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Climate Change Adaptation: A Canadian Electricity Sector Perspective

November 11, 2016

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Hurricane Sandy – October 2012

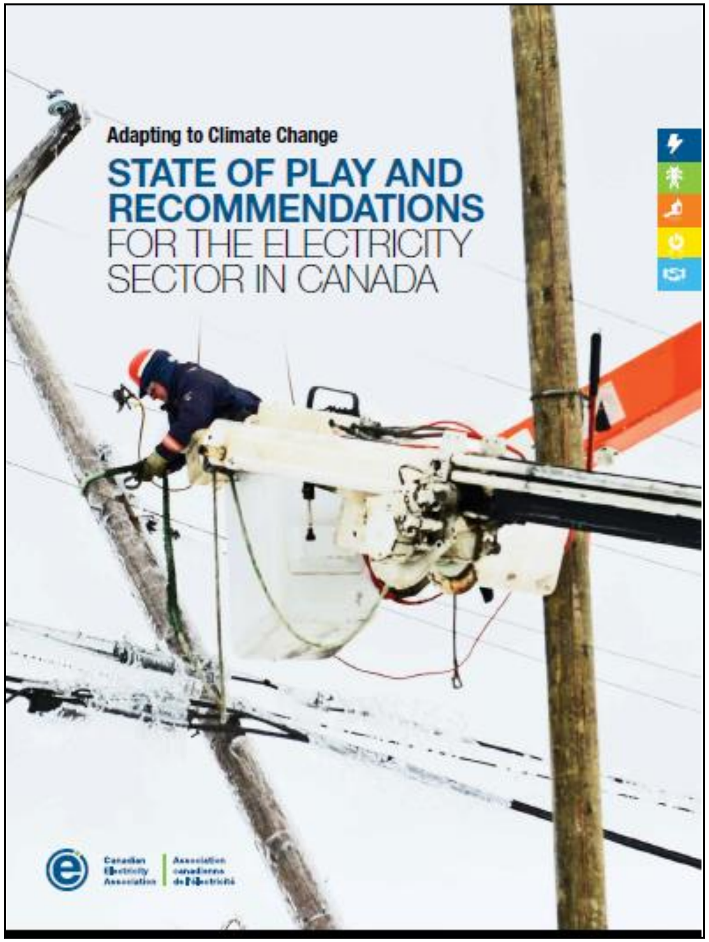
Hurricane Sandy

- The Stats
  - 28 States affected + 3 Provinces
  - $68 billion in damage
  - 72 direct deaths; 87 indirect deaths
  - Over 8.5 million customer outages at the peak
  - Over 200,000 outages in Canada

The Canadian Response

- Over 700 Canadian utility workers from 32 utilities crossed the border
- Crews stayed in the US for up to 25 days
- Spurred Canadian activity in two areas:
  1. Improving mutual assistance
  2. Better understanding climate risk

CEA Climate Adaptation Report



The report aims to demonstrate the value of climate change adaptation for the electricity sector and supporting stakeholders:

- **Chapter 1** – Introduction
- **Chapter 2** – Climate Science and Canada's Future
- **Chapter 3** – Climate Risks and Opportunities for the Electricity Sector
- **Chapter 4** – Sector Perspectives and Practices on Adaptation
- **Chapter 5** – Recommendations

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Urban flooding: Calgary

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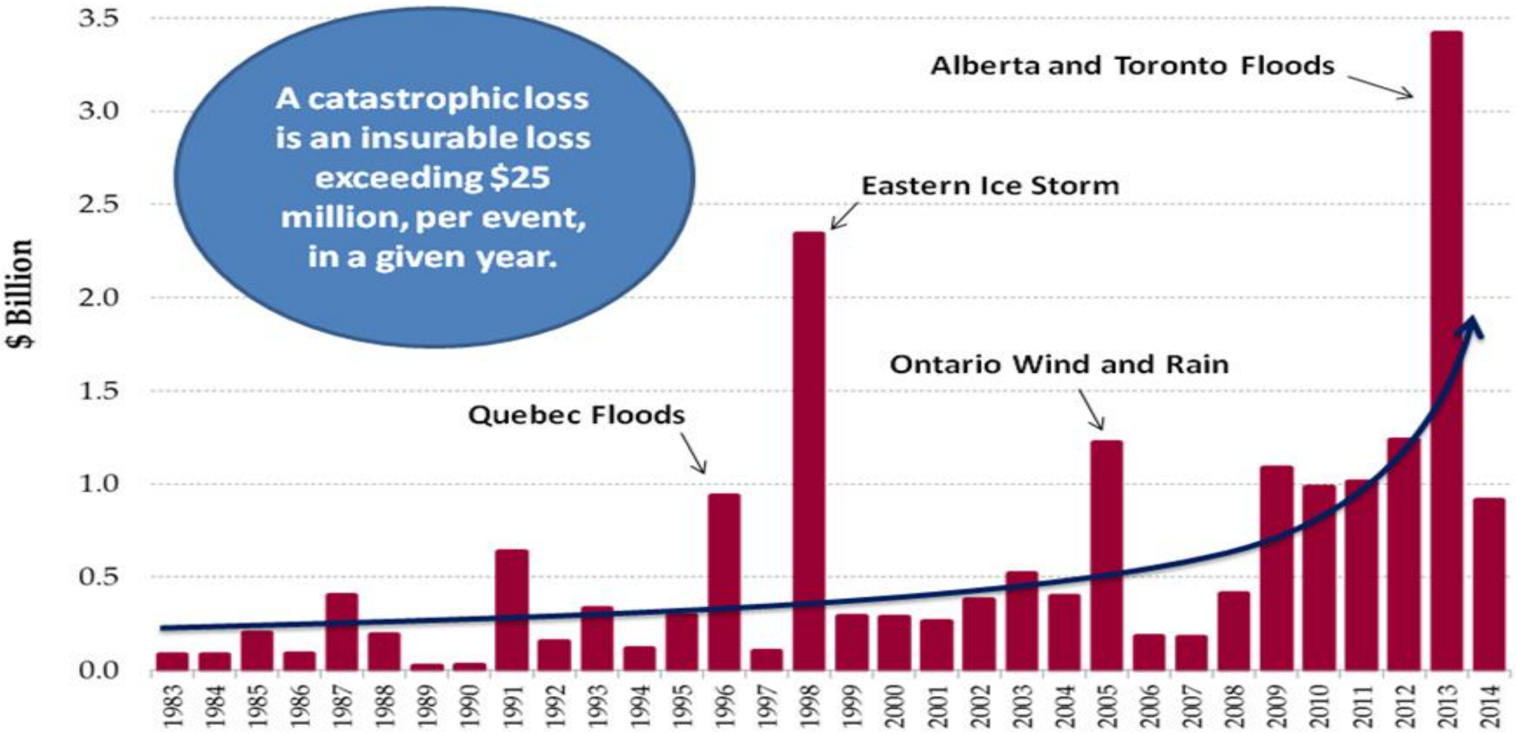
Rural flooding: Prairies

High winds: Maritimes

Ice storm: Toronto

Ice storm: New Brunswick

Annual Catastrophic Insurable Loss Claims for Canada, 1983 – 2014



Insurance Bureau of Canada, March 2015

CEA Adaptation Management Plan Template

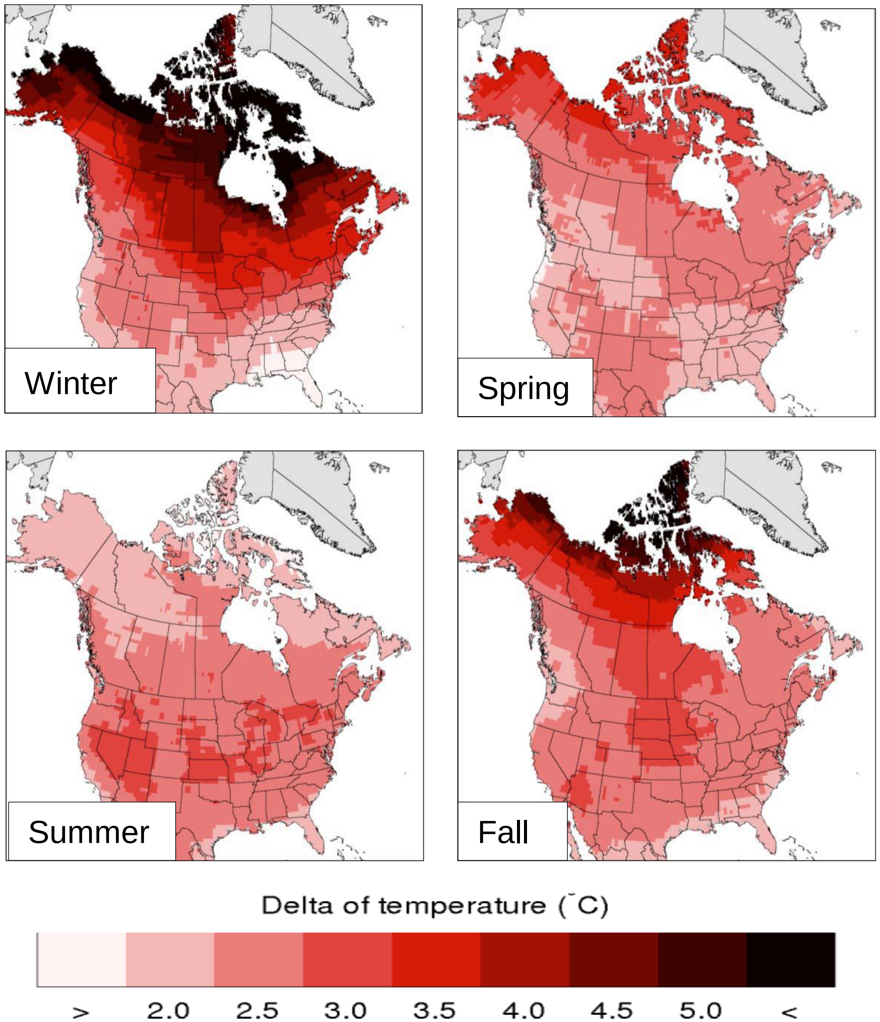
- Supports the creation of effective climate change adaptation management plans, and aims to ensure a consistent approach across the electricity sector.

- Outlines a strategic risk-based framework that can be readily incorporated into existing enterprise risk management (ERM) processes.

- In the absence of ERM processes, it supports the creation of an adaptation management process.

Gather Good Data

- Good national seasonal projections re: average temperatures, average precipitation, average runoff.
  - Useful for resource availability and energy demand projections.
- Short term reliability impacts require a different data set:
  - Max temperatures; duration of heat waves; scope of precipitation extremes; max wind speeds; ice loading



Understand Major Climate Risks

- Electricity demand
  - Summer increase / winter decrease
  - Sharper peaks during heat waves
- Electricity supply
  - Hydro: Potential changes in hydro availability as a result of changes in precipitation, temperature and runoff.
  - Transmission: Reduced transmission efficiency at higher temperatures.
  - Thermal generation: Reduced output from thermal power & reduced cooling water
  - Wind: Changes in wind patterns (turbulence, velocity).
- Infrastructure
  - Damage to overhead equipment from ice loading, high winds, tree contacts
  - Flooding of underground equipment
  - Changing soil conditions for transmission towers (e.g. permafrost/ice melt)

Understand Company Specific Risks

- Hydro-Québec has studied the climate change impacts on the Peribonka River system. By 2050:
  - Spring flood 2 to 5 weeks earlier
  - Peak flow highly variable
  - Decrease in average summer flows
  - Increase in average winter flows
- Overall, climate change could result in a hydropower output reduction of about 14%, whereas proactive adaptation could increase hydroelectric production by about 15%.

NSW Controle Inc, 2014

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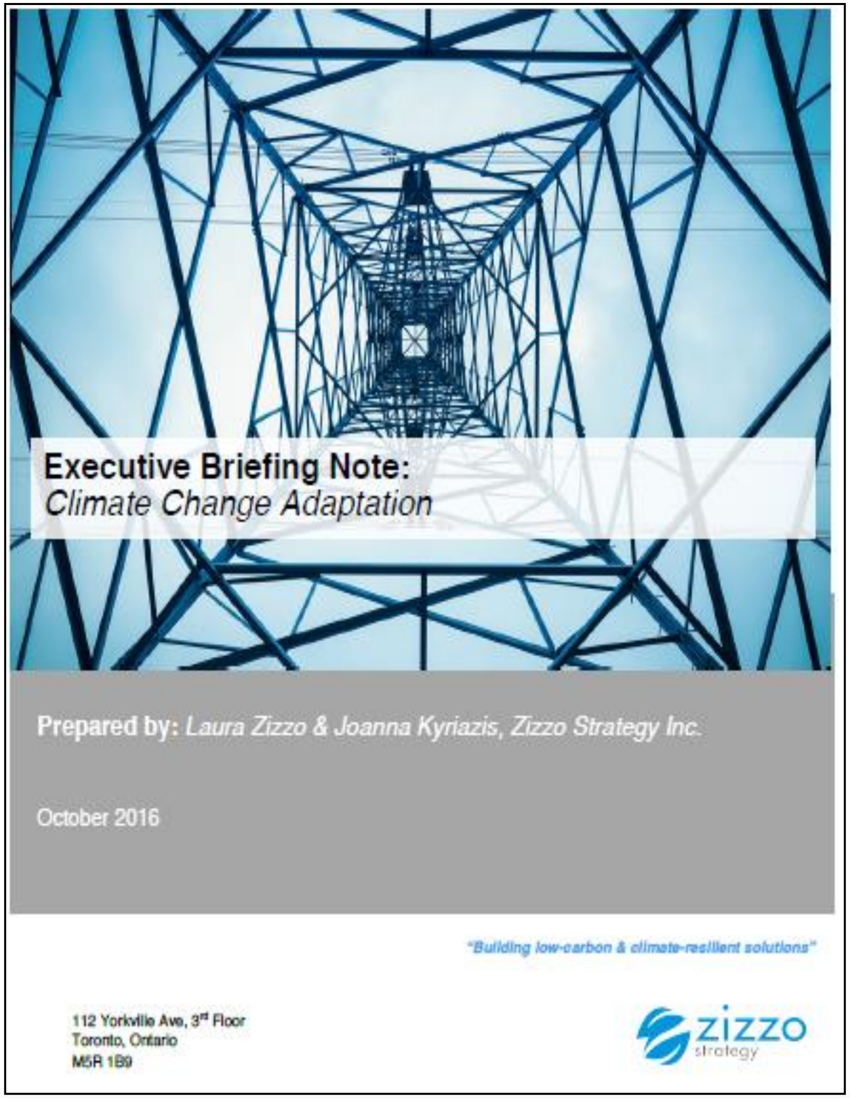
Engage CEOs

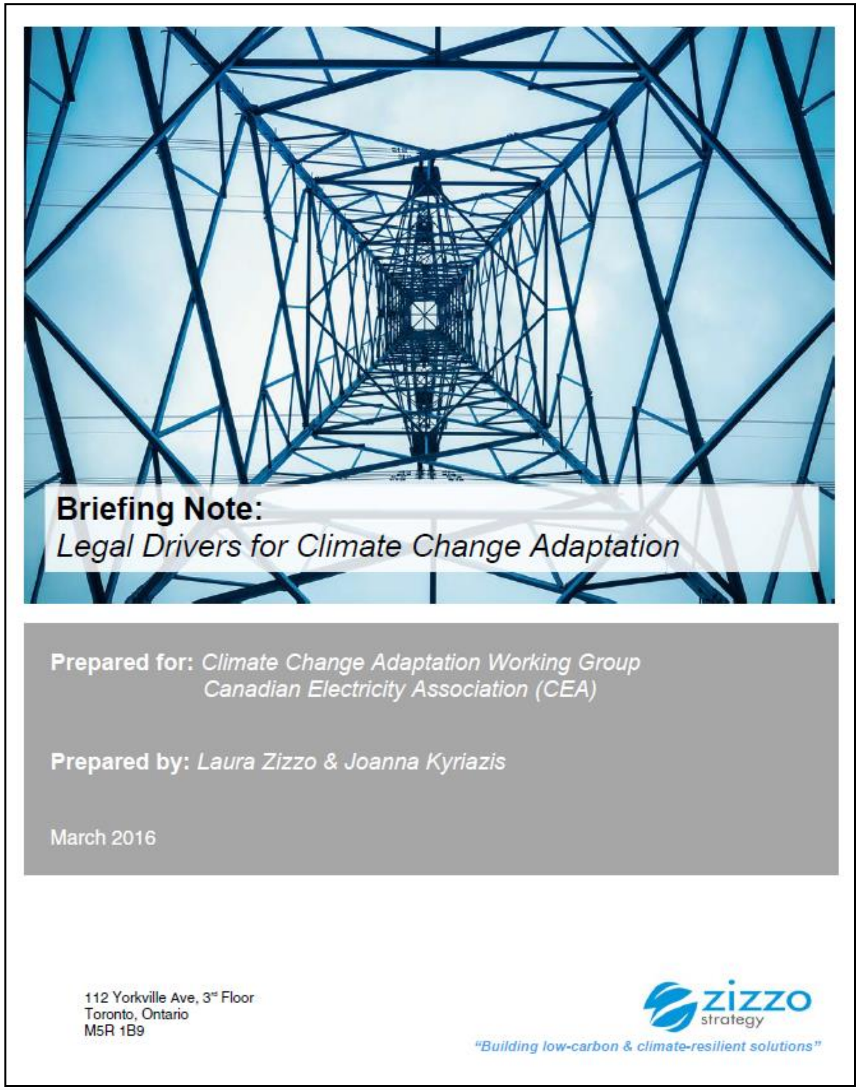
- Electricity generation, transmission and distribution sectors are, however, some of the most at risk in Canada of being disrupted by climatic variation.

- Four main categories of risks and opportunities:
    1. Physical risks and costs of inaction
    2. Regulatory and legal risks
    3. Changing investor perspectives and preferences
    4. Clean technology trends and market opportunities



Legal Risk Analysis

- As climate hazards become more common, it is conceivable that electrical utilities will be expected to act diligently and exercise reasonable care in preparing for, and responding to hazards, to ensure that their statutory duties are met.
- Rate cases are likely to consider climate change impacts over the coming years.
- Investors are increasingly demanding disclosure on companies' exposure to climate risks, to support more informed investment decisions.



Briefing Note:
Legal Drivers for Climate Change Adaptation

Prepared for: *Climate Change Adaptation Working Group*
Canadian Electricity Association (CEA)

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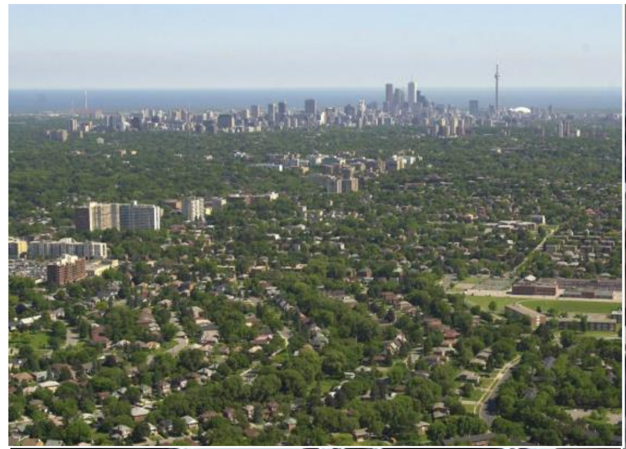
zizzo strategy
"Building low-carbon & climate-resilient solutions"

Source: *Understanding Canadian Electricity Generation and Transmission Sectors' Action and Awareness on Climate Change and the Need to Adapt*, ZizzoAllan, 2014.

Develop and Share Solutions

- Tree trimming standards
- Overhead infrastructure relocation
- Rear lot conversions
- Stainless steel submersible transformers
- Breakaway conductors



Integrate Best Practices into Design Standards

Table 30
Deterministic weather loads*†
(See Clauses 7.2, 7.3.1, 7.3.5, 7.5.1, 7.6.2.1, and A.7.3.)

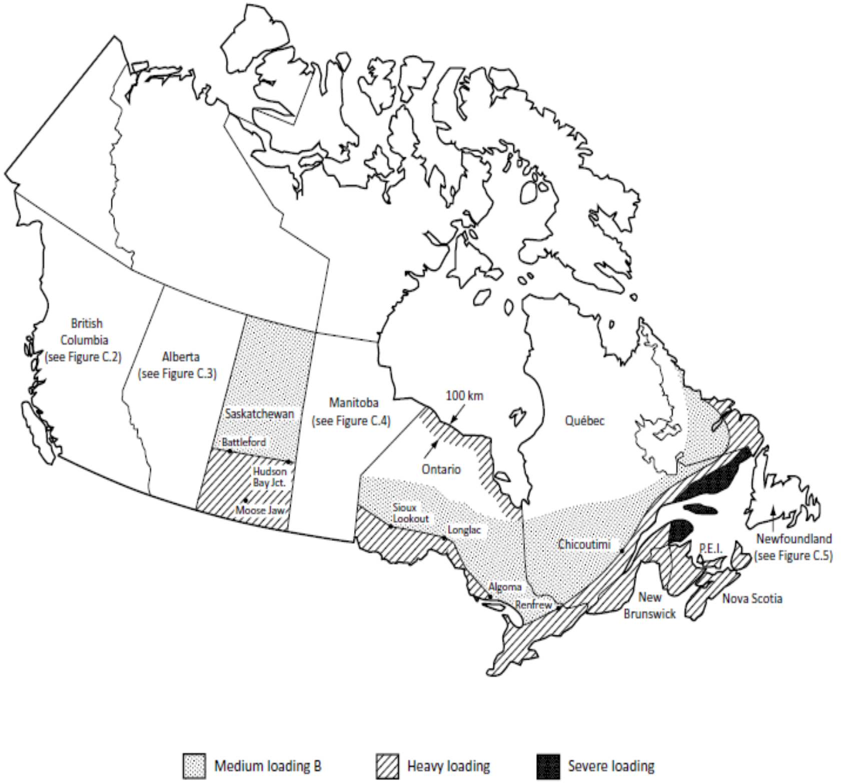
Loading conditions	Loading area‡			
			Medium	
	Severe	Heavy	A	B
Radial thickness of ice, mm	19	12.5	6.5	12.5
Horizontal wind loading, N/m²	400	400	400	300
Temperature	–20 °C	–20 °C	–20 °C	–20 °C

** When large conductors are used in locations where high winds are prevalent, the loading on bare conductors should be assessed, as high winds can produce a transverse loading in excess of the wind and ice combinations.*
† On small conductors, the ice effect is more significant than on large conductors, as it constitutes a greater percentage of the total mass.
‡ See Clause 7.2 and Annex C.

Overhead System Design Standard – C22.3

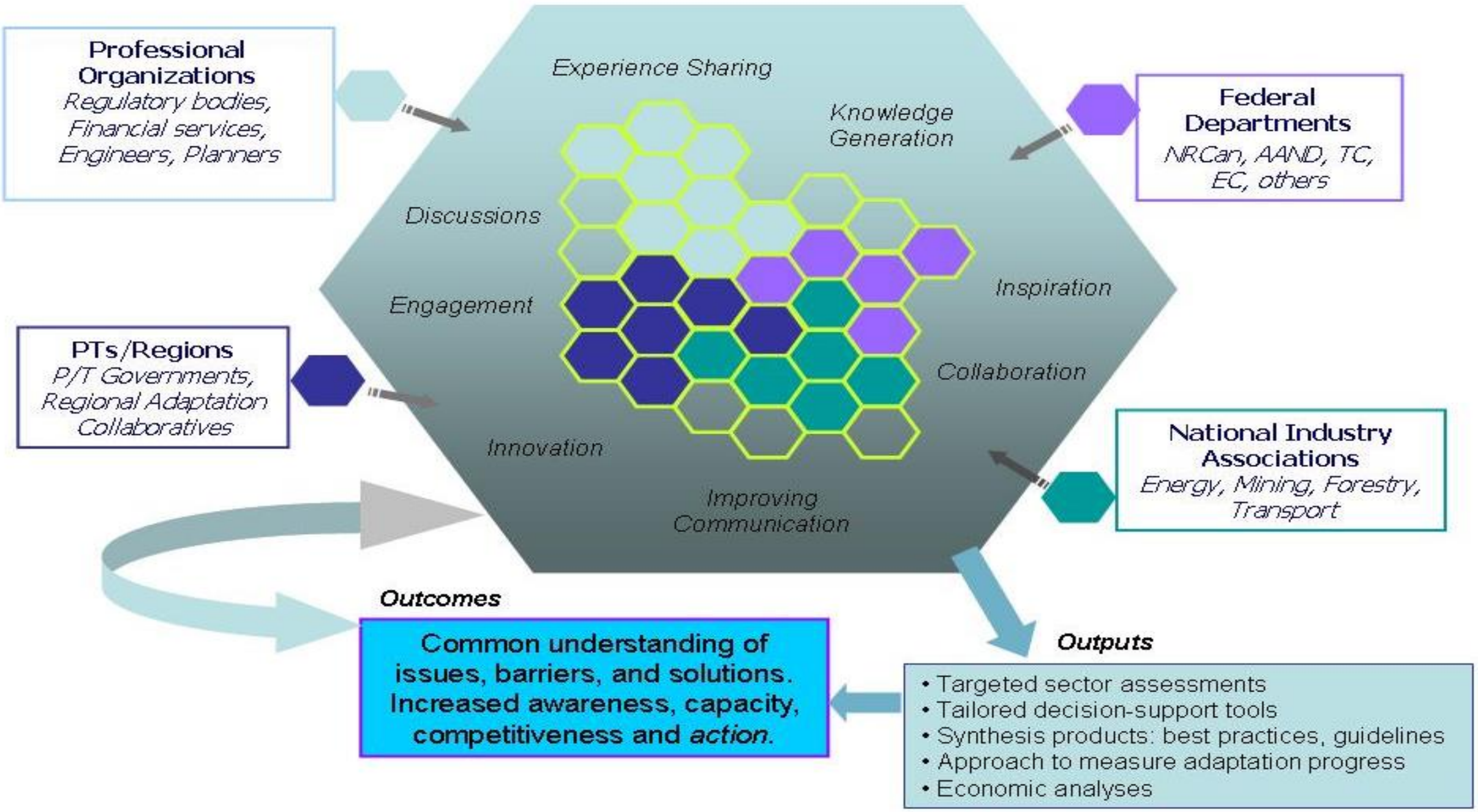
- The loading maps in Annex C are based on Environment Canada data and the experience of utilities across Canada. Designers are cautioned that these maps should be treated only as a guide and that local areas can have higher icing and/or wind forces.
- Designers unfamiliar with local weather conditions should acquaint themselves with the terrain and obtain local information from weather records and regional meteorologists. Where weather data are unavailable, local residents can be consulted.

Figure C.1
Loading map of Canada
(See Clause 7.2 and Table 30.)



Work with Partners

Natural Resources Canada Adaptation Platform



NRCan, 2015

Source: http://www.nrcan.gc.ca/environment/impacts-adaptation/adaptation-platform/10027#what

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