

Adapting to Climate Change The Role of Canada's Engineers

CCPE Climate Change Impact and Adaptation Action Plan Executive Summary June 2003

Climate change is an issue of growing concern in Canada and around the world. Whether caused by human activity or as part of a natural cycle, climate change has profound implications for the way in which professional engineers design and build facilities and infrastructure elements that last for many generations. It is crucial that Canada's professional engineers understand how to adapt their designs, and their daily work decisions, to minimize the long-term impacts of climate change.

In the face of this new reality, the Canadian Council of Professional Engineers (CCPE), with the support of the Government of Canada's Climate Change Action Fund held a two-day workshop on Climate Change Impact and Adaptation on February 28 and March 1, 2003. The workshop was attended by 60 professionals from the engineering and science community. Participants learned about the science of climate change and its impact. They also discussed how the engineering profession should proceed with this issue which resulted in the creation of this Action Plan.

Climate change is a long-term shift or alteration in the climate of a specific location, a region or the entire planet, and it occurs when the climate is altered between two different periods of time. Climate change can be confused with climate variability. Climate variability is often considered internal to the climate system while climate change is normally caused by external factors. What is considered climate change on century scales can be called climatic variability on millennial time scales.

There are two generally recognized strategies to respond to climate change impacts: mitigation and adaptation. **Mitigation** is defined as an intervention to reduce the sources or enhance the sinks for greenhouse gases that are a driver for climatic change. This strategy is used to slow the rate of climatic change. **Adaptation** is an adjustment in natural or human systems in response to actual or expected climatic changes, which moderates harm or exploits beneficial opportunities. Adaptation is a necessary strategy at all scales to complement climate change mitigation efforts.

International climate change research is well co-ordinated and very active. Efforts are co-ordinated through the World Climate Program as well as implemented within national research programs. There have been three international assessments of the global climate in the past 20 years. Thousands of peer-reviewed papers on the subject are published each year.

There is growing confidence of the certainty of climate change impacts from this research including:

- Global mean, mean surface temperature (combined land/ocean) is rising;
- Global costs of natural disasters are rising;
- CO₂ concentrations are now unprecedented in at least the past 400,000 years.

The projected impacts of climate change from modelling efforts suggest that:

- Winters in most of Canada are likely to become wetter;
- Summers in North America are expected to become drier;
- Sea ice will retreat, particularly in summer;

- Sea levels will rise;
- Inland flood disasters may become more frequent as rains become more intense;
- Frequency and severity of droughts are also likely to increase in southern Canada;

Most of the research has been at global or small scales. Engineers will require data at the local and larger scales to effectively engineer adaptation measures. Engineers should work with and encourage scientists to pursue research and modelling at larger engineering scales

The workshop participants discussed strategies to advance the issue of climate change adaptation within the engineering profession and came up with the following proposals:

- Develop an education strategy aimed at engineering students and professional engineers;
- Raise awareness within the profession and educate the profession, industry, decision makers and the public on the need for adaptation;
- Develop standards / codes of practice to ensure that adaptation concepts are integrated into engineering design / practice;
- Establish a formal and consistent link between scientists and engineers to exchange information and to communicate the needs of engineers for research and modelling, particularly at a regional and more detailed level;
- Develop a funding strategy to support this work.

These strategies were further developed into six areas for action by the profession:

- Communications;
- Education;
- Continuing Professional Development (CPD);
- Guidelines, Codes and Standards;
- Networking of Scientists and Engineers;
- Funding arrangements.

The activities proposed in each of these action areas are described in the draft plan. The first action is to undertake a communications activity to raise the awareness and profile of this issue with engineers and those organizations that support and interface with the engineering profession. This critical step is needed to secure support for the resources and the co-operation of other organizations (such as the technical societies) to implement the complete action plan. Technical workshops, media articles and a Speakers Bureau are among the proposed communication actions. Strong formal and consistent communication links with the scientific researchers will be required.

The plan includes a brief summary of potential funding sources to access for climate change impact and adaptation initiatives. CCPE, the associations/ordre and the technical societies will work together to access funding to the extent that it is appropriate and consistent with the scope of the final action plan.

CCPE's role in the Action Plan will be primarily one of facilitation and a mechanism to interface with the Federal government and other national bodies to obtain funding as well as access to scientific expertise and the organization of additional workshops at the national level. The proposed allocation of roles and responsibilities of the CCPE, the associations and the technical societies for the activities in the action plan is provided in Table 1.

The next step to finalize the plan is to formally consult with the 12 associations/ordre of the CCPE on the specific activities, funding, roles and responsibilities of the CCPE and the associations/ordre in the six action areas. Following completion of the consultations, the plan will be submitted to the CEQB for approval, then to the CCPE Board of Directors for approval.

TABLE 1
DRAFT ALLOCATION OF ACTIVITIES

Activity Area	CCPE	Associations/Ordre	Other Technical Societies	Comments
Communication	<ul style="list-style-type: none"> • Complete CCPE Action Plan; • Sponsor and/or develop fact sheets and case studies of climate change impacts and best adaptation engineering practices; • Write initial series of articles for publication; • Prepare standard presentation materials and provide to associations, technical societies and national/provincial consulting engineering associations; • Facilitate provision of speakers from the scientific , engineering and government communities; • Adopt Climate Change Impact and Adaptation as principal theme for NEW 2005 or 2006; • Organize Second National Workshop on Climate Change Impact and Adaptation in 2006; • Develop three year communications plan for 2006-2009; • Hold national forum in early 2004 with scientific community and government to determine research needs and priorities for engineering applications; • Set up and provide the Secretariat for a National Task Force of scientists, engineers and Federal government representatives to develop a national action plan by 2006 to implement and institutionalize climate change adaptation measures.; • 	<ul style="list-style-type: none"> • Sponsor and/or develop fact sheets and case studies of climate change impacts and best adaptation engineering practices • Host and conduct technical workshops at 2004 AGMs and best practices at 2005 AGMs; • Publish articles in magazines and newsletters; • Encourage individual engineers to write articles on climate change impact and adaptation measures; • Adopt Climate Change Impact and Adaptation as principal theme for NEW 2005 or 2006 • Host regional forums in 2004-2005 on climate change impact and adaptation with focus on regional issues; • Presentations at local industry and government conferences and workshops; 	<ul style="list-style-type: none"> • Publish technical articles on climate change impact and adaptation/mitigation measures in technical journals and association magazines; • Presentations at technical society conferences and workshops; • Raise awareness and support for the issue through their membership. 	Concentrate efforts in the first year on raising awareness within the profession

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Activity Area	CCPE	Associations/Ordre	Other Technical Societies	Comments
	<ul style="list-style-type: none"> • Presentations at national industry and government conferences 			
Education	<ul style="list-style-type: none"> • Define the body of knowledge of climate change science, impact, adaptation and mitigation, including reliable strategies and technologies; • Present the BOK to CEAB and NCDEAS and discuss possible amendments to accreditation criteria; • Encourage Deans to develop elective courses 	<ul style="list-style-type: none"> • Promotion and reinforcement of the issue with individual Deans of Engineering and department heads; 	<ul style="list-style-type: none"> • Prepare reports on the state of knowledge and engineering applications by discipline; • Support and in some cases lead proposals for funding research and engineering applications development 	
CPD	<ul style="list-style-type: none"> • Modify CCPE Guideline on continuing professional development and continuing competence to introduce this concept as a principal area for CPD; • Identify engineering disciplines where needs for adaptation tools are most important; • Develop action plan with associations/technical societies to identify and specify changes and specific adaptations for each discipline and all disciplines • Execute the CCPE portion of the plan. 	<ul style="list-style-type: none"> • Develop specific development programs and participate in pilot projects with target groups; • Sponsor or facilitate technical presentations/short courses on climate change impacts and adaptation for different areas of practice starting with higher risk areas. • Develop action plan with CCPE/technical societies to identify and specify changes and specific adaptations for each discipline and all disciplines; • Execute the association/ordre portion of the plan. 	<ul style="list-style-type: none"> • Develop and deliver programs in partnership with provincial and territorial associations/ordre as well as colleges, universities and industry; • Participate in the development of an action plan with CCPE and the associations/ to identify and specify changes and specific adaptations for each discipline and all disciplines; • Execute the technical society portion of the plan. 	Joint effort at specifying what is needed and developing it.
Guidelines	<ul style="list-style-type: none"> • Modify CCPE Guideline on Environment and Sustainability to include climate change and adaptation concepts; • Proposal to review National Building Codes; 	<ul style="list-style-type: none"> • Develop new practice guidelines and amend existing ones to account for climate change impacts, adaptation and mitigation; • Proposals to amend provincial building codes to account for climate change impact and adaptation; 	<ul style="list-style-type: none"> • Assess and document the effect of climate change impact and adaptation for the traditional and emerging engineering disciplines of study and practice areas 	Joint proposals for demonstration and pilot projects

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Activity Area	CCPE	Associations/Ordre	Other Technical Societies	Comments
	<ul style="list-style-type: none"> • Invite national standards associations to develop process to consider and amend standards and codes as required; • Monitor and report on processes and changes to international standards and those in the U.S. and Europe arising from climate change adaptation measures; • Review CCPE Code of Ethics to determine if this concept should be placed in the guideline. 	<ul style="list-style-type: none"> • Proposals to amend other safety-critical provincial regulations and codes to account for climate change, adaptation and mitigation. 		
Networking	<ul style="list-style-type: none"> • Join the C-CAIRN to represent the profession at the national level; • Join Adaptation and Impacts Research Group (AIRG); • Regular meetings with Federal government departments to exchange information and monitor and report on developments within Federal government departments; • Disseminate information from Federal government meetings on programs, funding opportunities and technical developments to associations and technical societies. 	<ul style="list-style-type: none"> • Join regional nodes of C-CAIRN and any equivalent provincial or territorial agencies; • Regular meetings with Provincial government departments to exchange information and monitor and report on developments within Provincial government departments; • Discussion with provincial and municipal government on current policies and budget allocation to account for climate change impact, adaptation and mitigation 		

TABLE 1
DRAFT ALLOCATION OF ACTIVITIES

Activity Area	CCPE	Associations/Ordre	Other Technical Societies	Comments
Funding	<ul style="list-style-type: none"> • Provide level of funding for basic level of effort and possible leveraging of other funds; • Pursue project-specific funding opportunities with Federal government Climate Change Action Fund and other funding programs; • Meet with Federal government to discuss partnering on Federal action plans in impacts and adaptation. 	<ul style="list-style-type: none"> • Pursue project-specific funding opportunities with provincial and municipal government agencies and programs; • Allocate funding and/or HR to support communication, proposal writing and CPD efforts at the provincial and territorial level 	<ul style="list-style-type: none"> • Partner with associations/ordre and/or CCPE for specific project proposals. 	<ul style="list-style-type: none"> • Joint discussion required among partners

Consultation Draft

Adapting to Climate Change The Role of Canada's Engineers

CCPE Climate Change Impact and Adaptation Action Plan June 2003

1.0 Introduction

Climate change is an issue of growing concern in Canada and around the world. Whether caused by human activity or as part of a natural cycle, climate change has profound implications for the way we live and work. One of those implications concerns the way in which professional engineers design and build facilities and infrastructure elements that last for many generations. Given that the impact of climate change is also long-term, it is crucial that Canada's professional engineers understand how to adapt their designs, and their daily work decisions, to minimize the long-term impacts of climate change.

Climate change is a long-term shift or alteration in the climate of a specific location, a region or the entire planet, and it occurs when the climate is altered between two different periods of time. Studies indicate there are positive and negative impacts of climate change on human and natural systems. There are two generally recognized strategies to respond to climate change impacts: mitigation and adaptation. Mitigation is an intervention to reduce the sources or enhance the sinks for greenhouse gases that are a driver for climatic change. This strategy is used to slow the rate of climatic change. Adaptation is an adjustment in natural or human systems in response to actual or expected climatic changes, which moderates harm or exploits beneficial opportunities. Adaptation is a necessary strategy at all scales to complement climate change mitigation efforts.

In the face of this new reality, the Canadian Council of Professional Engineers (CCPE), with the support of the Government of Canada's Climate Change Action Fund hosted a two-day workshop on climate change impacts and adaptation in March 2003. The workshop was organized by the Canadian Engineering Qualification Board (CEQB), a standing committee of the CCPE Board of Directors. The CEQB Environment and Sustainability Committee (CEQB E&SC) served as the organizing committee.

The objective of the workshop was to provide the profession with an increased understanding of climate changes, the present and future potential impacts associated with changes and appropriate adaptation responses which are relevant to the Canadian professional engineer in their designs and decisions. This workshop focused on impacts and adaptation, which is at an earlier stage of development. Engineers are already participating vigorously in the pursuit of knowledge and application and development of techniques to minimize climate change.

The information acquired from the workshop enabled the CEQB Environment and Sustainability Committee to prepare this draft Climate Change Impact and Adaptation Action Plan ("the Action Plan") for the consideration of the CEQB, the CCPE Board of Directors and the provincial and territorial associations/ordre. While the plan emphasizes climate change adaptation, there are a number of cases where adaptation and mitigation will be considered together, since both strategies are required. This plan has been prepared for consultation with the Constituent Members of the CCPE.

The process will follow the CEQB's formal consultation procedure and involve a review of the proposed activities and initiatives. The consultation will also explore and define the roles and responsibilities of the CCPE, the Constituent Members and those organizations that support or interface with the engineering profession. A final, but very important topic will be funding of the initiatives in the plan. Some of the

required resources must be secured from sources other than the CCPE, and there is allowance for this activity in the plan.

Comments on the plan will be used to determine adjustments in the nature, scope and timing of activities as well as roles, responsibilities and funding arrangements. It is unlikely that all the details will be settled in time for approval of the plan by the CCPE Board of Directors in September 2003. However, during the initial stages of implementation, a separate but parallel task will be to finalize these arrangements while the initial activities proceed. Time is of the essence for the profession to take advantage of this opportunity and show leadership.

This draft plan was presented to the CCPE Board of Directors in May 2003 for information. The CEQB formal consultation process with the associations/Ordre will be initiated. The objective is to complete this consultation sufficiently so that the CCPE Board of Directors can approve the final draft of the plan in September 2003. As noted earlier, further discussion and refinement of the plan will continue following approval.

This plan describes the roles and activities from the perspective of CCPE. In many cases the work carried out by CCPE will be limited. It will be up to other groups to continue or build upon the work. The final version of this plan will identify where the work of CCPE stops and the handover of responsibility should occur.

2.0 Action Plan Framework

Based on the scientific information received at the workshop, participants focused their efforts on identifying information needs and the barriers to receiving that information. Participants then recommended strategies to advance the issue of climate change adaptation within the engineering profession:

- Develop an education strategy aimed at engineering students and professional engineers;
- Raise awareness within the profession and educate the profession, industry, decision makers and the public on the need for adaptation;
- Develop standards / codes of practice to ensure that adaptation concepts are integrated into engineering design / practice;
- Establish a formal and consistent link between scientists and engineers to exchange information and to communicate the needs of engineers for research and modeling, particularly at a regional and more detailed level;
- Develop a funding strategy to support this work;
- Consult on the draft action plan to secure endorsement of the final version and enthusiastic support for its implementation.

This "Action Plan" identifies a course of action that can be adopted by the CCPE to implement the recommended strategies. The implementation steps listed for each strategy are based on the premise that engineers hold a privileged position of influence and decision-making within society. As such, the actions will ensure the engineering profession contributes to the advancement of technology and the body of knowledge pertaining to the 'Adaptation to Climate Change'.

The results of the national workshop identified six areas for action by the CCPE working in close partnership with its Constituent Members and those organizations that support the profession:

- Communications;
- Education;
- Continuing Professional Development (CPD);
- Guidelines, Codes and Standards;
- Networking of Scientists and Engineers;
- Funding arrangements.

The following sections propose the activities and initiatives CCPE believes are needed to achieve the objectives defined under each action area. Where known, roles and responsibilities of the various players involved in an activity are briefly described.

3.0 Communications

The first need is to raise the general awareness of the issue and its importance to future engineering practice among the engineering community and its support organizations. The average engineer may have heard of the issue, but may not believe the predicted impacts or the need to make adjustments to his or her engineering practice. The issue also needs to have the engineering perspective communicated to the general public and the clients for engineering services.

The CCPE believes the first action in the plan is to undertake a communications activity to raise the awareness and profile of this issue with engineers and those organizations that support and interface with the engineering profession. This critical step is needed to secure support for the resources and the cooperation of organizations other than CCPE to implement the complete action plan. Communication will however be a continuing activity throughout the life of this action plan and beyond.

3.1 Target Groups

Target groups for communication include the engineering profession, industry, universities, Federal, Provincial and Municipal governments, regulatory authorities, standards associations, scientific researchers and the general public. A mixture of different strategies and actions will be required to reach these groups individually and in different combinations. Communication with these target groups should be phased in a sequence that would see a gradual expansion of the audience as communication materials are developed.

Communication should occur in two phases with different target groups as the priority in each phase. The target groups for the first phase in order of priority are the engineering profession, scientific researchers and universities. The second phase would see the audience broadened to include the following groups in order of priority: Federal Government, Industry, Provincial and Municipal governments and the general public.

The first period of Phase I, approximately one year, should be dedicated to communicating with the engineering profession to build support for, and engagement in, the action plan. The engineering profession target group should be further subdivided into four subgroups: CCPE Boards and Committees, the 12 Constituent Members of the CCPE, the technical societies and Individual Engineers. Common and separate strategies are required to communicate to these audiences. It is essential that the nature and sequence of communication with these subgroups respect proper protocols.

CCPE will assume responsibility for the first two groups, and support the work of local associations/ordre to communicate with their individual members and the technical societies. Communication and education should take advantage of other events to optimize time, resources and access to the target groups.

Strong formal and consistent communication links with the scientific researchers will be required. The profession needs to join climate change impact and adaptation research networks such as C-CAIRN to foster dialogue and participate in technical meetings. Joint meetings to develop a mutual appreciation of the issues and constraints are needed to move the science of climate change into engineering adaptation and mitigation measures.

Universities can provide the knowledge required by individual engineers to practice engineering considering climate change. The Deans from applicable programs could facilitate the development of course and teaching materials focused initially at the general level (i.e. across disciplines) and later moving into discipline-specific applications as further research and engineering practice expands the body of knowledge and experience. The Canadian Engineering Accreditation Board (CEAB) has a

supporting role in this process through accreditation of undergraduate engineering programs and the control of accreditation criteria.

Therefore it is important to communicate early with the Deans of applicable programs to raise their awareness of the issue and to encourage them to pursue sponsorship of further research on climate change adaptation from the engineering perspective.

Communication with industry is required to raise the awareness of the issue with respect to the design and procurement of their engineering works. This extends to engineering consultants who design engineering works for others. The role and responsibilities of engineers and best practices are topics that could be discussed with industry. Industry support for further targeted research in climate change impact, and support of pilot projects to test adaptation measures to establish best practices would be desirable. The first stage of such cooperation would be an effective dialogue with industry on this issue through communication efforts at industry association and technical meetings.

As major consumers of engineering services, governments at all three levels have an important role. Raising their awareness of the importance and impact of climate change, and the presentation of adaptive measures to account for in the design and costing of future engineering works will help governments appreciate the need and allocate the proper resources to fund such measures. The experience gained will help provide examples for the development of best practices as well as education and communications materials.

Communication with the public on the role of Canada's engineers in climate change impact and adaptation will help raise the profile of the profession and help advance consideration of adaptation in the procurement of engineering design services.

Communication on the issue of climate change impact and adaptation will be a gradual and continually evolving process over the long-term. Communication activities will be required over many years, and it is suggested that a phased approach be used to develop and properly manage the effort.

3.2 Phase I – Raise Awareness (May 2003 to February 2006)

The profession itself needs to embrace this issue as one of its high priorities. This process was started with the national workshop, but the critical role to be played at the provincial and territorial level makes it imperative that the associations/ordre understand the need and value to commit time and resources to this issue, given all the other priorities. It is very clear that CCPE cannot do this alone – the leadership, partnership and cooperation with the associations/ordre, the technical and learned societies and other partners will be a prerequisite for success. It will require a focused communications and consultation process facilitated by CCPE to achieve these aims.

At the same time the human and financial resources of CCPE and those of the associations/ordre are limited. The first level of activity will be to a level matching the financial resources available in the annual CCPE budget. This funding may be used in part to leverage outside funding to increase the total financial resources available and thus expand the scope of activities accordingly. This will require the preparation and selling of proposals to government and other possible partners. It is not known when additional funding beyond what is allocated in the CCPE budget will become available. It will depend on the success of individual proposals and their cash flows. More elapsed time has been allowed and more may still be required to achieve the objectives of this phase, given limited staff and financial resources in the initial stages. Successful fundraising will be a significant element in the timing of many elements in the action plan. Effective communication of the issue and its importance will be one of the critical success factors towards securing additional resources beyond what the CCPE annual budget can provide.

Given this background the objectives of Phase I include:

- Raising the awareness of climate change impact and adaptation within the engineering profession;

- Raising the awareness of the role of engineers in climate change and adaptation/mitigation with organizations that support, interface with or employ the engineering profession;
- Securing an appropriate priority for climate change impact and adaptation (resources, agenda) within the engineering profession and those organizations that support or interface with it;
- Securing a long-term, two way communication on this issue between the engineering profession and its support/interface organizations and possibly with the general public;

Finalize a long-term communications plan for Phase II once the first four objectives have been achieved. To achieve these objectives the actions in Phase I will consist of the following elements:

1. Presentation and consultation on the draft CCPE Action Plan;
2. Presentation and endorsement of the final CCPE Action Plan;
3. Submission of proposals for funding the communications and education components of the CCPE Action Plan;
4. Technical Workshops at association/ordre AGMs on Climate Change Impact and Adaptation;
5. Setting a process to communicate engineering needs to climate change researchers and scientists on a systematic basis;
6. Up to five (5) Regional Forums in 2004-2005, hosted by the association/ordre at their AGMs if possible with a focus on climate change impact, adaptation and mitigation – versions of the 2003 national workshop with a regional focus i.e. to develop regional action plans;
7. In conjunction with the technical and learned societies, develop fact sheets and case studies of best practice as communication and education materials;
8. Encourage engineers to write articles on climate impact and adaptation engineering issues and practices for technical journals, magazines and newspapers. The first stage of this activity will be to write one or more articles for the engineering association/Ordre journals and newsletters, either a series of articles or perhaps a special theme issue on climate change impact, adaptation and mitigation;
9. Presentations (and in some cases monitoring) at industry and government conferences;
10. Consider establishing a Speakers Bureau to develop and manage a database of volunteer speakers (engineers and scientists and possibly others), and facilitate presentations where possible;
11. Adoption of Climate Change Impact and Adaptation as the principal theme for National Engineering Week 2005 or 2006;
12. Prepare and get approval for a three year communications plan to cover Phase II for 2006 to 2009.

Phase I would conclude with a Second National Workshop on Climate Change and Adaptation - The Role of Engineers to be held in conjunction with the CCPE Board of Directors meeting in Ottawa in February 2006. The workshop would include a presentation of the Phase II communication plan that would support the creation and adoption of best practices. A report card on the status and success of this Action Plan would also be presented. The results of the workshop would be used to develop the next action plan. Funding for this workshop will be sought through the Climate Change Action Fund.

4.0 Education

Education at the undergraduate level on climate change impact, adaptation and mitigation will enhance awareness and accelerate its application by our next generation of engineers.

The overall objective of this element of the action plan is to ensure that climate change science, impact, adaptation and mitigation concepts, strategies and technologies are integrated into the undergraduate engineering curriculum. The intent is to provide a solid basis of knowledge in the subject area appropriate to the discipline of study, which can be eventually utilized in practice. Familiarity with the concepts and applications will allow the students to further advance the engineering applications more quickly to the benefit of society.

However, the state of knowledge on climate change impacts and the application of strategies into engineering design is incomplete. It has not been formalized and organized into a body of material that can be presented at the undergraduate level. Therefore it will be important to collect and assemble current knowledge and experience first before deciding if the material is adequate or if further development is required. In any case the subject material will need to be organized into curriculum content that is at an appropriate level and that is both general and specific to the discipline of study. It will be important to determine which areas of practice will be most affected to help prioritize efforts in this area.

The principal mechanisms immediately available to CCPE to directly address the overall objective in education include:

- Accreditation of undergraduate engineering programs through the CEAB;
- Access to the National Council of Deans of Applied Science and Engineering;

The actions proposed to achieve this goal are as follows:

1. Determine the engineering disciplines where climate change impact and adaptation will have a major impact on current and future engineering design and practice;
2. For each of those disciplines prepare reports on the state of scientific knowledge and engineering applications;
3. Define the current body of knowledge as well as any major gaps in that knowledge;
4. Prepare funding proposals for the preparation of case studies and educational materials for each discipline or area of practice;
5. Support proposals for research funding to fill the knowledge gaps;
6. Define the common elements of climate change science, impact, adaptation and mitigation knowledge, strategies and technologies that would be common to all affected disciplines – the “Basic Science of Climate Change Impact, Adaptation and Mitigation”;
7. Brief the CEAB on this subject and ask them to review their accreditation criteria to see if anything needs to be changed to account for climate change impact, adaptation and mitigation;
8. Encourage the Deans of Engineering to offer elective courses in climate change adaptation and mitigation as a pre-cursor to potentially including this in the core part of some programs.

Due to incomplete knowledge and application experience, it is expected the incorporation of material on this subject into the core part of an undergraduate engineering curriculum is several years away. However, the basic science is likely mature enough to prepare materials that could be presented in optional courses. More advanced courses on engineering applications await further developments before the knowledge and experience gained can be assembled into a coherent, accepted engineering practice that can be taught formally to undergraduate students. It would therefore be premature to recommend CEAB review its accreditation criteria. However, the CEAB should be briefed on the subject area, and advised to monitor developments as the field develops further. Later, the CCPE could formally request CEAB review its accreditation criteria to see if any changes are needed once the field has matured whereby engineering strategies and practice have become more standardized and there is a body of knowledge and experience available for education purposes.

Integration into the CEAB accreditation criteria and core sections of undergraduate engineering program could be an important goal of the next action plan to be discussed at the Second National Workshop in early 2006.

5.0 Continuing Professional Development

Continuing Professional Development will be an extension of communication and awareness efforts. Indeed, with the new perception of the need for adaptation to climatic change, professional engineers will need tools to help themselves adapt to the new realities rising from climatic change.

The communication tools and workshops mentioned in the communication section will be the first tools for Continuing Professional Development. The engineering profession needs improvement to each discipline by way of a set of specialized technical tools that can only be acquired through a more elaborate development program. It will thus be necessary to develop a continuous Professional Development program specific to each engineering discipline.

We therefore propose development by the following steps:

1. Identification of the engineering disciplines where the needs for the adaptation tools are most important.
2. Identification of the changes and specific adaptations for each discipline.
3. Identification of the changes and general adaptations common to all disciplines.
4. Preparation of specific development programs and running pilot projects with target groups.
5. Distribution of the development programs to the constituent associations/ordre and organizing training sessions in larger Canadian cities.

This action plan in continuous professional development is the most ambitious that the CCPE has made to date in this field. It requires resources and time and could be completed in a period of 3 to 4 years with adequate financing. Financing will be necessary for steps 1 to 4 but the training courses in stage 5 will be self-financed.

The CCPE and the associations/ordre should combine this effort with the technical and learned societies such as the Canadian Society for Civil Engineers for the development of these continuous professional development programs. The technical and learned societies could provide and/or facilitate the development of the necessary expertise and could also share the effort of development and financing.

Finally it should be mentioned that this continuous professional development program is essential in notifying graduate engineers of the changes to the practice. The adaptation to climatic change is perhaps the greatest challenge to the engineering profession in the 21st century. These changes are essential for the protection and well being of our fellow-citizens and because of this fact, the various levels of government should be convinced to take part financially in this program.

6.0 Guidelines, Codes and Standards

The engineering profession relies upon the development and the application of guidelines, codes and design standards. The CCPE and its constituent associations/ordre are already active in this field and regularly delegate members to officially represent them on committees tasked in the development of these tools. Moreover, the organizations that support these codes and standards count on the work of their own engineers to develop and update them.

It should be understood that adaptation to climatic change would require significant modifications to several existing codes and standards. Even though the CCPE is not a standards organization, it can play an important part by implementing the following actions:

1. Identify the standards, codes and directives that must be adapted as a result of the climatic change.
2. Identify the responsible organizations and their past and current relationships with the CCPE and its constituent associations/ordre.
3. Be proactive and invite the standards organizations to initiate, if it is not already done, a revision program as a consequence to the adaptation to climatic change.
4. Actively monitor all the steps of adaptation of the standards, codes and directives concerning the engineering profession.

Moreover, CCPE can develop professional guidelines. An example is the Guideline on the Environment and Sustainability for all Professional Engineers. A similar guideline should be developed for adaptation to climatic change. Without being a technical guideline, this document would establish the broad outline directives from a concerned profession of the possibility of climatic change and its associated risks. The guideline could give recommendations on the way of incorporating the elements of risk and risk management in the design of the engineering projects.

The development and validation work could be done in 24 months. The experience from the previous admissions guideline supports this estimate. The development work of this guideline will not be solely entrusted to the expertise and resources of the Environment and Sustainability Committee. External expertise and resources in engineering and natural science will have to contribute. A part of the work will be done in collaboration with learned societies but it is obvious that certain other experts will have to be contracted and this will require special financing.

7.0 Networking between Engineers and Scientists

The scientific presentations at the workshop indicated that regardless of the cause, climate change is happening and it will have a profound impact on the earth. Climate change has serious economic consequences. There has already been a 10-fold increase in global losses due to natural disasters attributed largely to more frequent and intense climate extremes.

In Canada, climate change will probably impact in several different ways:

- The multi-year ice cover over the Arctic Ocean will likely disappear by 2050;
- Winters in most of Canada are likely to become wetter;
- The interior of North America could become much drier;
- Permafrost in northern Canada will likely disappear;
- Sea levels will likely rise;
- Inland flooding disasters will be more frequent and more severe;
- Soil erosion and heat damage in agriculture will be higher.

Climate change will also impact human health, forestry, transportation, energy, coastal zones, insurance, ecosystems and tourism/recreation. Natural Resources Canada has produced a book on climate change impacts and adaptation that indicates probable variations due to climate change. These are preliminary estimates done at the continental level. Engineers will need to consider specific regional data and accommodate extreme climatic conditions. This will necessitate close collaboration and communication between the scientists developing climate models and the engineering community.

To facilitate this process, the following initiatives are proposed:

1. CCPE becomes a member of the Environmental Adaptation and Impacts Research Group (AIRG).

The primary goal of AIRG is to ensure that information is available to Canadian decision and policy makers on the environmental, social and economic impacts caused by vulnerabilities to atmospheric change, variabilities and extremes, and viable adaptive responses.

AIRG along with other networks such as the Network on Environmental Technology Innovation (NETI) will be part of an evolving national focal point known as the Canadian Environmental Sciences Network or CESN. CESN aims to evolve into a network of networks providing a new horizontal management framework to build on current areas of environmental networking in Canada. Unfolding on the basis of the knowledge of shared experiences of its growing membership, CESN holds the promise of enhancing and strengthening environmental science in Canada, in support of sustainable development.

With minimum resources, CCPE could be aware and make available the developing science base on climate change to its membership. CCPE becomes a member in the third quarter of 2003 and summarizes the information for its membership.

2. CCPE joins the Canadian Climate Impacts and Adaptation Research Network or C-CIARN as another valuable link for information.

C-CIARN is a national network that facilitates the generation of new climate change knowledge by bringing researchers together with decision-makers from industry, governments, and non-government organizations to address key issues.

C-CIARN provides a collective voice for this community to:

- improve the knowledge of Canada's vulnerabilities to climate change;
- identify ways to minimize the negative effects of future impacts; and
- explore opportunities that take advantage of any positive impacts.

CCPE would need to establish two-way communications to ensure that the engineering profession needs for data collection and monitoring systems relative to critical thresholds are transmitted back to the scientists charged in setting up the data systems. CCPE becomes a member of C-CAIRN in the third quarter of 2003.

3. CCPE meets appropriate federal representatives on a quarterly basis.

The leading federal departments on climate change are Environment Canada, Natural Resources Canada, Industry Canada, Transportation Canada, and Agriculture & Agri-Food Canada. Much of the information generated to date on climate change has evolved from the activities of these key departments. With the advent of the Climate Change Action Fund, the Climate Change Secretariat was established in 1998 to manage the fund and coordinate activities of the various departments on climate change. This process is currently under review but some form of inter-departmental coordination will be maintained and CCPE should ensure that it is, at a minimum, on the distribution list for any material issued by such a coordinating body.

Resources would be required to explore, remain abreast and summarize on-going developments in interested domains.

Based on the above networking with scientists and federal government departments largely responsible for advancing the science of climate change, CCPE would then through its Environment and Sustainability Committee issue information packages to its Constituency Members. These packages would probably be released on a quarterly basis and/or issued as key developments arise. Although much of the information will be available from various networking events and Web sites, CCPE will need to ensure the information is properly presented for its various members. Apart from time commitments, this initiative will require resources to ensure the content is assembled into a newsletter format, edited and distributed as widely and effectively as possible.

Depending on the selected format and available mechanisms, this component of networking could be the most resource intensive.

8.0 Funding Possibilities

CCPE is best positioned to lobby for funding required to meet any engineering needs to advance on climate change adaptation. Lobbying for funding among the various levels of governments in Canada is usually within the domain of associations, as evidenced by their usual location in Ottawa.

Before approaching any government, a clear strategy is required in terms of what are the goals, the requirements, the deliverables, the timetable, the partnerships and the amounts required. Funds could be sought as umbrella funds for allocation by CCPE, usually by strong lobbying prior to major budget announcements, or project specific.

The funding strategy will focus on supporting those activities that are in addition to what can be supported through the resources of the CCPE and the associations/ordre. In the final action plan, CCPE and the associations/ordre will define and agree on a base level of core activities that do not require outside funding support. Additional activities will also be identified on a priority basis, considering outside funding opportunities and their requirements. These activities will be undertaken only when such funding is secured. The plan will therefore need to maintain some flexibility on the scope and timing of the additional activities.

Our success with the Climate Change Action Fund for the national workshop suggests the pursuit of outside funding can be successful and augment the base activities of the associations/ordre and CCPE.

The suggested initiatives to secure funding in addition to what is provided in the CCPE budget are as follows:

1. CCPE proposes to partner with the Federal Government in the delivery of elements of the Federal climate change action plan.

CCPE develops a strategy on the requirements identified in the Climate Change Impacts & Adaptation workshop. Based on the initiatives identified for CCPE: Education, Communications, Continuous Professional Development, Guidelines/Codes/Standards, and Networking Needs, the deliverables are identified and resource implications are defined. Potential for CCPE to partner in the delivery of the requirements are noted and a plan is submitted to the federal coordinating entity on climate change. The potential of the strategy to contribute to the overall federal climate change plan will be of utmost importance.

At present, such a request would be submitted to the Climate Change Secretariat or Environment Canada, Climate Change Bureau. CCPE would require significant resources to pursue this approach.

2. Submit project-specific proposals to various Federal and provincial climate change funding programs

Alternatively, CCPE, based on the above strategy could divide the deliverables into smaller components, which could then be pursued by specific Constituency Members. These could be submitted to various funding programs based on the objectives of the initiative, the region and other critical requirements of funding programs, such as: GHG implications, Partnerships, Leverage, Region, etc. The following is a list of possible funding programs under different activities or elements of climate change:

- i) Scientific Monitoring:

Canadian Foundation for Climate and Atmospheric Sciences

Improving further our understanding of climate systems and the occurrence of extreme weather is an important foundation for developing an appropriate response to environmental challenges such as climate change.

The Canadian Foundation for Climate and Atmospheric Sciences received an initial endowment of \$60 million in 2001 to further enhance Canada's research expertise in the area of climate sciences. Given the Foundation's success in building partnerships among researchers and universities, it has received an additional \$50 million in 2003–04 to increase climate and atmospheric research activities, including research related to northern Canada.

ii) Education & Outreach:

Climate Change Action Fund - Public Education & Outreach

The CCAF-PEO program establishes a solid base for climate change awareness and action. The Fund establishes an integrated investment approach that focuses on partnerships and government leadership for action. The program contributes to the achievement of the Government of Canada's overall objective of reducing greenhouse gas emissions by ensuring that the Canadian public understands the issue of climate change, has the knowledge to support policy measures that will be put in place, and is committed to action.

Although CCAF-PEO was used mainly for informing Canadians on how to reduce greenhouse gas emissions, this fund could be renamed under the new Climate Change Plan and consider a wider spectrum of activities for potential funding.

iii) Municipal Projects:

The Government of Canada has endowed the Federation of Canadian Municipalities with \$250 million to establish the Green Municipal Funds and support municipal government action to cut pollution, reduce greenhouse gas emissions and improve quality of life.

Green Municipal Enabling Fund

Innovation is key to creating sustainable communities, but municipal governments need sound information before investing in radically new approaches. Assistance is now available through FCM to share the risk of exploring new technologies or best practices.

Green Municipal Investment Fund

The Green Municipal Investment Fund (GMIF) is a \$200 million permanent revolving fund that supports the implementation of highly innovative environmental projects.

iv) Infrastructure Projects:

Canada Strategic Infrastructure Fund

While previous infrastructure programs have been successful, it has become apparent that some large-scale infrastructure projects across the country are beyond the scope and capacity of existing programs. The \$2 billion Canada Strategic Infrastructure Fund, announced in Budget 2001, responds to these needs.

The new Strategic Infrastructure Fund complements Canada's other infrastructure programs but differs in its orientation. It emphasizes partnerships with any combination of municipal, provincial, territorial governments, as well as the private sector, and each partnership will be governed by specifically tailored arrangements. Investments will be directed to projects of major national and regional significance, and will be made in areas that are vital to sustaining economic growth and supporting an enhanced quality of life for Canadians.

v) Other Projects:

Partnership Fund - will cost-share emissions reductions in collaboration with provincial and territorial governments, as well as municipalities, Aboriginal communities, non-governmental organizations, and the private sector to increase energy efficiency and reduce greenhouse gas emissions in the most effective way.

Sustainable Development Technology Canada - this \$350 million fund strengthens the Federal government support for development and demonstration of technology related to climate change and clean air.

Technology Early Action Measures - offers support to federal programs that fund technology projects to reduce GHG emissions nationally and internationally, while sustaining economic and social development. TEAM investments accelerate the demonstration and deployment of new technologies into the marketplace, sometimes many years ahead of time.

Apart from 'Scientific Monitoring' and 'Education & Outreach', the other funding mechanisms are largely geared towards greenhouse gas reductions. CCPE members could have difficulty in preparing appropriate proposals on C.C. adaptation to secure necessary resources. CCPE and its members should therefore target the monitoring and education initiatives. Necessary resources would be project specific. CCPE could initiate a process to solicit ideas in 2003 among its membership. The selected proposals could then be given additional support through CCPE's Environment & Sustainability committee.

9.0 Consultation on the Draft Action Plan

This section explains the steps to be undertaken to consult with the constituent associations/ordre of the CCPE. It includes a proposed schedule for review and adjustment of this draft plan prior to commencing the formal consultation process.

The draft plan was provided in advance of the CCPE Board of Directors meeting in May 2003, in the agenda book. There was a brief presentation on the draft plan by the CEQB Chair to the CCPE Board of Directors. The objective of the presentation was to brief everyone on the basic elements of the plan.

The feedback received from this meeting was used to revise the first draft of the plan. The consultation draft will be sent to the associations/ordre by mid to late June 2003. The objective is to have the final version of the Action Plan approved at the CCPE Board of Directors meeting in September 2003. If more time is required to complete the consultation process, the final approval will be delayed until later in the fall of 2003, perhaps through a teleconference call of the CCPE Board of Directors.

To expedite the consultation process, it is suggested that each association/ordre form a special task force or delegate the preparation of a response to an existing committee. This group should be identified or formed as soon as possible to permit the maximum time for review and preparation. CCPE staff and CEQB representatives are prepared to attend meetings or answer any questions or clarifications. Discussions of roles, responsibilities and funding could also occur during the consultation process.

This section of the action plan will be deleted once approved by the CCPE Board of Directors.

Respectfully submitted by:

CEQB Environment and Sustainability Committee

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