CANADA’S ELECTRICITY INDUSTRY
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The Canadian Electricity Association (CEA)

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

- Mission Statement: A safe, secure, reliable, sustainable and competitively-priced supply of electricity is essential to Canada’s prosperity.
CEA’s Corporate Utility Members
CEA Corporate Partners Program Membership
CEA Mission Statement

A safe, secure, reliable, sustainable and competitively priced supply of electricity is essential to Canada’s prosperity. CEA is the voice of the Canadian electricity industry, promoting electricity as the critical enabler of the economy and Canadians’ expectations for an enhanced quality of life.
CEA Strategic Goals

**Infrastructure** – Ability to build needed electricity infrastructure, to meet growing demand and replace aging assets.

**Energy Efficiency** – Ability to provide options to customers to assist them in using electricity more efficiently, manage costs and minimize environmental impacts.

**Technology** – Ability to maximize and deploy leading-edge technologies.

**Regulation** – Need for more coordinated, effective and efficient regulatory regimes within and between governments, and more timely decisions.

**Environment** – Need for holistic approach and greater regulatory coherence on environmental issues.

**Security** – Need to ensure the long-term security, reliability and stability of the electricity system.
Canada’s Multi-Jurisdictional Environment

<table>
<thead>
<tr>
<th>Jurisdictional Division of Responsibility</th>
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<tbody>
<tr>
<td><strong>Provincial/Territorial Governments</strong></td>
<td><strong>Federal Government</strong></td>
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<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>
</tr>
<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 Structures in Canada

Saskatchewan
- Wholesale open access
- Vertically-integrated Crown corporation

Alberta
- Mandatory Power Pool
- Wholesale & retail open access since 2001
- Fully competitive wholesale market

Manitoba
- Wholesale open access
- Vertically-integrated Crown corporation

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

BC
- Wholesale & industrial open access
- Vertically-integrated Crown corporation serves 94% of customers

Ontario
- Industry unbundling in 1998
- Wholesale & retail open access since 2002
- Hybrid regulation and competition model

Newfoundland
- Vertically-integrated Crown corporation and investor-owned distribution utility

PEI
- Procures electricity from New England market and long-term contracts with New Brunswick

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

Nova Scotia
- Wholesale open access
- Investor-owned utility regulated on cost-of-service
North American Electric Reliability Corporation (NERC) Regions
Electricity Demand in Canada by Sector, 2013

Total Electricity Demand in Canada, 2013 = 481.52 TWh

- Industrial: 43%
- Residential: 33%
- Commercial & Institutional: 18%
- Agriculture: 2%
- Transportation: 1%
- Public Administration: 3%

*Numbers may not sum to 100 percent due to rounding

Electricity Demand in Canada by Sector, 1990 - 2013

Total Electricity Demand in Canada, 2013 = 481.52 TWh

Electricity Generation in Canada by Fuel Type, 2013

Total Electricity Generated in Canada, 2013 = 620.44 TWh

- Hydro: 62.8%
- Conventional Steam: 14.6%
- Nuclear: 13.3%
- Combustion Turbine: 7.1%
- Wind: 1.9%
- Internal Combustion: 0.3%
- Tidal: 0.00%
- Solar: 0.06%

*Numbers may not sum to 100 percent due to rounding.

Source: Statistics Canada, Electric power generation, by class of electricity producer, annual (CANSIM Table 127-0007), 2013

Retrieved May 30, 2015
Electricity Generation in Canada by Fuel Type, 1990 - 2013

Total Electricity Generation in Canada, 2013 = 620.44 TWh

*Prior to 2008, wind and tidal generation are included in hydro.

Source: Statistics Canada, Electric power generation, by class of electricity producer, annual (CANSIM Table 127-0007), 2013

Retrieved May 30, 2015
Electricity Generation in Canada by Province and Fuel Type, 2013

Total Electricity Generation in Canada, 2013 = 620.44 TWh

*Point Lepreau nuclear generating station resumed power production on November 23, 2012, nuclear has been re-established as a major source (about 30%) of electricity in New Brunswick.

Source: Statistics Canada, Electric power generation, by class of electricity producer, annual (CANSIM Table 127-0007), 2013
Retrieved May 30, 2015
Canada-U.S. Electricity Trade Volume, 1990 – 2014

Canada-U.S. Natural Gas Trade Volume, 1990 – 2014

Source: Statistics Canada, Natural Gas Exports and Imports, 2014
Retrieved May 30, 2015
The California Energy Crisis of 2000 and 2001 was the situation when California had a shortage of electricity. 

Canada-U.S. Natural Gas Trade Revenue, 1990 – 2014

Source: Statistics Canada, Natural Gas Exports and Imports, 2014
Retrieved May 30, 2015
Canada-U.S. Natural Gas Export/Import Prices, 2002 – 2014

Source: Statistics Canada, Natural Gas Exports and Imports, 2014
Retrieved May 30, 2015
Canada-U.S. Electricity Export/Import Prices, 1997 – 2014

Canada-U.S. Natural Gas and Electricity Export/Import Price Comparison, 2002 – 2014

Source: National Energy Board, 2012
Retrieved May 30, 2015
U.S.-Canada Electricity Trade Volume (1990–2014)

2014 Exports = 59.2 TWh  
2014 Imports = 12.8 TWh  
2014 Net = 46.4 TWh

Retrieved March 6, 2015.
Major Canada-U.S. Transmission Interconnections

Source: National Energy Board
Electricity Exports and Imports Between Canada and the U.S. (2014)

Data displayed are in gigawatt hours
Numbers may not sum due to rounding
The Integrated North American Grid

Map copyright CEA.

Lines shown are 345kV and above. There are numerous interconnections between Canada and the U.S. under 345KV that do not appear on this map.
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.
Utility Investment in Canada’s Transmission and Distribution Cable and Lines, 1998 – 2010

2010 Transmission Investment = $2.4 Bn
2010 Distribution Investment = $2.5 Bn

Source: Statistics Canada, Survey 2803, 2009
Source: CEA member reporting data for years 2008-2010, based on 2010 Sustainable Electricity Annual Report
Note: Statistics Canada and CEA member data combined

Source: Statistics Canada, Gross domestic product at basic prices, utilities, trade, transportation, and communications. Retrieved June 9, 2015
Capital Investment in Canada’s Electric Power Sector, 2007–2012 (billions of constant 2007 dollars)

Total capital investment in 2012 = $18.7 billion

Source: Statistics Canada, Survey 2820, 2012
Retrieved June 21, 2015
Electric Sector Environmental Protection Expenditures by type, 2012

Total electric sector environmental protection expenditures, 2012 = $1301.6 million

- Reclamation and decommissioning: 27%
- Waste management and sewerage services: 42%
- Environmental assessments and audits: 15%
- Pollution prevention, abatement and control: 7%
- Wildlife and habitat protection: 6%
- Fees, fines and licenses: 0%
- Other: 0%

Environmental Protection Expenditures by the Electric Power Sector, 1996 – 2012

Total electric sector environmental protection expenditures, 2012 = $1301.6 million

Greenhouse Gas (GHG) Emissions in Canada by Sector, 2013

Total GHG Emissions in Canada, 2013 = 726 Mt CO$_2$ Equivalent

- Oil and Gas (179 Mt CO$_2$ equivalent) 24.8%
- Electricity (85 Mt CO$_2$ equivalent) 12.3%
- Transportation (170 Mt CO$_2$ equivalent) 23.6%
- Agriculture (75 Mt CO$_2$ equivalent) 9.9%
- Buildings (86 Mt CO$_2$ equivalent) 11.5%
- Emissions Intensive & Trade Exposed Industries (76 Mt CO$_2$ equivalent) 11.2%
- Waste & Others (54 Mt CO$_2$ equivalent) 6.7%
- Buildings (86 Mt CO$_2$ equivalent) 11.5%

Note: Emissions do not include the following sectors: land use change and forestry, solvent and other product use and biomass.


Total GHG Emissions in Canada, 2013 = 726 Megatonnes CO₂ Equivalent

Total Energy Sector GHG Emissions in Canada, 2013 = 588 Megatonnes CO₂ Equivalent

- Transportation: 28.6%
- Electricity & Heat Generation: 14.3%
- Emissions Intensive and Trade Exposed Industries: 7.0%
- Fossil Fuel Industries*: 10.5%
- Buildings: 12.7%
- Agriculture: 2.5%
- Light Manufacturing, Construction & Forest Resources: 4.0%

Note: Total energy sector emissions include all those under the National Inventory Category, ‘Energy’.

*includes Oil & Gas and Coal Production
CO₂ Emissions in Canada for Public Electricity and Heat Production Sector, 2013

Total Public Electricity & Heat Sector CO₂ Emissions in Canada, 2013 = 85 Megatonnes

- Gaseous Fuels (e.g. natural gas), 18.35%
- Liquid Fuels (e.g. diesel, oil), 2.38%
- Solid Fuels (e.g. coal), 78.74%
- Biomass, 0.53%

Source: UNFCCC, National Inventory Submission for Canada, for 1990-2013, Report dated June 11, 2015
Utility-Generated Electricity by Source and GHG Emissions, 1990–2013

Public Electricity Generation by Source and GHG Emissions, 1990–2013

Nitrogen Oxide (NO\textsubscript{x}) Emissions in Canada by Sources, 2013

Total NO\textsubscript{x} Emissions in Canada, 2013 = 2,061 Kilotonnes

Source: Environment Canada, National Pollutant Release Inventory, 2013 Air pollutant emissions summary for Canada
Retrieved June 10, 2015
Sulphur Oxide (SO$_x$) Emissions in Canada by Sources, 2013

Total SO$_x$ Emissions in Canada, 2013 = 1,230 Kilotonnes

- **Electric Power** 22.6%
- **Petroleum Industry (Up & Downstream)** 24.5%
- **Other Industrial** 14.1%
- **Open & Natural Sources** 0.8%
- **Residential/Commercial Fuel & Wood** 3.0%
- **Incineration & Miscellaneous** 0.2%
- **Non-Ferrous Smelting and Refining Industry** 30.1%
- **Mobile Sources** 6.1%

Source: Environment Canada, National Pollutant Release Inventory, 2013 Air pollutant emissions summary for Canada
Retrieved June 11, 2015
Electric Sector Sulphur Oxide (SO$_x$) Emissions in Canada, 1990 - 2013

Total Electric Sector SO$_x$ Emissions in Canada, 2013 = 278 Kilotonnes

Mercury Emissions in Canada by Sources, 2013

Total Mercury Emissions in Canada, 2013 = 3,969.2 Kilograms

- Electric Power: 22.5%
- Residential & Commercial Fuel & Wood: 4.1%
- Open Sources: 13.3%
- Incineration & Miscellaneous: 16.4%
- Non-Ferrous Smelting and Refining Industry: 9.0%
- Cement and Concrete Industry: 7.8%
- Iron and Steel Industries: 15.0%
- Other Industrial Sources: 6.5%
- Petroleum Industry (Up- & Downstream): 3.0%
- Mobile Sources: 2.2%

Source: Environment Canada, National Pollutant Release Inventory, 2013 Air pollutant emissions summary for Canada
Retrieved June 15, 2015
Electric Sector Mercury Emissions in Canada, 1990 - 2013

Total Electric Sector Mercury Emissions in Canada, 2013 = 895.1 Kilograms

Source: Environment Canada, National Pollutant Release Inventory (NPRI)
Retrieved on June 15, 2015
Particulate Matter ($PM_{2.5}$) Emissions in Canada by Sources, 2013

Total $PM_{2.5}$ Emissions in Canada, 2013 = 1,483.4 Kilotonnes

- Open & Natural Sources: 79.5%
- Mobile Sources: 3.8%
- Petroleum Industry (Up- & Downstream): 0.7%
- Other Industrial: 3.0%
- Electric Power: 0.2%
- Incineration & Miscellaneous: 0.6%
- Mining and Rock Quarrying: 0.7%
- Residential & Commercial Fuel & Wood: 11.4%

Source: Environment Canada, National Pollutant Release Inventory, 2013 Air pollutant emissions summary for Canada
Retrieved June 15, 2015
Electric Sector Particulate Matter (PM) Emissions in Canada, 1990 - 2013

Total Electric Sector PM$_{2.5}$ Emissions in Canada, 2013 = 3,207 Kilotonnes

Source: Environment Canada, National Pollutant Release Inventory (NPRI)
Retrieved on June 15, 2015
2013 CO₂ Electricity Emissions and Intensity in Canada

88.3 MT CO₂ e Emissions
160 Tonnes/GWh CO₂ e System Intensity

Source: National Inventory Report, 1990-2013
Greenhouse Gas (GHG) Emissions in Canada and the US by Sector, 2013

**Total GHG Emissions in Canada, 2013 = 726 Megatonnes CO₂ Equivalent**

- Transportation: 24.4%
- Other Energy*: 16.8%
- Electricity & Heat Generation: 12.2%
- Fossil Fuel Industries...
- Agriculture: 10.8%
- Industrial Processes: 10.9%
- Residential: 6.6%
- Commercial & Institutional: 5.7%
- Waste: 3.6%

**Total GHG Emissions in US, 2013 = 5,791.2 Megatonnes CO₂ Equivalent**

- Transportation: 27.0%
- Industry: 20.8%
- Agriculture: 8.8%
- Commercial: 6.0%
- Residential: 5.6%
- U.S. Territories: 0.9%
- Electric Power Industry: 31.0%


*includes all the other energy sector emission sources, such as mining, manufacturing, and construction, fugitive sources and agriculture/forestry/fisheries
Electricity Generating Capacity in the US and Canada by Fuel Type,¹ 2013

Canada

- Hydro: 59.26%
- Nuclear: 10.46%
- Combustion Turbine: 8%
- Internal Combustion: 0.06%
- Conventional Steam (Coal): 16.00%
- Wind: 4.20%
- Tidal and Solar: 0.01%

Total Generating Capacity = 127.8 GW

United States

- Natural Gas: 40%
- Coal: 27%
- Petroleum: 4%
- Wind: 5%
- Hydro: 6%
- Nuclear: 9%
- Others: 9%

Total Generating Capacity = 1,065 GW

¹Numbers may not sum to 100 percent due to rounding.
Electricity Generation in the US and Canada by Fuel Type,¹ 2014

Note: Total Electricity Generation in 2014 = 599.8 TWh

¹Numbers may not sum to 100 percent due to rounding.

Building the Next Generation of Infrastructure: Capital Investment Requirements

<table>
<thead>
<tr>
<th></th>
<th>Billions of 2010 CDN dollars</th>
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<tbody>
<tr>
<td></td>
<td>Generation</td>
</tr>
<tr>
<td>2010 – 2030</td>
<td>195.7</td>
</tr>
</tbody>
</table>

Total Canadian Electric Sector Investment Required by 2030 = 293.8 Billion in 2010 CDN dollars, or **347.5 Billion in current CDN dollars**.

Source: The Conference Board of Canada, Shedding Light on the Economic Impact of Investing in Electricity Infrastructure, February 2012
## Active MPMO Electricity Sector 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>

Source: Major Projects Management Office, Project Tracker, updated June 22, 2015
Active MPMO Electricity Sector 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.

Source: Major Projects Management Office, Project Tracker, Updated June 22, 2015
Non-MPMO Electricity 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.

# Canada’s Regulatory Regime for Large Energy Projects

<table>
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<tr>
<th>Planning</th>
<th>Environmental Assessment Process</th>
<th>Permitting</th>
<th>Follow-up</th>
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<tr>
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<td><strong>Species at Risk Act - EC/DFO</strong></td>
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<td><strong>Metal Mining Effluent Regulations - EC/DFO</strong></td>
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<td><strong>Explosives Act - NRCan</strong></td>
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<td><strong>Fisheries Act - DFO</strong></td>
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<td><strong>NWPA - TC</strong></td>
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<td></td>
<td>Others: MBCA / IBWTA / CPRA / Offshore Accords / CEPA</td>
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<td><strong>Impact reviews (YESAA, MVRMA Land Claim / CEAA)</strong></td>
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<td><strong>Innuvialuit Final Agreement - INAC</strong></td>
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<td><strong>Management Boards</strong></td>
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<td><strong>Territorial Lands / Water Act</strong></td>
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<td><strong>Environmental Assessment Process Permitting Planning Follow-up</strong></td>
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<td><strong>Canadian Environmental Assessment Act - CEA Agency</strong></td>
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<td><strong>National Energy Board Act - NEB</strong></td>
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<td><strong>Nuclear Safety and Control Act - CNSC</strong></td>
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*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
Average Residential Electricity Price in Canada, 1998 – 2014 (cents/kWh)

Ontario Hydro: Electricity Rates by Province, Retrieved June 20, 2015

Notes: Based on 1,000 kWh monthly consumption
Average electricity price is an average of 11 major Canadian cities for years 1998-2008 and an average of 12 major Canadian cities for years 2009-2013; and may not represent an exact national average.
Selected World Residential Electricity Prices, 2013

<table>
<thead>
<tr>
<th>Country</th>
<th>US cents/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>40</td>
</tr>
<tr>
<td>Italy</td>
<td>35</td>
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<td>Japan</td>
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<td>Ireland</td>
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<td>Finland</td>
<td>22</td>
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<tr>
<td>Poland</td>
<td>20</td>
</tr>
<tr>
<td>Turkey</td>
<td>20</td>
</tr>
<tr>
<td>France</td>
<td>20</td>
</tr>
<tr>
<td>United States</td>
<td>18</td>
</tr>
<tr>
<td>Canada</td>
<td>11</td>
</tr>
<tr>
<td>Mexico</td>
<td>10</td>
</tr>
</tbody>
</table>


Hydro Quebec, *Comparison of Electricity Prices in North American Cities 2014*
Selected World Industrial Electricity Prices, 2013

- Italy
- Ireland
- Portugal
- Turkey
- United Kingdom
- Switzerland
- Belgium
- France
- Mexico
- Denmark
- Poland
- Finland
- Canada
- United States

Hydro Quebec, *Comparison of Electricity Prices in North American Cities 2014*
Note: The price increase for the residential electricity sector has increased 39% between 1999 and 2013, the lowest amongst property taxes, water and internet services for principle accommodation.
Canada’s Future Residential Electricity Needs

- **20 Years Ago**: 27.5M
  - RESIDENTIAL USAGE: 129,331 GWh/yr
- **Today**: 34.0M
  - RESIDENTIAL USAGE: 160,261.6 GWh/yr
- **20 Years Ahead***: 42.0M
  - RESIDENTIAL USAGE: 197,969.47 GWh/yr

*Estimated forecast

Reference: Graphics from BC Hydro: Lighting the Way. Estimates based on a business as usual scenario. Stats Canada Population Projections: Table 052-0005
### 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><strong>Wind Power</strong></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><strong>Small Hydro</strong></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><strong>Biomass</strong></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><strong>Geothermal Energy</strong></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><strong>Solar PV</strong></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><strong>Ocean Energy</strong></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><strong>Clean Coal</strong></td>
<td>Highly efficient, potential for reduced greenhouse gas emissions</td>
<td>High capital costs, lengthy start-up period</td>
</tr>
</tbody>
</table>
Canadian Electricity Statistics

By the Global numbers…

5 Canada’s world ranking in primary energy production (2014)

6 Canada’s world ranking in primary energy consumption (2014)

24.3 Per cent of Canada’s total exports that were energy related (2014)

3 Canada’s ranking in Hydroelectricity generation (2014)

By the Domestic numbers…

14.7 Per cent of Canada’s electricity produced from nuclear generation (2014)

10.77 Per cent of Canada’s electricity produced by coal (2014)

62.6 Per cent of Canada’s electricity generated from hydropower (2014)

599.8 Terawatt-hours of total electricity generation (2014)
Installed Wind Capacity in Canada as of May 2014

Canada’s current installed capacity: 6,927 MW

Source: Canadian Wind Energy Association, retrieved May 28, 2014
Coal Fleet Profile (MW)

Coal Capacity Reduction - Retirement as per the Coal Regulation*

(Source: NPRI data)

* 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.
NO$_x$ and SO$_2$ Reductions from CO$_2$ Regulation

Reduction in SO$_2$ emission from 2002 levels:
- 54% reduction by 2020
- 84% reduction by 2030

Reduction in NO$_x$ 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
Electricity leading all Canadian industrial sectors in reduction of CO₂

Forecasted Change in Emissions By Economic Sector (2005-2020)

Regulations to address GHG emissions from coal-fired electricity (Sept. 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.
Vision 2050: the sector’s vision for Canada’s electricity system between now and 2050

- 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.
The CEA’s Sustainable Electricity Program: Guiding member efforts on sustainability

<table>
<thead>
<tr>
<th>ENVIRONMENTAL PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environment:</strong> Minimize the adverse environmental impacts of our facilities, operations and businesses</td>
</tr>
<tr>
<td><strong>Stewardship and Biodiversity:</strong> Manage the environmental resources and ecosystems that we affect to prevent or minimize loss and support recovery</td>
</tr>
<tr>
<td><strong>Climate Change:</strong> Manage greenhouse gas emissions to mitigate the impact of operations on climate change, while adapting to its effects</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOCIAL PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health and Safety:</strong> Provide a safe and healthy workplace for our employees and contractors</td>
</tr>
<tr>
<td><strong>Workplace:</strong> Support a fair, respectful and diverse workplace for our employees and contractors</td>
</tr>
<tr>
<td><strong>Communications and Engagement:</strong> Communicate with and engage our stakeholders in a transparent and timely manner</td>
</tr>
<tr>
<td><strong>Aboriginal Relations:</strong> Communicate with and engage Aboriginal Peoples in a manner that respects their culture and traditions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECONOMIC PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Economic Value:</strong> Provide economic benefits to shareholders, communities and regions in which we operate</td>
</tr>
<tr>
<td><strong>Energy Efficiency:</strong> Produce, deliver and use electricity in an efficient manner while promoting conservation and demand-side management</td>
</tr>
<tr>
<td><strong>Security of Supply:</strong> Provide electricity customers in a safe, reliable and cost-effective manner to meet current and future needs</td>
</tr>
</tbody>
</table>

Source: Canadian Electricity Association, 2014 *Sustainable Electricity Annual Report, Engaged for a Sustainable Future*
The CEA Councils

• Generation Council
  • Develops and influences policy associated with investment in electricity generation infrastructure, as well as manages environmental and health impacts related to generation
• Transmission Council
  • Formulates positions on transmission, including cross border reliability, electric and magnetic fields and utility properties
• Distribution Council
  • 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
• Customer Council
  • Seeks to increase the value of electricity service to Canadians
• Power Marketers Council
  • Promotes competitive and efficient electricity markets in Canada and the United States
Energy Efficiency

- Commitment to sustainability through efficient production, delivery and use of energy, while promoting energy conservation and demand side management
- CEA’s involvement in initiatives
  - Old refrigerator removal
  - Exchange programs to lower air conditioner levels during peak summer demand
  - Support for implementation of new technologies – smart meters for time-of-use pricing
- Promotion of conservation programs by CEA member utilities for their larger commercial, industrial and direct customers
- Demand Side Management
  - can be a least cost option,
  - postpones the development of new power plants,
  - improves energy efficiency
- Partnership among CEA, NRCan and utilities in promotion of ENERGY STAR qualified light fixtures
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 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
## Economic Value

<table>
<thead>
<tr>
<th>Economic Indicators for 2013</th>
<th>All Canadian Sectors Contribution</th>
<th>Canadian Electricity Sector Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP (billions chained 2007 dollars)</td>
<td>19,164</td>
<td>37.5</td>
</tr>
<tr>
<td>Merchandise Exports (dollars x 1,000,000)</td>
<td>528,954</td>
<td>2,945</td>
</tr>
<tr>
<td>Merchandise Imports (dollars x 1,000,000)</td>
<td>535,955</td>
<td>622</td>
</tr>
</tbody>
</table>
## Electricity in Canada at a Glance

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Generation in 2014 (Twh)</td>
<td>599.8</td>
</tr>
<tr>
<td>Total Demand in 2013 (Twh)</td>
<td>481.5</td>
</tr>
<tr>
<td>Average Price in 2014 (¢/kWh)</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>12.15</td>
</tr>
<tr>
<td>Industrial</td>
<td>7.31</td>
</tr>
<tr>
<td>Canada – US trade volume in 2014 (Twh): exports/imports</td>
<td>58/12.8</td>
</tr>
<tr>
<td>Canada – US trade revenue in 2014 (billions $): exports/imports</td>
<td>2.9/0.6</td>
</tr>
<tr>
<td>Capital Expenditure on New/Refurbished Infrastructure in 2010 (billion $)</td>
<td>8.8</td>
</tr>
<tr>
<td>Environmental Expenditure in 2010 (million $)</td>
<td>1171</td>
</tr>
<tr>
<td>GHG emissions from Public Electricity and Heat Production Sector</td>
<td>85</td>
</tr>
<tr>
<td>(CO₂, CH₄ and N₂O eq. Mt) in 2013</td>
<td></td>
</tr>
</tbody>
</table>
For more information, contact:

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Ottawa, ON   K1P 5H9

613 230 9263

info@electricity.ca