

A CANADIAN INITIATIVE



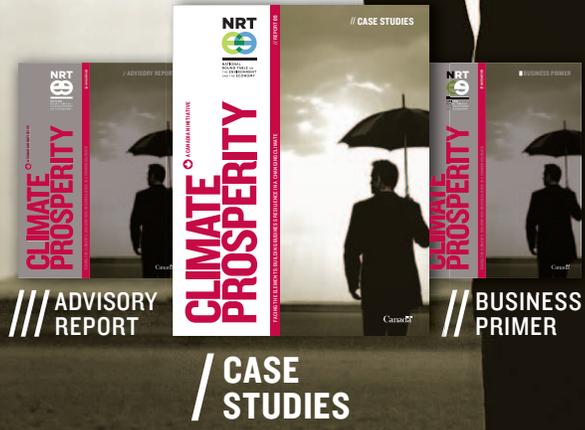
CLIMATE PROSPERITY



// REPORT 05

FACING THE ELEMENTS: BUILDING BUSINESS RESILIENCE IN A CHANGING CLIMATE

/ CASE STUDIES



/ CASE STUDIES

Canada

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NATIONAL ROUND TABLE TABLE RONDE NATIONALE
ON THE ENVIRONMENT SUR L'ENVIRONNEMENT
AND THE ECONOMY ET L'ÉCONOMIE

**THIS IS NOT
JUST ABOUT
COPING WITH
CLIMATE CHANGE,
BUT PROSPERING
THROUGH IT.**



FOR THEIR COLLABORATION ON THESE CASE STUDIES, THE NRT THANKS

COMPANY LOGOS LISTED IN THE ORDER THEY
ARE PRESENTED IN THIS REPORT.





ABOUT US

Through the development of innovative policy research and considered advice, our mission is to help Canada achieve sustainable development solutions that integrate environmental and economic considerations to ensure the lasting prosperity and well-being of our nation.

Emerging from the famous Brundtland Report, *Our Common Future*, the NRT has become a model for convening diverse and competing interests around one table to create consensus ideas and viable suggestions for sustainable development. The NRT focuses on sustaining Canada's prosperity without borrowing resources from future generations or compromising their ability to live securely.

The NRT is in the unique position of being an independent policy advisory agency that advises the federal government on sustainable development solutions. We raise awareness among Canadians and their governments about the challenges of sustainable development. We advocate for positive change. We strive to promote credible and impartial policy solutions that are in the best interest of all Canadians.

We accomplish that mission by fostering sound, well-researched reports on priority issues and by offering advice to governments on how best to reconcile and integrate the often divergent challenges of economic prosperity and environmental conservation.

The NRT brings together a group of distinguished sustainability leaders active in businesses, universities, environmentalism, labour, public policy, and community life from across Canada. Our members are appointed by the federal government for a mandate of up to three years. They meet in a round table format that offers a safe haven for discussion and encourages the unfettered exchange of ideas leading to consensus.

We also reach out to expert organizations, industries, and individuals to assist us in conducting our work on behalf of Canadians.

The *NRTEE Act* underlines the independent nature of the Round Table and its work. The NRT reports, at this time, to the Government of Canada and Parliament through the Minister of the Environment. The NRT maintains a secretariat, which commissions and analyzes the research required by its members in their work.

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A BUSINESS MESSAGE

Facing the elements of climate change is an increasing reality for Canadian business. Already, we are experiencing early examples of climate change impacts. It is inevitable that these will increase in both severity and frequency in the years and decades to come. Climate change effects are pernicious and pervasive. And Canadian business needs to get ready.

For three years now, the National Round Table on the Environment and the Economy (NRT) has been studying and reporting on the economic risks and opportunities of climate change for Canada. Our *Climate Prosperity* program is advancing understanding of how and where climate change will impact our environment and economy and what we can do about it. While much of the discussion in our country and globally has been on how to reduce climate-changing carbon emissions, more and more, governments and business are considering what they will have to do to adapt — to build resilience — to climate change impacts already occurring and likely to grow in the years ahead.

Businesses are already on the frontline of climate change. Their infrastructure assets, their supply chains, operations and reputation — indeed, their bottom line — are increasingly at risk due to weather and climate phenomena. Managing risk, and exploiting opportunities is the subject of this unique compilation of Canadian and international case studies to successfully adapt to climate change.

From energy to resource companies, to small and bigger operators, from across Canada and strategic locations around the world, the NRT sought the experience and advice of what we call “climate pacesetters.” These firms have resolved to understand climate change impacts and act in the best interests of their business, their products and services, their employees, and the customers they serve.

Learn about the practical yet far-seeing actions already taken and being considered by frontline firms facing the elements of climate change. Understand what their experiences could mean for your firm. This is not just about coping with climate change, but prospering through it.



The NRT is grateful to these leaders for sharing their experiences and helping other Canadian businesses learn from them. This report is one of three we are releasing in spring 2012 on building business resilience through good climate adaptation steps and actions.

We trust you will find it useful.

A handwritten signature in black ink that reads "David McLaughlin".

DAVID McLAUGHLIN
NRT President and CEO

KEY LESSONS

BUILDING RESILIENCE

Climate change means business. Canadian firms have a key role to play in mitigating the speed and scale of climate change through carbon management. But because some degree of climate change is inevitable, businesses also need to adapt to those irreversible effects. Firms are increasingly familiar with tactics and strategies to reduce their carbon footprint and are now looking for practical tools, best practices, and lessons learned from other businesses to help them understand climate change risks and opportunities and learn what it means to develop and implement cost-effective strategies to adapt.

This case studies report presents successes, challenges, and key lessons of thirteen Canadian and international companies as they discover the business implications of climate change, assess and manage risks and opportunities, and build climate resilience across their enterprise.^a By building resilience, firms can respond quickly and recover readily from events beyond their control. The case studies show that adjusting business practices in light of changing climate is not only feasible but also offers real benefits that preserve and create value. But, more importantly, they illustrate practical and tangible steps applicable to a range of firms.

This is not just about coping with climate change, but prospering through it.

This report, and its two companion reports that provide advice to governments and business — Business Primer and Advisory Report — are part of the NRT's program on the economic risks and opportunities of a changing climate called *Climate Prosperity*. The NRT is exploring the economic implications to Canada resulting from a changing climate, how we should adapt to it, and what this will cost.

Our work on business resilience in the face of climate change follows two earlier NRT reports that describe the impacts for our country of a changing climate and make a strong case for climate change adaptation to minimize negative impacts and exploit opportunities. Published in 2010, *Degrees of Change: Climate Warming and the Stakes for Canada* highlighted a wide range of physical impacts of climate change that we can expect in Canada over this century. In 2011, we released *Paying the Price: The Economic Impacts of Climate Change for Canada* in which we estimated the economic costs of climate change for the country as a whole and for coastal areas, forestry, and human health in particular. Now, we are turning our attention to considering how business can adapt to climate change by building resilience in their assets, operations, supply chains and decision making

^a This report is based on a consultant report titled *A series of case studies of business resilience in a changing climate: lessons from early adapters in Canada and abroad* (Acclimatise 2011), available upon request.

SELECTING AND WORKING WITH CASE STUDY COMPANIES

By design, case studies cover a range of industry sectors. But coverage of diverse industry sectors was just one criterion among several. Geographic coverage, availability and depth of publicly disclosed information, evidence of benefit to the company from taking steps to adapt, and degree of integration of adaptation thinking within corporate business practices were all important in our recruitment effort. We favoured Canadian companies or multinational companies with significant operations in Canada. In the end, we included three well-known international companies, drawing out transferable lessons for Canadian firms.

Case study development proceeded in four stages. The first was an extensive review of public information on each company's actions to adapt to climate change. Telephone interviews were then conducted with representatives from each company. Information from document searches and telephone interviews fed into each draft case study. Finally, each company reviewed and signed off on its case study.

Three limitations in our approach are worth noting, and we discuss them here for the benefit of other organizations seeking to engage business on climate adaptation. First, not all industry sectors of the economy are represented. We were careful to include a balance of industries producing both goods and services with significant importance to the Canadian economy. A notable gap is in oil and gas where we were unable to recruit a case study firm. Second, throughout the economy, firms are likely making small, incremental changes to supplier relationships, operations or products, and not recognizing that these actions are, in effect, climate adaptation. Here, we focus on planned and deliberate action to adapt, but include a few examples of “unconscious” adaptation. Finally, confidentiality concerns can constrain disclosure of actions to assess and manage risks of changing climate. Concerns stem from competition and the perception of a public position on adaptation appearing defeatist or cavalier toward climate change mitigation. The case study companies we showcase are quite possibly atypical in their level of comfort in presenting their actions publicly.

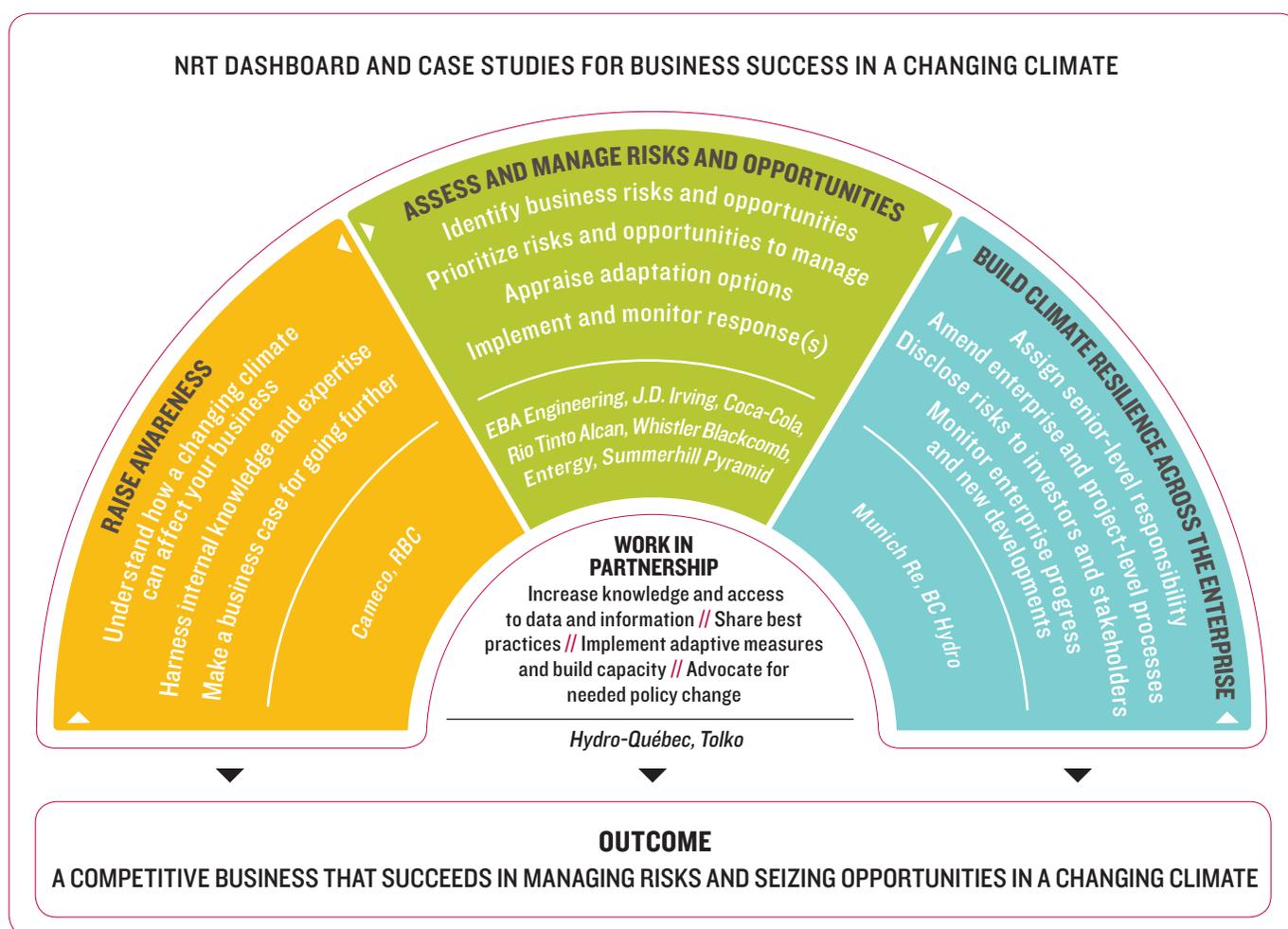
BUSINESS STRATEGIES TO SUCCEED IN A CHANGING CLIMATE

In a changing climate, firms that routinely incorporate climate change impacts and adaptation in major investment decisions and in decisions with long-term consequences will be better off than their competitors. So, we provide a roadmap for business success in a changing climate broken down into three phases. Because the range of climate and physical effects (and in turn the range of possible business impacts) is broad, firms first need to understand how shifts in severe weather and more gradual changes in climate conditions affect them. To prioritize actions, firms then assess specific risks and opportunities, evaluate the options to manage them, and implement the ensuing plan. A further phase is then to integrate climate resilience across the enterprise — from the boardroom to the copy room. Working in partnership with like-minded organizations is an efficient approach to moving

through each of these phases. Gaining access to data and information, learning about good practice, implementing cross-cutting strategies, and successfully advocating for policy change, are all outcomes of collaboration. The dashboard in **Figure 1** is not prescriptive. The “right” strategy for a firm will depend on risk exposure and a host of firm-specific factors, including capacity, risk tolerance, and current knowledge of problems and solutions. Some firms may undertake all the steps laid out below; others will instead focus on a few that are most relevant to them.

The thirteen case studies in this report profile the actions of pacesetter companies as they move through different phases of this roadmap to business resilience — from the early stages of emerging business awareness of climate risk, through to robust integration of climate risk management as a part of doing business. The case studies often illustrate a specific phase or even specific steps within that phase, but do not necessarily paint a comprehensive picture of each company’s strategy.

FIGURE 1



FACTORS SHAPING BUSINESS ADAPTATION

A common question we hear is “What gets firms started”? Experiences of the thirteen companies suggest that, for firms to “get it,” one or more factors need to align: they need to understand the connection between climate impacts and business success, view sustainability as a business imperative, have good risk management systems in place, or have first-hand experience with climate-related events or impacts. As information on climate change and its impacts increases and advice on how to adapt becomes more accessible, stakeholders’ expectations of firms will evolve. Several companies profiled in the case studies are beginning to prepare accordingly. They understand the potential for regulatory risk; legal liability due to failure to proactively consider, disclose, and manage climate change risks; enhanced demands for reporting; and reputational risks arising from climate change impacts on the environment and local communities.

The experiences of these companies show that real benefits can accrue from taking steps to adapt to the effects of climate change. Benefits lie in both value protection, by reducing existing weather and climate-related risks, and value creation. In the near term, value creation comes from exploiting opportunities and strengthening their market position relative to peers. In the long term it comes from incorporating climate change into capital investments so that assets continue to perform reliably in the future. For example, Alberta-based EBA Engineering Consultants Ltd. has built expertise and a reputation for developing robust engineering solutions for shifts in permafrost, ice, and winter conditions in Canada’s North. By doing so, EBA has also realized considerable business opportunities. Wood products manufacturer Tolko expects its timber stands to cope with a range of climate futures because of changes in tree planting practices attuned to the principles of ecological resilience. It also pays to be informed about risk exposure and viable options for risk control ahead of stakeholder demands for this information. Uranium producer Cameco conducted a climate change risk assessment that instilled confidence among senior management that no hidden liabilities existed because of climate change and improved its communications with stakeholders on climate change risks and opportunities.

What are government roles in supporting business action to adapt to changing climate? We asked the thirteen case study companies this question and heard that they believe the government has both direct and indirect roles. Some of the companies profiled in this report have benefitted directly from government funding for consortia specializing in regionally relevant research and indirectly through government collection and provision of climate data, impacts and adaptation research, tool development, and initiatives to raise awareness of future impacts. As for the future, the companies featured in our report offered a number of perspectives on government roles additional to today’s: supporting collaboration between business and experts on climate risk management, ensuring the climate resilience of critical infrastructure, clarifying policy and regulatory signals, and providing financial incentives.

What's the future outlook? This report and others¹ show that firms in Canada and around the world are starting to prepare for future climate realities. Since risk management and entrepreneurship come naturally to business, progress with existing information, tools, and capacity is likely. In the years ahead and as the impacts of climate change intensify, enhanced dialogue, collaboration, and focused efforts across private and public sectors alike can help to minimize the costs of adapting, take advantage of opportunities, and put our economy on a path to climate resilience.

CASE STUDIES AT A GLANCE

COMPANY NAME AND LOCATION	PROFILE	INDUSTRY	KEY ADAPTATION DRIVERS	ADAPTATION TO CLIMATE CHANGE	BUSINESS BENEFITS	BUSINESS CHALLENGES
CAMECO CORPORATION Saskatoon, Saskatchewan cameco.com	Employees (2011): 3,500 worldwide Revenue (2010): C\$2.12B Total uranium production (2010): 22.8m lbs (Cameco's share)	Chemical manufacturing	Consideration of climate change impacts and adaptation in public policy debates and the media Climate risk assessment and adaptation actions by other companies	Climate change risk assessment for selected facilities	Increased confidence in risk management among senior management Improved climate change communication	Lack of government incentives
ROYAL BANK OF CANADA Toronto, Ontario rbc.com	Employees (2011): 74,000 Revenue (2010): C\$27.7B	Finance and Insurance	Heightened credit and insurance risks due to climate change Client exposure in a number of sectors and locations	Adoption of corporate-level objectives Raising staff and client awareness Understanding business implications of climate change	Improvement of risk management and due diligence	Understanding how climate change interacts with other risks in relation to insurance
HYDRO-QUÉBEC Montréal, Québec hydroquebec.com	Revenue (2010): C\$12.34B Employees (2010): 23,259 (incl. temporary staff)	Utilities	Intrinsic relationship between hydropower production and climate factors Existing present-day imperative to manage weather risk Recent costly extreme weather events Government requests for clarification on climate change impacts and adaptation	Create a specialist research consortium in collaboration with government Identify sensitive areas of the business Develop future climate change scenarios in cooperation with experts Assess impacts on runoff, demand and environmental impacts	Considerable avoided climate change costs, though they remain unquantified	Difficulty quantifying benefits Limitations to adaptation in cross-boundary water basins
TOLKO INDUSTRIES LTD Vernon, British Columbia tolko.com	Total sales (2010): over C\$50 million Employees (2010): 2,200	Wood product manufacturing	Commitment to sustainable forest management practices, and recognition that forest management is directly impacted by a changing climate Recent climate-related impacts on operations	Working in partnership with government, First Nations, researchers and industry representatives to guide future forest management Changes to site selection, planting, and forest yield forecasting	More resilient woodland	Cost Lack of economic incentive
EBA ENGINEERING CONSULTANTS LIMITED, A TETRA TECH COMPANY Edmonton, Alberta eba.ca	Total sales (2010): US\$100M Employees (2011): 650	Consulting engineering and sciences services	Present-day extreme climate variability Absence of observed climate-related data and engineering precedents	Development of innovative methods and technical solutions Technical support in updating engineering codes and standards Technical assistance on climate adaptation projects	Established reputation bringing repeat business and new contracts	

COMPANY NAME AND LOCATION	PROFILE	INDUSTRY	KEY ADAPTATION DRIVERS	ADAPTATION TO CLIMATE CHANGE	BUSINESS BENEFITS	BUSINESS CHALLENGES
J.D. IRVING LIMITED Saint John, New Brunswick jdirving.com	Total sales (2010): over C\$50 million Employees (2010): 15,000	Wood product manufacturing	Long-term forest productivity Observed changes in climate Land stewardship commitment	Improve siting decisions Maintain or improve forest health Understand adaptive genetic variations	Increased economic value of forest land Improved resilience through genetic diversity	
COCA-COLA LTD AND COCA-COLA REFRESHMENTS CANADA Toronto, Ontario cocacola.ca	Employees (2010): 6,300 in Canada Annual per capita consumption of Coca-Cola products by Canadians (2010): 236 single servings (8 oz)	Food and beverage manufacturing	Water, a climatically-sensitive resource, is a core business input Building a good corporate reputation	Source Water Vulnerability Assessments and Protection Plans Use holiday advertising campaigns to raise public awareness	Maintaining competitive position	Increased commodity costs (water, oil, and gas)
RIO TINTO ALCAN Montréal, Québec riotintoalcan.com	Total revenue (2010): US\$60.32B Employees (2010): 22,000	Metals and mining (aluminum manufacturing)	Safeguarding operational stability Increased scrutiny by stakeholders	Development of a climate change sensitivity framework	Identification of potential risks Potential to gain competitive advantage	
WHISTLER BLACKCOMB HOLDINGS INC. Whistler, British Columbia whistlerblackcomb.com	Revenue (2010): C\$224M Employees: 3,500 (winter) Number of visitors each winter: 2M	Arts, entertainment and recreation	Additional revenue in off-peak months Risk management	Seven-step framework strategy for climate change Summer and winter grooming, snowfencing and snowmaking Diversification from a two- to a four-season guest experience	Investments maximized by building resilience into infrastructure at the planning stage Improved communication about climate change risk to investors and the media	Significant range of projected changes in climate
ENTERGY New Orleans, Louisiana, USA entergy.com	Employees (2010): 14,958 Revenue (2010): US\$11.49B	Utilities	Enhancing the resilience of customer base Welfare of our employees, their families, and our communities Cost savings	Corporate-wide climate risk assessment Comprehensive, fact-based climate risk assessment and cost-effectiveness assessment of coastal adaptation options Stakeholder outreach on risks and viable responses Prioritized our resiliency investments to reduce business interruption losses Collaborated with stakeholders on building greater resiliency for local communities	Reduction of downtime and disruption More robust, resilient economy Capital investment previously diverted to repair infrastructure now can be redeployed to creating wealth for the region Enhance prosperity, safety and quality of life Stakeholder support for our resilience investments	

COMPANY NAME AND LOCATION	PROFILE	INDUSTRY	KEY ADAPTATION DRIVERS	ADAPTATION TO CLIMATE CHANGE	BUSINESS BENEFITS	BUSINESS CHALLENGES
SUMMERHILL PYRAMID WINERY Kelowna, British Columbia summerhill.bc.ca	Total revenue (2010): C\$6.9M Employees (2010): 40 year round, full time	Agribusiness	Exploitation of opportunities in niche organic wine markets	Protecting watersheds Creating ecosystem resilience	International acclaim within the organic wine market Improved crop quality and pest control without pesticides or fertilizers	Initial costs for design, education, labour and inputs to adaptation strategies
MUNICH RE Munich, Germany munichre.com	Gross premiums written: (2010) C\$62 billion Revenue (2010): C\$63.5 billion Employees (2010): 47,000	Finance and insurance	Risk management and insurance pricing models Responsibility to help vulnerable populations and countries adapt	Adoption of corporate adaptation strategy and establishment of Climate Centre Data collection and research Development of new insurance products	Improved risk management New business opportunities identified	Short-termism in insurance pricing and absence of regulation Lack of normalized data on weather-related loss
BC HYDRO Vancouver, British Columbia bchydro.com	Employees (2011): 5,800 Revenue (2011): C\$4.02B	Utilities	Regulatory requirement as a crown corporation Logical progression after addressing climate change mitigation	Modification of maintenance and design standards for new and existing transmission lines	Data and models of climate change available for other industries and companies in B.C. Improved internal and external communication on climate change	Difficulty of making business decisions using uncertain future climate projections



CAMECO CORPORATION

SASKATOON, SASKATCHEWAN

“Overall the potential climate change benefits outweigh the potential drawbacks.”

- *Shane Borchardt, Program Manager, Environmental Systems, Cameco*



INDUSTRY
**CHEMICAL
MANUFACTURING**

EMPLOYEES (2011)
**3,500
WORLDWIDE**

REVENUE (2010)
**C\$2.12
BILLION**

KEY ADAPTATION DRIVERS

Consideration of climate change impacts and adaptation in public policy debates and the media

Climate risk assessment and adaptation actions by other companies

ADAPTATION TO CLIMATE CHANGE

Climate change risk assessment for selected facilities

BUSINESS BENEFITS

Increased confidence in risk management among senior management

Improved climate change communication

BUSINESS CHALLENGES

Lack of government incentives

COMPANY OVERVIEW

Cameco is one of the world's largest uranium producers, accounting for 16% of world production. The company is involved in all stages of the uranium value chain: it operates mines, mills and conversion facilities, and it generates nuclear power. It has assets in Canada, the U.S. and Kazakhstan, and interests in exploration and development projects in Canada, Australia, Kazakhstan, the U.S., Mongolia and Peru.

Since 1975, known uranium resources have increased almost threefold because of higher investment in exploration.² As nuclear power generation produces negligible greenhouse gas (GHG) emissions, uranium companies could benefit from increased demand for nuclear energy as an alternative to fossil fuels, particularly as developing countries' economies continue to grow and targets to reduce GHG emissions become more stringent.

MINING IN A CHANGING CLIMATE

Most of the climate risks faced by Cameco as a uranium producer come from its mining activities, which are often undertaken in isolated environments with harsh and challenging climates. Mining operations are directly exposed to the impacts of a changing climate because of their reliance on long-lived and capital-intensive assets, their extensive transportation networks and long supply chains. The International Council on Mining and Metals (ICMM) recognizes climate change as a significant issue, and encourages its members to develop appropriate adaptation strategies specific to operations.³

Rising temperatures, projected to be particularly pronounced during the winter in the Far North, will affect access to resources on winter roads, for example. These roads depend on the structural integrity of the underlying frozen base material, and observed trends have already shown a substantial reduction in the duration of the winter-road season over the past 30 years.⁴ Water-intensive mining and milling activities could also be affected by future changes in the seasonal distribution of precipitation; this is particularly critical in locations where seasonal water scarcity is already a constraint.

With climate change, the frequency and severity of extreme weather events (such as storms, droughts and flooding) and other disturbances are expected to increase, with knock-on costs and potential for downtime and disruption of mining operations. For example, increased risk of forest fires in the Prairies due to hotter temperatures and reduced summer precipitation could result in increased costs for fire risk management, particularly in remote locations that do not benefit from publicly-funded firefighting services.

Finally, climate change has the potential to complicate the safe, long-term decommissioning of assets, a process that is critical for the mining industry.

DRIVERS

Cameco created an Environmental Leadership team in 2006, part of a concerted effort to become a forerunner in understanding and managing the environmental issues facing the industry. The Environmental Leadership team's mandate includes scanning and studying environmental challenges that have the potential to become company liabilities, in order to incorporate them into the corporate risk assessment system if warranted.

Climate change (both the reduction of GHG emissions and physical impacts of a changing climate) was identified early on as a potential company risk issue, because of its importance in public policy debates and the media. Cameco's Environmental Leadership team also felt that the company should join the large number of companies across a broad range of sectors that had started considering climate change risks and opportunities.

A FOCUS ON RISK ASSESSMENT

In 2008, as a first step in managing the corporate risks of climate change, the Environmental Leadership team conducted a climate change risk assessment by coordinating working group discussions with staff from different divisions of the company. This exercise was facilitated by an external consultant from Acclimatise, a specialist climate risk management consultancy.

In addition to considering the implications of climate change for the company as a whole, a small number of individual Cameco facilities (which represented a range of geographies and business areas) were selected for this exercise:

- // a high-grade uranium mill in Key Lake (Saskatchewan) and an *in situ* recovery operation (Joint Venture Inkai) in a remote part of Kazakhstan represented the company's mining division, and
- // a uranium refinery at Blind River (Ontario) represented the fuel and power division.

The climate change risk assessment conducted by Cameco followed a well-known framework for making decisions in the face of climate change uncertainty.⁵ Four working groups considered a broad range of climate change risks and opportunities, including the potential need for higher amounts of cooling water, increased fire risk, higher road maintenance costs, and possible supply chain disruptions.

The most significant risk identified by Cameco was reduced water availability for operations in Kazakhstan, as a result of projected increases in temperature and decreases in precipitation. The assessment also concluded that climate change could affect water quality, with knock-on consequences for local communities, which could be attributed to Cameco's operations.

Overall, the climate risk assessment found that for the majority of Cameco's operations the benefits of climate change (which include increased demand for uranium and nuclear energy due to GHG emission targets, as well as savings associated with reduced heating requirements) are likely to outweigh potential risks. As a result, climate change is not considered to be an enterprise risk and no specific management measures were put forward. Responsibility for climate risk management currently sits with individual site managers.

The results of Cameco's climate risk assessment formed part of the company's response to an annual request for information from the Carbon Disclosure Project, which represents 551 institutional investors.

BENEFITS AND/OR CHALLENGES

The comprehensive climate risk assessment exercise conducted in 2008 has provided senior management with the confidence that no hidden liabilities exist because of climate change. The assessment has also helped the company to improve its communication with stakeholders on climate change risks and opportunities.

Formal government incentives or obligations would prompt action at the site level that might otherwise not have been undertaken.

NEXT STEPS

Cameco will continue to monitor possible risks and opportunities at a high level, especially in connection with communication and investor relations, so long as climate change remains a high profile issue in the public realm. However, unless new information showing considerable under- or overestimation of future changes in climate becomes available, there is no plan to update the results of Cameco's climate change risk assessment.

In countries where legislation or regulation requires consideration and management of climate risks, Cameco currently assesses the implications of future climate change at the project design stage. As an example, planning authorities in some Australian states and territories (such as the Australian Capital Territory and New South Wales) require a climate change risk assessment to be undertaken as part of environmental impact assessments.

PERSPECTIVES ON GOVERNMENT ROLES

Cameco's interaction with government on climate change has mostly concentrated on GHG emissions issues. Though the topic of adaptation has arisen, there has not been much engagement with government to date on this issue, primarily because government activity has not focused on business adaptation to climate change. Cameco feels that the option to evaluate climate change impacts and adapt accordingly should remain the prerogative of individual companies, not least because the imperative for managing climate risks will vary from location to location and from business to business. However, if government imposes new requirements on proposed projects that are solely directed at adapting to climate change, Cameco would encourage favourable government funding and taxation regimes to help offset some of the additional costs.

In locations that are highly exposed to climate-related hazards and/or where climate models project significant changes, a more hands-on role for governments could be justified. Obviously, regulatory or legislative changes introduce costs for business. Should government wish to integrate climate risk management obligations into law (for example by increasing the design standard for storm water management on retention ponds), it is vital that businesses are provided with financial incentives and sufficient lead time to effect changes.

Finally, Cameco feels that government has a fundamental role in supporting business decision-making by providing clear and reliable data and information on climate change. Government also has a responsibility to minimize climate-related disruptions to public infrastructure and services on which businesses rely.



RBC Royal Bank®

ROYAL BANK OF CANADA

TORONTO, ONTARIO

“At RBC, we believe that financial services companies must carefully balance environmental concerns, society’s needs, and economic opportunity to provide credit responsibly to all sectors. We acknowledge the important role banks play in the development of the green economy, both through their own operations as well as through their business activities.”

- RBC, 2010 Corporate Responsibility Report



**INDUSTRY
FINANCE
& INSURANCE**

EMPLOYEES (2011)
74,000

REVENUE (2010)
**C\$27.7
BILLION**

**KEY ADAPTATION
DRIVERS**

Heightened credit and insurance risks due to climate change

Client exposure in a number of sectors and locations

**ADAPTATION
TO CLIMATE CHANGE**

Adoption of corporate-level objectives

Raising staff and client awareness

Understanding business implications of climate change

BUSINESS BENEFITS

Improvement of risk management and due diligence

**BUSINESS
CHALLENGES**

Understanding how climate change interacts with other risks in relation to insurance

COMPANY OVERVIEW

The Merchants Bank of Halifax, renamed The Royal Bank of Canada (RBC) in the early twentieth century, has closely followed Canada's economic development since its creation in 1864. Today RBC is Canada's largest bank with \$73 billion in market capitalization.

RBC operates five business segments: Canadian banking, wealth management, international banking, capital markets, and insurance. Canadian banking and wealth management account for 60 to 70% of RBC's revenues.⁶

FINANCE AND INSURANCE IN A CHANGING CLIMATE

Climate change can give rise to credit risk for financial institutions that lend to climatically vulnerable businesses. For instance, credit worthiness may be reduced if climate change impacts decrease asset value and/or income for a particular client.

The banking sector will also face changing operational risks, such as the potential for disruptions to business continuity due to more frequent and severe weather events in certain geographies.

Climate change presents threats to various sectors and regions, and it may affect the long-term returns of investment portfolios specialized in one or a few sectors in locations predicted to be significantly exposed to changing climatic patterns. If climate risks are not integrated into investment analysis and portfolio management, investors may make uninformed and non-optimal investment decisions, contrary to the best interests of their fiduciaries. For example, they may invest in water-dependent companies in regions to be affected by more and longer drought events in the near- to mid-term on the basis of good short-term cash flow projections, despite the possibility of future decreased output and increased costs.

A report by four institutional investors focusing on four climatically sensitive investment sectors stated that “climate change is now recognized as one of the most serious long-term challenges facing the investment community.”⁷ Some institutional investors have taken notice of these potential impacts on corporate value and have supported shareholder resolutions encouraging companies to disclose or take into account climate change issues.⁸

Insurers are directly affected by climate change since they pay the bill for insured losses caused by weather-related perils, such as floods, storms, wildfires, etc. Weather-related losses have been increasing in the past 30 years globally and the predicted increase in severe weather events is expected to lead to higher insurance premiums and reduced available insurance coverage in exposed locations.⁹

DRIVERS

Overall, RBC considers that its vulnerability to climate change is low. RBC is for the most part a retail bank and, as such, deals with intangible goods.¹⁰ However the company has identified three risk areas that could be affected by climate change:

1 // CREDIT Some industry sectors in some regions will be faced with challenges to resources availability, and may suffer more frequent and/or severe business interruption

2 // INSURANCE Property and casualty insurance is directly affected by adverse extreme weather

2 // OPERATIONS Business continuity could be impacted by an increase in extreme weather events

In a high-level climate risk assessment, RBC examined the potential physical impacts of climate change on the following sectors in its banking and investment portfolio: agriculture, fisheries, forestry, cement, tourism, property and casualty insurance, energy, and manufacturing. The study illustrated the magnitude and nature of physical impacts on sectors in different regions of North America. Because many of its clients have international operations, RBC is also exposed indirectly to climate risk in foreign markets.

A FOCUS ON CLIENT AND STAFF AWARENESS AND UNDERSTANDING

RBC has recognized in its Environmental Blueprint that climate change will pose considerable financial, environmental and social challenges in the future, and that the Canadian economy needs to start adapting. This publicly available document outlines the company's objectives and policy with regards to sustainability, and it includes a series of objectives that relate to climate change:¹¹

- // Incorporate climate change into relevant policies and decision-making processes.
- // Support transactions and business activities intending to facilitate adaptation to climate change.
- // Participate in market-based initiatives that focus on promoting climate adaptation.
- // Review the potential impacts of climate change on RCB's insurance businesses.

In practice, RBC promotes climate resilience on two separate fronts: raising client and staff awareness, and understanding the business implications of climate change impacts.

Conscious that the best form of risk management involves encouraging clients to build climate resilience into their assets and decisions, RBC has trained staff to offer advice to small and medium-sized businesses through its "Greening Your Business" advice centre. The bank uses instruments such as publications, webinars and public speaking events to educate clients on climate change impacts and the importance of making climate-smart decisions.^b

RBC has also carried out analytical research to understand the implications of a changing climate. RBC is working with the Insurance Bureau of Canada, the University of Waterloo, and the Institute for Catastrophic Loss Reduction to better understand how to assess climate risks for its property and casualty insurance lines. Going forward, RBC intends to examine in detail how its own assets and operations, particularly in coastal areas and the Caribbean, could be impacted by a changing climate.

Finally, the bank serves a critical financing role for activities that build climate resilience. Although it is difficult to calculate the proportions of RBC's lending and investment portfolios that support adaptation-related activities, RBC recognizes that some of its financing activities can be indirectly inked

^b For example, climate impacts and adaptation are discussed in RBC's publication "Greening your business": a guide to getting started' (RBC ND).

to climate adaptation. For instance, a number of U.S. utilities RBC counts as clients have been affected by droughts in 2010–2011 and are considering infrastructural changes to reduce their vulnerability to water scarcity. However, neither RBC nor its clients consider this as climate change adaptation.

BENEFITS AND/OR CHALLENGES

RBC has thorough risk management and investment due diligence processes in place. In general, RBC assesses industry, company, and transaction-level risks and ensures that staff is trained to address these as part of its credit risk analyzes. In some cases, RBC has added new risk dimensions to its credit review process in response to the increasing body of knowledge on climate change and its impacts.

An interesting challenge for the insurance industry is to understand how climate change interacts with other risks and what the compound effect on insurance is. For instance, several factors contribute to the recent increase in weather-related claims for property and casualty insurance, such as higher intensity and frequency of extreme weather events, inadequate municipal infrastructure, more property developments located in areas exposed to severe weather, property value increases, and more finished basements. However, little is known about the relative weight of these factors and how much climate change *alone* will affect insured losses in the future.

PERSPECTIVES ON GOVERNMENT ROLES

RBC sees several ways government can facilitate adaptation to climate change.

First, the main role of government is to educate the public and businesses on climate change impacts, the benefits of adapting, and the risk management measures that can reduce climate vulnerability.

Further, government can build resilience to a changing climate by investing in upgraded infrastructure and by updating Canadian building codes, zoning laws and other infrastructure standards to ensure the integrity of new built infrastructure.

Government must also continue to support data collection and research on climate change, impacts, and adaptation, especially at the municipal and local levels. This is critical since businesses cannot achieve reliable climate impact assessments without quality climate observations and projections.

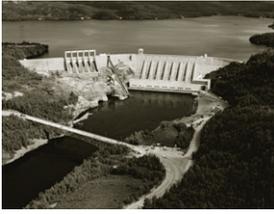


HYDRO-QUÉBEC

MONTRÉAL, QUÉBEC

“The northern economies are primarily dependent on their natural resources and public services. Their vast unexploited resources and the new economic opportunities that will be created by a changing climate could make the North one of the fastest growing Canadian economies.”

- T. Vandal, Chief Executive Officer, 2009



INDUSTRY UTILITIES

EMPLOYEES (2010)
23,259
INCL.
TEMPORARY
STAFF

REVENUE (2010)
C\$12.34
BILLION

KEY ADAPTATION DRIVERS

- Intrinsic relationship between hydropower production and climate factors
- Existing present-day imperative to manage weather risk
- Recent costly extreme weather events
- Government requests for clarification on climate change impacts and adaptation

ADAPTATION TO CLIMATE CHANGE

- Create a specialist research consortium in collaboration with government
- Identify sensitive areas of the business
- Develop future climate change scenarios in cooperation with experts
- Assess impacts on runoff, demand and environmental impacts

BUSINESS BENEFITS

Considerable avoided climate change costs, though they remain unquantified

BUSINESS CHALLENGES

- Difficulty quantifying benefits
- Limitations to adaptation in cross-boundary water basins

COMPANY OVERVIEW

Hydro-Québec is one of the largest electric utilities in North America. The company has a total installed electricity generation capacity of 36,671MW (more than 90% of which comes from hydropower installations), and the longest electricity transmission system in the U.S. and Canada.

Hydro-Québec supplies electricity in Québec, where the company is responsible for ensuring reliable and continuous service. It sells excess output to other suppliers in northeast Canada and U.S., and purchases electricity from other suppliers in periods of peak power demand. The company has partnerships in place with other power producers in Québec, such as Alcoa and Rio Tinto Alcan, which buy or sell electricity to Hydro-Québec depending on their seasonal output. Selling and purchasing excess electricity is made possible through 17 interconnections with the Ontario, New Brunswick, and U.S. northeast power systems.

Hydro-Québec owns and manages 59 hydroelectric generating stations, 26 large reservoirs, 571 dams, four thermal and one nuclear power plants, 33,453 km of electric lines and 514 electric substations.

HYDRO-ELECTRIC UTILITIES IN A CHANGING CLIMATE

The effect of a changing climate on electric utilities will depend on the assets at risk and their location. For instance, hydropower production is likely to be more vulnerable to climate change than thermal power production. Assets located on the coast may be vulnerable to sea level rise, and those dependent on glacier-fed rivers will be affected by earlier onset and more rapid glacial melting. Facilities located in northern Canada could be affected by degradation of permafrost as temperatures increase. Several elements of the planning, design and operations of electricity assets are sensitive to changes in average and extreme climatic conditions:

- // Renewable electricity production relies directly on aspects of the climate (such as wind or solar radiation) or natural resource endowment (such as surface runoff).
- // The supply of coal, oil, gas, or uranium to thermoelectric or nuclear power plants could also be affected by a changing climate at the extraction or transportation stages (e.g. because of limited water or supply-chain disruptions during storms).
- // Hydropower output is directly affected by seasonal precipitation, temperature, and glacial and snow melt. Hydropower plants may face increased risks of spillover and dam failure during heavy downpours. Thermal power plants can suffer small changes in optimal performance due to a changing climate, through effects on operating efficiency or cooling water temperature.
- // Transmission and distribution assets (e.g. electric lines, transmission poles, sub-stations) are vulnerable to climate change, for example through risk of damage to lines.
- // Finally, higher temperatures and changing rainfall will affect electricity demand for space heating and cooling, with implications for peak loads.

DRIVERS

Hydro-Québec recognizes that sound climate risk management is key to the company's success, as 97% of its electricity output comes from hydroelectricity, and the company already manages highly variable water flows into its reservoirs.¹²

In the 1980s a number of low-stream-flow events raised the profile of weather and climate risk management within the company. Hydro-Québec commissioned studies to determine whether these events were due to a natural climatic cycle or other causes. At the time, the company considered special management measures in addition to improved reservoir management, including a guarantee fund shared by different utilities and special insurance coverage.

In recent years, a number of costly weather-related disasters have further highlighted the risk of a changing climate for electricity generation, transmission and distribution.

- // Between July 19 and 20 1996, heavy rainfall in the Saguenay-Lac-Saint-Jean region of Québec caused severe flooding. Floodwater overtopped a number of dams, which aggravated the effect of

rainwater flooding.¹³ Hydro-Québec was forced to spill water from some of its reservoirs to preserve the integrity of its dams. The company estimated the repair costs for its transmission and distribution network to be around \$10 million.¹⁴

// In January 1998 freezing rain caused ice accumulations of over 80 mm in certain areas of Québec and Ontario.¹⁵ The ice storm caused severe power outages and left over 1.6 million people without electricity in Canada.¹⁶ The transmission and distribution network failed because of ice loads in excess of design standards on electric lines, support structures (such as poles and pylons) and surrounding tree branches. More than 3,000 km of Hydro-Québec's network was damaged by the storm, which left 24,000 electric line poles, 4,000 transformers and 1,000 steel pylons in need of repair. The ice storm cost Hydro-Québec \$725 million in 1998; the company invested over \$1 billion in successive years to strengthen its transmission and distribution network against possible similar events.¹⁷

// Between 2001 and 2004, dry conditions and reduced water levels in Hydro-Québec's reservoirs created a concern about long-term production deficits.¹⁸

Finally, the Québec government has asked questions or made requests to Hydro-Québec to consider climate change impacts in its project planning.^c

A FOCUS ON RESEARCH AND PLANNING

In 2002, Hydro-Québec's research institute (IREQ) developed a research program to further knowledge of climate change, business impacts and technological adaptation options in the mid- to long-term, so that risks could be managed and opportunities exploited.

In response to a series of costly weather events (the 1996 Saguenay-Lac-Saint-Jean flooding, the 1998 ice storm and drought conditions), Hydro-Québec and the Québec government joined efforts to create a unique consortium with the mandate to study regional climate, climate change impacts and adaptation solutions. Called Ouranos (the Consortium on Regional Climatology and Adaptation to Climate Change), this organization is partly financed by Hydro-Québec. As part of Ouranos, Hydro-Québec cooperates with Rio Tinto Alcan, Ontario Power Generation (OPG) and Manitoba Hydro on climate change risk and adaptation issues.

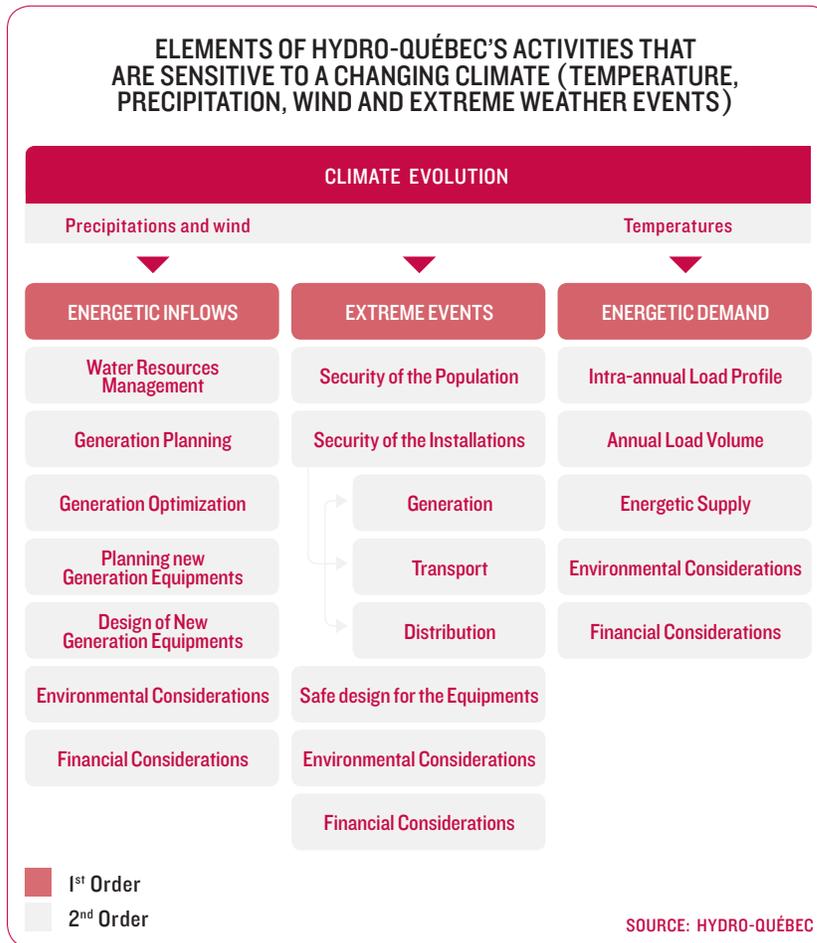
Since 2002, Hydro-Québec has developed a comprehensive work program to tackle climate change, which includes the following elements:

// **Identify areas of activity that are sensitive to climate change.** Hydro-Québec consulted staff from different divisions to assess sensitivity to a changing climate. Hydro-Québec identified several areas of sensitivity and prioritized where further work is needed: for example, Hydro-Québec decided that assessing climate change impacts on water resources was a priority.

Figure 2 shows the areas of sensitivity that were identified.

^c For example, during the public hearing of Hydro-Québec in 2006 in front of the Permanent Commission for the Economy and Labour about Hydro-Québec's Strategic Plan for 2006-2010, climate change impact considerations were discussed (Assemblée nationale 2006).

FIGURE 2



// **Project future changes in average and extreme climatic conditions.** Through collaboration with Ouranos, Hydro-Québec has contributed to the development of future climate change scenarios that can be used to model business impacts.

// **Analyze the implications of climate change for targeted activities.** Hydro-Québec has used future climate change scenarios to model impacts on various elements of the business, working with staff from the Production, Distribution and Equipment divisions.

// **Develop climate change adaptation strategies for Hydro-Québec's activities vulnerable to climate change.** Hydro-Québec wants to understand the implications of changing the operating rules of hydropower assets for future electricity output under a changing climate. In the next few years, Hydro-Québec will work toward mainstreaming climate risk management into planning, design and operations.

The company's climate change impact and adaptation work has resulted in a number of important achievements. First, the company produced an extensive set of future runoff projections based on a number of climate change scenarios for each of its hydropower operations. Despite the high uncertainty across climate models, results point to a general increase in runoff by the 2050s, with a higher increase in the northeast compared with the southeast. Results also point to increased winter runoff and reduced summer runoff because of future higher rain to snow ratio and higher summer evaporation rates respectively. Furthermore, high river flows will occur earlier in the spring due to increased temperatures. Peak river flows will be lower on average due to reduced winter snow mass. Hydro-Québec has planned further refinements to its hydro-climatic modelling; for instance, it plans to analyze water flow and balance in Canadian bogs and fens.

The Hydro-Québec Equipment division used climate change scenarios to assess impacts on hydrological conditions for the 'Eastmain 1A – Dérivation Rupert' project. The results were presented at a public hearing to answer questions from the public on the cumulative impact of climate change for fisheries.¹⁹

Working with the Distribution division, Hydro-Québec's climate change team integrated future temperature projections into the company's electricity demand forecasts in 2008. The projected increase in average temperature reduced energy requirements by almost 1 TWh (0.5% decrease) per year as a result of reduced heating needs. Furthermore, Hydro-Québec forecast a 350 MW reduction in peak loads (1.0% decrease) using projected climate information. These reduced electricity demand forecasts have been incorporated into Hydro-Québec's annual tariffs, as well as its 10-year Procurement Plan, both of which were approved by the Québec regulator. Results showed that by 2050, 2TWh per year could be saved across all sectors as a result of reduced heating needs.^d

Hydro-Québec used future runoff projections to evaluate the environmental impacts of the hydroelectric development on La Romaine River and consider adaptive management measures that are flexible enough to cope with different possible futures.^e This approach was approved by the Canadian Environmental Assessment Agency in a report of April 2008.²⁰

Finally, Hydro-Québec analyzed the benefits of adapting the operating rules of hydropower reservoirs according to future hydrological regimes. Through a case study, the company found that, by 2050, without adaptation electricity output could drop by up to 14% due to higher unproductive water spills compared to the reference case. However, adapting operating rules could prevent production losses and even increase output by up to 15%.²¹

^d Higher cooling requirements during summer are not expected to compensate reduced heating demand.

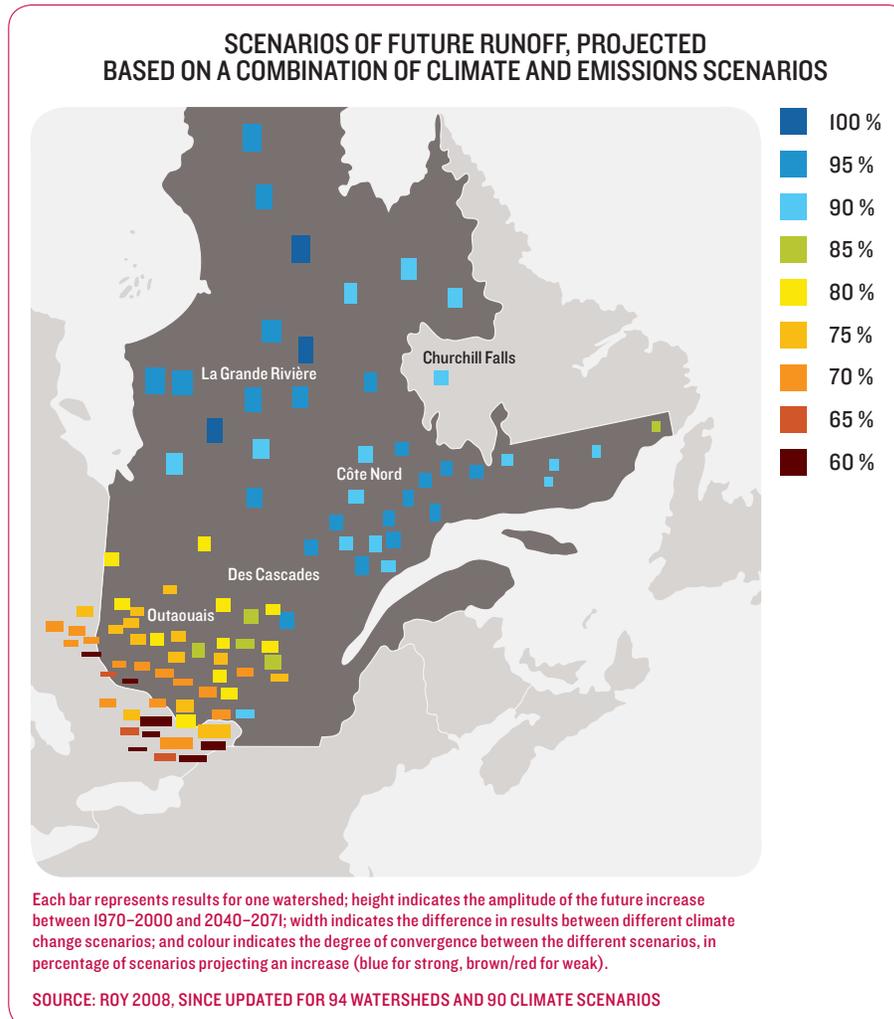
^e See the environmental impact assessment for La Romaine hydroelectric complex (Hydro-Québec 2008).

STRATEGIES TO MANAGE CLIMATE CHANGE UNCERTAINTY

To increase the level of confidence in its projections, Hydro-Québec has appraised the sensitivity of its hydro-climatic simulations to different greenhouse gas (GHG) emission scenarios, climate models, hydrological models and methodologies to conduct impact analyzes. This “multi-method” approach has shown that the choice of climate model influences hydro-climatic simulations much more than the choice of GHG emission scenario or hydrological models (for the 2050 time horizon).

Hydro-Québec has consequently revised its set of future runoff projections for all the watersheds in its service area, drawing upon a combination of climate and hydrological models and emissions scenarios. The results of this work are presented in **Figure 3**.

FIGURE 3



BENEFITS AND/OR CHALLENGES

Although it is difficult to quantify the economic benefits of assessing climate change impacts and adopting adaptation measures, Hydro-Québec finds them considerable. Hydro-Québec believes that some benefits have already been realized through the integration of climate change impacts and adaptation knowledge into planning, design, and operational decisions, such as in the Equipment and Distribution divisions. This position justifies Hydro-Québec's considerable investment in research on climate change, business impacts, and adaptation since 2001.

PERSPECTIVES ON GOVERNMENT ROLES

The Québec government has played a central role in Hydro-Québec's climate change adaptation journey through the financing of Ouranos. The federal government has also helped indirectly by supporting academic research of relevance to Hydro-Québec's projects or operations.^f

Moving forward with adaptation strategies, Hydro-Québec feels that government intervention is needed in relation to cross-boundary water management (between Canadian provinces and between Canada and the U.S.). For instance, Hydro-Québec has considerable margins of manoeuvre to manage climate change impacts on water resources in Québec, however limitations exist for water bodies that are shared with another province or the U.S. (as is the case with the Saint Lawrence and Richelieu Rivers that are shared with the U.S.). The creation of cross-boundary water management commissions where climate change impacts and adaptation is discussed could be helpful in the future to facilitate adaptation action by utilities.

^f For an example, see Minville et al. 2009.

TOLKO

TOLKO INDUSTRIES LTD

VERNON, BRITISH COLUMBIA

“Tolko’s woodlands teams have risen to the challenges of forest management in today’s changing world”

- Randy Chan, Vice President Forestry & Environment



INDUSTRY
WOOD PRODUCT
MANUFACTURING

EMPLOYEES (2010)
2,200

TOTAL SALES (2010)
OVER C\$50
MILLION

KEY ADAPTATION DRIVERS

Commitment to sustainable forest management practices, and recognition that forest management is directly impacted by a changing climate
Recent climate-related impacts on operations

ADAPTATION TO CLIMATE CHANGE

Working in partnership with government, First Nations, researchers and industry representatives to guide future forest management
Changes to site selection, planting, and forest yield forecasting

BUSINESS BENEFITS

More resilient woodland

BUSINESS CHALLENGES

Cost
Lack of economic incentive

COMPANY OVERVIEW

Tolko Industries Ltd is a family-owned manufacturer of wood products headquartered in British Columbia, with operations in British Columbia, Alberta, Saskatchewan and Manitoba. Ontario, Québec, the U.S. and Asia are important markets for the company, though Tolko sells wood products to more than 20 countries in total.

Tolko produces a broad range of forest products, including the following:

Lumber; Plywood, veneer and other manufactured wood products; oriented strand board (OSB); manufactured ties, poles and timbers for the transport industry (such as railway or dock construction); by-products, including wood chips; and Kraft paper for packaging and other uses.

Lumber represents the majority of the company's sales. Tolko also owns and operates eight biomass energy facilities that produce heat or biogas from wood residues for the company's operations. Two of those facilities are combined heat and power plants producing electricity sold to BC Hydro and other power utilities.

FOREST-BASED ACTIVITIES IN A CHANGING CLIMATE

Climate change is already affecting Canada's forests and will continue to do so in the foreseeable future.²² Forest managers and timber companies are beginning to assess the implications of climate change for drought and fire risk, pest and disease outbreaks and forest productivity.

Some of these biophysical impacts are already being felt:

// In recent years, considerable fire activity in the western boreal forest has been linked in part to a changing climate.²³ In the future, higher temperatures (particularly heat waves) and seasonal drought conditions could increase fire risk to forests.

// The economic implications of a shift in the distribution of forest pests and diseases are considerable. These shifts can contribute to tree mortality, reduce woodlands' resilience to climatic stresses (such as droughts) and aggravate fire risk by clearing large portions of forest. Climate change has exacerbated recent mountain pine beetle (MPB) outbreaks. In recent years, unusually hot, dry summers (favourable for beetle reproduction) and mild winters (which allow beetle larvae to survive), have contributed to MPB infestations destroying more than 700 million m³ of pine in B.C.; this represents more than 50% of the province's commercially important pine. The geographic distribution of this species is expected to move northward and eastward into habitat that was formerly limited by climate.²⁴

// Forests in Western Canada have suffered record dry conditions in the recent past. Drought episodes in 2001-2003 caused widespread forest dieback and mortality.²⁵ Studies show that some forest areas, particularly the low-elevation southern portion of the western boreal forest,²⁶ could experience considerable decline in productivity due to increased drought in the future.

// The bioclimatic suitability of different tree species will also shift in a changing climate, leading to changes in yield forecasts. In anticipation of future warming, the BC Ministry of Forests and Range has made climate-based upward elevation changes to the Chief Forester's Standards for Seed Transfer, raising elevation limits for some species by 100-200m.²⁷

Climate change is likely to affect access to standing timber. Timber is often harvested on frozen soils, because high soil moisture and the risk of soil compaction from heavy machinery restrict access during warmer seasons. Warmer temperatures and changing patterns of precipitation could shorten the period during which timber companies can safely harvest wood.

The impacts of climate change on wood manufacturing activities are less well understood. Weather-related delays and disruptions to transport of wood products could increase. As well, higher temperatures could reduce the efficiency of biomass energy production facilities, and changing availability of water could reduce cooling capacity.

A changing climate has significant implications for the health of forest ecosystem services, such as biodiversity and carbon sequestration. Forest-based communities will see their standard of living affected if woodland health diminishes in a changing climate. These impacts could have consequences for companies with strong forest stewardship commitments.

The risk of negative impacts on forest-based communities and forest ecosystems is compounded by the fact that timber harvesting activities are increasingly under scrutiny by government agencies and the public.

A number of sustainable forest management certification schemes are considering integrating climate risk management into their standards and audit requirements.⁸

Finally, climate change could lead to changes in forest product trade patterns, since forest cover will increase in certain countries at the same time as forest health declines in other places. Two studies suggest that Canadian forest product companies are particularly vulnerable to climate change impacts compared with competitors from other countries.²⁸

DRIVERS

Tolko manages large areas of woodland, primarily from natural reproduction and regeneration, across British Columbia, Alberta, Saskatchewan and Manitoba. The company owns little freehold land; the majority of its timber stands are leased from the Crown. Since most of the stands Tolko manages are publicly owned, the company feels a strong obligation to manage forests in a sustainable manner.

Tolko has made clear commitments to sustainable forest management to preserve the quality of life of surrounding communities and maintain the environmental, social and economic benefits of woodlands for future generations. For example, the company maintains sustainable forest management certification from the Canadian Standard Association (CSA Z809) on all of its woodlands.

The company has already been affected by a number of climate-related impacts in recent years. In response to mountain pine beetle infestations, Tolko has invested in innovative technology to extract maximum economic value from MPB-damaged timber.²⁹ To counter increased fire risk, the company has selectively harvested Douglas fir stands to protect planned roads in an area close to Williams Lake, BC.³⁰ Finally, Tolko manages humid forest areas that have experienced droughts in recent years.

⁸ For example, the new version of the Canadian Standard Association standard for sustainable forest management (Z809-08, Sustainable Forest Management) has provisions for exploring climate change impacts and adaptation. The Forest Stewardship Council or FSC (another leading international certification and labeling scheme) is exploring possible strategic engagement options on climate change adaptation. See Canadian Standards Association 2008 and Forest Stewardship Council Forest Carbon Working Group 2010.

A FOCUS ON BOOSTING FOREST RESILIENCE

The company's leadership developed an early interest in climate change impacts and adaptation. In its 2008 Sustainability Report Tolko recognized the need to develop integrated and adaptive strategies to cope with the impacts of a changing climate.

Tolko chairs the Timber Supply Area team of the Kamloops Future Forest Strategy (KFFS), a new initiative that involves the B.C. government, First Nations, academics and other industry representatives. The KFFS recognizes climate change as a significant challenge to the forest sector, and aims to guide forest management activities and investments towards a more diversified, resilient future. Tolko manages woodlands and has operations within the KFFS area, which is dominated by Douglas firs, lodgepole pine and spruce. The area is also characterized by considerable bioclimatic diversity.

To manage the uncertainty of future climate change, the KFFS team has used a range of plausible climate change impact scenarios, and recommended a number of adaptation approaches to minimize the impacts of climate change on forests and maintain ecological, economic and social benefits of forest areas.

The KFFS team undertook the following activities between 2007 and 2009:

- // It modelled future climate and ecosystem composition and mapped projected changes;
- // It assessed the climate change sensitivity of ecological zones and forest management regimes in the Kamloops timber supply area;
- // It developed climate change adaptation options.

This work showed that 60% of the timber that can be harvested within the Kamloops area is expected to suffer a moderate to high degree of ecological alteration due to climate change by 2080. The KFFS team made a number of recommendations for successfully adapting woodlands in the Kamloops area, including:

- // Promote species diversity and limiting climate-induced tree mortality by favouring resilient species, such as Douglas fir.
- // Proactively harvest high-risk tree stands to realise economic value before trees are damaged by changes in climatic conditions.
- // Carefully promote broadleaf species as they hold benefits for conservation and fire risk management, keeping in mind their vulnerability to dry conditions.^h

^h For instance, drought has recently caused significant mortality of aspen trees in the southern boreal forest of Alberta and Saskatchewan. See Johnston and et al. 2009.

Tolko has built on the efforts of the KFFS initiative, making a number of changes in its forest management practices to build resilience. The company has refined its site selection process, paying more attention to local bioclimatic conditions (soil composition, exposure to drought, etc.) before making decisions about tree species and planting density. At a micro-site level, Tolko now strives to avoid soils that are considered to be vulnerable to climatic stresses, particularly shallow soils exposed to drought conditions. The company has also increased the proportion of Douglas firs in certain forest areas (for example, where lodgepole pines dominate) to increase resilience and improve carbon sequestration. For more than 10 years, Tolko has practised mixed bag planting over monoculture, with an increasing focus on multi-species and a higher proportion of drought-resistant species. The company also carefully selects microsites for optimum seedling health and growth, experimenting with intertree spacing to avoid thin soils, and avoiding sites that have previously produced poor results because of shallow or drought-sensitive soils. More importantly, this diversity increases the capacity of a timber stand to cope with different possible climate futures, in line with the ecological concept of “resilience.”

Finally, the company is taking small steps to change its corporate culture to integrate climate change contingencies. For example, Tolko now considers the potential for more conservative forest yield forecasts to manage future uncertainty.

BENEFITS AND/OR CHALLENGES

Tolko believes the steps it has taken to adapt its forest management practices will help its woodlands better cope with future climate change.

The company is now considering how far down the “climate change adaptation” journey it wants to go, given its strong sustainability values and policy. Presently, a key barrier Tolko is facing in this area is the lack of economic incentive. Adaptation has an upfront cost. For example, Tolko pays an additional 10-15 cents for each new Douglas fir planted to increase forest resilience (compared to cheaper pine species).

PERSPECTIVES ON GOVERNMENT ROLES

Climate change adaptation is a long journey for businesses. There are a number of things government should put in place before forest product companies can implement a comprehensive adaptation strategy on Crown land.

Government has a role in supporting research on climate change impacts and adaptation solutions for forest-based activities. Government should also guarantee a “level-playing field”, with economic incentives offered to companies making climate adaptation efforts. Because historic forest management practices are unlikely be robust in the future, comprehensive private sector adaptation requires a cultural change involving forest product suppliers, customers, and forest-based communities.



EBA ENGINEERING CONSULTANTS LTD.

EDMONTON, ALBERTA

“Climate change adaptation is already built into what we do on northern projects when it is needed.”

*- Don Hayley P.Eng FEIC, Director of Arctic Resource Development, EBA Engineering Consultants,
a Tetra Tech Company*



INDUSTRY
**CONSULTING
ENGINEERING
& SCIENCES
SERVICES**

EMPLOYEES (2011)
650

TOTAL SALES (2010)
**US\$100
MILLION**

KEY ADAPTATION DRIVERS

Present-day extreme
climate variability
Absence of observed
climate-related data and
engineering precedents

ADAPTATION TO CLIMATE CHANGE

Development of
innovative methods and
technical solutions
Technical support in
updating engineering
codes and standards
Technical assistance
on climate adaptation
projects

BUSINESS BENEFITS

Established reputation
bringing repeat business
and new contracts

COMPANY OVERVIEW

EBA is a 40-year-old engineering consulting company founded in Edmonton, Alberta. In 2010, the company merged with the Engineering and Consulting Services division of Tetra Tech Inc. of Pasadena, California.³¹

EBA offers planning, design, regulatory permitting and project management services for mining, energy, transportation and infrastructure development.

EBA is renowned for its engineering expertise in areas of permafrost, ice and winter conditions. EBA's Arctic division is the largest dedicated team in Canada for engineering consultancy services in Arctic conditions, with a total of 80 employees in Edmonton (Alberta), Yellowknife (Northwest Territories) and Whitehorse (Yukon).

ENGINEERING-BASED ACTIVITIES IN THE CANADIAN NORTH IN A CHANGING CLIMATE

Climate is changing across Canada, and northern parts of the country have been most intensely affected.³² According to records from weather stations north of the 60th parallel, the rate of warming in northern latitudes has been greater than the global world average in recent decades, corresponding to an average increase of 0.09°C per decade. This is due in part to the reflective properties of ice and snow.³³ Climate model projections predict a possible average temperature increase in the Arctic this century of approximately 6°C compared with 1980-1999, varying from 3.5°C to 12.5°C depending on the model and greenhouse gas emissions scenario considered.³⁴

Warming in Canada's North will affect sea ice, snow cover, ice sheets, lake levels, river flow, permafrost conditions and local topography.³⁵ This will translate into opportunities and risks.

Economically, Canada's North could benefit from several changes:

- // Increased shipping through the Northwest passage;
- // Reduced costs of oil, gas and mining exploration; and
- // Increased forest cover.

However, there are considerable risks for existing infrastructure. For example, warming and reduced ice cover pose threats to winter roads. These roads are built out of snow and ice, connecting isolated mining camps and resource exploration lands during the few months in the winter when the muskeg and lakes are frozen over. They play a critical socio-economic function for communities and businesses in Canada's North, as emphasised by the TV show "Ice Road Truckers."ⁱ In recent years, safe operating days on ice roads are more difficult to predict because of the warming trend and more frequent warm temperature extremes.³⁶

Finally, impacts on built infrastructure will be compounded by risks to the natural environment. A number of fauna and flora in northern Canada have narrow habitats and niche requirements, which make them sensitive to climate change.³⁷ Although they are well-adapted to current extreme climate conditions, warming and reduced ice and snow cover have been shown to contribute to increased mortality rates, reduced reproductive capacity and higher competition for resources.³⁸ This will have critical implications for Aboriginal ways of life in the Canadian North who rely on Arctic plants and animals for their diet, traditions and cultures.

ⁱ Early episodes of the TV show were filmed on the Tibbitt to Contwoyto Winter Road, which services the diamond mining industry in the Lac de Gras region of Northwest Territories.

DRIVERS

EBA routinely considers climate risk management as part of its core business services. This is explained by the company's early involvement in northern projects.^j

Ambient conditions in Canada's North are extreme and fast changing. Further, meteorological and environmental observations are limited in the North. As a result, most engineering projects in the North require a strong research component aimed at understanding local conditions. This explains why EBA started analyzing environmental changes and developing adaptation solutions before most other engineering companies.

A FOCUS ON TECHNICAL SOLUTIONS

Over the past 20 to 30 years, EBA's professionals developed innovative engineering methodologies and technical solutions to manage climate variability and long-term changes.

For example, EBA developed a technique to build frozen core dams out of permafrost for the EKATI diamond mine in 1995. Part of the engineering challenge consisted of ensuring that the permafrost foundation would remain frozen over the asset lifetime. To achieve robust design standards, EBA refined its ground thermal analysis to incorporate the most recent warming observations, knowledge of climate variability and long-term warming projections. Frozen core dams became a proven successful and cost-effective technique to build dams in Arctic conditions with cold continuous permafrost.

EBA has also done considerable work to improve the design and construction of winter roads. By optimizing engineering practices, EBA's engineers made it possible to increase truck loads on ice roads, while coping with increased warming and reduced ice cover.

EBA contributed to the 2010 Canadian Standards Association technical guide "Infrastructure in permafrost: A guideline for climate change adaptation", as well as the updated Alberta best practice guidelines for building and working safely on ice covers with consideration of future climate change.³⁹

Due to its expertise, EBA also offers technical assistance on dedicated climate adaptation projects. For example, EBA prepared a guideline for the Transportation Association of Canada in 2010 on the development and management of transportation infrastructure in permafrost regions, which included a review of climate change impacts and adaptation for roads in Canada's North.⁴⁰

^j The company's engineers worked on the first Canadian surface and underground diamond mine, EKATI, in the Northwest Territories.

BENEFITS AND/OR CHALLENGES

EBA's management approach of climate and environmental changes has earned the company a good reputation for designing robust engineering projects in Canada's North in such a way as to receive planning approval, even from the most stringent regulators. This has ensured considerable repeat business, as well as contracts from new clients for EBA's Arctic division.

EBA has developed its robust management approach by working with universities and government agencies, such as the University of Alberta and Natural Resources Canada, to apply fundamental research to "real life" engineering projects.

PERSPECTIVES ON GOVERNMENT ROLES

EBA believes that those actively working in the Canadian North and governments have a role in educating the public, especially potential investors, on the challenges of climate variability and long-term change for the built environment. This would influence businesses to consider routinely climate risk for new projects and existing assets, as well as raise awareness on the avoided cost of climate change if adaptation measures are adopted.

Government also has the responsibility to provide quality data and support research on a changing climate and its impacts, for use by project promoters, and engineering consultants. It is EBA's opinion that this role is currently well managed by both federal and provincial and territorial governments.

Finally, government can favour climate change adaptation through regulation and/or guidance, especially at the permit review stage.



J.D. IRVING, LIMITED

J.D. IRVING LIMITED

SAINT JOHN, NEW BRUNSWICK

“Our commitment is to manage our operations for the long term in an environmentally sustainable and socially responsible manner. Our approach and research investments around active and sustainable forest management provide flexibility to respond to climate change.”

- *Blake Brunsdon, Chief Forester, J.D. Irving*



INDUSTRY
**WOOD PRODUCT
MANUFACTURING**

EMPLOYEES (2010)
15,000

TOTAL SALES (2010)
**OVER C\$50
MILLION**

KEY ADAPTATION DRIVERS

Long-term forest productivity
Observed changes in climate
Land stewardship commitment

ADAPTATION TO CLIMATE CHANGE

Improve siting decisions
Maintain or improve forest health
Understand adaptive genetic variations

BUSINESS BENEFITS

Increased economic value of forest land
Improved resilience through genetic diversity

COMPANY OVERVIEW

J.D. Irving, Limited (JDI) is a family-owned group, founded in 1882 by J.D. Irving, an entrepreneur of Scottish descent. The business included a number of assets: a sawmill, a flourmill, a carding mill to produce textiles for clothing, a general store, a lumber business, and three farms. Today, the company remains diversified and operates six main business units: forestry and forest products; transportation; shipbuilding and industrial marine products; retail; industrial equipment, construction services and building materials; and consumer products, such as frozen potatoes and tissue products.

The company's forestry operations are located in eastern Canada (New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador, Québec, and Ontario) as well as the U.S. (State of Maine). J.D. Irving's forestry activities are extremely important in the Atlantic Provinces: in the last 50 years, the company has achieved a national record by planting over 850 million trees.

Compared to other Canadian forestry companies, J.D. Irving owns a considerable amount of land in New Brunswick, Nova Scotia and Maine. Approximately 1 million of the 2.3 million hectares of land it manages is leased from the Province of New Brunswick.

In both Canada and the U.S., the forests owned or managed by the company are certified under the Sustainable Forestry Initiative. JDI's woodlands in Maine also are certified under the Forest Stewardship Council (FSC) program.

The company produces a number of forest-based products including the following: pulp to produce paper or tissue; printing paper of different grades; tissue paper for facial tissues or napkins; packaging material for food and other consumer products; and lumber products for construction, building finishing materials. J.D. Irving, Limited sells most of these products in Canada and the U.S. The company's tissue brands include Majesta™, Royale™ and Scotties (U.S.) tissues™.

FOREST MANAGEMENT AND FOREST PRODUCT MANUFACTURING IN A CHANGING CLIMATE

The impacts of climate change are already being felt in the forestry industry.⁴¹ For example, consider the following:

// In recent years, considerable fire activity has affected Western Canada.⁴² Though fire disturbance in Atlantic Canada has been low in the past, climate model projections indicate a future increase in fire hazard.⁴³

// There is evidence that extreme weather events, such as storms and droughts, have become more severe and frequent in Atlantic Canada in recent years.⁴⁴

// The frozen ground season has decreased in recent years, making it more difficult to harvest timber in wet areas or where soil could easily become compacted by the use of heavy machinery.

The bioclimatic suitability of tree species in Atlantic Canada will shift due to a changing climate. For example, black spruce (the dominant tree species in the boreal forest of Labrador) could see its net productivity increase with higher springtime temperatures.⁴⁵

Increased drought, due to reduced summer precipitation and higher temperatures, will likely put at risk natural regeneration, as well as mature forests.⁴⁶ The increased number of cycles of freezing and thawing could also affect a number of tree species, especially those with shallow roots, such as spruce.

Changing pest and disease dynamics may compound with direct climatic stresses (such as heat or drought) to damage forests. For example, the spruce budworm is the single biggest threat to forests in New Brunswick. Though scientific uncertainty remains, there is evidence that higher summer temperatures and milder winters could cause a northward shift in the distribution of this insect and more severe and prolonged outbreaks in areas already affected by it.⁴⁷

Increased drought will extend the fire season and increase fire hazard, putting more forest hectares at risk of loss or damage.

Climate change has the potential to increase storminess in Atlantic Canada, including extreme wind speeds, which is a known determining factor of tree damage.⁴⁸

Climate change may also affect wood manufacturing activities, though impacts are less well understood. For example, weather-related delays and disruptions to transport of wood products could increase.

Climate change could also affect international sales. Two studies suggest that Canadian forest product companies are particularly vulnerable to climate change impacts compared with competitors from other countries.⁴⁹

Finally, a number of forest ecosystem services are vulnerable to a changing climate, such as biodiversity and carbon sequestration. This will likely affect not only the environmental performance of forest management activities, but also the standard of living of forest-based communities. The reputation of forestry companies could be affected by such impacts, especially since government and public scrutiny of timber harvesting activities are increasing. As evidence, a number of sustainable forest management certification schemes have started integrating climate risk management into their standards and audit requirements.^k

DRIVERS

J.D. Irving, Limited has observed changes in climate in recent years, such as milder winters and an earlier spring season. This has had a discernable effect on winter harvesting already. The company has considerable timber in areas that need to be harvested while soils are frozen. Reduced winter freezing and earlier ice melting make it more difficult to access these areas.

Long-term forest productivity is critical to JDI's economic success and environmental performance. This is why all land under JDI's stewardship is covered by a Management Plan, which includes long-term forecasts extending 80 years into the future for wood supply, forest communities, habitats and other land management values. These plans are re-evaluated on a five-year cycle. Climate change will have an impact on long-term forest management plans and wood flow forecasts, thus affecting revenues, budgets for modernization and overall competitiveness. This is an important driver for building climate change resilience for JDI.

A FOCUS ON BOOSTING FOREST RESILIENCE

J.D. Irving, Limited does not have an explicit climate change adaptation strategy. Instead, risk management including potential effects of climate change is an integral component of its land stewardship commitment. This is embedded in forest management across forest areas and forest types managed by the company.

First, JDI recognizes that in order to manage future climate change successfully, the company needs to have a good understanding of local bioclimatic conditions, including climate, soil and ecology. Appropriate site-by-site decision making lies at the forefront of climate change adaptation strategies for forest management. This means “doing the right things in the right places”. Using appropriate harvest methods, stand tending and regeneration techniques across the range of forest types including softwoods, hardwoods and mixed forests is an integral part of forest operations.

^k For example, the new version of the Canadian Standard Association standard for sustainable forest management (Z809-08, Sustainable Forest Management) has provisions for exploring climate change impacts and adaptation. The Forest Stewardship Council or FSC (another leading international certification and labelling scheme) is exploring possible strategic engagement options on climate change adaptation. See Canadian Standards Association 2008 and Forest Stewardship Council Forest Carbon Working Group 2010.

A mixture of allowing natural regeneration and establishing planted stands is employed according to the forest type and condition. Hardwood stands are typically regenerated using natural regeneration that is related to the prolific seeding and sprouting of hardwoods. Softwoods are regenerated through natural regeneration or by establishing planted stands. When planting trees, great attention is paid to selecting the best species or mixture of species for the specific site.

J.D. Irving, Limited has started making changes to silvicultural decisions with knowledge of climate change impacts in mind. For example, balsam fir in Southern New Brunswick suffers from balsam woolly adelgid, a pest that damages and kills the trees and is favoured by mild winters. A changing climate will create more favourable conditions for this pest. As a result, the company often plants a mixture of resistant tree species, such as spruce and pine rather than relying too much on balsam fir natural regeneration, in part to increase resilience to climate change related damage.

Secondly, JDI invests in actions that maintain or improve forest health. Overall, healthy forests are more capable of withstanding climatic stresses, such as drought or windstorms, than already stressed forests. JDI maintains vigorous tree growth with an active thinning program. This is not strictly implemented as part of a climate change adaptation strategy, but it builds resilience nonetheless. It also improves carbon sequestration in the long term.

J.D. Irving, Limited has a tree genetics improvement program based on selection of the highest quality trees in forests across the region. These superior trees are grafted and planted in seed orchards to produce seed for use in reforestation stock production. Traditional breeding is conducted among the selected trees and resulting offspring are planted in replicated field tests across the region. These are measured over time, beginning five years after they are planted. Field test tree growth analyses are used to understand genetic variation and how trees in the tree improvement program perform in different sites and climates. This also helps in understanding how the trees will respond in changing climate conditions. On average, the company measures 30,000 trees each year to support these efforts.

Such work is made possible because JDI's land holdings have a large number of different bioclimatic characteristics. For example, the number of frost-free days varies between 90 and 170 across JDI's land holdings, which the company sees as a much larger climatic difference than the projected future climatic changes over the next 50 years.

Finally, JDI has made significant investments in fire risk management for many years. For example, the company owns five fixed-wing aircrafts and two helicopters, which it keeps on standby during the fire season. The company expects these investments to help to reduce vulnerability to possible future increased fire hazard.

BENEFITS AND/OR CHALLENGES

Overall the company spends \$1.5 million on research per year, often in collaboration with universities and government. Not all of this money is spent on adaptation. In fact, JDI recognizes that a lot of its adaptation efforts correspond with good sustainable forest management practices. This makes it difficult to assess the cost and benefits of adaptation actions.

For example, through its tree genetics improvement program and forest management practices the company expects to increase the economic value of its forest land and maintain broad genetic diversity that coincidentally builds climate change resilience.

Another important aspect related to JDI's approach to sustainable forest management and climate change is the overall carbon footprint. Carbon sequestration estimates are frequently made with respect to only one or a few components of the continuum of carbon dynamics from the forest through to product lifecycle. Understanding and integrating carbon accounting is necessary from the standpoint of economic and ecological service values of management options.

PERSPECTIVES ON GOVERNMENT ROLES

The potential economic implications of climate change are considerable for the industry. Although natural genetic variation will help cope with climate variability and long-term climatic changes in the next 50 years, the forest sector needs to start bringing in new tree species that are resistant to future climate change. This form of adaptation should be implemented gradually, since the effect of short-term natural climatic variability (for example, colder than usual winters) can cause significant damage to newly introduced trees that are not as tolerant to local environmental variation.

This type of research and development is best done through public-private co-operation, since it is resource-intensive, costly and requires a broad genetic pool. The New Brunswick Tree Improvement Council (NBTIC) is a good example of public-private collaboration that can help build climate change resilience. The NBTIC assists the exchange of genetic information and material between agencies, companies, and universities.¹

Government can also facilitate adaptation in the forestry sector by re-defining tree breeding zones to take account of future climate change, as well as improving soils and site information for better decision making on the ground.

Finally, federal and provincial governments should continue to support research on climate change. However, it is important to address both research on impacts and research on adaptation solutions.

¹ For more information, see New Brunswick Forest Products Association ND.

Coca-Cola Canada

COCA-COLA CANADA

TORONTO, ONTARIO

“Global climate change has widespread implications for the planet and the communities where we operate. Water resources, public health, agriculture and more are at risk. We recognize that climate change has the potential to significantly affect the sustainability of our business and supply chain. The actions listed below are but a small sample of the steps we are taking to prepare for the impact of climate change.”

- Nicola Kettlitz, President, Coca-Cola Canada



INDUSTRY
**FOOD &
BEVERAGE
MANUFACTURING**

EMPLOYEES (2010)
**6,300
IN CANADA**

PER CAPITA
CONSUMPTION (2010)
**236
SINGLE
SERVINGS (8 OZ)**

KEY ADAPTATION DRIVERS

Water, a climatically-sensitive resource, is a core business input

Building a good corporate reputation

ADAPTATION TO CLIMATE CHANGE

Source Water Vulnerability Assessments and Protection Plans

Use holiday advertising campaigns to raise public awareness

BUSINESS BENEFITS

Maintaining competitive position

BUSINESS CHALLENGES

Increased commodity costs (water, oil, and gas)

COMPANY OVERVIEW

The Coca-Cola Company, headquartered in Atlanta, is the world's largest beverage company with operations in more than 200 countries and a portfolio of more than 3,500 products, including soft drinks, waters, juices, teas, coffees, sports drinks, and energy drinks.

The Coca-Cola Company represents a global business that operates on a local scale through multiple channels. For instance, the Coca-Cola Company manufactures the concentrates, beverage bases and syrups that are used in the production of soft drinks, and sells them to more than 300 bottling manufacturers throughout the world. These bottling partners manufacture, package, merchandise, and distribute the final branded beverages to customers and vending partners. The Coca-Cola Company owns all the Coca-Cola brands and is responsible for consumer brand marketing initiatives.

The Coca-Cola Company operates in Canada through two principal separate entities: Coca-Cola Ltd, which is – responsible for advertising, marketing, quality assurance, and control of the Coca-Cola trademarks in Canada; – and Coca-Cola Refreshments Canada, which is– in charge of manufacturing, sales and distribution of Coca-Cola products across the country. Lastly, The Minute Maid Company Canada Inc. owns and operates a frozen concentrated and base manufacturing facility in Peterborough, Ontario.

With more than 50 facilities, seven of which are for production, Coca-Cola Canada operates in all ten Canadian provinces and three territories.

BEVERAGE MANUFACTURING, SALES, AND DISTRIBUTION IN A CHANGING CLIMATE

Water is the primary ingredient in Coca-Cola beverage products. As a result, climate change impacts on water availability represent a key business risk for the company globally. Shifts in precipitation amounts and frequency, temperature increases, changes in snow, ice and glacial melt, increased droughts, and extended dry periods can affect availability of fresh water, while extreme weather events (such as storms) can damage water infrastructure and lead to pollution of water supplies. Climate change is also likely to increase demand for irrigation and drinking water in some areas, which can lead to heightened competition and water scarcity, especially in areas of the world that already experience periods of water stress.

Production of Coca-Cola's products requires a number of raw agricultural inputs, such as sugar, corn, and citrus. Because agriculture is highly sensitive to climate conditions, Coca-Cola's beverage manufacturing is vulnerable to crop yield disruptions. Changes in temperature, soil moisture, rainfall, incidence of pests and diseases, and frequency and intensity of extreme weather events (including floods, droughts and storms), will have consequences for crop quality, supply, and price.

Because it relies on stable transport and logistics systems, product distribution is also susceptible to transport disruptions or delays that may be more likely in a changing climate.

Finally, weather significantly influences consumer preferences and beverage sales. This will translate into both seasonal opportunities and risks, depending on the product concerned.

A FOCUS ON WATER STEWARDSHIP

Global climate change has widespread implications for the planet and the communities where Coca-Cola operates. Water resources, public health, agriculture and more areas are at risk, and Coca-Cola recognizes that climate change has the potential to significantly affect the sustainability of the company's business and supply chain.

The Coca-Cola Company has made a commitment to become "water neutral" throughout its global operations by 2020. The aim of this commitment is to return to communities and nature an amount of water equivalent to what they use in their beverages and production.

Because water is at the core of the company's operations and is intricately linked to both climate change and carbon, the company has adopted a global and holistic Water Stewardship Strategy. This strategy sets objectives in three areas globally:

- // Improve water efficiency;
- // Increase the amount of water recycled and the proportion of clean water returned to the environment; and
- // Support freshwater conservation through watershed protection (for example, by eliminating invasive species in water bodies, or by restoring wetlands).

While the impetus for these initiatives is not strictly climate change, Coca-Cola recognizes that they help the company to build resilience against potential climate change impacts, while also helping to build the adaptive capacity of surrounding ecosystems and communities that depend on shared water resources.

To promote responsible water resource management, The Coca-Cola Company has adopted a corporate source water protection standard.⁵⁰ This standard requires that by 2012 all Coca-Cola manufacturing plants must do the following:

- // Form a water resource management team.
- // Work with experts to complete a Source Water Vulnerability Assessment (SVA) to produce an inventory of watershed-level risks.
- // Prepare and implement a Source Water Protection Plan (SWPP).
- // Maintain and update the SWPP as-needed, at a minimum every five years.

The impacts of a changing climate are considered within SVAs, together with: infrastructure pressure, pricing, drought, competing use, increasing demand, regulatory limits and social acceptance. The SVA are based upon an independent scientific review of the watershed in question. This review is accompanied by qualitative input from local officials and non-government organizations (NGOs).

Source Water Protection Plans are a roadmap toward a more sustainable watershed. These roadmaps typically include an outline of the appropriate role Coca-Cola should play in the watershed stewardship as well as a framework for working with local officials, conservation authorities, the public, and NGOs. To date, Coca-Cola Canada has completed SVAs at five manufacturing facilities and started preliminary water risk assessments in the remaining two facilities.

To achieve optimal results, Coca-Cola Canada works in partnership with NGOs, such as World Wildlife Fund, and local governments. External third-party reviewers also assure the company's water stewardship initiatives.

A FOCUS ON PUBLIC AWARENESS

Coca-Cola and WWF are teaming to help protect the polar bear's home. Together they are raising awareness and funds to help create a safe haven for polar bears through a project called 'Arctic Home'. Coca-Cola is making a contribution of \$2 million to WWF over five years. Coca-Cola invites everyone to join the effort and will match all individual donations made in Canada and the U.S. by March 15, 2012, up to US\$1 million. Furthermore, to call attention to this cause, for a limited time Coke is turning its red cans white – a first in Coca-Cola's history.

Coca-Cola's holiday advertising campaigns have used polar bears for more than 80 years. In 2011, Coca-Cola decided to use the force of its iconic Christmas campaigns to raise public awareness of the effects of climate change on Arctic communities and ecosystems, including polar bears. The campaign is designed to raise awareness of the impact of climate change on the Arctic and is a call to action for individuals to support WWF in its efforts to protect the Arctic and polar bears.

BENEFITS AND/OR CHALLENGES

Coca-Cola Canada has observed that society is increasingly aware of the implications of climate change, and increasingly requires renowned brands to demonstrate sustainable practices. By adopting a holistic approach to sustainability, through a climate change lens, the company aims to preserve its leader position in the beverage industry.

PERSPECTIVES ON GOVERNMENT ROLES

To achieve long-term sustainability, the company believes that it is essential for businesses to work alongside government and society. For example, once a manufacturing plant has completed its SVA, Coca-Cola Canada reaches out to the communities and local governments that are connected to the watershed to discuss the water resource management actions that each group can take to ensure long-term sustainability.

RioTintoAlcan

RIO TINTO ALCAN

MONTRÉAL, QUÉBEC

“Demonstrating leadership in climate change strengthens our long term competitiveness.”

- Nigel Steward, Vice- President Carbon, Energy and Climate Change, Rio Tinto Alcan



INDUSTRY
**METALS
& MINING**
ALUMINUM
MANUFACTURING

EMPLOYEES (2010)
22,000

REVENUE (2010)
**US\$60.32
BILLION**

KEY ADAPTATION DRIVERS

Safeguarding operational stability
Increased scrutiny by stakeholders

ADAPTATION TO CLIMATE CHANGE

Development of a climate change sensitivity framework

BUSINESS BENEFITS

Identification of potential risks
Potential to gain competitive advantage

COMPANY OVERVIEW

Rio Tinto Alcan is one of the world's largest producers of bauxite, alumina and aluminum. Based in Montréal, it is one of five product groups operated by Rio Tinto, a leading international mining group.

The group operates large-scale, long-life assets on six continents and in 27 countries. This includes a significant presence in Canada, Australia and France. Rio Tinto Alcan currently owns, operates or has an interest in bauxite mines, alumina refineries, aluminum smelters and power generating plants.

ALUMINUM SMELTING IN A CHANGING CLIMATE

Aluminum smelting operations are characterized by large capital investments, long lead-times for new developments, and very tight supply chains. Aluminum smelting covers the entire value chain, from the mining of bauxite, the production of alumina in a refinery, and conversion of alumina into primary metal in a smelter. Because many of the raw materials that go into aluminum smelting are also in demand in other sectors (e.g. cement and steel industries), the market for each input is very tight. At each link in the supply chain, delays or disruptions that prevent a critical material from reaching the next stage in the manufacturing process can be very costly. In the spring of 2011, for example, the aluminum market experienced production disruptions due to flooding of critical ports along the Mississippi River.⁵¹

In recent years, lean supply chains have become the standard for mining and smelting operations. Businesses have invested considerable effort in maximizing efficiency by acquiring raw materials and delivering products to the customer with minimal waste. This is achieved by streamlining operations across all links in the supply chain, from procurement and manufacturing to warehousing and transportation. Leanness has brought efficiency and cost savings, but it has also resulted in increased risk of disruption. A survey from the Business Continuity Institute, which analyzed responses from businesses in 35 countries, showed that more than 70% of respondents recorded at least one supply chain disruption in 2010.⁵² Adverse weather was the main cause of disruption, with 53% of businesses citing this as contributing to recent supply chain disruption.

Supply chain disruptions can cause significant harm to business operations.⁵³ They can raise costs, trigger inventory accumulations, and reduce business market share. A broken or damaged chain puts production and distribution in jeopardy, reducing revenue when goods can't be manufactured or delivered. Disruptions can also affect credibility with customers, investors, and other stakeholders.

Climate change will cause shifts in both average conditions and the frequency and severity of extreme climate events. These shifts have the potential to affect every aspect of the business supply chain, often in ways that are gradual, diffuse or indirect.

STRATEGIC PLANNING THROUGH A CLIMATE CHANGE SENSITIVITY FRAMEWORK

Rio Tinto Alcan is developing a climate change sensitivity framework that will help the group assess the exposure of operations and associated infrastructures to climate change risks. This framework will provide a strategic perspective on the exposure to climate change risks in any geography. The framework will help the group to form a picture of the exposure of potential new sites to current and future climate change impacts across the business model. It presents information about potential climate changes, and draws on the expert knowledge of Rio Tinto Alcan staff to identify a broad range of risks, including (but not limited to) the following:

- // Vulnerability of land and marine (sea and river) transport systems, and knock-on risks for supply chains and logistics; problems with marine transport and port facilities due to sea level rise.
- // Potential for increased maintenance requirements and degradation of assets that have been designed on the basis of historic climate data and a period of relatively stable weather.
- // Potential for downtime and disruption to operations from extreme weather events (natural climatic variability combined with a changing baseline climate) that exceed engineering or operational standards.
- // Changes in power generation capacity including variation of production related to increased weather changes.
- // Operational risks due to project location and site. Depending on geography, project sites could be exposed to higher temperatures resulting in increased drought risks, or low lying coastal areas at increased risk of flooding. Projects could also be located in pristine ‘frontier’ environments that are uniquely sensitive to changes in climate (e.g. permafrost zones).
- // Changes in social performance because of increased competition with local communities for access to climate-sensitive natural resources and changes in socio-economic conditions. For example, water use is at the nexus of different economic activities. Future climate-related impacts on water resources could induce situations of water stress and conflict between users.
- // Changes in environment (through changes in habitats, flora and fauna, impacts of discharges and use of natural resources), with consequent risks of failing to meet environmental performance standards.
- // Reduced brand equity/reputation of not demonstrably dealing with climate change impacts.
- // Political instability as a risk driven by climate change.
- // Impacts on site remediation costs.

HANDLING UNCERTAINTY

The climate change sensitivity framework being developed by Rio Tinto Alcan is not intended to *predict* future climate change by quantifying and reducing the uncertainty of projections. Instead, it accepts that some uncertainties associated with projected climate change are irreducible, and takes account of a *range* of potential future greenhouse gas emissions scenarios and global climate models. The framework depends on the expert input of Rio Tinto staff, and emphasizes learning from past events. The framework also incorporates a risk matrix that highlights risks that can be addressed as a matter of priority. Instead of a top-down methodology that attempts to foresee the future, Rio Tinto Alcan is building a bottom-up approach that increases the group’s capacity to deal with the unexpected.

BENEFITS AND/OR CHALLENGES

Adapting to the impacts of a changing climate requires a strategic, integrated approach which takes account of moving climatic baselines and changes in social, economic and environmental systems. By developing its climate change sensitivity framework, Rio Tinto Alcan derives the following potential benefits:

- // Opportunity realization in new geographies – either by identifying risks and opportunities when entering new markets, or through benchmarking against competitors.
- // Identification of new risk dimensions – a thorough analysis of both direct and indirect climate change impacts will reveal compound, cross-sectoral, and knock-on issues that can create a domino effect, as impacts in one area create consequential impacts elsewhere within the group’s business model.
- // Development of a competitive edge – by acquiring future insights into societal and physical climate sensitivities, and clarity around future asset performance and optimization.

NEXT STEPS

The climate change sensitivity framework described in this case study is part of a wider program of climate change initiatives being undertaken by Rio Tinto Alcan. The group is also developing a methodology for taking account of detailed climate risks at the project design and engineering stage. Taken together, these initiatives help the group manage climate change as part of its robust risk management portfolio.

PERSPECTIVES ON GOVERNMENT ROLES

Rio Tinto Alcan has developed a collaborative research partnership with Québec’s Ouranos consortium to better understand the impact of climate change on the Lac Saint-Jean basin in Québec, Canada over the coming years. This partnership, Ouranos’ first with a private-sector organization, highlights the importance of cooperation between public and private organizations. Ouranos is a joint initiative of the Québec government, Hydro-Québec, Environment Canada, the Université du Québec à Montréal (UQAM), Université Laval, McGill University, and INRS (Institut national de la recherche scientifique) University. Through partnerships like this one, Rio Tinto Alcan underscores its support for government-funded research and data on climate change and its future impacts on business.



WHISTLER BLACKCOMB

WHISTLER, BRITISH COLUMBIA

“What we build today must ensure climate change resilience tomorrow.”

- Arthur DeJong, Mountain Planner and Environmental Resource Manager, Whistler Blackcomb



INDUSTRY
**ARTS,
ENTERTAINMENT
& RECREATION**

EMPLOYEES (WINTER)
3,500

REVENUE (2010)
**C\$224
MILLION**

**KEY ADAPTATION
DRIVERS**

Additional revenue
in off-peak months
Risk management

**ADAPTATION
TO CLIMATE CHANGE**

Seven-step framework
strategy for climate
change
Summer and winter
grooming, snowfencing
and snowmaking
Diversification from a
two- to a four-season
guest experience

BUSINESS BENEFITS

Investments maximized
by building resilience
into infrastructure at
the planning stage
Improved communi-
cation about climate
change risk to investors
and the media

**BUSINESS
CHALLENGES**

Significant range
of projected changes
in climate

COMPANY OVERVIEW

Whistler Blackcomb is a ski resort located in the resort municipality of Whistler, BC, 125 kilometres from Vancouver. The ski area was officially opened to the public in 1966 as the Whistler Mountain. In 1980, the neighbouring Blackcomb Mountain was opened, and in 1997 Whistler and Blackcomb ski resorts merged into one of the largest mountain ski resort in the world.

Today the company is responsible for managing close to 32 km² of ski area on two neighbouring mountains connected by a pedestrian village and a mechanical gondola. Vertical elevation on both mountains approaches 2330 m. Overall, the resort includes three glaciers, twelve snow-filled mountain valleys, over 200 trails and a system of 37 mechanical lifts.

Recently Whistler Blackcomb made headlines as the official alpine skiing venue for the 2010 Olympic and Paralympic Winter Games.

The resort's new "Peak 2 Peak" gondola links Whistler and Blackcomb mountain tops. At 436 metres above the valley floor, and with an unsupported span of more than 3 kilometres, this feat of engineering has broken several world records for height and length.

Whistler Blackcomb is both symbolically and financially important for the Canadian tourism industry. The resort generates considerable revenues, the majority of which are presently generated during winter.

SKI RESORTS IN A CHANGING CLIMATE

Winter sport resorts are directly vulnerable to climate change, as the quality of skiing and snowboarding guest experiences are dependent on snowfall. In recent decades, rising temperatures have resulted in decreased snow accumulation, particularly at low elevations, and a higher ratio of rain to snow.⁵⁴ In future, a reduction in winter snowpack and earlier snowmelt is projected for mountainous areas.

Glacier retreat on Whistler Blackcomb's tenure area is very evident. Although glacier loss will not affect revenues (the resort's summer glacier ski operation is very small), the glaciers are certainly a key indicator for climate warming. Glaciers are often considered "nature's thermometer", such is their sensitivity to climate change. Interestingly, the glaciers at Whistler Blackcomb are not reducing in size because of reduced snowpack (the last two decades have seen more snow at glacier elevations in the area), but rather the increased summer heat is primarily causing the retreat.

Wildfires are another concern at Whistler Blackcomb. In 2009, wildfires necessitated evacuations from the resort area. Rising temperatures and higher risk of drought are likely to exacerbate wildfire risk in future.

ADAPTATION AS PART OF A COMPREHENSIVE CLIMATE CHANGE MANAGEMENT STRATEGY

In its 2008-2009 Sustainability Report, Whistler Blackcomb highlighted the resort's historical dependence on a stable climate, and acknowledged that it is on the frontlines of climate change impacts. Taking into account the projected impacts on mountain ecosystems and the knock-on financial consequences, the company has since recognized climate change as an umbrella issue that is integral to all elements of its environmental program.

The company's approach to climate risk management is described as flexible and iterative. Exchange with other ski resorts and associations is encouraged, and assessments and management measures are re-assessed regularly.

Whistler Blackcomb has developed a seven-step strategic framework around three pillars: assessment, action and advocacy (see **Figure 4**). Four of these steps include consideration of climate change risks and adaptation:

FIGURE 4

OVERVIEW OF WHISTLER BLACKCOMB'S SEVEN-STEP CLIMATE CHANGE STRATEGY		
ASSESSMENT PHASE	1	What are the financial implications of climate change? (negative, neutral, positive)
	2	What are our emissions?
	3	Declared statement of commitment with goals and metrics of reduced emissions.
ACTION PHASE	4	Adaptation
	5	Mitigation
	6	Risk Diversification
ADVOCACY PHASE	7	Inspire others through your actions and education programs.

SOURCE: INTRAWEST WHISTLER BLACKCOMB ND

STEP 1 // WHAT ARE THE FINANCIAL IMPLICATIONS OF CLIMATE CHANGE (NEGATIVE, POSITIVE, NEUTRAL)?

At the assessment phase, Whistler Blackcomb took stock of likely climate change impacts on the resort, and appraised the potential financial consequences. The resort used figures from the Intergovernmental Panel on Climate Change (IPCC) that projects a 120m snowline rise with every degree Celsius increase. Using a scenario-based approach, the assessment concluded that the ski resort could withstand the financial consequences of an increase in average global temperature between 2 and 3.5°C this century compared with 1980-1999. This is partly due to the significant adaptive capacity of the resort. Whistler Blackcomb has over a mile of vertical rise with the majority of its terrain at higher elevations. Its physical geography is like an ice cream cone – wide at the top and narrow at the bottom – which gives the resort the option of moving ski areas upslope where snow is more abundant, a comparative advantage that many lower-altitude ski areas do not have.

STEP 4 // ADAPTATION

Whistler Blackcomb has already started to plan and implement climate change adaptation measures. In recent years, the company has doubled its snow making capacity to maintain its ski area extent. To improve ski run conditions in a warmer climate, the company is also investing in a summer grooming program, removing rocks and smoothing out run surfaces with earth moving equipment, and cultivating a thick grass root cover. These measures are known to optimize winter snow cover. During the winter, Whistler Blackcomb manages snow cover on runs by snowfencing, which consists of installing fences to force snow to accumulate in desired areas, such as ski runs. The company also uses snow groomers to collect and distribute snow. Finally, the company has developed plans to increase upslope lift capacity and develop lift interconnections at high altitudes. In a changing climate these investments will allow Whistler Blackcomb to transport visitors higher up the mountains to take advantage of high elevation snowpack.

STEP 6 // RISK DIVERSIFICATION

In recent years, Whistler Blackcomb has developed a ‘buffer’ of recreational activities for the off-peak months of May through November, including nature walks, hiking trails and mountain biking routes. Though winter visitors tend to spend more money on average, the company is working hard to achieve a ‘four-season’ growth model whereby revenues are less dependent on skiing and snowboarding.

These new nature-based activities take advantage of the resort’s natural beauty and contribute to the achievement of the company’s low-energy, low-waste and conservation objectives.

STEP 7 // INSPIRE OTHERS THROUGH YOUR ACTIONS AND EDUCATION PROGRAMS

Whistler Blackcomb has made a concerted effort to communicate the results of its climate change work. For example, the company presented its seven-step climate change strategy to the 2007 UN World Tourism Climate Change Conference in Davos. The company also aims to inspire change by being a ‘pro-active educator’ on climate change impacts. To this end, the resort offers glacier visits so that guests can observe firsthand how ice has receded in recent years.

BENEFITS AND/OR CHALLENGES

Thanks to its informed approach to climate change adaptation, the company is maximizing current investment in infrastructure by ensuring that new and upgraded lifts reach snow areas at higher altitudes. This avoids the need for costly early replacement as the climate changes.

Furthermore, because the company understands its vulnerability to climate change and the adaptation solutions that are available, it is better prepared to respond to media or investor queries about the future resilience of the resort.

NEXT STEPS

Climate change adaptation is fully recognised as a business and environmental necessity by Whistler Blackcomb. However, the company wants to avoid over-adapting, given that some climate risk management measures (e.g. snow-making machines) are costly. For this reason the resort is concentrating on increasing energy efficiency as part of mitigation efforts to avoid unmanageable changes in climate, diversifying guest experiences, and other short-term actions which are expected to reduce costs or create value for the company.

PERSPECTIVES ON GOVERNMENT ROLES

Government has a leading role to play to help ski resorts adapt to a warmer world by reviewing land use policy and legislation and considering innovative land transfer mechanisms. With increasing temperatures, ski areas such as Whistler Blackcomb will need to move upslope to reach higher snowpack. At present, this is impossible since the province owns the land at higher altitudes. Land transfer mechanisms or flexible land use legislation could help to maintain the size of ski areas by facilitating exchanges between lowland mountain areas owned by ski resorts and highland mountain areas owned by the Crown.

Government should also continue to support climate monitoring and research efforts to understand changing climate patterns at the local level.



ENTERGY

NEW ORLEANS, LOUISIANA, USA

“We live in a region that requires us to be resilient in order to survive. Doing nothing is not an acceptable plan. That’s a plan to put Entergy out of business, a plan for misery and suffering for our customers and a plan that would devastate a region already economically impaired.”

- J. Wayne Leonard, Chairman and Chief Executive Officer, Entergy.



**INDUSTRY
UTILITIES**

**EMPLOYEES (2010)
14,958**

**REVENUE (2010)
US\$11.49
BILLION**

KEY ADAPTATION DRIVERS

Enhancing the resilience of customer base
Welfare of our employees, their families, and our communities
Cost savings

ADAPTATION TO CLIMATE CHANGE

Corporate-wide climate risk assessment
Comprehensive, fact-based climate risk assessment and cost-effectiveness assessment of coastal adaptation options
Stakeholder outreach on risks and viable responses
Prioritized our resiliency investments to reduce business interruption losses
Collaborated with stakeholders on building greater resiliency for local communities

BUSINESS BENEFITS

Reduction of downtime and disruption
More robust, resilient economy
Capital investment previously diverted to repair infrastructure now can be redeployed to creating wealth for the region
Enhance prosperity, safety, and quality of life
Stakeholder support for our resilience investments

COMPANY OVERVIEW

Entergy Corporation is an integrated energy company engaged primarily in electric power production and retail distribution operations. Entergy owns and operates power plants with approximately 30,000 megawatts of electric generating capacity, and it is the second-largest nuclear generator in the United States. Entergy delivers electricity to 2.7 million utility customers in Arkansas, Louisiana, Mississippi and Texas and supplies natural gas to approximately 191,000 customers in Baton Rouge and New Orleans. In addition to its electricity generation capacity, Entergy operates a system of more than 15,500 miles of high-voltage transmission lines and 1,550 transmission substations. The company holds a long list of awards for its efforts in sustainability and corporate responsibility. The Carbon Disclosure Project Best in Class award, the Dow Jones Sustainability Index award and recognition on the Forbes list of America's Most Trustworthy Companies are particularly noteworthy.

ENERGY GENERATION AND DISTRIBUTION IN A CHANGING CLIMATE

Many of Entergy's assets are located along the Gulf Coast, near areas that are directly exposed to hurricanes or storm surges. The company's operations are also at risk during heat waves, when access to cooling water for generation facilities is limited.

Storm risks – an example from hurricanes Katrina and Rita

A number of Entergy's generating stations, several substations, operating centres, customer service centres, IT servers, and its corporate main office were badly affected during two major hurricanes in 2005. The company recorded inundation levels of up to 12 feet (3.6 m) within many of its facilities, and had to dedicate full-time crews to restoring critical company assets damaged as a result. This was in addition to efforts to relocate displaced employees, bring in and house mutual aid crews, and restore electric and natural gas services to its customers. Before Entergy could allow workers to re-enter its damaged facilities, the presence of widespread mould and concerns over potential toxins associated with the floodwaters necessitated a thorough health and safety assessment. Replacing all lost assets and bringing generation, transmission and distribution back online after hurricanes Katrina and Rita in 2005 cost \$US1.5 billion.

The Gulf Coast region has 6% of the U.S. population, but accounts for approximately 30% of national GDP.⁵⁵ Entergy provides service to coastal communities in Louisiana and eastern Texas, and the company is keenly aware that its customers, and the generation, transportation, and distribution systems that serve them, can be heavily impacted by extreme weather events.

Operational risks during heat waves

Low river flows during hot, dry summers can lead to restrictions on water abstractions from local water courses, with consequences for essential cooling at energy generation facilities when the need for cooling is highest. During times of drought, demand for water resources from other parties will also increase, leading to increased competition for a scarce resource in areas where water availability is already constrained. When extreme high temperatures cause spikes in energy demand, power generation systems are likely to be stressed and less able to meet higher demand. The 2011 Texas drought was marked by daily extremes of high temperature. Several electricity plants, not owned and operated by Entergy, were forced to curtail generation during this event (despite record demand for electricity) because of a lack of availability of cooling water. To date Entergy has not had to respond to this kind of impact, but rising temperatures increase the risk of downtime and service disruption to energy supply in the future.

Climate risks to supply chains

Entergy uses a blend of inputs to produce electricity. Natural gas comes from pipelines, while the company's coal supplies come mostly from the western United States. Although the company has contingency plans, ultimately it is also exposed to the same risks that Entergy's suppliers face in getting raw inputs to market.

During storm and flood events Entergy's supply chains and distribution channels are disrupted; this was particularly notable during the Mississippi River flooding in spring 2011. Although the supply chain is robust in that it incorporates several nodes and links to support the distribution system, Entergy has noted spikes in coal and gas prices during widespread flooding events.

DRIVERS

Hurricanes Katrina and Rita demonstrated the extent to which climate-related events can impact a company's operations, and galvanized efforts to assess and manage climate risks within Entergy. The utility has since conducted an assessment of climate related risks, and this initiative is continuously updated as part of ongoing risk assessment procedure. The company-wide assessment of climate risks found that a large proportion of facilities are not likely to face significant impacts, and these elements (e.g. the Information Technology department) are being managed separately to concentrate efforts in high-priority risk areas.

A FOCUS ON RISK AND OPPORTUNITY ASSESSMENT

The climate risk assessment conducted in the wake of damage suffered during hurricanes Katrina and Rita led Entergy to update its assets to become more resilient against future storm events. The company is also gradually strengthening service delivery and lessening vulnerability by working with community stakeholders and engaging directly with customers on climate change risks.

Entergy's asset renewal program involves replacing transmission poles near the Gulf to ensure they support higher wind loads associated with more intense hurricanes. Entergy is following a strict policy to strengthen all high risk assets so that as many customers as possible benefit from increased resilience.⁵⁶ In addition, Entergy monitors its assets closely, and through vegetation management reduces risks that the surrounding environment can present (e.g. windthrow disturbance to power lines when trees are uprooted or broken during storms). The company has also implemented a program to maintain these assets and prevent environmental damage.

During the storm recovery efforts following hurricanes Katrina and Rita, Entergy hired a disaster preparedness expert to hasten and improve recovery efforts; this position now has a permanent role in the company, with responsibility for improving preparedness for future storm events.

Entergy understands that working with stakeholders can increase resilience to storm events and that those benefits extend to its employees, their families as well as to the surrounding community. The company continuously improves its business continuity plans, and has strengthened the capacity and speed with which it safely restores power to its customers during storm emergencies.

In addition, Entergy and America's Wetland Foundation (AWF) have collaborated to create *Blue Ribbon Resilient Communities (BRRC)*. This initiative is helping local communities prepare themselves for extreme events and improve their resilience against unanticipated disasters like the recent hurricanes and the BP oil spill. Communities have welcomed these forums, which bring together local government and residents, to assess, analyze and discuss management measures to counter environmental risks along America's Energy Coast. Through this initiative, communities are better informed and armed with tools to assist in resilience planning to bolster their protection against environmental risks that jeopardize their economic and cultural assets. These communities are benefiting from a stronger regional voice on local issues that call for common-sense solutions to federal policy conflicts and collaborative approaches to sustaining themselves into the future.

The company has learned practical lessons from speaking to customers directly about climate change vulnerability and strategies to build resilience. Through discussion with communities, city managers, county and parish leaders in Texas and Louisiana, Entergy established that power for sewage and water treatment plants was critical during disruptive events. As an adaptation measure in anticipation of further disruption in future, cities have now acquired generators to provide temporary power to water and sewage systems during emergencies. As a result of these discussions, many communities have also begun planning to restore and protect marshlands along the coast to provide added protection against storm surge flood events. This initiative has allowed Entergy and the community it serves to share information and act together to reduce the vulnerability of critical power supply during storm events.

NEXT STEPS

America's Wetland Foundation, Entergy and a diverse group of stakeholders are holding the tenth and final BRRC forum in June, 2012. AWF will compile all of the lessons learned through the initiative into a report, to further raise awareness of climate change impacts and the imperative of improving resilience. Following the report, AWF is considering an event that would bring together NGOs, communities and government to discuss findings. There seems to be additional value to further collaboration with America's Wetlands Foundation to strengthen adaptation of the region by focusing on a healthy Mississippi River System. The initiative would bring together the 31 states in the Mississippi River Basin to address policies, challenges and opportunities comprehensively, building on the Gulf Coast adaptation strategies emerging from the "*Blue Ribbon*" forums.

Entergy is planning to collaborate with representatives from the reinsurance industry, as they are also heavily impacted by climate-related damage. The company has previously partnered with Swiss Re on research programs. The impetus for new collaboration is the exponential increase in insurance premiums for new and existing assets along the coast that are considered at risk due to climate change impacts.

PERSPECTIVES ON GOVERNMENT ROLES

Entergy's climate risk assessment initiatives benefit greatly from environmental and climate data provided by NASA, the National Oceanic and Atmospheric Administration (NOAA) the Environmental Protection Agency (EPA) and the U.S. Geological Survey (USGS). In order to proactively tackle climate risks, Entergy and other service providers depend on freely accessible environmental data sets and products. It is more efficient and cost-effective for these data to be collected, updated and shared by government bodies than it is for individual organizations to collect the information they need independently.

Government also has a role to play in revising and promoting building codes (particularly with regard to elevation and extreme events) so that newly built assets are more resilient to climate change.

Local, state and federal government have an important role to play in designing, funding and building integrated "multiple lines" of defence where barrier island restoration, beach renourishment, wetland restoration combined with levy protection and the hardening infrastructure can cost effectively reduce losses and build greater community resilience.⁵⁷



SUMMERHILL PYRAMID WINERY

KELOWNA, BRITISH COLUMBIA

“Diversity is resilience. We need to regenerate, protect and enhance our naturally diverse ecosystems.”

- Gabe Cipes, Director of Permaculture and Biodynamics, Summerhill Pyramid Winery



INDUSTRY
AGRIBUSINESS

EMPLOYEES (2010)
40
YEAR ROUND,
FULL TIME

REVENUE (2010)
C\$6.9
MILLION

KEY ADAPTATION DRIVERS

Exploitation of opportunities in niche organic wine markets

ADAPTATION TO CLIMATE CHANGE

Protecting watersheds
Creating ecosystem resilience

BUSINESS BENEFITS

International acclaim within the organic wine market
Improved crop quality and pest control without pesticides or fertilizers

BUSINESS CHALLENGES

Initial costs for design, education, labour and inputs to adaptation strategies

COMPANY OVERVIEW

Summerhill is a Certified Organic Vineyard, located in the heart of British Columbia's Okanagan Valley wine country.

The winery does not use herbicides, pesticides, or chemical fertilizers in the soil, and approximately one quarter of the vineyard's 80 acres are given over to wetland and nature habitat. The proprietors' motivation for organic cultivation comes from a strong commitment to preserving watershed purity and building ecosystem resilience, though this management regime also affords real benefits for agribusinesses adapting to a changing climate.

OKANAGAN VITICULTURE IN A CHANGING CLIMATE

Though viticulture currently makes a small contribution to the provincial economy, it is a significant economic sector for the Okanagan region, and recent growth of vineyards and wineries in the Valley has been impressive. There are now over 175 grape wineries in B.C. and several licences pending, up from just 13 in 1984.⁵⁸ The viticulture industry is also closely tied to the tourism and leisure sectors, which are forecast to expand in future.

The Okanagan Valley sits at the same latitude as northern French and German vineyards, but is also the northernmost tip of the Sonoran Desert, which extends into the Okanagan Valley from Mexico. The long summer days associated with the Okanagan's northern latitude allow sugars to build up in the fruit, and this is countered by cool nights that prevent the breakdown of acids. The Valley's unique climate, coupled with soil conditions resulting from pre-historic glacial movement, give this region micro-climates unlike those of any other growing region in the world.

Over the period 1901-1999, minimum daily temperatures (night-time lows) measured at Vernon Coldstream Ranch in the Okanagan have increased by approximately two degrees Celsius.⁵⁹ Daily maximum temperatures have also increased, but by a smaller margin. Temperature increases are corroborated by records at Kamloops, Summerland, and Cranbrook, indicating a warming trend for the region as a whole. This warming is associated with an increase in the number of frost-free days in the area; Summerland has averaged an increase of 3.1 frost-free days per decade from 1907-1993.⁶⁰

Several meteorological monitoring stations in the Valley also show a trend toward increased rainfall over the last century. This reflects a larger global tendency toward higher precipitation, which is believed to be a consequence of intensification of the hydrological cycle in response to rising temperatures.⁶¹ This observed increase in precipitation should be seen in the context of population growth and sharply rising demand for water in the Okanagan Basin, a region that has the lowest per capita water supply in Canada.⁶²

CLIMATE CHANGE AND AGRIBUSINESS

The agricultural sector is directly reliant on climatic variables like precipitation and temperature, and is thus likely to experience a wide range of unavoidable impacts as the climate changes.

Rising temperatures may in future exceed the optimum growing conditions for crops. Conversely, warmer temperatures may lead to increases in crop productivity, and the opportunity to cultivate new crops. Changes in hydrological regimes will have a direct effect on agricultural production and production methods. Knock-on impacts on pests, diseases, and competing plants all mean that crops may no longer be viable in current locations under future climate conditions, and crops that remain viable may be of reduced quality.

Any reductions in crop yield and quality as a result of climate change could result in a loss of agricultural income. Unplanned spending to repair damage caused by extreme weather events and other natural hazards (e.g., forest fires) could further exacerbate financial impacts.

Proactive management of climate risks can help to ensure that the agribusiness sector is prepared to cope with, and possibly even benefit from, climate change. The agricultural management practices employed at Summerhill offer several examples of adaptation strategies, all of which strengthen the winery's capacity to adapt in the face of a changing climate.

A FOCUS ON ECOSYSTEM RESILIENCE

Summerhill's proprietors are taking conscious, deliberate steps to preserve watershed purity and build ecosystem resilience. Though their motivations centre on organic wine production rather than adapting to climate change, these actions have the side benefit of making the business (and, indeed, the region) more resilient in the face of a changing climate.

Protecting watersheds

Organic crop management makes use of natural compost and periodic fallow periods, enabling soil to regenerate without fertilizers. These efforts foster healthy plants that are better able to protect themselves from pests and disease, avoiding the need for pesticides. By eschewing the pesticides and fertilizers that are a leading source of agricultural nonpoint source pollution, the winery contributes to protection of water quality. This is particularly significant in the Okanagan Basin, where climate change and population growth are likely to put increasing pressure on water supplies in the decades ahead, outstripping any gains in precipitation. According to results from the Okanagan Water Supply and Demand Project, future shortages are likely to occur in late summer when water supplies from surface sources are low and demands for water withdrawals and ecosystem needs are high. Protection of water quality at the watershed level is particularly critical during shortages, when there is less water available to dilute pollutants.

Creating ecosystem resilience

Organic farmers tailor their planting to suit local soil and climate conditions, allowing crops to grow naturally without the use of chemical pesticides and fertilizers. This approach encourages a variety of plants in a single location and promotes biodiversity. For example, Summerhill is experimenting with ecological diversity by interplanting herbs and propagating mushrooms between grapevines. The winery uses established grape row spacing for its experiments in vineyard companion cropping; these native plants should benefit each other and be less susceptible to blight.

Organic agriculture systems have a strong potential for building resilient food systems in the face of uncertainties. Biodiversity increases resilience to changing environmental conditions and stresses. Genetically-diverse populations and species-rich ecosystems have greater potential to adapt to climate change than monocultures.⁶³

By eschewing synthetic fertilizers, organic agricultural systems are forced to adapt to local environmental conditions. Species and varieties are chosen for their adaptability to the local soil and climate and their ability to attract beneficial insects and animals for pest management. Additionally, growing companion crops enhances the soil food web^m to sustain the agro-ecosystem's resilience to external shocks such as extreme weather events (e.g., forest fires or droughts), which are likely to increase as the climate changes.⁶⁴

By protecting watersheds and building ecosystem resilience, Summerhill has improved the winery's capacity to adapt to a changing climate.

HANDLING UNCERTAINTY

By promoting diversity and building resilience, Summerhill is implementing effective strategies to cope with change characterized by surprises and unknowable risks. By building resilience in the agro-environmental system, the winery is learning to live with change and uncertainty, as well as increasing options for reducing risks in future.

BENEFITS AND/OR CHALLENGES

Summerhill produces organic wine because of a sincerely held belief that it results in a better product than that which is conventionally produced. However, organic production offers a number of distinct side-benefits to the company. First, buying "organic" makes the consumer's selection meaningful and simple – a critical benefit in the wine market where product choice is vast and often confusing. Because organic cultivation means association with standards organizations, it offers the tangible benefit of promotion and routes to market by the registered bodies. Finally, there is a significant and growing market of people who share the values of organic producers, particularly health- and environment-conscious consumers. Summerhill is well-placed to take advantage of these market opportunities.

The company maintains that there are no disadvantages to protecting watersheds and encouraging robust ecosystems. Though Summerhill will bear initial costs for design, education, labour and inputs to adaptation measures, these will provide financial and ecological self-sufficiency with minimal waste in the long-term.

^m "Soil food web" refers to the complex system of organisms that live in the soil, and how this system interacts with the environment, plants, and other animals.

NEXT STEPS

As well as its own vineyard holdings, Summerhill has established long term relationships with a dozen small scale family farms, all of them growing organically. The winery is developing training and networking programs to share experience, best practices, and lessons learned on organic wine production. By increasing the range of knowledge on sustainability, and by strengthening local institutions and networks, the proprietors hope to foster local action to protect watersheds and encourage robust ecosystems, further increasing the region's capacity to adapt to a changing climate.

PERSPECTIVES ON GOVERNMENT ROLES

Summerhill works closely with various stakeholders to protect watersheds and develop the hardiness of surrounding ecosystems. For example, the winery collaborates with the Okanagan Basin Water Board, which aims to facilitate climate change adaptation through improving water efficiency, and developing water policies for sharing during times of shortages. The Water Board has taken a very proactive approach to studying the potential impact of climate change on both water supply and demand for water in the region, evaluating these risks within the context of other important local changes in population, land-use, socio-economic conditions, and technological change. The Water Board consults extensively with customers and has enjoyed a lot of support from the business community, which sees water conservation as part of sensible contingency planning and good management in general. The Okanagan Basin Water Board's approach highlights the important role that water boards may play in encouraging adaptation in the community.

The winery has also worked with the En'owkin Centre, an indigenous cultural, educational, ecological and creative arts organization. The Centre has shared many insights into using native wild plants and recognizing invasive species. Finally, efforts to save seeds from open pollinated plants and propagate perennial plant guilds along the shelves and floodplains of the winery's natural watershed and property edges at Summerhill have benefited greatly from the Canada Revenue Agency's Scientific Research and Experimental Development (SR&ED) tax incentive program. SRED covers 65% of overhead and more than 40% of materials for this research.



MUNICH RE

MUNICH, GERMANY

“Climate change affects the fundamentals of doing business,
both yours and ours.”

- Prof. Dr. Peter Hoeppe, Head of Munich Re's Geo Risks Research/Corporate Climate Centre.
Munich Re (2009) Climate Change, Climate Risk, Climate Chance.



INDUSTRY FINANCE & INSURANCE

EMPLOYEES (2010)
47,000

REVENUE (2010)
**C\$63.5
BILLION**

KEY ADAPTATION DRIVERS

Risk management and insurance pricing models

Responsibility to help vulnerable populations and countries adapt

ADAPTATION TO CLIMATE CHANGE

Adoption of corporate adaptation strategy and establishment of a Climate Centre

Data collection and research

Development of new insurance products

BUSINESS BENEFITS

Improved risk management

New business opportunities identified

BUSINESS CHALLENGES

Short-termism in insurance pricing and absence of regulation

Lack of normalised data on weather-related loss

COMPANY OVERVIEW

Munich Re is a leading global reinsurance group. In 2010, it underwrote the equivalent of C\$62 billion in annual premiums. The group's services range from traditional primary and reinsurance, comprehensive services and consulting, to complex risk solutions, covering the entire value chain of the global insurance industry in life and non-life business.

Munich Re's primary insurance operations are mainly concentrated in the ERGO Insurance Group. Furthermore the company offers healthcare solutions under the brand Munich Health. The group's worldwide assets are managed by MEAG (Munich Ergo Asset Management). Munich Re operates extensively in Canada, offering reinsurance cover to Canadian primary insurers as well as to industrial clients.

INSURANCE IN A CHANGING CLIMATE

Re-insurers and insurers are directly affected by climate change since they pay the bill for insured losses caused by weather-related perils (e.g. floods, storms, wildfires). As part of Munich Re's core business, they have developed detailed knowledge of the risks associated with climate change.

Munich Re's Geo Risks Research unit reports a rising trend in weather-related losses, partly due to climate change: insured losses due to weather catastrophes increased significantly worldwide between 1980 and 2010 (Figure 5). This trend cannot be explained solely by economic growth and increased population density in areas exposed to extreme weather. The number of storms, water-related perils (including floods) and extreme weather events like heat waves, droughts and wildfires has increased considerably in recent years (Figure 6).

FIGURE 5

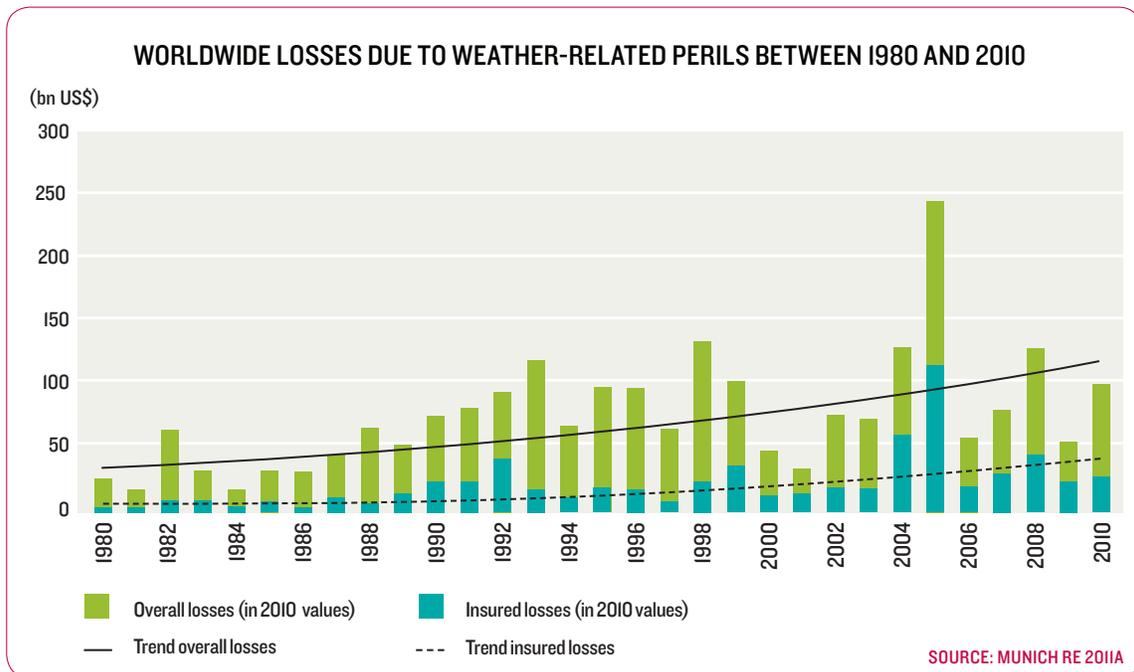
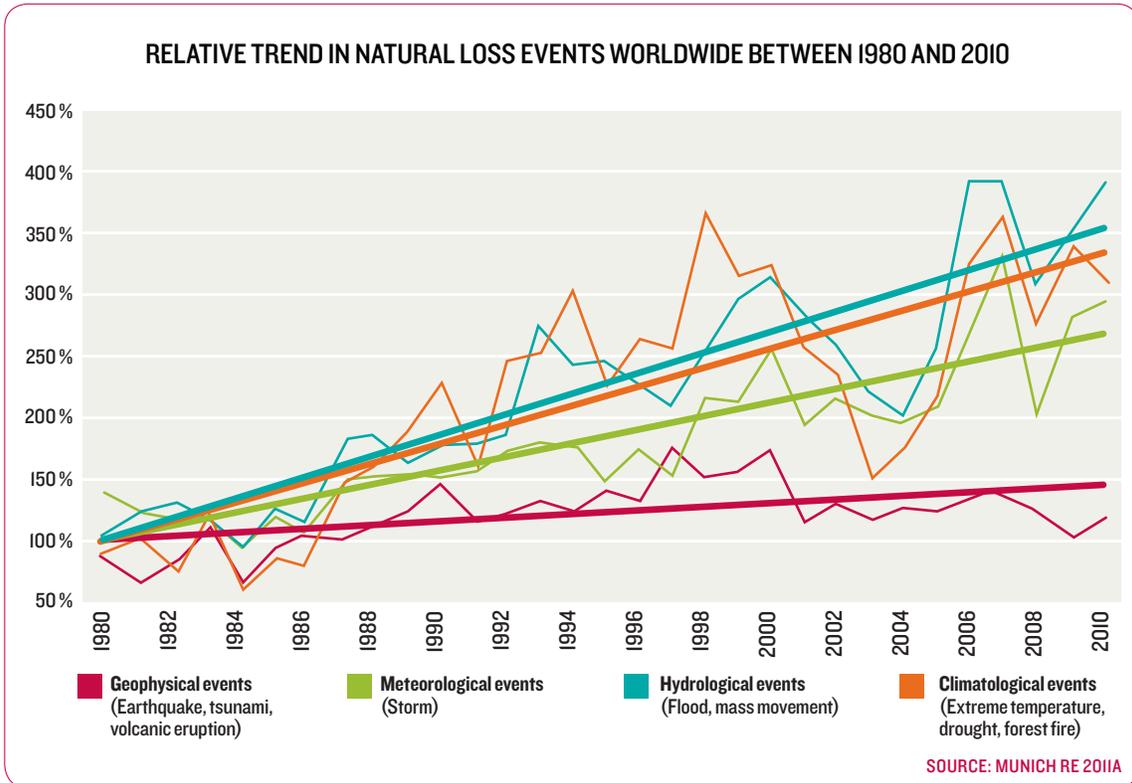


FIGURE 6



Though it is not possible to attribute any single weather event to climate change, research has shown that climate change has already increased the likelihood of some extreme events, such as heat waves and heavy downpours.⁶⁵

More extreme weather is costly for re-insurers. Hurricane Katrina in 2005 was the single most expensive weather catastrophe in history.⁶⁶ In the first nine months of 2011 storm damages in the United States totalled US\$32.6 billion in insured losses. This was compounded by the cost of a record drought in southern states and flooding on the Mississippi River.

Munich Re has identified the U.S. and Europe as “hotspots”, as these are regions where high market penetration of insurance products coincides with high exposure to climate risk. The company does not consider Canada to be among the countries most vulnerable to climate change, as most of its population is located in moderate climate zones, and warming could represent an opportunity rather than a risk for some activities in the country. However, the Canadian insurance sector is somewhat exposed to a number of risks, namely more frequent and more intense precipitation events, increased storminess, higher flood risk, more heat waves and accelerated degradation of permafrost. Northern Canada is particularly vulnerable to climate change because of the presence of permafrost, and because this region is projected to warm faster than the rest of Canada. Finally, as asset managers, Canadian insurance companies will be affected by the financial repercussions of overseas climate change impacts.

ACTIONS TO BUILD CLIMATE CHANGE RESILIENCE

Munich Re recognizes that a changing climate will affect its core business by increasing weather-related loss claims. Furthermore, the reinsurer believes that the insurance industry as a whole should support vulnerable populations and countries adapt to the consequences of climate change. Munich Re has helped to embed climate change-related activities within the company's operations by assigning responsibility for climate risk management at the Board of Management level. Through the creation of the Corporate Climate Centre, the reinsurer collects information on climate change, initiates projects, monitors progress on the company's climate change strategy and identifies new business opportunities. Munich Re also advocates taking a long view in setting insurance premiums.

CORPORATE CLIMATE ADAPTATION STRATEGY

In 2007, Munich Re adopted a corporate climate change strategy founded on the following three pillars:

// RISK ASSESSMENT Munich Re has committed to investment in research on climate change impacts and climate risk management measures. The reinsurer also takes into account observed and projected changes in the frequency and intensity of extreme weather events when underwriting certain risks. For example, Munich Re's new risk models for hurricanes in the U.S. now include the potential for increased sea-surface temperature due to changing climate conditions.

// BUSINESS OPPORTUNITIES Munich Re wants to respond to the growing demand for climate change risk transfer solutions with new insurance products. For example, it now offers insurance cover to photovoltaic electricity producers, which covers loss of revenue in the event of lower solar radiation levels.

// ASSET MANAGEMENT Munich Re has more than C\$270 billion of assets under management. The third pillar in its climate change strategy describes the company's efforts to consider climate change risks as part of investment decision-making.

Munich Re has had concerns about the financial implications of climate change for many years – the first reference to climate change impacts in Munich Re's publications can be traced to the early 1970s. In an effort to document economic losses due to natural perils, the reinsurer maintains a comprehensive database called NatCatSERVICE. The database currently contains around 29,000 records, most of which pertain to extreme weather-related events. NatCatSERVICE was originally developed to help the company calculate insurance premiums. Today, Munich Re recognizes the importance of raising awareness of changing climate risks among the financial industry, and the company uses NatCatSERVICE to communicate with clients and their own risk models. The company also shares NatCatSERVICE with governments and universities for research purposes.

Through its Munich Climate Insurance Initiative (MCII), Munich Re is involved in the United Nations Framework Convention on Climate Change (UNFCCC) process. Since 2005, the MCII has successfully petitioned for insurance to be included as a key climate change response in official UNFCCC negotiations.

Munich Re is also aiming to achieve carbon neutrality. It is hoped that the reinsurance group will be carbon neutral by 2012 and the whole Group by 2015.

BENEFITS AND/OR CHALLENGES

Thanks to its work on climate change impacts, Munich Re has confidence in its understanding of the business risks of a changing climate. Furthermore, through the process of assessing and managing climate risk, the company has identified business opportunities.

Munich Re is well aware of the challenges that re-insurers and insurers face in integrating climate risk management into their operations. Firstly, the industry has the advantage of reviewing premiums on a yearly basis so that insurance premiums always tend to reflect current loss risk. As a result, there is little incentive for underwriters to use long-term climate change projections. However, Munich Re pursues a more long-term approach to underwriting. By integrating information on recent climatic trends and future projections, insurers can help to avoid client discontent associated with abrupt premium increases.

Secondly, a number of factors influence weather-related losses (natural climate variability, increase in wealth, extent of insurance market penetration, siting decisions, etc.) and it is difficult to identify with confidence the ‘climate change signal’. Munich Re is working toward normalizing natural catastrophe data, which will help to identify the financial effect of increased temperatures and other climatic changes.

PERSPECTIVES ON GOVERNMENT ROLES

Munich Re feels that the government has an important role to play in facilitating climate change adaptation by business. Government can raise awareness on climate change and the need to adapt. In countries like the U.S., the U.K. and Germany, dedicated groups are currently funded by government to develop freely available, high quality climate change data and risk management methods, tools, and guidance.ⁿ

Government can also support the development of insurance schemes to cover vulnerable groups against weather-related risks. Munich Re is part of a strategic alliance with a German governmental organization (GIZ) that offers insurance services to protect cooperatives in the Philippines against weather-related perils.

Finally, legislation or regulation is needed to make climate risk management compulsory for certain businesses or industries. For example, in 2009 the U.S. National Association of Insurance Commissioners adopted a climate change risk disclosure standard for insurers, which was made compulsory in certain states.

ⁿ The National and Regional Climatic Data Centers (U.S.), the U.K. Climate Impacts Programme (U.K.) and the Climate Service Center (Germany), respectively.

BChydro 

FOR GENERATIONS

BC HYDRO

VANCOUVER, BRITISH COLUMBIA

“Understanding the potential effects of climate change upon our business operations and embedding it into our planning and decision-making is parallel to pursuing efforts now to minimize our direct impacts.”

- Brenda Goehring, Corporate Environment & Sustainability Manager, BC Hydro



**INDUSTRY
UTILITIES**

**EMPLOYEES (2011)
5,800**

**REVENUE (2011)
C\$4.02
BILLION**

**KEY ADAPTATION
DRIVERS**

Regulatory requirement as a crown corporation
Logical progression after addressing climate change mitigation

**ADAPTATION
TO CLIMATE CHANGE**

Modification of maintenance and design standards for new and existing transmission lines

BUSINESS BENEFITS

Data and models of climate change available for other industries and companies in BC
Improved internal and external communication on climate change

**BUSINESS
CHALLENGES**

Difficulty of making business decisions using uncertain future climate projections

COMPANY OVERVIEW

BC Hydro is one of Canada's largest electricity utilities. In 2010, the *Clean Energy Act* consolidated BC Hydro and BC Transmission Corporation into one single entity. As a crown corporation, BC Hydro reports to the B.C. Ministry of Energy and Mines.

BC Hydro generates between 43,000 and 54,000 GWh a year, depending on prevailing hydrological conditions. Most of the utility's installed capacity comes from hydropower facilities on the Peace and Columbia rivers. These river basins contributed 30% and 25%, respectively, of the company's total power production in 2010. Facilities on other river basins contributed 25% of the company's 2010 electricity output, and the remainder came from conventional thermoelectric plants and electricity purchases.

BC Hydro manages the planning, operation and maintenance of an 18,500km transmission system that connects electricity generation sites in the interior regions of B.C. with the major load centres in the southwest of the province. The company services 1.8 million customers, and projects that electricity needs in the province will grow by 20-40% over the next 20 years.^o

In response to the projected electricity supply gap, BC Hydro develops an Integrated Resource Plan that outlines the company's strategy to meet future demand, including demand-side management, enhancement of existing assets, development of new assets, purchases of new clean power and improved transmission and distribution capacity. The utility has plans to invest more than \$460 million toward its Strategic Asset Management Plan objectives in 2011 alone.

^o This load forecast is based on socio-economic factors and rolling 10-year average Heating and Cooling Degree Days.

HYDROELECTRICITY IN A CHANGING CLIMATE

Though climate change has been strongly recognized as an issue within the energy sector, the industry has mainly focused on the responsibility for greenhouse gas (GHG) mitigation rather than on adaptation of energy supply and services. Because they are low emitters of GHGs and are highly dependent on climate-sensitive water resources, hydroelectricity providers have been much quicker to consider the potential impacts of climate change on service provision. Changes in average temperature and precipitation, and increasing climatic variability, are likely to have impacts across the breadth of the hydroelectricity supply chain.

Direct impacts on energy supply and demand are the most obvious: more rapid melting and changes in hydrological runoff patterns will alter generating capacities, and higher seasonal temperatures will likely reduce energy demand for heating in winter while increasing demand for cooling in summer.⁶⁷

Climate change could also impose a new set of conditions on the design, operation, and maintenance of existing and planned assets and infrastructure. Changes to river flow patterns into reservoirs may make hydroelectric generation planning more difficult to manage, with more frequent potential for flooding and longer summer low-flow periods. Transmission and distribution lines exposed to wind gusts, forest fires, storms, icing, erosion, and storm-related landslides and rock falls, are also potentially more at risk in a changing climate.⁶⁸

Finally, the complex relationships between the energy sector and other economic sectors (e.g. agriculture, tourism, water) can result in knock-on climate change impacts for hydroelectricity providers. For example, balancing water available for energy generation with demand from other sectors will be increasingly challenging, as rising demand due to population growth may require more water in areas projected to face reduced availability.

ADAPTATION AS PART OF A COMPREHENSIVE CLIMATE CHANGE MANAGEMENT STRATEGY

As a crown corporation, BC Hydro is guided by federal and provincial government regulation concerning climate change, though this has generally focused on energy efficiency and emissions reductions objectives. The company has independently undertaken steps to improve climate resilience as part of a robust risk management approach and as the logical next step after implementing GHG mitigation measures.

As part of the International Council on Large Electric Systems (CIGRE), BC Hydro learns from and shares best practice with peer utilities. The company has been particularly influenced by Hydro-Québec's collaboration with partner organization Ouranos to monitor climate change data and develop a climate change adaptation strategy.

BC Hydro developed a comprehensive Climate Change Strategy in 2009. While the first part of the Strategy mainly relates to reduction of GHG emissions from sources of electricity generation and corporate operations, the last part focuses on consideration of adaptation in corporate and project risk management processes. The Strategy includes adaptation actions ranging from collaborative research on impacts and corporate climate risk assessments, to practical changes that help to manage climate risks operationally.

BC Hydro collaborates with the Pacific Climate Impacts Consortium (PCIC) and the Western Canadian Cryospheric Network (WC2N) to study climate change impacts on the hydrology of B.C.⁶⁹ Since 2007, the company has invested almost \$2.5 million in research on the historical and projected runoff of B.C.'s watersheds, with the goal of understanding changes to the hydrological regime in which B.C. Hydro will operate in the future. The PCIC has produced an overview study of historical climate trends in B.C., as well as river-specific hydrological impacts of climate change on provincial water resources.⁷⁰ This research program focuses on future risks to hydroelectric generation capacity due to climate change, but the company is actively assessing and managing other potential risks.

For example, BC Hydro has also conducted climate risk assessments to identify climate change impacts on assets and infrastructure. During the assessment phase, the company identified all likely climate change impacts on its distribution and transmission grid, and estimated the potential increase in outages and financial consequences if no action were taken. Drawing on climate model projections from freely accessible sources such as the Intergovernmental Panel on Climate Change (IPCC), BC Hydro used a downscaling method to produce regional climate scenarios that help the company optimize transmission and distribution operations. This method helps to determine the best allocation for existing assets, and decide whether new resources are needed under a range of future climate scenarios.

BC Hydro has also taken steps to protect its transmission lines. The company makes use of research carried out by the University of Alberta and the University of British Columbia to gather data on potential changes in future wind speed and direction, icing loads and precipitation to assess impacts on transmission lines. BC Hydro has modified maintenance regimes and line design standards to increase their resilience to wind and ice loads, exceeding the current Canadian standard requirement.⁷¹ BC Hydro's research and development department is exploring the potential for new corrosion-resistant materials that would extend the lifetime of new transmission lines in a future climate.

Finally, BC Hydro supported the work of the Future Forest Ecosystems Scientific Council led by the UBC Dean of Forestry, through a focused three-year study to assess climate change impacts on forest and other land cover, and the economic, environmental and social resilience of regional planning, public interest, and First Nations and Métis communities in the South Selkirk area of B.C.

BENEFITS AND/OR CHALLENGES

The biggest challenge faced by BC Hydro in its efforts to adapt is the difficulty of implementing operational change on the basis of uncertain climate model projections. Some key climate variables for this sector, such as local wind direction and intensity, remain very difficult to predict using climate models, and this constrains the company's ability to take account of changes in wind in the design and development of new transmission lines. However, the company is learning to deal with the uncertainty associated with climate projections. By gaining a thorough understanding of the limitations of climate models, BC Hydro can assess how the currently available climate and hydrological scenarios can be applied in the existing planning process, with some measure of the uncertainty associated with the projections.

The main benefits of the company's work on adaptation include a significant improvement in communication on climate change and knowledge of potential impacts to the business. Externally, the company has engaged more actively with its customers and stakeholders on climate change issues, and believes that it serves them better as a result. The 2011 Power Smart Forum held with more than 1,500 key customers of BC Hydro had "Climate Adaptation and Resiliency" as its theme, with the objectives to build upon knowledge transfer and research to support customer, government and industry efforts to leverage shared understanding and action on this emerging business issue. Internally, the Climate Change Strategy empowers employees and allows business units to appraise and assess changing needs and risks.

NEXT STEPS

By December 2012 BC Hydro intends to present an Integrated Resource Plan to the Ministry of Energy, which will demonstrate how the utility expects to meet the projected increase in demand for electricity.⁷² The plan will include an in-depth look at mitigation measures, but adaptation is increasingly being emphasised in the Plan's implementation phase.

PERSPECTIVES ON GOVERNMENT ROLES

BC Hydro emphasizes the critical role of government in supporting adaptation research and developing practical tools and guidance for business. The B.C. provincial government is a founding member of the Pacific Climate Impact Consortium (PCIC), along with BC Hydro, and in 2008 it provided significant sustaining funding to PCIC through an endowment to the University of Victoria. The Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) funding program supported much of the work done by WC2N (in collaboration with BC Hydro) on glacier studies in BC.

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CLIMATE PROSPERITY

THE TIMELINE

2010

2012



REPORT 01 //
**MEASURING UP:
 BENCHMARKING CANADA'S
 COMPETITIVENESS IN A
 LOW-CARBON WORLD**

This report will assess Canada's capacity to be competitive in a new global low-carbon economy, by comparing us to other G8 nations in areas such as emissions and energy, skills, investment, innovation and governance.



REPORT 02 //
**DEGREES OF CHANGE:
 CLIMATE WARMING AND
 THE STAKES FOR CANADA**

This report will communicate the risks and benefits that a warming climate poses to Canada over the next one-hundred years in areas such as ecosystems, water resources, health, infrastructure and natural resource sectors and how adaptation can help.



REPORT 03 //
**PARALLEL PATHS:
 CANADA-U.S. CLIMATE
 POLICY CHOICES**

This report will examine Canadian climate policy choices based on potential U.S. courses of action and what this means for achieving Canadian environmental goals at the least economic cost.



REPORT 04 //
**PAYING THE PRICE:
 THE ECONOMIC IMPACTS
 OF CLIMATE CHANGE
 FOR CANADA**

This report will provide, for the first time, national economic costings of the impact of climate change on Canada, together with a detailed look at three key sectors.



REPORT 05 //
**FACING THE ELEMENTS:
 BUILDING BUSINESS
 RESILIENCE IN A
 CHANGING CLIMATE**

**/ CASE STUDIES
 // BUSINESS PRIMER
 /// ADVISORY REPORT**
 These three reports set out what Canadian businesses can and should do to prepare and take action to manage the risks and opportunities of a changing climate, and how governments can help.



REPORT 06 //
**POLICY PATHWAY
 REPORT FOR GLOBAL
 LOW-CARBON
 TRANSITION**

Building on previous reports in the series, this advisory report will provide policy pathways and actions necessary for Canada to thrive in a global low-carbon economy in areas such as energy, innovation, skills, investment and governance.



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