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Climate Change Adaptation in the Canadian Energy Sector

Workshop Report

January 2009



PRI Project
Sustainable Development

Canada 

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1.0 Preamble

At their 2007 annual meeting, the Council of Energy Ministers (CEM) affirmed the importance of developing climate change adaptation strategies for the energy sector. As a meaningful step toward advancing such adaptation strategies, the Council approved the creation of a federal/provincial/territorial Climate Change Adaptation Working Group. The Working Group's primary goal would be to develop a work plan that will advance the understanding of, and the response to, the potential impacts of climate change on Canada's:

1. energy infrastructure;
2. energy consumption patterns; and
3. electrical power generation.

Further, the CEM directed the Working Group to conduct a workshop with members of the energy sector to review priorities in relation to these three topics and inform recommendations for future CEM activities on climate change adaptation. In response to this directive, the "Climate Change Adaptation in the Canadian Energy Sector" workshop was held on June 19 and 20 in Toronto. The workshop was attended by government officials, including members of the Working Group, and representatives of energy sector companies, industry associations and utilities. The 1.5-day workshop was organized by the Policy Research Initiative and Natural Resources Canada in collaboration with the Working Group and was assisted by Intersol.

2.0 Workshop Overview

The "Climate Change Adaptation in the Canadian Energy Sector" workshop had three key objectives:

- To better understand whether or how climate change has been considered and planned for within Canada's energy sector;
- To contribute to a work plan for the CEM on adaptation to climate change within the energy sector, and to assess the scope and breadth of the issues to address;
- To promote awareness and dialogue within Canada's energy sector on adaptation to climate change.

In order to meet these objectives, the workshop was designed to both build awareness through presentations and to extract important insights from participants through engagement and dialogue.¹ Four presenters set the context for the workshop:

1. **Don Lemmen**, of Natural Resources Canada (NRCan), identified some of the key findings from NRCan's assessment report on climate change adaptation, *From Impacts to Adaptation: Canada in a Changing Climate 2007*. His presentation shared some definitions and the key conclusions of the assessment report as they relate to the energy industry.
2. **Wishart Robson**, of Nexen Inc., described ways in which the international oil and gas industry is continually adapting its operations and technologies to ensure

¹ The Participant List and Workshop Agenda are provided in Appendix A and Appendix B.

safety, and to mitigate risks of all kinds. He emphasized that there are technological solutions to operate in climates all over the world and that Nexen Inc. has sought to engage the relevant experts as necessary to operate successfully.

3. **René Roy**, from Hydro-Québec, described how his organization was using hydrological models to forecast impacts of climate change and help improve their operating rules and physical configuration. He explained that Hydro-Québec was using an adaptive resource management (ARM) approach to address issues related to impacts from climate change.
4. **Valerie Chort**, from Deloitte Consulting, provided her views on developing an integrated strategy for climate change adaptation. Her presentation included information about the drivers of climate change adaptation, the risks faced by business and government, and the current response to climate change. She shared the key components of a risk-based approach to climate change and highlighted some of the key success factors for addressing climate change.

Highlights from the four presentations are reviewed in section 3.0.

Following the introductory presentations, workshop participants took part in a facilitated two-stage discussion. In the first stage, participants were asked to identify and discuss topics that they viewed as important to the issue of climate change adaptation and that could warrant further effort going forward. The following intention question was used to identify topics:

What do we need to do to best inform the CEM about work to support adaptation to climate change by energy sector industries in the coming year? And beyond?

A total of 26 topics were identified (when appropriate, participants grouped similar topics under a single heading) and 13 were selected for further exploration through group discussions.² The 13 group discussions that occurred over two rounds of break-out sessions were aided by a template that encouraged the participants to examine the selected topic from a variety of perspectives, concluding with key messages to report back in the plenary session.

In the second stage, the remaining 13 topics were prioritized based on impact and urgency. The five topics below received the most votes and were identified as priority topics:

- Climate change adaptation science;
- Co-ordinated local, provincial, national, and international policies;
- Information sharing and knowledge transfer;
- Aging infrastructure and increasing demand; and
- Market mechanisms for adaptation.

² See Appendix C for the list of topics.

Again, the participants were divided into break-out groups to narrow the focus on the top five topics to extract specific actions for consideration by the CEM. These five topics are the focus of section 4.0 of this report.

3.0 Context for Climate Change Adaptation and the Energy Sector

The following section summarizes the material that was provided by the workshop's four guest presenters.

The world's climate is changing. Canada is experiencing relatively pronounced increases in temperature and changes in precipitation and sea level.³ The impacts of climate change are already evident in every region of Canada and range from increased erosion of our coastlines to permafrost degradation in the North, reduced ice and snow cover, and reduced lake and river levels. With respect to our ecosystems, some regions are experiencing an earlier onset of spring, increased plant productivity, and changing animal distributions. Climate change projections suggest that such impacts are expected to continue and amplify over the coming decades. Adaptation is therefore a necessary complement to ongoing research on impacts.

Adaptation is defined as adjusting decisions, activities, and thinking because of observed or expected changes in climate in order to moderate harm or take advantage of new opportunities. Adaptation and mitigation are necessary complements in addressing climate change. The capacity of different countries, regions, and sectors to adapt can vary. In general, the adaptive capacity of Canada is high, but some regions (e.g. the North) and communities (e.g. Aboriginal and resource-based) are particularly vulnerable for a variety of physical and socio-economic reasons.

Although sector-specific assessments have yet to be conducted, there is evidence to suggest that the energy sector will be somewhat vulnerable due in large part to the climate-related risks associated with water availability, extreme weather events, and changes in seasonal temperatures. These particular impacts will have implications for energy supplies, including hydro, oil and gas, and thermal power, all of which depend on water at some stage of their production. From the demand side, increased temperatures will cause an increase in demand for electricity in the summer and a decrease in demand for heating in the winter. Energy infrastructure, such as transmission lines and off-shore drilling rigs, are particularly vulnerable to extreme weather events such as flooding, landslides, wave heights, and ice storms. The degradation of permafrost and other physical impacts will also have important implications for infrastructure.

There is some adaptation occurring in Canada, particularly within industry, but it is still ad hoc and reactive. Integrating climate change impacts into existing planning processes such as risk management is a constructive approach. Barriers to overcome to make

³ In March 2007, the Government of Canada released its most recent assessment report, *From Impacts to Adaptation: Canada in a Changing Climate 2007*, which outlines our current understanding of climate change impacts and adaptation in Canada. The report is available at http://adaptation.nrcan.gc.ca/assess/2007/toc_e.php.

adaptation more strategic include limitations in awareness, availability of information, and decision-making support tools. In addition, ongoing research is required but we know enough now about the nature of the risks to begin to act and put in place adaptive measures that can be adjusted as we learn more.

Climate change will not have impacts on oil reserves but is likely to impact the access, development, and transportation of oil. Oil and gas exploration is all about risk management – physical, technical, political, policy, and market risks. Climate change magnifies all of these risks and adds increased complexity (e.g. energy security and the intersections between climate change, energy, and foreign policy). Addressing these risks is generally associated with higher capital and operating costs – particularly when operating at the frontier, including offshore. However, failure to address risk can have costly consequences. Large international companies may have an advantage in responding to these risks through the experience and lessons learned from operating under different conditions (physical and otherwise).

The loss of capital can be dramatic with an increased frequency of extreme events and conditions. Risks to infrastructure can be assessed over the life of the facility to recover from or prevent damages. More importantly, the risk to human life needs to be front and centre. For example, Nexen consults climate experts and meteorologists that provide early warnings of potential climate-related threats to their facilities and their people. This direct link to developments in weather conditions has proven to be more informative and efficient than conventional sources – thus reducing risk.

One of the challenges that industry faces is the patchwork of initiatives and regulatory regimes across North America. There is a need for some certainty and harmonization of rules. There is also a need for more education and sharing between governments and industry. Costs are reduced significantly with increased experience. Finally, being engaged and addressing political risks is also part of corporate risk management.

In Quebec, adaptive resource management is being used as an approach for dealing with climate change in water resources planning and operations. Climate-associated risks to existing and planned water resources infrastructure prompted impact studies and adaptation initiatives within Quebec's hydro sector. To refine the projected impacts on water resources, outputs from downscaled global climate models were integrated into hydro models. The results suggested that climate change will impact the hydrological regime, which will have implications for hydro projects across the province. These results were then used to inform adaptation strategies.

Adaptation of hydro infrastructure can fall within two categories – adaptation of operating rules (non-structural) and adaptation of physical configuration (structural). Table 1 outlines some examples of non-structural and structural adaptation instruments, the latter of which are typically more costly.

Table 1: Examples of Non-Structural and Structural Adaptation Instruments for Hydro Infrastructure Planning and Operations (from René Roy’s “Adaptive Management for Climate Change in Water Resources Planning and Operations,” June 19, 2008)

Non-Structural	Structural
<ul style="list-style-type: none"> • Bring changes to operating rules • Develop or improve hydrological forecasting tools • Better co-ordination of the operation of the project with other water-use projects in the watershed • Develop improved technologies to evaluate the performance of projects and to identify ways of operating them under modified climatic conditions • Modification of engineering design practices. 	<ul style="list-style-type: none"> • Divert water course of upstream tributaries • Create new upstream storage reservoirs • Increase the capacity of spillway • Design dams in such a way that, if needed, additional spillways or other physical components could be considered in the project • Modify the dimension of canals or tunnels • Change the number and type of turbines • Modify the dimensions of canals in order to reduce head loss or increase their discharge capacities • Modification to the characteristics of electrical components (generators, transformers, transmission line, etc.) • Add controllable gates to free spillways.

In the context of the hydro sector, adaptation requires a long-term vision, long-term monitoring and documentation, modelling (climate and hydrology, and possible management pathways and infrastructure design), documentation of management actions, trust among parties, an organizational structure that values learning, and risk acceptance. Conversely, there are a number of barriers to adaptation including the maintenance of status quo, legal and political concerns over adaptive management, internal rules and regulations, jurisdictional boundaries, and the asymmetry between present certain costs and possible future benefits. Furthermore, the fixed discount rate typically used for the cost-benefit analysis of hydro installations renders the benefits beyond a time-scale of several decades irrelevant.

Despite uncertainties (although important) climate change impacts need to be considered on existing and planned hydro projects. For existing equipment, operational adaptations (i.e. non structural) may need to be considered whereas structural adaptations can be integrated into the design of new equipment. Although there is enough science on which to make such adaptations now, climatology and hydrology research and development (R&D) efforts need to be maintained while striving to reduce the gap between such research activities and decisions regarding planning, design, and operations.

For businesses, sustainability and climate change are now mainstream topics and they are becoming increasingly important from the perspective of corporate governance, strategic risk assessment, and community planning. Regulatory drivers and pressure from informed investors and rating agencies as well as consumers are leading to an increased demand for disclosure of environmental and climate-related risks. Initiatives such as the Carbon Disclosure Project, Standard and Poor’s 2008 Enterprise Risk Management Review, and the Corporate Governance Guidelines of the Ontario Securities Commission are all encouraging industry to better identify, plan, manage, monitor, and disclose risks, including those posed by climate change, to support the investor in

making decisions. In looking forward, as soon as carbon has a price, companies need to assess if their risk is material or not, and disclose it.

Sectors that could face significant climate change risks are those with long-term planning and investment horizons, sensitive to weather conditions, and dependent on extensive infrastructure and international supply chains. Most energy-sector businesses possess at least one of these vulnerabilities. Governments are also at risk from climate change impacts that directly and indirectly affect the public sector's mandate, as well as institutional and budgetary implications related to natural disasters and emergency response.

Currently the business response to climate change risks illustrates a disconnect between awareness and action. While 98.6 percent of businesses believe that climate change will affect their organization, only 17 percent have a formal action plan in place. Most surveyed consider government policy critical to promote and facilitate adaptation action, including qualitative data and the identification of tools.

Addressing climate change requires an integrated and enterprise-wide risk-management approach that examines the potential impacts of climate change on all aspects of an organization, including external factors like weather and workforce, operations and organizational scope and structure, the delivery of products and services, suppliers, and customers or the end user. The following are examples of the types of big questions that a business could consider in such an approach⁴:

- What if access to water is restricted, regulated or expensive?
- What is the response to 100-year floods occurring every five years?
- What if oil remains above \$100/barrel?
- What is the response to heat waves, drought, or extreme weather events?
- What measures are in place to adapt if your supply chain is impacted due to extreme weather events?

The determination of climate-related risks and potential future scenarios will provide the context in which to develop integrated climate change strategies that plan for mitigation and adaptation responses as well as new business opportunities. For the energy sector, risks include: regulatory (municipal, provincial, federal and international – especially the United States) both for the energy company and the supply chain; technology (e.g. accelerated investments or uncertainty of mitigation technologies); price and market risks (e.g. carbon price volatility and lack of historical data); physical operations (e.g. severe weather impact on infrastructure); and volume (e.g. changes in supply or demand).

There are a number of examples that illustrate the nature of strategic responses that could be planned for, some of which are shown in Table 2. Although mitigation and adaptation are shown as distinct, linkages between the two may exist.

⁴ Questions from Valerie Chort's "Ahead of the Curve" presentation, June 20, 2008.

Table 2: Examples of Possible Response Elements of a Climate Change Strategic Plan (From Valerie Chort's "Ahead of the Curve" Presentation, June 20, 2008)

Mitigation	Adaptation	Opportunities
<ul style="list-style-type: none"> • Identify and implement all demand management/ energy efficiency opportunities • Conduct voluntary emissions trading • Implement pilot offset projects • Diversify energy portfolio • Develop renewables • Implement clean technology R&D purchase 	<ul style="list-style-type: none"> • Understand infrastructure vulnerability and implement infrastructure reinforcement measures • Relocate infrastructure to more secure locations • Develop appropriate health and safety response policies to deal with catastrophes • Consider relevant insurance products • Develop strategies to address changing demand patterns 	<ul style="list-style-type: none"> • Conduct speculative emissions trading • Develop additional product/service offerings (e.g. energy audit services) • Conduct energy-efficiency cost reductions • Develop new technologies • Pursue new market opportunities (expanding to new regions or markets)

4.0 Summary of Discussion by Priority Themes

After the presentations, participants were engaged in identifying and discussing a number of issues that they viewed as important for the energy sector to address climate change adaptation. To narrow the focus of discussions, workshop participants were each asked to identify five themes they felt were most important to discuss in more depth, toward identifying specific actions for consideration by the CEM. The participants selected their themes based on their level of impact should they be pursued with actions and the sense of urgency surrounding the theme. The results from this exercise are shown in Table ii of Appendix C. The five themes that received the highest number of votes are discussed in this section. It should be noted that the following discussion captures the outcomes of brainstorming exercises in which the participants from the break-out groups were asked to consider specific questions in a limited amount of time.

4.1 Climate Change Adaptation Science

Scientific research will continue to be an important element of advancing adaptation in the energy sector. Of specific interest is the continued development of regional models that provide insight into climate change impacts including weather extremes, variability, hydro resources, mean temperatures, and wind speeds. Such information will allow analysts to assess the implications of climate on regional demand and supply of energy, which will facilitate the development of adaptation options. Other science that needs to be developed includes permafrost modelling and linking physical changes in climate to sector-specific planning tools that look at variability and market analysis.

The approach in which this science is pursued should be based on relevancy, collaboration, and effective communication. To ensure that research results and applications (e.g. models) will influence planning (including supply planning), scientists should consult with decision-makers and other users to clarify their needs. Furthermore, research efforts should be collaborative between industry, government, and other researchers, and should recognize and assess linkages with other initiatives relating to water and land-use planning, cumulative impacts, and conservation. Finally, gathering

and disseminating research results and information on research tools will be critical both within and outside government.

In moving forward, research should be increasingly supported and funded. Government could act as a catalyst toward facilitating and establishing regional consortiums (similar to Ouranos⁵) that focus on developing regional climate change adaptation models. Industry engagement will be essential.

4.2 Co-ordinated Local, Provincial, National, and International Policies

To ensure harmonization and clarity, different levels of government should take a co-ordinated and consistent approach toward mitigation and adaptation policies and regulations, including those that are related to technical standards. Integrating adaptation into legislative reviews (such as the *Canadian Environmental Protection Act* and environmental assessment) and annual reporting could also be considered in a co-ordinated approach.

Working in a collaborative way will also be important, including but not limited to, consultations with industry, and transparent review and reporting processes and requirements. Part of this involves improved communications among governments and with industry in terms of sharing research and performance results, assessments, and best practices. Engaging working-level staff from industry associations and governments will be important toward achieving improved communication and collaboration while looking to high-level decision-making fora, such as the CEM, to provide direction. A recognized appreciation of the urgency of climate change adaptation will also help in this regard.

In terms of specific actions, a review of regulatory frameworks could identify real opportunities for harmonization as well as existing barriers to adaptation, such as those that relate to the acceptance of new technologies. Furthermore, the CEM can continue to engage similar fora internationally to ensure broader markets and explore opportunities for international harmonization, particularly in North American markets.

4.3 Information Sharing and Knowledge Transfer

To advance adaptation within the energy sector, existing information, best practices, and tools need to be shared and made available. Although the sector is still in the early stages of adaptation, there are valuable sources of information resulting from ongoing research and initiatives that could have a greater impact and influence if communicated and shared. To ensure that governments and industry alike are made aware of such information (including best practices), a mechanism should be put in place to efficiently and effectively collect and disseminate. Such a mechanism could consist of a centralized body that would fund and take ownership of this task. Depending on the scope of the partnership or body, funds could also be collected to support new research needs that are identified from a gap analysis of existing work and to create adaptation education and awareness-building initiatives.

⁵ Ouranos is a Quebec-based research consortium that focuses on regional climatology and climate change adaptation. For more information, go to <<http://www.ouranos.ca>>.

The best way to facilitate the sharing of information may be a public-private partnership with participation from governments and industry – particularly industry associations and engineer associations. Best practices for this type of public-private mechanism should be explored to maximize efficiency and participation from industry. Initial steps toward achieving this could include compiling existing research and initiating a dialogue with industry associations to clarify needs.

4.4 Aging Infrastructure and Increasing Demand

As so much of Canada's existing infrastructure is reaching the end of its lifetime, there is a unique opportunity to address climate change adaptation. When replacing, updating, or conducting maintenance on aging infrastructure, a long-term and integrated approach is needed – one that is mindful of anticipated changes to climate both in terms of physical changes and the potential implications for energy demand. Infrastructure will typically last decades, and thus a long-term approach is essential when planning and designing new infrastructure to ensure a reliable supply of energy.

Among the long-term considerations are the frequency of extreme weather events, changes in water availability, denser developments, and mixed-use urban planning. In many instances it will not be appropriate to replace infrastructure with a similar product. New designs and approaches will be necessary. For example, design codes may need to be updated to account for physical changes to the environment. With respect to approaches, different systems may need to be considered, such as replacing an aging transmission line with decentralized energy generation.

Integrated planning within the energy sector and with other sectors (e.g. transportation, water, waste management, land use) will be important, particularly at the community level and in urban environments. This will allow for supply and demand to be considered jointly, co-ordinating energy efficiency, and demand-side management strategies with matters regarding local supplies and the energy?

In general, a long-term and integrated approach can be facilitated through decision-enabling research (climate science, technical, codes and standards), vision and leadership, collaboration, real-cost pricing, and improved communication. Some useful work is underway and there are initiatives that could serve as examples.

More specifically, the CEM could consider initiating an assessment of the energy infrastructure (including supporting infrastructure and its exposure to climate change), and a review process for codes and standards by which infrastructure is built and retrofitted. There is a need to engage other government departments and agencies, whose responsibilities are critical to addressing many of these issues in an integrated way. The CEM could work as a catalyst to engage colleagues in other portfolios.

4.5 Market Mechanism for Adaptation

This theme encompasses any mechanism that could fund, finance, and facilitate the investment in adaptation, whether it be research, capital investments, or increasing demand. Although industry has a leading role in this regard, clarity is needed in the regulatory frameworks and broader policies (including price signals) to allow industry to get a sense for the market and the operating environment. Policies that support

mechanisms like cap and trade or a carbon tax should use funds transparently to finance adaptation activities.

For regulated industries in the energy sector, there is a need for consistency in how climate change adaptation is accounted for in rate structures. For example, at present any access to funds for capital investment or studies must be outside the rate base. This imposes competition between mitigation and adaptation investment, and limits the possibility of linking climate change adaptation measures to demand reduction strategies.

There is also a need for education processes aimed at raising the awareness and sensitivity of boards of directors, planning authorities, regulatory bodies, and the public to enhance support for climate change adaptation measures.

5.0 The Emergence of Common Messages

Throughout the 1.5-day event, a total of 13 individual topics were discussed, with more detailed discussion focusing on the five priority issues that are highlighted in this report. Several common messages emerged. Although some of these messages were identified as themes themselves, they were echoed throughout the group discussions. Many of these messages reflect an approach, or principle, toward advancing climate change adaptation in the energy sector:

Thinking and Planning for the Long Term – The notion of taking a long-term approach to planning was identified in numerous discussions. Long-term approaches were suggested for the planning of policies, regulations, codes and standards, business strategies, and the design of infrastructure. Long-term plans should also be flexible to facilitate further adaptation as more is learned about the impacts of climate change. The rationale for this approach is to consider changing climate conditions (and the implications for the sector) and not to base decisions on historic trends or the status quo.

Information Sharing and Engagement – Many discussions offered the sharing and dissemination of knowledge, research, and best practices as an approach to advancing adaptation within the sector. Collaboration, education, and engagement are among the specific approaches mentioned in addition to the more formalized mechanisms discussed in section 4.3.

Resolving Funding Mechanisms and Market Signals – Throughout the workshop, a number of discussions noted the need for incentives, such as access to funding to advance industry's work and progress on adaptation. This topic was discussed as an individual theme (see section 4.5); however, it was highlighted in several other discussions.

Integrating Climate Change Adaptation – Integrating climate change considerations into existing planning and decision-making processes was reiterated throughout the discussions. Integration of climate change within system planning studies (including socio-economic impacts), operations, codes and standards, hydrologic models, funding criteria, and other tools and approaches will ensure that climate change is considered

with respect to both mitigation and adaptation. This notion is parallel to the long-term thinking approach discussed above. New tools to support this integrated approach, such as adaptive management, scenario development, and increased information, need to be further developed and shared widely.

Inter-jurisdictional Harmonization – From an industry perspective, the harmonization of policies, regulations, and standards between the various levels of government was stated as an important element of advancing mitigation and adaptation. Harmonization and the provision of clear signals are desired by industry – some of which operate within, or are affected by, more than one jurisdiction.

Improve Incorporation of Science – Although there are many gaps and uncertainties in climate change science, there is sufficient evidence to suggest that climate change will introduce new elements of risk in the future. There is also energy-specific research regarding climate impacts and adaptation that can be adopted and further developed to help inform decisions. Governments and business should not restrain from addressing and responding to the information that is available today, and they should endeavour to conduct future adaptation research in a co-ordinated, timely, and relevant manner.

Linking Mitigation and Adaptation – There was strong concurrence about the connection between mitigation and adaptation from the business perspective, particularly in terms of investment decisions (including possible competition between the two), market mechanisms, and technological funding. The need for policy co-ordination between mitigation and adaptation, and for governments to understand industry needs and co-ordinate across portfolios and jurisdictions is very important. It was pointed out that mitigation and adaptation do not necessarily involve the same types of responsibilities or skill sets at either the government or industry levels. For example, mitigation focuses on financial and regulatory policies and instruments, while adaptation gets more into operations. There could be a need to bring the two groups together to address the connections between these issues.

6.0 Conclusions and Next Steps

The CEM and the energy sector as a whole are generally in the early stages of considering adaptation to climate change. In this initial information exchange between governments and industry, there was an opportunity to increase awareness around the issue of adaptation and initiate discussions on some important topics or themes.

In a post-workshop evaluation, a strong majority of participants indicated that the event helped to increase their awareness of adaptation and gain an understanding of how different players within the sector and across the country are dealing (or not dealing) with the issue.⁶ Participants also stated an enhanced appreciation for the complexity of the issue with several citing a need for clearer definitions of adaptation and how it differs from mitigation.

⁶ A summary of the workshop evaluation responses is in Appendix D.

Several topics were covered during the 1.5-day workshop and participants were able to hear different perspectives from across the sector (i.e. utilities, industry associations, private businesses) on these important themes. Among the messages and lessons that participants will take back to their respective organizations are the importance of planning tools and strategic approaches (e.g. risk management), contacts across the sector, the need to link science and policy, and an increased sensitivity to the issue.

Overall, participants felt that adaptation is an issue that needs to be addressed both by government and within the industry sectors. Climate change has been an important issue for the energy sector primarily from a mitigation perspective. Work on adaptation has been more reactive and a different approach is now needed – one that is consistent and integrated. Although this workshop was an important first step, the dialogue between government and industry should continue, with 95% of the workshop participants⁷ who responded to an evaluation survey indicating that they would be willing to participate in future sessions on adaptation.

⁷ Nineteen out of 20 participants who completed the evaluation indicated they would be willing to participate.

Appendix A – Participant List

CEM Adaptation Workshop June 19–20, 2008 Delta Chelsea, Toronto, ON		
1.	Affonso, Amanda	Canadian Energy Pipelines Association
2.	Brace, John	Northlands Power
3.	Cantin, Bernard	Projet de recherche sur les politiques
4.	Chee-Aloy, Jason	Ontario Power Authority
5.	Chesze, Jonathon	Ontario Power Authority
6.	Chort, Valerie	Deloitte Consulting
7.	Collins, Bob	Energy, Mines and Resources (Yukon)
8.	Curtis, Darwin	Department of Energy (New Brunswick)
9.	Desjarlais, Claude	Consortium Ouranos
10.	Des Rosiers, Louis	Ministry of the Environment (Ontario)
11.	Dorey, Steve	Hydro One
12.	Finn, Jean	Department of Energy (New Brunswick)
13.	Fiset, Steven	Association des ingénieurs conseils du Québec
14.	Hicks, Darren	Department of Natural Resources (Newfoundland and Labrador)
15.	Léger Eric	Ministère des Ressources naturelles et de la Faune (Québec)
16.	Lemmen, Don	Natural Resources Canada
17.	MacDonald, David	Yukon Energy Corp.
18.	Mallum, John	Newfoundland and Labrador Hydro
19.	Marmen, Louis	Canadian Gas Association
20.	Milne, Kyla	Department of Energy (Nova Scotia)
21.	Morin, Anne	Policy Research Initiative
22.	Nielsen, Debbie	Saskatchewan Power Corporation
23.	Pelzer, Cam	Ministry of Energy and Resources (Saskatchewan)
24.	Penny, Richard	Nova Scotia Department of Energy
25.	Perera, Chana	Canadian Electricity Association
26.	Prosen, Stephanie	Ministry of Energy (Ontario)
27.	Proulx, Isabelle	Natural Resources Canada
28.	Robson, Wishart	Nexen Inc.
29.	Rother, Patrice	B.C. Hydro
30.	Roy, René	Hydro-Québec
31.	Samray, Jean-François	Association de l'industrie électrique du Québec
32.	Singh, Satender	Natural Resources Canada
33.	Sparkes, Adam	Canadian Association of Petroleum Producers
34.	Smith, Doug	B.C. Hydro
35.	Taylor, James	Nova Scotia Power
36.	Venugopal, Srikanth	Association of Power Producers of Ontario
37.	Watling, Judy	Policy Research Initiative
38.	Wieringa, Paul	Ministry of Energy, Mines and Petroleum Resources (British Columbia)
39.	Wist, Floyd	Ministry of Energy and Resources (Saskatchewan)

Appendix B – Agenda

Climate Change Adaptation in the Canadian Energy Sector

Delta Chelsea Hotel, Toronto
June 19–20, 2008

Objectives

- To better understand whether or how climate change has been considered and planned for within Canada’s energy sector;
- To contribute to a work plan for the Council of Energy Ministers on adaptation to climate change within the energy sector, and assess the scope and breadth of the issues to address;
- To promote awareness and dialogue within Canada’s energy sector on adaptation to climate change.

Intention Question

What do we need to do to best inform the CEM about work to support adaptation to climate change by energy sector industries in the coming year? And beyond?

Day One – June 19, 2008

A. GETTING STARTED

Time	Description	Presenters / Facilitators
8:30am	Welcome and Purpose of Meeting	Co-chairs Floyd Wist and Isabelle Proulx
8:45am	Review of Agenda and Approach for Meeting	Christopher Comeau – Lead facilitator

B. LAYING THE FOUNDATION

Time	Description	Presenter
9:00am	From Impacts to Adaptation: Canada in a Changing Climate	Don Lemmen, <i>Natural Resources Canada</i>
9:45am	Industry Experiences Dealing with Climate Change Impacts and Adaptation at Nexen	Wishart Robson, <i>Nexen Inc.</i>
	Adapting Water Resources Management and Infrastructure to Climate Change Q&A – 30 minutes	René Roy, <i>Hydro-Québec</i>

10:45am *Health Break*

11:00am **Scope Check** Plenary discussion
Exercise based on previous presentations and dialogue to come to an understanding of the existing and potential impacts of climate change (if any) on energy sectors

12:00pm **Lunch**

C. DIALOGUE ON THE KEY TOPICS AND ISSUES

Time	Description	Presenter
1:00pm	Identifying the Issues Identify the key topics that should be discussed in order to answer the Intention Question	Facilitator
1:30pm	Dialogue Session I Discuss 6 to 8 of the key topics identified above that pertain to climate change impacts on the energy sector	Break-out discussion groups
2:30pm	<i>Health Break</i>	Break-out discussion groups
2:45pm	Dialogue Session II An additional 6 to 8 key topics will be discussed and reported on using the process described above	
3:45pm	Review of Discussions Break-out discussion groups report back on their results	Plenary discussion Break-out discussion groups
5:15pm	End of Day Wrap-up Opportunity to update participants on what to expect on Day Two and any other relevant messages.	Facilitator

Day Two – June 20, 2008

D. INTEGRATING RESULTS

Time	Description	Presenters/Facilitators
8:30am	Outline of the Day	Facilitator
8:40am	Check-in with Co-chairs Co-chairs present their thoughts on the key messages that they have heard so far and discuss with participants	Isabelle Proulx and Floyd Wist
9:00am	Climate Change and Risk Management in the Energy Sector	Valerie Chort, <i>Deloitte Touche</i>
9:45am	Narrowing our Focus From the topics discussed on Day One, the group will identify priorities in terms of what will have the most overall impact and what needs to be done within the next 12 months	Plenary session
10:15am	Dialogue III – Narrowing our Focus Groups will discuss in more detail work that can be done on the priority items identified in plenary	Break-out discussion groups
11:15am	Plenary Review of the dialogue on priorities	Plenary session
11:45am	Wrap-Up	Facilitator
12:00pm	Closing Remarks	Isabelle Proulx and Floyd Wist

Appendix C – Results from Facilitated Process

Table i – Topics identified by all participants. Those receiving votes were discussed in break-out sessions.

	Topic	Vote
1.	<ul style="list-style-type: none"> • Need to facilitate the integrated planning of energy demand and supply. • Promote conservation as an alternate to infrastructure (\$\$\$\$) and to reduce climate change impact. • Impact and adaptation of energy demand to climate change. 	14
2.	<ul style="list-style-type: none"> • Provide a market price signal that engages private enterprises to invest in adaptation practices and/or capital • United carbon trading markets across Canada (across the continent) • Financially incent good behaviour. 	14
3.	<ul style="list-style-type: none"> • Inclusion of adaptation in early years' compliance mechanisms for mitigation (i.e. pre-certified project under Tech Fund • How can we establish public partnerships (P3s) to address adaptation to climate change? • Establish a fund for adaptation and cost sharing. • Facilitating technology development and deployment in relation to climate change and adaptation. • What does industry think the role of government should be? • What public policy tools (measures) do governments need to consider/develop to encourage adaptation? 	12
4.	<ul style="list-style-type: none"> • Assess impact of climate change on water and wind resources • What are the predicted climate change impacts on future water supply and hydro capacity? Climate change impacts on water availability and cooling water requirements. • What does climate change mean for me? By regions, what do the climate change models indicate the changes in magnitude and annual distribution of temperature, precipitation, winds, etc. look like? We need to know the characteristics of the change to chart how to adapt • Water and water shortage supply issues • Integration of electricity and domestic water supply in planning and management. • Wind power integration climate change on wind regimes. 	12
5.	<ul style="list-style-type: none"> • Capital investment cycle and infrastructure renewal • Aging infrastructure. Double burden to adapt? • What role should government play in the replacement of assets to facilitate both mitigation or adaptation? • How is electricity reliability impacted by climate change and adaptation? 	10
6.	<ul style="list-style-type: none"> • New generation = \$\$, Transmission = \$\$ + nimbly?, Cost on Carbon = \$. • Building codes and appliance standards = cost solution to all of the above • Do current codes and standards (i.e. building codes) accommodate climate scenarios and adaptation? • Review and revision of codes and standards with a view of what is appropriate for a changed climate. 	9

7.	<ul style="list-style-type: none"> • Leverage learnings from energy “sub sectors” (e.g. oil/gas <=> electricity) • How do we address information gaps and disseminate information/intelligence? • To address the long- term problem related to climate change effects on energy, we need to make sure we will have enough skilled people (* engineers, scientists, geologues, architects) • What partners/other sectors share our challenges with respect to adaptation? 	8
8.	<ul style="list-style-type: none"> • Long term public energy planning and policy. Put in place a clear and transparent policy making process for the public, the shareholders, and policy workers. Sensitization – clear and good information. 	8
9.	<ul style="list-style-type: none"> • What are the regulatory, requirements process burdens we need CEM to help industry address climate change? 	6
10.	<ul style="list-style-type: none"> • Co-ordinated local, provincial, national, and international policies. 	4
11.	<ul style="list-style-type: none"> • Climate adaptation science basis? : What are scientific community doing or saying about this? • Make Cross-country data on climate changes user-friendly / accessible to users (up to date / sortable by sector). 	3
12.	<ul style="list-style-type: none"> • Improved understanding of ecosystem/impacts and adaptive management requirements /approaches • Climate change impacts on key sectors and how those might change demands and responses from the energy sector. 	1
13.	<ul style="list-style-type: none"> • Consideration of the economic consequences of greenhouse gases (GHG) control, and assurance that they are fairly and realistically allocated 	1
14.	<ul style="list-style-type: none"> • Climate change mitigation policy regulation and how this will increase or decrease opportunities for adaptation • Are mitigation and adaptation mutually exclusive? 	0
15.	<ul style="list-style-type: none"> • Co-ordinated and formalized emergency response processes for electricity outages across broader regions of Canada/U.S. could include central stockpile of materials, equipment, central planning for resources deployment’s central emergency outages centre. • Planning now for infrastructure that lasts for decades • Critical need good for mass public transport infrastructure in Canada. 	0
16.	<ul style="list-style-type: none"> • First decision oil and gas industry/enterprises need to make to start adaptation process? 	0
17.	<ul style="list-style-type: none"> • How to make supply/distribution to consumers more robust and less vulnerable to impact prone climate? 	0
18.	<ul style="list-style-type: none"> • Identify relevant fields of activities that need to be addressed with respect to climate change (vulnerability) 	0
19.	<ul style="list-style-type: none"> • Mechanism to identify policy disincentives “approval of new technology” (e.g., in water/wastewater sector) 	0
20.	<ul style="list-style-type: none"> • Most energy is used in cities. At what point are municipalities brought into operational or Policy Discussions? 	0
21.	<ul style="list-style-type: none"> • Most obvious “no regret” adaptation choices in energy industries? 	0

22.	<ul style="list-style-type: none"> • One adaptation that electricity utilizes use is interconnections (inter-jurisdictional). Do we understand enough about Climate Change Impact regionally to know if this adaptation will be available in the future? • Integrated transmission of electricity (regional/ national /continental) given diversity of sources • Integration of renewable. 	0
23.	<ul style="list-style-type: none"> • Open and frank public engagement. 	0
24.	<ul style="list-style-type: none"> • What consideration must be given to concerns outside of what must be done? For example, legal implications of adaptation with regard to new real estate, liability and regulatory requirements? 	0
25.	<ul style="list-style-type: none"> • What problems and what opportunities are created by the adaptation measures we propose? 	0
26.	<ul style="list-style-type: none"> • How adequate are existing industry, utility, and government institutions and policies to cope with severe weather events in the energy sector? 	0

Table ii – Tally of individual votes for identifying priority themes based on impact and urgency. “X” indicates that the theme was selected as a priority for further discussion.

Theme	Impact	Urgency	Priority
Aging infrastructure and increasing demand	14	7	X
Market mechanism for adaptation	12	4	X
Co-ordinated local, provincial, national, and international policies	12	11	X
Climate change adaptation science and information dissemination	10	19	X
Information sharing and knowledge transfer	9	10	X
Integrated long-term and open process to address energy and climate change policy	9	8	
Codes and standards	7	4	
Water considerations in a changed climate	6	4	
Regulatory process requirements and how they can help industry address climate change impact	5	8	
Integrating demand-side management with supply and an adaptation tool	5	5	
Implementing mechanisms	4	7	
Economic consequences	4	6	
Non-energy constraints on energy systems and water	1	1	

Appendix D – Workshop Evaluation Results

1. Did this Workshop increase your awareness of adaptation to climate change?

- Yes (six responses).
- Yes, I knew very little about climate change adaptation before the conference and I thank all of the people here today for allowing me to learn so much from them.
- Yes, I saw different industry perspectives on the issue.
- Yes, good mix of supporting presentation and discussion with others.
- Yes, this topic has not been addressed in my utility. Learning what others have done will help me raise awareness in my utility and will initiate the process to deal with this issue.
- Yes, first to know that many sectors are at the same level of accomplishment.
- Didn't increase my awareness of the issues in general but did improve my knowledge of the subject – what it entails, what my peers are thinking and grappling with.
- Yes, particularly as it relates to industry.
- This session did increase my awareness of the complexities the energy sector faces in order to adapt to climate change.
- Yes, (I) heard a number of converging and diverging definitions/linkages and concerns relative to mitigation and adaptation.
- Yes, impacts of climate change on hydrological cycles, risk management frameworks, etc.
- Absolutely.
- Yes, but I was aware of adaptation before. I hope more scientific and real-world knowledge or successes are shared in the future.
- La présentation de Valerie sur la planification et l'intégration des risques a ce processus elle m'a aussi permis de comprendre les enjeux d'autres acteurs du secteur énergétique.
- Because of the different mix of people and companies, there was a richer discussion and it did increase my understanding.

2. What did you learn that you will take back with you and apply to your organization?

- Challenges related to setting co-ordinated strategies.
- Perspectives of other industries.
- Increased sensitivity to issues.
- Add to planning criteria.
- Dimensionality of issues.
- Strong linkage to mitigation.
- How to better serve clients in the energy sector as they face new adaptation and other environmental challenges.
- I will share the perspectives with my colleagues.
- Need for revisiting risks through engagement with planners/risk managers across the organization.

- The extent to which some of the other utilities have investigated the issue and are beginning to plan to accommodate the changes that will occur.
- Information/knowledge sharing is critical to save time and money within organizations, industries, and governmental initiatives.
- Learned about issues within the sector that can be taken back to my team.
- Affirmation of the strategy we are currently using as it is similar to that presented by Valerie.
- Formed contacts with industry and other jurisdictions that will prove useful as we move forward on climate change adaptation policy.
- There are several issues that have varying urgencies and timelines. We will have to assess these issues and address them accordingly.
- Great presentations on Thursday and Friday, contained great information and some issues that I want to factor into our work on risk management.
- Risk-management framework, understanding of the impacts on supply, demand, and energy infrastructure.
- We will start conducting reviews of our operations and their exposure to climate change.
- Important link between actions that will mitigate climate change and will help adapt to climate change.
- Presentations are good. Knowing what Nexen and Hydro-Québec and private businesses are doing can guide us in the future.
- Wide range of issues and opportunities to address adaptation in public policy.
- Awareness/appreciation of the complexity has been raised.
- Need to link science and policy to make decisions and plan for the future.
- Une méthode de “brainstorming” originale et efficace.
- There are significant stakeholders (regulator, general public, large industry) that need to understand that history is not a good predictor of the future because climate change is likely significant. I will be taking that back to broaden aspects.

3. Would you be willing to participate in a similar Workshop in the future?

YES – 19 (One said, “depending on focus and outcomes as a result of this meeting”).

NO – 1

4. Do you have any comments?

- Use of Option Finder
- Facilitation was excellent.
- Limiting scope of question to “adaptation” is problematic. It is explicitly linked to mitigation.
- Facilitation was excellent and I appreciate the grounding provided by the team, it certainly assisted in understanding the topic.
- It was a well-run session, but could do with a bit more time to discuss the issue and develop the topic.
- I am concerned that many of the recommendations were outside the purview of the CEM. As a result, will this go forward? Speaks to obvious need for federal/provincial integration if this is truly a serious issue to deal with. It is

unreasonable to think that industry would take this seriously (as a priority) if, indeed, government does not.

- There is tremendous potential in this country for provinces and utilities to assist each other with adapting to climate change. A key component that will help us all to adapt is missing – a strong east-west transmission network.
- Make clear from the beginning what the CEM can and cannot do in order for the participants to come up with practical and actionable solutions.
- It is important for the participants to get the minutes/proceedings of the workshop.
- I appreciated the efficiency with which the facilitators moved us through the complex subject to “diverge and then converge” on recommendations. Keep on that approach to reduce travel requirements for participants.
- Great facilitation.
- I was a bit skeptical about how well the facilitation process might work in this type of workshop, but I must compliment Intersol and PRI folks for their assistance to NRCan and Saskatchewan hosts.
- This is obviously only a 1.5-day affair asking for what is in essence top-of-mind thinking. While the information collected is very good, I would caution against thinking it is the only thing.
- Well organized.
- Need breakfast.
- Complex subject; session was very well organized, but expectations for results shouldn't be very high for one session.
- La formule utilisée était géniale. Elle a dégagé des priorités consensuelles. Est-il possible d'obtenir les présentations?
- Job well done.
- Important work to progress.