



ELECTRICITY 101

The following slide deck contains information about CEA and the Canadian electricity industry. Unless noted otherwise, charts were prepared by CEA based on data from third-party sources, such as Statistics Canada, Environment and Climate Change Canada, the International Energy Agency and the World Bank.



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IN 2016 THE ELECTRICITY INDUSTRY REPRESENTED 1.1% OF THE NATIONAL GDP.

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Canadian Electricity Association

LEARN MORE ABOUT THE *NATIONAL VOICE* OF
CANADIAN ELECTRICITY.

- [Vision and Mission](#)

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 is the best trade association.

Mission: CEA is the national voice for sustainable electricity for its members and the customers they serve.

Regulatory

CANADA HAS A *STRONG REGULATORY* ENVIRONMENT.

- [Canada's Multi-Jurisdictional Environment](#)
- [Electricity Structures Market in Canada](#)
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Canada's Multi-Jurisdictional Environment

Jurisdictional Division of Responsibility

Provincial/Territorial Governments

- Resource management within provincial boundaries
- Intra-provincial trade and commerce
- Intra-provincial environmental impacts
- Generation and transmission of electrical energy
- Conservation and demand response policies

Federal Government

- Resource management on frontier lands
- Nuclear safety
- Inter-provincial and international trade
- Trans-boundary environmental impacts
- Environmental impacts where federal lands, investment or powers apply
- Codes, standards and labeling relating to conservation and demand
- Other policies of national interest

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

PEI

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

Québec

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

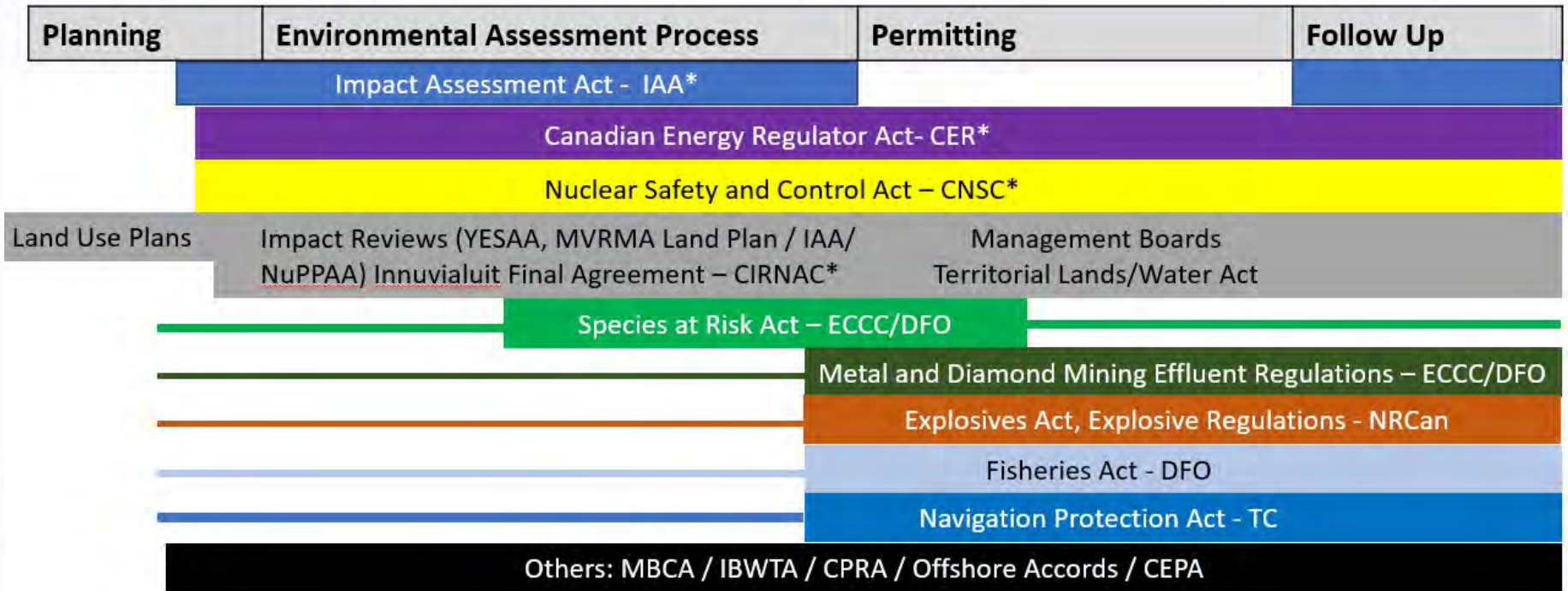
Saskatchewan

- Wholesale open access
- Vertically-integrated Crown corporation

Yukon

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

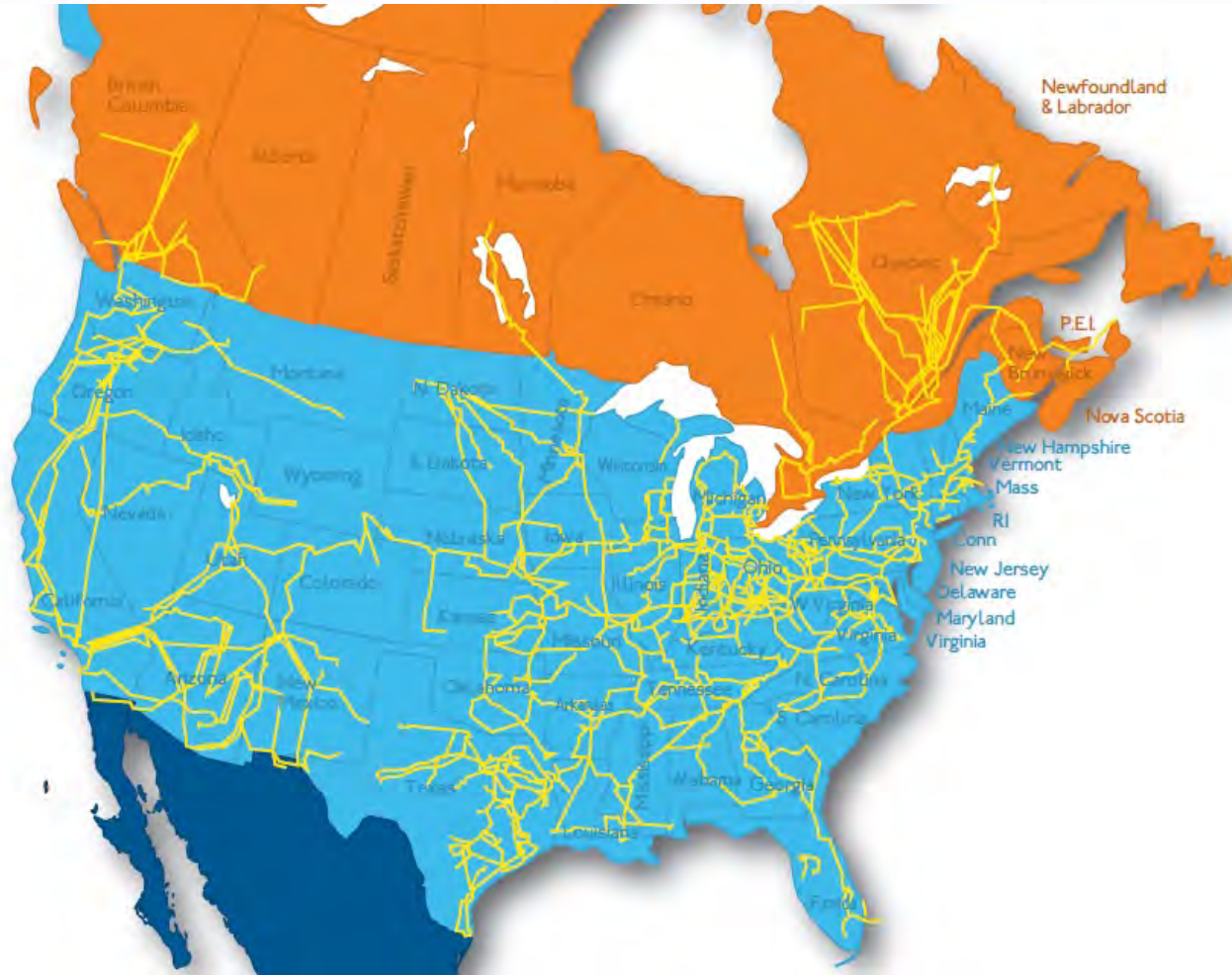
Canada's Regulatory Regime for Large Energy Projects



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

YESAA – Yukon Environmental and Socio-Economic Assessment Act / **MVRMA** – Mackenzie Valley Resource Management Act / **MBCA** – Migratory Birds Convention Act / **IBWTA** – International Boundary Waters Treaty Act / **CPRA** – Canadian Petroleum Resource Act / **Offshore Accords** – Canada – NS and NFDL Offshore Accords / **CEPA** – Canadian Environmental Protection Act / **NuPPAA** – Nunavut Planning and Project Assessment Act (NuPPAA)

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)



Acronym	Name
WECC	Western Electricity Coordinating Council
MRO	Midwest Reliability Organization
TRE	Texas Reliability Entity
SERC	Southeast Reliability Corporation
RF	Reliability First Corporation
NPCC	Northeast Power Coordinating Council, Inc.

Industry



THIS INDUSTRY EMPLOYS OVER 90,000 PEOPLE.

- [Industry Overview](#)
- [Customer Reliability](#)
- [Labour Statistics](#)
- [Electricity Consumption with Human Development Index](#)

Industry Overview

Electricity

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

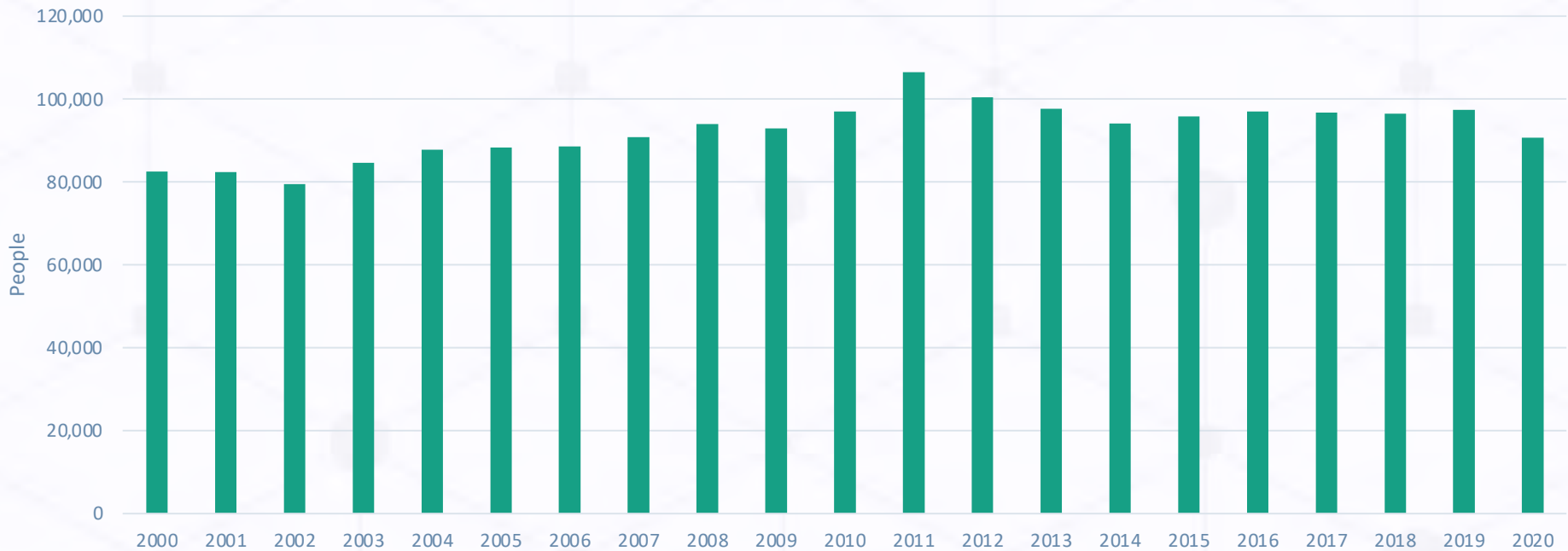
- + **90,685** Employed
- + **633 TW.h** Generation
- + **57.3 TW.h** Net Exports
- + **Over 80%** Non-Emitting
- + **\$33.1 Billion** GDP
- + **99.93%** Customer Reliability
- + **2.3 Billion** Net Trade Revenue
- + **54%** GHG Emissions Reduction Since 2000



Industry Labour Statistics in Canada

2020: 90,685

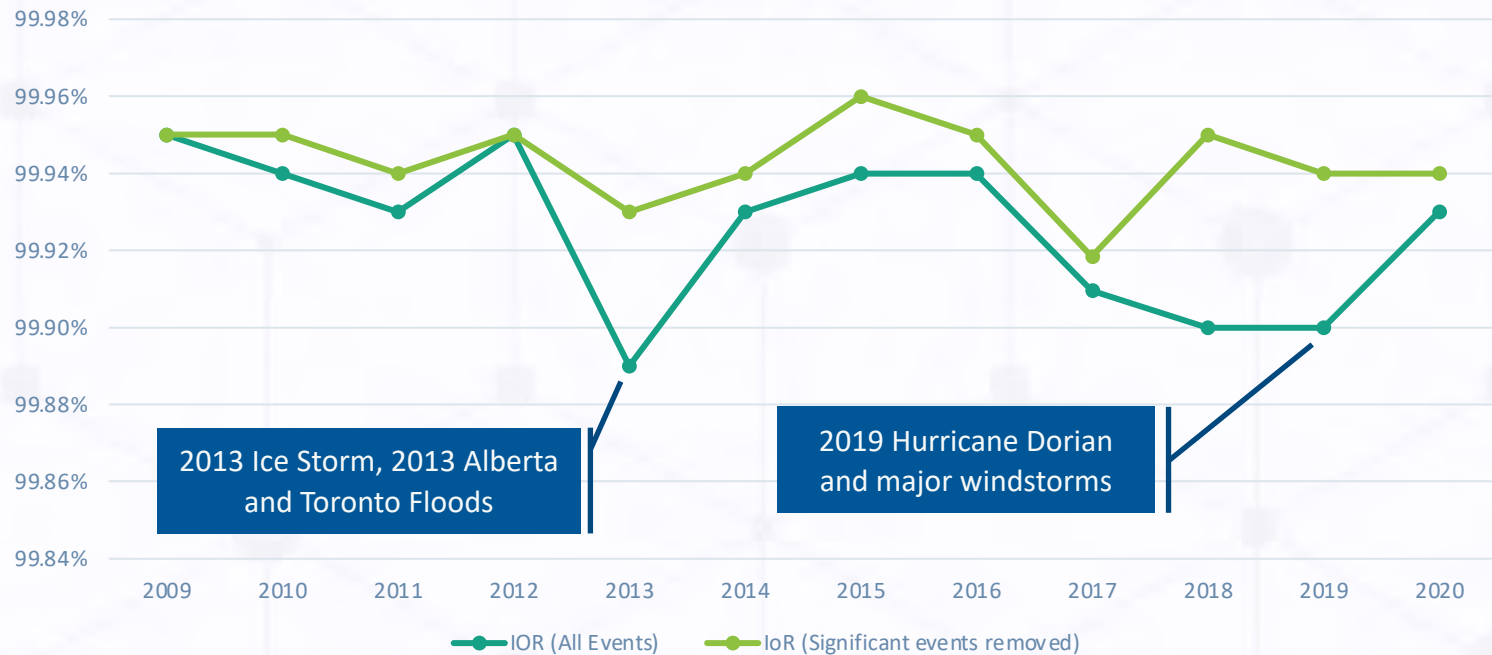
Electric Power (Generation, Transmission and Distribution)



Excludes consultants, vendors and related manufacturers dedicated to the industry.

Customer Reliability in Canada

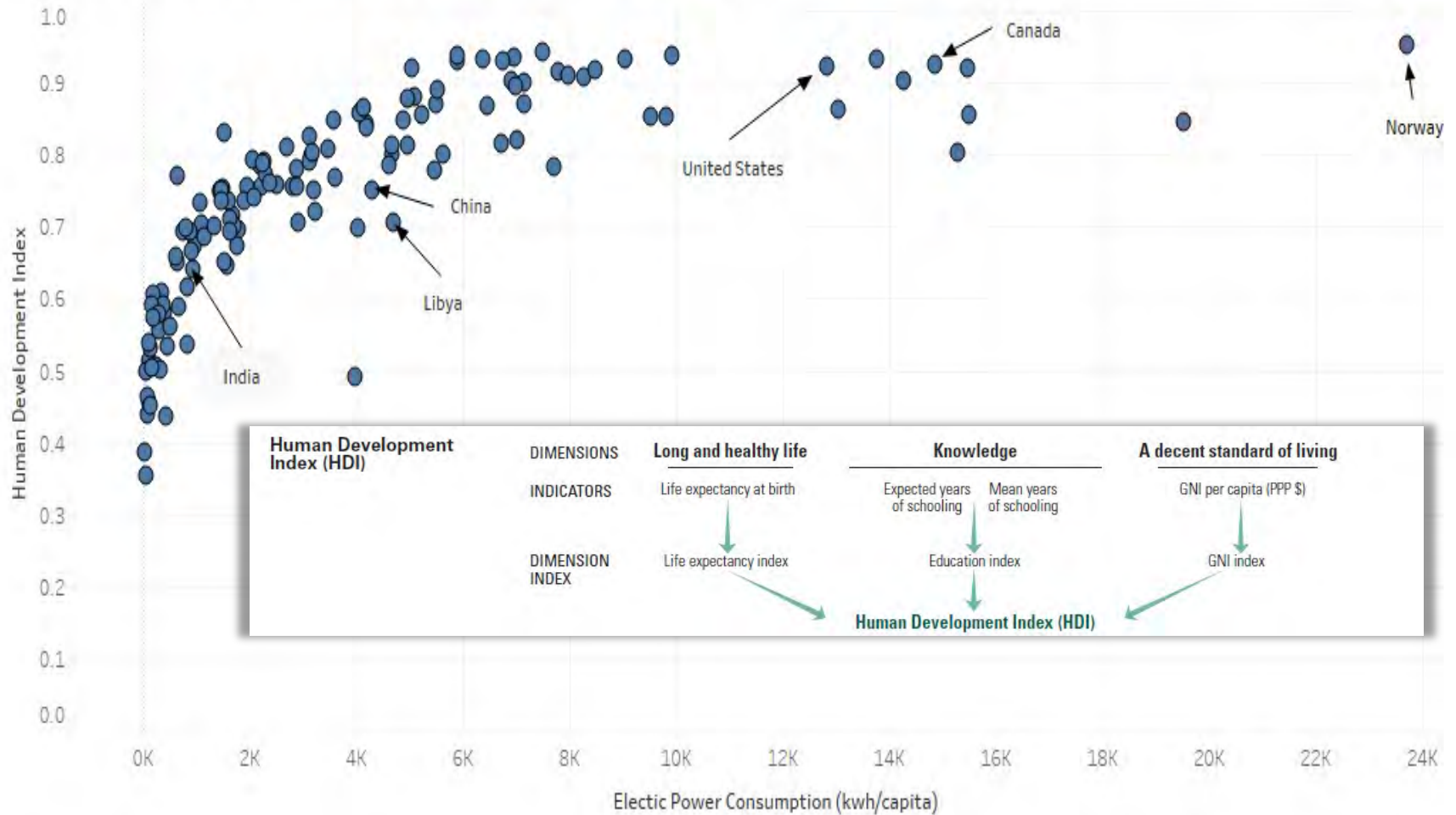
Canadian Index of Reliability (IoR) (2009-2020)



Significant Events are catastrophic events that are outside the control of the utility and impact the Canadian Index.

Electricity Consumption Benefit

Human Development Index with Electric Power Consumption (kwh per capita)



Data Source: HDI data, HDI Definition: United Nations; and Energy Consumption: EIA, World Energy Statistics 2018
Data Retrieved: June 2019; Visual Created by the Canadian Electricity Association.

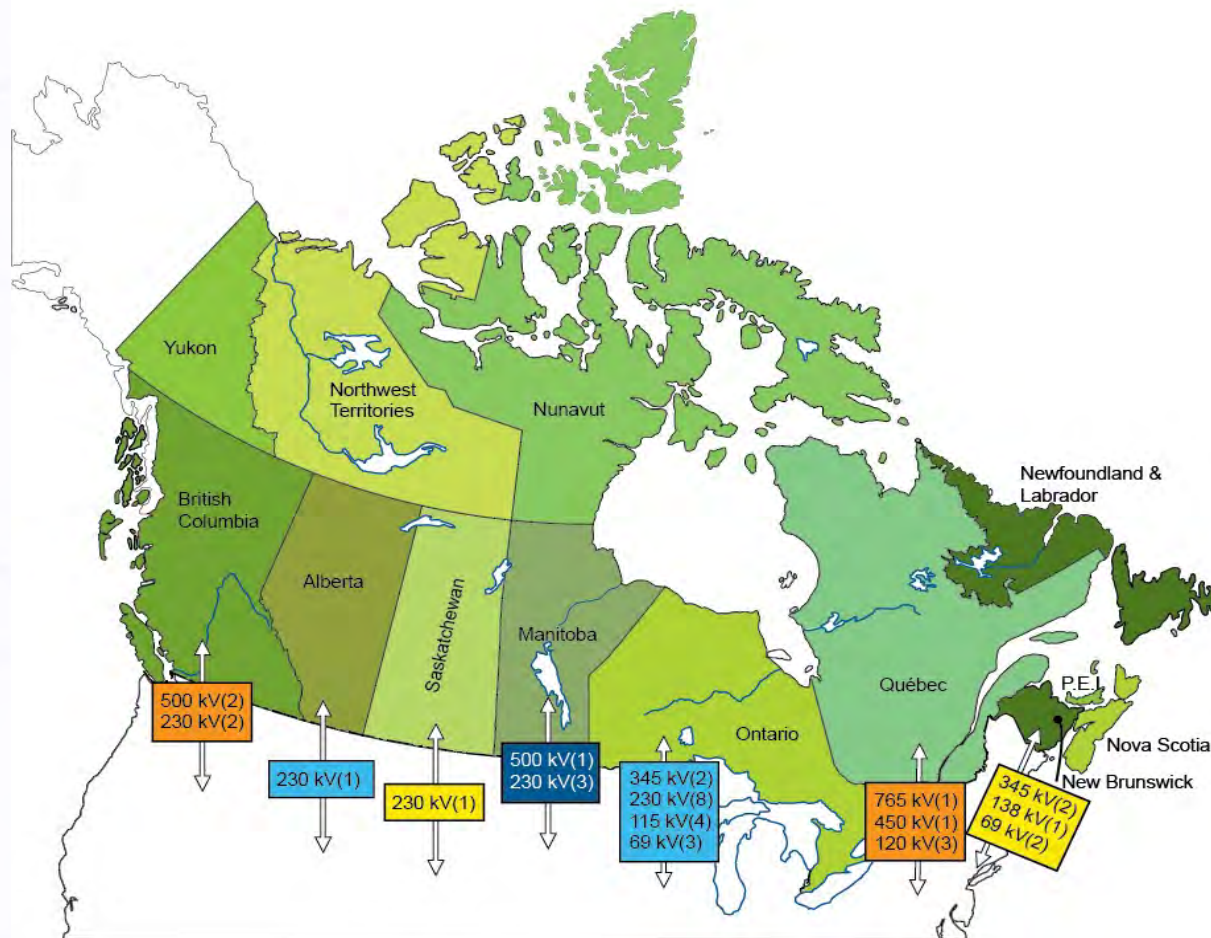
Trade

ELECTRICITY TRADING BETWEEN CANADA AND THE USA
BEGAN IN 1901.

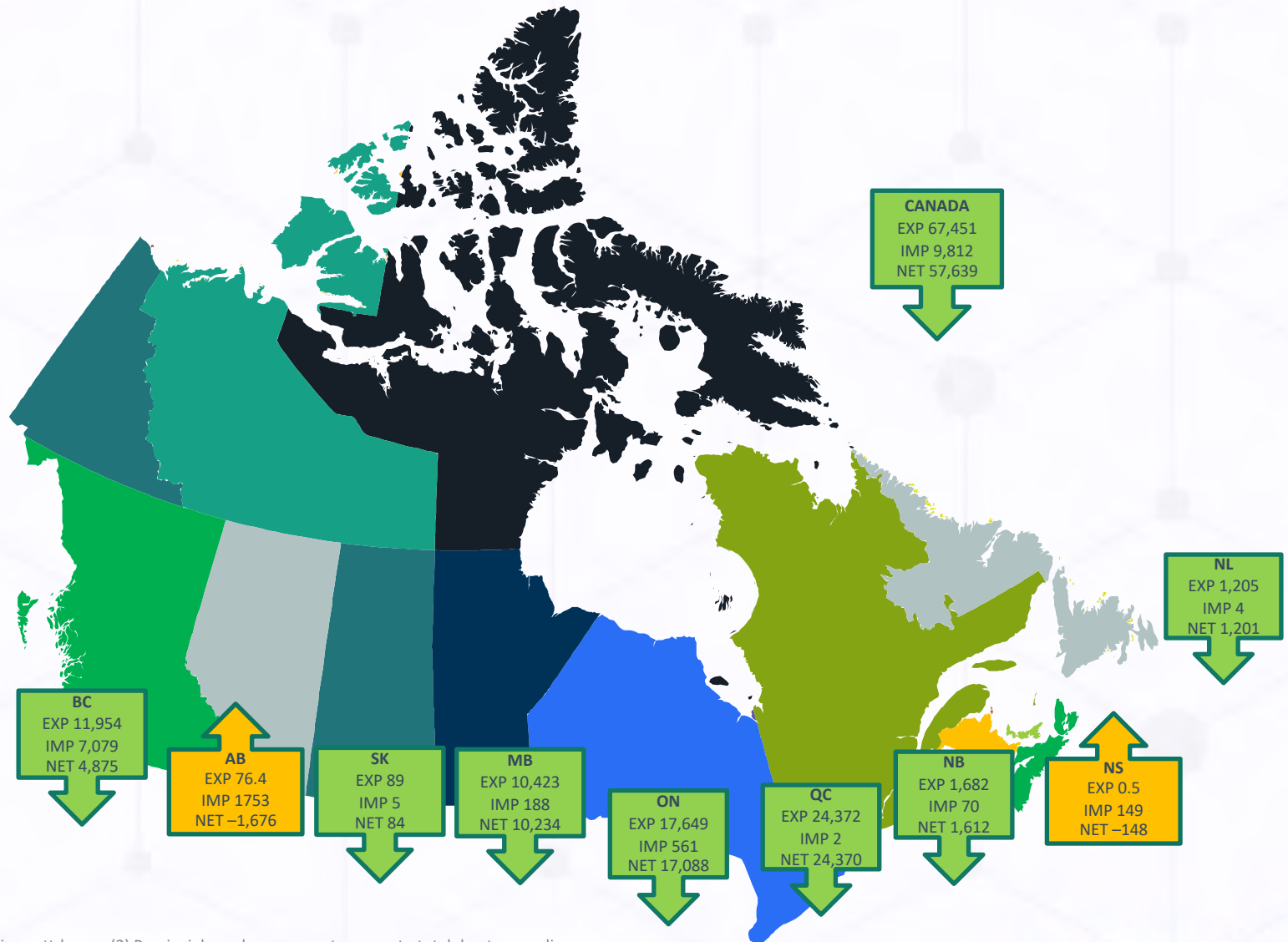


- [Major Canada-US Transmission Interconnections](#)
- [Canadian Electricity Exports/Imports by Province](#)
- [National Trade Volume Trends](#)
- [Trade Prices Trends](#)
- [Trade Revenue Trends](#)

Major Canada-U.S. Transmission Interconnections



Canadian Electricity Imports and Exports by Region (GW.h) (2020)



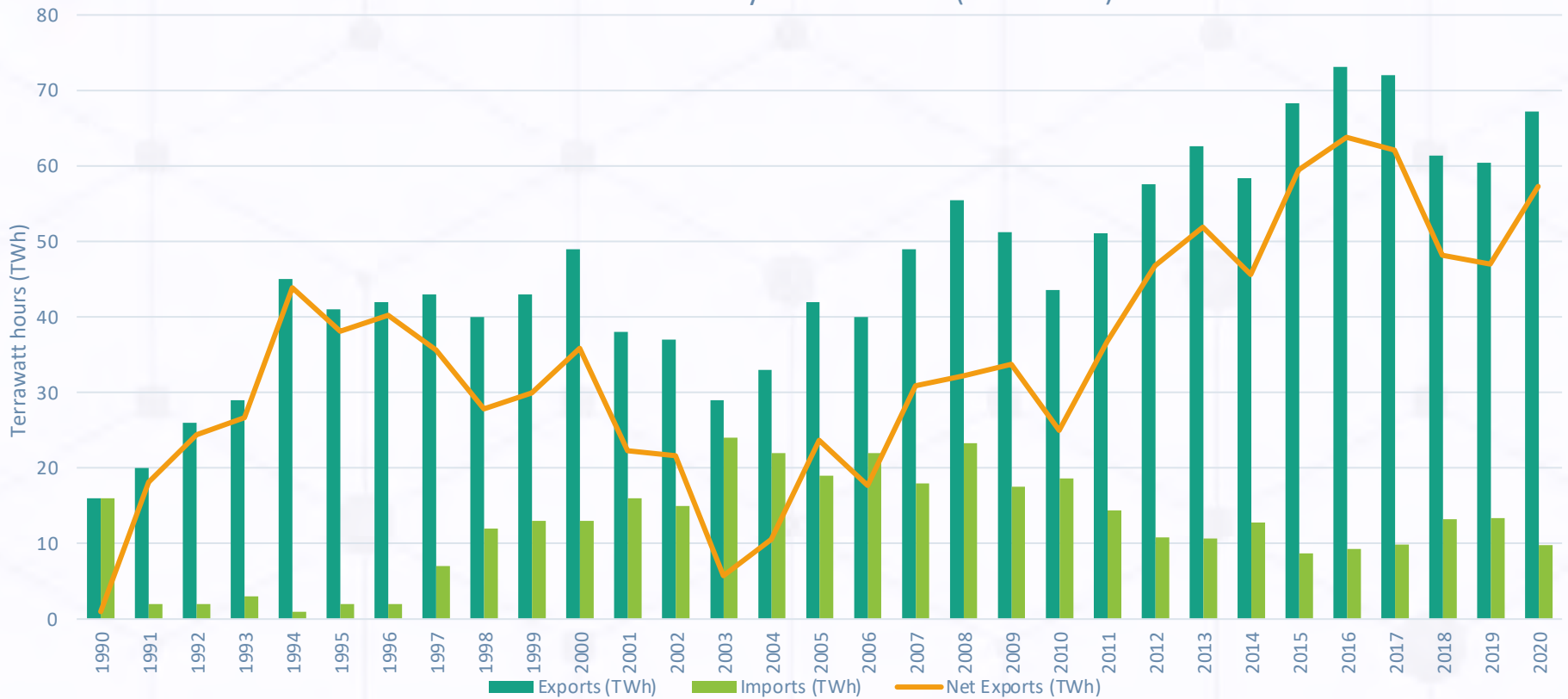
Notes: (1) Data in gigawatt-hours; (2) Provincial numbers may not sum up to total due to rounding.

Data Source: Canada Energy Regulator (CER).

Data Retrieved: July 2021.

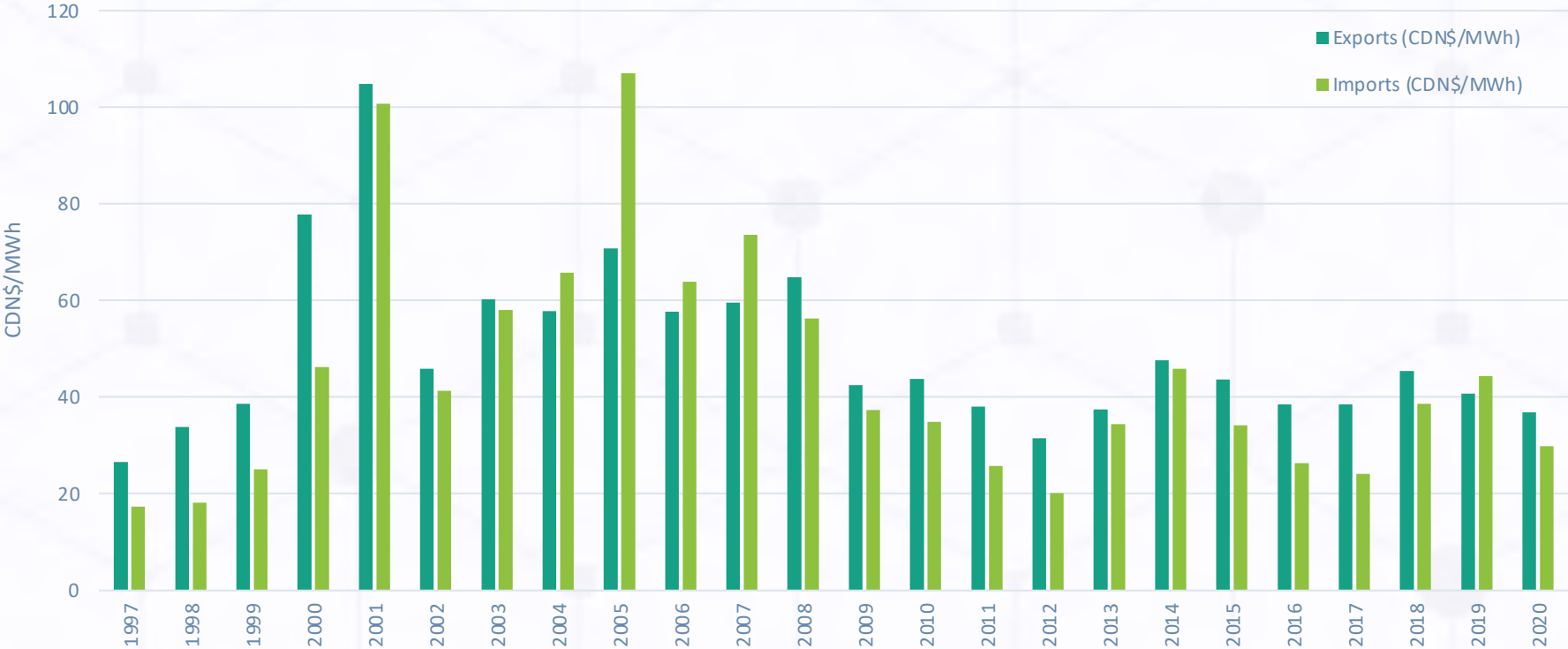
Trade Volume

Canada-U.S. Electricity Trade Volume (1990-2020)



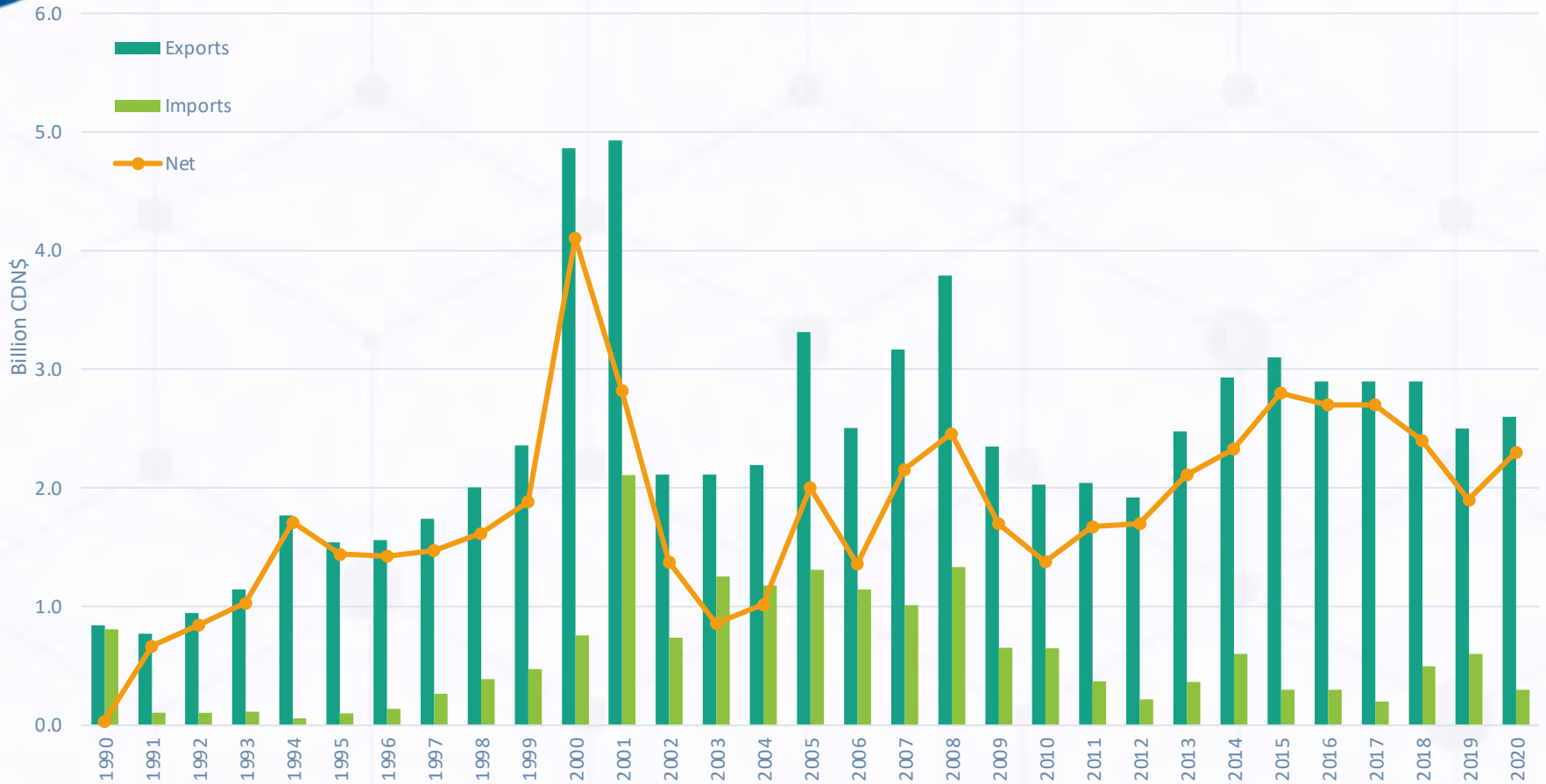
Trade Prices

Canada - U.S. Electricity Trade Prices (1997-2020)



Trade Revenue

Canada - U.S. Trade Revenue (1990 -2020)



Data Source: Canada Energy Regulator (CER).
Data Retrieved: July 2021.

Supply & Demand

The electricity industry is over 80% non-emitting.

- [Supply and Disposition of Electricity in Canada](#)
- [Generation Capacity \(US and Canada\)](#)
- [Electricity Demand by Sector in Canada](#)
- [Electricity as Share of Total Demand](#)
- [Electricity Generation by Fuel](#)
- [Electricity Generation Breakdown Comparison](#)
- [Generation by Province](#)



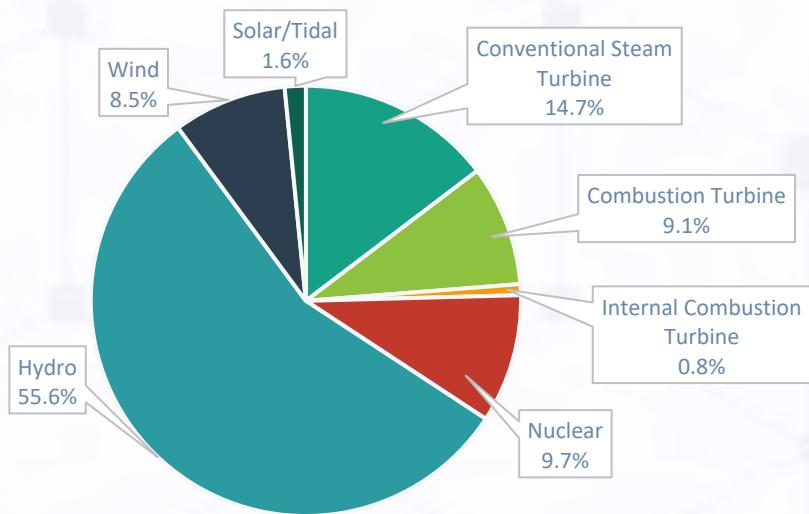
Annual Supply and Disposition of Electricity Generation in Canada, 2019



Data Source: Statistics Canada, Table 25-10-0021-01.
Data Retrieved: July 2021.

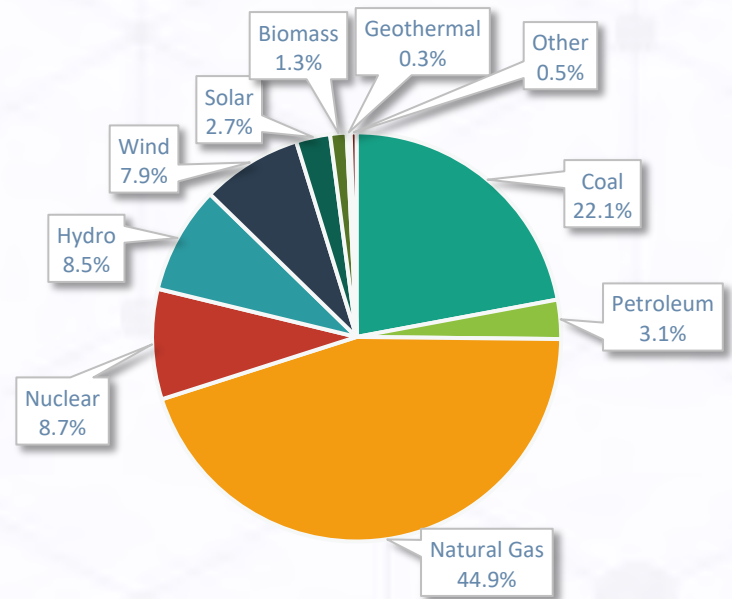
Generating Capacity

Canada, 2017



Generating Capacity
145 GW

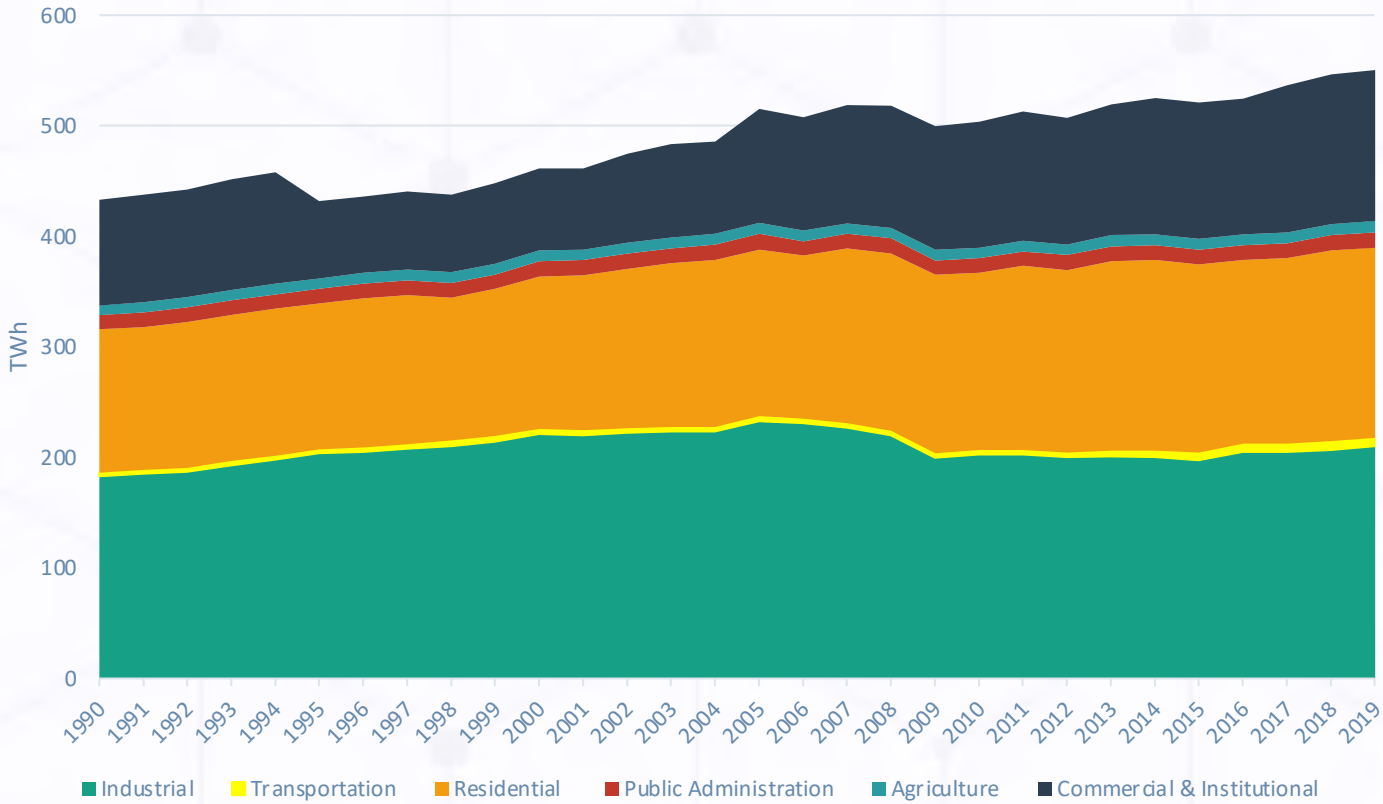
United States, 2018



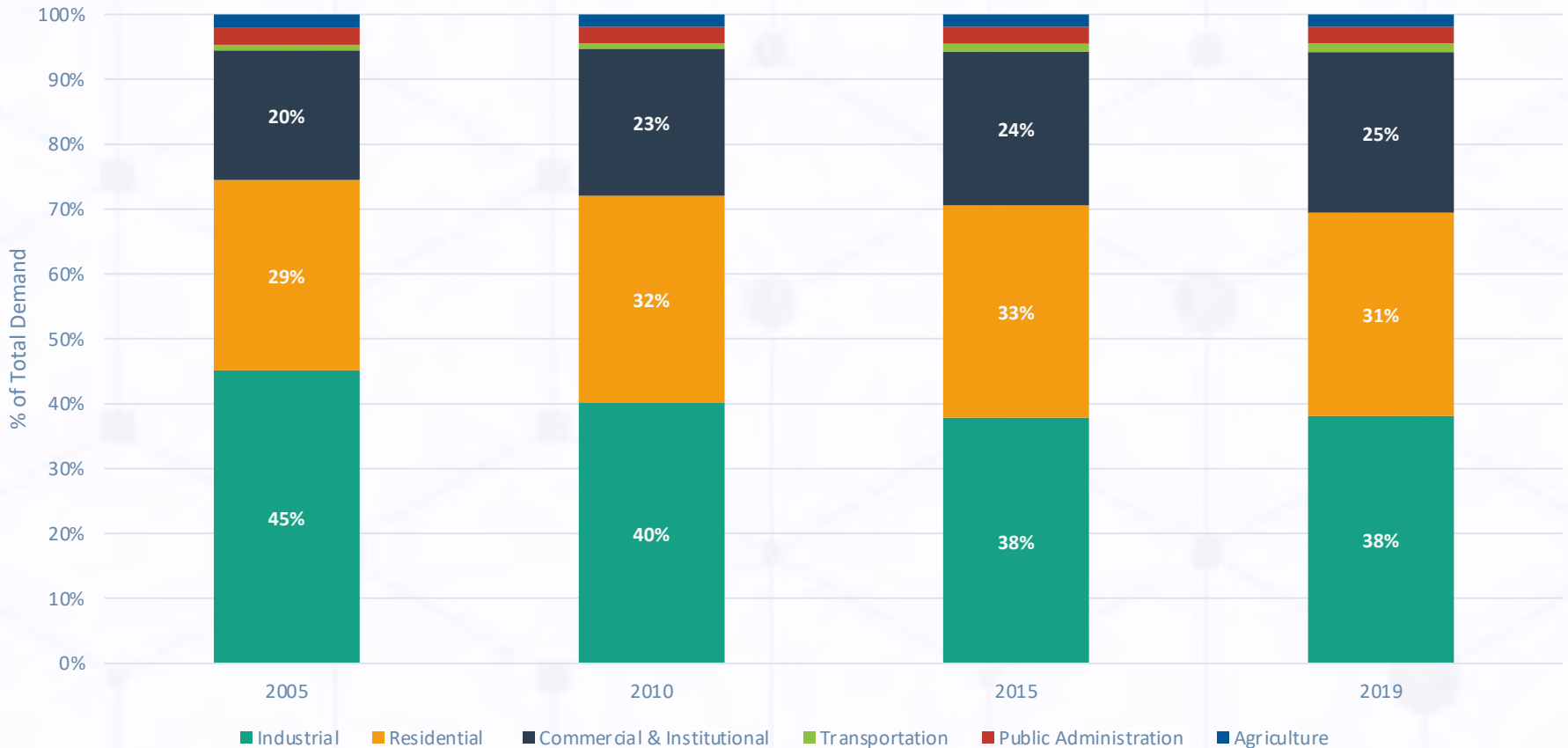
Generating Capacity
1,196 GW

Electricity Demand by Sector in Canada, 1990 -2019

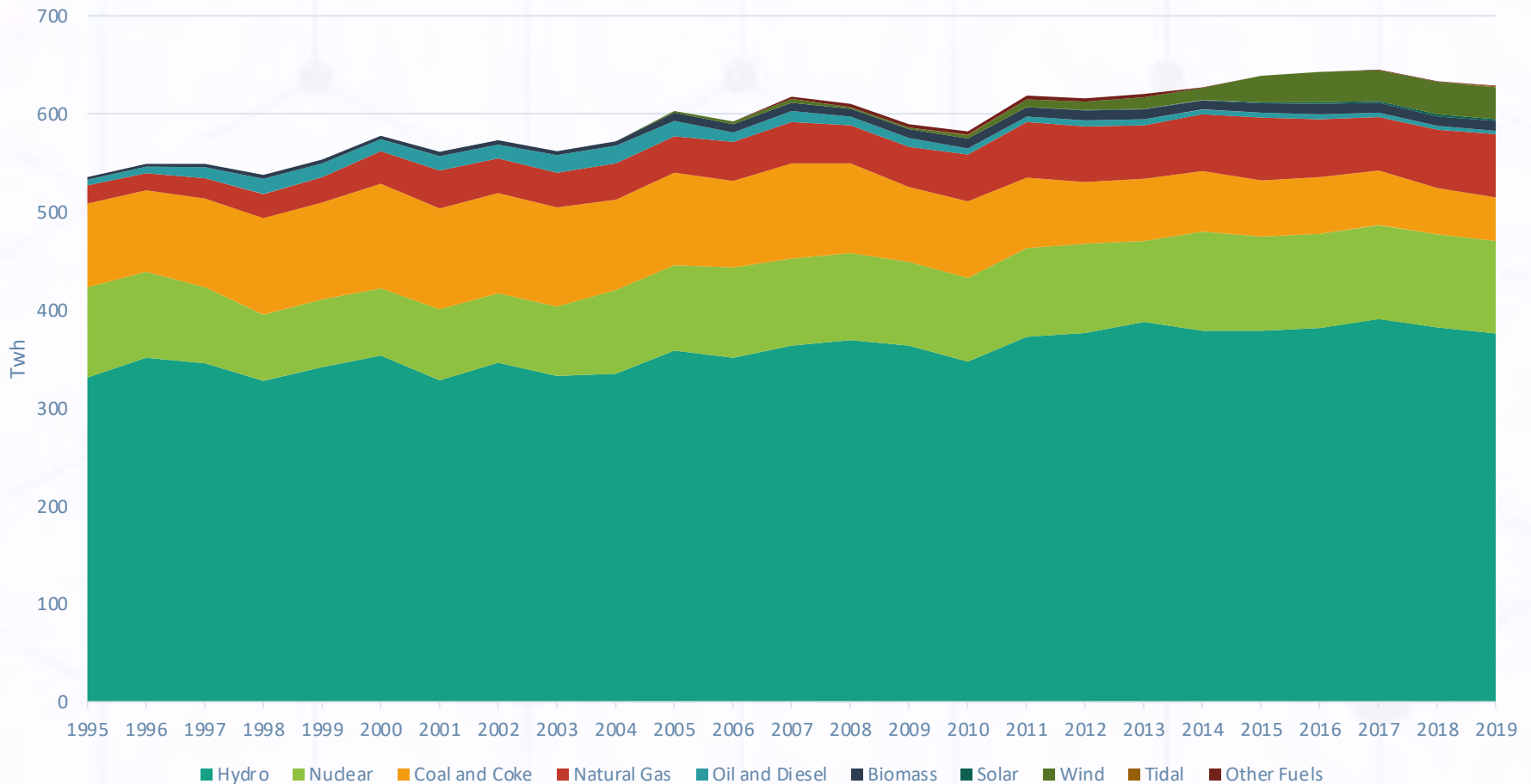
Total Electricity Demand in Canada for 2019 = 550.4 TWh



Electricity Demand in Canada by Sector (sectoral demand as a share of total demand)

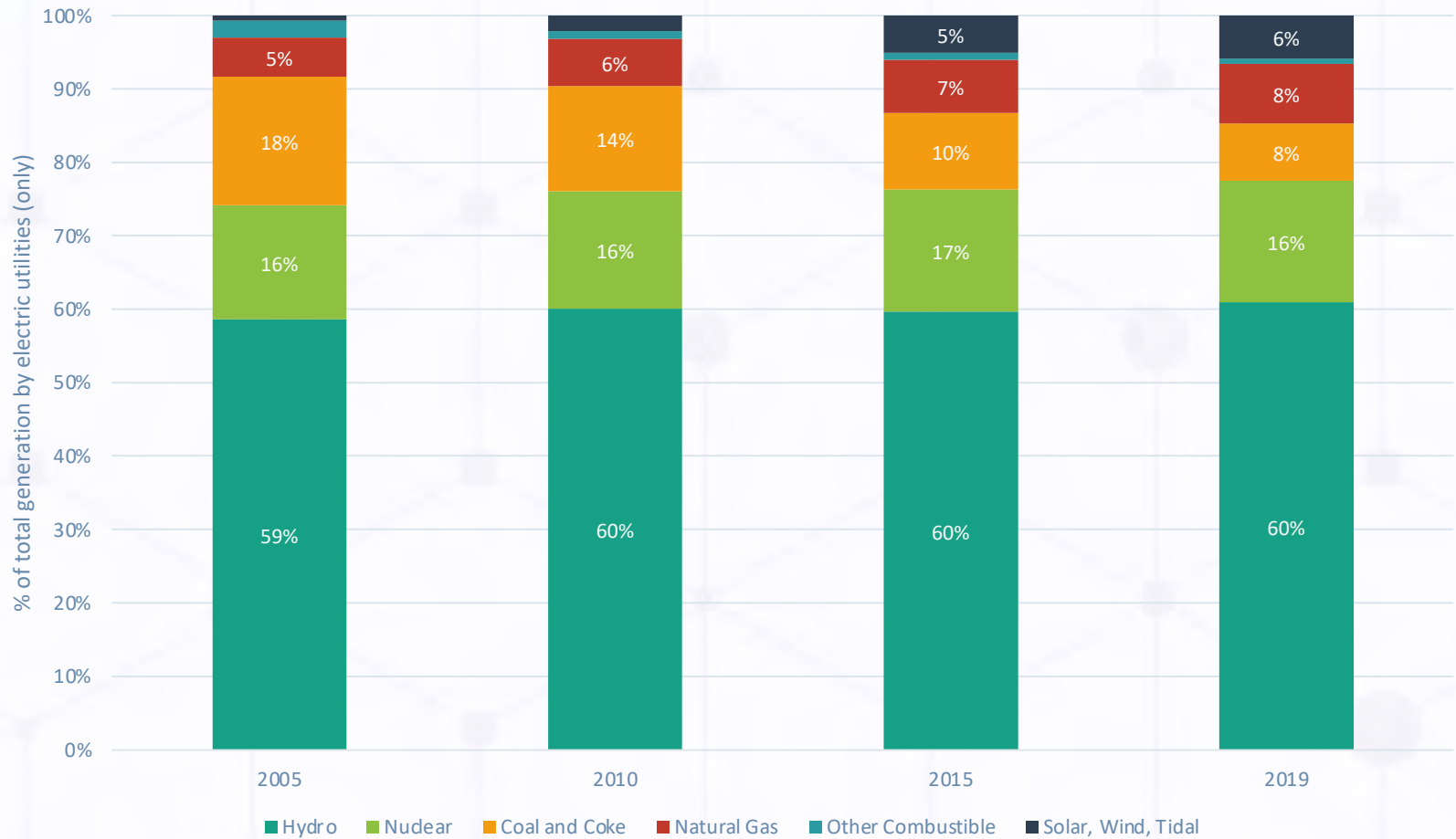


Electricity Generation by Fuel Type, 1995-2019 (Electric Utilities and Industry)



Data Source: Statistics Canada, Tables 25-10-0020-01 and 25-10-0028-01 .
 Data Retrieved: July 2021.

Generation Mix in Canada for electric utilities, 2005-2019 (generation type as a share of total generation)

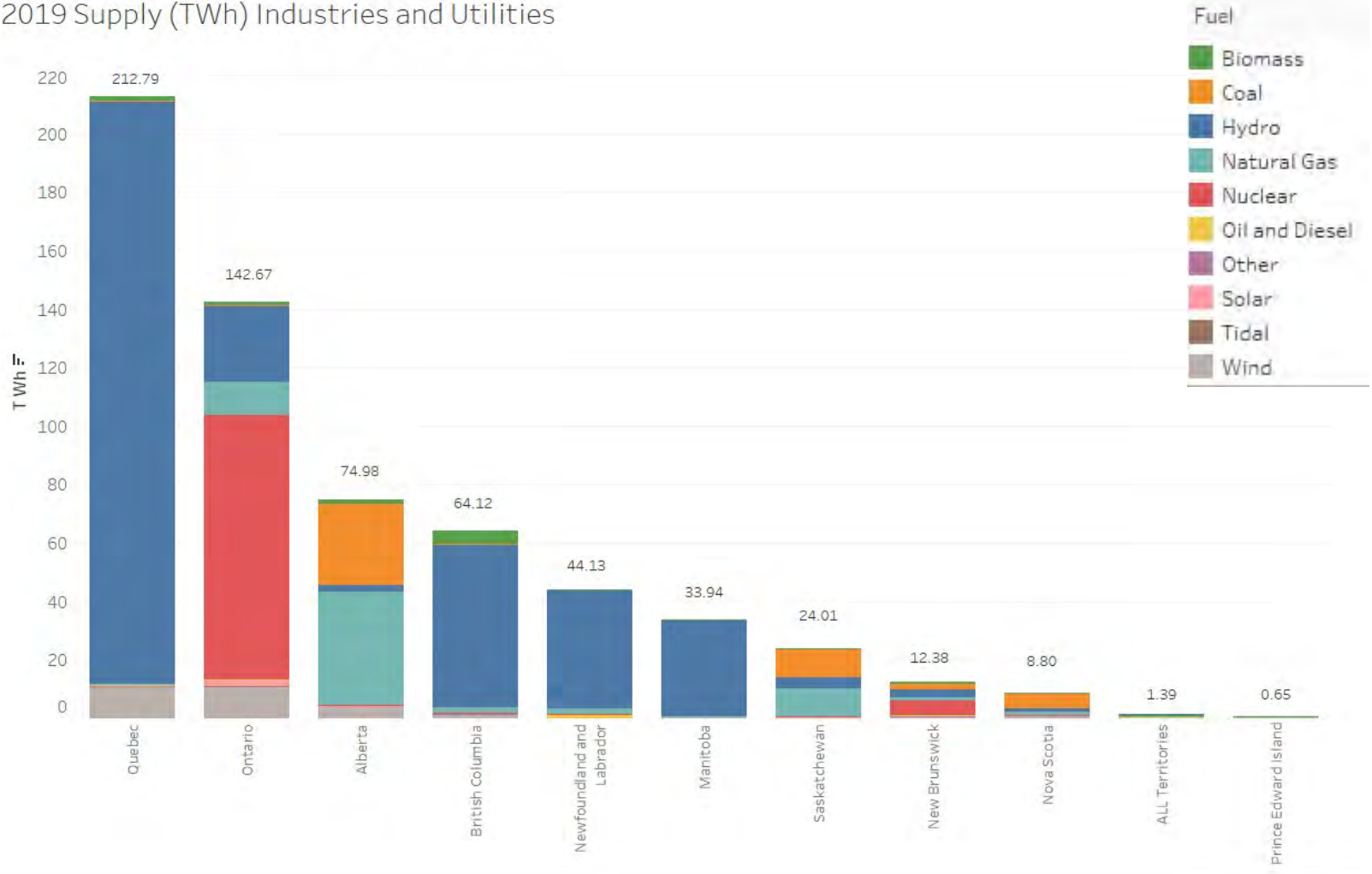


Data Source: CEA calculations based on Statistics Canada data, Tables Table 25-10-0019-01 and 25-10-0020-01.

Data Retrieved: July 2021; Visual Created by the Canadian Electricity Association

Supply Industries and Utilities by Province

2019 Supply (TWh) Industries and Utilities



Environmental Sustainability

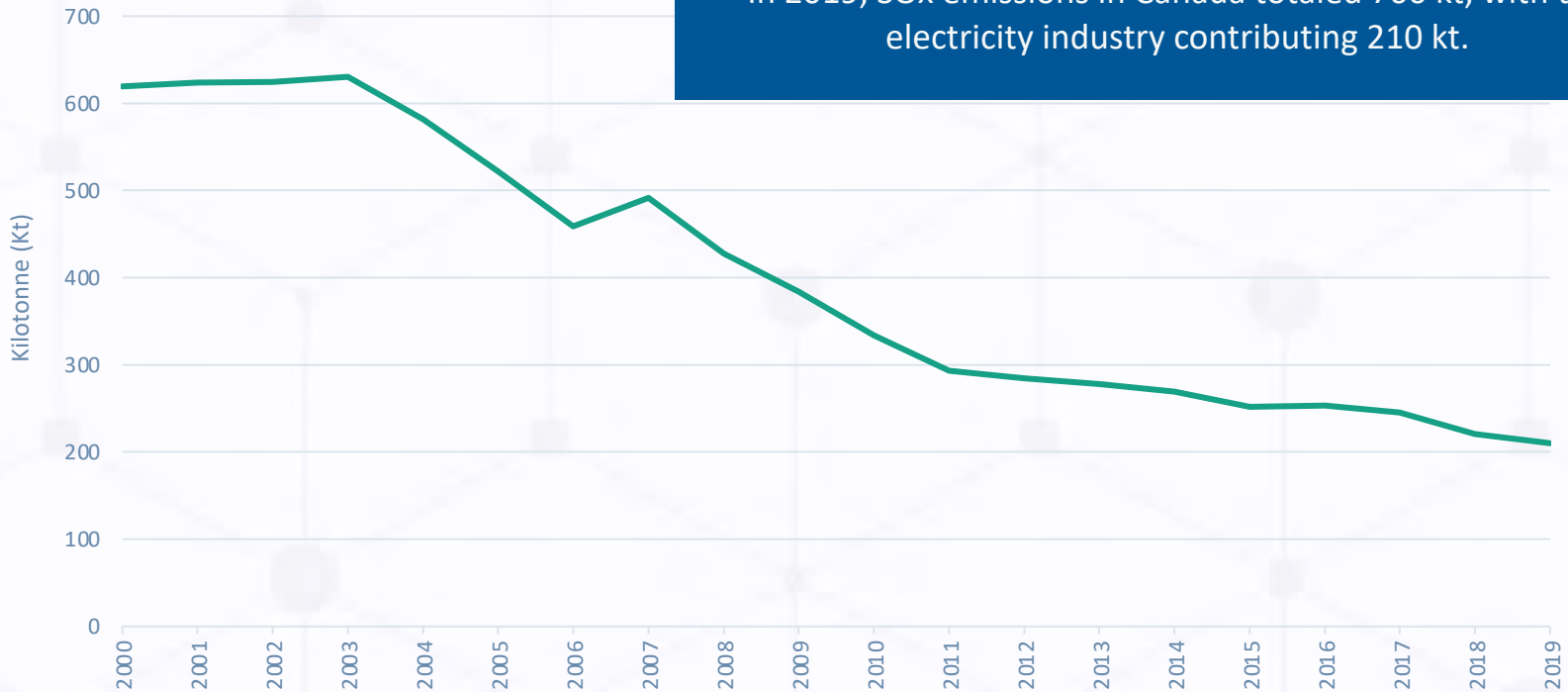
THE ENVIRONMENT IS *EVERYTHING* THAT ISN'T ME.
ALBERT EINSTEIN

- [Low Emissions and Sustainable Technologies](#)
- [Emissions - Sulphur Oxide](#)
- [Emissions - Nitrogen Oxide](#)
- [Emissions – Mercury](#)
- [Emissions – Particulate Matter](#)
- [Emissions – Carbon Dioxide Equivalent](#)
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- [Coal Fleet Profile](#)
- [NOx and Sox Reductions from CO2 regulation](#)
- [GHG Emissions in the US \(1990-2015\)](#)
- [GHG Emissions by Sector](#)
- [Canada with US comparison](#)
- [U.S. Emissions Trends](#)

Low Emission and Sustainable Technologies Used for Electricity Generation in Canada

Resource	Advantages	Challenges
Wind Power	No fuel cost, no emissions or waste, renewable source of energy, commercially viable source of power	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
Small Hydro	Low capital costs, many potential sites in Canada, well established technology, able to meet small incremental capacity needs, reduction in GHG emissions	Regulatory approval can be costly and time consuming, access to grid, local opposition to new development
Biomass	Uses landfill gas, wood pellets, and waste products to create electricity, reduces greenhouse gas, high availability of sites	High capital equipment and fuel costs; produces some emissions; access to transmission, competition for biomass materials use
Geothermal Energy	Reliable source of power, low fuel and operating costs, clean and renewable source of energy	High capital costs, connecting to the grid can be difficult, few potential sites in Canada
Solar PV	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	Restrictive and lack of grid connection for remote areas, not cost competitive, sun does not always shine and potential varies across regions
Ocean Energy	Costs are expected to decline as technology develops, intermittent, but predictable source of green energy	Potentially intrusive to marine life, investment is needed to promote research and development
Clean Coal	Highly efficient, potential for reduced greenhouse gas emissions	High capital costs, lengthy start-up period

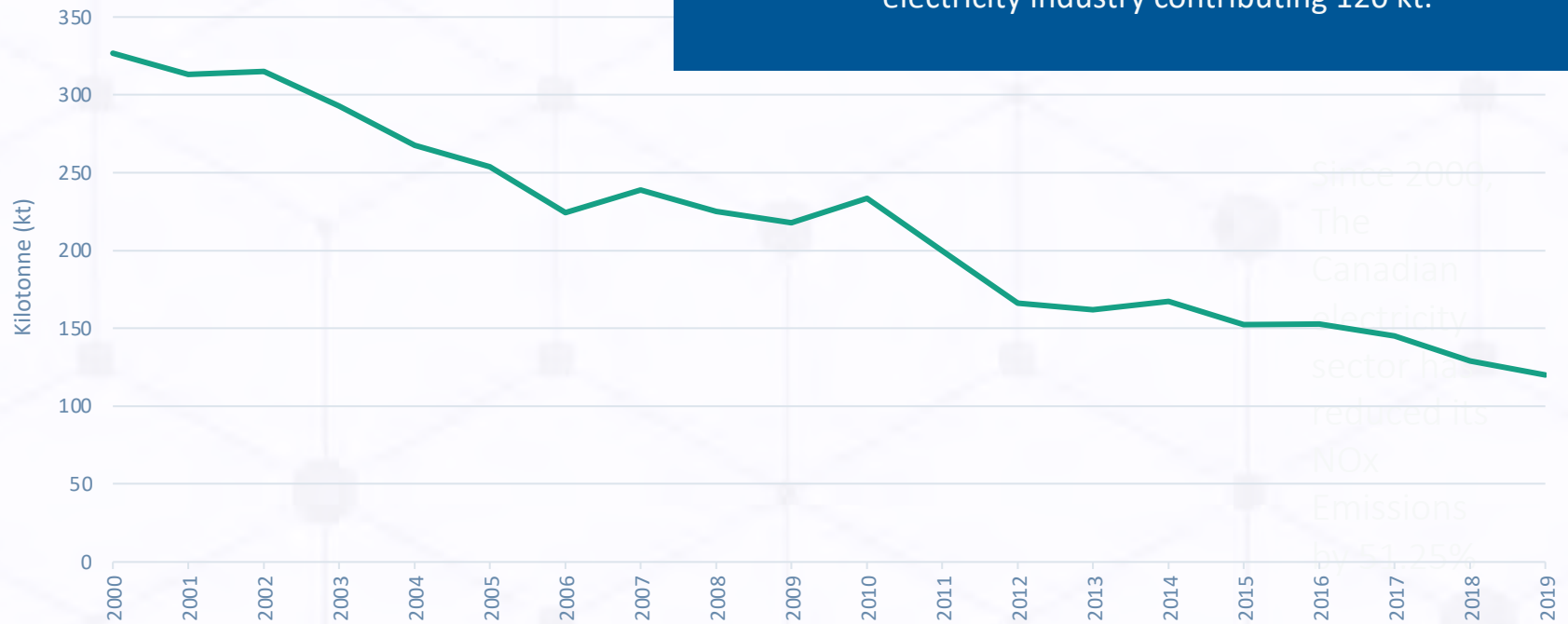
Sulphur Oxide (SOx) Emissions Canadian Electricity Sector, 2000-2019



Since 2000, the Canadian electricity industry has reduced its SOx emissions by 66%.

Nitrogen Oxide (NOx) Emissions Canadian Electricity Sector, 2000-2018

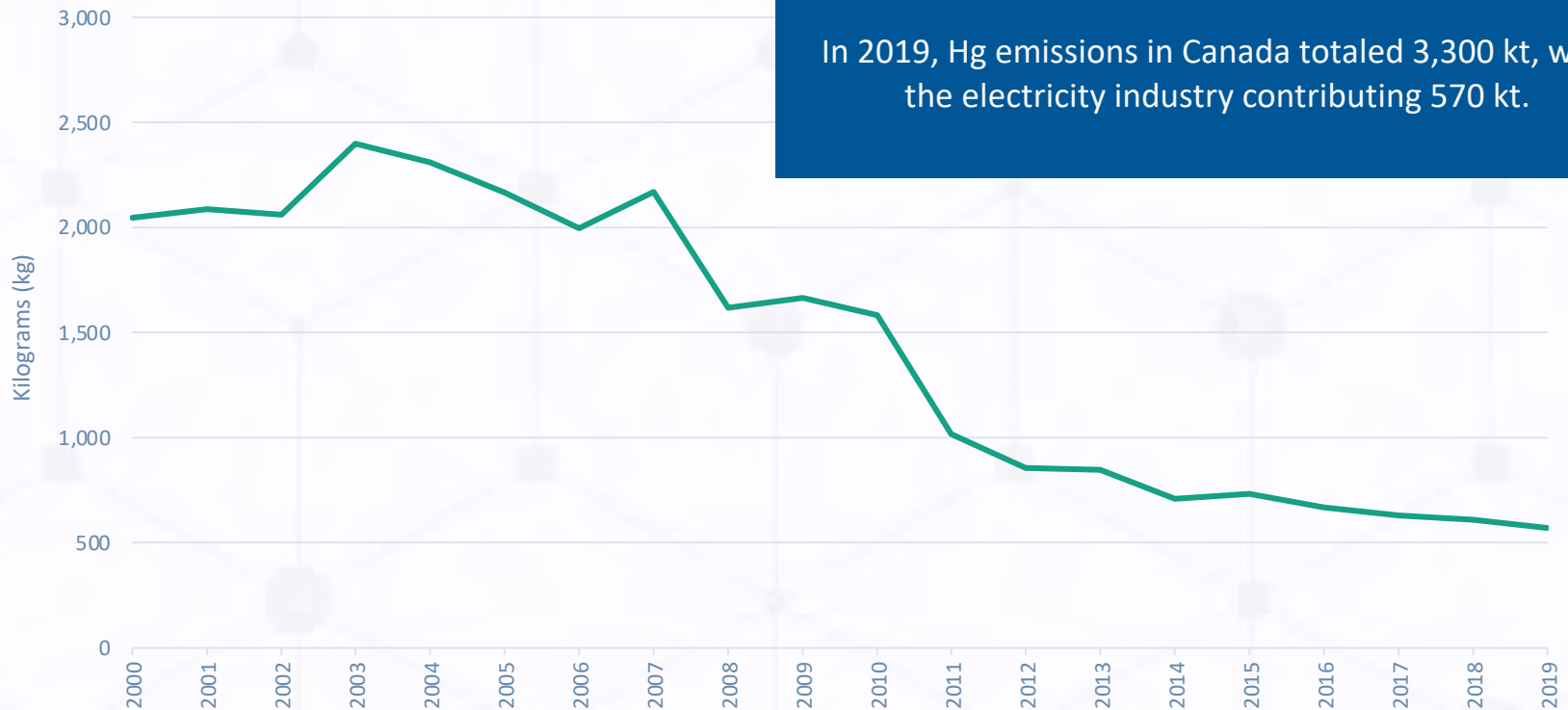
In 2019, NOx emissions in Canada totaled 1,600 kt, with the electricity industry contributing 120 kt.



Since 2000,
The
Canadian
electricity
sector has
reduced its
NOx
Emissions
by 63%.

Since 2000, the Canadian electricity industry has reduced its NOx emissions by 63%.

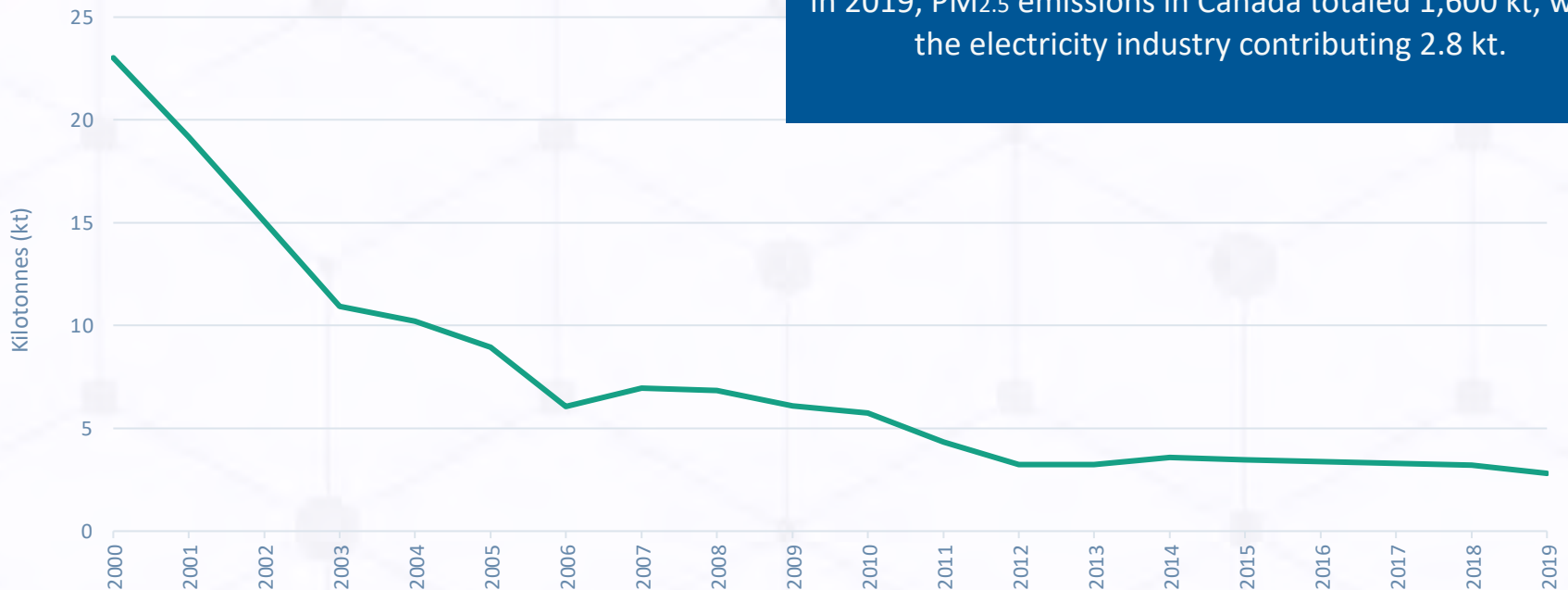
Mercury (Hg) Emissions Canadian Electricity Sector, 2000-2019



Since 2000, the Canadian electricity industry has reduced its Hg emissions by 72%.

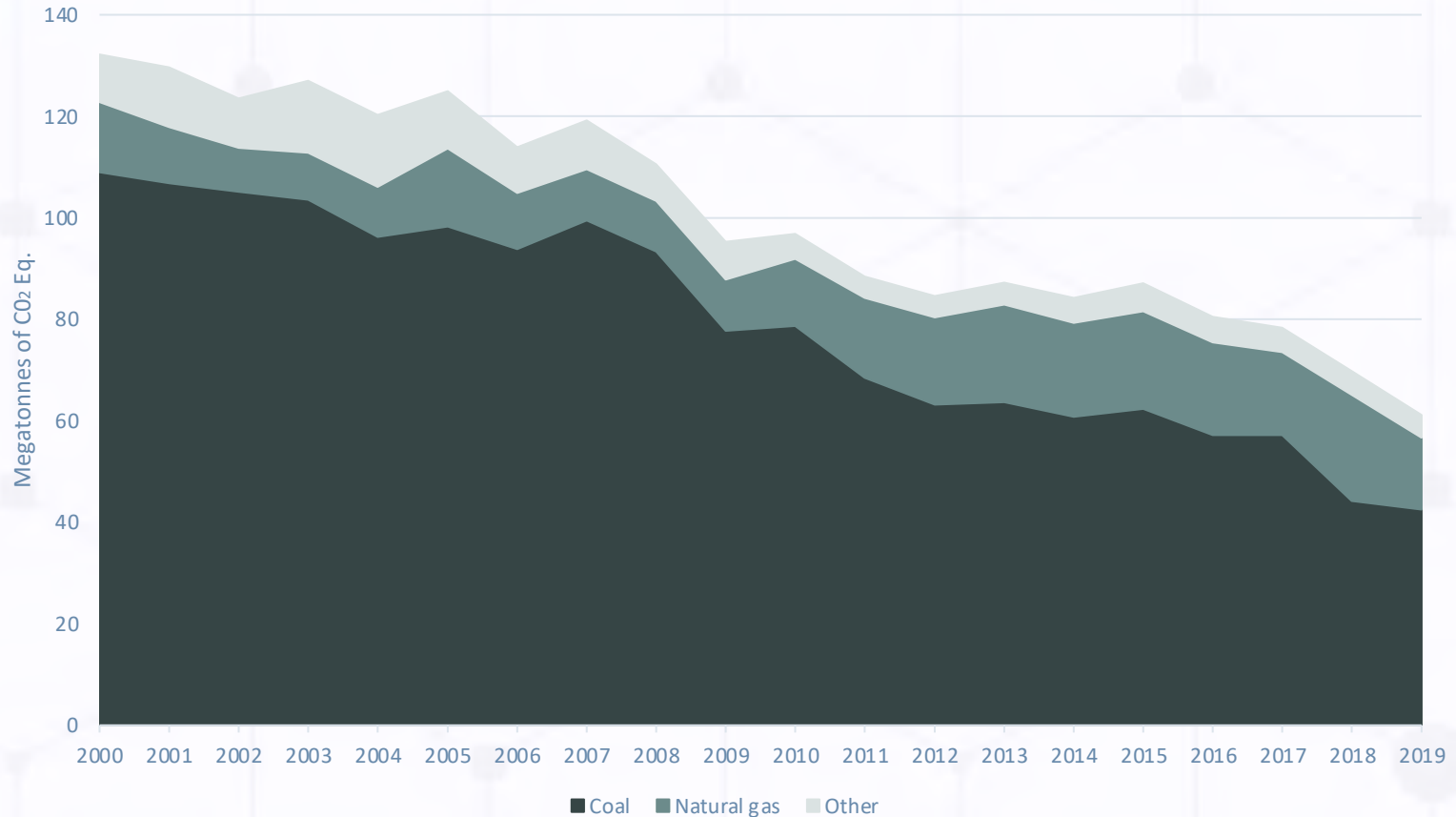
Particulate Matter_{2.5} Emissions Canadian Electricity Sector, 2000-2019

In 2019, PM_{2.5} emissions in Canada totaled 1,600 kt, with the electricity industry contributing 2.8 kt.



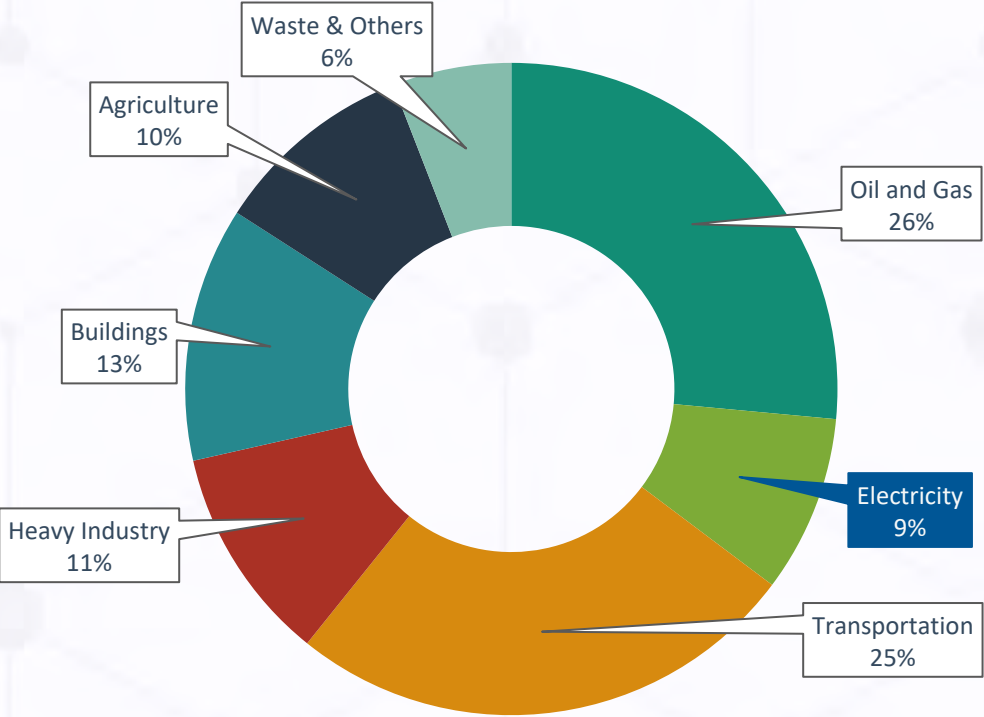
Since 2000, the Canadian electricity industry has reduced its particulate matter emissions by 88%.

Greenhouse Gas (GHG) Emissions Canadian Electricity Sector, 2000-2019



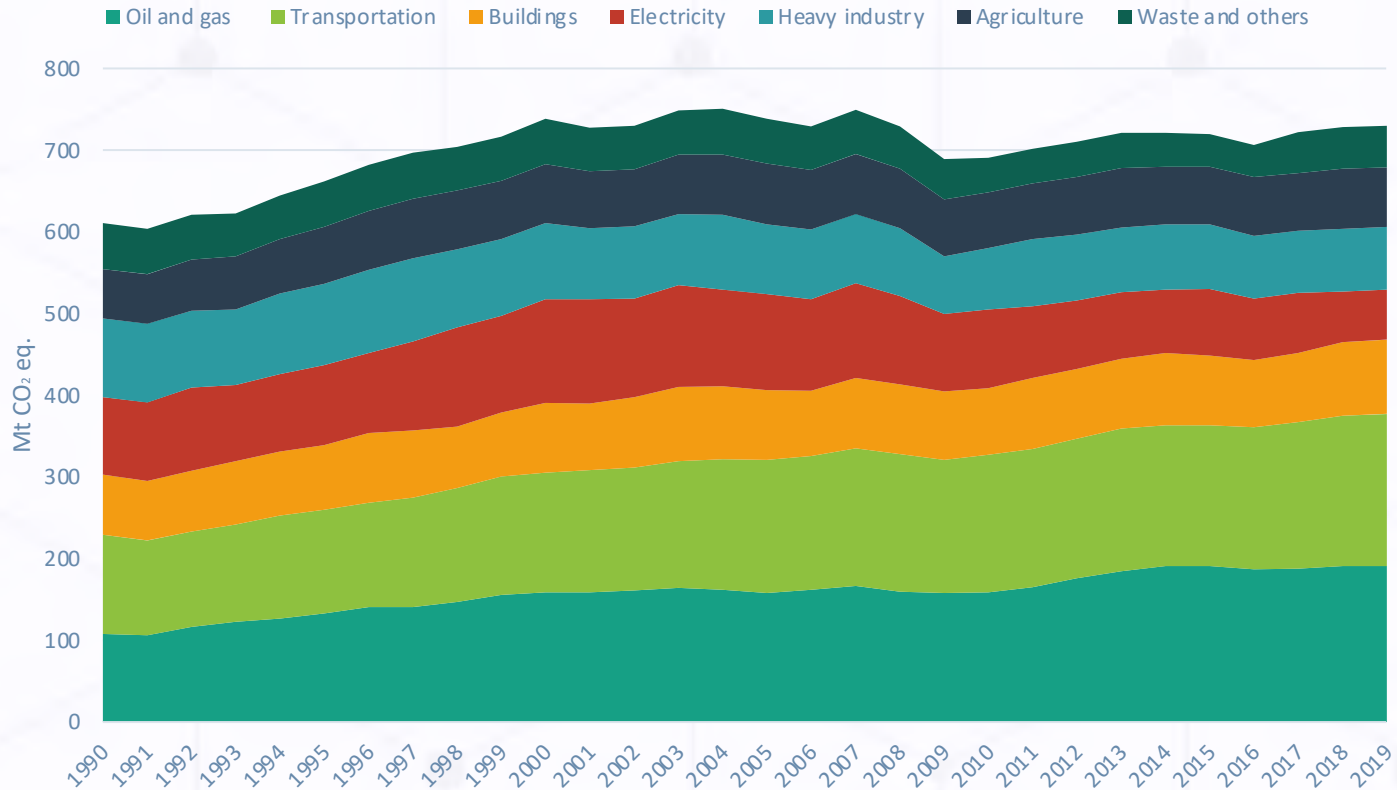
Since 2000, the Canadian electricity industry has reduced its GHG emissions by 54%.

Greenhouse Gas (GHG) Emissions by Economic Sector in Canada, 2019



In 2019, GHG emissions in Canada totaled 730 million tonnes.

Greenhouse Gas (GHG) Emissions by Economic Sector in Canada, 1990 - 2019

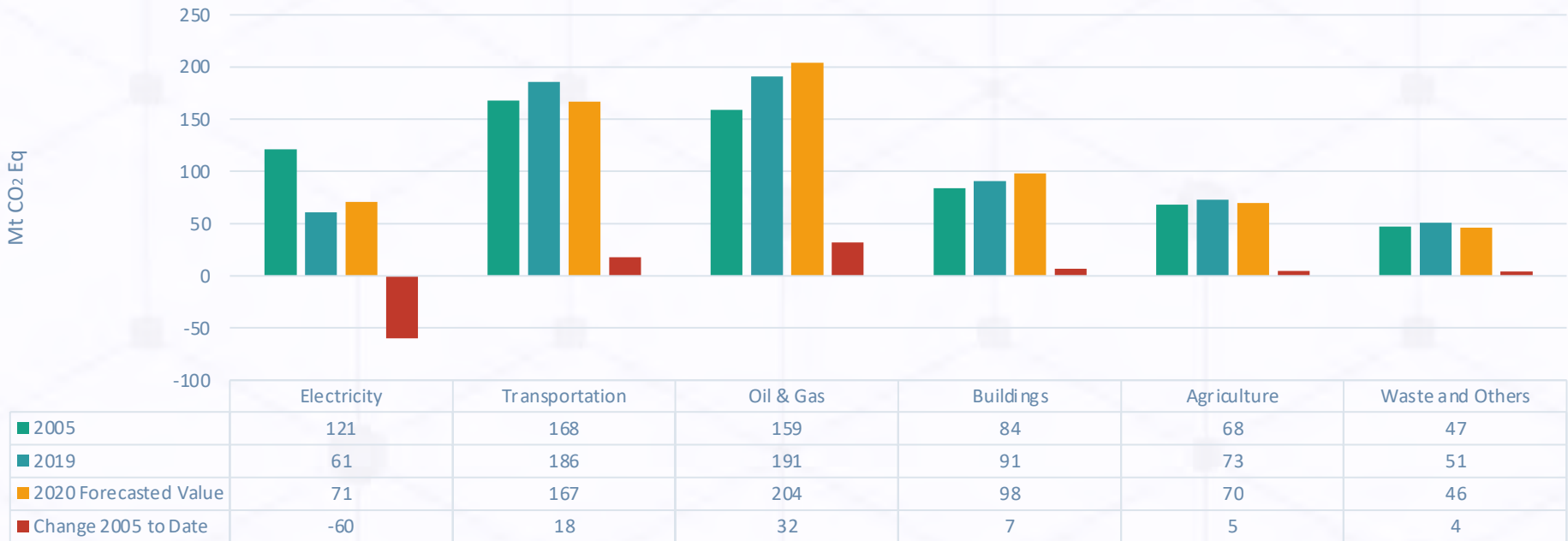


In 2019, GHG Emissions by Sector totaled 730 Mt CO₂ eq.

Data Source: Environment and Climate Change Canada. 2021. National Inventory Report.
Data Retrieved: July 2021.

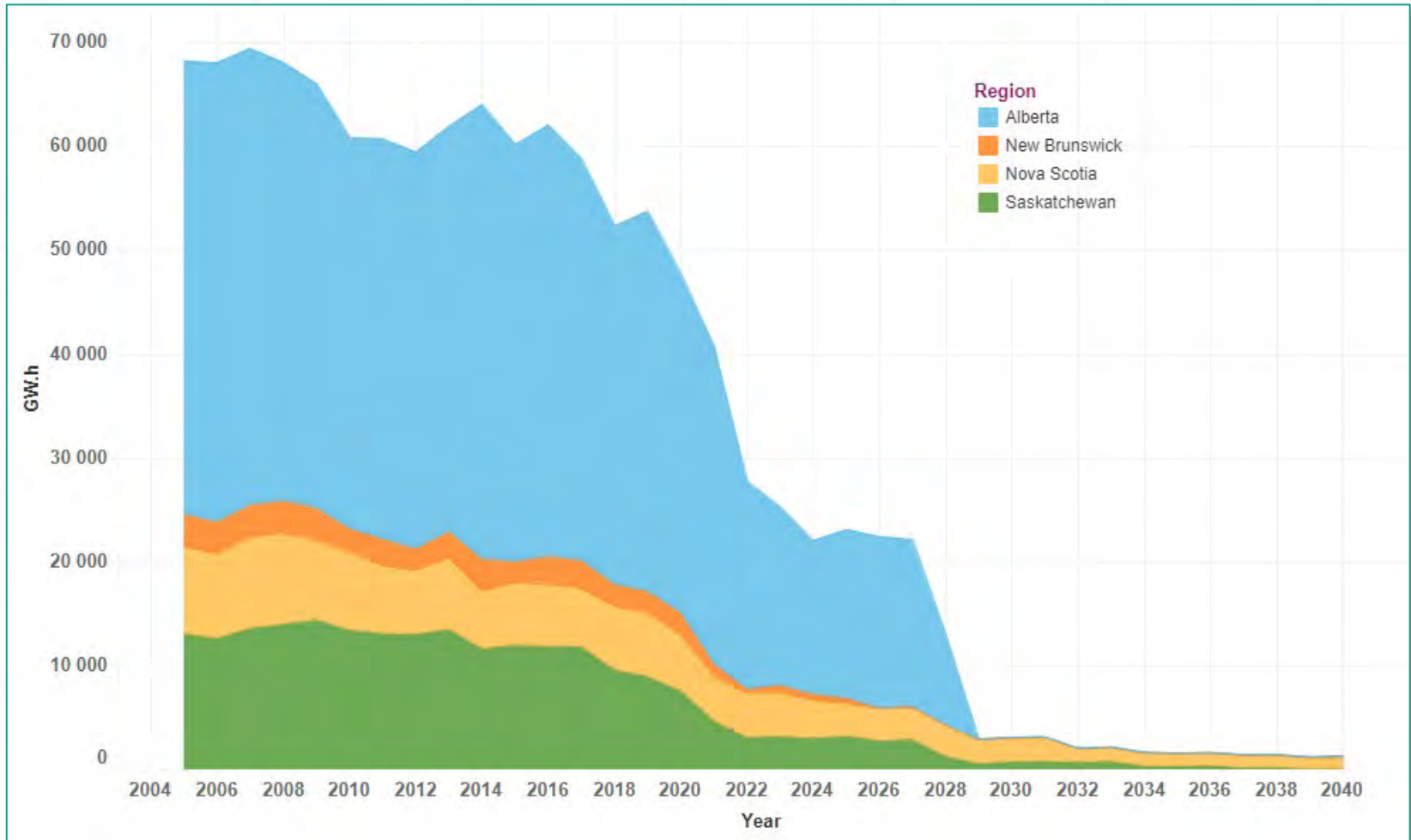
Electricity Sector Leads In CO₂Eq. Reduction

Forecasted Change in Emissions by Sector 2005-2020

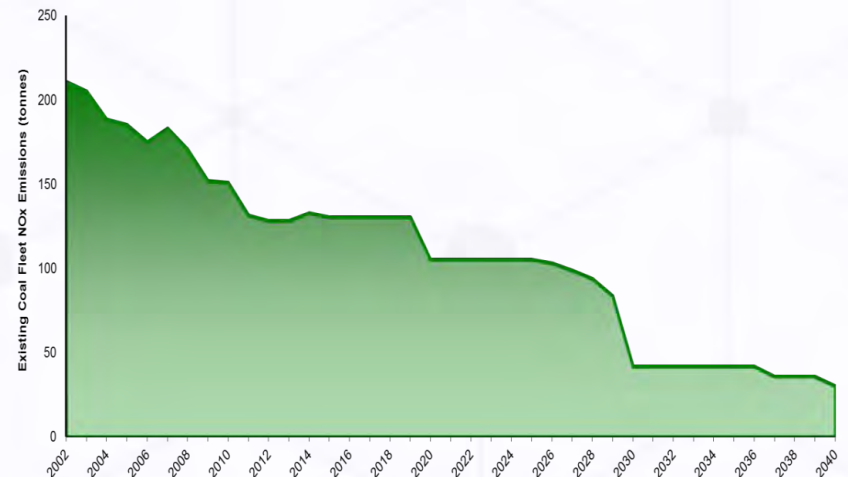


Coal Fleet Profile (MW)

Canadian coal electricity generation by region to 2040



NO_x and SO₂ Reductions from CO₂ Regulation



Reduction in SO₂ emission from 2002 levels:

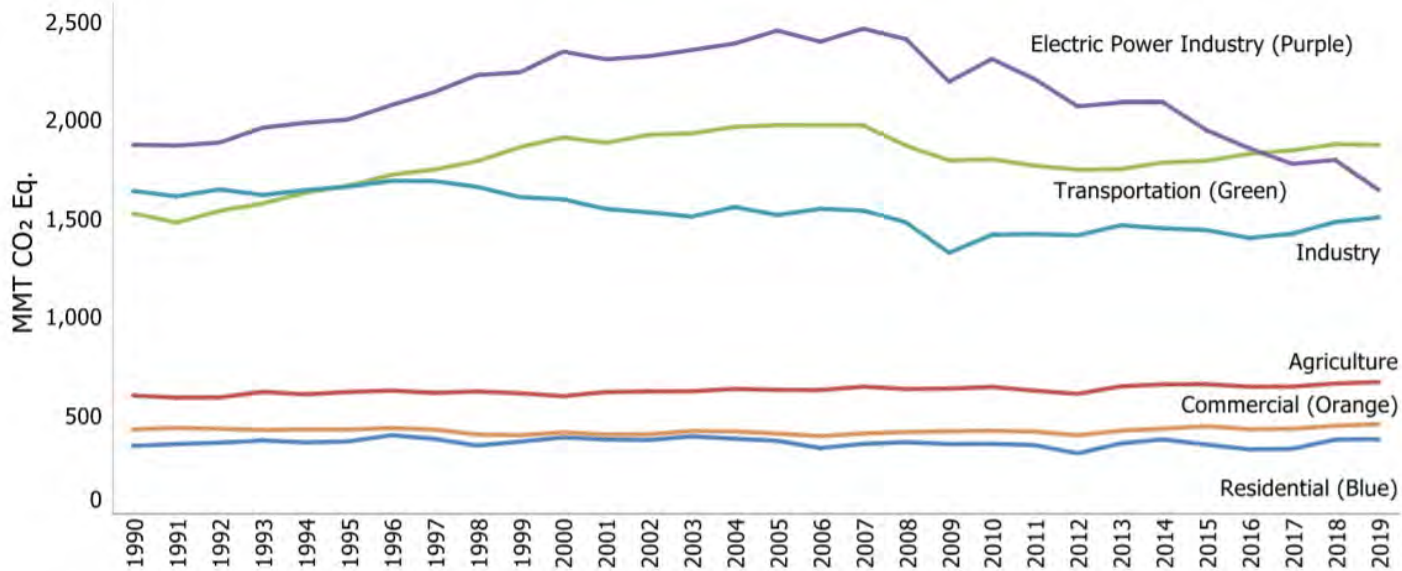
- 54% reduction by 2020
- 84% reduction by 2030

Reduction in NO_x emissions from 2002 levels:

- 50% reduction by 2020
- 80% reduction by 2030

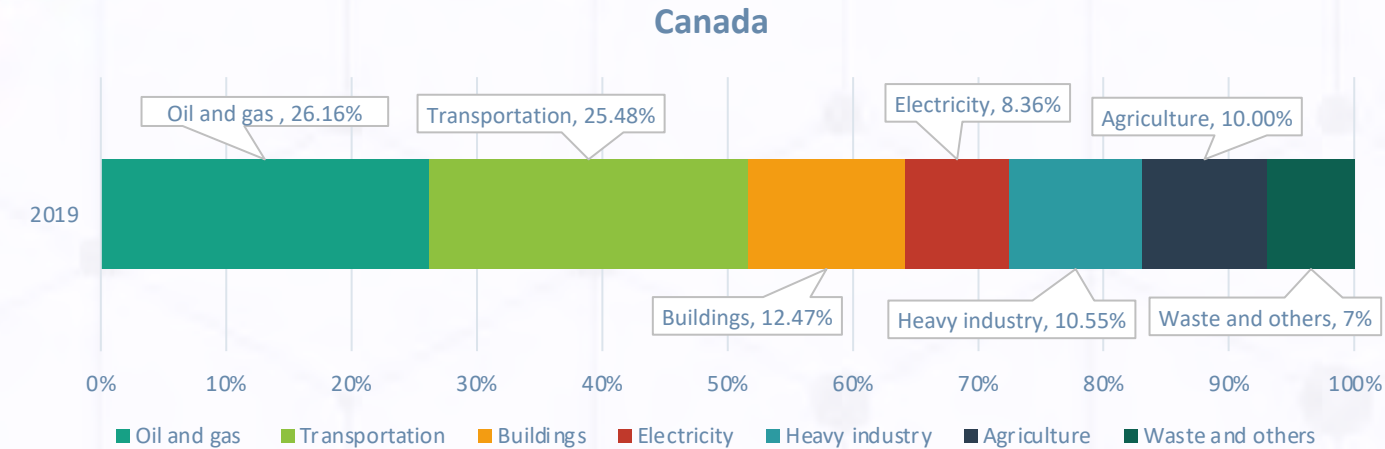
Source and assumptions: NPRI data was used for existing unit emissions, forecast based on 2009-2011 operation, coal unit retirement from 45-50 years as outlined in the 2012 *Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations*

U.S. Greenhouse Gas Emissions Trends (1990-2019)

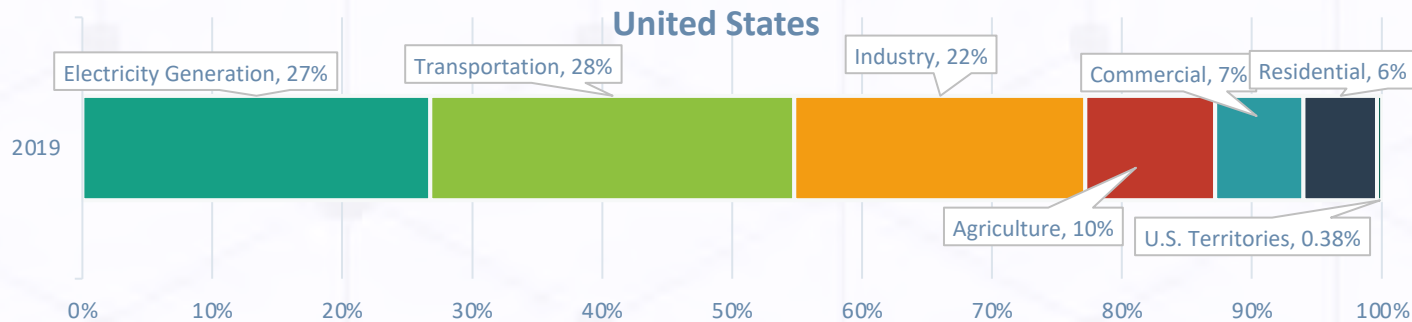


Source: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions Allocated to Economic Sectors (1990-2019), Figure ES-14. Data Retrieved: July 2021.

Greenhouse Gas (GHG) Emissions by Economic Sector Canada and United States Comparison, 2019



Emission Total – Canada:
730 Mt CO₂ Eq.



Emission Total – United States:
6,710 Mt CO₂ Eq.

Data Source: (1) Environment and Climate Change Canada. 2021. National Inventory Report; (2) U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2019).

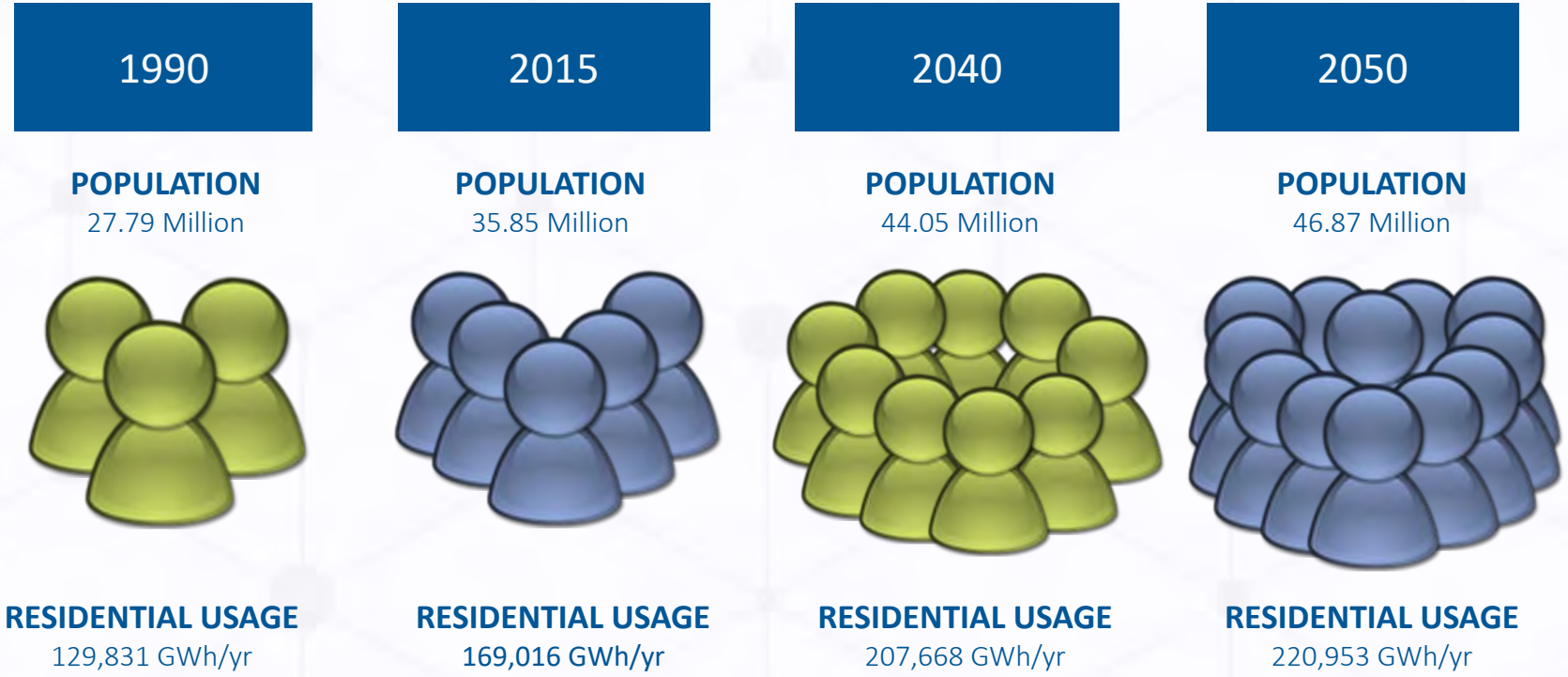
Data Retrieved: July 2021.

Price & Customers

THERE IS A FUNDAMENTAL COST IN PROVISIONING
ELECTRICITY FOR A NATION.

- [Canada's Future Residential Electricity Needs](#)
- [Household Spending Trends \(cumulative change\)](#)
[Household Spending 1999 vs. 2019](#)
- [Household Spending 2010 vs. 2019](#)
- [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 \(Canada\)](#)

Canada's Future Residential Electricity Needs

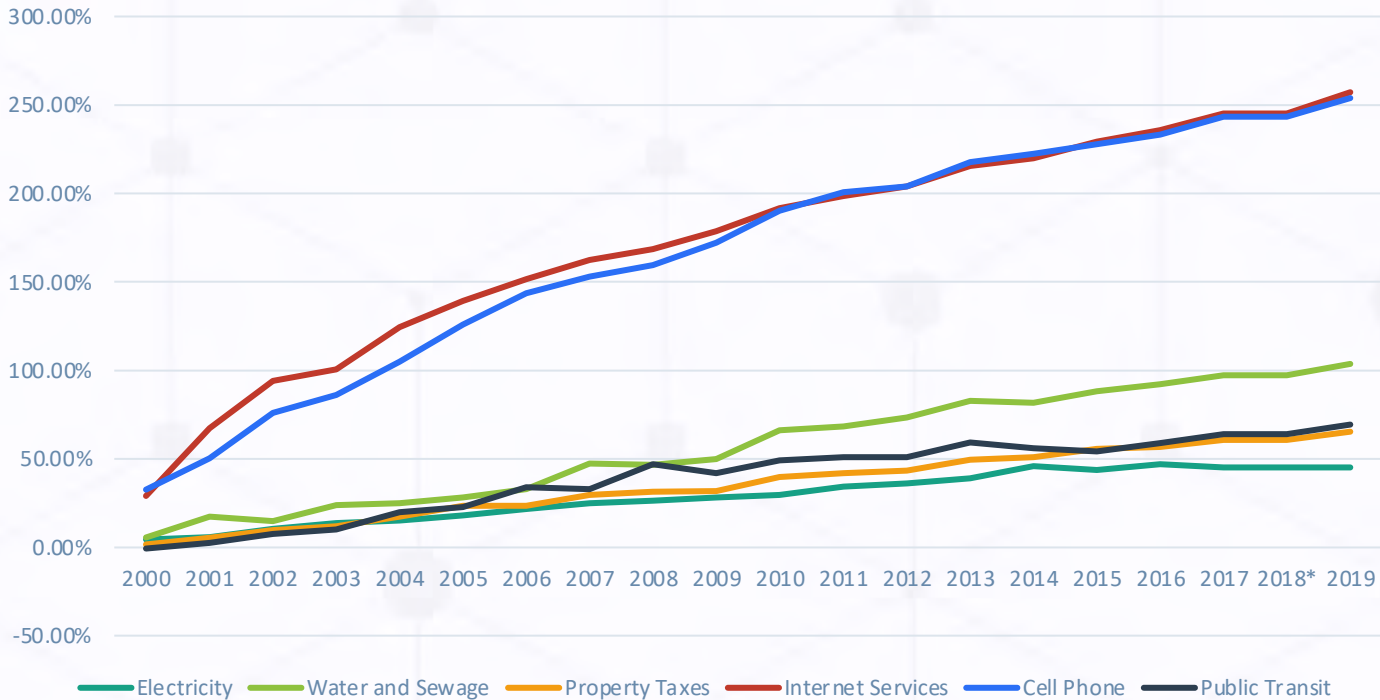


BUSINESS AS USUAL SCENARIO

Demand with Moderate Economic Growth	Residential Usage	Residential Usage
	350,660 GWh/yr	373,092 GWh/yr

Household Spending (1999 - 2017)

Household Spending Cumulative Change from 2000-2019



Direct Change per Household from 1999-2019.

Internet Services
95%

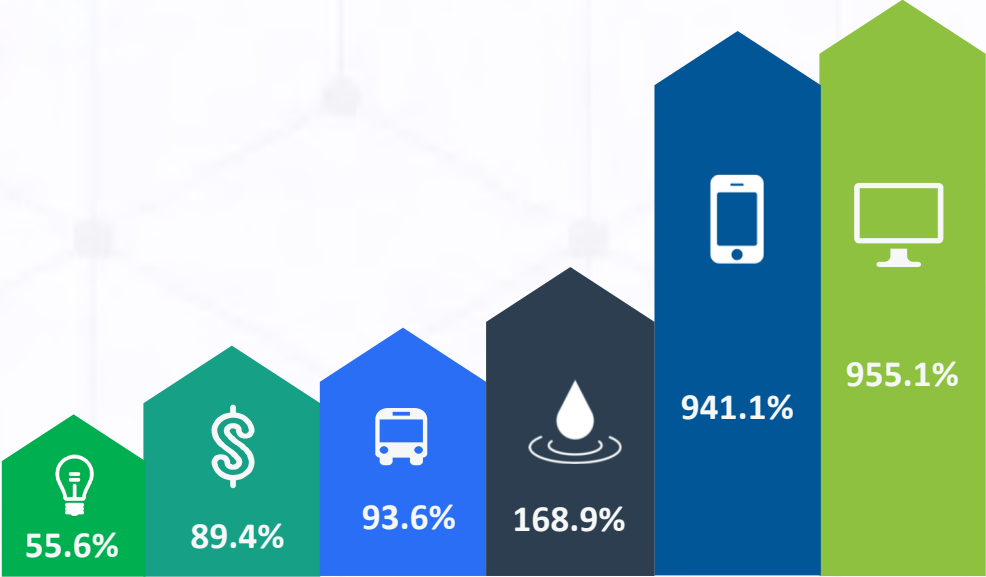
Electricity
55.6%

Data Source: StatsCan, Table: 11-10-0222-01 (formerly CANSIM 203-0021)

* No data available from Statscan in 2018, marked as unchanged from 2017 in chart.

Retrieved: July 2021; Visual Created by the Canadian Electricity Association

Household Spending (1999 vs. 2019)



Data Description

Percentage increase in 2019 comparing against 1999 household spending levels.

- Electricity
- Public Transit
- Property Taxes
- Water and Sewage
- Internet Services
- Cell Phone Services



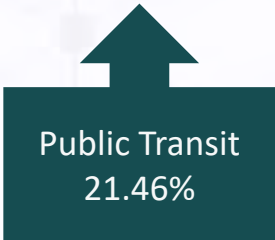
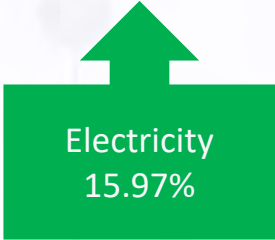
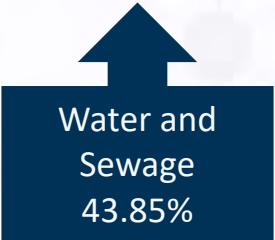
133.5 TW.h
Residential Demand in 1999



172.3 TW.h
Residential Demand in 2019

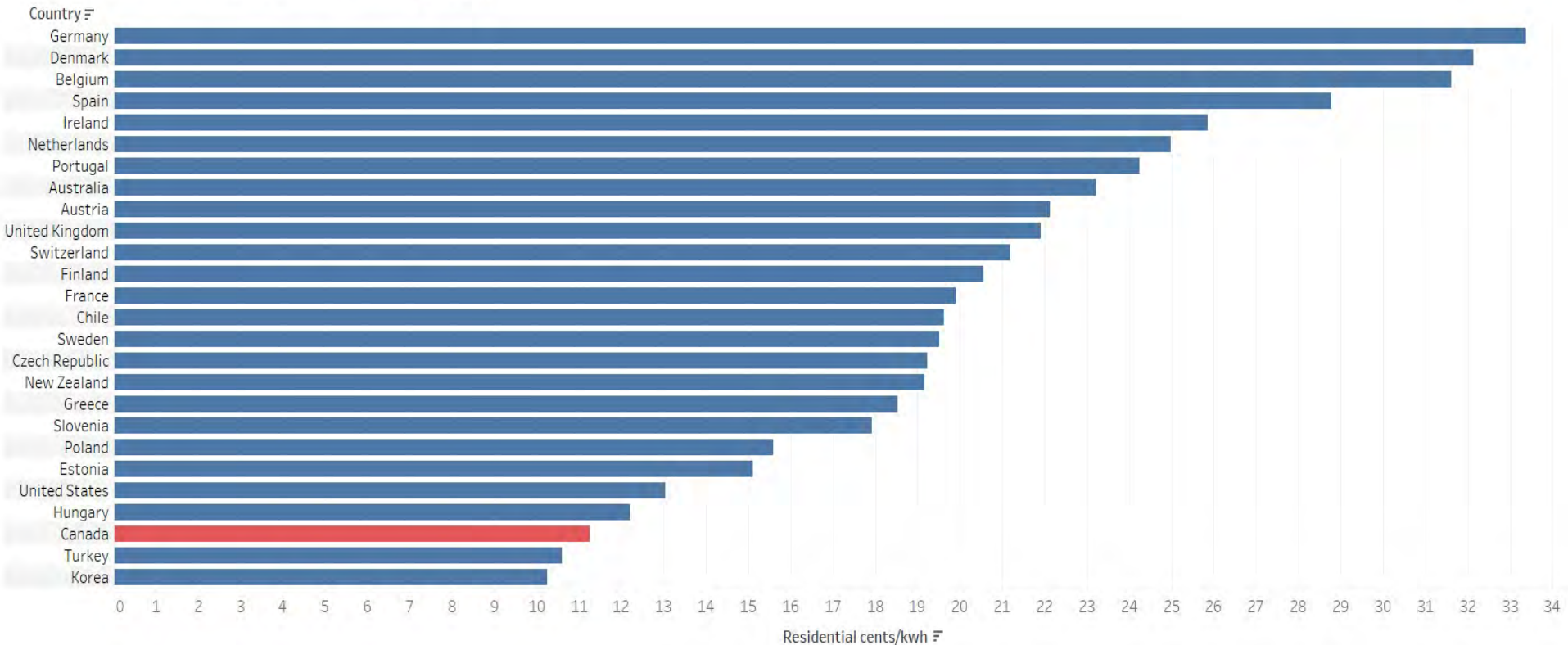
Household Spending (2010 vs. 2017)

Spending Increases Per Household
Comparing **2019** to **2010**.



Multinational Comparison (Residential Pricing)

Selected Countries Residential Pricing (2020)



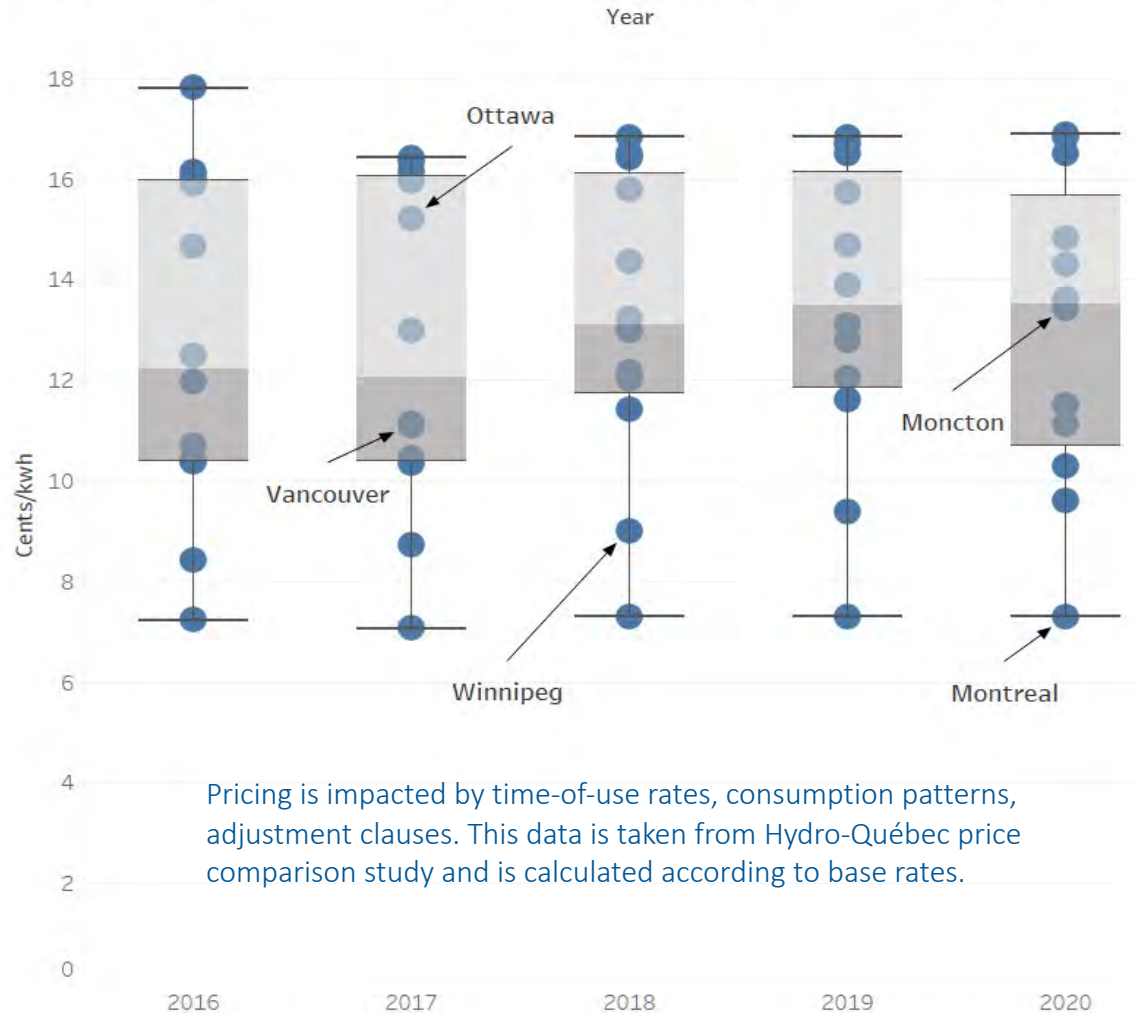
Multinational Comparison (Residential Pricing -2020)

Residential Price vs. Non-GHG Emissions by Population



Canadian Urban Centres Comparison (Residential Pricing)

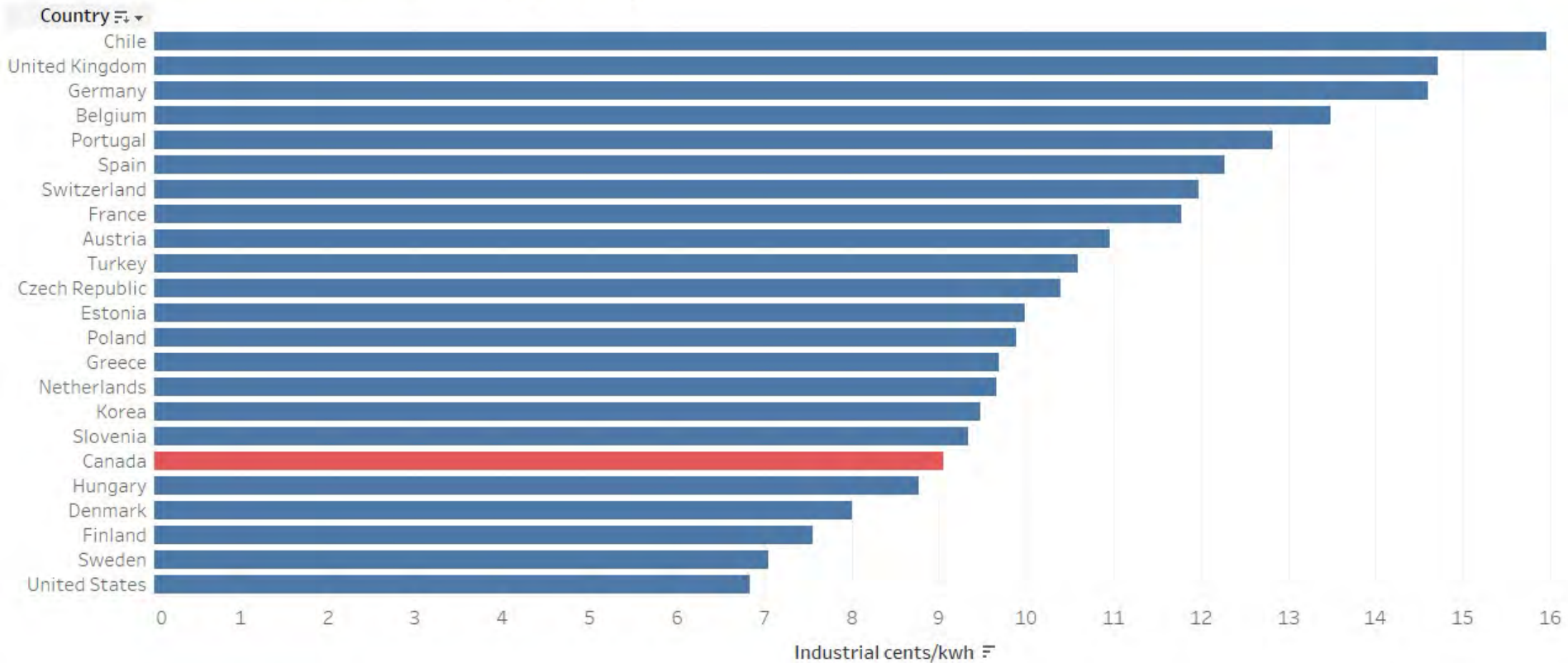
Range of Urban Electricity Prices (1000 kwh consumption)



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 Pricing (2020)



Multinational Comparison (Industrial Pricing)

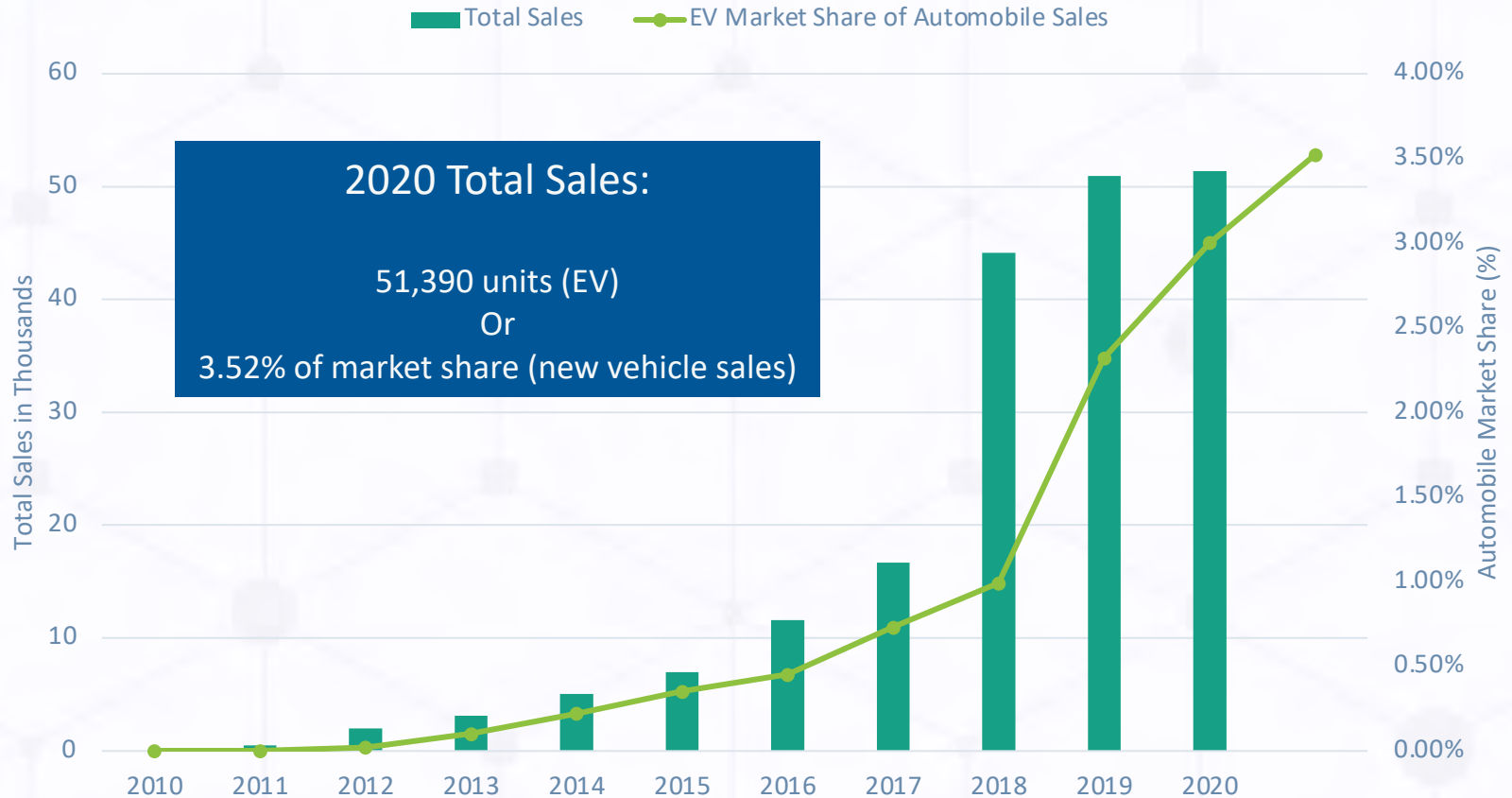
Industrial Price vs. Non-GHG Emissions by Population



Shaded area indicates top quartile.

Electric Vehicle Sales (Canada)

Electric Vehicle Market Share and Sales Growth (2010-2020)



Financials



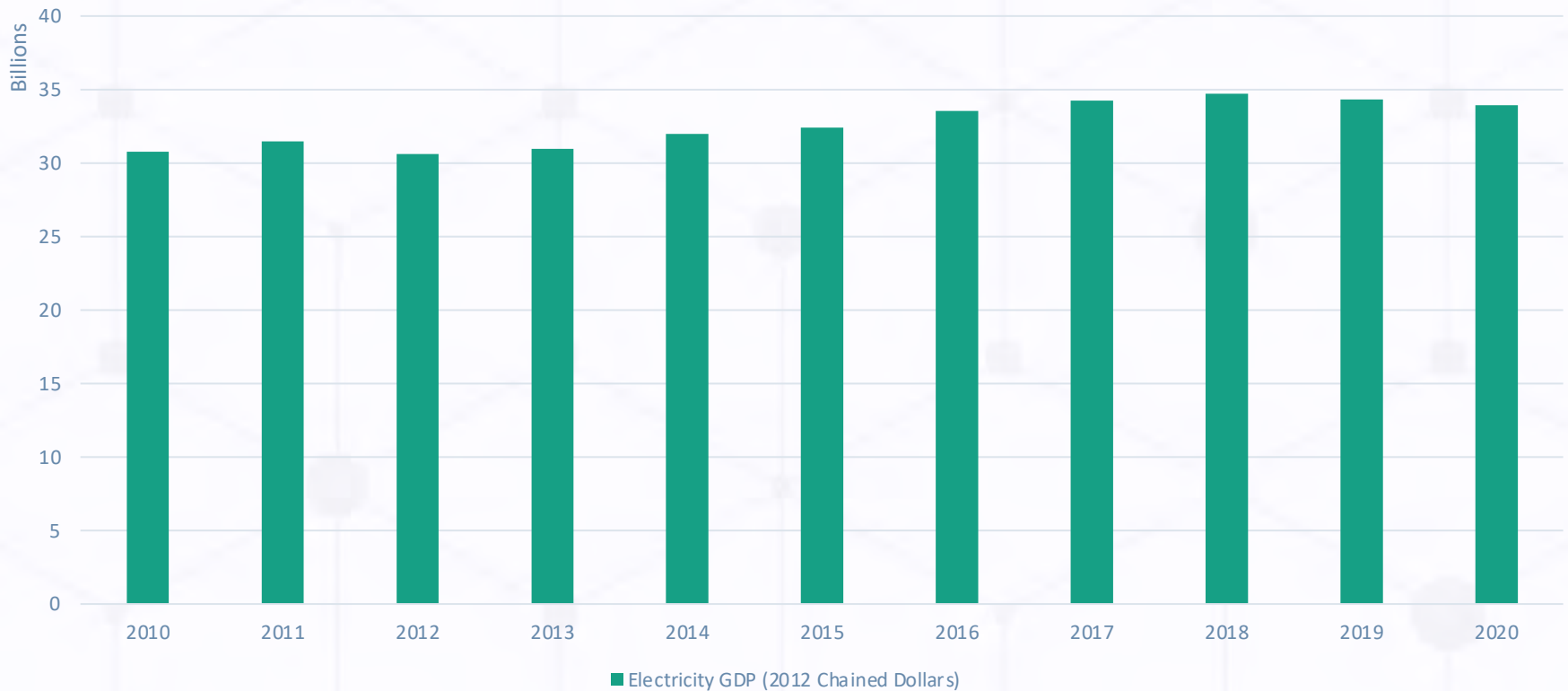
IN 2016 THE ELECTRICITY INDUSTRY REPRESENTED 1.7%
OF THE *NATIONAL GDP*.

- [GDP Contribution](#)
- [Utility Investments](#)



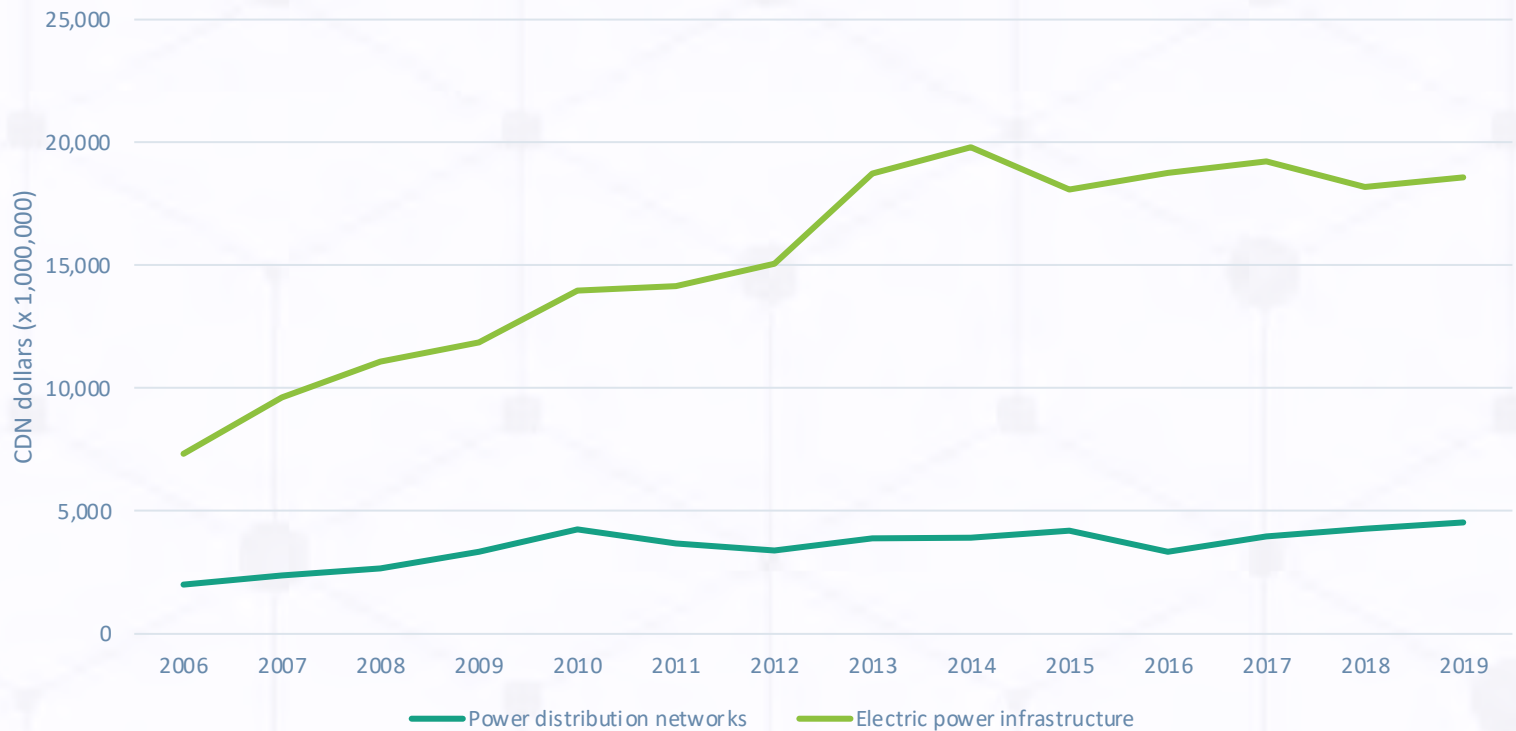
GDP Contribution

Electric Power(Generation, Transmission, Distribution) to Canada's GDP (2010-2020)



Utility Investments

Annual Capital and Repair Expenditures



Data Source: Statistics Canada. [Table 34-10-0063-01 Capital expenditures, non-residential tangible assets, by type of asset and geography \(x 1,000,000\)](#)

Data Retrieved: July 2021; 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](#)
- [Known Transmission Projects \(Renew/MPMO\)](#)

Known Generation Projects (Renew/MPMO)

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

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)

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

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

Major Transmission Projects (MPMO/Renew)

MPMO Project Name	Description	Proponent	Location	Value (\$)	Estimated Completion
Bipole III Transmission Line	1,384 km line	Manitoba Hydro	MB	5.04B	2018
Chamouchouane-Bout-de-l'Île Transmission Line	735 kV line (406 km)	Hydro-Quebec	QC	1.4B	2018
East-West Transmission Tie	230kV line	NextEra Energy Canada/ Enbridge	ON	0.6B	2020
Fort McMurray Transmission Line	500 kV AC line (over 900km)	AESO	AB	1.43B	2019
ITC Lake Erie Connector	50 kV International Power Line (IPL)	ITC Holdings Corporation	ON	TBD	TBD
Juan de Fuca Power Cable	550 MW line	Sea Breeze Power	BC	0.665B	TBD
Manitoba-Minnesota Transmission Project	500 kV AC line	Manitoba Hydro	MB	TBD	TBD
Maritime Link Transmission	500-MW, +/- 200 to 250-kV HVDC & HVAC	ENL Maritime Link Inc.	NL/NS	1.577B	2018
Romaine	315kV and 735kV lines	Hydro Quebec	QC	1.3B	2020
Wakaynikaneyap Transmission Project	1,800 km line	FortisOntario	ON	1.35B	2024

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

FOR MORE INFORMATION CONTACT US

Canadian Electricity Association
275 Slater Street, Suite 1500
Ottawa, Ontario, K1P 5H9
613.230.9263



Twitter: @CDNElectricity

LinkedIn: <https://www.linkedin.com/company/canadian-electricity-association/>

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