The following slide deck contains data and information about CEA and the Canadian Electricity Industry. The data is derived from 3rd party sources (i.e., World Bank, StatsCan, IEA, Environment Canada) and has been visualized by CEA.
Canadian Electricity Association

LEARN MORE ABOUT THE NATIONAL VOICE OF CANADIAN ELECTRICITY.

- Vision and Mission
- Strategic Goals
- CEA Councils
- Energy Efficiency
- Smart Grid
- Human Resources
- Sustainable Electricity
- Vision 2050
Canadian Electricity Association (CEA)

Founded in 1891, the Canadian Electricity Association is the national forum and voice of the evolving electricity business sector in Canada.

**Vision:** CEA will be the leading energy association, indispensable to the regional, national, and international success of its members, ensuring they remain at the forefront of customer service, sustainability, and technological innovation.

**Mission:** CEA is the national voice for safe, secure and sustainable electricity for all Canadians, and provides its members with value-added products and services to advance the strategic interests of Canada’s electricity industry.
Through scenarios identify emerging trends and issues, and promote the interests of members accordingly.

Ensure the appropriate positioning of electricity, CEA and the industry.

Create and share knowledge to mitigate members’ business risk, and provide the services and support that members need.

Ensure the efficiency and effectiveness of the organization.
CEA Councils

The story of our industry is told through our councils and committees

**Transmission**
Formulates positions on transmission, including cross border reliability, electric and magnetic fields and utility properties.

**Distribution**
Focuses on technological and regulatory developments associated with smart grid development and deployment, advanced meter performance, power quality issues, and national trends in provincial distribution utility regulation.

**Generation**
Develops and influences policy associated with investment in electricity generation infrastructure as well as manages environmental and health impacts related to generation.

**Customer**
Seeks to increase the value of electricity service to Canadians.

**Power Marketers**
Promotes competitive and efficient electricity markets in Canada and the United States.
The Canadian Electricity Association (CEA) will facilitate the development of key Energy Efficiency & Conservation Demand Management (EE&CDM) messages to be used on a national basis and for policy advocacy. The main objective is to consistently convey the cost/benefits of EE&CDM to key stakeholders and member customers.

EE and CDM initiatives respond to needs of utility customers.

Electric Utilities are leaders in EE and CDM and are well positioned to design, deliver education and programs to customers.

EE and CDM initiatives can be maximized through an integrated and collaborated approach between government and utilities.

EE and CDM is a cost effective and complementary alternative to address infrastructure constraints.

EE and CDM is a cost-effective option that contributes to meeting climate change targets.

Encouraging EE and CDM is good for utility business and the economy.
Smart Grid

• A suite of information-based applications through increased automation of the electricity grid and the underlying automation and communication infrastructure itself

• Smart grid is posed to deliver grid resilience, environmental performance, and/or operational efficiencies

• Design and implementation of the smart grid integrated system aims to achieve desired customer priorities, interoperability with legacy infrastructure, and be appropriate for use with respect to geographical location and other needs

• Key characteristics or capabilities:
  • Demand response, facilitation of distributed generation, facilitation of electric vehicles, optimization of asset use, and problem detection and mitigation
  • Capabilities supported by development of hard infrastructure, soft infrastructure through stakeholder engagement
  • Expected results in new service offerings, reduced delivery charges, and faster response time

• Security, privacy, implementation cost, and stakeholder engagement requires collaboration among vendors, policy-makers, regulators and utilities
Human Resources
Commitment by CEA Member Utilities

• Providing a safe environment for general public as well as ensuring the health and safety of employees and contractors in the workplace,

• Support a fair, respectful and diverse workplace for our employees and contractors, and investing in human resources

• Partnering with communities and stakeholders, communicating and engaging in a transparent and timely manner

• Engaging Aboriginal Communities while respecting their culture and traditions
In 2016, the CEA Sustainable Electricity Program adopted a new set of strategic pillars and performance indicators to better communicate the electricity sector’s sustainability goals and commitments:

**LOW-CARBON FUTURE**
- Climate change management and mitigation
- Internal energy efficiency and customer conservation programs
- Electrification of transportation, buildings and processes

**INFRASTRUCTURE RENEWAL AND MODERNIZATION**
- Investments in new and refurbished infrastructure
- Integration of renewable energy
- System reliability and resiliency against severe weather impacts

**BUILDING RELATIONSHIPS**
- Early engagement and consultation with local communities, stakeholders and Aboriginal Peoples
- Enhancement of the customer experience
- Support for low-income customers

**RISK-MANAGEMENT SYSTEMS**
- Environmental stewardship
- Employee, contractor and public health and safety
- Security management systems and standards

**BUSINESS INNOVATION**
- Investments in innovation and technology advancement
- Engagement of regulators, supply chain partners and other stakeholders
- Employee recruitment, training and retention
The four key recommendations of Vision 2050 include:

- Accelerating customer innovation and management of energy;
- Implementing financial instruments for carbon reduction, including a North American carbon price that is implemented across the economy;
- Enabling electric vehicles; and,
- Expanding collaboration with the U.S. to optimize electricity assets while expanding opportunities for electricity storage and the export of low-carbon electricity.
CANADA HAS A STRONG REGULATORY ENVIRONMENT.

- Canada’s Multi-Jurisdictional Environment
- Electricity Structures Market in Canada
- Canada’s Regulatory Regime
- The Integrated North-American Grid
- NERC Regions
- Regulations to Address GHG
## Canada’s Multi-Jurisdictional Environment

### Jurisdictional Division of Responsibility

<table>
<thead>
<tr>
<th>Provincial/Territorial Governments</th>
<th>Federal Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Resource management within provincial boundaries</td>
<td>• Resource management on frontier lands</td>
</tr>
<tr>
<td>• Intra-provincial trade and commerce</td>
<td>• Nuclear safety</td>
</tr>
<tr>
<td>• Intra-provincial environmental impacts</td>
<td>• Inter-provincial and international trade</td>
</tr>
<tr>
<td>• Generation and transmission of electrical energy</td>
<td>• Trans-boundary environmental impacts</td>
</tr>
<tr>
<td>• Conservation and demand response policies</td>
<td>• Environmental impacts where federal lands, investment or powers apply</td>
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<tr>
<td></td>
<td>• Codes, standards and labeling relating to conservation and demand</td>
</tr>
<tr>
<td></td>
<td>• Other policies of national interest</td>
</tr>
</tbody>
</table>
Electricity Market Structure in Canada

**Alberta**
- Mandatory Power Pool
- Wholesale & retail open access (2001)
- Fully competitive wholesale market

**BC**
- Wholesale and industrial open access
- Vertically-integrated Crown Corporation serves 94% of customers

**Manitoba**
- Wholesale open access
- Vertically-integrated Crown corporation

**New Brunswick**
- Wholesale open access
- Vertically-integrated Crown corporation

**Newfoundland**
- Vertically-integrated Crown Corporation and investor-owned distribution utility.

**Nova Scotia**
- Wholesale open access
- Investor-owned utility regulated on cost-of-service

**Nunavut**
- Vertically-integrated Crown Corporation.

**NWT**
- Vertically-integrated Crown Corporation.
- Investor-owned distribution utility provides service in several communities.

**Ontario**
- Industry unbundling (1998)
- Wholesale & retail open access (2002)
- Hybrid regulation and competition model

**Québec**
- Wholesale open access
- Vertically-integrated Crown corporation
- Expanding IPP development

**Saskatchewan**
- Wholesale open access
- Vertically-integrated Crown corporation

**Yukon**
- Vertically-integrated Crown Corporation.
- Investor-owned distribution utility provides service in several communities.

**PEI**
- Procures electricity from New England market and long-term contracts with New Brunswick.
## Canada’s Regulatory Regime for Large Energy Projects

<table>
<thead>
<tr>
<th>Planning</th>
<th>Environmental Assessment Process</th>
<th>Permitting</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Land use plans</td>
<td>Management Boards Territorial Lands / Water Act</td>
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<tr>
<td></td>
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<td>Species at Risk Act - EC/DFO</td>
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<td></td>
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<td>Metal Mining Effluent Regulations - EC/DFO</td>
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<td>Explosives Act - NRCan</td>
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<td>Fisheries Act - DFO</td>
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<td></td>
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<td>NWPA - TC</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Others: MBCA / IBWTA / CPRA / Offshore Accords / CEPA</td>
</tr>
</tbody>
</table>

* Permits required under other Acts trigger CEAA OGD participants. Illustrative – some components would not apply to same project.

NWPA – Navigable Waters Protection Act / YESAA – Yukon Environmental and Socio-Economic Assessment Act
Offshore Accords – Canada - NS and NFLD Offshore Accords / CEPA – Canadian Environmental Protection Act
The Integrated North American Grid

Details: Lines shown are 345kV and above. Transmission Lines under 345KV do not appear on this map.
North American Electric Reliability Corporation Regions (NERC)
Regulations to Address GHG emissions from Coal-fired Electricity (2012)

• Establish an emissions performance standard of 420 tonnes of CO$_2$ per gigawatt hour of electricity produced for new coal-fired electricity generation units (those commissioned after July 1, 2015), and units that have reached the end of their life.

• The proposed Regulations are to be promulgated under the Canadian Environmental Protection Act (CEPA) and are set to come into effect on July 1, 2015.

• Existing and new units may apply for a deferral in meeting the performance standard until January 1, 2025, if the technology for Carbon Capture and Storage (CCS) is incorporated.

• The regulation will be effective only if compliance is achievable.

• Compliance will contribute to clarity and stability for industry that will enable investment in electricity infrastructure to flow.

• Cumulative reduction in GHG emissions of approximately 214 megatonnes and cumulative health benefits of $4.2 billion expected in the first 21 years.

• Some jurisdictions will be more heavily impacted than others.
Industry

This industry employs over 80,000 people.

- Industry Overview
- Labour Statistics
- Customer Reliability
- Electricity Consumption with Human Development Index
Industry Overview

Electricity

Electricity supports quality of life, economic well-being, and a clean environment.

+ 80,730 Employed
+ 648 TW.h Generation
+ 62.8 TW.h Net Exports
+ Over 80% Non-Emitting
+ $31.2 Billion GDP
+ 99.91% Customer Reliability
+ 2.69 Billion Trade Revenue
+ 39.16% CO₂ Eq. Reduction Since 2000

CANADIAN ELECTRICITY INDUSTRY
Industry Labour Statistics in Canada

Electric Power (Generation, Transmission and Distribution)

2017: 80,730

Excludes contractors, consultants, vendors and related manufacturers dedicated to the industry.
Customer Reliability in Canada

Canadian Index of Reliability (IoR)

Source: Canadian Electricity Association, Service Continuity Committee
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association

2005-2017

- 2010 Hurricane Igor and Earl
- 2013 Ice Storm, 2013 Alberta and Toronto Floods,
- 2015 BC Windstorm
Electricity Consumption Benefit

Human Development Index with Electric Power Consumption (kwh per capita) (2014 World Bank and UN Data)

Data Source: HDI data, HDI Definition: United Nations; and Energy Consumption: Open Data Portal, World Bank
Data Retrieved: August 2017; Visual Created by the Canadian Electricity Association
Trade

Electricity trading between Canada and the USA began in 1901.

- Major Canada-US Transmission Interconnections
- Canadian Electricity Exports/Imports by Province
- National Trade Volume Trends
- Trade Prices Trends
- Trade Revenue Trends
Major Canada-U.S. Transmission Interconnections
Data displayed are in gigawatt-hours. Numbers may not sum due to rounding. Source: National Energy Board, Electricity Exports and Imports, 2016.
Canadian Electricity Imports and Exports by Region (2017)

Data displayed are in gigawatt-hours. Numbers may not sum due to rounding. Source: National Energy Board, Electricity Exports and Imports, 2017.
Trade Volume

Canada-U.S. Electricity Trade Volume (1990-2017)

Data Source: National Energy Board (NEB) and Statistics Canada, CANSIM Table 176-0064

Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association
Trade Prices

Canada - U.S. Electricity Trade Prices (1997-2017)

Data Source: National Energy Board (NEB).
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association
Trade Revenue

Canada - U.S. Trade Revenue (1990 -2017)

Data Source: National Energy Board (NEB).
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Supply & Demand

A RESUME OF ANALYTICS FROM MAY 2014 TO MAY 2015

- Generation Capacity (US and Canada)
- Electricity Demand in Canada (1 year)
- Electricity Demand in Canada (1990-2015)
- Electricity Generation Outlook (2040)
- Electricity Generation Breakdown Comparison (2015)
- Generation by Province (2016)
- Canada’s Wind Capacity (2016)
Generating Capacity

(U.S. & Canada, 2017)

Canada

Generating Capacity
143.44 GW

United States

Generating Capacity
1,177.18 GW

Data Source: U.S. Data from Energy Information Administration, 2016; Canada Data from StastCan, CANSIM Table 127-0009
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association
Electricity Demand

ELECTRICITY DEMAND BY SECTOR IN CANADA (2016)

- Industrial: 41%
- Transportation: 1%
- Residential: 33%
- Public Administration: 3%
- Agriculture: 2%
- Commercial and Institutional: 20%

Total Electricity Demand in Canada for 2016 = 501.90 TWh
Electricity Demand by Sector (Trend)

Data Source: StatsCan  CANSIM Table 128-0016
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association

Total Electricity Demand in Canada for 2016 = 501.90 TWh
Electricity Generation by Fuel

Generation by Fuel (1995-2016)

Total Electricity Generation by Utilities & Industry in Canada, 2016 = 648.11 TWh

Data Source: StatsCan CANSIM Table 127-0001, Table 127-0002, 128-0014
Data Retrieved: June 2018; Visual Created by the Canadian Electricity Association
Electricity Generation Outlook by Fuel Type

Source: NEB, [https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016/index-eng.html#s8](https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2016/index-eng.html#s8)
Data Retrieved: June 2018;
Electricity Generation Breakdown

Generation by Fuel - Utilities Only (2016)

Generated 587.91 TWh

- Hydro, 60.82%
- Nuclear, 16.45%
- Coal and Coke, 10.55%
- Natural Gas, 7.19%
- Solar, 0.30%
- Wind, 5.06%
- Oil and Diesel, 0.59%
- Tidal, 0.00%
- Steam from Waste Heat, 0.02%
- Biomass, 0.38%

Generation by Fuel Industry and Electric Utilities (2016)

Generated 648.29 TWh

- Hydro, 59.55%
- Nuclear, 14.82%
- Coal and Coke, 9.50%
- Natural Gas, 9.88%
- Solar, 0.31%
- Wind, 4.73%
- Oil and Diesel, 0.62%
- Tidal, 0.00%
- Steam from Waste Heat, 0.04%
- Biomass, 1.24%
# Canada’s Wind Capacity (2017)

## Table

<table>
<thead>
<tr>
<th>Province/Territory</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yukon</td>
<td>0.8</td>
</tr>
<tr>
<td>NWT</td>
<td>9.2</td>
</tr>
<tr>
<td>Nunavut</td>
<td>0</td>
</tr>
<tr>
<td>British Columbia</td>
<td>698</td>
</tr>
<tr>
<td>Alberta</td>
<td>1,479</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>221</td>
</tr>
<tr>
<td>Manitoba</td>
<td>258</td>
</tr>
<tr>
<td>Ontario</td>
<td>4,900</td>
</tr>
<tr>
<td>Québec</td>
<td>3,510</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>294</td>
</tr>
<tr>
<td>PEI</td>
<td>204</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>610</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>55</td>
</tr>
</tbody>
</table>

Total Capacity: 12,239 MW
Environmental Sustainability

The environment is everything that isn’t me.
Albert Einstein

- Low Emissions and Sustainable Technologies
- Emissions - Sulphur Oxide
- Emissions - Nitrogen Oxide
- Emissions – Mercury
- Emissions – Particulate Matter
- Emissions Trends (previous 4 trends)
- Emissions – Carbon Dioxide Equivalent
- CO2 source by Economic Sector Trend
- Factors on the Change in GHG Emissions
- Coal Fleet Profile
- NOx and Sox Reductions from CO2 regulation
- GHG Emissions by Sector Canada with US
## Low Emission and Sustainable Technologies Used for Electricity Generation in Canada

<table>
<thead>
<tr>
<th>Resource</th>
<th>Advantages</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Power</td>
<td>No fuel cost, no emissions or waste, renewable source of energy, commercially viable source of power</td>
<td>Less cost competitive than conventional energy source, variable energy resource, transmission issues, environmental concerns with regards to noise and interaction with birds, land use issues</td>
</tr>
<tr>
<td>Small Hydro</td>
<td>Low capital costs, many potential sites in Canada, well established technology, able to meet small incremental capacity needs, reduction in GHG emissions</td>
<td>Regulatory approval can be costly and time consuming, access to grid, local opposition to new development</td>
</tr>
<tr>
<td>Biomass</td>
<td>Uses landfill gas, wood pellets, and waste products to create electricity, reduces greenhouse gas, high availability of sites</td>
<td>High capital equipment and fuel costs; produces some emissions; access to transmission, competition for biomass materials use</td>
</tr>
<tr>
<td>Geothermal Energy</td>
<td>Reliable source of power, low fuel and operating costs, clean and renewable source of energy</td>
<td>High capital costs, connecting to the grid can be difficult, few potential sites in Canada</td>
</tr>
<tr>
<td>Solar PV</td>
<td>Reliable, renewable energy source with zero emissions and silent operation, fuel is free, suitable for areas where fossil fuels are expensive or where there is no connection to the grid</td>
<td>Restrictive and lack of grid connection for remote areas, not cost competitive, sun does not always shine and potential varies across regions</td>
</tr>
<tr>
<td>Ocean Energy</td>
<td>Costs are expected to decline as technology develops, intermittent, but predictable source of green energy</td>
<td>Potentially intrusive to marine life, investment is needed to promote research and development</td>
</tr>
<tr>
<td>Clean Coal</td>
<td>Highly efficient, potential for reduced greenhouse gas emissions</td>
<td>High capital costs, lengthy start-up period</td>
</tr>
</tbody>
</table>
Since 2000, the Canadian electricity sector has reduced its SOx Emissions by 59.12%.
In 2016, in Canada Sulphur Oxide emissions were measured at 1,066.63 kilotonnes.
Nitrogen Oxide Emissions

Since 2000, the Canadian electricity sector has reduced its NOx emissions by 50.54%.

Source: Environment and Climate Change Canada, Air Pollutant Emissions Database
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association
In 2016, in Canada Nitrogen Oxide emissions were measured at 1,813.72 kilotons.
Since 2000, the Canadian electricity sector has reduced its Hg Emissions by 66.7%.
In 2016, in Canada Mercury emissions were measured at 4,280.80 kg.
Particulate Matter Emissions

Since 2000, the Canadian electricity sector has reduced its PM2.5 emissions by 85.25%
In 2016, in Canada PM2.5 emissions were measured at 1,605.81 kilotonnes.
Emissions Trends (1990-2016)

Electricity Sector in Canada Sulphur Oxide (SOx) Emissions

Electricity Sector in Canada Nitrogen Oxide (NOx) Emissions (1990-2016)

Electricity Sector in Canada Mercury Emissions

Electricity Sector in Canada PM2.5 Emissions

Source: Environment and Climate Change Canada, Air Pollutant Emissions Database
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association
Since 2000, the Canadian electricity sector has reduced its CO₂ Eq. Emissions by 39.16%
In 2016, in Canada CO\textsubscript{2} Eq. emissions were measured at 704 Megatonnes.
Carbon Dioxide (CO$_2$) Emissions

1990-2016 Trend of CO$_2$ Eq. Emissions by Economic Sector

- Oil and gas
- Transportation
- Buildings
- Electricity
- Heavy industry
- Agriculture
- Waste and others

Source: Environment and Climate Change Canada, Air Pollutant Emissions Database
Data Retrieved: June 2018; Visual Created by the Canadian Electricity Association
Electricity Sector Leads In CO$_2$ Eq. Reduction

Forecasted Change in Emissions by Sector 2005-2020

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2012</th>
<th>2020</th>
<th>Change 2005 to 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>121</td>
<td>86</td>
<td>71</td>
<td>-50</td>
</tr>
<tr>
<td>Transportation</td>
<td>168</td>
<td>165</td>
<td>167</td>
<td>-1</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>159</td>
<td>173</td>
<td>204</td>
<td>45</td>
</tr>
<tr>
<td>Buildings</td>
<td>84</td>
<td>80</td>
<td>98</td>
<td>14</td>
</tr>
<tr>
<td>Emissions-intensive &amp; Trade exposed</td>
<td>89</td>
<td>78</td>
<td>90</td>
<td>1</td>
</tr>
<tr>
<td>Agriculture</td>
<td>68</td>
<td>69</td>
<td>70</td>
<td>2</td>
</tr>
<tr>
<td>Waste and Others</td>
<td>47</td>
<td>47</td>
<td>46</td>
<td>-1</td>
</tr>
</tbody>
</table>

Source: Environment and Climate Change Canada, Canada’s Emissions Trends 2014
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Factors on the Change in GHG Emissions

1990 - 2015

2005 - 2015

Notes:

**Demand** – the level of electricity generation activity in the sector and consists of generation from combustion and non-combustion sources.

**Generation mix** – the relative share of combustion and non-combustion sources in generation activity.

**Fuel mix (combustion generation)** – the relative share of each fuel used to generate electricity.

**Energy efficiency** – the efficiency of the equipment used in combustion related generation of electricity.

**Emission factors** – The emission factor effect reflects changes to fuel energy content over time.

Source: UNFCCC, National Inventory Report for Canada, for 1990-2015
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Coal Fleet Profile (MW)

Coal Capacity Reduction - Retirement as per the Proposed Amendment to the Coal Regulation (2018)

Source: NPRI data
Data Retrieved June 2018; Visual Created by the Canadian Electricity Association
**NO\textsubscript{x} and SO\textsubscript{2} Reductions from CO\textsubscript{2} Regulation**

**Reduction in SO\textsubscript{2} emission from 2002 levels:**
- 54% reduction by 2020
- 84% reduction by 2030

**Reduction in NO\textsubscript{x} emissions from 2002 levels:**
- 50% reduction by 2020
- 80% reduction by 2030

Source and assumptions: NPRI data was used for existing unit emissions, forecast based on 2009-2011 operation, coal unit retirement from 45-50 years as outlined in the 2012 Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations

Source: NPRI data
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association

Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2016), Figure ES-14
Data Retrieved: June 2018; Visual Created by the U.S. Environmental Protection Agency

GHG Emissions in Canada by Sector (2016)

- Oil and Gas, 25.94%
- Electricity, 11.16%
- Transportation, 24.62%
- Buildings, 11.56%
- Waste & Others, 5.88%
- Heavy Industry, 10.61%
- Agriculture, 10.22%

Emission Total – Canada: 704 Mt CO2 Eq.

U.S. GHG Emissions by Economic Sector (2016)

- Electricity Generation, 28.03%
- Transportation, 28.15%
- Industry, 21.34%
- U.S. Territories, 0.71%
- Agriculture, 9.29%
- Residential, 5.04%
- Commercial, 6.30%

Emission Total – United States: 6,511 Mt CO2 Eq.

Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2016), Figure ES-14; Environment Canada, National Inventory Report (1990-2016) Table S-3;
Data Retrieved: July 2018; Visual Created by the U.S. Environmental Protection Agency
Price & Customers

There is a fundamental cost in provisioning electricity for a nation.

- Canada's Future Residential Electricity Needs
- Population Growth and Residential Needs (BAU)
- Population Growth and Residential Needs (Economic)
- Household Spending (1999-2015: Cumulative Change)
- Household Spending 1999 vs. 2015
- Household Spending 2010 vs. 2015
- Multinational Comparisons Residential Pricing (Bar chart)
- Multinational Comparisons Residential Pricing (Bubble Chart)
- Pricing Canadian Urban Centres – Residential
- Multinational Comparisons Industrial Pricing (Bar chart)
- Multinational Comparisons Industrial Pricing (Bubble Chart)
- Electric Vehicle Penetration (Canada)
- Electric Vehicle Penetration (World)
Canada’s Future Residential Electricity Needs

1990

POPULATION
27.79 Million

RESIDENTIAL USAGE
129,831 GWh/yr

2015

POPULATION
35.85 Million

RESIDENTIAL USAGE
169,016 GWh/yr

2040

POPULATION
44.05 Million

RESIDENTIAL USAGE
207,668 GWh/yr

2050

POPULATION
46.87 Million

RESIDENTIAL USAGE
220,953 GWh/yr

BUSINESS AS USUAL SCENARIO

Demand with Moderate Economic Growth

Residential Usage
350,660 GWh/yr

Residential Usage
373,092 GWh/yr

Data Source: StatsCan, CANSIM Table 052-0005; Moderate Growth from Canada’s Energy Future 2016, Open Data Portal
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Population Growth and Residential Needs

Forecasted Population Growth in Canada (2025 - 2055)

- **Electricity Needs**
- **Low Growth**
- **Moderate Growth**
- **High Growth**

**Business as usual scenario.**
Electricity Needs based on Moderate Population Growth.

Data Source: StatsCan, CANSIM Table 052-0005
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Population Growth and Residential Needs

Forecasted Population Growth in Canada (2025 - 2055)

Moderate Economic and Population Growth and Energy prices. Electricity needs are far superior.
Household Spending (1999 - 2016)

Cumulative changes per Household from 1999-2016.

- Internet Services: 235.79%
- Electricity: 47.04%
Household Spending (1999 vs. 2015)

Data Description

Percentage increase in 2015 comparing against 1999 household spending levels.

- Electricity: 133.5 TW.h Residential Demand in 1999
- Public Transit: 164.2 TW.h Residential Demand in 2016
- Property Taxes: 58.6%
- Internet Services: 73.8%
- Water and Sewage: 74.8%
- Cell Phone Services: 140.4%

Data Source: StatsCan, CANSIM Table 203-0021
Data Retrieved: June 2018; Visual Created by the Canadian Electricity Association
Household Spending (2010 vs. 2016)

Spending Increases Per Household Comparing **2016 to 2010**.

- **Internet Services** 53.09%
- **Cell Phone Services** 51.16%
- **Water and Sewage** 28.57%
- **Property Taxes** 18.12%
- **Electricity** 18.22%
- **Public Transit** 9.72%
Multinational Comparison (Residential Pricing)

Selected Countries, Industrial Electricity Prices, (2017)

<table>
<thead>
<tr>
<th>Country</th>
<th>Residential cents/kwh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>32.2</td>
</tr>
<tr>
<td>Belgium</td>
<td>30.9</td>
</tr>
<tr>
<td>Portugal</td>
<td>29.6</td>
</tr>
<tr>
<td>Ireland</td>
<td>29.3</td>
</tr>
<tr>
<td>Austria</td>
<td>29.0</td>
</tr>
<tr>
<td>Japan</td>
<td>28.7</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>27.7</td>
</tr>
<tr>
<td>Switzerland</td>
<td>26.1</td>
</tr>
<tr>
<td>Greece</td>
<td>25.9</td>
</tr>
<tr>
<td>France</td>
<td>25.7</td>
</tr>
<tr>
<td>Slovenia</td>
<td>25.4</td>
</tr>
<tr>
<td>Netherlands</td>
<td>25.1</td>
</tr>
<tr>
<td>Sweden</td>
<td>24.0</td>
</tr>
<tr>
<td>Finland</td>
<td>23.7</td>
</tr>
<tr>
<td>Chile</td>
<td>22.9</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>22.6</td>
</tr>
<tr>
<td>Poland</td>
<td>21.6</td>
</tr>
<tr>
<td>Turkey</td>
<td>20.7</td>
</tr>
<tr>
<td>Estonia</td>
<td>19.9</td>
</tr>
<tr>
<td>Hungary</td>
<td>19.6</td>
</tr>
<tr>
<td>United States</td>
<td>17.8</td>
</tr>
<tr>
<td>Korea</td>
<td>17.7</td>
</tr>
<tr>
<td>Canada</td>
<td>17.0</td>
</tr>
<tr>
<td>Norway</td>
<td>15.4</td>
</tr>
<tr>
<td>Mexico</td>
<td>13.1</td>
</tr>
</tbody>
</table>

Data Source: World Energy Statistics 2016, IEA
Data Retrieved: July 2018; Visual Created by the Canadian Electricity Association
Multinational Comparison (Residential Pricing)

Data Retrieved: July 2018; Visual Created by the Canadian Electricity Association

Shaded area indicates top quartile.
Canadian Urban Centres Comparison (Residential Pricing)

Pricing is impacted by time-of-use rates, consumption patterns, adjustment clauses. This data is taken from Hydro-Québec price comparison study and is calculated according to base rates.

Data Source: 2017 Edition Comparison of Electricity Prices in North America in Major North American Cities, Hydro-Québec
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association
Multinational Comparison (Industrial Pricing)

Selected Countries, Industrial Electricity Prices, (2017)

Country
- Japan
- Germany
- Switzerland
- Portugal
- Chile
- Ireland
- Belgium
- France
- Turkey
- United Kingdom
- Greece
- Korea
- Estonia
- Czech Republic
- Hungary
- Netherlands
- Slovenia
- Austria
- Finland
- Poland
- Canada
- Mexico
- United States
- Sweden
- Norway

Industrial cents/kwh $
Shaded area indicates top quartile.
Electric Vehicle Sales (Canada)

In 2016 Canada sold a total of 11.58 Thousand EV's
Electric Vehicle Penetration (World)

Public Charging Stations to EV sales per 100k Pop. (2017)

Data Source: World EV Outlook 2017, IEA,
Data Retrieved: June 2018; Visual Created by the Canadian Electricity Association
Financials

In 2016 the electricity industry represented 1.7% of the national GDP.

- GDP Contribution
- Utility Investments
- Utility Investments (with Conference Board of Canada reference)
Electric Power (Generation, Transmission, Distribution) to Canada's GDP (2000-2017)

Billions

- *Electricity GDP (2007 Chained Dollars)*

Data Source: StatsCan  CANSIM Table 379-0031

Data Retrieved: June 2018; Visual Created by the Canadian Electricity Association
Utility Investments

Annual Capital and Repair Expenditures

Data Source: StatsCan CANSIM Table 029-0050, Annual Capital and Repair Expenditures Survey
Data Retrieved: June 2018; Visual Created by the Canadian Electricity Association
Utility Investments

Annual Capital and Repair Expenditures

**Conference Board of Canada:** Total Investment Required by 2030 = 347.5 Billion CDN$

Or 17.38 Billion CDN$ annually from 2010 to 2030

Data Source: StatsCan CANSIM Table 029-0050, Annual Capital and Repair Expenditures Survey; Conference Board of Canada, Shedding Light on the Economic Impact of Investing in Electricity Infrastructure, 2012

Data Retrieved: June 2018; Visual Created by the Canadian Electricity Association
Infrastructure Projects

Infrastructure is critical to national security and longevity.

- Known Generating Stations (Renew/MPMO) Slide 1
- Known Generating Stations (Renew/MPMO) Slide 2
- Manitoba-Minnesota Transmission Project
- Known Transmission Projects (Renew/MPMO)
# Known Generation Projects (Renew/MPMO)

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Description</th>
<th>Proponent</th>
<th>Project Type</th>
<th>Location</th>
<th>Value ($)</th>
<th>Estimated Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amisk Hydroelectric Project</td>
<td>330 MW</td>
<td>AHP Development Corp</td>
<td>Hydro</td>
<td>AB</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Beauharnois Station Renovations</td>
<td>Refurbishment</td>
<td>Hydro-Quebec</td>
<td>Hydro</td>
<td>QC</td>
<td>1.6</td>
<td>2019</td>
</tr>
<tr>
<td>Bruce Power Nuclear Refurbishment</td>
<td>6,300 MW</td>
<td>Bruce Power</td>
<td>Nuclear</td>
<td>ON</td>
<td>13B</td>
<td>2030</td>
</tr>
<tr>
<td>Chinook Power Station</td>
<td>350 MW</td>
<td>SaskPower</td>
<td>Natural Gas</td>
<td>SK</td>
<td>0.68B</td>
<td>2019</td>
</tr>
<tr>
<td>Darlington Nuclear Refurbishment</td>
<td>3,512 MW</td>
<td>OPG</td>
<td>Nuclear</td>
<td>ON</td>
<td>12.8B</td>
<td>2025</td>
</tr>
<tr>
<td>Genesee 4 and 5 Generation Units</td>
<td>1060 MW</td>
<td>ENMAX, Capital Power</td>
<td>Natural Gas</td>
<td>AB</td>
<td>1.4B</td>
<td>2019</td>
</tr>
<tr>
<td>Gordon Shrum Power Station Refurbishment</td>
<td>Refurbishment</td>
<td>BCHydro</td>
<td>Hydro</td>
<td>BC</td>
<td>0.6B</td>
<td>2022</td>
</tr>
<tr>
<td>Great Spirit Power Project</td>
<td>930 MW</td>
<td>Focus Energy Group</td>
<td>Natural Gas</td>
<td>AB</td>
<td>1.5B</td>
<td>TBD</td>
</tr>
<tr>
<td>John Hart Generating Station Replacement Project</td>
<td>Refurbishment</td>
<td>BCHydro</td>
<td>Hydro</td>
<td>BC</td>
<td>1.093B</td>
<td>2019</td>
</tr>
</tbody>
</table>

Data Source: MPMO Tracker, (Major Project Management Office), Renew Magazine Top 100 Projects List
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association
# Known Generation Projects (Renew/MPMO)

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Description</th>
<th>Proponent</th>
<th>Project Type</th>
<th>Location</th>
<th>Value ($)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeyask Hydroelectric Generation</td>
<td>695 MW</td>
<td>Keeyask Hydropower Limited Partnership</td>
<td>Hydro</td>
<td>MB</td>
<td>8.7B</td>
<td>2020</td>
</tr>
<tr>
<td>Lower Churchill Hydroelectric Generation</td>
<td>3,074 MW</td>
<td>Nalcor Energy</td>
<td>Hydro</td>
<td>NL</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Milner Energy Centre</td>
<td>520 MW Expansion</td>
<td>Maxim Power</td>
<td>Natural Gas</td>
<td>AB</td>
<td>1B</td>
<td>2020</td>
</tr>
<tr>
<td>Muskrat Falls Project</td>
<td>824 MW</td>
<td>Nalcor Energy, Emera</td>
<td>Hydro</td>
<td>NL</td>
<td>12.7B</td>
<td>2020</td>
</tr>
<tr>
<td>Naikun Offshore Wind Energy</td>
<td>396 MW</td>
<td>Naikun Wind Energy</td>
<td>Wind</td>
<td>BC</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Rehabilitation of Robert Bourassa Generating Units</td>
<td>Refurbishment</td>
<td>Hydro-Quebec</td>
<td>Hydro</td>
<td>QC</td>
<td>0.743B</td>
<td>TBD</td>
</tr>
<tr>
<td>Romaine Complex</td>
<td>1,550 MW</td>
<td>Hydro Quebec</td>
<td>Hydro</td>
<td>QC</td>
<td>6.5B</td>
<td>2020</td>
</tr>
<tr>
<td>Site C Clean Energy Hydroelectric Generation</td>
<td>1,100 MW</td>
<td>BC Hydro</td>
<td>Hydro</td>
<td>BC</td>
<td>9.385B</td>
<td>2024</td>
</tr>
<tr>
<td>Tazi Twe Hydroelectric Generation</td>
<td>50 MW</td>
<td>Saskatchewan Power Corp.</td>
<td>Hydro</td>
<td>SK</td>
<td>0.5B</td>
<td>2019</td>
</tr>
</tbody>
</table>

Data Source: MPMO Tracker, (Major Project Management Office), Renew Magazine Top 100 Projects List
Data Retrieved: May 2018; Visual Created by the Canadian Electricity Association
<table>
<thead>
<tr>
<th>MPMO Project Name</th>
<th>Description</th>
<th>Proponent</th>
<th>Location</th>
<th>Value ($)</th>
<th>Estimated Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipole III Transmission Line</td>
<td>1,384 km line</td>
<td>Manitoba Hydro</td>
<td>MB</td>
<td>5.04B</td>
<td>2018</td>
</tr>
<tr>
<td>Chamouchouane-Bout-de-l’Ile Transmission Line</td>
<td>735 kV line (406 km)</td>
<td>Hydro-Quebec</td>
<td>QC</td>
<td>1.4B</td>
<td>2018</td>
</tr>
<tr>
<td>East-West Transmission Tie</td>
<td>230kV line</td>
<td>NextEra Energy Canada/ Enbridge</td>
<td>ON</td>
<td>0.6B</td>
<td>2020</td>
</tr>
<tr>
<td>Fort McMurray Transmission Line</td>
<td>500 kV AC line (over 900km)</td>
<td>AESO</td>
<td>AB</td>
<td>1.43B</td>
<td>2019</td>
</tr>
<tr>
<td>ITC Lake Erie Connector</td>
<td>50 kV International Power Line (IPL)</td>
<td>ITC Holdings Corporation</td>
<td>ON</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Juan de Fuca Power Cable</td>
<td>550 MW line</td>
<td>Sea Breeze Power</td>
<td>BC</td>
<td>0.665B</td>
<td>TBD</td>
</tr>
<tr>
<td>Manitoba-Minnesota Transmission Project</td>
<td>500 kV AC line</td>
<td>Manitoba Hydro</td>
<td>MB</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Maritime Link Transmission</td>
<td>500-MW, +/- 200 to 250-kV HVDC &amp; HVAC</td>
<td>ENL Maritime Link Inc.</td>
<td>NL/NS</td>
<td>1.577B</td>
<td>2018</td>
</tr>
<tr>
<td>Romaine</td>
<td>315kV and 735kV lines</td>
<td>Hydro Quebec</td>
<td>QC</td>
<td>1.3B</td>
<td>2020</td>
</tr>
<tr>
<td>Wakaynikaneyap Transmission Project</td>
<td>1,800 km line</td>
<td>FortisOntario</td>
<td>ON</td>
<td>1.35B</td>
<td>2024</td>
</tr>
</tbody>
</table>

Data Source: MPMO Tracker, (Major Project Management Office), Renew Magazine Top 100 Projects List
Data Retrieved: May 2018,; Visual Created by the Canadian Electricity Association
Manitoba-Minnesota Transmission Project

• **Manitoba Hydro (MH):** 500 kV line to U.S. border.

• **Minnesota Power (MP):** 500 kV line from border to Duluth.

• “Hydro by wire” from Manitoba enables “wind by wire” from North Dakota.

• Overall project enhances regional reliability and provides energy market benefits.

• 2020 expected in-service date.
FOR MORE INFORMATION
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Facebook: canadianelectricityassociation