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.
Canadian Electricity Association Strategic Goals

**Business Scenarios and Emerging Issues**
Through scenarios identify emerging trends and issues, and promote the interests of members accordingly.

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

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

**Association Effectiveness**
Ensure the efficiency and effectiveness of the organization.

**Effectiveness**

**CEA and the Industry**

**Canadian Electricity Association**
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.
• 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 safe environment for general public as well as ensuring 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
Vision 2050
Vision for Canada’s Electricity Sector

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.
Regulatory

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

<table>
<thead>
<tr>
<th>Jurisdictional Division of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provincial/Territorial Governments</strong></td>
</tr>
<tr>
<td>• Resource management within provincial boundaries</td>
</tr>
<tr>
<td>• Intra-provincial trade and commerce</td>
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<tr>
<td>• Intra-provincial environmental impacts</td>
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<tr>
<td>• Generation and transmission of electrical energy</td>
</tr>
<tr>
<td>• Conservation and demand response policies</td>
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</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><strong>Canadian Environmental Assessment Act - CEA Agency</strong></td>
<td>National Energy Board Act - NEB*</td>
<td></td>
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<td></td>
<td><strong>Nuclear Safety and Control Act - CNSC</strong></td>
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<td></td>
<td>Impact reviews (YESAA, MVRMA Land Claim / CEAA)</td>
<td>Management Boards</td>
<td></td>
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<tr>
<td></td>
<td>Innuvialuit Final Agreement - INAC*</td>
<td>Territorial Lands / Water Act</td>
<td></td>
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<td></td>
<td>Land use plans</td>
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<td></td>
<td>Species at Risk Act - EC/DFO</td>
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<td></td>
<td>Metal Mining Effluent Regulations - EC/DFO</td>
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<td>Explosives Act - NRCan</td>
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<td></td>
<td>Fisheries Act - DFO</td>
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<td></td>
<td>NWPA - TC</td>
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<tr>
<td></td>
<td>Others: MBCA / IBWTA / CPRA / Offshore Accords / CEPA</td>
<td></td>
<td></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 Newfoundland 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 CO₂ 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
Electricity

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

- **81,665** Employed
- **640 TW.h** Generation
- **63.8 TW.h** Net Exports
- Over 79% Non-Emitting
- **$29 Billion** GDP
- **99.95%** Customer Reliability
- **2.7 Billion** Trade Revenue
- **38.05%** CO₂ Eq. Reduction Since 2000

CANADIAN ELECTRICITY INDUSTRY
Industry Labour Statistics in Canada

Electric Power (Generation, Transmission and Distribution)

2016: 81,665

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

Canadian Index of Reliability (IoR)

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

Source: Canadian Electricity Association, Service Continuity Committee
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Electricity Consumption Benefit

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
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
Canadian Electricity Imports and Exports by Region (2016)

Data displayed are in gigawatt-hours. Numbers may not sum due to rounding.
Canada-U.S. Electricity Trade Volume (1990-2016)

Data Source: National Energy Board (NEB) and Statistics Canada, CANSIM Table 176-0064
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Trade Prices

Canada - U.S. Electricity Trade Prices (1997-2016)

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

Canada - U.S. Trade Revenue (1990 - 2016)


Global Financial Crisis (2009)

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 by technology (1990-2015)
- Electricity Generation Breakdown Comparison (2015)
- Generation by Province (2016)
- Canada’s Wind Capacity (2016)
Generating Capacity

(US. & Canada, 2015)

Canada

- Conventional Steam Turbine: 15.11%
- Combustion Turbine: 9.21%
- Internal Combustion Turbine: 0.89%
- Nuclear: 10.36%
- Hydro: 58.50%
- Wind: 5.64%
- Solar/Tidal: 0.29%

Generating Capacity: 135.45 GW

United States

- Conventional Steam Turbine: 15.11%
- Combustion Turbine: 6.18%
- Internal Combustion Turbine: 8.61%
- Nuclear: 8.90%
- Hydro: 8.61%
- Wind: 6.29%
- Solar: 1.18%
- Biomass: 0.33%
- Other: 0.42%
- Coal: 26.11%
- Petroleum: 3.63%
- Natural Gas: 43.17%

Generating Capacity: 1,167.37 GW

Data Source: U.S. Data from Energy Information Administration, 2015; Canada Data from StatCan, CANSIM Table 127-0009
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Electricity Demand

Electricity Demand By Sector In Canada (2015)

Total Electricity Demand in Canada for 2015 = 499.61 TWh

- **Industrial**: 40%
- **Transportation**: 1%
- **Residential**: 34%
- **Public Administration**: 3%
- **Commercial and Institutional**: 20%
- **Agriculture**: 2%

Data Source: StatsCan CANSIM Table 128-0016
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Electricity Demand by Sector (Trend)

Electricity Consumption by Sector (1990-2015)

Total Electricity Demand in Canada for 2015 = 499.61 TWh

Data Source: StatsCan  CANSIM Table 128-0016
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Electricity Generation by Tech.

Electricity Generation by Generation Technology (1990-2015)

Total Electricity Generation by Utilities & Industry in Canada, 2015 = 640.43 TWh

Data Source: StatsCan CANSIM Table 128-0016
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Electricity Generation by Fuel

Total Electricity Generation by Utilities & Industry in Canada, 2015 = 640.43 TWh

- Hydro
- Nuclear
- Coal and Coke
- Natural Gas
- Oil and Diesel
- Biomass
- Solar
- Wind
- Tidal
- Steam from Waste Heat

Data Source: StatsCan CANSIM Table 127-0001, 128-0014
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Electricity Generation Breakdown

Generation by Fuel - Utilities Only (2015)

Generated 574.88 TWh

- Hydro, 60.22%
- Nuclear, 16.64%
- Natural Gas, 6.81%
- Coal and Coke, 11.09%
- Oil and Diesel, 0.60%
- Biomass, 0.35%
- Solar, 0.06%
- Wind, 2.91%
- Steam from Waste Heat, 1.31%


Generated 640.43 TWh

- Hydro, 58.37%
- Nuclear, 14.94%
- Coal and Coke, 10.26%
- Natural Gas, 10.22%
- Oil and Diesel, 0.70%
- Biomass, 1.59%
- Solar, 0.05%
- Wind, 2.67%
- Steam from Waste Heat, 1.17%
Supply Industries and Utilities

2015 Electricity Generation by Fuel Type in Canada (Province and Territories)

Data Source: StatsCan CANSIM Table 127-0001, 128-0014, 127-0007
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Canada’s Wind Capacity (2016)

<table>
<thead>
<tr>
<th>Province/Territory</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yukon</td>
<td>0.9</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>489</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>4,781</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>597</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>55</td>
</tr>
</tbody>
</table>

11,898 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
- CO2 Reduction 2020 forecast
- 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 59.37%
In 2015, in Canada Sulphur Oxide emissions were measured at 1,054.40 kilotonnes.
Nitrogen Oxides Emissions

Electricity Sector in Canada Nitrogen Oxide (NOx) Emissions (1990-2015)

Since 2000, the Canadian electricity sector has reduced its NOx emissions by 50.62%.

Source: Environment and Climate Change Canada, Air Pollutant Emissions Database
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
In 2015, in Canada Nitrogen Oxide emissions were measured at 1,893.78 kilotons.
Since 2000, the Canadian electricity sector has reduced its Hg Emissions by 62.9%.
In 2015, in Canada Mercury emissions were measured at 4,386.8 kg.

2015 Mercury Emissions in Canada by Source

- Total Ores and Mineral Industries: 31%
- Total Electric Power Generation: 18%
- Total Incineration and Waste: 31%
- Total Oil and Gas Industry: 2%
- Total Commercial/Residential/Institutional: 13%
- Total Transportation: 2%
- Total Manufacturing: 3%

Source: Environment and Climate Change Canada, Air Pollutant Emissions Database
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Since 2000, the Canadian electricity sector has reduced its PM2.5 emissions by 82.98%.
In 2015, in Canada PM2.5 emissions were measured at 1,620.87 kilotonnes.
Emissions Trends

Electricity Sector in Canada Sulphur Oxide (SOx) Emissions (1990-2015)

Electricity Sector in Canada Nitrogen Oxide (NOx) Emissions (1990-2015)

Electricity Sector in Canada Mercury Emissions (1990-2015)

Electricity Sector in Canada PM2.5 Emissions (1990-2015)

Source: Environment and Climate Change Canada, Air Pollutant Emissions Database
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Since 2000, the Canadian electricity sector has reduced its CO$_2$ Eq. Emissions by 38.05%
In 2015, in Canada CO\(_2\) Eq. emissions were measured at 723 Megatonnes.
Carbon Dioxide (CO₂) Emissions

1990 - 2015 Trend of CO₂ Eq. Emissions by Economic Sector

Source: Environment and Climate Change Canada, Air Pollutant Emissions Database
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Electricity Sector Leads in CO₂ Eq. Reduction

Forecasted Change in Emissions by Sector 2005-2020

<table>
<thead>
<tr>
<th>Sector</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
Electricity Sector Leads Reduction Forecast

CO2 Electricity (Economic Sector) CO2 Eq. Emissions Intensity Forecast to 2020

2016-2020 projections performed with linear regression

Source: Environment and Climate Change Canada, Canada’s Emissions Trends 2015, StasCan Table 127-001 – Utilities Only
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 Coal Regulation*

* Retirement age 45-50 years as per the 2012 *Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations*. Includes Ontario coal shutdown by 2014.

Source: NPRI data
Data Retrieved: July 2017; 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

Figure ES-14: U.S. Greenhouse Gas Emissions Allocated to Economic Sectors (MMT CO₂ Eq.)

Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2015), Figure ES-14
Data Retrieved: August 2017; Visual Created by the U.S. Environmental Protection Agency

GHG Emissions in Canada by Sector (2015)
- Oil and Gas, 26.14%
- Electricity, 10.93%
- Transportation, 23.93%
- Buildings, 11.89%
- Heavy Industry, 10.37%
- Agriculture, 10.10%
- Waste & Others, 6.64%
- Other, 6.64%

Emission Total – Canada: 723 Mt CO2 Eq.

- Electricity Generation, 29.47%
- Transportation, 27.43%
- Industry, 21.43%
- Commercial, 6.64%
- Agriculture, 8.66%
- Residential, 5.66%
- Other, 5.66%
- U.S. Territories, 0.71%

Emission Total – United States: 6,587 Mt CO2 Eq.

Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2015), Figure ES-14; Environment Canada, National Inventory Report (1990-2015) Table S-3, Data Retrieved: August 2017; 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

<table>
<thead>
<tr>
<th>Year</th>
<th>Population (Million)</th>
<th>Residential Usage (GWh/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>27.79</td>
<td>129,831</td>
</tr>
<tr>
<td>2015</td>
<td>35.85</td>
<td>169,016</td>
</tr>
<tr>
<td>2040</td>
<td>44.05</td>
<td>207,668</td>
</tr>
<tr>
<td>2050</td>
<td>46.87</td>
<td>220,953</td>
</tr>
</tbody>
</table>

**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
Forecasted Population Growth in Canada (2025 - 2055)

- **Low Growth**: Business as usual scenario.
- **Moderate Growth**: Electricity Needs based on Moderate Population Growth.
- **High 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 - 2015)

Cumulative changes per Household from 1999-2015.

- Internet Services: 229.34%
- Electricity: 43.70%

Data Source: StatsCan, CANSIM Table 203-0021
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Household Spending (1999 vs. 2015)

Data Description
Percentage increase in 2015 comparing against 1999 household spending levels.

- Electricity: 53.5%
- Public Transit: 67.1%
- Property Taxes: 72.4%
- Water and Sewage: 131.7%
- Internet Services: 708.7%
- Cell Phone Services: 711.6%

Data Source: StatsCan, CANSIM Table 203-0021
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Spending Increases Per Household Comparing 2015 to 2010.

- Internet Services 43.81%
- Cell Phone Services 43.23%
- Water and Sewage 23.92%
- Property Taxes 17.15%
- Electricity 14.39%
- Public Transit 4.86%
Multinational Comparison (Residential Pricing)


Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
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.
Multinational Comparison (Industrial Pricing)

Selected Countries, Industrial Electricity Prices (2015)

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

Data Source: World Energy Statistics 2016, IEA
Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Multinational Comparison (Industrial Pricing)


Data Retrieved: July 2017; Visual Created by the Canadian Electricity Association
Electric Vehicle Penetration (Canada)

In 2016 Canada sold a total of **11.58 Thousand EV’s**
In 2016, Canada had over 4,200 publicly available charging stations. That is 404 for 100,000 km of roadways or less than 0.5 per 100km of roadways.
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)
GDP Contribution

Electric Power (Generation, Transmission, Distribution) to Canada’s GDP (2000-2016)

Data Source: StatsCan CANSIM Table 379-0031
Data Retrieved: August 2017; Visual Created by the Canadian Electricity Association

- 2000: 20.0 Billion CDN$
- 2001: 20.2 Billion CDN$
- 2002: 20.5 Billion CDN$
- 2003: 20.8 Billion CDN$
- 2004: 21.1 Billion CDN$
- 2005: 21.4 Billion CDN$
- 2006: 21.7 Billion CDN$
- 2007: 22.0 Billion CDN$
- 2008: 30.6 Billion CDN$
- 2009: 29.3 Billion CDN$
- 2010: 28.3 Billion CDN$
- 2011: 28.1 Billion CDN$
- 2012: 28.0 Billion CDN$
- 2013: 27.9 Billion CDN$
- 2014: 27.8 Billion CDN$
- 2015: 27.7 Billion CDN$
- 2016: 27.6 Billion CDN$

- 30.556 Billion CDN$
- 29.261 Billion CDN$
Utility Investments

Annual Capital and Repair Expenditures

Data Source: StatsCan CANSIM Table 029-0050, Annual Capital and Repair Expenditures Survey
Data Retrieved: August 2017; 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: August 2017; Visual Created by the Canadian Electricity Association
Infrastructure Projects

Infrastructure is critical to national security and longevity.

- MPMO Sector Projects – Active Projects
- MPMO Sector Projects – Indirect Relevance
- Manitoba-Minnesota Transmission Project
- MPMO Sector Projects – New Proposals
### Active Projects

<table>
<thead>
<tr>
<th>MPMO Project Name</th>
<th>Description</th>
<th>Proponent</th>
<th>Project Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labrador - Island Transmission Link</td>
<td>1,100 km line</td>
<td>Nalcor Energy</td>
<td>Transmission</td>
<td>NL</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>Transmission</td>
<td>NL/NS</td>
</tr>
<tr>
<td>Keeyask Hydroelectric Generation</td>
<td>695 MW</td>
<td>Keeyask Hydropower Limited Partnership</td>
<td>Hydro</td>
<td>MB</td>
</tr>
<tr>
<td>Lower Churchill Hydroelectric Generation</td>
<td>3,074 MW</td>
<td>Nalcor Energy</td>
<td>Hydro</td>
<td>NL</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>
</tr>
<tr>
<td>Darlington New Nuclear Power Plant</td>
<td>Up to 4,800 MW</td>
<td>OPG</td>
<td>Nuclear</td>
<td>ON</td>
</tr>
<tr>
<td>NaiKun Offshore Wind Energy</td>
<td>320 MW (off-shore)</td>
<td>NaiKun Wind Development</td>
<td>Wind</td>
<td>BC</td>
</tr>
<tr>
<td>Tazi Twe Hydroelectric Generation</td>
<td>50 MW</td>
<td>Saskatchewan Power Corp.</td>
<td>Hydro</td>
<td>SK</td>
</tr>
</tbody>
</table>
### Active Projects: Indirect Relevance

<table>
<thead>
<tr>
<th>MPMO Project Name</th>
<th>Description</th>
<th>Proponent</th>
<th>Project Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bow City Coal Mine and Power</td>
<td>2x 500 MW</td>
<td>Bow City Power Ltd.</td>
<td>Coal</td>
<td>AB</td>
</tr>
<tr>
<td>Deep Geological Depository</td>
<td>Waste Management</td>
<td>Ontario Power Generation</td>
<td>Nuclear</td>
<td>ON</td>
</tr>
</tbody>
</table>

**Note:** indirect relevance refers to projects that are indirectly related to electricity generation and include infrastructure related activities, such as mining (of coal for power generation), waste management (of radioactive waste) and dam (re)construction.
# Non-MPMO – Sector Projects

## New Proposals

<table>
<thead>
<tr>
<th>MPMO Project Name</th>
<th>Description</th>
<th>Proponent</th>
<th>Project Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipole III Transmission Line</td>
<td>1,475 km</td>
<td>Manitoba Hydro</td>
<td>Transmission</td>
<td>MB</td>
</tr>
<tr>
<td>Chamouchouane - Bout-de-l’Île Transmission Line</td>
<td>735 kV</td>
<td>Quebec Hydro</td>
<td>Transmission</td>
<td>QC</td>
</tr>
<tr>
<td>Green Electron Natural Gas Power Generation Project</td>
<td>300 MW</td>
<td>Greenfield South Power Corporation</td>
<td>Generation</td>
<td>ON</td>
</tr>
<tr>
<td>Hawkeye Green Energy Hydroelectric Generation</td>
<td>175 MW</td>
<td>Hawkeye Energy Corporation</td>
<td>Hydro</td>
<td>BC</td>
</tr>
<tr>
<td>Mica 5 and 6</td>
<td>1000 MW</td>
<td>BC Hydro</td>
<td>Hydro</td>
<td>BC</td>
</tr>
<tr>
<td>Rocky Creek Wind Power</td>
<td>500 MW</td>
<td>Rupert Peace Power Corporation</td>
<td>Wind</td>
<td>BC</td>
</tr>
<tr>
<td>Trillium Offshore Wind Farm</td>
<td>414 MW</td>
<td>Trillium Power Wind Corporation</td>
<td>Wind</td>
<td>ON</td>
</tr>
</tbody>
</table>

**Note:** indirect relevance refers to projects that are indirectly related to electricity generation and include infrastructure related activities, such as mining (of coal for power generation), waste management (of radioactive waste) and dam (re)construction.
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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