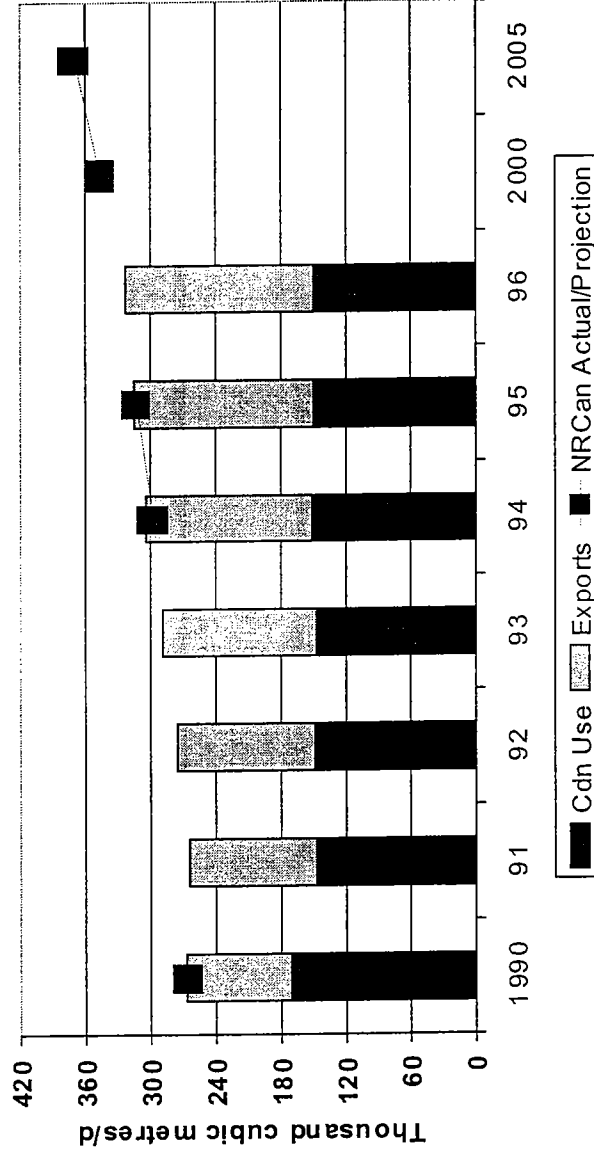
Canadian Global Change Program Presentation

November 5, 1997

CAPP

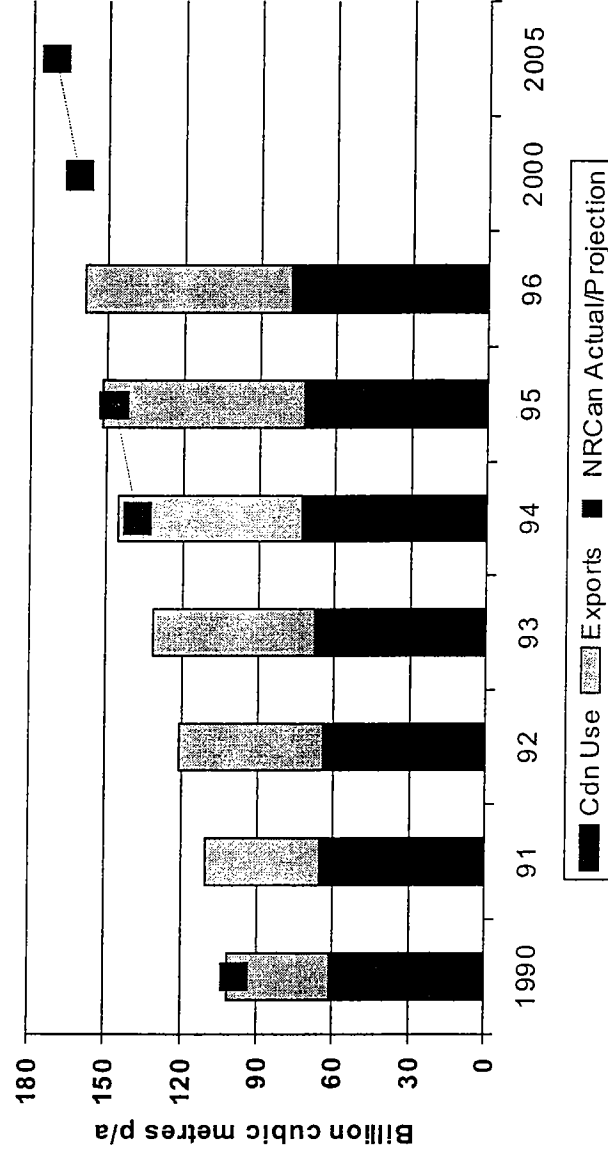
Canadian Global Change Program

Crude Oil Exports and Canadian Sales: 1986-1996



Canadian Global Change Program

Natural Gas Exports and Canadian Sales: 1986-1996



Canadian Global Change Program

- CAPP's 170 Explorer, Producer Members:
 - find and produce 95% of Canada's crude oil, heavy oil, synthetic crude oil, natural gas liquids and sulphur
 - make 95% of the upstream industry's investments
 - are actively involved in a wide range of environmental programs

Canadian Global Change Program

- Voluntary approach important tool
Industry Emissions Prevented/Reduced

(in million tonnes of CO₂ E):

➤ 1994	3.20
➤ 1995	2.47
➤ 1996	<u>2.52</u>

Total 8.19

1.5% of Canada's 1990 inventory of GHG

Canadian Global Change Program

- Components of a Canadian Plan:
 - Long term issue 50-100 yrs. - plan accordingly
 - Flexible targets with measurable interim goals
 - Credits for early action
 - Improve understanding of climate change science

Canadian Global Change Program

- Encourage research & development of new more efficient technology
- Better systems of measurement of inventories and regular performance assessment
- Remove barriers to efficiency
- Engage developing nations by helping them use new efficient technologies

Canadian Global Change Program

- Key to the Oil and Gas Industry Future
 - Technology Development and Use
 - Examples in place:
 - more efficient motors & drives on drill rigs
 - improved drill bit technology
 - directional and horizontal drilling
 - use of pad technology
 - improved computer technology to remotely operate facilities more efficiently
 - improved measurement of emissions using laser technology

Canadian Global Change Program

- Future
 - More efficient burners to turn poor quality associated gas to electricity and reduce flaring
 - Downhole separation of oil and water
 - Continued improvement in energy utilization
 - Continued awareness and support for the challenge and registry program

Canadian Global Change Program

- Greenhouse Gas Emissions are related to lifestyle and Energy Consumption
- Everybody should understand how they contribute to the problem
- Everybody should contribute to solutions

Climate Change and Property/Casualty Insurance

Notes for Remarks by:

**Alan Wood, F.I.I.C.
Vice President - Prairies and N.W.T.
Insurance Bureau of Canada**

to

**Canadian Global Change Program
Cross-Canada Briefings Before Kyoto
University of Calgary
November 5, 1997**

Climate Change and the Property & Casualty Insurance Industry

Thank you. It seems like you cannot pick up a newspaper, or turn on the news, without reading or hearing about climate change. Depending on your perspective, climate change can be good news or bad news. I suppose that I'm going to be somewhat the bad news guy today, as I provide some information about climate change from the perspective of the property and casualty insurance industry.

My industry, the property and casualty insurance industry or, in plain language, car, home and business insurance companies, is most often the first in line to respond to the financial costs of rebuilding and repairing damaged property after catastrophe strikes. So we get hit in the wallet and, ultimately, of course, so do you, because guess where the money that we spend came from in the first place? That's right - you, and you, and you. So, the next time you drive by a building that's being repaired because a windstorm blew the roof off, you can look at it and say, "Ah ha, my premium dollars at work!".

Most of these catastrophic events involve either earthquake, or bad weather. And what we know is that over the last couple of decades, the world has experienced an apparent sharp increase in the frequency and severity of losses from

natural catastrophe's.

A few figures will help put this in perspective. On a worldwide basis, Swiss Reinsurance Company has calculated the inflation adjusted insured cost of the 40 most severe catastrophic losses from 1970 through 1996 to be \$100 billion US. However, only 8% of this was incurred in the 70's and 22% in the 80's. 70% of the \$100 billion has been incurred in the first 6 years of the 90's. That's quite phenomenal, when you think about it for a moment.

In our country, we've so far avoided a billion \$ event but that is more likely due to our sparse population. In 1991, this city saw a hailstorm that caused almost \$400 million in insured damage, and two hailstorms within 10 days of each other in 1996 cost about \$200 million. The floods in Quebec in 1996 did over \$600 million in damage, and this years Flood of the Century in Manitoba about the same - although I must admit that little of the Manitoba damage and about half of the tab out of Quebec was insured, with most of the damage claims being left to the various levels of government to look after. Flood insurance is just not available for residential properties and while businesses can buy the coverage, it is not cheap.

Why has this trend in heavier and heavier costs associated with weather related catastrophe's evolved the way it has? A number of factors are involved.

One such factor is population growth in urban areas. For example, last years two Calgary hail storms 10 days apart both hit the same area of the city, an area that was home to only prairie dogs and porcupines 15 years earlier. So what cost insurers \$200 million in 1996 would have cost virtually nothing in 1981.

Secondly, we have more valuable infrastructure in more vulnerable places. Same examples - that area of Calgary hit last year is directly in a known hail path, and the houses are middle income style, 2500 square feet and up. The bigger the house, the more expensive to repair. And more than one house had a Mercedes parked in the driveway. If your 82 Buick has a few hail dents in the roof, it becomes a car with character. If your 97 Mercedes has a dent, a trip to the Bahamas will be in the future for the car repair guy.

Thirdly, it's becoming clearer that some form of climate change is occurring around the world and more frequent severe weather events seem to be the result. El Niño, of course, is a perfect example.

A couple of other factors that have certainly affected my industry. Throughout the world, the level of insurance protection in place today is better than ever in history. So we are getting claims that we would not have faced 75 or 100 years ago because in those days, if you had any insurance at all, it was only for fire. And of course record keeping and quick access to media coverage of events around the world are far superior to 100 years ago or even 30 years ago (we didn't have CNN in the 60's). Hearing and seeing the devastation in other parts of the world or country provides incentive for everyone else to try and obtain appropriate insurance coverage.

So, is the change in the weather due to greater concentration of greenhouse gases like carbon dioxide? Quite frankly, we don't know. The science of climate change points strongly toward human causes, but there is no absolute scientific proof that I'm aware of that will likely ever satisfy the skeptics.

For insurers, the scientific merit of the debate on climate change is not the central issue. We're not scientists and we don't proclaim to be. What does matter is the survival and sustainability of affordable, widely available insurance coverage on which modern society has either come to depend on, or in the case of floods,

would like to see in the future.

It will take many years for the world's economies just to stabilize greenhouse gas emissions on a global scale, let alone begin to reduce them. For the insurance industry, the implications are quite clear: precautionary actions are essential, and these actions must involve effective loss mitigation strategies promoted by the insurance industry itself, working with governments and other allies. I am pleased to advise that one such strategy was approved by IBC's Board of Directors this past September, and that is to play a leadership role in establishing the Institute for Catastrophic Loss Reduction. The mission of this Institute is to reduce the loss of life and property caused by severe weather and earthquake through the identification and support of sustained actions that improve society's capacity to adapt to, anticipate, mitigate, withstand and recover from natural disasters. I expect the Institute to be operational very quickly - our member insurance companies have already been assessed their share of implementation costs and the response has been excellent.

In the short time available today, all we can do is touch the surface of a very difficult problem. I hope that I have provided a bit of insight into the perspective of insurers about climate change, enough to at least perhaps fill in another blank as we all try to understand the magnitude of what's happening.

Thank you.

Kyoto: An ENGO Perspective

Dan Smith - Pembina Institute

CGCP Calgary Briefing

Why Kyoto?

- IPCC - “a discernible human influence on global climate”
- Canada is particularly vulnerable to climate change
- current UNFCCC commitments are inadequate

A Meaningful First Step Timeline

- 2005
- to change our emissions trend
- send a strong signal to consumers/investors
- send a strong signal to developing countries

Kyoto Outcome

- negotiating positions range from 20% cuts by 2005 to stabilization in 2012
- Canada likely to support the US - weakest position on the table
- Kyoto will be inadequate from an environmental perspective
- we'll be back at the table again soon

Canada and Kyoto

- any Kyoto commitment will require new actions in Canada
- 1990 - 1996: carbon dioxide emissions increased 10.5%
- 1990-2010 - GHG emissions projected to increase by 19%

What Does Canada Need To Do?

- needs to determine how to allocate responsibility for meeting a Kyoto commitment
- needs to strengthen the Voluntary Challenge Program
- need to implement additional actions to take advantage of the economic opportunities of reducing GHG emissions

Energy Efficiency

- reduces energy bills, increases competitiveness
- creates 3-4 times as many jobs as investments in new energy supply
- addresses a number of other environmental concerns

Renewable Energy

- significant environmental benefits
- growing export markets
- real opportunities to promote with electricity deregulation

Fossil Fuel Industry

- transition from fossil fuels will be gradual
- efficient firms will see market share increase
- demand for natural gas will increase
- demand for energy efficient production and distribution technologies in developing countries and Eastern Europe

A Canadian Action Plan (1)

- no single measure will do the job - need a package
- strengthen VCR (reporting, support, incentives)
- level the playing field (tax incentives + credits for efficiency and renewables)
- increased R,D+D and commercialization support

A Canadian Action Plan (2)

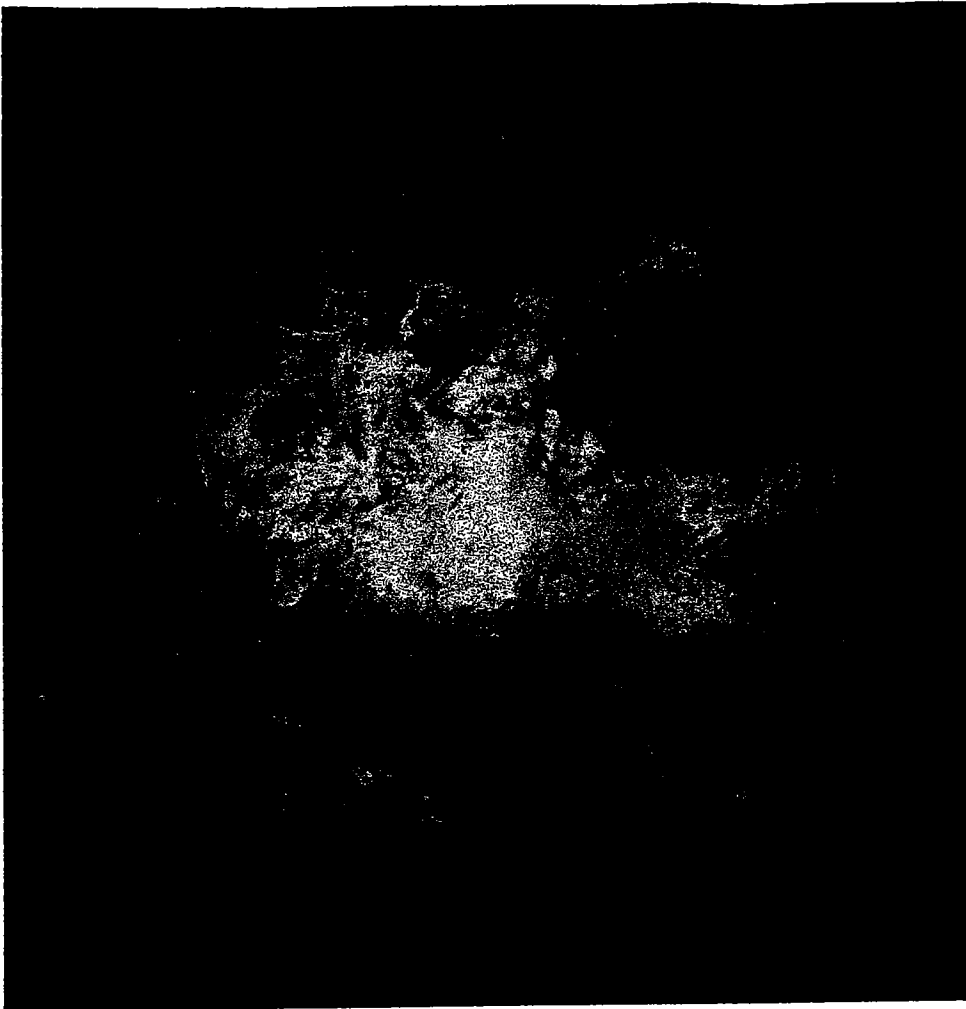
- performance based regulation (cars, buildings, equipment)
- ecological tax reform (tax shifts to protect the environment and promote economic growth)
- public education

Vancouver - British Columbia

Friday, November 7th, 1997

Impacts of Climate Change

Stewart J. Cohen
Environmental Adaptation Research Group,
Environment Canada, and
Sustainable Development Research Institute,
University of British Columbia



30/09/97 12:31 PM

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

ARTICLE 2

OBJECTIVE

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Three Questions for Climate Impact Assessments

- ◆ What If?
 - in a scenario of climate change, what would the impacts be if there was no proactive adaptation?
- ◆ So What?
 - does the impacts scenario make a difference to stakeholders’ visions of the future?
- ◆ What Should Be Done?
 - what potential responses to this scenario can be identified?

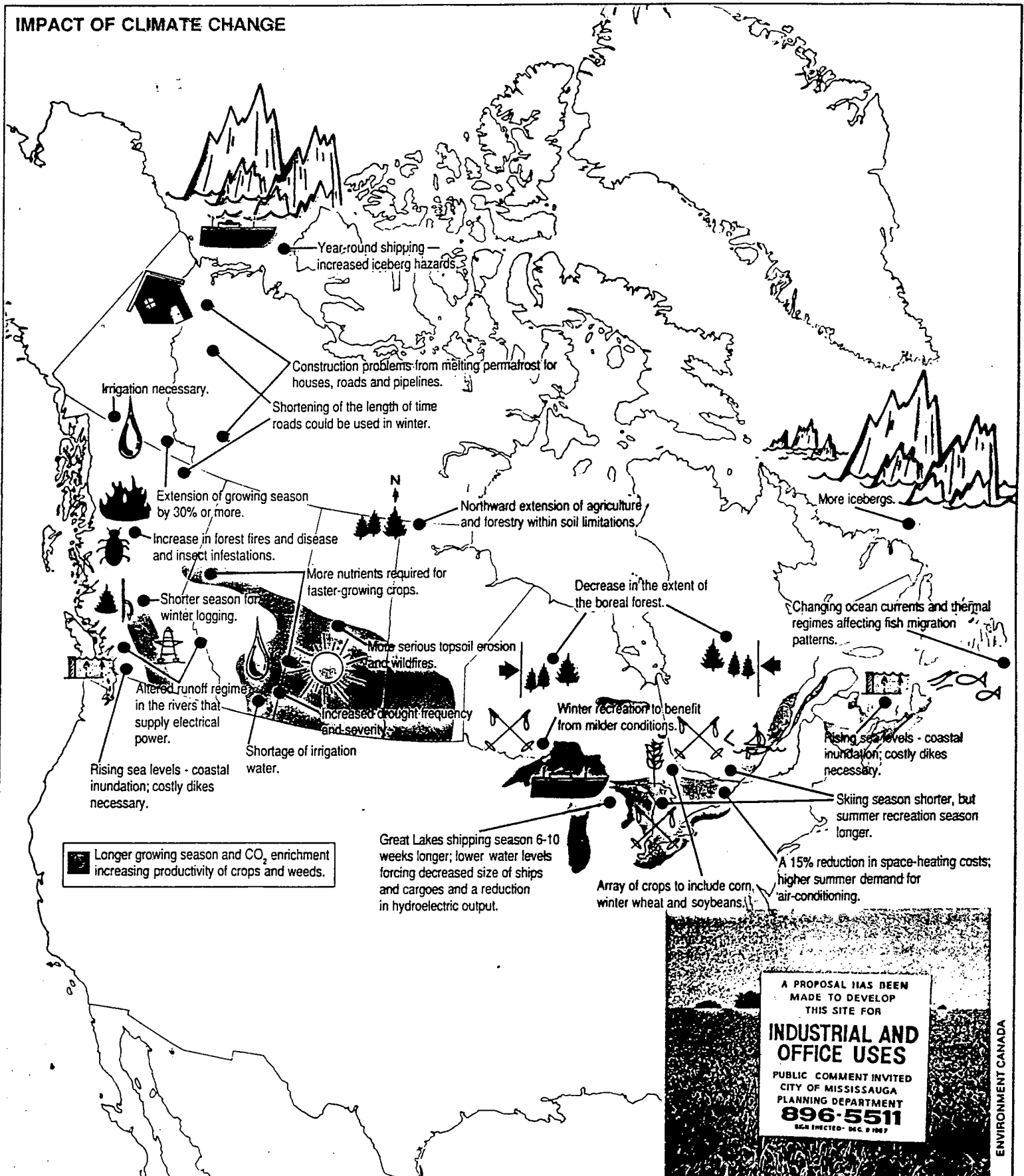
Impacts of a Changed Climate

Needless to say, the effects of climate change on Canada's economy, society and environment are expected to be substantial, both in threatening and beneficial ways.

Changes would be most evident in the resource sectors — agriculture, water and energy. Concerns exist about water shortages, reduced soil moisture, falling lake levels, rising sea-levels, reduced river flow and worsening droughts. At the same time,

climate change might offer easier navigation on the Great Lakes and in the Arctic, lower heating bills, lengthen the growing season, and induce milder winters and longer summers.

IMPACT OF CLIMATE CHANGE



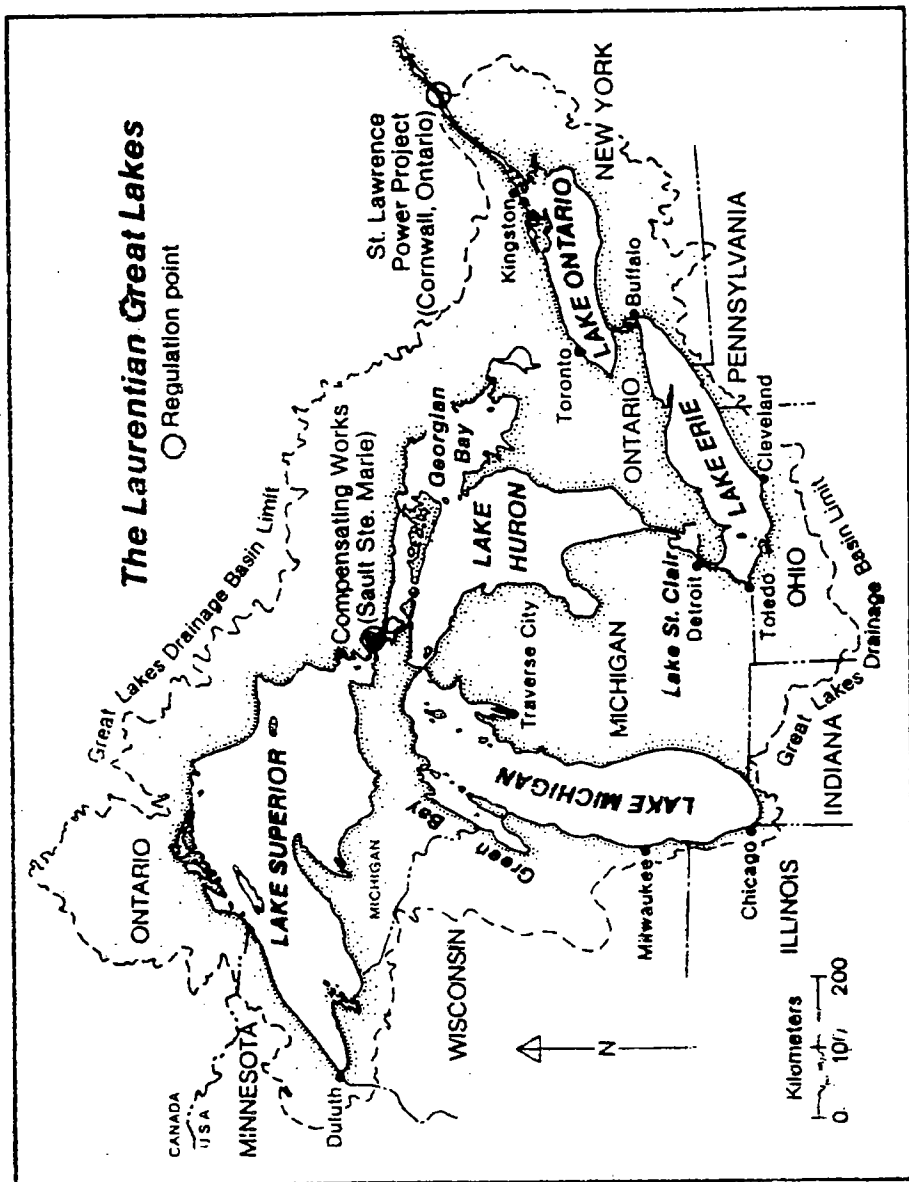


Figure 1. The Great Lakes System

lake

ge

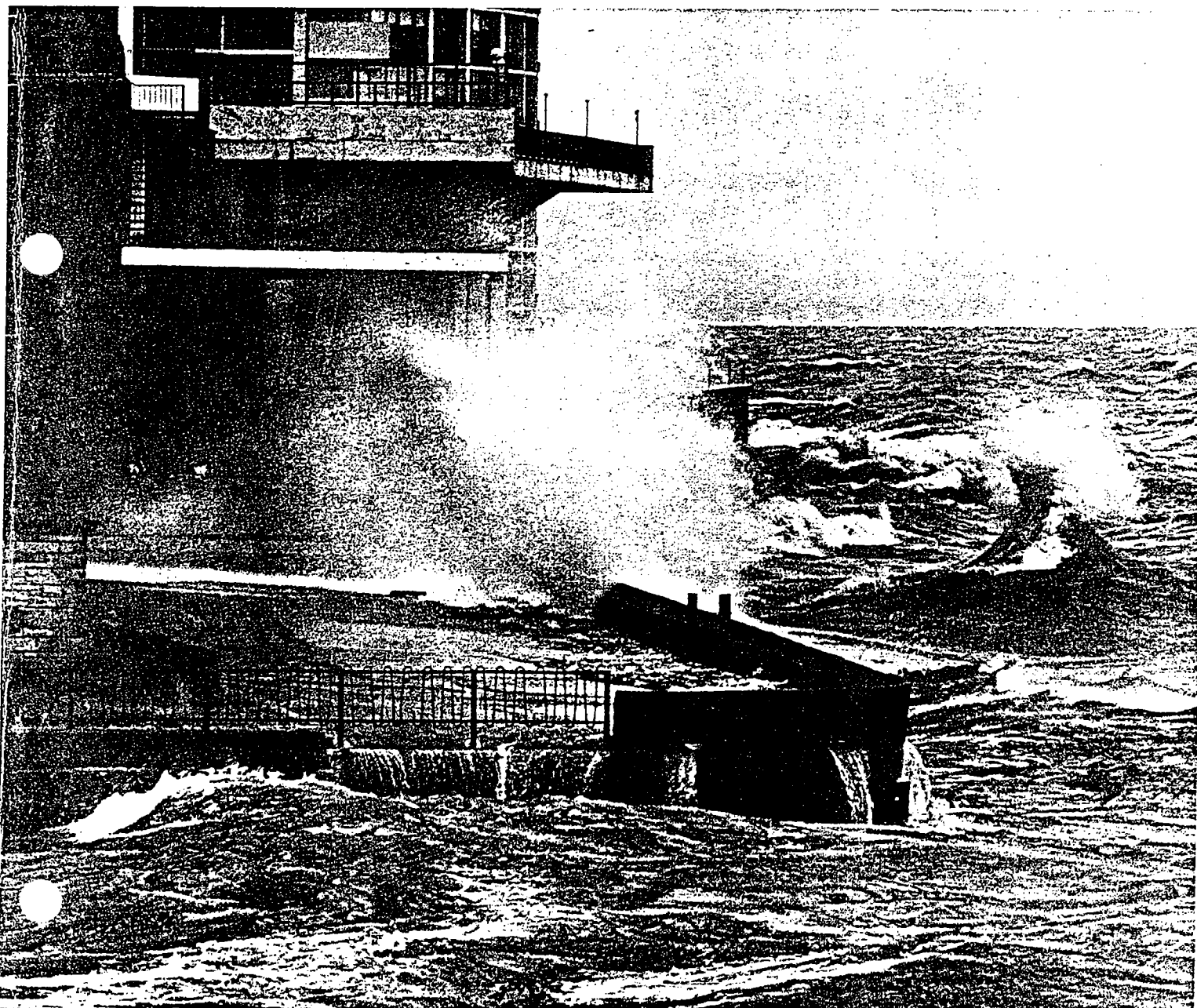
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Bulletin of the American Meteorological Society

Volume 68 Number 11 November 1987

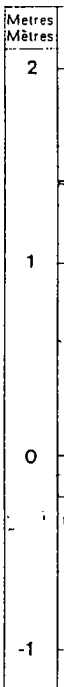


LAKE SUPERIOR (Thunder Bay) LAC SUPÉRIEUR



METRIC - MÉTRIQUE

LAKE HURON (Goderich) LAC HURON



Don't divert more water Ottawa tells Washington

By Bob Hepburn Toronto Star

WASHINGTON — Canada yesterday formally protested a U.S. proposal to divert more water from the Great Lakes to the drought-stricken Mississippi River valley.

Ambassador Allan Goltz delivered the diplomatic protest to John Whitehouse, deputy U.S. secretary of state, barely 30 minutes after senators from parched Midwest states issued an anguished plea to President Ronald Reagan to approve the massive diversion scheme.

After meeting with Whitehouse, Goltz said he was assured Canada would be fully consulted on the issue and that the U.S. government would obey the 1909 Boundary Waters Act, which requires consultation before any water diversion could occur.

"I don't think we need to be concerned that the United States government intends to act unilaterally," he said.

□ Congressman says free trade means water for U.S. Page A1

But at least one U.S. senator, John Sasser of Tennessee, said he believed Reagan as commander-in-chief has the authority to take the action in a national emergency.

In Ottawa, Justice Minister Ray Hnatyshyn said Canada can veto any such proposal as a result of several treaties.

"We control our resources," he said yesterday during Question Period in the House of Commons. "We will continue to control our resources."

Senator David Pryor, an Arkansas Democrat, told a packed news conference on Capitol Hill: "We're not trying to steal anything. What we are attempting very simply, is to come on behind them and say that we are in desperate need for help."

Pryor and 11 other senators joined several Midwest state governors in urging Reagan to authorize the U.S. Army Corps of Engineers to divert water from Lake Michigan through the Chicago canal and into the lower Mississippi.

Goltz told the U.S. State Department in his diplomatic reply:

and
at
free
3 p.m.
da

Continued from page A1

Chicago River towards the Mississippi.

The boat owners association and Thompson have asked the U.S. Army Corps of Engineers to triple the amount of water per second that flows from Lake Michigan to the river system to get navigation moving.

But nobody has even considered the side of the border. Lake Michigan connects with Lake Huron which flows into Lake Erie which connects with Lake Ontario at Niagara Falls where our hydroelectric power is produced.

Lower the level of one lake and eventually we could all be left high and dry with no lights.

Can they do such a thing?

They actually did it back in 1956 sending 283 cubic metres (10,000 cubic feet) of water per second cascading down the Chicago River. In two weeks, it raised the level of the Mississippi by 0.3 metres (one foot) at St. Louis, Mo., and 0.15 metres (six inches) at Memphis, Tenn.

But it didn't sit well with the eight states bordering the Great Lakes who sued. The U.S. Supreme Court eventually set the flow of Lake Michigan at an average 91 cubic metres (3,200 cubic feet) a second and said it would take a court order to change that.

Canada has consistently opposed any move to change it ever since, says Ann Cronin-Gosselle of the external affairs department's U.S.

potential plight is worse than ours. Farrell, president of the owners' already, tugboats and barges are being up at several spots along the Mississippi, Ohio and Arkansas Rivers because of low water.

Farrell says if current weather

Saline River flow at 10% of normal

White River, 7.5 ft. deep, one-way traffic

Ohio River restricted to one-way traffic

St. Louis, Mississippi River 0.3 ft. above record low

Memphis, Mississippi River 11.4 ft. below record low

Helena, Ark. Mississippi River 0.4 ft. above record low

New Orleans, Mississippi River 3.4 ft. above record low

Saline water is now 60 miles up the Mississippi River, 3 to 4 months ahead of the normal time frame.

Source: U.S. Army Corps of Engineers, Vicksburg, Miss.

Diversion of water from the Mississippi River to the Illinois River and the Arkansas River has been proposed.

On Monday, the province unveiled legislation to assert its jurisdiction over critical energy exports and pricing, and But Brandt attacked the bill as "the

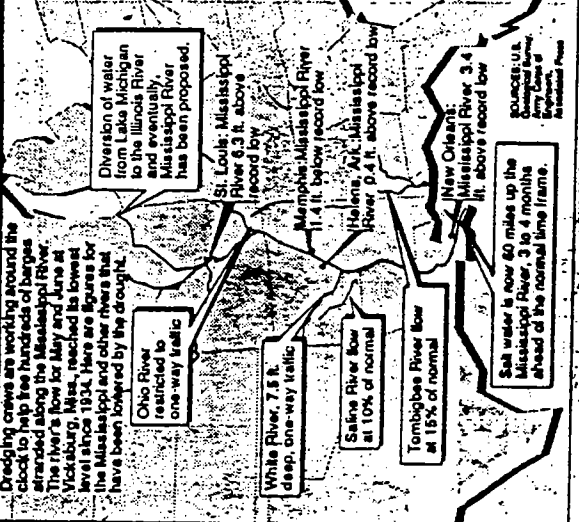
Great Lakes water has approached Canada, a joint owner, to discuss the issue.

Without so much as a mention of Canada, the Wall Street Journal outlined the plan to save the Midwest's navigation in a front-page story this week.

William Eyre, supervising engineer for the Sanitary District of Greater Chicago, stands ready to push a bill out of a downtown

Great Lakes water eyed to quench U.S. Midwest

Drought hits Mississippi basin



potential plight is worse than ours. Farrell, president of the owners' already, tugboats and barges are being up at several spots along the Mississippi, Ohio and Arkansas Rivers because of low water.

Farrell says if current weather

U.S. drought threat to our water, Premier says

Ontario unveils tough bill to control vital resource

By William Walker Toronto Star

The drought will soon prompt the U.S. to pressure Canada to divert large amounts of water south, Premier David Peterson warns.

Peterson made the comments in the Legislature yesterday, moments after Natural Resources Minister Vince Kerrio introduced the Water Transfer Control Act, which would assert the province's control over water supplies.

As reported by The Star, Peterson said the U.S. government is concerned that the proposed free trade agreement places control of Canada's water supply at risk.

Peterson noted that the governor of Illinois has proposed increasing the flow of water out of Lake Michigan, through a canal at Chicago, and into the Mississippi River.

"We in this party concur with the minister's position with regard to prohibiting persons from taking water out of the provincial drainage basin without the consent of the minister," Wilkinson said.

But Brandt attacked the bill as "the

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Parched U.S. thirsts for Great Lakes

Saturday special

Michigan to allow billions of litres of water to surge down a series of parched rivers until the boats are set afloat.

This week, Illinois governor James R. Thompson threw his weight behind the request and preventing it is a meeting of the National

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★ THE TORONTO STAR, THURSDAY, JUNE 10, 1988

Congressman says water included in free trade

By David Crane Toronto Star

Americans will have greater access to Canada's abundant water supplies if the free trade pact between the two countries is implemented, an American congressman says.

"I think one of the reasons the United States wants to negotiate a free trade agreement with Canada is Canada has the water resources that this country is eventually going to need," Iowa Republican Fred Grandy told an open-line TV show last week.

The marriage of these two nations is to take a resource-rich country like Canada and merge it with a capital-rich country like America, and that I think is something we are looking at down the pike.

An aide to Grandy said yesterday that the congressman reached his conclusion on the basis of information supplied by the Office of the Trade Representative, the U.S. agency that negotiates the trade deal with Canada. Grandy is a member of the House of Representa-

tatives agriculture committee. The comments come at a time when the drought-ravaged U.S. Midwest — including Grandy's Iowa — is eyeing Canada's vast water resources.

Canadian officials have adamantly denied water exports are included in the trade agreement. Grandy was campaigning for reelection yesterday and was not available for comment.

But senior aide Reg Myers said Grandy's views were based on comments made by a U.S. trade official at a discussion on trade issues organized by Grandy for his constituents.

Myers refused to name the trade official or discuss details of the session.

Both Canadian Trade Minister John Crosbie and his parliamentary secretary, Brampton MP John McDermid, have gone to great lengths in recent weeks to dismiss suggestions that water is included in the trade deal.

They say the agreement applies just to bottled water and that, in

any event, Canada has a water policy that excludes the diversion of water from major basins to the U.S.

Tight schedule

The issue is expected to come up when a House of Commons committee next week begins a tight schedule of hearings on the legislation implementing the trade deal.

However, the Progressive Conservative majority has set a deadline on those hearings, and it is unlikely there will be much opportunity to examine the water issue in detail.

Other developments, though, could make water a bigger issue in the free trade debate.

One is the drought that has gripped many areas of North America. Severe water shortages in the Midwest have withered crops and lowered water levels in many rivers essential to transportation, such as the Mississippi.

As a result, Illinois wants to divert water from Lake Michigan at Chicago to the Mississippi River. Canada says the idea is insane.

The water crisis is not short-term, some experts warn.

Changes in climate will cut moisture in Prairie soil by half before the year 2000, the head of an Ottawa-based water research insti-



FRED GRANDY: Was briefed by U.S. agency that negotiated trade deal with Canada.

Star yesterday. "Illinois," he said, are simply the first indication of how the U.S. will instinctively search for new water supplies from the Great Lakes and Canada instead of tackling the problem locally.

And the terms of the free trade deal could make it hard for Canada to block the sale of water to the U.S., Grandy said.

Critics say that water is a "good" like sweaters, computers or automobiles under the trade deal. They say the deal gives the U.S. additional rights to Canadian resources, including water, and imposes new obligations on Canada in dealing with the U.S. on water.

Policy overridden

Environment Minister Tom McMillan stressed in the Commons recently that the government's water policy "excludes inter-basin diversions for large-scale water export purposes. Nothing could be clearer, if we wrote it in a million laws, the policy would not be clearer than that."

But according to Mel Clark, a former senior trade negotiator for Canada, the trade deal "overrides the federal water policy. No U.S. negotiators."

unilateral statement by either government will supersede the bilateral agreement.

The implementing legislation states that the terms of the deal override any other act of Parliament or any policy or regulation made under the laws of Canada.

In an exchange during a recent question period, New Democrat leader Angus asked McMillan to explain why Grandy and other Americans believed they had access to Canadian water.

McMillan replied that the NDP will "quote any American they can find (and) twist his remarks to buttress every manner of conformation of policy of the federal government."

At one point it was intended that the trade deal would contain a specific clause exempting water from the trade deal, just as beer and raw logs were exempted. Officials from Environment Canada even worked on the wording of such a clause.

According to Grandy, "water was explicitly excluded in the free trade agreement up until the last few weeks of negotiations. But the exclusion was dropped by Derek Burney of the Prime Minister's Office, apparently at the request of U.S. negotiators."

Figure 17: Potential Impact of Climate Change on Great Lakes Flows

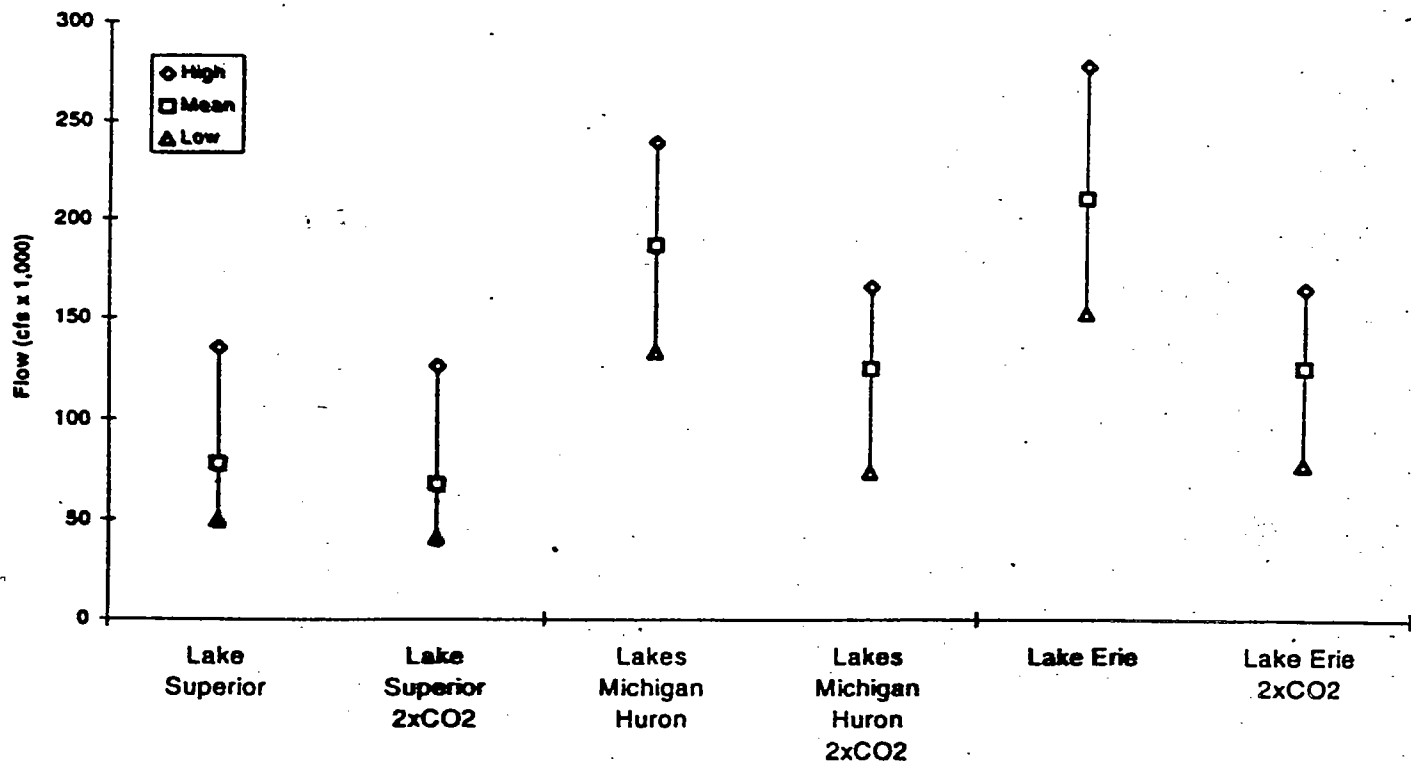
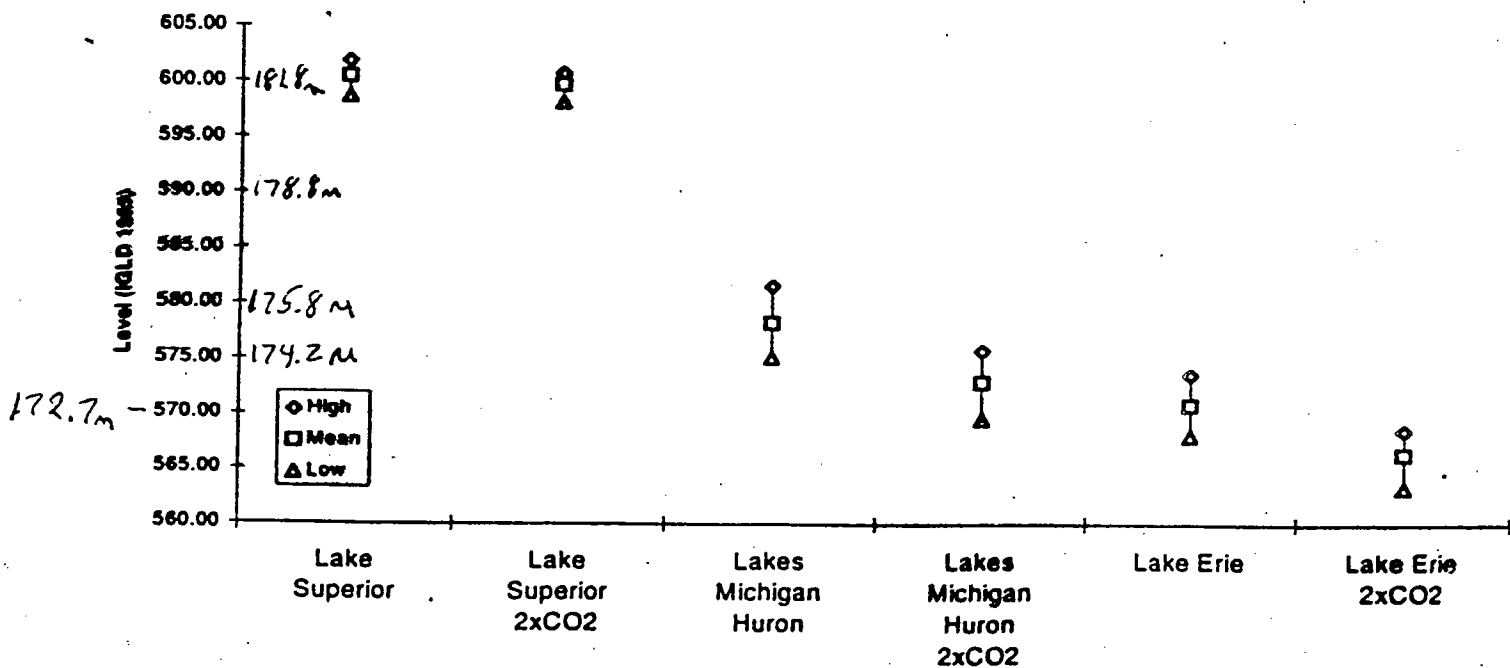


Figure 18: Potential Impact of Climate Change on Lake Levels³²



³² Based on the Canadian Climate Centre Global Climate Model.

Croley (1991)
Changnon et al
(1994)

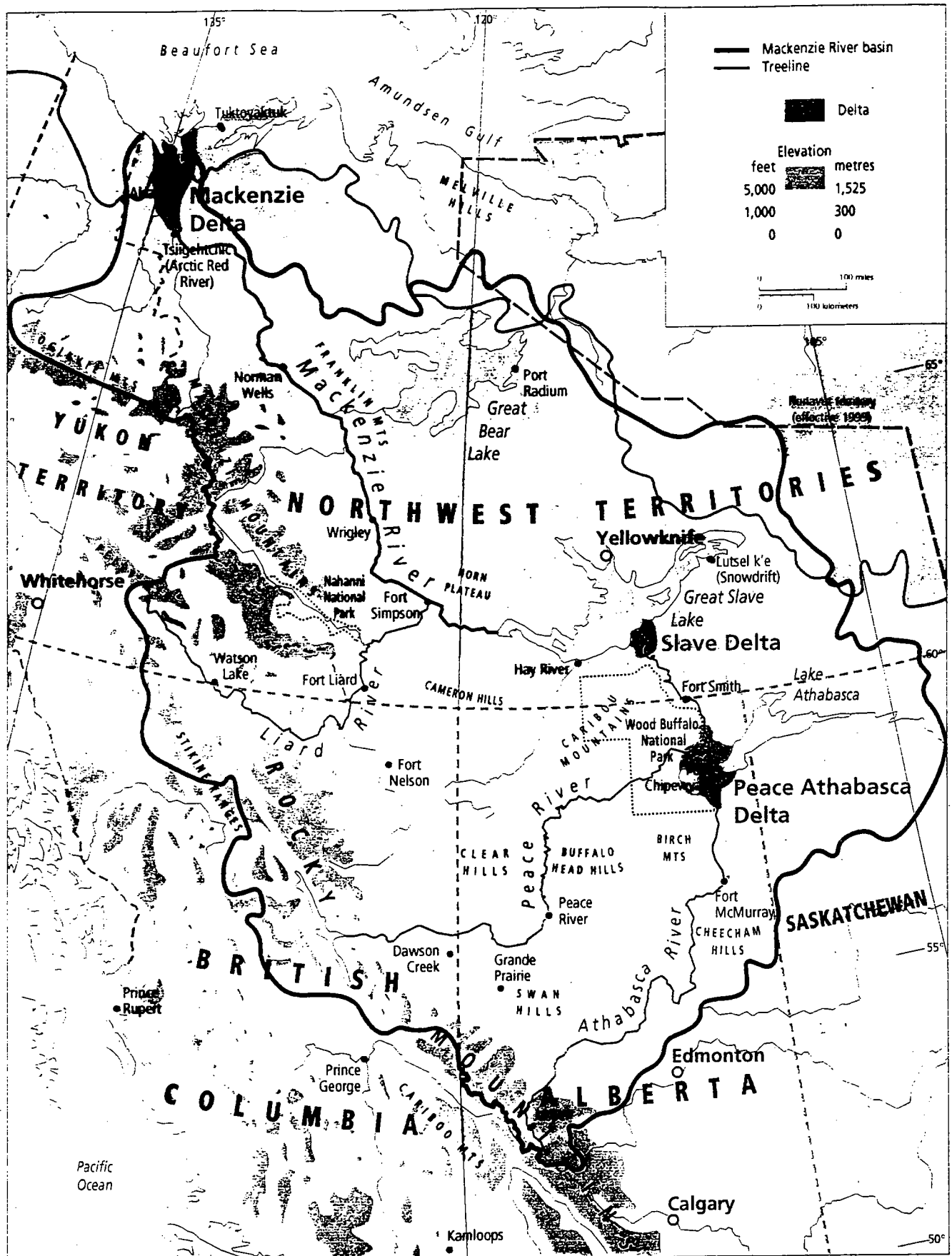
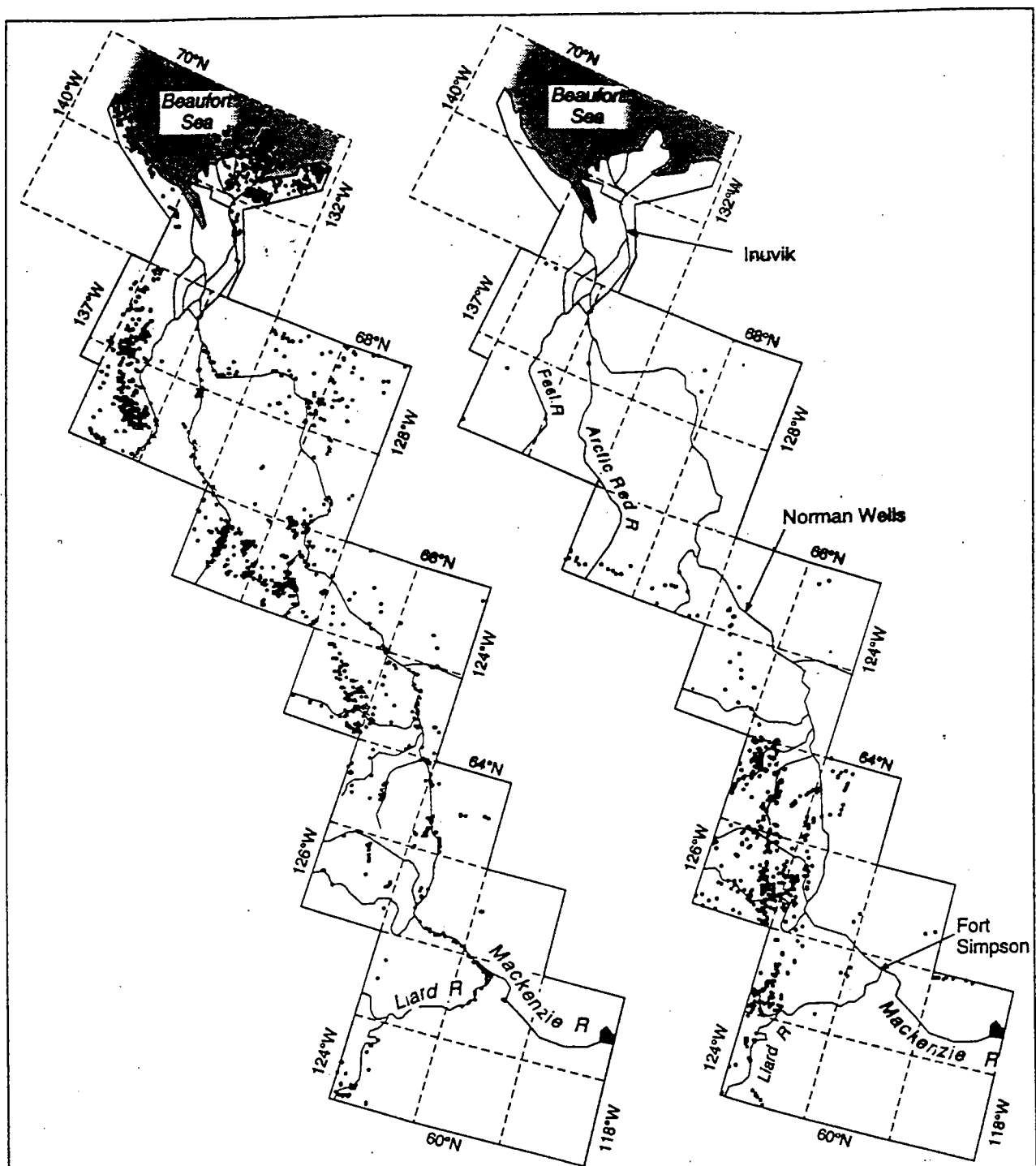




Figure 5. Projected minimum mean changes in the depth of the water table relative to the peat surface (dm) for peatlands in the Mackenzie Basin River Basin based on climatic data obtained from the Canadian Climate Centres (CCC) Model for 1X and 2X present CO₂ concentrations.



LANDSLIDES IN QUATERNARY SEDIMENTS

LANDSLIDES IN BEDROCK

Distribution of landslides in the Mackenzie Valley, adjacent mountains, and Beaufort Coast. Compiled by J.M. Aylsworth, A. Duk-Rodkin, G. Kruszynski, and J.A. Traynor; Geological Survey of Canada

J.M.A.



2a



2b

Aggregate Changes with Changing Climate in the Mackenzie Basin

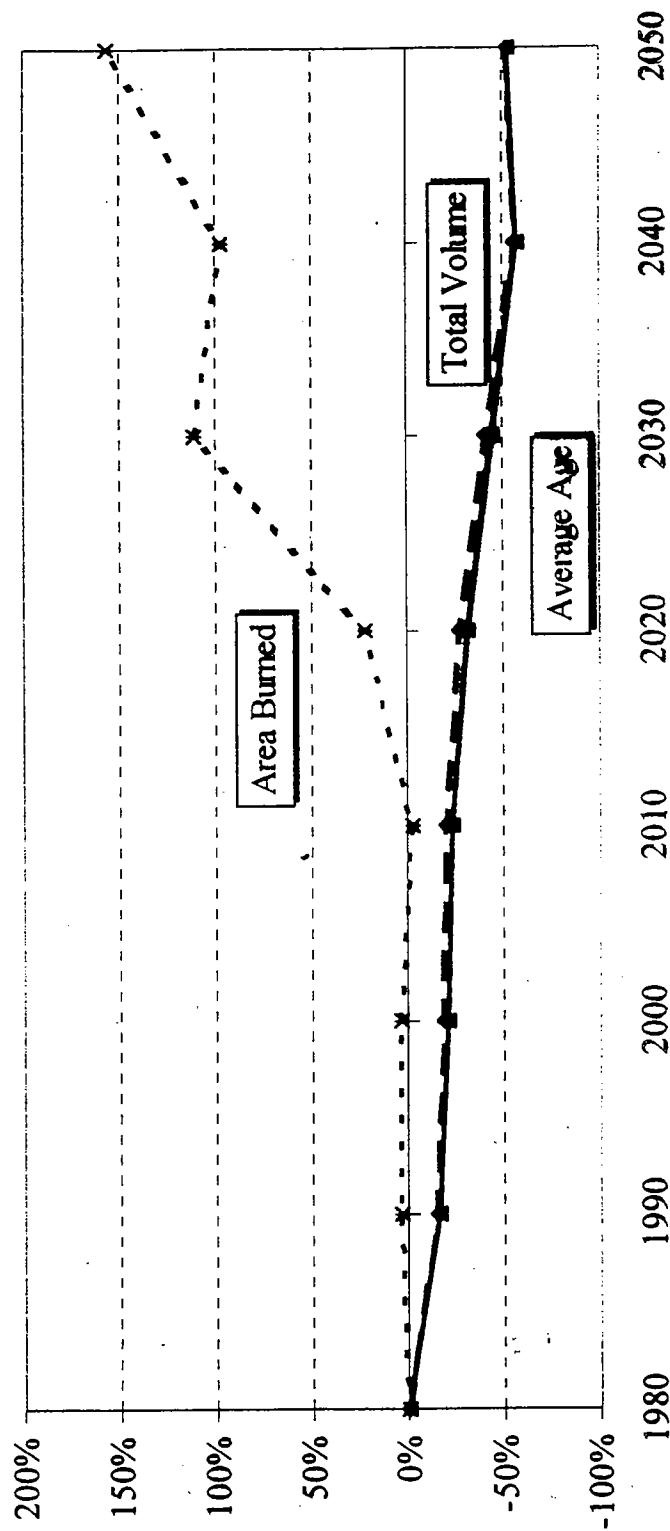


Table 3. Estimated Impacts of Agricultural Adaptation Measures and Climatic Change on Wheat Yields at Two Sites in the Mackenzie Basin.

a) Beaverlodge

Adaptation Measure	% Change From Baseline Yield	
	CCC Scenario	GFDL Scenario
Longer Season Cultivar	-16	+12
Longer Season Cultivar & Irrigation	+14	+26
Winter Wheat	+ 1	+28
Winter Wheat & Irrigation	+41	+51

b) Fort Vermillion

Adaptation Measure	% Change From Baseline Yield	
	CCC Scenario	GFDL Scenario
Longer Season Cultivar	-25	-10
Longer Season Cultivar & Irrigation	+60	+78
Winter Wheat	-68	-68
Winter Wheat & Irrigation	-64	-64

NOTE: The longer season spring seeded wheat cultivar considered in this analysis was Butte. The winter wheat cultivar was based upon cultivars currently used in the northern regions of the US Great Plains. Analyses considering irrigation assumed irrigation levels sufficient to eliminate crop moisture deficits. Analyses summarized in Table 3 were based on biophysical conditions, and did not consider the socio-economic feasibility of the selected adaptation measures.

RESPONDING TO GLOBAL CLIMATE CHANGE



YUKON

BRITISH
COLUMBIA

IN
BRITISH
COLUMBIA
AND
YUKON

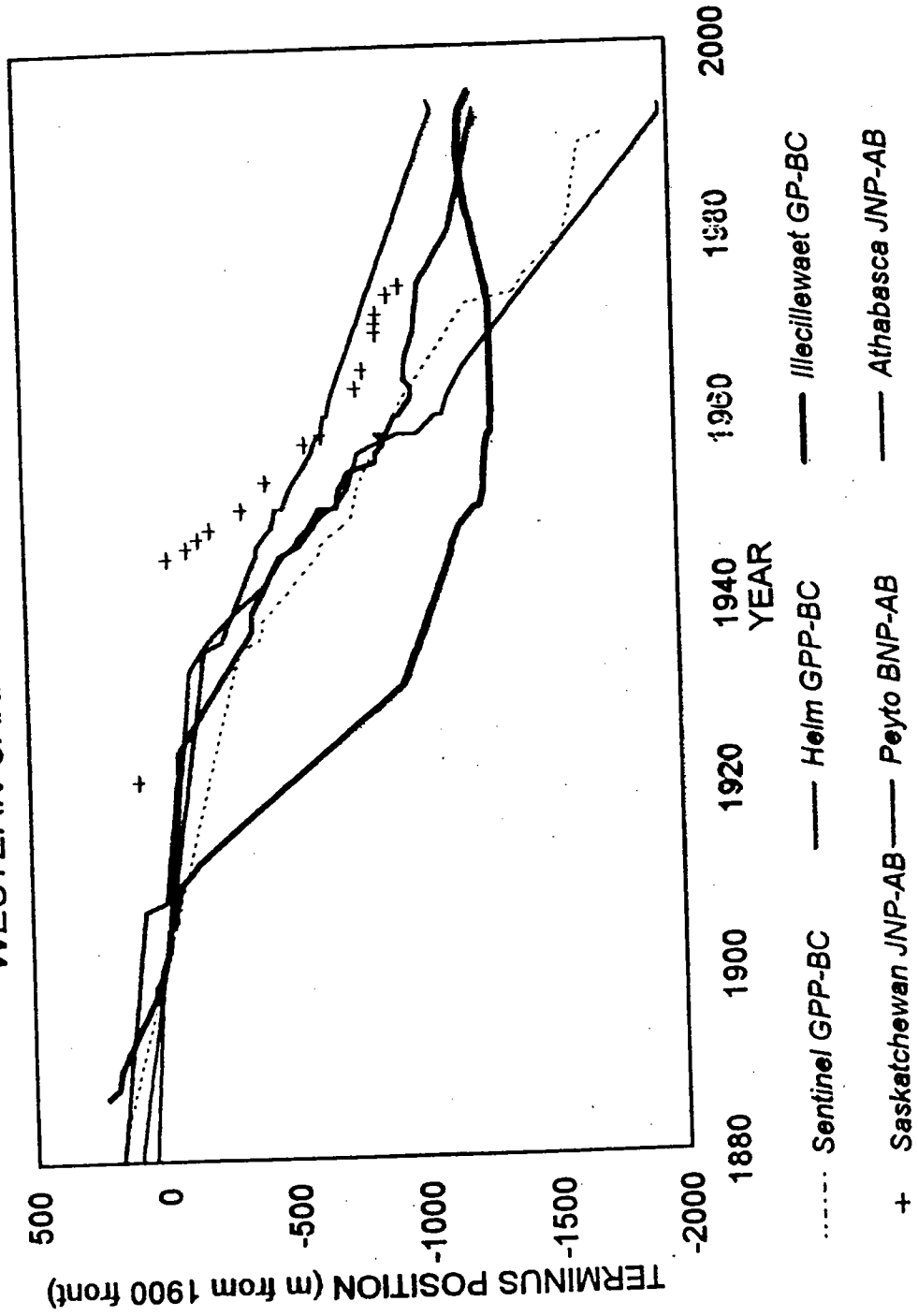


Working with the Canadian Government to address climate change

Most glaciers in British Columbia have dramatically retreated throughout the last century (Brugman, 1991; Harper, 1993; Luckman et al., 1987; Wood, 1988). This corroborates the glacier margin balance calculations noted above. The glacier terminus positions for a number of glaciers is shown in Figure 3.

FIGURE 3. Glacier length variations in Western Canada 1880 to 1995.

GLACIER LENGTH VARIATIONS WESTERN CANADA 1880-1995



GLACIER AUGMENTATION OF STREAM

most of the summer, then high reflectivity will lead to reduced summer melt and runoff.

Figure 5. Aerial view of the breached moraine dam at Nostetuko Lake, Coast Mountains, British Columbia in 1987. As described by Blown and Church (1985), the breach and outburst flood took place in 1983 when a mass of ice broke off the tongue of Cumberland Glacier (left background) and entered Nostetuko Lake. This generated a wave which overtopped the moraine and initiated the breach. The moraine dam was formed by a terminal moraine complex which marks the Little Age extent of Cumberland Glacier. The lake was created during the twentieth century retreat of the glacier.



Table . Computed runoff based on observed temperature and precipitation data, calculated runoff under doubled CO₂ temperature and precipitation conditions and the percent change for all climate stations.

	Computed runoff (mm)	2XCO ₂ runoff (mm)	% change
Tofino A	2833	3105	+18
Nanaimo A	591	776	+31
Whistler	775	922	+19
Mission WA	1180	1382	+15
Princeton A	49	91	+86
McCulloch	299	382	+21
Vernon Coldstream	67	113	+69
Revelstoke	479	603	+26
Cranbrook A	53	90	+71
Fernie	743	845	+14
Bella Coola	1115	1315	+18
Sandspit A	754	892	+18
Terrace A	901	961	+ 7
Fort St James	117	146	+26
Prince George A	169	197	+16
Ft Nelson A	57	72	+28
Watson Lake YT	84	106	+26
Dease Lake	83	98	+19

Table 6. Potential changes in evapotranspiration and precipitation at climate stations given a doubling in atmospheric CO₂.

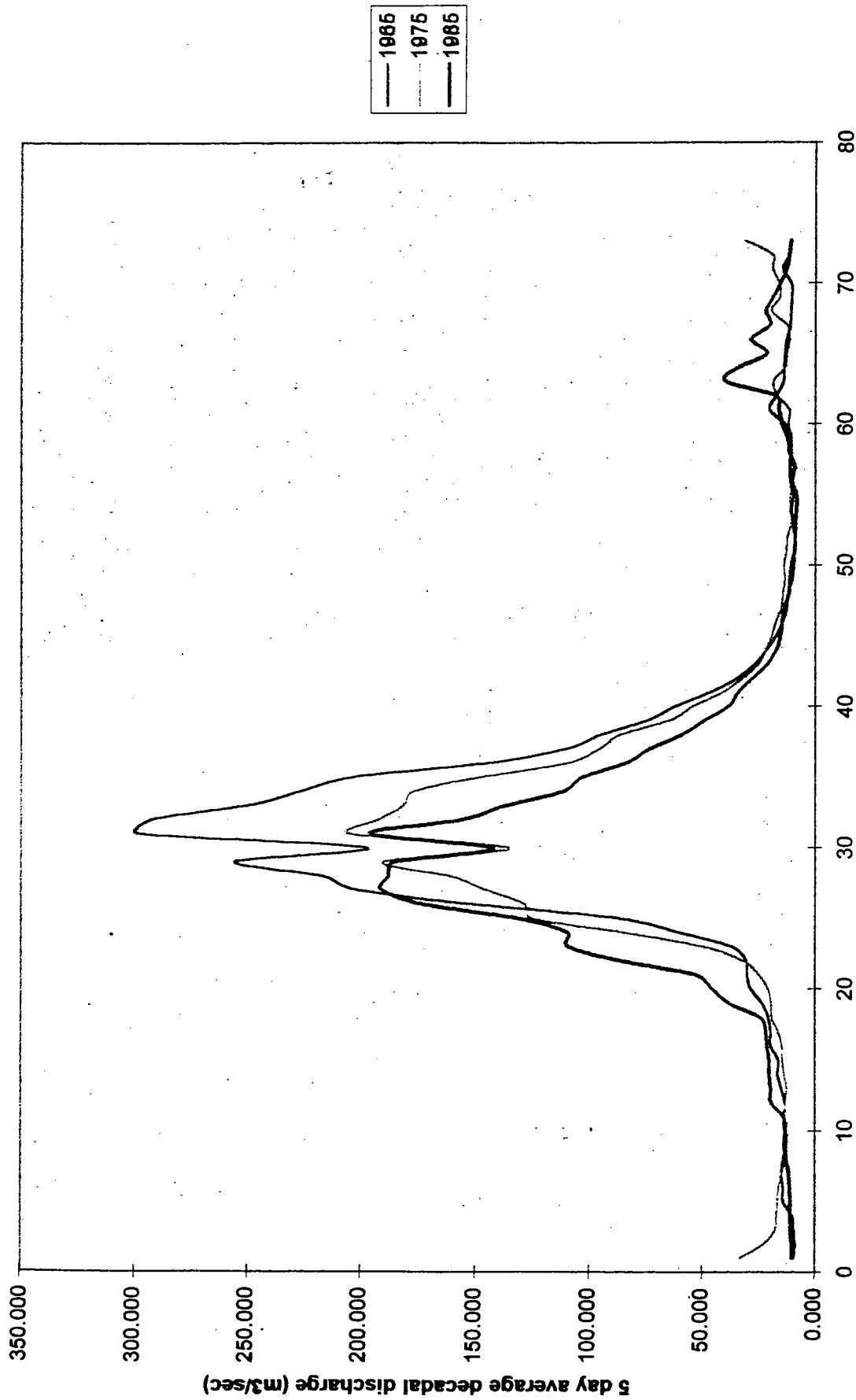
	Potential evapotranspiration change (mm)	Precipitation change (mm)
Tofino A	+13	-32
Nanaimo A	+17	-10
Whistler	+14	-18
Mission WA	+17	-22
Princeton A	+20	-4
McCulloch	+13	-4
Vernon Coldstream	+22	-4
Ravelstoke	+21	-7
Cranbrook A	+23	-3
Fernie	+20	-7
Bella Coola	+17	-35
Gandepit A	+14	-8
Townsite A	+17	-4
Port St James	+15	-7
Prince George A	+12	-15
Stikine River	+17	8
Pt Moreson A	+14	+7
Watson Lake YT	+9	+18
Dease Lake	+7	+18

Table 7. Increase in maximum monthly runoff at each climate station computed by the Thornthwaite model for a doubling in atmospheric CO₂.

	Max Month change (mm)
Tofino A	+184
Nanaimo A	+88
Whistler	+6
Mission WA	+86
Princeton A	+22
McCulloch	-4
Vernon Coldstream	+15
Ravelstoke	-28
Cranbrook A	+19
Fernie	+30
Bella Coola	+81
Gandepit A	+41
Townsite A	+11
Port St James	+9
Prince George A	+6
Stikine River	+1
Pt Moreson A	+11
Watson Lake YT	+8
Dease Lake	+3

SIMILKAMEEN RIVER NEAR HEDLEY

08NL038



LEITH & WHITFIELD

Break-up

Yukon River at Dawson YT

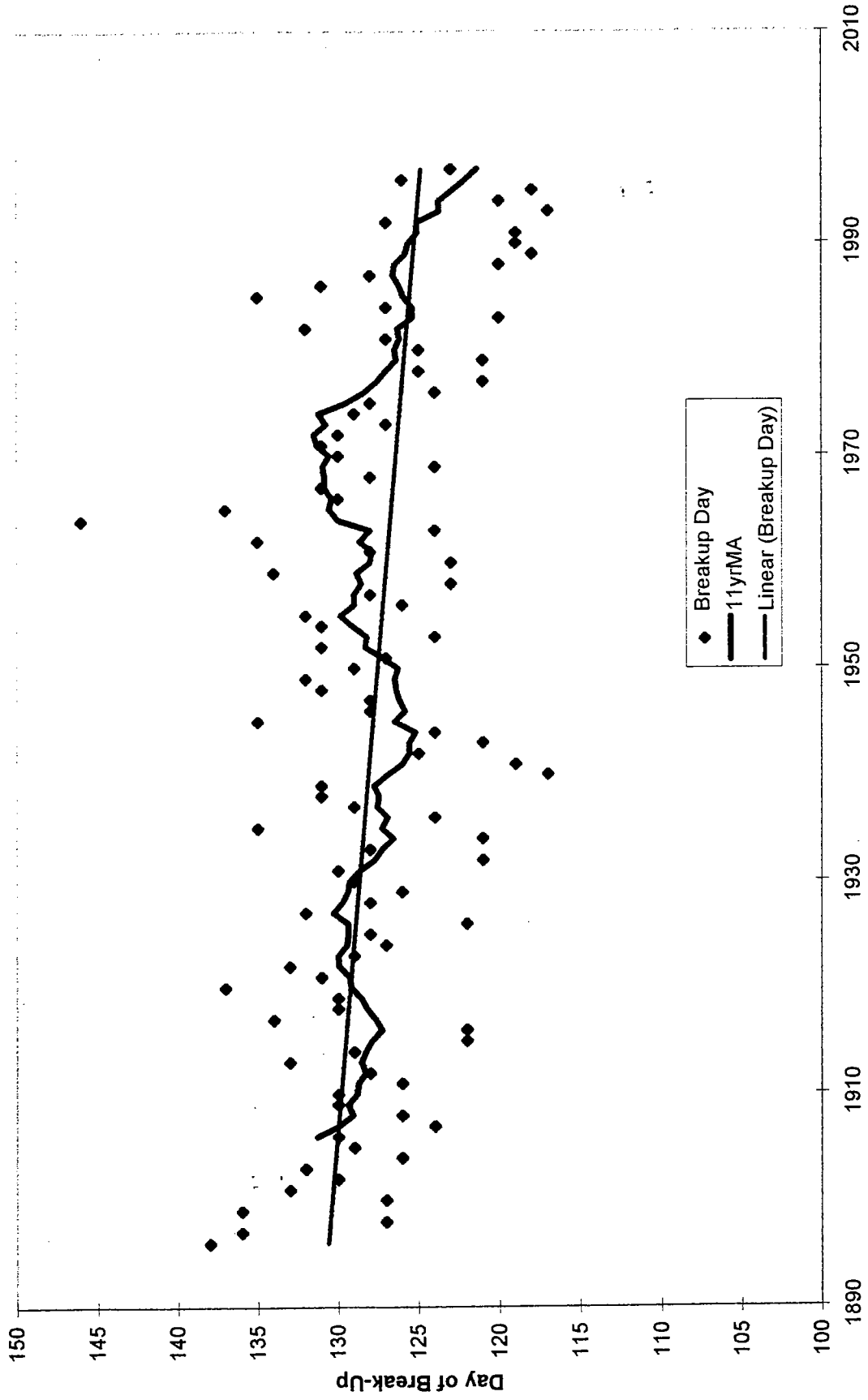


Table 2
Estimates of the Cost of Doubled CO₂ for Canadian Society in 1988

(2.5°C, 50 cm sea level rise)

	Raw Data for US + Canada (From Tol (Tol 1995))		Data for Canada assuming Equal Share of Damages between Sectors in Two Countries (Total GDP from CANSIM)	
Category	Billion SUS	Percentage of Total Damages		Billion 1986 Can\$
Coastal Defense	1.5	2.0%		0.167
Dryland Loss	2.0	2.7%		0.223
Wetland Loss	5.0	6.7%		0.557
Species Loss	5.0	6.7%		0.557
Agriculture	10.0	13.4%		1.113
Human Amenity	12.0	16.1%		1.336
Human Life	37.7	50.6%		4.197
Migration	1.0	1.3%		0.111
Natural Hazards	0.3	0.4%		0.033
Impacts on the Insurance, Construction, Transport, and Energy Supply Sectors				neglected
Damage from Nontropical Storms, River Floods, Hot/Cold Spells, and Other Catastrophes				neglected
Other Ecosystem Losses				neglected
Other Human Impacts, including Morbidity, Physical Comfort, Political Stability, and Human Hardship				neglected
TOTAL	74.5	100%		8.294
% of GDP	1.5			

Several categories, e.g. coastal defense, dryland and wetland loss, and agriculture, reflect costs of adaptation plus residual damages.

Categories considered in other studies not considered by Tol - forestry, energy, water, other sectors, air pollution, water pollution.

A statistical life, the "personal willingness to pay for risk reductions" (Pearce 1997, p.3), is assessed at \$250,000 plus 175 times per capita income. (Tol 1996)

Migration costs reflect the costs of incorporating immigrants into the social welfare infrastructure (Pearce, Cline et al. 1996).

Figure 1: Economic and Insured losses due to Great Natural Disasters, 1960-1993, with trends extrapolated to 2000

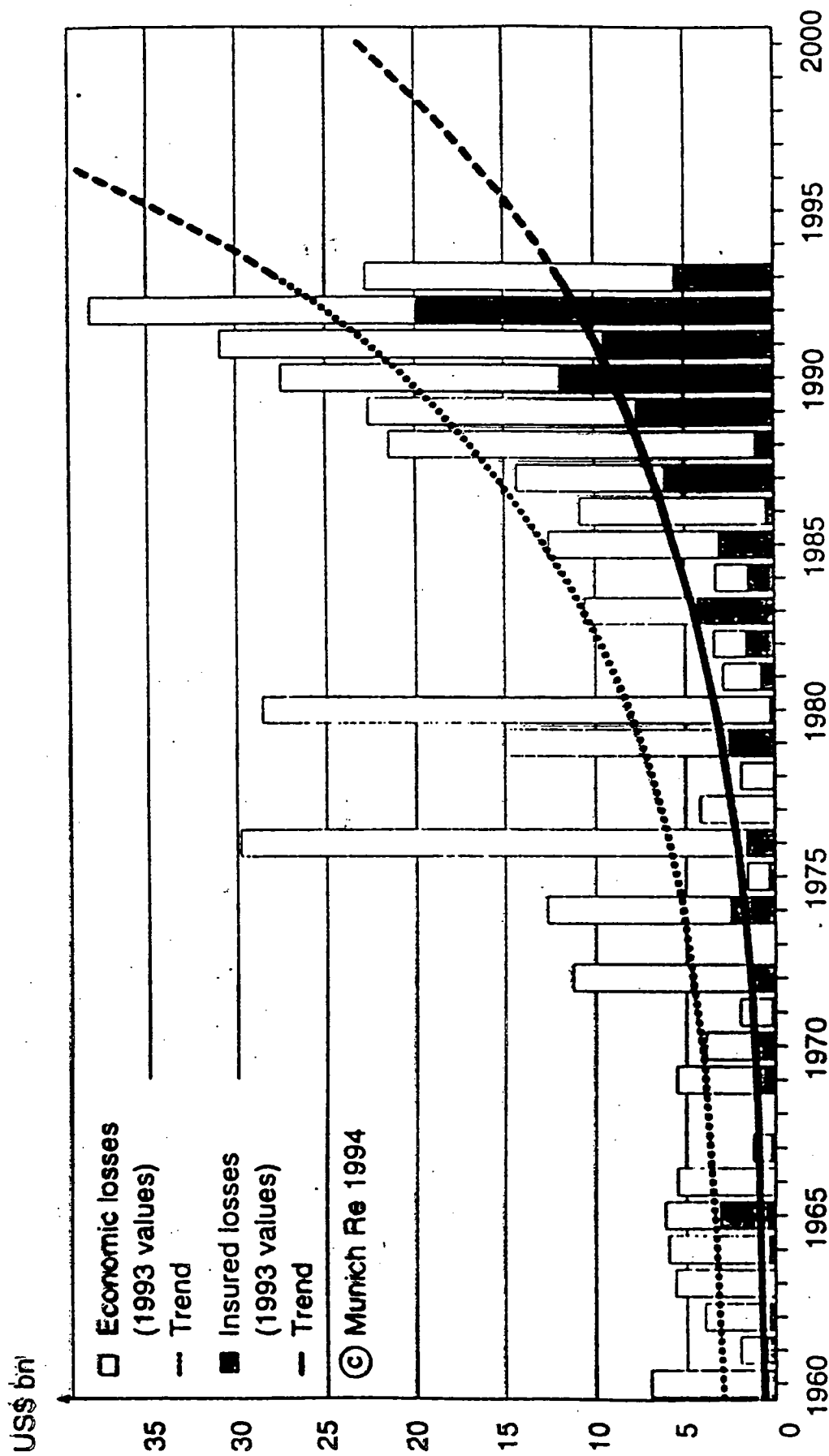
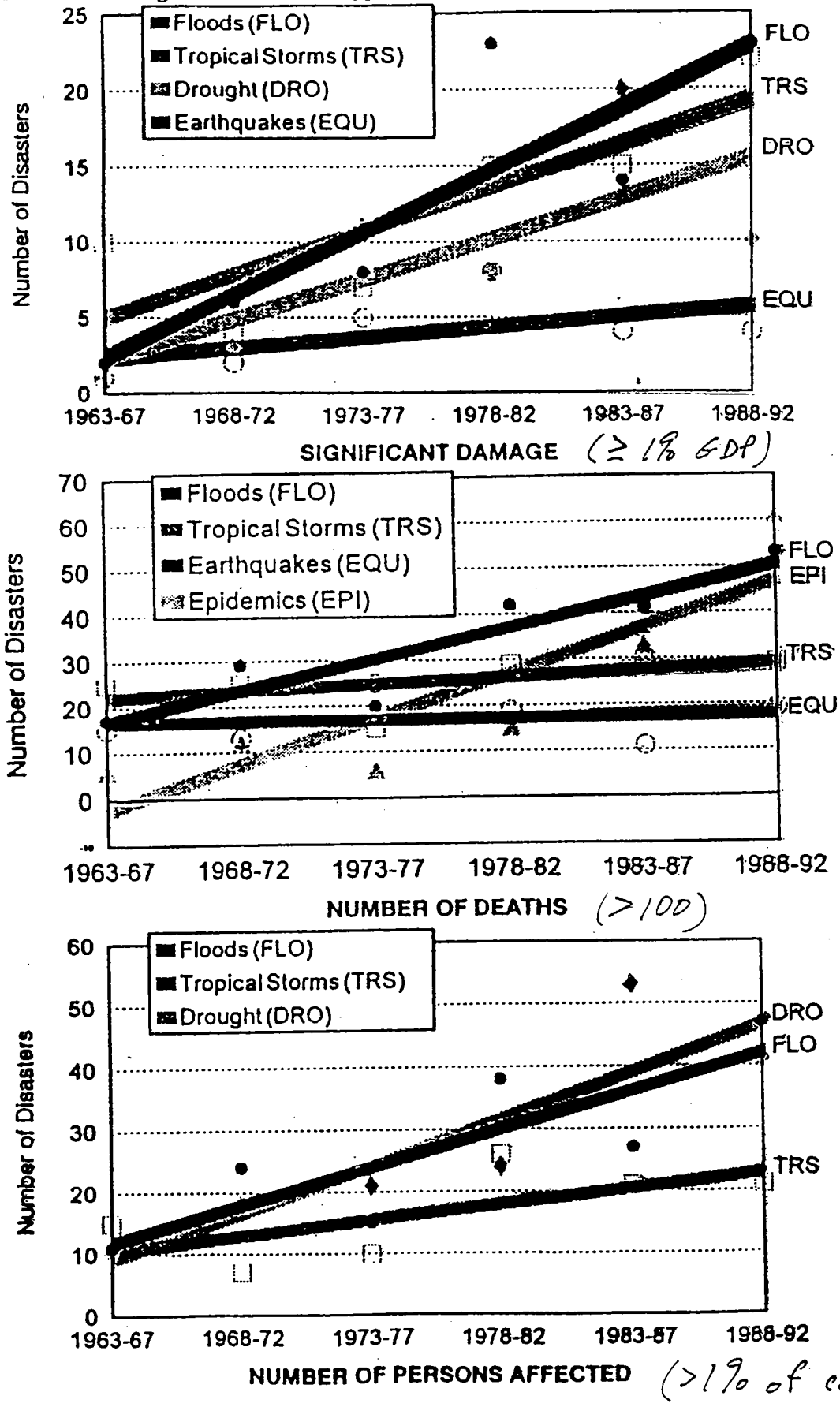


Figure 3: Trends - Most Significant Disaster Types by Category



Bruce (in McCollough & Etkin, 1994)

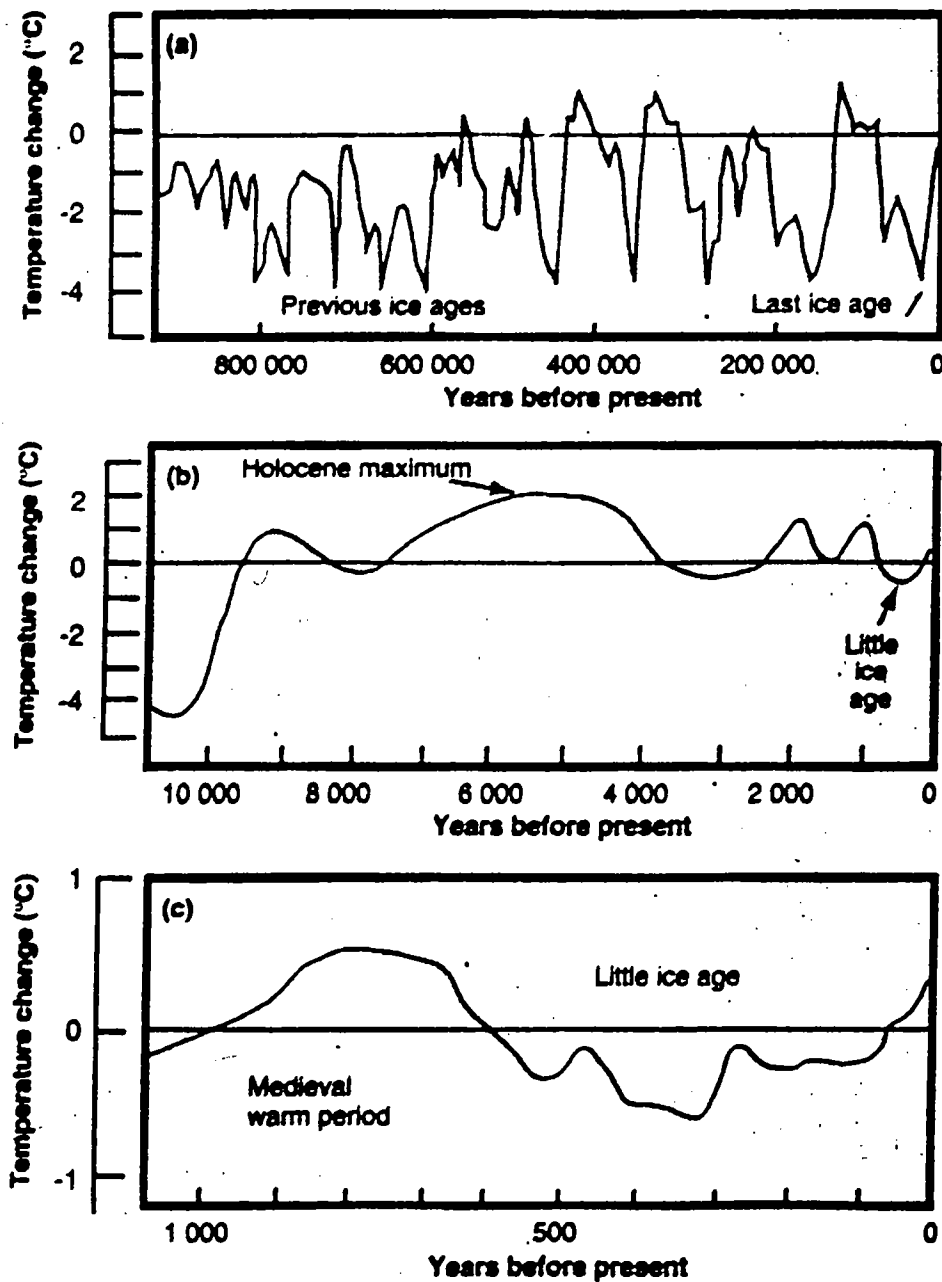
Questions for Stakeholders?

- is the climate change impacts scenario a new vision of the future?
- could this new vision make a difference to long term planning?
- is it possible to adapt proactively, or should we react to whatever comes?
- where is it appropriate to intervene?
 - professions (e.g. forestry? energy industry?)
 - governments at other levels (local? provincial/territorial? national? international?)

Is Adaptation Enough...

- if climate becomes less stable (e.g. season length, ice and snow conditions, extreme event frequencies)?
- if wildlife habitats change (e.g. water temperatures, water levels, tree species)?
- if domestic land capabilities change (e.g. agricultural potential improves while spruce production potential declines)?
- if traditional (aboriginal) lifestyles become more difficult to pursue while wage employment becomes available away from home?

Figure 6
Global temperature variations of the past
one million years



SOURCE: Adapted from Folland et al. 1990.

ANALOGIES AND CLIMATE CHANGE

(D. Jamieson, 1988)

- historical or cross-cultural analogies (e.g. comparison of Medieval warm period and 21st century global warming) can fail due to:
 - differences in technology
 - differences in political and social organization
 - differences in available information

Conclusions

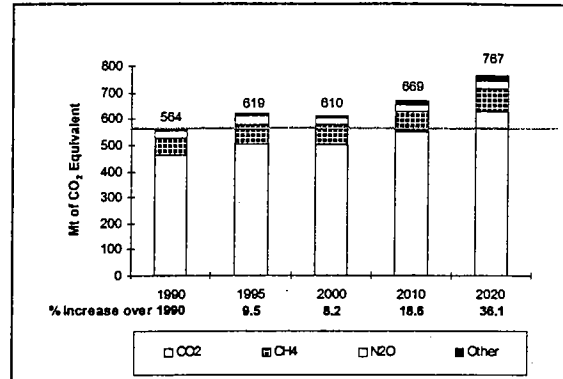
- climate change is a long term issue requiring long term planning; climate stability cannot be taken for granted
- a warmer climate is not a gloom-and-doom scenario, but there are impacts, and most of them are negative
- where new vulnerabilities or opportunities are identified, major land use or infrastructure changes would be needed (e.g. coastal zone protection, expanded irrigation networks); the impacts of such changes are not known
- there are new questions relating climate change to adaptation and sustainable development

Federal Government Perspectives The Road to Kyoto

Climate Change: Cross-Canada Briefings

November 7, 1997 - Vancouver

Domestic Context - Emissions



Source: NRCan

Why are projected emissions increasing?

- There are four main reasons why emissions are expected to rise:
 - the strong linkage between economic (GNP) growth and emissions growth
 - increasing population
 - low and stable energy prices
 - increasing carbon intensity of the energy mix in electrical generation

Canadian Position at Kyoto

(December 1 – 10, 1997)

- New meaningful, realistic and equitable legally binding targets
- Practical, step-by-step approach

Key Issues at Kyoto

- Targets and Time Tables
- Flexibility Elements - Baseline
- Differentiation
- Emissions Trading
- Joint Implementation (JI)
- Developing Countries' Participation
- Greenhouse Gas Coverage

Process for the Ratification of an International Agreement

1. Adoption of the Kyoto Agreement by the Parties to the FCCC.
2. Signature of the Agreement by Canada
3. Ratification of the Agreement by Canada
4. Entry into Force internationally

Process for the Ratification of an International Agreement

1. Adoption

- At the third CoP to FCCC this December, Canada and other Parties will indicate if they support adopting the final text

2. Signature with a view to ratification

- After the Kyoto meeting, there will be federal / provincial / territorial discussion of the outcome through the National Air Issues Coordinating Mechanism (NAICM)
- Cabinet will then decide if they wish to sign

Process for the Ratification of an International Agreement

3. Ratification

- A national implementation plan needs to be developed in conjunction with the provinces and territories prior to the ratification of the Kyoto agreement
- Full federal / provincial / territorial collaboration will be pursued too identify appropriate policies and measures by all orders of government
- The federal government would not ratify an agreement without broad-based support
- Requires Order-in-Council from Cabinet.

4. Entry into Force (under negotiation)

- Kyoto agreement would enter into force only after the ratification protocol is satisfied. The ratification protocol is still under negotiation

National Framework for Collaboration

The provinces and territories are key partners in the development and implementation of a national implementation plan

Key Considerations Implementation Principles

- NAPCC described a set of principles to guide domestic implementation of a climate change action plan in Canada
- The evolution of these principles have been the subject of extensive federal / provincial / territorial discussion

The principles are:

• Precautionary Principle	• International Cooperation
• Shared Responsibility	• Equitable Burden Sharing
• Competitiveness	• Effectiveness
• Flexibility	• Emitter Responsibility
• Transparency	• Accountability

Key Considerations Implementation Principles

- No single jurisdiction or government has full responsibility for efforts to reduce emissions; responsibilities of and actions by all our governments will be required
- Provincial and territorial jurisdictional (e.g. electricity generation, urban transportation and infrastructure) and constitutional responsibilities will be respected
- Canada's national economic and environmental interests and well as differing regional and sectoral circumstances and opportunities will be taken into consideration
- The national approach will recognize provincial actions and decisions and should be reflected in the implementation plan

Implementation Plan

Implementation should:

- build on existing initiatives such as the VCR
- use a phased approach for new measures
- consider the actions of our trade partners and market opportunities that exist
- recognize the need for sequencing decisions to maintain flexibility, and to take advantage of new information on effectiveness and costs
- use existing and new consultative/discussion mechanisms as appropriate

Stakeholder Involvement

- **Stakeholders, municipal levels of government, First Nations, industry, ENGOs and others will have an important role in the development of Canada's implementation plan**
- **Either through new fora (yet to be identified), or existing mechanisms, opportunities will be identified to consult with stakeholders on an implementation strategy**

RDG SPEAKING NOTES

Cross-Canada Briefing on Climate Change

The Federal Government Perspective Road to Kyoto

November 7, 1997 - Vancouver

November 7, 1997 Draft #2 by Stan Liu

Slide number mentioned in speaking notes corresponds to slide number in the Powerpoint Presentation

Slide 1

THANK YOU FOR INVITING ENVIRONMENT CANADA TO SPEAK ABOUT THE FEDERAL GOVERNMENT PERSPECTIVE ON CLIMATE CHANGE.

AS YOU CAN SEE, THE TITLE OF MY PRESENTATION IS NOT THE SAME AS THE ONE ON THE AGENDA. BECAUSE THE CANADIAN NEGOTIATION POSITION AT KYOTO HAS NOT YET BEEN ANNOUNCED, I WILL FOCUS MY PRESENTATION ON HOW THE FEDERAL GOVERNMENT IS DEVELOPING THE CANADIAN POSITION, WHAT CANADA WILL BRING TO KYOTO AND WHAT HAPPENS AFTER KYOTO.

YOU WILL NOTICE THAT I SAID WE ARE WORKING ON A CANADIAN POSITION, AND NOT A FEDERAL POSITION. I WANT TO POINT THIS OUT RIGHT FROM THE START BECAUSE THE FEDERAL GOVERNMENT IS NOT WORKING IN ISOLATION, WE ARE CONSULTING WITH PROVINCIAL AND TERRITORIAL GOVERNMENTS AND OTHER STAKEHOLDERS IN DEVELOPING THE CANADIAN POSITION.

I WILL BEGIN BY GOING OVER, VERY BRIEFLY, SOME BACKGROUND INFORMATION ABOUT THE CANADIAN GREENHOUSE GAS EMISSION INVENTORY.

Slide 2

CANADA CONTRIBUTES ABOUT 2% OF THE GLOBAL GREENHOUSE GAS EMISSIONS TO THE ATMOSPHERE. ABOUT 76% OF THE CANADIAN GREENHOUSE GAS EMISSIONS ARE ATTRIBUTABLE TO THE BURNING OF FOSSIL FUELS WITH TRANSPORTATION ACTIVITIES AS THE MAJOR USERS OF THESE FUELS. ENERGY DRIVES OUR ECONOMY AND 89% OF GREENHOUSE GAS EMISSIONS ARE ENERGY RELATED. BC AND YUKON CONTRIBUTE ABOUT 9.4% AND 0.5% OF THE CANADIAN GREENHOUSE GAS EMISSIONS, RESPECTIVELY.

THE STABILIZATION GAP IS EXPECTED TO GROW FROM 46 MEGATONNES IN 2000 TO 203 MEGATONNES IN 2020.

CURRENT MIX OF DOMESTIC ACTIONS ARE INSUFFICIENT TO MEET STABILIZATION OR REDUCTIONS FOR THE YEAR 2000 AND BEYOND.

Slide 3

CANADA'S GREENHOUSE GAS EMISSIONS WERE ABOUT 9 PER CENT HIGHER IN 1995 THAN IN 1990, RISING FROM 564 MEGATONNES OF CARBON DIOXIDE EQUIVALENT IN 1990 TO 619 MEGATONNES IN 1995. THIS INCREASE IS PRIMARILY DUE TO INCREASED ENERGY CONSUMPTION WHICH

**IS A REFLECTION OF POPULATION GROWTH
AND AN EXPANDING ECONOMY.**

**OVER THE SAME PERIOD, CANADA'S
POPULATION GREW 6.5 PER CENT, AND
THERE WAS ALSO A 3 PER CENT INCREASE
IN GREENHOUSE GAS EMISSIONS PER
CAPITA. GROSS DOMESTIC PRODUCTS (GDP)
INCREASED 8.2 PER CENT OVER THE SAME
PERIOD, RESULTING IN AN INCREASE IN
EMISSIONS OF 1.2 PER CENT PER UNIT OF
GDP.**

Slide 4

**THE FEDERAL GOVERNMENT IS COMMITTED
TO CONSULT WITH PROVINCIAL AND
TERRITORIAL GOVERNMENTS TO COME UP**

WITH THE CANADIAN NEGOTIATION POSITION AT KYOTO. THE TWO LEVELS OF GOVERNMENTS HAVE BEEN HOLDING MEETINGS AND TELEPHONE CALLS ON VIRTUALLY A WEEKLY BASIS FOR MANY MONTHS NOW TO WORK ON THE VARIOUS ISSUES. AS KYOTO APPROACHES, THE DISCUSSION IS INTENSIFYING. A MEETING OF THE JOINT MINISTERS OF ENVIRONMENT AND ENERGY WILL BE HELD IN REGINA ON NOVEMBER 12, AT WHICH TIME, THE FEDERAL AND PROVINCIAL MINISTERS WILL WORK ON DEVELOPING THE FINAL CANADIAN POSITION.

AT THIS TIME, I AM NOT ABLE TO TELL YOU ABOUT THE SPECIFICS AND DETAILS OF THE

DISCUSSION BUT THERE IS A BOARD RANGE OF ITEMS ON THE TABLE.

HOWEVER, I CAN TELL YOU THAT THE MAJOR ISSUES CURRENTLY UNDER DISCUSSION ARE NEW, MEANINGFUL, REALISTIC AND EQUITABLE, LEGALLY BINDING TARGETS TO LIMIT GREENHOUSE GAS EMISSIONS.

MEANINGFUL IN THAT THE TARGETS WILL ULTIMATELY RESULT IN REDUCTION OF DISCERNIBLE HUMAN INFLUENCE ON GLOBAL CLIMATE. REALISTIC IN TERMS OF ACHIEVING THE TARGETS COST-EFFECTIVELY, GIVEN OUR NATIONAL CIRCUMSTANCES AND OUR ABILITY TO DELIVER. EQUITABLE IN THAT ALL

**JURISDICTIONS AND INDUSTRY SECTORS
WILL SHARE IN THE BURDEN OR BENEFIT IN
ACHIEVING THE TARGETS.**

**CANADA'S GOAL WILL BE TO ENSURE
CONTINUED ECONOMIC GROWTH AND
PROTECT THE ENVIRONMENT. WE WILL DO
THIS THROUGH A PRACTICAL STEP-BY-STEP
APPROACH. UNDER THIS APPROACH, THERE
MIGHT BE SEVERAL TARGETS (FOR
EXAMPLE: STABILIZATION THEN REDUCTION
OF EMISSIONS) BASED ON A REASONABLE
TIMETABLE FOR EACH TARGET.**

**THE CANADIAN POSITION WILL BE
ANNOUNCED SOMETIME BETWEEN THE
JOINT MINISTERS' MEETING ON NOVEMBER**

**12TH AND THE KYOTO MEETING ON
DECEMBER 1ST.**

**THE COMPOSITION OF THE CANADIAN
DELEGATION TO KYOTO WILL STILL HAVE TO
BE DETERMINED. FIVE PROVINCES,
INCLUDING B.C., HAVE INDICATED AN
INTEREST IN ATTENDING. THEY WILL BE
ACCOMMODATED AS MUCH AS POSSIBLE.**

Slide 5

**NOW, LETS TALK ABOUT SOME OF THE KEY
ELEMENTS AT THE KYOTO NEGOTIATIONS.**

**ON TARGETS, A VARIETY OF DIFFERING
VISIONS REMAIN ON THE TABLE REGARDING
POST-2000 TARGETS FOR GREENHOUSE GAS**

EMISSION LIMITATIONS/REDUCTIONS FOR DEVELOPED COUNTRIES. THEY RANGE FROM A REDUCTION OF 15% FROM 1990 LEVELS TO 2010 (E.U.) TO STABILIZATION AT 1990 LEVELS IN THE 2008 – 2012 PERIOD (U.S.A.)

ON THE FLEXIBILITY ELEMENTS, THE MAIN ISSUES INCLUDE SINGLE YEAR VERSUS MULTI-YEAR BASELINES. MULTI-YEAR APPROACH COULD ALLOW PARTIES TO DEAL EFFECTIVELY WITH ANOMALIES CREATED BY ABNORMAL ECONOMIC, CLIMATIC OR TECHNOLOGICAL OCCURRENCES THAT MAY EMERGE OVER A ONE-YEAR TIME SPAN. HOWEVER, MULTIPLE BASE YEARS IS NOT CURRENTLY RECEIVING WIDE SUPPORT.

DIFFERENTIATION IS DEFINED AS INDIVIDUAL COUNTRY TARGETS AND TIMETABLES AS OPPOSED TO ONE FLAT-RATE TARGET FOR ALL COUNTRIES. IT IS A CONCEPT USED TO REFLECT THE FACT THAT COUNTRIES HAVE DIFFERENT NATIONAL CIRCUMSTANCES WHICH CAN RESULT IN DISPROPORTIONAL COSTS AND OPPORTUNITIES OF REDUCING GREENHOUSE GAS EMISSIONS. CANADA'S CIRCUMSTANCES INCLUDE CONSTANT FACTORS SUCH AS OUR COLD CLIMATE AND LONG DISTANCES AS WELL AS CHANGING FACTORS SUCH AS POPULATION GROWTH AND ECONOMIC STRUCTURE SHIFTS (E.G. ENERGY-INTENSIVE EXPORTS).

EMISSIONS TRADING IS AN ECONOMIC INSTRUMENT THAT CAN MINIMIZE THE COSTS OF ACHIEVING A GREENHOUSE GAS REDUCTION OBJECTIVE; PROVIDING PARTICIPATING PARTIES WITH THE OPPORTUNITY TO REDUCE EMISSIONS WHERE IT IS MOST COST-EFFECTIVE TO DO SO. EMISSIONS TRADING IS PROMOTED BY A NUMBER OF NON-EUROPEAN UNION PARTIES, PARTICULARLY THE UNITED STATES, AS A NECESSARY INSTRUMENT TO ALLOW PARTIES TO MEET THEIR NEW TARGET.

A JOINT IMPLEMENTATION (JI) PROJECT IS AN INTERNATIONAL PROJECT WHICH RESULTS IN A REAL, MEASURABLE AND LONG-TERM REDUCTION IN NET

GREENHOUSE GAS EMISSIONS IN A HOST COUNTRY. JI, WHICH IS IN ITS PILOT PHASE, CALLED ACTIVITIES IMPLEMENTED JOINTLY (AIJ) , IS OPEN TO VOLUNTARY PARTICIPATION BY ALL PARTIES. NO CREDITS ARE ALLOCATED AGAINST CURRENT (PRE-2000) COMMITMENTS.

ON THE QUESTION OF DEVELOPING COUNTRIES' PARTICIPATION, THE CONVENTION DOES NOT SET SPECIFIC EMISSIONS LIMITATION COMMITMENTS FOR DEVELOPING COUNTRIES, ONLY REPORTING/NATIONAL PROGRAMS REQUIREMENTS. CLIMATE CHANGE BEING A GLOBAL PROBLEM, DEVELOPED COUNTRIES WOULD LIKE TO SEE THE DEVELOPING WORLD TAKE ON SERIOUS MITIGATION

COMMITMENTS, PARTICULARLY IN LIGHT OF THE PROJECTED INCREASE OF GREENHOUSE GAS EMISSIONS FROM DEVELOPING COUNTRIES. AN ISSUE IS THE INCLUSION IN THE KYOTO AGREEMENT OF A PROVISION ADDRESSING NEGOTIATIONS OF NEW SUBSTANTIVE COMMITMENTS ON THE PART OF DEVELOPING COUNTRIES FOLLOWING KYOTO.

ON GREENHOUSE GAS COVERAGE, THE QUESTION IS WHETHER THE LEGALLY BINDING TARGETS SHOULD ENCOMPASS ALL GREENHOUSE GASES, ANTHROPOGENIC SOURCES AND SINKS OR ONLY THOSE GASES OR SOURCES WHICH ARE MOST EASILY ESTIMATED, SUCH AS

CARBON DIOXIDE, METHANE AND NITROUS OXIDE.

I THINK YOU WILL HEAR FROM THE NEXT SPEAKER THAT THESE KEY ELEMENTS ARE VERY SIMILAR, IF NOT IDENTICAL, TO THE KEY ELEMENTS RAISED BY THE BC GOVERNMENT.

Slide 6

AT THE CONCLUSION OF THE KYOTO NEGOTIATIONS UNDER THE FRAMEWORK CONVENTION ON CLIMATE CHANGE (FCCC) TO FULFILL THE BERLIN MANDATE, THERE ARE A NUMBER OF STEPS BEFORE THE LEGAL INSTRUMENT RESULTING FROM THESE NEGOTIATIONS WILL BECOME

BINDING ON CANADA IN INTERNATIONAL LAW. I WILL GO THROUGH EACH OF THE FOUR STEPS SHOWN ON THIS SLIDE.

Slide 7

AT THE THIRD CONFERENCE OF PARTIES TO FRAMEWORK CONVENTION ON CLIMATE CHANGE THIS DECEMBER, CANADA AND THE OTHER PARTIES WILL INDICATE IF THEY SUPPORT ADOPTING THE FINAL NEGOTIATED TEXT.

AFTER THE KYOTO MEETING, THERE WILL BE FEDERAL / PROVINCIAL / TERRITORIAL DISCUSSIONS OF THE OUTCOME THROUGH THE NATIONAL AIR ISSUES COORDINATING MECHANISM (NAICM). IT IS ONLY AFTER

**THESE DISCUSSIONS THAT CABINET WILL
DECIDE IF THEY WILL ISSUE THE NECESSARY
ORDER-IN-COUNCIL TO AUTHORIZE THE
CANADIAN GOVERNMENT TO SIGN THE
AGREEMENT.**

**SIGNATURE DOES NOT CREATE ANY
IMMEDIATE OBLIGATION FOR CANADA TO
CARRY OUT THE PROVISIONS OF THE
AGREEMENT BUT IT DOES IMPLY THAT
CANADA WILL NOT ACT CONTRARY TO THE
OBJECTIVES AND PURPOSE OF THE
AGREEMENT.**

Slide 8

**IN GENERAL, CANADIAN PRACTICE IS FOR
THE FEDERAL GOVERNMENT TO RATIFY AN**

INTERNATIONAL TREATY ONLY AFTER IT IS ASSURED THAT CANADA CAN MEET ITS OBLIGATIONS UNDER THE TREATY. IN SOME INSTANCES, THIS MAY INCLUDE APPROPRIATE DOMESTIC POLICIES AND MEASURES, OR OTHER INSTRUMENTS.

FOR RATIFICATION OF A CLIMATE CHANGE TREATY WE WILL NEED TO DEVELOP A NATIONAL IMPLEMENTATION PLAN IN CONJUNCTION WITH THE PROVINCES AND TERRITORIES PRIOR TO THE RATIFICATION OF THE KYOTO AGREEMENT. GIVEN THE NATURE OF THE CLIMATE CHANGE ISSUE, FULL FEDERAL / PROVINCIAL / TERRITORIAL COLLABORATION WILL BE PURSUED TO IDENTIFY APPROPRIATE POLICIES AND MEASURES BY ALL ORDERS OF

**GOVERNMENT. THE FEDERAL GOVERNMENT
WOULD NOT RATIFY AN AGREEMENT
WITHOUT BROAD-BASED SUPPORT,
WITHOUT A CLEAR PATH TO
IMPLEMENTATION AND WITHOUT EXTENSIVE
INVOLVEMENT OF PROVINCIAL AND
TERRITORIAL PARTNERS. THE CABINET
WILL HAVE TO APPROVE ANOTHER ORDER-
IN-COUNCIL TO AUTHROIZE THE CANADIAN
GOVERNMENT TO RATIFY THE AGREEMENT.**

**A LEGAL INSTRUMENT WOULD ENTER INTO
FORCE ONCE THE CONDITIONS OF
RATIFICATION SPECIFIED IN THE
NEGOTIATED AGREEMENT HAVE BEEN MET.
THE CONDITIONS NECESSARY FOR THE
ENTRY INTO FORCE ARE PART OF THE ON-**

GOING NEGOTIATIONS PROCESS AND AT KYOTO.

Slide 9

**LOOKING FORWARD, WE ARE NOW MOVING
INTO A NEW STAGE IN ADDRESSING THE
CLIMATE CHANGE ISSUE; THE
DEVELOPMENT OF CANADA'S
IMPLEMENTATION PLAN TO DEAL WITH
POST-2000 GHG EMISSIONS REDUCTIONS.
RECOGNIZING THAT FEDERAL / PROVINCIAL /
TERRITORIAL COLLABORATION AND ACTION
WILL BE NECESSARY TO ACHIEVE THE
REQUIRED EMISSIONS REDUCTIONS, ALL
LEVELS OF GOVERNMENTS ARE KEY
PARTNERS IN THE DEVELOPMENT AND
IMPLEMENTATION OF A NATIONAL**

**IMPLEMENTATION PLAN. IT IS IN CANADA'S
BEST INTEREST FOR ALL JURISDICTIONS TO
ACT COOPERATIVELY RATHER THAN
UNILATERALLY IN THE DEVELOPMENT OF
THE IMPLEMENTATION PLAN.**

Slide 10

**THE NATIONAL ACTION PLAN ON CLIMATE
CHANGE (NAPCC) DESCRIBES A SET OF
PRINCIPLES TO GUIDE DOMESTIC
IMPLEMENTATION OF A CLIMATE CHANGE
ACTION PLAN IN CANADA. THE EVOLUTION
OF THESE PRINCIPLES HAVE BEEN THE
SUBJECT OF EXTENSIVE FEDERAL /
PROVINCIAL / TERRITORIAL DISCUSSION.
THE CURRENT SET OF PRINCIPLES, AS**

**MODIFIED THROUGHOUT THE DISCUSSIONS,
ARE SHOWN AT THE BOTTOM OF THIS SLIDE.**

Slide 11

**AS WELL, THE PRINCIPLES OUTLINED IN
CANADA'S COMPREHENSIVE AIR QUALITY
MANAGEMENT FRAMEWORK COULD ASSIST
IN GUIDING THE FEDERAL GOVERNMENT,
PROVINCES AND TERRITORIES IN THE
DEVELOPMENT OF AN IMPLEMENTATION
PLAN. AS OUTLINED IN THE CANADIAN AIR
QUALITY MANAGEMENT FRAMEWORK FOR
CANADA, *"NO SINGLE JURISDICTION OR
GOVERNMENT HAS FULL RESPONSIBILITY
FOR EFFORTS TO REDUCE EMISSIONS;
RESPONSIBILITIES OF AND ACTIONS BY ALL
OUR GOVERNMENTS WILL BE REQUIRED."***

THE PRINCIPLES WHICH WILL ULTIMATELY GUIDE THE DEVELOPMENT OF A DOMESTIC IMPLEMENTATION PLAN IN CANADA CONTINUES TO EVOLVE.

THE DEVELOPMENT OF A DOMESTIC IMPLEMENTATION PLAN SHOULD FOLLOW A PRACTICAL STEP-BY-STEP APPROACH, IDENTIFYING AND FOCUSING ON THE MOST COST-EFFECTIVE ACTIONS FIRST, AT BOTH THE FEDERAL AND PROVINCIAL LEVELS. THE NATIONAL APPROACH WILL RECOGNIZE PROVINCIAL ACTIONS AND DECISIONS AND SHOULD BE REFLECTED IN THE IMPLEMENTATION PLAN.

THE PRIME MINISTER RECENTLY STATED THAT, AND I QUOTE, MITIGATION MEASURES

“WILL BE FAIR TO ALL REGIONS, PROVINCES AND SECTORS ACROSS CANADA. WE ARE NOT INTERESTED IN PENALIZING OR SINGLING OUT ONE REGION AND ONE INDUSTRY”

Slide 12

THE NATIONAL IMPLEMENTATION PLAN WILL BUILD ON THE EXISTING INITIATIVES SUCH AS THE VOLUNTARY CHALLENGE AND REGISTRY (VCR). 619 COMPANIES AND ORGANIZATIONS, ACCOUNTING FOR OVER ONE-HALF OF THE GREENHOUSE GAS EMISSIONS IN CANADA, ARE PARTICIPATING IN THE VCR AS OF DECEMBER 1996. OF THESE, 284 HAVE FILED ACTION PLANS TO REDUCE EMISSIONS.

SEVERAL ONGOING MEANS UNDER THE NAICM, SUCH AS THE NATIONAL AIR ISSUES COORDINATING COMMITTEE (NAICC) AND CLIMATE CHANGE WORKING GROUP, HAVE PROVIDED A USEFUL AND PRODUCTIVE FORUM FOR DISCUSSIONS ON CLIMATE CHANGE AND SHOULD MAINTAIN THAT ROLE POST-KYOTO.

Slide 13

STAKEHOLDERS, MUNICIPAL LEVELS OF GOVERNMENT, FIRST NATIONS, INDUSTRY, ENGOS AND OTHERS WILL HAVE AN IMPORTANT ROLE IN THE DEVELOPMENT OF CANADA'S IMPLEMENTATION PLAN. , OPPORTUNITIES WILL BE IDENTIFIED TO

CONSULT WITH STAKEHOLDERS ON THE IMPLEMENTATION STRATEGY, EITHER THROUGH NEW FORA, OR EXISTING MECHANISMS SUCH AS THE NON-GOVERNMENT ADVISORY GROUP (NGAG) & THE STAKEHOLDER ADVISORY COMMITTEE OF THE NAICC.

CLOSING REMARKS

THAT'S MY PRESENTATION, BUT BEFORE I LEAVE, I WOULD LIKE TO SAY SOMETHING ABOUT THE BC GREENHOUSE GAS FORUM AND THE FORUM'S REPORT WHICH WAS RELEASED LAST WEEK. I UNDERSTAND THE NEXT SPEAKER, DON FAST, WILL BE TALKING IN DETAIL ABOUT THE FORUM'S ACTIVITIES AND THE REPORT. THE REPORT

**IS A CONSTRUCTIVE CONTRIBUTION ON
CANADA'S APPROACH TO KYOTO. THE
RECOMMENDATIONS ARE ALL WORTHWHILE
GOALS WHICH THE FEDERAL GOVERNMENT
IS PURSUING. ON BEHAVE OF THE FEDERAL
GOVERNMENT, I WANT TO THANK THE
FORUM FOR ITS WORK.**

THANK YOU.

END

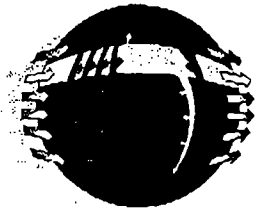
Montréal - Québec

Mercredi le 12 novembre 1997



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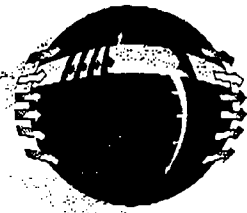
Objectifs:

- Faire le point le concernant cet important sujet d'actualité,
- Comprendre la complexité du problème grâce à la participation de spécialistes renommés en sciences naturelles et sciences humaines et sociales,
- Aborder la question de façon multisectorielle, soit avec des représentants universitaires, gouvernementaux, d'entreprises et de groupes de pression



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Les changements climatiques:

Séance d'information en vue de la réunion de Kyoto

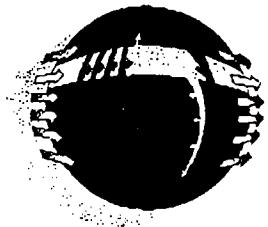
Présentée pour la journée de Montréal par:

- le Programme canadien des changements à l'échelle du globe
- l'Institut des sciences de l'environnement de l'UQAM
- l'Association de climatologie du Québec



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Survol des connaissances scientifiques

L'équilibre climatique de la planète

L'effet de serre

L'instabilité du climat de notre planète au
cours de son histoire

Le climat: résultante d'une superposition de
nombreux cycles planétaires

L'exemple d'un grand changement
climatique récent

Les différentes composantes naturelles de
notre climat actuel

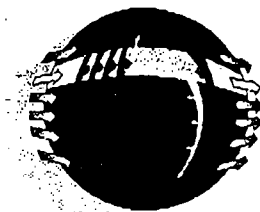
Les rejets anthropiques de gaz à effet de
serre

L'évolution actuelle de notre climat



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En guise de préambule...

Les grandes civilisations humaines se sont développées grâce à une stabilité climatique exceptionnelle des derniers 6000 ans...

Les réserves alimentaires mondiales sont de moins d'un an...

La population mondiale vient de doubler en 30 ans...

80% de la population mondiale vit à moins de 5 mètres d'altitude...

Lors de la dernière période glaciaire, les températures moyennes étaient à peine 4°C plus basses qu'aujourd'hui...

Avec les États-Unis et le Brésil, nous détenons au Canada le record per capita d'émissions annuelles de gaz à effet de serre...



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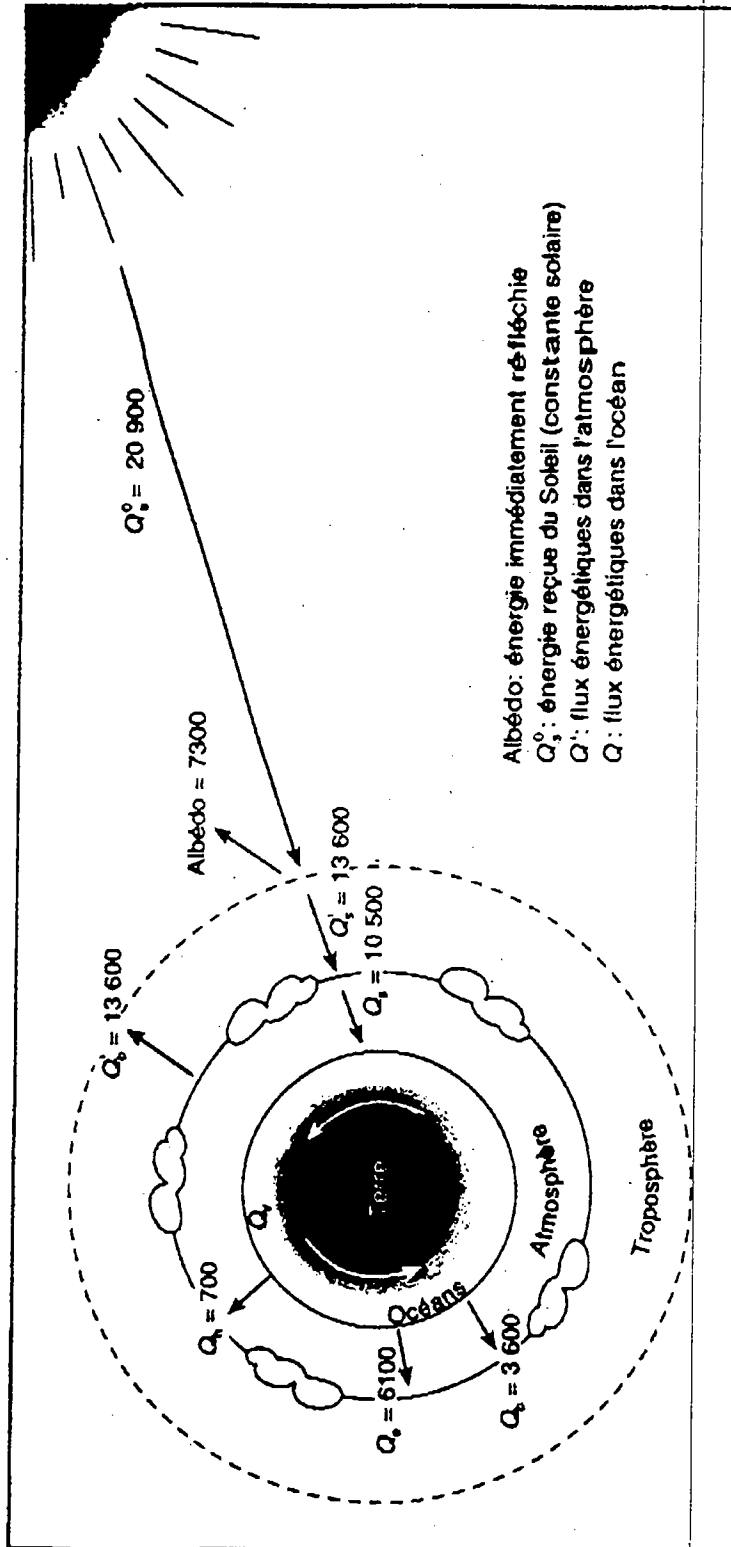
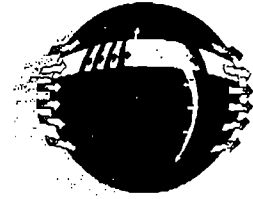


Figure 13.17 Transferts de chaleur entre l'atmosphère et les océans, exprimés en J/cm²/s. Chaque flux représente une moyenne intégrée pour toute la planète. Les déficits ou surplus d'énergie locaux sont équilibrés par les vents et les courants océaniques qui n'apparaissent pas sur ce schéma.

EFFET DE SERRE

Mitchell: "GREENHOUSE" EFFECT

Q_s'

Q_b'

27,1 / REVIEWS OF GEOPHYSICS • 117



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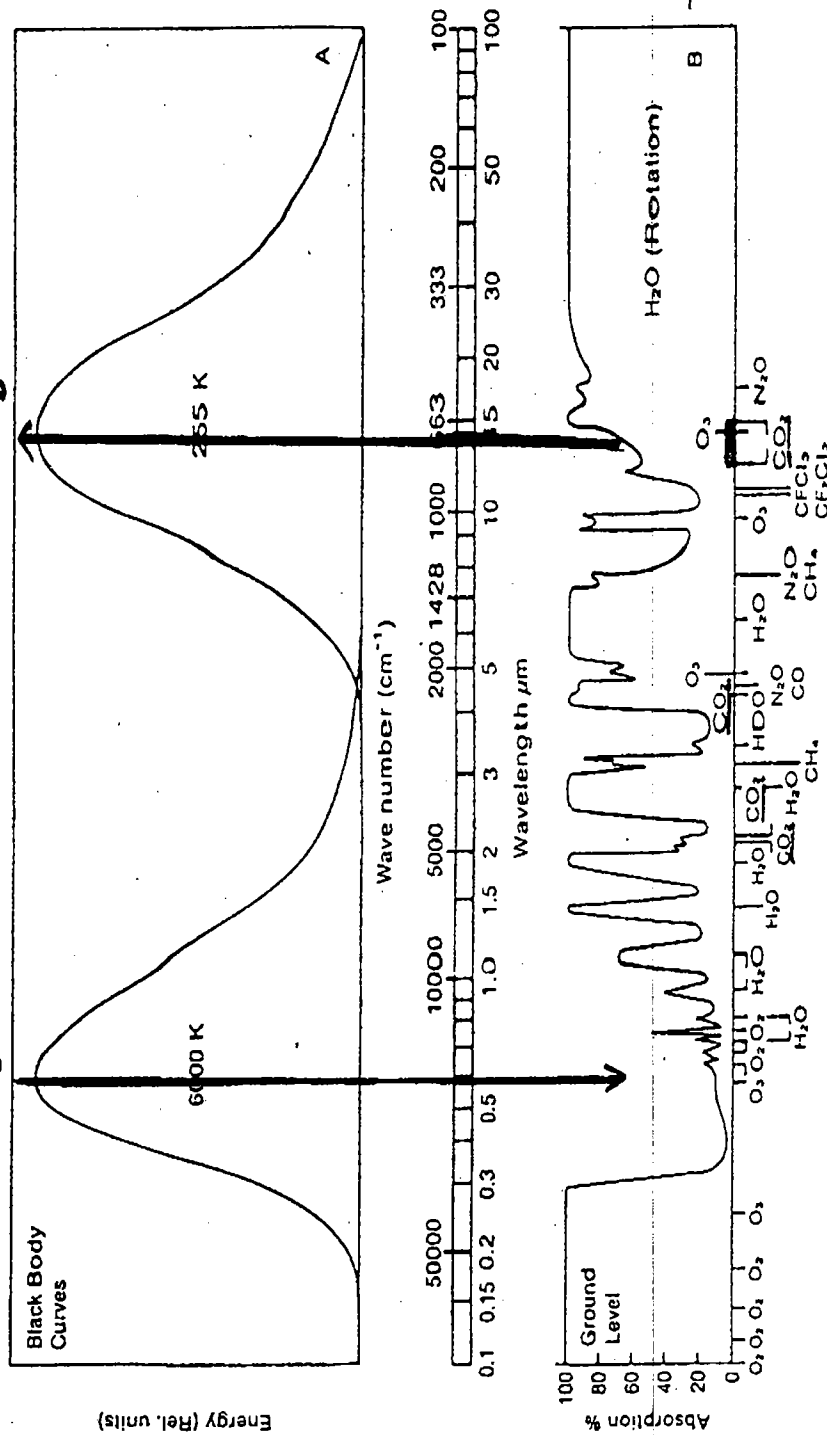


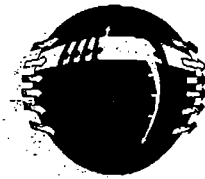
Figure 2. (a) Spectral distribution of long-wave emission from blackbodies at 6000 K and 255 K, corresponding to the mean emitting temperatures of the Sun and Earth, respectively, and (b) percentage of atmospheric absorption for radiation passing from the top of the atmosphere to the surface. Notice the comparatively weak absorption of the solar spectrum and the region of weak absorption from 8 to 12 μm in the long-wave spectrum [from MacCracken and Luther, 1985].

Sans effet de serre, T_{planète} ≈ -18 °C





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Carbone dans l'histoire de la planète

Variations internes sur une échelle géologique (→ notions d'échelle de temps des processus).

⇒ Importance du CO_2 et de l'effet de serre dans l'équilibre climatique de la planète

Archéen: (il y a plus de $2.5 \cdot 10^9$ ans)

- 30 à 1000 X pCO_2 d'aujourd'hui
- Intensité du Soleil $\approx 70\%$ celle d'aujourd'hui
- $T^\circ (?) < 50^\circ\text{C} (?)$

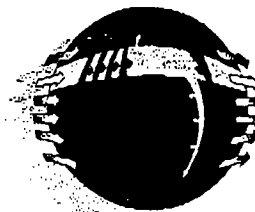
Protérozoïque: (il y a moins de $2.5 \cdot 10^9$ ans)

- 5 à 10 X pCO_2 d'aujourd'hui
- Intensité du Soleil $\approx 90-95\%$ celle d'aujourd'hui
- $T^\circ \approx 20-30^\circ\text{C}$
- Glaciations



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En gros, il existe une corrélation entre les estimations des teneurs en CO₂ dans l'atmosphère et les estimations des températures moyennes de notre planète

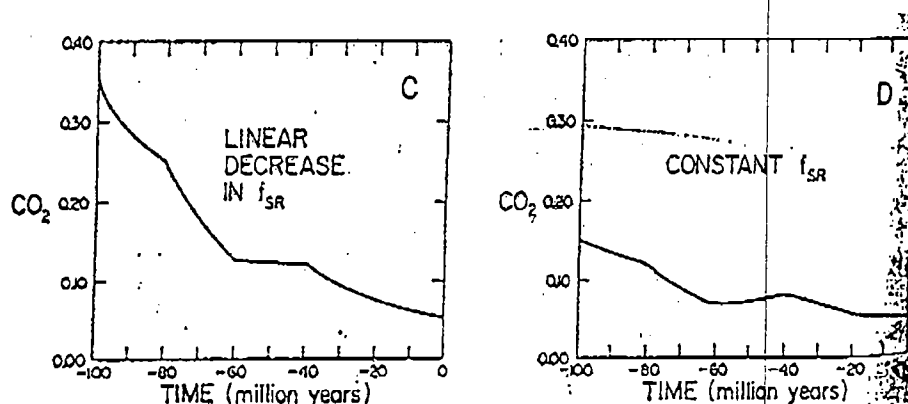


Fig. 5. Computer results for the mass of CO₂ (in 10¹⁴ moles) as a function of time for the past 100 my using the land area curve of Barron and others (1980) (see fig. 2) and various spreading rate formulations (see fig. 4 for details on spreading rates):

- A. Pitman (1978) spreading rate. (Dashed line based on value, assumed here, of $f_{SR}(0)$ 1.70 at 100 my pr.)
- B. Southam and Hay (1977) spreading rate corrected for loss by subduction (see text).
- C. Linear decrease in spreading rate from 20 percent higher at 100 my pr.
- D. Constant spreading rate with time equal to the present value.

NOTE DIFFERENCES IN VERTICAL (CO₂) SCALE, BUT WITH THAT FOR C AND D BEING THE SAME.

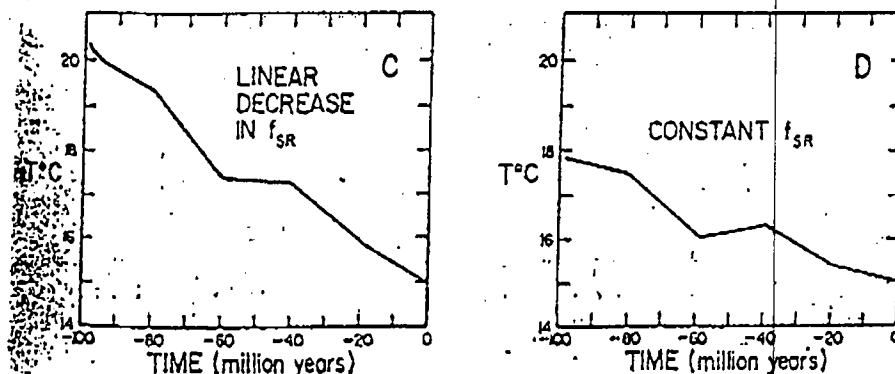
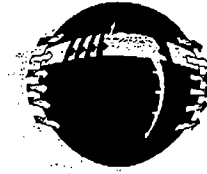


Fig. 6. Computer results for worldwide mean annual air surface temperature as a function of time corresponding to each of the four situations for CO₂ depleted in figure 5. NOTE DIFFERENCES IN VERTICAL (TEMPERATURE) SCALE, BUT WITH THAT FOR C AND D BEING THE SAME.

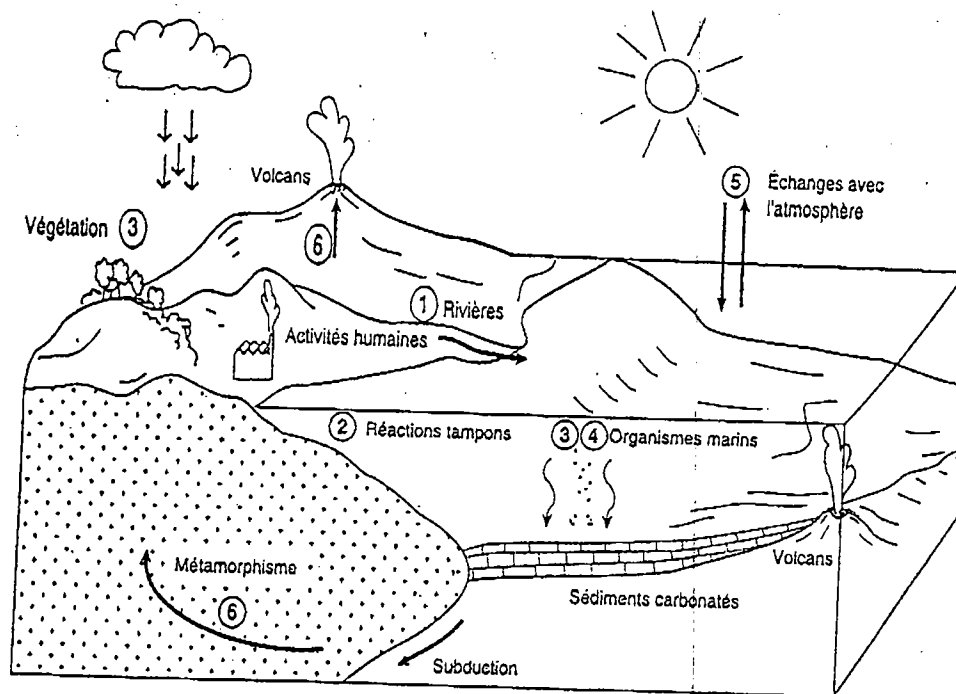


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Les teneurs en CO₂ dans l'atmosphère, qui
contrôlent en grande partie le climat,
dépendent du complexe cycle du carbone à
la surface de notre planète





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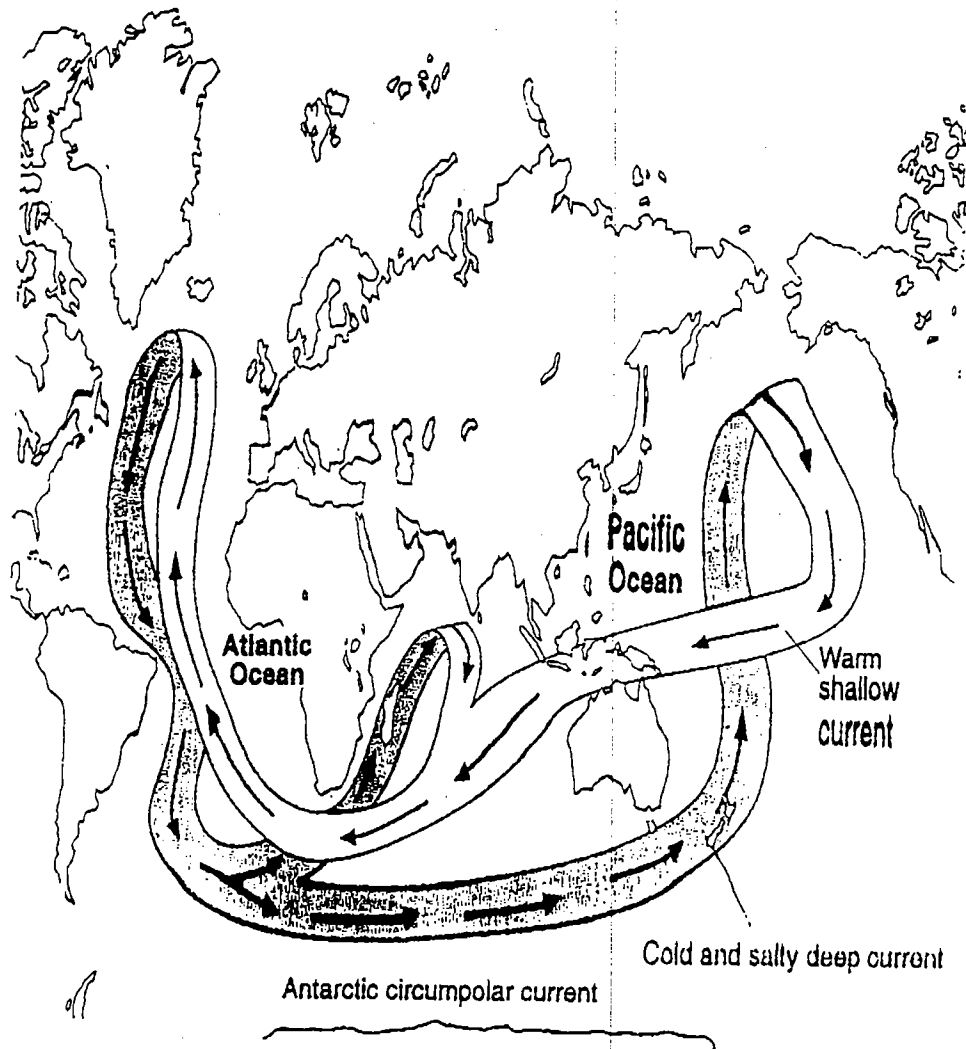
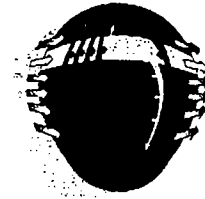
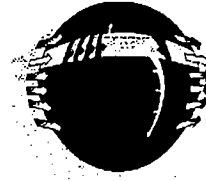


Figure 2. Conveyor belt of oceanic surface and deep-water currents, illustrating the major pattern of deep-sea circulation deduced from chemical tracer measurements.



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Passage d'une période glaciaire à une période interglaciaire

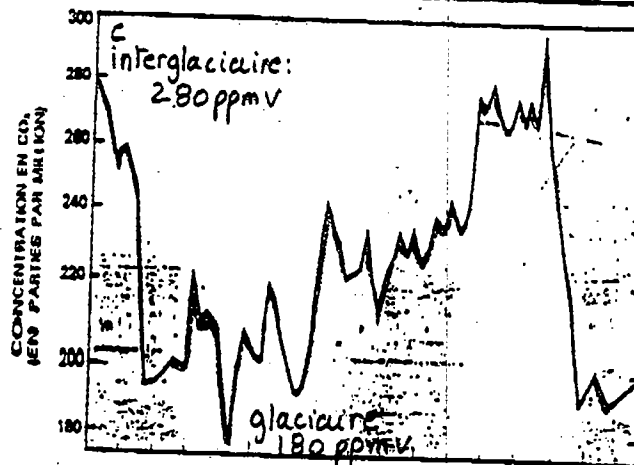
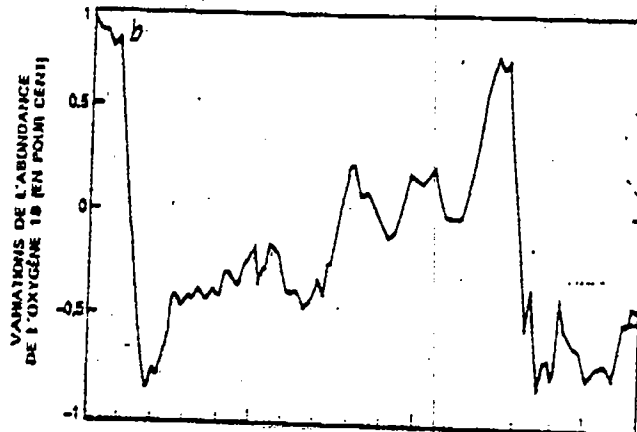
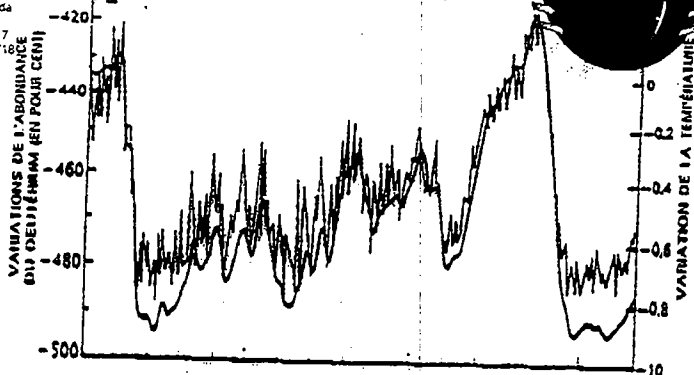
- Cycle astronomique de Milankovitch
- Influence sur les productions primaires des hautes et des basses latitudes, qui par ricochet influencent les teneurs en CO₂ dans l'atmosphère
- Poursuite de l'influence de l'effet de serre sur la boucle de convoyage et sur les niveaux marins, et effets rétroactifs amplifiés



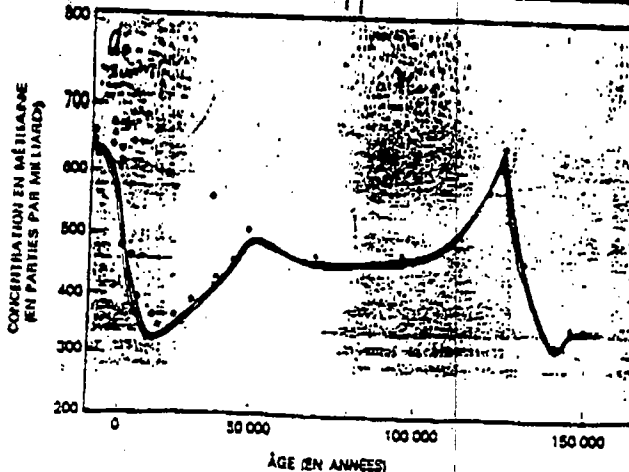
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PROFONDEUR (EN MÈTRES)



CO₂

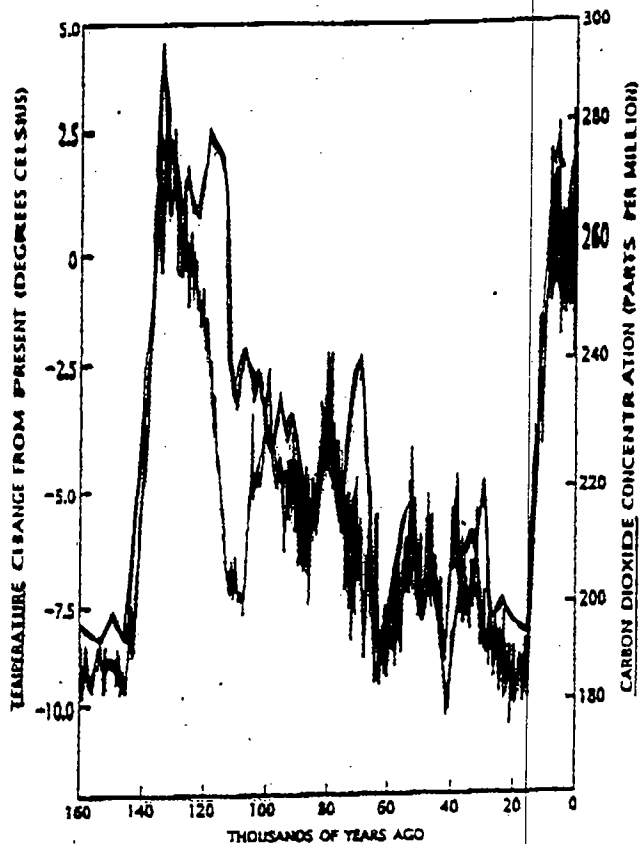
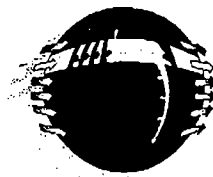


CH₄



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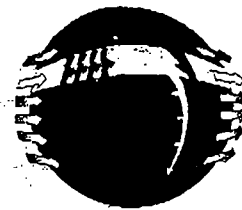
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Deux exemples de possibilités de rétroactions négatives sur le climat:

1. Augmentation du CO₂, donc des
températures, et de l'évaporation

- avec pour conséquence l'augmentation des
précipitations neigeuses aux hautes latitudes,
c'est-à-dire de l'albédo, entraînant un
refroidissement rapide

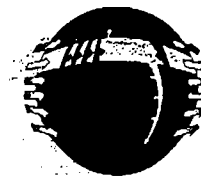
2. Augmentation du CO₂, donc des
températures surtout aux hautes latitudes

- avec pour conséquence de ralentir
considérablement la boucle de convoyage et
de déstabiliser l'équilibre planétaire en
quelques années



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Fluctuations climatiques attribuables à des forçages "naturels":

- La faible activité solaire entre 1645 et 1715
a provoqué "le petit âge glaciaire"

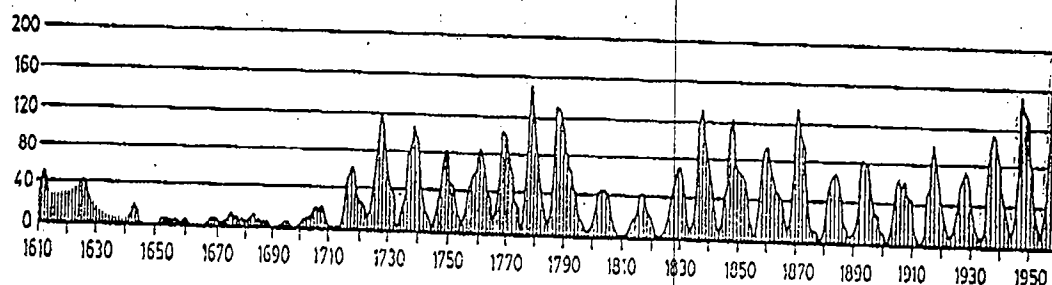
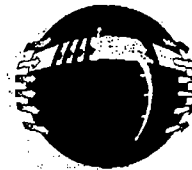


FIG. 6. The annual mean sunspot number. The decreased sunspot number between 1645 and 1715 (the Maunder minimum) was both and followed by the Little Ice Age (Beaty 1978).



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Les poussières des grandes éruptions volcaniques provoquent des refroidissements notoires du climat planétaire

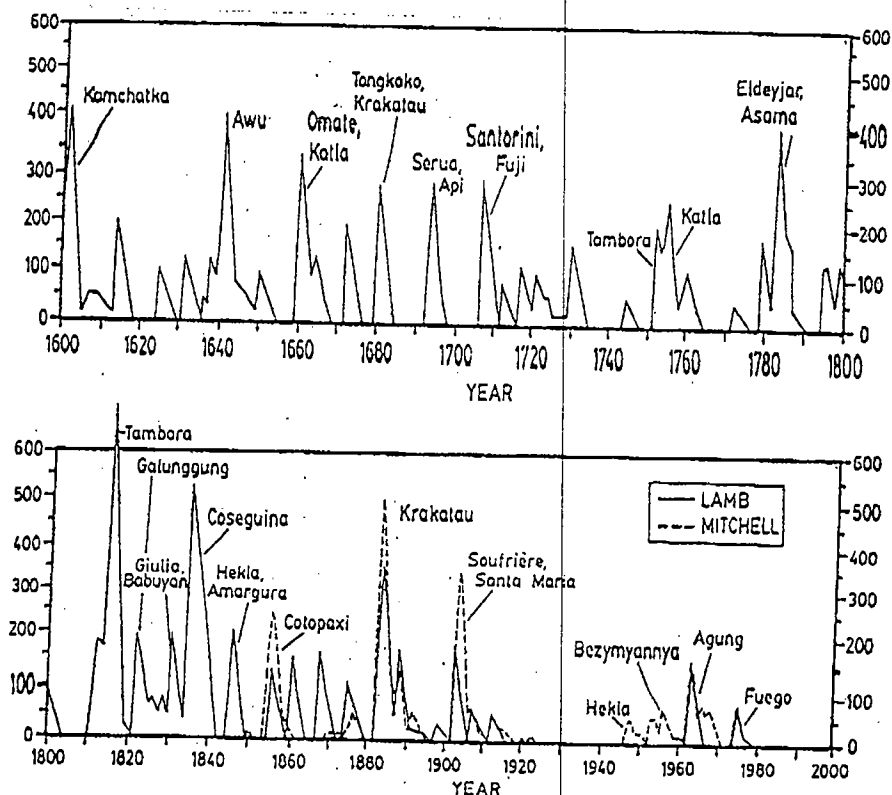
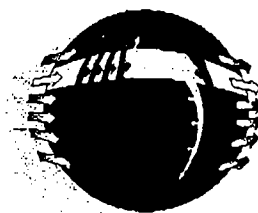


Fig. 8. Volcanic dust veil index (DVI) for the Northern Hemisphere. (Redrawn with permission from Robock 1978, p. 1117, © 1978 Meteorological Society.)



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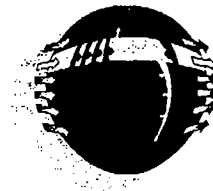
Réservoirs globaux du carbone

D'après Hedges J.I. (1992), *Mar. Chem.* 39: 67-93

Réservoirs de Carbone	Masse approximative (10^{18} g.C)	Proportion du total (%)
Réservoir total	<u>75 043.06</u>	
Roches sédimentaires		
Carbonates (roches et sédiments)	60 000	<u>≈ 80</u>
Carbone organique fossile (kérogène, charbon,...)	15 000	<u>≈ 20</u>
Réservoirs actifs (de surface)		
Inorganique		
CID marin	38	<u>0.05</u>
carbonate des sols	1.1	0.001
CO ₂ atmosphérique	0.66	$9 \cdot 10^{-4}$
Organique		
Humus des sols	1.6	0.002
Plantes terrestres	0.95	0.001
COD marin	0.60	$8 \cdot 10^{-4}$
Sédiments marins de surface	0.15	$2 \cdot 10^{-4}$



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Perturbation du cycle du carbone

Teneur en C dans l'atmosphère:

$700 \times 10^9 \text{ tC}$

Rejets anthropiques de C dans l'atmosphère:

$7 \times 10^9 \text{ tC/an}$ (1% de la teneur totale)

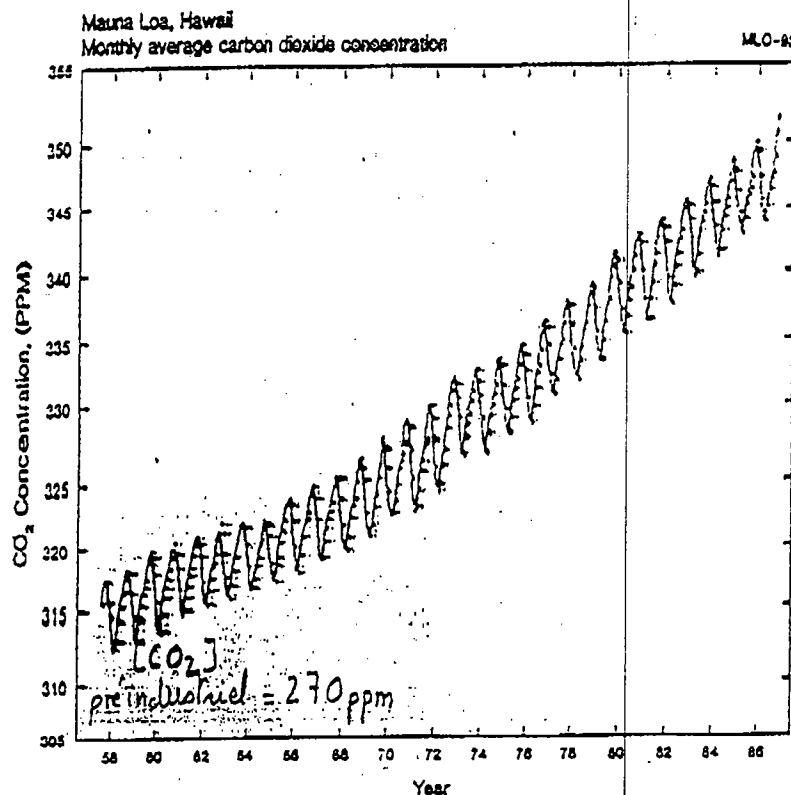


Figure 10.2

Concentration of atm
carbon dioxide in pa
of dry air versus time
observed at the Maun
Observatory, Hawaii.
indicate monthly ave
concentrations.

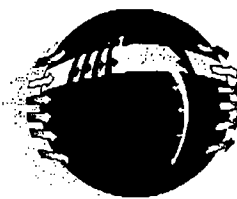
A titre de comparaison,

- Production biologique marine:

$27 \times 10^9 \text{ tC/an}$

- Production biologique terrestre:

$70 \times 10^9 \text{ tC/an}$



Sources anthropiques de CO₂

- Combustion de produits carbonés
"fossiles": $5.5 \times 10^9 \text{t/an}$

Déforestation: $1.6 \times 10^9 \text{t/an}$

Incinération des déchets: $0.1 \times 10^9 \text{t/an}$

Termites (sols dégradés): $0.2 \text{ à } 1.2 \times 10^9 \text{t/an}$

Puits de CO₂

Accumulation dans l'atmosphère:
 $3.2 \times 10^9 \text{t/an}$

Océans $2 \times 10^9 \text{t/an}$

Forêts en régénération dans l'hémisphère
Nord: $0.5 \times 10^9 \text{t/an}$

Puits manquant $1.5 \times 10^9 \text{t/an}$



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- Environ 60% de l'effet de serre anthropique
actuel est attribuable au CO₂

- L'effet de serre comparatif d'autres gaz est
obtenu en tenant compte de leur forçage
instantané et de leur temps de séjour dans
l'atmosphère.

TABLE 1 Global warming potentials for various greenhouse gases on mole and weight bases relative to carbon dioxide

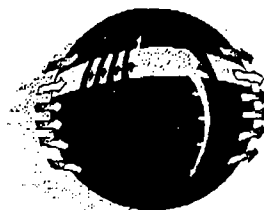
Gas	Residence time (yr)	(Molar basis)		(Weight basis)		1 F
		Instantaneous forcing (W m ⁻² p.p.m. ⁻¹)	Cumulative forcing (W m ⁻² yr Pmol ⁻¹)	Global warming potential	Cumulative forcing (W m ⁻² yr Pg ⁻¹)	
CO ₂	230	0.015	19	1.0	0.42	
CO	(2.1)	(0.65)	26	1.4	0.94	
CH ₄	(14.4)	(0.65)	71	3.7	4.4	
N ₂ O	160	3.8	3,400	180	77	
HCFC-22	15	190	15,000	810	180	
CFC-11	60	220	74,000	4,000	540	1
CFC-12	120	280	190,000	10,000	1,600	3

Residence times are derived as follows: CO₂ (ref. 14), CH₄ and N₂O (ref. 20) and CFCs (ref. 6). The residence times of CO₂ and CH₄ are discussed in the text. CO is ascribed a residence time equivalent to 0.22 times that of methane (see text). The cumulative forcing and GW CH₄ are based on net carbon and therefore include the warming potential of CO₂. Instantaneous radiative forcings are based on the param given in ref. 3, except for HCFC-22 which is calculated from tables in ref. 4. Values that depend on concentration are based on increasing to 450 p.p.m., increasing CH₄ from 1.7 to 2.7 p.p.m. with a 70% amplification (see text), and increasing N₂O from 0.31 to 0.41 p.p.m. Climate estimated to be 0.5-1.3 °C W⁻¹ m², corresponding to a warming of 2-5 °C for a doubling of CO₂ (ref. 12).



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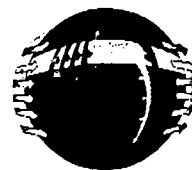
Le méthane, autre gaz à effet de serre important

- Environ 15 à 20% de l'effet de serre anthropique est attribuable aux émissions de CH_4 (rizières, élevage d'animaux, forages et transports gaziers, brûlage de biomasse, termites, sites d'enfouissement, mines de charbon).
- Les teneurs atmosphériques en CH_4 ont augmenté de 30% en 40 ans.
- Le temps de séjour moyen du CH_4 dans l'atmosphère étant court (moins de 14 ans), l'importance relative du CH_4 comme gaz à effet de serre par rapport au CO_2 dépend de l'horizon de temps sur lequel on travaille.



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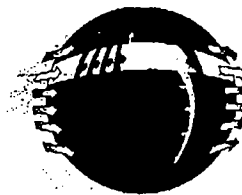
Les autres gaz à effet de serre émis par les activités humaines

- Les oxydes nitreux (agriculture intensive), les chlorofluoro-carbones (CFC) et l'ozone à basse altitude (pollution de l'air) sont responsables des 20% restant de l'effet de serre anthropique.
- Les émissions atmosphériques de CFC se sont stabilisées depuis une dizaine d'années



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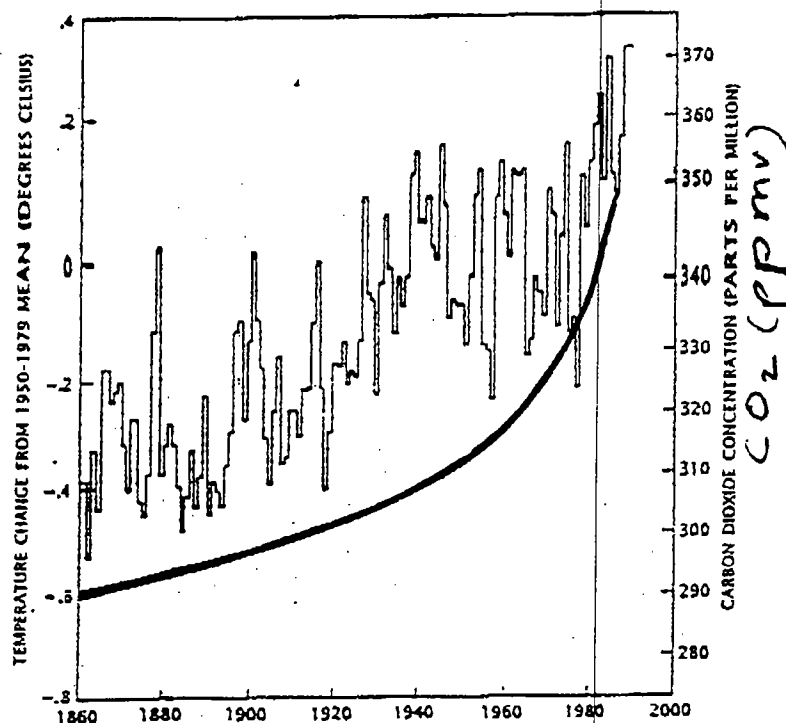
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En 100 ans, les teneurs en CO₂ dans l'atmosphère ont augmenté de 30%.

Parallèlement, la température moyenne de la planète a augmenté de 0.3 à 0.6 °C.

Les 10 dernières années ont été les plus chaudes du siècle.



CARBON DIOXIDE AND TEMPERATURE are very closely correlated over the past 160,000 years (top) and, to a lesser extent, over the past 100 years (bottom). The long-term record, based on evidence from Antarctica, shows how the local temperature (color) and atmospheric carbon dioxide rose nearly in step as an ice age ended about 130,000 years ago, fell almost in synchrony at the onset of a new glacial period and rose again as the ice retreated about 10,000 years ago. The recent temperature record shows a slight global warming (color), as traced by workers at the Climatic Research Unit of the University of East Anglia. Whether the accompanying buildup of carbon dioxide in the atmosphere caused the half-degree warming is hotly debated.

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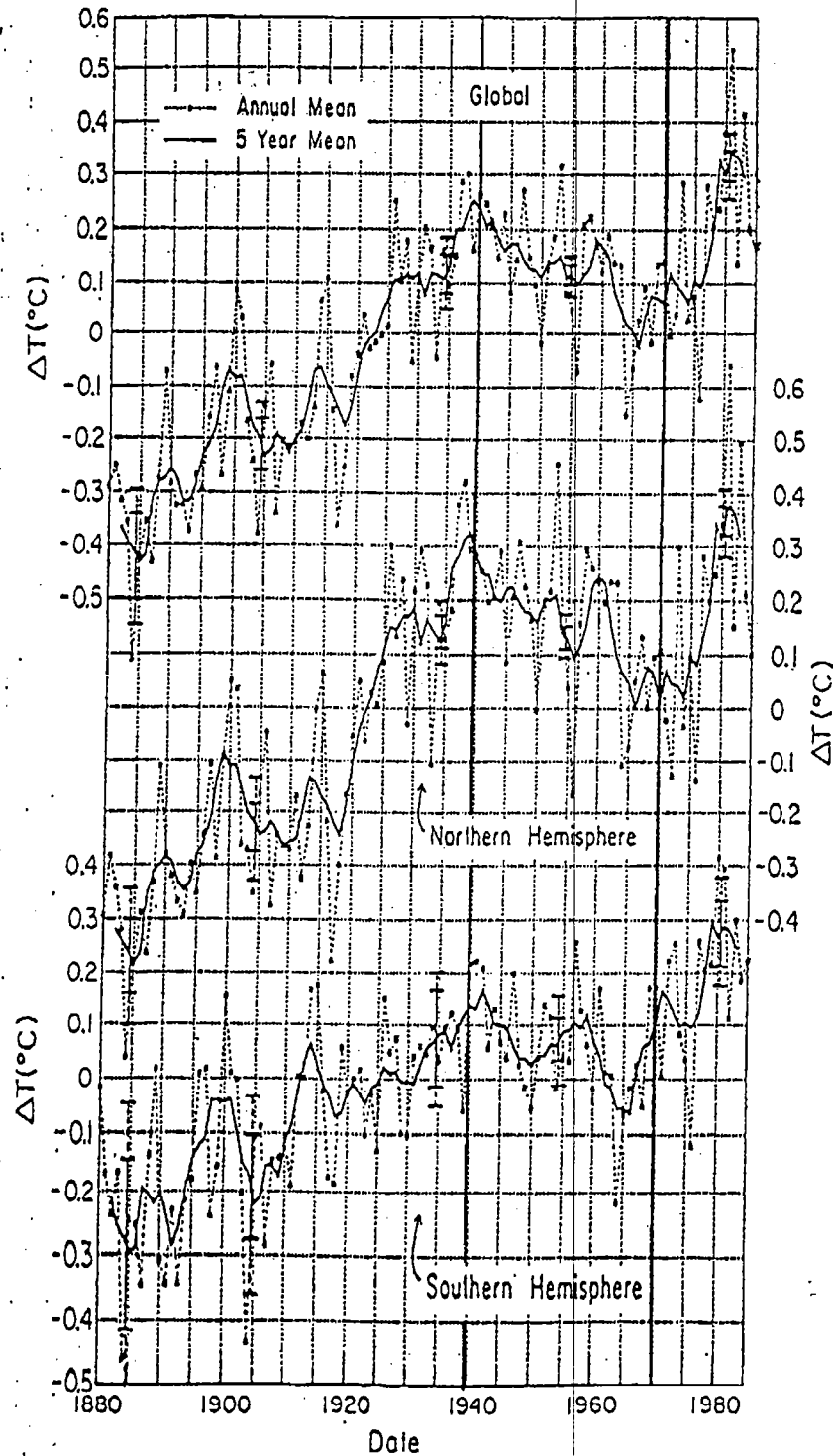
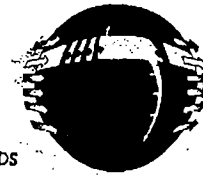


Fig. 6. Global and hemispheric surface air temperature change estimated from meteorological station records. The northern hemisphere scale is on the right. The 5-year running mean is the linear average for the 5 years centered on the plotted year. The uncertainty bars (95% confidence limits) are based on the error analysis in section 5; the inner bars refer to the 5-year mean and the outer bars to the annual mean.



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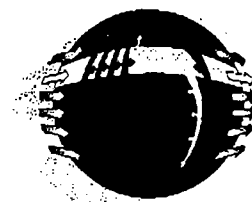
Autres indices de changements climatiques à l'échelle du globe

- Les températures nocturnes ont augmenté plus que les températures diurnes
- Le niveau moyen des océans a monté de 10 à 25 cm depuis 100 ans
- La fréquence et l'intensité des événements climatiques exceptionnels a augmenté (d'après les compagnies d'assurance)
- Les intensités des récents phénomènes d'El Niño sont supérieures à celles des phénomènes plus anciens
- Changements régionaux: discutés à la suite.



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En guise de conclusion d'étape:

Comment discerner les effets attribuables
aux activités humaines des variations
naturelles de notre climat?

Comment prédire l'ampleur des changements
climatiques anticipés alors qu'on ne peut
prédire avec précision le temps qu'il fera à
plus de 3 jours d'avance?

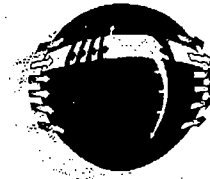
Quelques certitudes:

- les gaz émis dans l'atmosphère par les
activités humaines ONT un effet de serre,
- les augmentations des teneurs en GES que
nous vivons en ce moment se font à un
rythme beaucoup plus rapide que ce que
notre planète a connu au cours des dernières
centaines de milliers d'années,
- nous nous dirigeons vers un réchauffement
climatique, mais à quel rythme?, avec
quelles conséquences? avec quels risques de
bascullement climatique?



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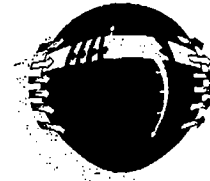
Moyens de contrôle des gaz à effet de serre

En principe, les masses d'eau océaniques profondes, sous-saturées en CO₂, peuvent recevoir les surplus anthropiques de ce gaz. Mais, les échanges (boucle de convoyage,) sont très lents.

Divers scénarios de géoingénierie ont été proposés:



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- Injection de CO₂ atmosphérique produit par les centrales thermiques dans les océans profonds

- 1. Séparation du CO₂ des autres gaz de
combustion

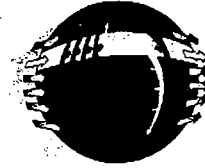
2. Compression du CO₂ à environ 150 bars
(opération requérant 1/3 de l'énergie de
combustion)

3. Augmentation des coûts de production de
l'électricité de 4 à 10 cents US/kW-h

4. Coûts additionnels pour le pipe-line
(environ 30% supplémentaires)



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- Fertilisation de la surface des océans

1. Fertilisation avec des phosphates.

- Prix de revient: 0.4\$ US par tonne de CO₂ fixée.

- Les réserves de phosphates sont de l'ordre de 100×10^9 tonnes, donc non limitantes en principe.

2. Fertilisation des océans froids avec du fer

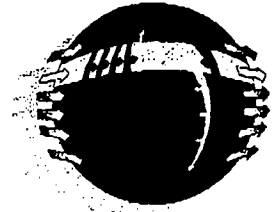
- Beaucoup moins cher que pour les phosphates

- Mais résultats envisagés sujets à controverse



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- Modification de l'albédo de la planète

- 1. Il faut augmenter de 1.4% l'albédo de la planète pour anihiler l'effet de serre anthropique.

2. Il a été proposé d'installer des panneaux réfléchissant en orbite autour de notre planète (feuilles d'aluminium de 0.1 à 0.5 μm d'épaisseur).

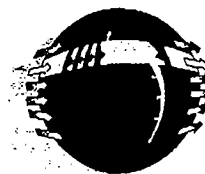
3. Coûts estimés de l'opération: 20×10^{12} \$ US, soit une taxe de 0.25\$ US à 2.5\$ US par tonne de CO₂ émise

4. Mais nombreux problèmes de faisabilité (voile solaire).



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- Compensation de l'effet de serre anthropique par les aérosols sulfatés

- 1. 1.35×10^6 t/an de SO_2 devraient être injectés dans la stratosphère pour contrecarrer l'effet de serre anthropique (sauf en période d'éruption volcanique). Ceci n'augmenterait l'acidité des précipitations que de 10%.

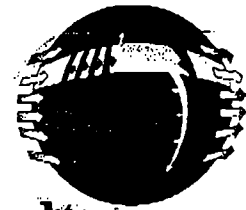
-2. Cette "solution" est économique, ne revenant qu'à 0.007\$ US par tonne de CO_2 émise.

-3. Les effets de ces émissions sur l'albédo de la troposphère ou la chimie de l'atmosphère ne sont pas connus.



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- Fermeture du détroit de Gibraltar

- 1. La salinité de la Méditerranée augmente présentement (captage des eaux douces pour les besoins des humains), menaçant les échanges de la boucle de convoyage.

2. Barrage pour limiter 80% du volume de sortie des eaux de la Méditerranée.

3. Coûts "minimes" par rapport à ceux prévus si la boucle de convoyage ralentit.

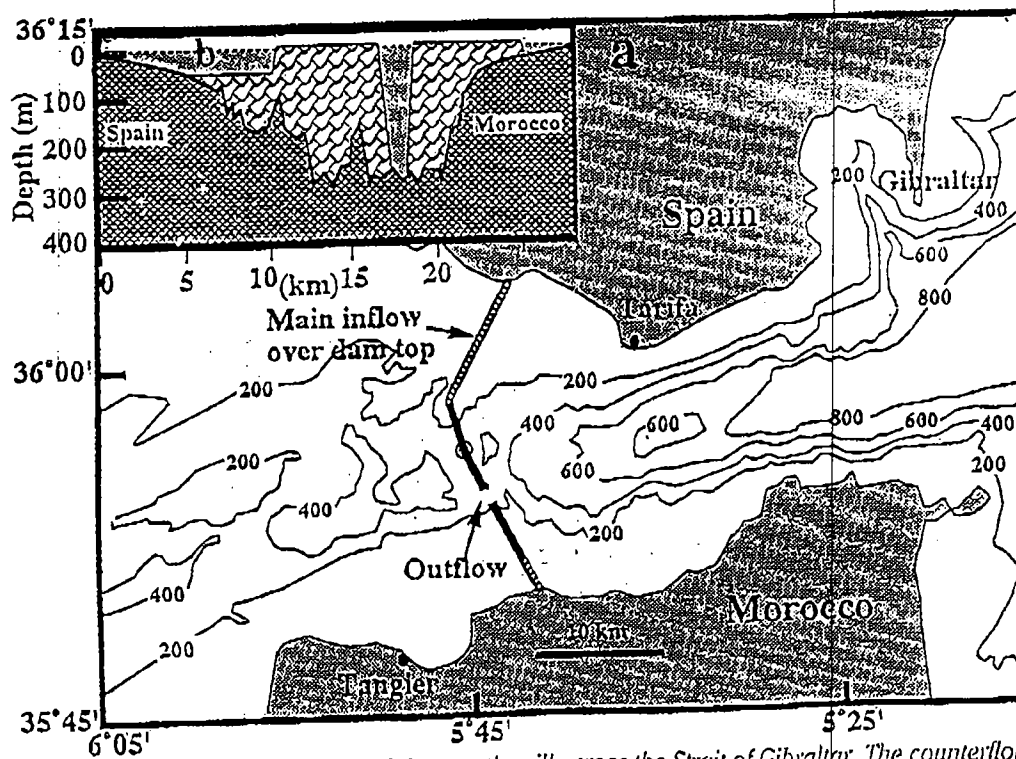
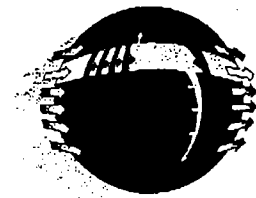


Fig. 3. a) Location of the proposed dam on the sill across the Strait of Gibraltar. The counterflow exchange of salt is greatly minimized by separating most of the surface inflow from the deeper Mediterranean outflow water entering the Atlantic. Bathymetry is in meters. Adapted from Bryden and Kinder [1991]. b) Profile of the suggested large-rock dam structure on the transect of a). Assumed angle of repose is 30°. Maximum depth on the sill is 284 m. Bridges over inflow openings (not shown) would enable transport of material to the extending faces. A bridge over the central



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- **Reforestation de terres déforestées**
- 1. Les zones de reforestation peuvent fixer le CO₂ à des taux de 2t/ha/an, et même parfois 3 à 5 fois plus.
- 2. Une zone d'environ 1.5×10^9 ha croissante pendant 30 ans serait nécessaire pour absorber les rejets annuels actuels de CO₂ anthropiques (10 fois la superficie du Québec, ou la superficie de l'Australie).
- 3. Il faut ensuite disposer du bois sans que son carbone soit à nouveau libéré dans l'atmosphère.
- 4. Les effets de la sylviculture à répétition sur l'équilibre des sols sont mal connus.

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Chercheure

Groupe de Recherche Interdisciplinaire en Gestion de l'Environnement

Ingénieure en génie énergétique et détentrice d'une Maîtrise en Sciences de l'Environnement, Maryse Labriet s'intéresse plus particulièrement aux questions Énergie - Environnement, appliquées notamment au secteur des transports. Elle a d'abord travaillé à l'Institut de l'Énergie des Pays ayant en commun l'usage du Français au sein du programme de soutien à la maîtrise de l'énergie des pays en développement, avant de collaborer avec le GERIGE dans le dossier de la gestion des gaz à effet de serre. Elle intervient également comme consultante en environnement au sein de plusieurs groupes et organisations oeuvrant dans les domaines de l'électrification des transports et plus largement de développement durable.

ML / 12 novembre 1997

COMPRENDRE LES CHANGEMENTS CLIMATIQUES : LE CAS DES TRANSPORTS

**Maryse Labriet
Groupe de Recherche Interdisciplinaire
en Gestion de l'Environnement (GREIGE- UQAM)**

**Séance d'information en vue de la réunion de Kyoto
Montréal, 12 novembre 1997**

I - Situation des gaz à effet de serre et des transports

**II -Stratégies de gestion des gaz à effet de serre dans le secteur
des transports (Projet GREIGE-GERAD)**

→ Rapport final disponible en JANVIER 98.

I - SITUATION DES GES ET DES TRANSPORTS

☞	Transport = contributeur majeur aux émissions de GES • 27% des émissions d'éq-CO₂ au Canada (1995). • 41% des émissions d'éq.-CO₂ au Québec (1995).
☞	Augmentation possible de la consommation d'énergie du secteur des transports de 40 à 100% d'ici 2025 (échelle mondiale).
☞	Segments prioritaires : • Déplacements individuels des personnes (automobiles) • Déplacements interurbains des marchandises (camions)
☞	Absence de diversité énergétique
☞	Gestion du secteur fondée sur la gestion de l'offre
☞	Perception de complexité des interventions • Transport sous-produit d'un ensemble hétérogène de besoins • Utilisation dispersée de l'énergie / nombreux agents économiques • Atteinte à la liberté de choix



Peu d'interventions dans le secteur des transports

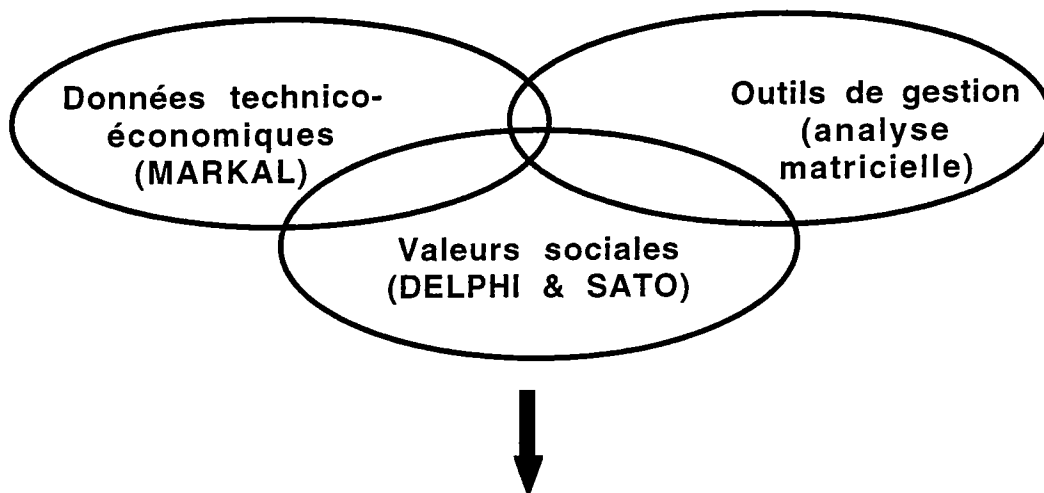


Potentiel d'interventions et de réduction important

- ☞ Gestion de la demande d'énergie
- ☞ Gestion de la demande de déplacement

II - STRATÉGIES DE GESTION DES GAZ À EFFET DE SERRE DANS LE SECTEUR DES TRANSPORTS (GREIGE-GÉRARD)

DÉMARCHE INTÉGRATRICE



Stratégies de gestion des GES au Québec (1995-2035)

- ☞ Cibles de réduction
(5% et 17% de réduction par rapport à la stabilisation au niveau de 1990)
- ☞ Scénarios d'interventions
(efficacité énergétique, transfert modal, tarification différentielle)
- ☞ Outils de gestion
(juridiques, économiques, techniques, organisationnels, éducatifs)

RÉSULTATS PRINCIPAUX

	Consensus social sur la place primordiale que le secteur des transports doit occuper dans les stratégies de gestion des GES au Québec et au Canada / sur la nécessité d'action immédiate.
	Nécessité d'interventions mixtes et vigoureuses : • Atteinte des cibles de réduction. • Fiabilité des stratégies et diminution des risques. • Meilleure acceptabilité sociale (interventions extrêmes évitées).
	Mix technologique de type sans regret (électricité, alcools). • Optimisation du système technico-énergétique du Québec. • Opportunités d'innovation technologique et de développement industriel • Subventions au développement et à la commercialisation des technologies.
	Plan d'action immédiat pour l'amélioration de l'efficacité énergétique des déplacements et le transfert modal. • Interventions vigoureuses requises. • Contribution à la réduction des émissions en attendant la disponibilité de nouvelles technologies de transport sur le marché. • Effets structurants sur le transport et l'aménagement. • Acceptabilité sociale : - Potentiel technique et commercial de gains énergétiques. - Intégration nord-américaine de l'industrie automobile. - Résistance sociale face au transfert modal. - Limiter les avantages artificiels de l'utilisation de l'automobile et du camion. - Augmenter l'offre de modes alternatifs. - Limiter l'étalement urbain. • 3 regroupements d'outils : - Efficacité énergétique des véhicules. - Gestion intermodale de l'offre et de la demande de déplacement. - Optimisation de l'aménagement et des transports.

RÉSULTATS PRINCIPAUX (SUITE)

☞	Tarification différentielle des carburants, variable selon les cibles de réduction des GES, le niveau et le succès des interventions en efficacité énergétique et transfert modal. • Efficacité (principe pollueur-payeur). • Flexibilité. • Acceptabilité sociale : - Planification à long terme (adaptation). - Limitation des effets régressifs (tarification <i>différentielle</i>). - Disponibilité d'options et de technologies alternatives. • Préférée aux permis échangeables pour une application ciblée sur le secteur des transports (faible élasticité-prix de la demande de déplacement).
☞	Plan de sensibilisation et d'éducation des acteurs économiques. • Permettre l'émergence de nouvelles valeurs et de nouveaux comportements (niveau de connaissance du problème insuffisant). • Préparer l'implantation de mesures vigoureuses et/ou impopulaires.
☞	Actions structurelles requises, amorcées immédiatement, mais planifiées à long terme. • Volonté politique. • Modification du système de valeurs économiques. • Évaluation macro-économique des coûts et des avantages <i>réels</i> à long terme. • Modification du système de valeurs sociales.
☞	Programmes d'initiative volontaire. • Insuffisants. • Incitatifs préparatoires.
☞	Planification flexible mais vigoureuse. • Intégration des marchés nord-américains. • Incertitudes.



- ☞ **Potentiel élevé d'interventions sans regret et/ou à bénéfices indirects.**
☞ **Action immédiate.**

TABLEAU A8 : MATRICE D'ÉVALUATION DES OUTILS DE GESTION

Catégories d'outils	Outils de gestion	Efficacité environnementale	Effets structurants	Faisabilité financière de mise en œuvre	Acceptabilité sociale	Acceptabilité socio-économique	Faisabilité institutionnelle et administrative	Horizon temporel d'attente des résultats
1. Outils juridiques	1.1. Norme sur l'efficacité énergétique ou les émissions.	Fort	Moyen	Fort	Fort	Faible	Fort (Québec: faible)	> 5 ans
	1.2. Programme de mise au rancart accélérée des véhicules.	Faible	Faible	Moyen	Fort	Fort	Fort (Québec: fort)	< 5 ans
	1.3. Programme obligatoire d'inspection et d'entretien.	Moyen	Faible	Moyen	Moyen	Fort	Fort (Québec: fort)	< 5 ans
	1.4. Norme de gestion de la circulation.	Moyen	Moyen	Moyen	Moyen	Moyen	Moyen (Québec: fort)	> 5 ans
	a - Limitation de la vitesse sur les autoroutes.							
	b - Réglementation du tonnage autorisé pour le camionnage.							
2. Outils économiques	c - Norme de circulation et de livraison des marchandises.							
	d - Norme de gestion de la circulation et du stationnement en milieu urbain.							
	1.5. Exigence de consolidation et d'usage polyvalent du territoire.	Fort	Fort	Moyen	Faible	Moyen	Faible (Québec: fort)	> 5 ans
	1.6. Exigence d'optimisation des services de l'auto.	Fort	Fort	Moyen	Faible	Faible	Faible (Québec: fort)	> 5 ans
	2.1. Redevance sur les véhicules.	Moyen	Moyen	Fort	Moyen	Faible	Fort (Québec: moyen)	> 5 ans
	2.2. Redevance sur l'utilisation de la route.	Fort	Fort	Moyen	Faible	Moyen	Moyen (Québec: fort)	> 5 ans
3. Outils techniques	2.3. Taxe sur le stationnement.	Fort	Fort	Fort	Faible	Moyen	Moyen (Québec: faible)	> 5 ans
	2.4. Taxe sur l'énergie, le carbone ou sur les carburants.	Fort	Fort	Fort	Faible	Faible	Fort (Québec: fort)	> 5 ans
	2.5. Permis échangeables.	Fort	Moyen	Moyen	Moyen	Moyen	Moyen (Québec: moyen)	> 5 ans
	2.6. Subvention en faveur des formes d'énergie, technologies et/ou modes alternatifs.	Fort	Fort	Faible	Fort	Fort	Faible (Québec: faible)	> 5 ans
	3.1. Soutien logistique à la gestion de la circulation et du stationnement automobiles.	Moyen	Moyen	Moyen	Moyen	Moyen	Moyen (Québec: fort)	> 5 ans
	3.2. Soutien logistique au transfert modal et à l'intermodalité pour les marchandises.	Moyen	Moyen	Moyen	Fort	Moyen	Fort (Québec: fort)	> 5 ans
4. Outils organisationnels	4.1. Organisation des structures de travail	Moyen	Fort	Fort	Moyen	Fort	Fort (Québec: fort)	> 10 ans
	4.2. Organisation des activités de production-distribution	Moyen	Moyen	Moyen	Fort	Faible	Fort (Québec: faible)	> 10 ans
	4.3. Programme d'initiative volontaire.	Faible	Faible	Fort	Fort	Fort	Fort (Québec: fort)	< 5 ans
	4.4. Création d'un partenariat multipartite.	Fort	Fort	Moyen	Moyen	Moyen	Moyen (Québec: fort)	> 5 ans
5. Outils éducatifs	5.1. Éducation - sensibilisation.	Moyen	Fort	Moyen	Fort	Fort	Fort (Québec: fort)	> 5 ans
	5.2. Étiquetage - labellisation des produits et/ou procédés.	Faible	Faible	Fort	Fort	Fort	Fort (Québec: faible)	> 5 ans

En supposant une mise en œuvre des outils d'ici 2 ans. Pour les outils dont les résultats visent un horizon de moyen et long terme (> 5 ans et > 10 ans), il faut comprendre que les résultats peuvent commencer à être visibles après 5 ou 10 ans, mais sont gradués sur un horizon plus long.

GREIGE/ML/12-11-97

REGROUPEMENTS D'OUTILS

«EFFICACITÉ ÉNERGÉTIQUE DES VÉHICULES»

Transport des personnes	Transport des marchandises
<i>Outils principaux:</i> • Normes sur l'efficacité énergétique ou les émissions des automobiles et camions légers [1.1] <i>Outils complémentaires:</i> • Éducation - sensibilisation [5.1] • Étiquetage - labellisation [5.2] • Subventions (R&D et pénétration de marchés) [2.6] • Programme obligatoire d'inspection et d'entretien [1.2] • Programme d'initiative volontaire [4.3] <i>Outils facultatifs:</i> • Redevance sur les automobiles et camions légers [2.1] <i>Outils non-retenus:</i> • Mise au rancart [1.2]	<i>Outils principaux:</i> • Normes sur l'efficacité énergétique ou les émissions des camions moyens et lourds [1.1] • Éducation - sensibilisation [5.1] <i>Outils complémentaires:</i> • Subventions (R&D et pénétration de marchés) [2.6] • Programme obligatoire d'inspection et d'entretien [1.2] • Programme d'initiative volontaire [4.3]

«GESTION INTERMODALE DE L'OFFRE ET DE LA DEMANDE DE DÉPLACEMENT»

Transport des personnes	Transport des marchandises
<i>Outils principaux:</i> • Normes de gestion de la circulation et du stationnement en milieu urbain [1.4.d] • Redevance sur l'utilisation de la route [2.2] • Taxe sur le stationnement [2.3] • Soutien logistique (circulation et stationnement) [3.1] <i>Outils complémentaires:</i> • Éducation - sensibilisation [5.1] • Subventions (modes alternatifs) [2.6] • Programme d'initiative volontaire [4.3] <i>Outils non-retenus:</i> • Limitation de la vitesse sur les autoroutes [1.4.a] • Organisation des structures de travail [4.1] (Télétravail, initiative volontaire envisageable)	<i>Outils principaux:</i> • Normes de circulation et de livraison des marchandises [1.4.c] • Limitation de la vitesse sur les autoroutes [1.4.a] • Redevance sur l'utilisation de la route [2.2] • Soutien logistique (transfert modal et intermodalité) [3.2] <i>Outils complémentaires:</i> • Éducation - sensibilisation [5.1] • Subventions (modes alternatifs, intermodalité) [2.6] • Programme d'initiative volontaire [4.3] • Réglementation du tonnage autorisé (comionnage) [1.4.b]

« OPTIMISATION DE L'AMÉNAGEMENT ET DES TRANSPORTS »

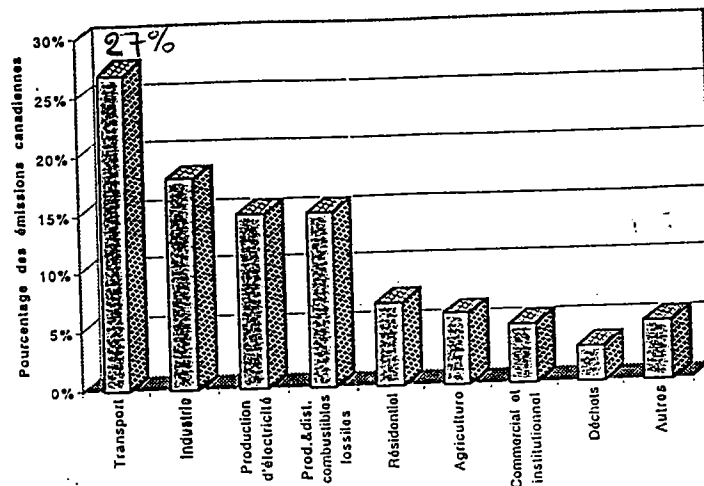
Transport des personnes	Transport des marchandises
<i>Outils principaux:</i> • Exigence de consolidation et d'usage polyvalent du territoire [1.5] • Exigence d'optimisation des services de transport [1.6] <i>Outils complémentaires:</i> • Éducation - sensibilisation [5.1] • Programme d'initiative volontaire [4.3]	<i>Outils principaux:</i> • Exigence d'optimisation des services de transport [1.6] <i>Outils complémentaires:</i> • Exigence de consolidation et d'usage polyvalent du territoire [1.5] • Éducation - sensibilisation [5.1] • Programme d'initiative volontaire [4.3] <i>Outils non-retenus :</i> • Organisation des activités de production-distribution [4.2]

« TARIFICATION DIFFÉRENTIELLE DES CARBURANTS »

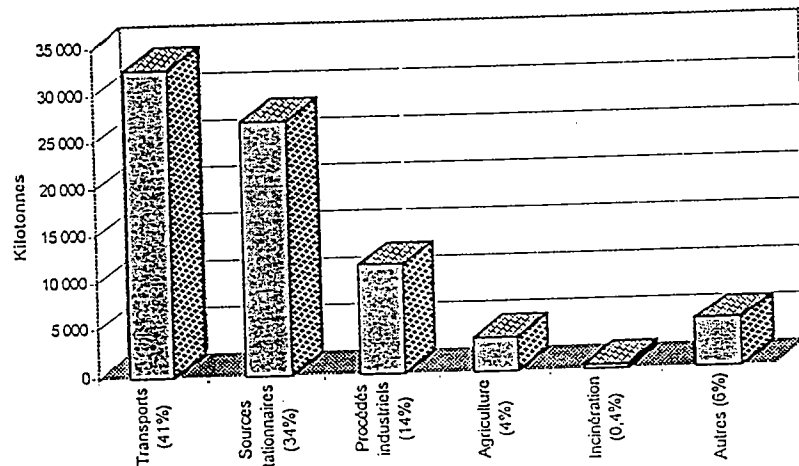
Transport des personnes	Transport des marchandises
<i>Outils principaux:</i> • Taxe sur le CO₂ des carburants [2.4] <i>Outils complémentaires:</i> • Éducation - sensibilisation [5.1] • Subvention (R&D et pénétration de marchés) [2.6] <i>Outils non-retenus:</i> • Permis échangeables [2.5]	<i>Outils principaux:</i> • Taxe sur le CO₂ des carburants [2.4] <i>Outils complémentaires:</i> • Éducation - sensibilisation [5.1] • Subvention (R&D et pénétration de marchés) [2.6] <i>Outils non-retenus:</i> • Permis échangeables [2.5]

BILAN DES ÉMISSIONS

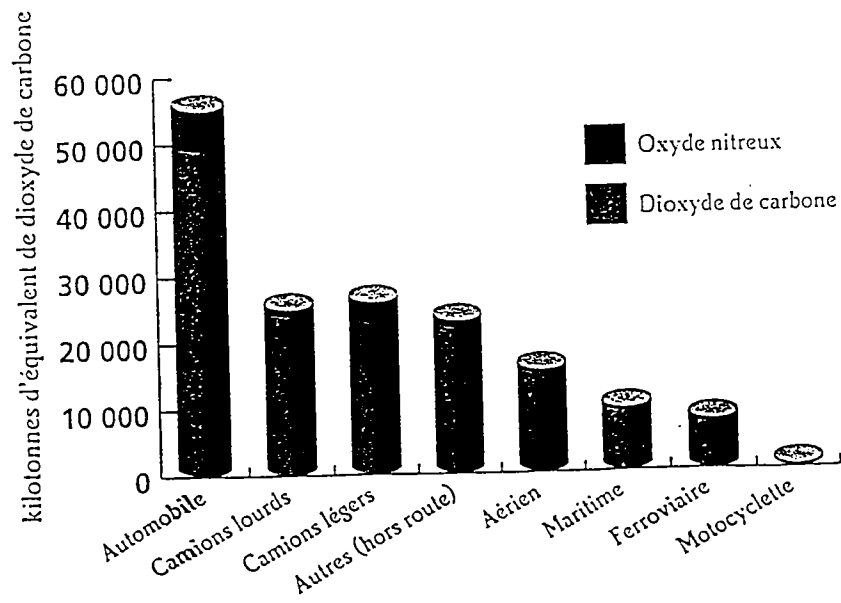
Par secteur au Canada (1995)



Par secteur au Québec (1995)



Dans le secteur des transports, au Canada (1990)



La dimension politique des changements climatiques

Présentation préparée pour la Session de formation de Montréal, 12 novembre 1997
Programme canadien des changements à l'échelle du globe, Société royale du Canada

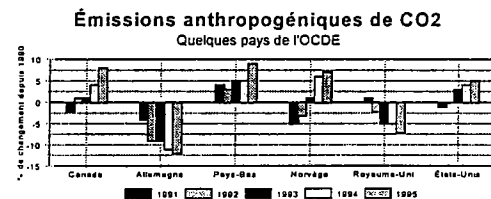
1997 - Kyoto - COP3: quels résultats?

- ♦ Entente : de la stabilisation jusqu'à une réduction de 5% d'ici à 2010 - obligation légale + mandat pour des négociations concernant les engagements des pays en développement
- ♦ Entente: "Cible souple" suivie de négociations pour faire l'allocation de cibles légalement contraignantes prenant en considération les différences et engagements pour les pays en développement
- ♦ Aucune entente: les discussions achopent sur l'absence d'engagements de la part des pays en développement et sur le manque de progrès de la part des pays développés

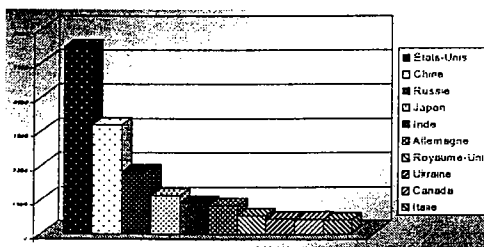
Survol de la situation au Canada

- ♦ La croissance économique au Canada:
 - ♦ 1950
 - ♦ 1995
 - ♦ 2020
- ♦ Particularités physiques - climat et géographie
- ♦ Contexte politique - juridictions

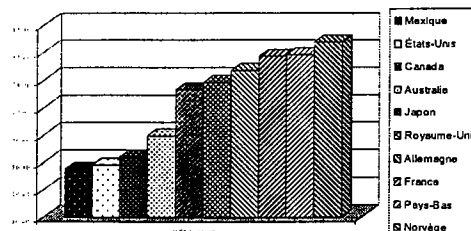
Performance canadienne 1990-1995



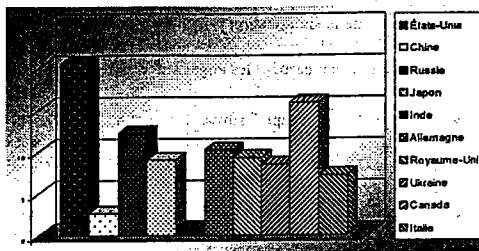
Dix plus importants pays émetteurs de CO₂ en 1995



Prix de l'essence dans quelques pays choisis - 1996

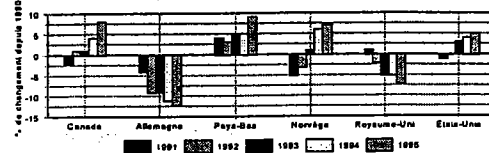


Émissions par habitant - 10 plus importants pays émetteurs (1995)

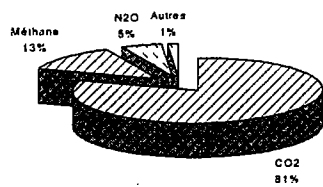


Performance du Canada - Projections

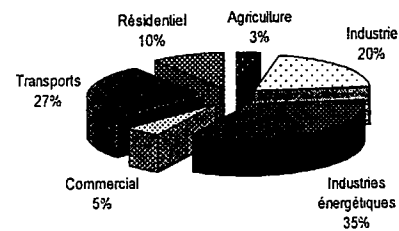
Émissions anthropogéniques de CO2 pour quelques pays de l'OCDE



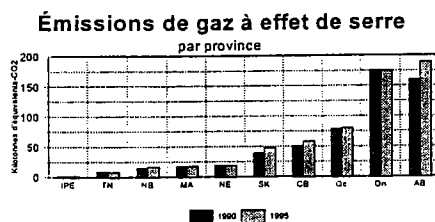
Les gaz à effet de serre au Canada - 1995



Les gaz à effet de serre au Canada: émissions par secteur - 1995

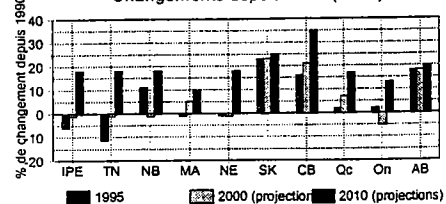


GES: profil par province - 1995



GES: croissance par province (en %) - 1990 à 1995

Émissions de gaz à effet de serre Changements depuis 1990 (en %)



*Programme national d'action sur le
changement climatique du Canada*

- ◆ Principaux éléments:
 - ◆ Mesures volontaires et registre
 - ◆ Progrès à ce jour
 - ◆ Prochaines étapes?
-

La situation au Québec

- ◆ Émissions par personne beaucoup moins importantes que pour le reste du Canada
 - ◆ L'hydroélectricité comme source principale d'électricité
 - ◆ Le secteur du transport comme principale source de GES (41% au Québec contre 27% pour le Canada dans son ensemble)
-

La situation au Québec

- ◆ Plan d'action québécois de mise en oeuvre de la Convention-cadre des Nations Unies sur les Changements Climatiques (mars 1995)
 - ◆ Écogeste: Programme d'enregistrement des mesures volontaires sur les changements climatiques (septembre 1996)
 - ◆ Prochaines étapes?
-

Processus politique au Canada

- ◆ Rôle du gouvernement fédéral - niveau international
 - ◆ Comité fédéral-provincial de coordination (NAICC)
 - ◆ Participation des principaux intervenants
-

*L'après Kyoto: quelques défis pour
le Canada et le Québec*

- ◆ La volonté politique
 - ◆ Assurer l'imputabilité et le partage équitable des réductions de GES
 - ◆ Assurer une certaine flexibilité dans l'atteinte des objectifs
 - ◆ Exploiter les possibilités
-

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research. It also provides a brief overview of the methodology used in the study.

2. The second part of the report is a detailed description of the study area. It includes information about the location of the study area, the population of the study area, and the characteristics of the study area. It also discusses the data sources used in the study.

3. The third part of the report is a detailed description of the study results. It includes information about the findings of the study, the conclusions drawn from the findings, and the implications of the findings. It also discusses the limitations of the study and the need for further research.

4. The fourth part of the report is a conclusion and recommendations. It summarizes the findings of the study and provides recommendations for future research. It also discusses the importance of the study and the need for further research.

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Toronto - Ontario

Monday, November 17th, 1997

IMPACTS OF CLIMATE CHANGE ON ONTARIO

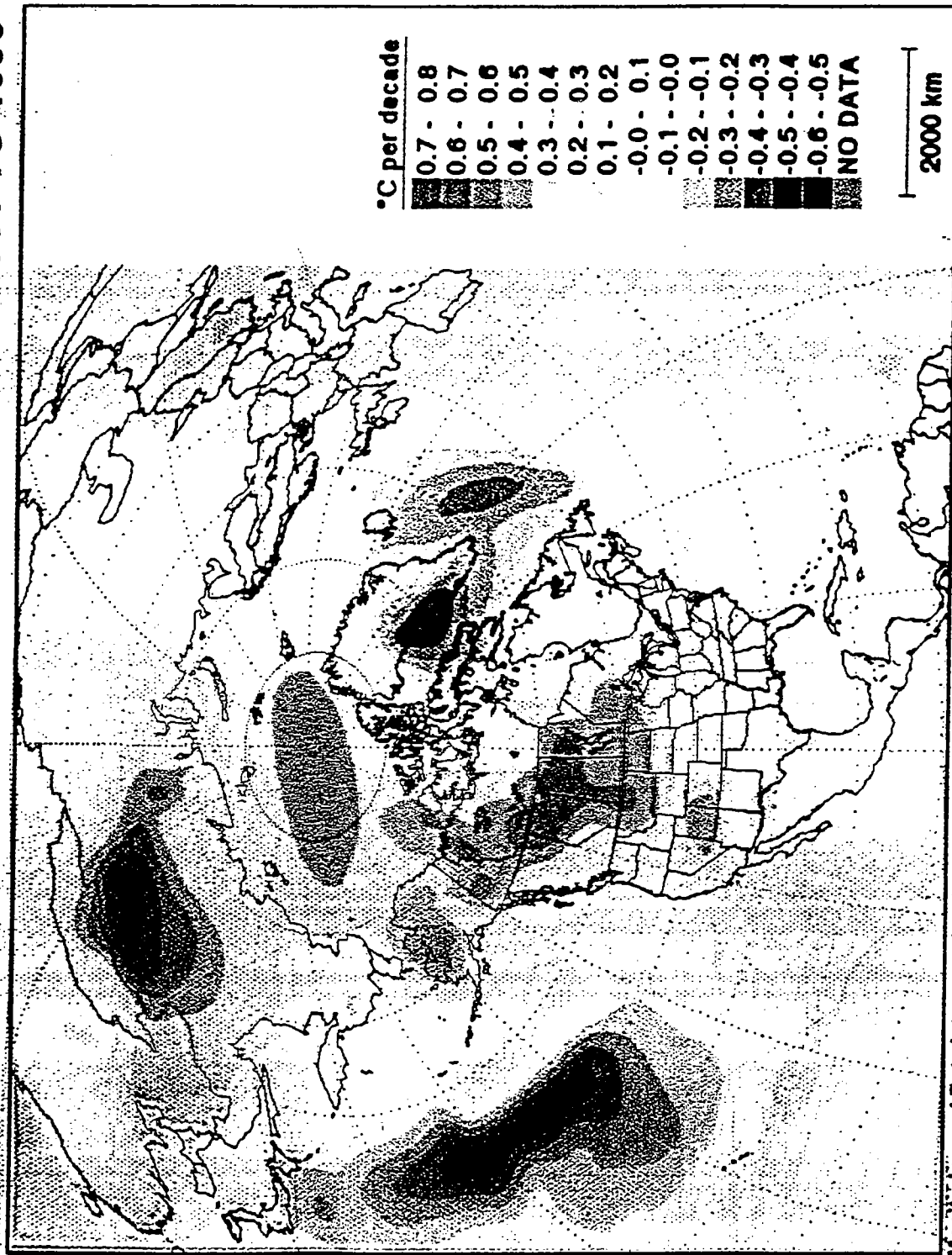
**Linda Mortsch, Environmental
Adaptation Research Group,
Environment Canada**

**Jamie Smith, Smith & Lavender
Environmental Consulting**

Current Climate Context

- Is climate change really happening?
- temperature changes in Canada
- regional 'Hot Spots'
- hydrologic changes
- statistics

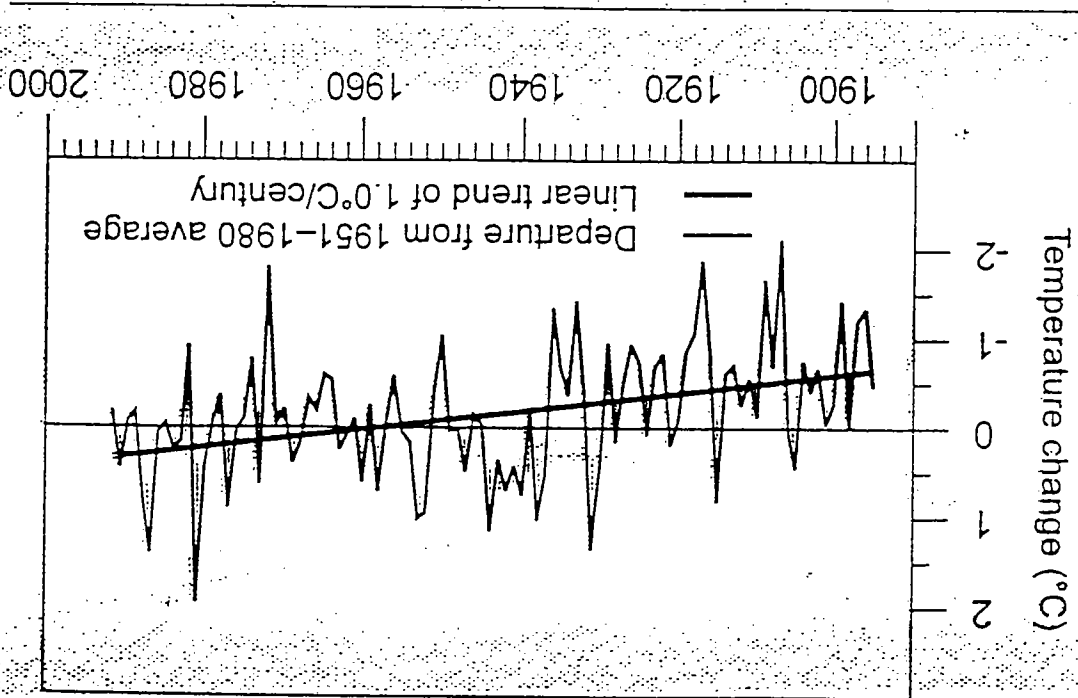
ANNUAL SURFACE TEMPERATURE TRENDS 1961 TO 1990



Monitoring and Data Interpretation Division
Climate Research Branch
Environment Canada

Data Source: Climatic Research Unit
University of East Anglia, U.K.

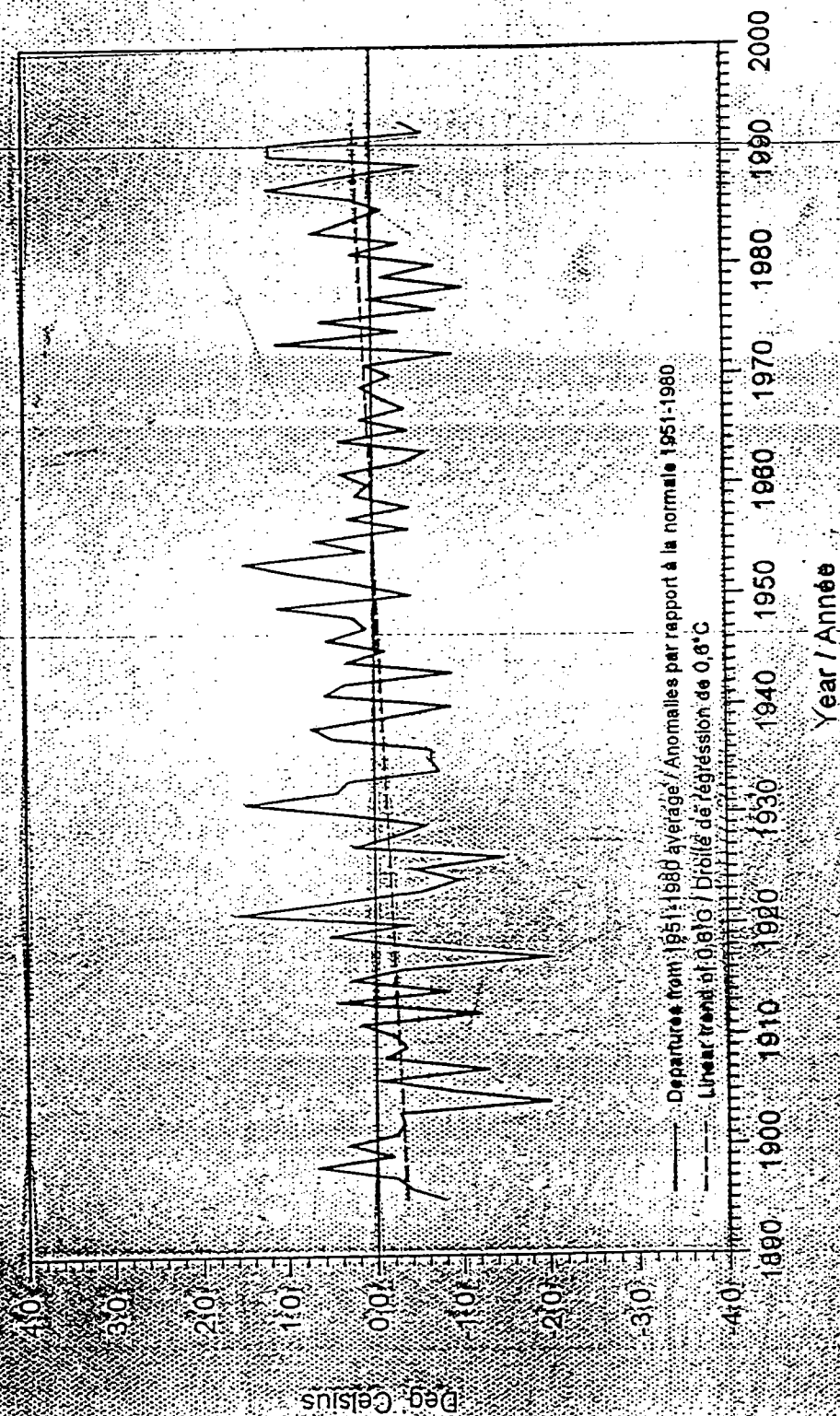
**National annual temperature trend
for 1895-1992**



Source: Environment Canada.

GREAT LAKES BASIN / SAINT LAWRENCE LOWLANDS BASSES-TERRES DU BASSIN DES GRANDS LACS ET DU SAINT LAURENT

ANNUAL TEMPERATURE / TEMPERATURE ANNUELLE 1895-1993

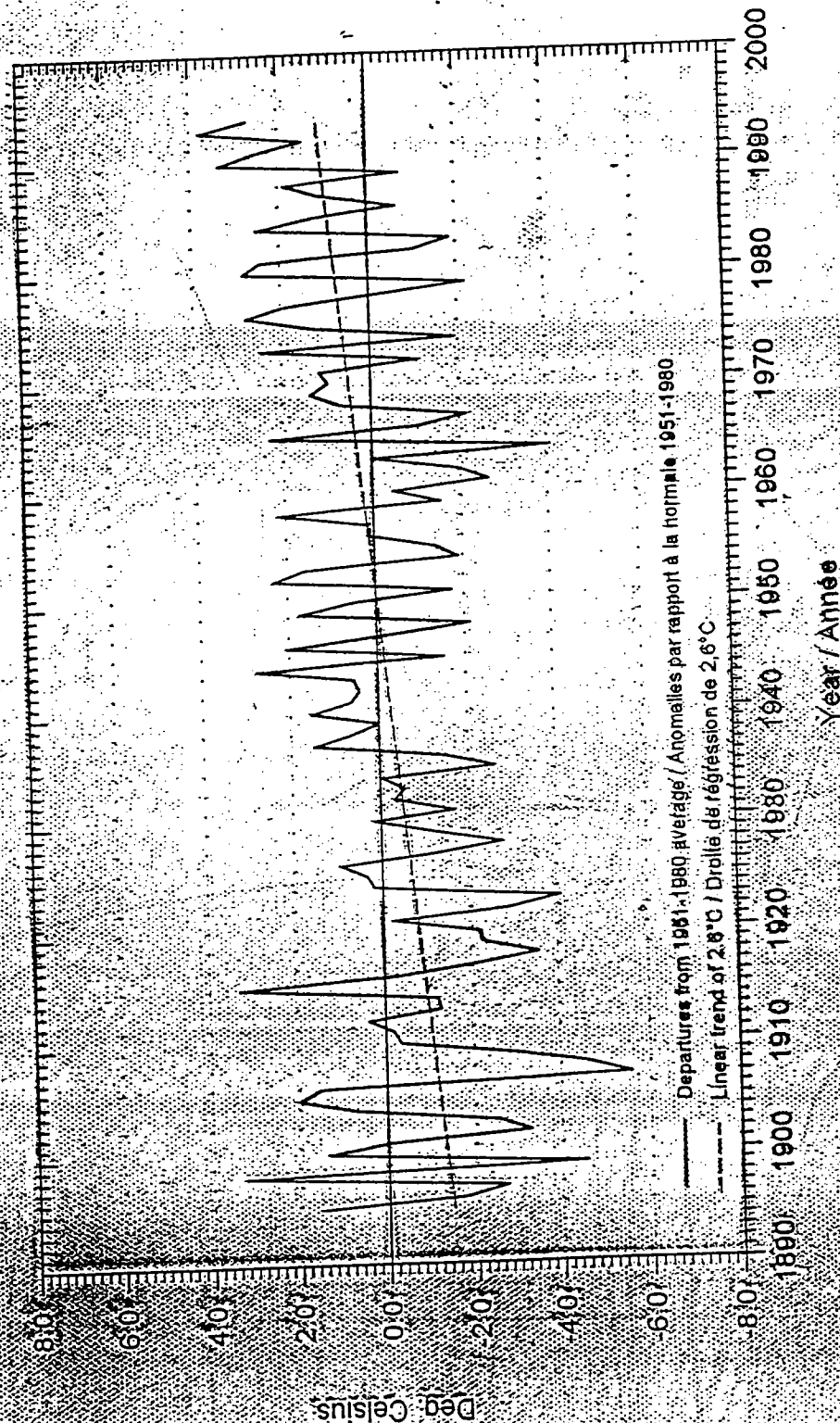


Climate Change Detection
Atmospheric Environment Service
Environment Canada
January 12, 1994

Détection du changement climatique
Service de l'environnement atmosphérique
Environnement Canada
12 janvier 1994

MACKENZIE DISTRICT DISTRICT DE MACKENZIE

SPRING TEMPERATURE / TEMPERATURE DU PRINTEMPS 1895-1994



CCRM/CORD
Atmospheric Environment Service
Environnement Canada
June 8, 1994

CCRM/CORD
Service de l'environnement atmosphérique
Environnement Canada
9 juin 1994

How well do we understand potential impacts?

- Keep in mind the 'problems' of climate change
 - rate of change
 - magnitude of change
 - complex problem, complex world
 - imperfect information

Does this mean we can't say anything?

■ **We do know this:**

- **direct and indirect impacts**
- **vulnerable people**
- **vulnerable systems**
- **vulnerable regions**

How well do we understand potential impacts?

- Ontario is sensitive to climate change
 - health
 - ecosystems
 - economic systems

Great Lakes - St. Lawrence Basin: comparison of GCM temperatures

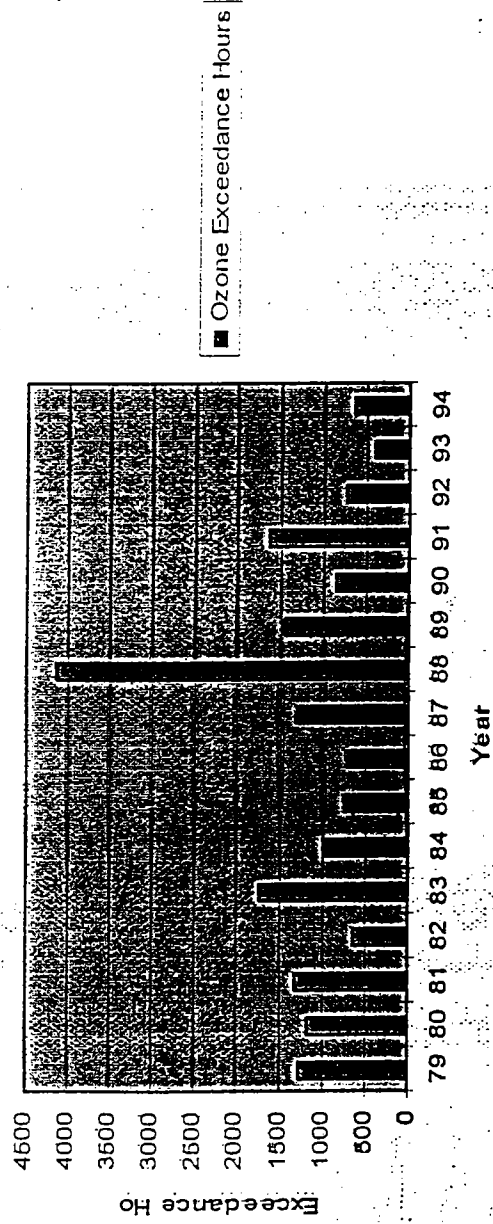
GCM	winter	spring	summer	fall
CCC, GCMII	4-9°C	3-8°C	4-6°C	3-5°C
GISS	4-7°C	4-5°C	3-4°C	3-6°C
GFDL	5-9°C	4-8°C	6-9°C	6-7°C
OSU	3-4°C	3-4°C	3-4°C	3-3.5°C

Source: modified from Mortsch and Burton, 1992

Human Health

- **Impacts of Current Climate**
 - climate affects health directly
 - || heat stress
 - climate affects health indirectly
 - || air quality
 - || smog
 - || inhalable particulate
 - || airborne toxic chemicals
 - || ultraviolet radiation

Trend of Ozone Exceedances in Ontario



Human Health

- **Anticipated Impacts of Future Climate**
- increased heat stress
- warmer climate may facilitate migration of disease-carrying organisms from other regions
- increased air pollution

Human Health

■ Possible Adaptation Strategies

- further research into air quality impacts
- building design changes
- adjustments in the health care system

Forestry

■ Impacts of Current Climate

- boreal forest is sensitive to the mean climate
- climate has direct impacts on the health of existing stands
- the industry is vulnerable

Forestry

- **Anticipated Impacts of Future Climate**
- changes in forest growth rates in marginal areas
- possible increase in damage from disease and pests
- extent of boreal forest may be reduced
- operating costs may increase

Forestry

■ Possible Adaptation Strategies

- reduce demand or improve utilization of existing stock
- preserve existing tree stocks
- introduce new strains of species, tune practices

Agriculture

■ Impacts of Current Climate

- mean climate conditions and soils determine viable agricultural products
- productivity governed by interannual variability of climate
- costs of lost production
- costs of insurance

Agriculture

- **Anticipated Impacts of Future Climate**
- increased concentrations of CO₂ will improve yields and water utilization for some crops
- longer growing season=increase in crop selection possibilities
- moisture-limited productivity in some areas
- increased variability in available moisture could increase variability in productivity

Agriculture

■ Possible Adaptation Strategies

- improvements in seasonal climate prediction**
- changes in practices to improve use of inputs including water, nutrients and pest control**
- improve government policies and programs**

Water

■ Impacts of current climate.

- floods
- drought

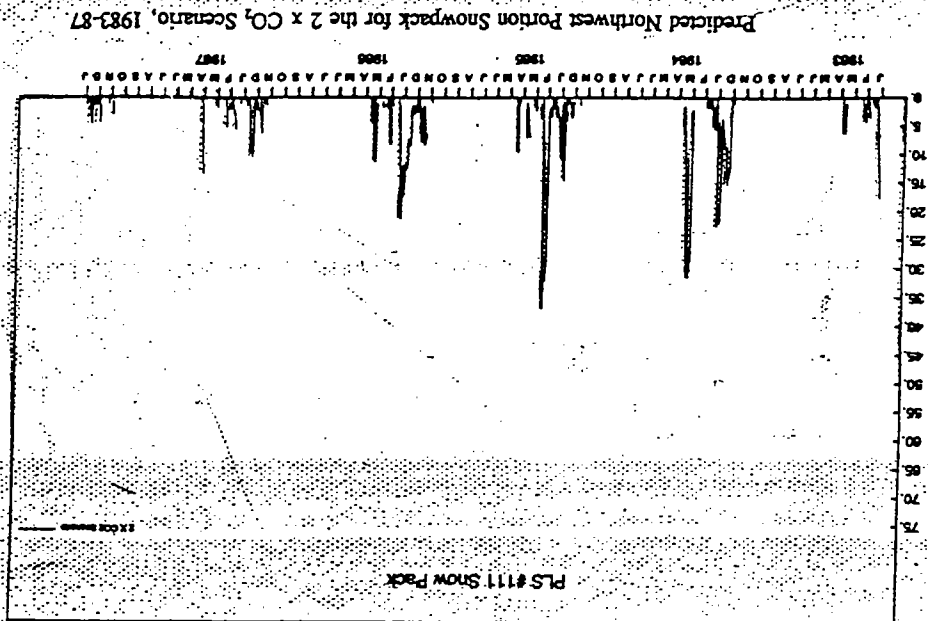
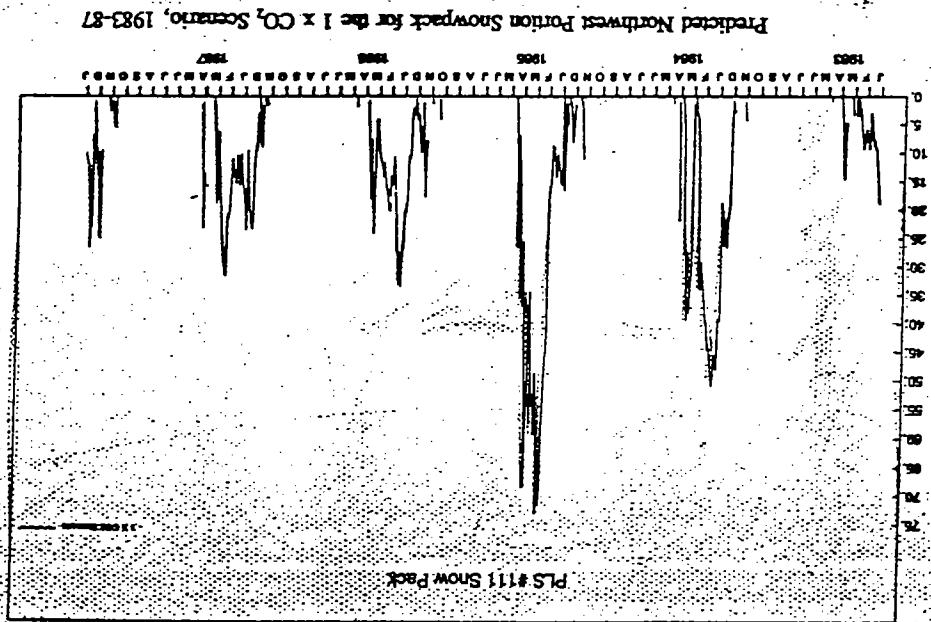
Water

- **Anticipated impacts of future climate**
- lower Great Lakes levels
- uncertain flows and poorer water quality
- diversions to and from Great Lakes
- controversies over competing uses
 - || irrigation
 - || municipal supply
 - || pollution dilution
 - || hydropower

Great Lakes Lawrence Basin Project

on detecting the effects of climate change and

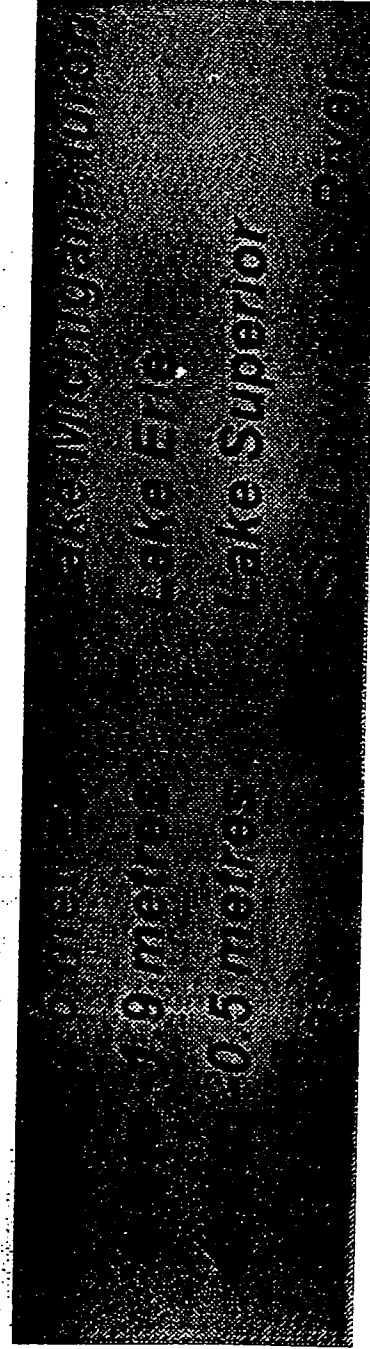
Snow Pack Change in the Bay of Quinte Watershed



Great Lakes - St. Lawrence Basin Project

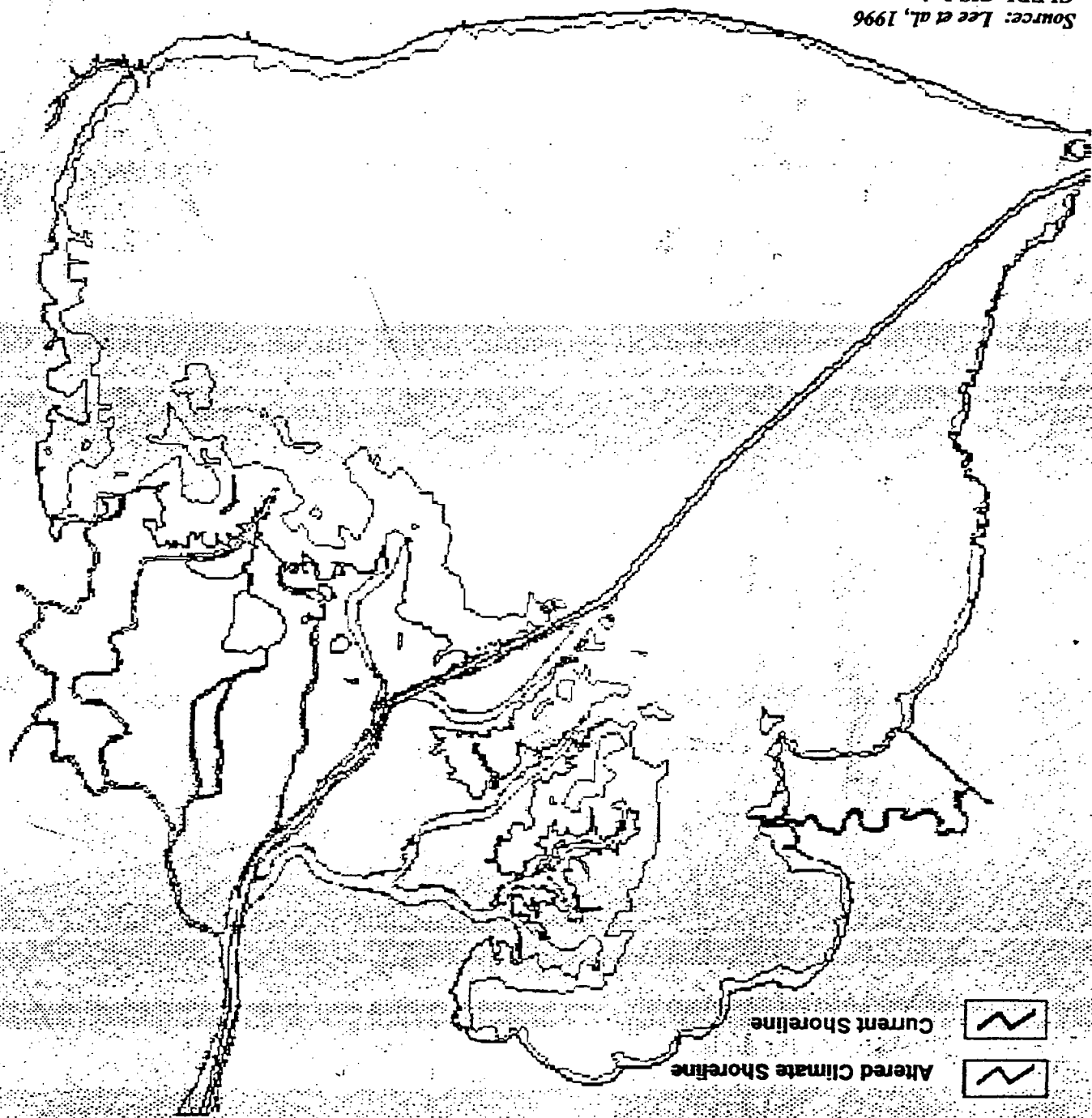
on adapting to the impacts of climate change and variability

- **Climate scenarios suggest LOWER lake levels:**



Great Lakes - St. Lawrence Basin Project on adapting to the impacts of climate change and variability

LAKE ST. CLAIR SHORELINE IMPACTS



Source: Lee et al., 1996
GLERL GIS Laboratory

Water

■ Possible adaptation strategies

- water conservation**
- water pricing (metering)**
- reducing water pollution**

People and systems can adapt, so what is the problem?

- adaptation costs
- winners and losers
- regional distributive effects

"We shall have to view the climate change issue in terms of an increased risk for damage. It is then important to realize that uncertainty about the details of a potential climate change (i.e. regional and local climate change) does not diminish risks; it merely makes it more difficult to assess quantitatively..."

B. Bolin, Chair IPCC,

Address to UN Conference of Parties, 1995

Key Messages

Action to address climate change is economically justified

How much to spend to limit climate change is a policy judgement

The costs depend significantly on the policies adopted

Proposed targets are affordable for Canada

A prudent strategy involves a portfolio of measures

Social and Economic Costs of Climate Change

Erik Haites
Margaree Consultants Inc.

Climate Change Briefing

Toronto
17 November, 1997

Key Messages

Action to address climate change is economically justified

How much to spend to limit climate change is a policy judgement

The costs depend significantly on the policies adopted

Proposed targets are affordable for Canada

A prudent strategy involves a portfolio of measures

Do You Have Insurance?

Do you wait until you are sure you will have an auto accident and your house will burn down?

The *RISK* of loss justifies the cost of insurance

All available studies indicate a *RISK* of global net damage due to climate change

Action to address climate change is justified by the risk of damage

How Much Insurance Should We Buy?

Individual coverage depends on risk aversion and ability to afford potential losses

We can only buy one insurance policy to protect the world from the consequences of climate change

How much damage we can expect future generations to cope with?

How much we are prepared to spend collectively to reduce the risks of climate change damage?

How Much Insurance Should We Buy?

Estimates of global damages due to 2-3°C warming are a few percent of global GDP

But our insurance coverage should reflect our aversion to low probability events with large damages -- surprises

Risks to food supplies, human health and ecosystems

Impacts may be irreversible for a century or more

How much to spend is a policy judgement

Costs Depend Significantly On The Policies Adopted

Implementing available "no regrets" measures reduces the cost to society

Implementing efficient policies can reduce the cost of achieving an emissions target significantly

Costs are sensitive to requirements for early replacement of capital

Implement Available "No Regrets" Measures

"No regrets" measures are those for which benefits such as reduced energy costs and reduced emissions of local pollutants equal or exceed their cost to society

Examples: elimination of fossil fuel subsidies, some energy efficiency measures, full cost pricing for transportation

Energy efficiency gains of 10%-30% from baseline trends possible over next two to three decades

No regrets measures often have private costs and so require policy intervention

Implement Efficient Policies

Implement the most cost-effective measures to achieve the emissions target

The diversity of gases, sources and control measures means a wide range of control costs

Emissions trading, emissions taxes, regulations with credit trading, and joint implementation encourage adoption of cost-effective measures

Estimated savings are significant (30%-80%) relative to equal percentage reductions

Costs Sensitive To Need For Early Replacement of Capital

Large share of total emissions associated with fossil fuel use and industrial processes

Oil and gas production, coal mines, oil and gas pipelines, petroleum refineries, generating stations, and industrial plants may last over 40 years

New facilities may take 2-15 years to build

Emission reduction schedules that minimize early retirement of existing capital are less costly

Proposed Targets Are Affordable for Canada

Seven studies of cost of limiting energy-related CO₂ emissions in 2010 to 1990 levels

Maximum loss of GDP is 0.5% to 2.8% from baseline. GDP is 27 to 29.5% (rather than 30%) higher in 2010.

International emissions trading reduces impacts over 50%

Output of some fossil fuel production and processing industries may fall from current levels. Adjustment assistance may be appropriate

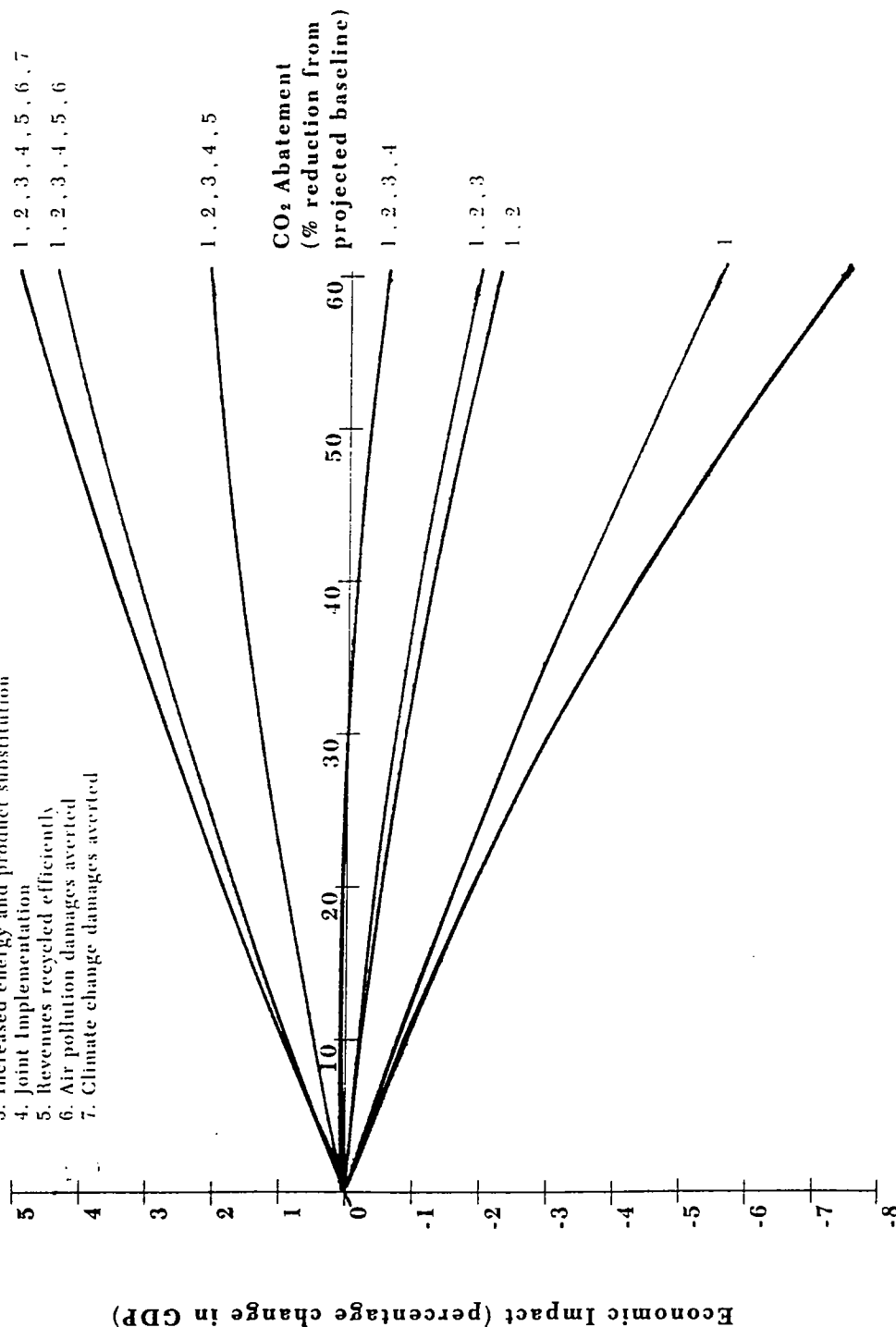
PREDICTED IMPACTS ON GDP FOR VARIOUS ABATEMENT TARGETS IN 2020 THE EFFECTS OF CHANGING, DEFERRING ASSUMPTIONS ONE-BY-ONE

Best Case Assumptions

1. Non-carbon backstop fuel available
2. Efficient economic responses (CGE model)
3. Increased energy and product substitution
4. Joint Implementation
5. Revenues recycled efficiently
6. Air pollution damages averted
7. Climate change damages averted

KEY

Shows which assumptions are made



A Prudent Strategy Involves A Portfolio Of Measures

The challenge is not to find the best strategy for the next 100 years, but to select a prudent strategy and to adjust it over time in the light of new information

A prudent strategy involves a portfolio of actions aimed at mitigation, adaptation and improving our knowledge

Implement "no regrets" and low cost measures to reduce emissions or enhance sinks

Support research on emission reduction technologies and climate change and its impacts

Climate Change

- Why is this an issue for Ontario?
- The provincial context
- Ontario's position

Climate Change

Why this is an issue for Ontario

- Environmental impacts
- Economic impacts
 - International effects
- Provincial jurisdiction
 - role of municipalities

Climate Change

The Canadian Context

- High energy use
 - cold climate
 - large country, small population
 - low energy prices
 - resource industries
- High emissions
 - 2% of world
 - 2nd highest per capita
 - growing rapidly

Climate Change

The Ontario Context

- 40% of the Canadian population and economy
- 30% of the greenhouse gas emissions
- Regional and sectoral differences across Canada
- Trade links are crucial

Climate Change

Ontario's Position

- A federal and provincial partnership
- Principles:
 - comprehensive approach
 - cost effective responses
 - partnerships
 - sustainable solutions
 - evolving responses

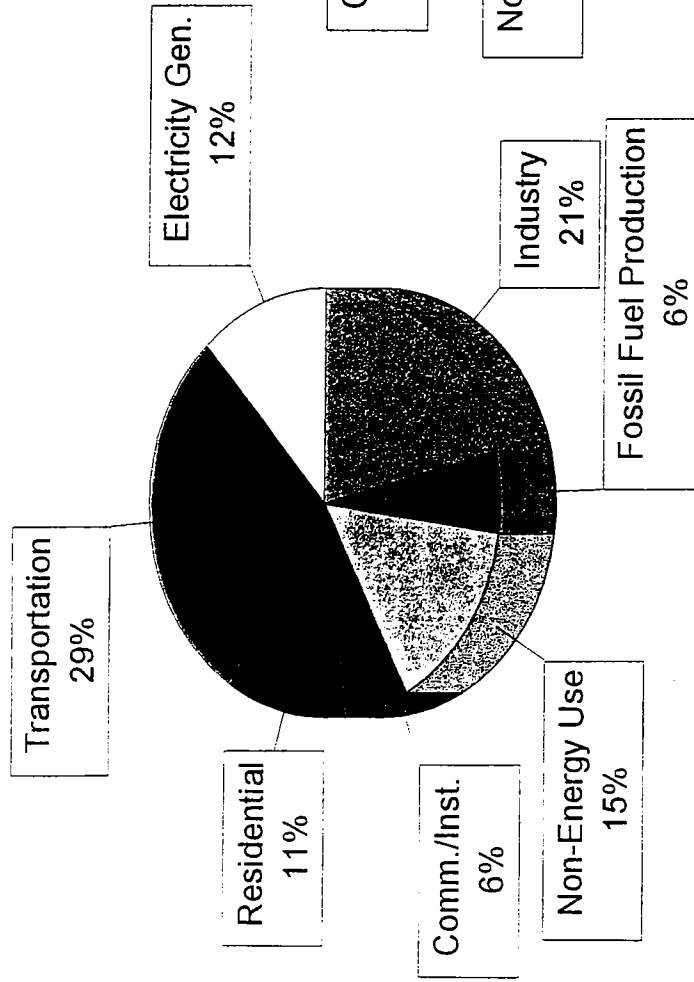
Climate Change

Ontario's position

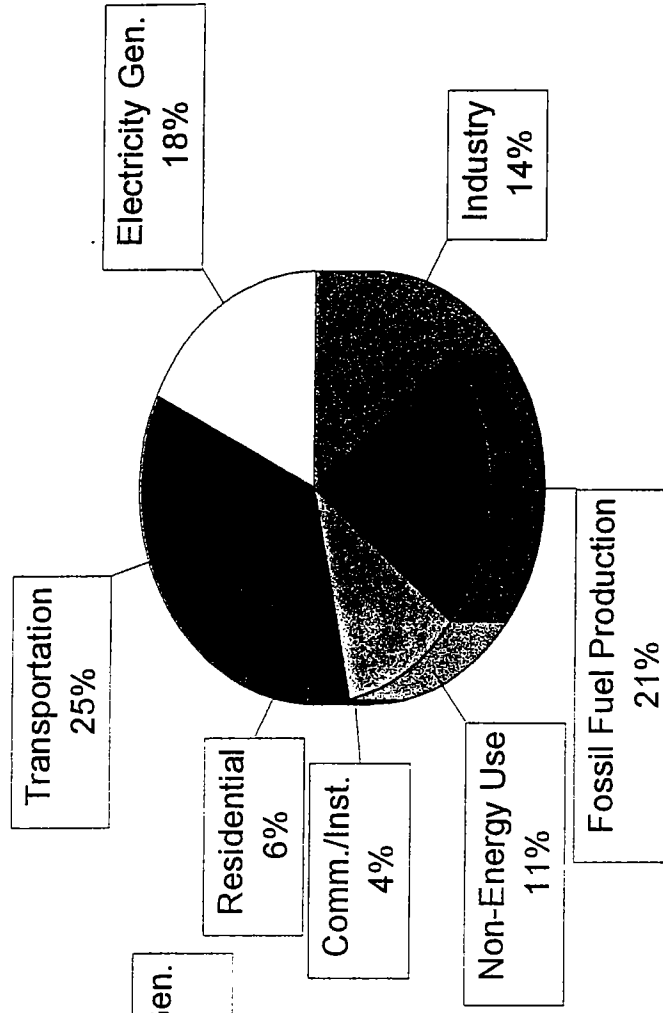
- An issue worth addressing.
- We will do our fair share.
- We support a national stabilization target for 2010.
- Before Ontario can support an agreement
 - The U.S. must ratify
 - Deal must be fair and flexible
 - Provincial consultations must take place

GREENHOUSE GAS EMISSIONS BY SOURCE %

ONTARIO



REST OF CANADA



ATMOSPHERIC HAZARDS

HAIL

TORNADO

LIGHTNING

FLOOD

BLIZZARD

DROUGHT

EXCESSIVE HEAT

HURRICANE

STORM

SEA ICE AND ICEBERGS

FOG

HEAVY SNOW

FREEZING RAIN

EXTREME COLD

FACTORS IMPACTING LOSS FREQUENCY AND SEVERITY

1. GROWTH OF CITIES
2. INSUFFICIENCY OF
INFRASTRUCTURE
3. POOR PLANNING
4. POST-LOSS GOUGING
5. FRAUD
6. DAMAGEABILITY OF
STRUCTURES
7. "MAINTENANCE" LOSSES
8. ABILITY OF INSURERS TO
RESPOND

GREAT NATURAL CATASTROPHES

- DECADE 1960-69 16 LOSSES
 - » ECONOMIC COST \$48.4BN, INSURED \$6.5BN
 - »
- DECADE 1970-79 29 LOSSES
 - » ECONOMIC COST \$93.0BN, INSURED \$10.9BN
 - »
- DECADE 1980-89 70 LOSSES
 - » ECONOMIC COST \$147.6BN, INSURED \$29.8BN
 - »
- LAST 10 YEARS 64 LOSSES
 - » ECONOMIC COST \$404.4BN, INSURED \$98.8BN

AMOUNTS ARE US\$ AT 1996 PRICE LEVELS

**RECENT ATMOSPHERIC DISTURBANCE
LOSSES
LAST SEVEN YEARS OF 1980's**

<u>YEAR</u>	<u>PROV</u>	<u>TYPE</u>	<u>COST</u>
1984	ONT.	WIND	\$39,000,000
1985	ONT.	HAIL/WIND	\$16,000,000
	ONT.	TORNADO	\$85,000,000
1986	QUE.	STORM	\$12,000,000
1987	QUE.	STORM	\$21,000,000
	ALTA.	TORNADO	\$149,000,000
1988	ALTA.	TORNADO	\$50,000,000
	ALTA.	HAIL	\$37,000,000
1989	ONT.	FLOOD	\$14,000,000

4

RECENT ATMOSPHERIC DISTURBANCE LOSSES FIRST SEVEN YEARS OF OF 1990's

1990	ALTA.	HAIL	\$16,000,000
1991	ONT.	TORNADO	\$25,000,000
	ALTA.	STORM	\$28,000,000
	QUE.	TORNADO	\$14,000,000
	ALTA.	HAIL	\$400,000,000
	B.C.	WINDSTORM	\$4,000,000
	ONT.	WINDSTORM	\$5,000,000
	NFLD.	WINDSTORM	\$8,000,000
1992	ALTA.	HAIL	\$22,000,000
	ONT.	FLOOD	\$5,000,000
	ALTA.	HAIL	\$7,000,000
	ALTA.	HAIL	\$5,000,000
	NFLD.	WIND	\$9,000,000
	ONT.	FLOOD	\$4,000,000
	ONT.	WIND	\$36,000,000
	QUE.	WIND	\$8,000,000
1993	MAN.	FLOODS	\$184,000,000
	ONT/QUE.	WINTER	\$50,000,000+
	ALTA.	HAIL	\$8,000,000
	SASK.	FLOOD	\$5,000,000
	QUE.	FLOOD	\$8,000,000

ENERGY SAVINGS GUARANTEE

- FINANCED BY THIRD PARTY
- OWNER PUTS VERY LITTLE CASH UP FRONT
- INSURANCE IN FAVOUR OF FINANCIER AND OWNER
- GUARANTEES THAT PROJECTED SAVINGS WILL BE ATTAINED
- 3 TO 5 YEAR PAY-BACK PERIOD
- FINANCIER REPAID FROM SAVINGS
- OWNER HAS UPGRADED AND ENERGY EFFICIENT BUILDING WITH ALL FUTURE SAVINGS GOING TO BOTTOM LINE

REDUCTION OF SEVERE STORMS

- 7 MAJOR CANADIAN INSURERS
- OIL AND GAS INVESTMENTS OF \$135,000,000
- 1996 EXTREME WEATHER EVENT LOSSES \$165,000,000
- TAKE 10 - 15% OF FOSSIL FUEL INVESTMENTS AND IN INDUSTRY POOLING OR INDIVIDUALLY INVEST IN RENEWABLE ENERGY PROJECTS.
- PROACTIVE NOT REACTIVE POSITION

INSURANCE INDUSTRY NATIONAL MANAGEMENT STRATEGY

- **Build safer communities - building codes, infrastructure spending targeted at mitigation, research into safer building techniques**
- **Establish safety partnerships with better coordination with government, insurers, researchers, engineers, builders and others**
- **Strengthen research base with better data and targeted research**
- **Promote community awareness - informed community action is the most effective means of reducing loss of life and property**