

Electricity 101

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

Electricity Canada

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

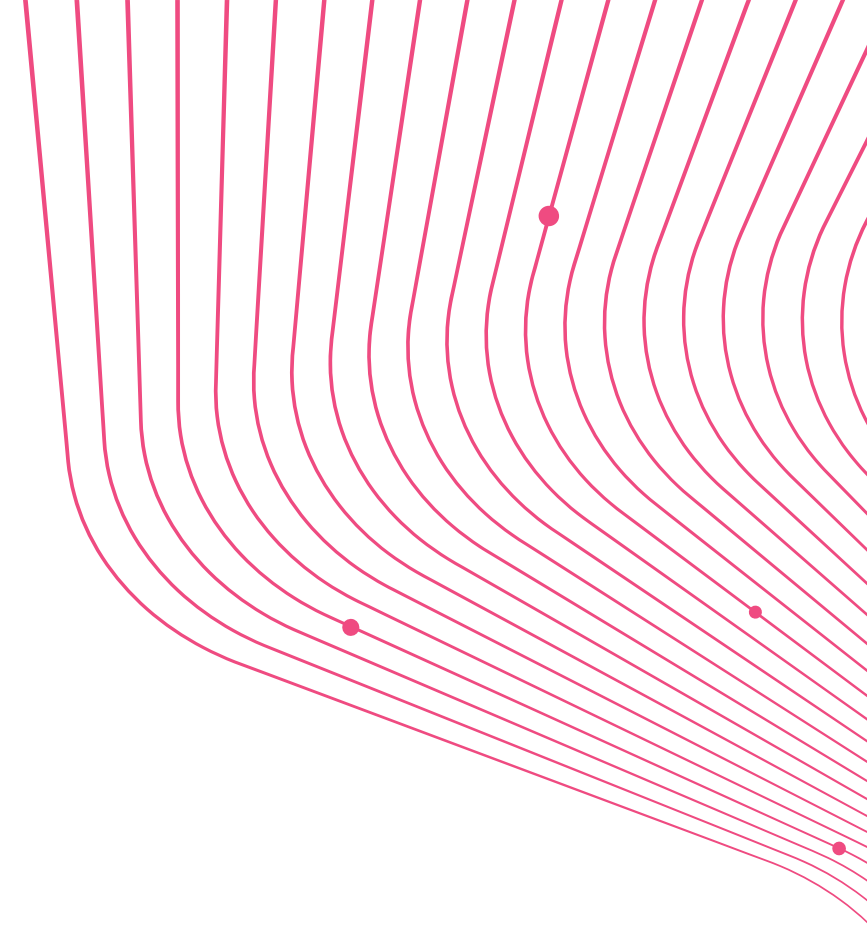
Mission: Electricity Canada is the national voice for sustainable electricity for its members and the customers they serve.



Regulatory

Canada has a strong regulatory environment.

- [Jurisdictional Environment](#)
- [Market Structure](#)
- [Regulatory Regime for Infrastructure Projects](#)
- [Integrated North American Grid](#)
- [North American Electric Reliability Corporation \(NERC\)](#)



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

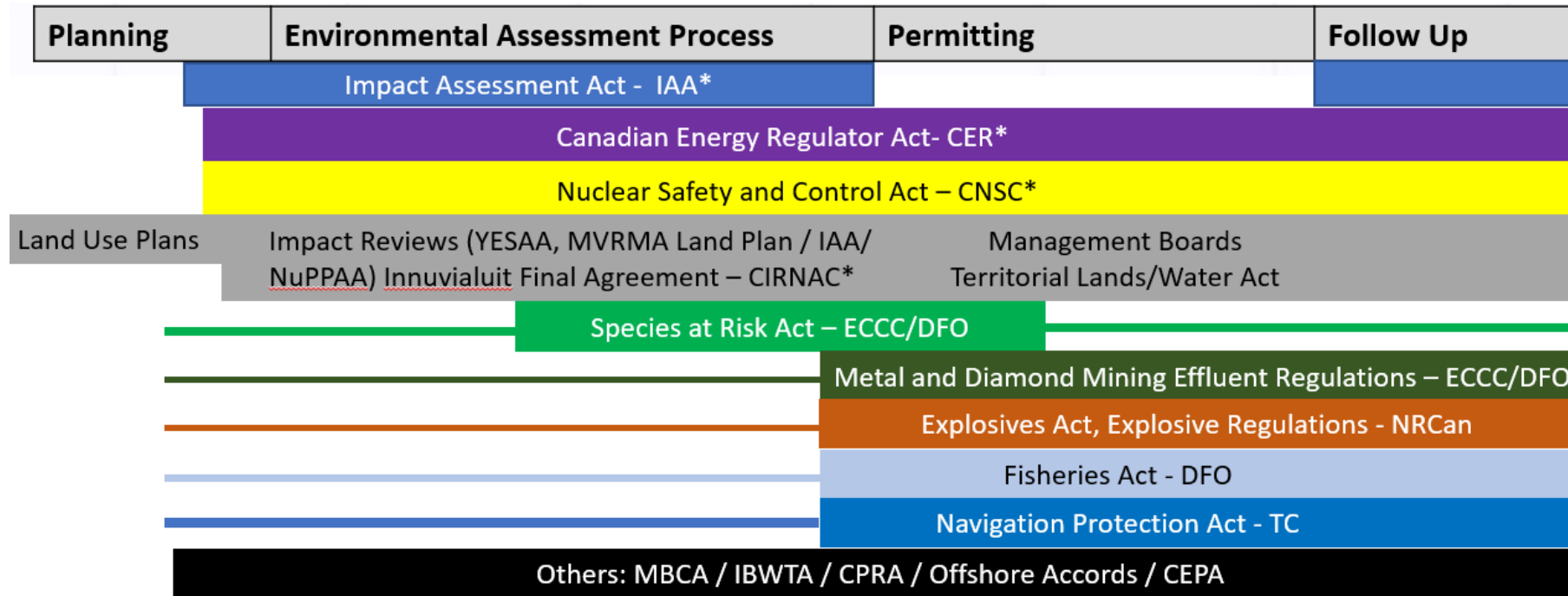
- Wholesale open access
- Vertically-integrated Crown corporation

Yukon

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



Canada's Regulatory Regime for Large Energy Projects

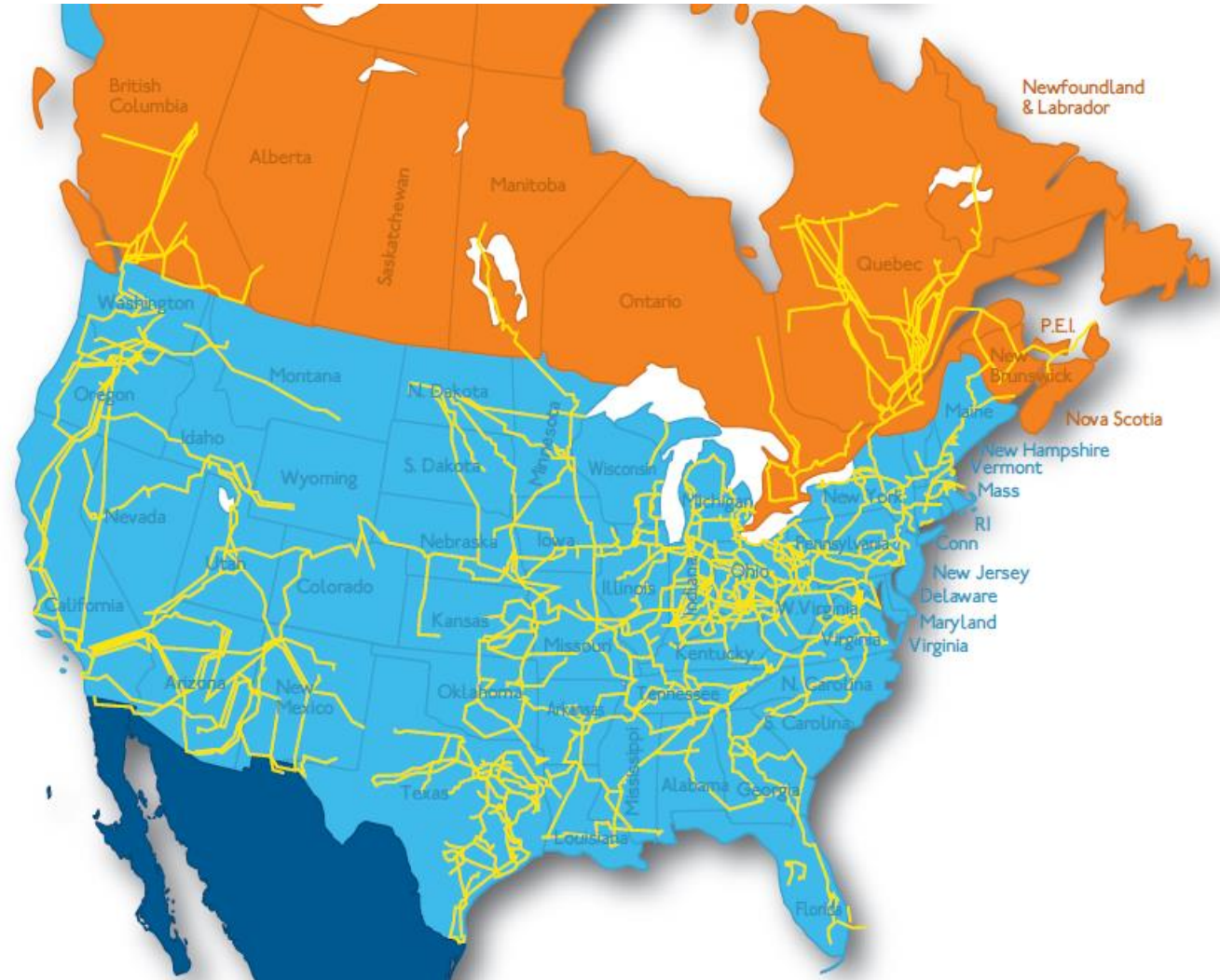


*Permits required under other Acts trigger IAA OGD participants | Illustrative – some components would not apply to same project
YESAA – Yukon Environmental and Socio-Economic Assessment Act / **MVRMA** – Mackenzie Valley Resource Management Act / **MBCA** – Migratory Birds Convention Act / **IBWTA** – International Boundary Waters Treaty Act / **CPRA** – Canadian Petroleum Resource Act / **Offshore Accords** – Canada – NS and NFLD Offshore Accords / **CEPA** – Canadian Environmental Protection Act / **NuPPAA** – Nunavut Planning and Project Assessment Act (NuPPAA)

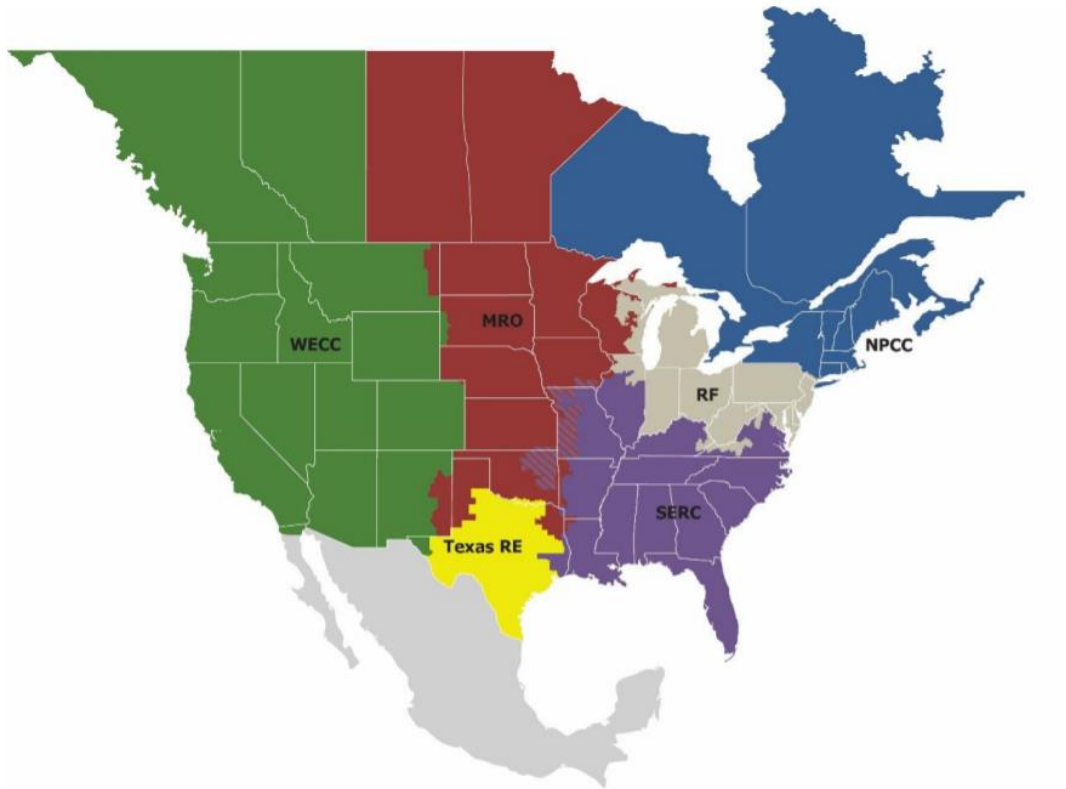


The Integrated North American Grid

Details: Lines shown are 345kV and above. Transmission Lines under 345KV do not appear on this map.



North American Electric Reliability Corporation Regions (NERC)



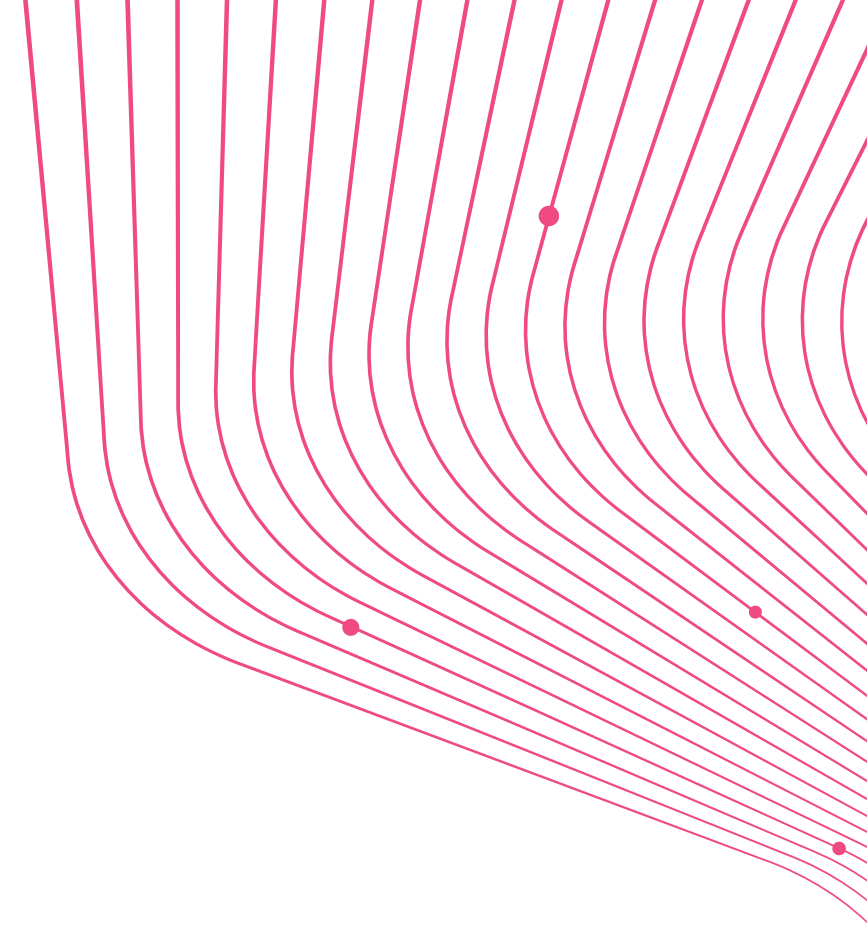
Acronym	Name
WECC	Western Electricity Coordinating Council
MRO	Midwest Reliability Organization
TRE	Texas Reliability Entity
SERC	Southeast Reliability Corporation
RFC	Reliability First Corporation
NPCC	Northeast Power Coordinating Council, Inc.



Industry

The industry employs over 90,000 people.

- [Industry Overview](#)
- [Top Electricity Projects](#)
- [Labour Statistics](#)
- [Index of Reliability](#)
- [Severe Weather, Growing Risk](#)
- [GDP Contribution](#)
- [Utility Investments](#)



Industry Overview

Electricity Industry Overview

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

- + **92,410**
Employed
- + **625.9 TWh**
Generation
- + **65.2 TWh**
Net Exports
- + **Over 80%**
Non-Emitting
- + **\$34.84 Billion**
GDP
- + **99.83%**
Customer Reliability
- + **4.44 Billion**
Net Trade Revenue
- + **60.0%**
GHG Emissions
Reduction Since
2000



Top 10 Electricity Infrastructure Projects - 2022

3 of the largest 10 Infrastructure Projects are Electricity Based and valued at \$41.8B

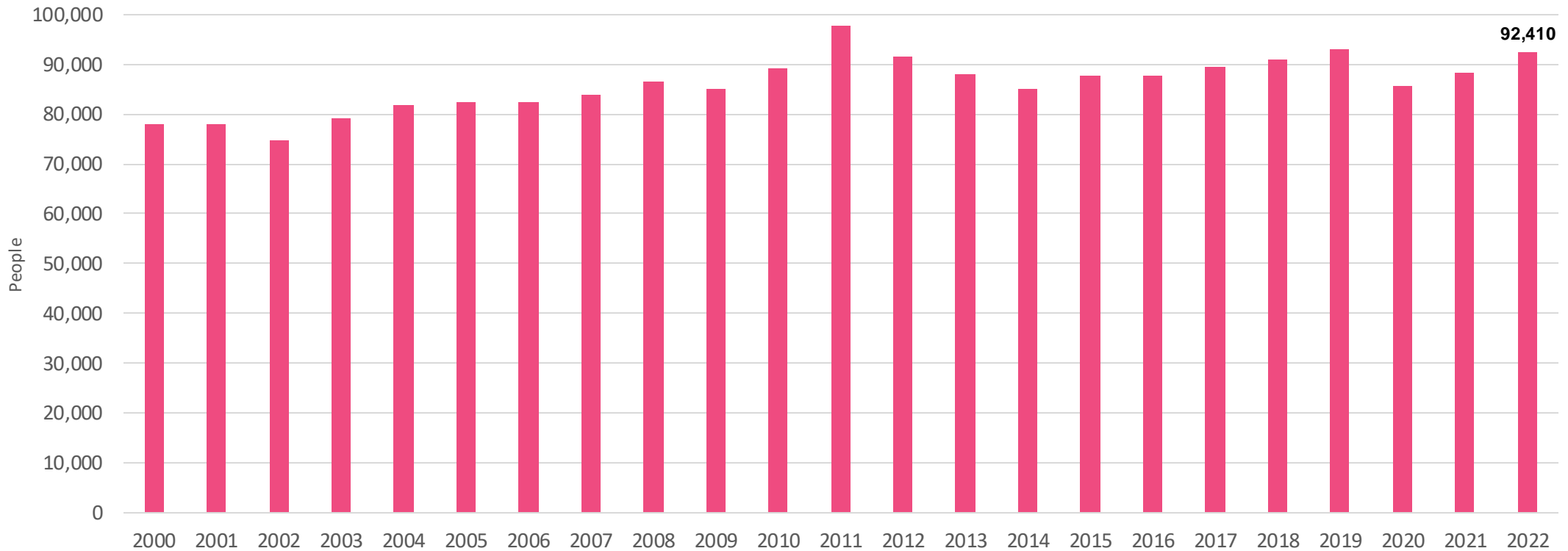
11 of the largest 100 infrastructure projects in Canada are electricity Based and valued at \$50.65B

Description	Description	Project Owner	Project Type	Location	Value (\$)	Estimated Completion
Site C Clean Energy Project	1,100 MW	BC HYDRO	Hydro	BC	16B	2025
Bruce Power Refurbishment	Refurbishment	Bruce Power	Nuclear	ON	13B	2033
Darlington Nuclear Refurbishment	Refurbishment	OPG/Nalcor Energy	Nuclear	ON	12.8B	2026
Wataynikaneyap Transmission Project	1800 km Transmission line	Wataynikaneyap Power	Transmission	ON	1.9B	2023
Renovations to Beauharnois Generating Station	Refurbishment 1900 MW	Hydro-Québec	Hydroelectric	QC	1.6B	2023
Cascade Power Project	900 MW Construction	Kineticor Resource Corp.	Natural Gas	AB	1.5B	2023
Micoua-Saguenay Transmission Project	262 km transmission line	Hydro-Québec	Transmission	QC	1.0B	2023
Great Plains Power Station	350 MW power plant construction	SaskPower	Natural Gas	SK	0.76B	2024
Carillon Generating Station Refurbishment Project	Refurbishment	Hydro-Québec	Hydroelectric	QC	0.75B	2027
Rehabilitation of Robert-Bourassa Generating Units	Rehabilitation	Hydro-Québec	Hydroelectric	QC	0.73B	2023



Industry Labour Statistics in Canada -2022

Electric Power (Generation, Transmission and Distribution)



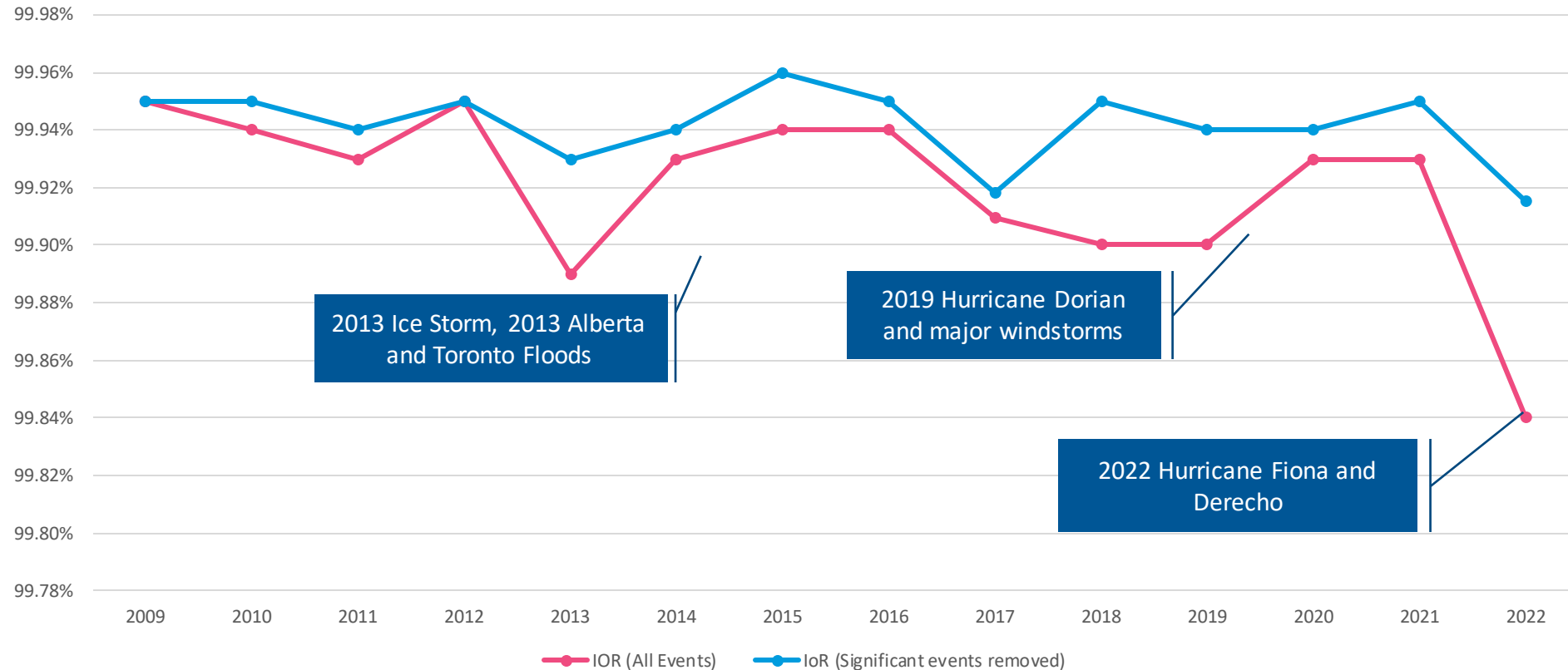
Excludes consultants, vendors and related manufacturers dedicated to the industry.

Staffing at its lowest point since 2007.



Customer Reliability in Canada

Canadian Index of Reliability (IoR) (2009-2022)

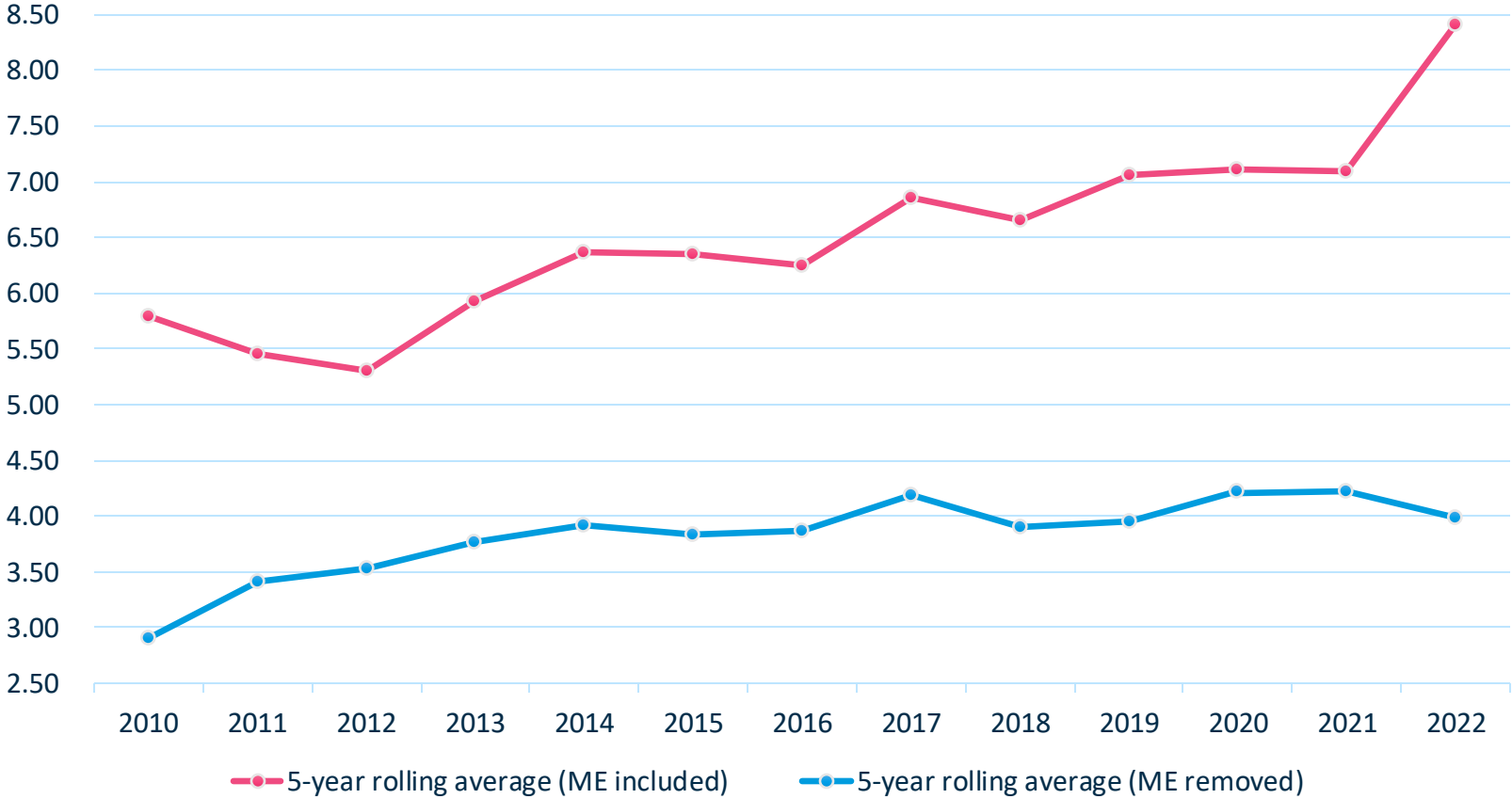


Significant Events are catastrophic events that are outside the control of the utility and impact the Canadian Index.



Severe Weather = Growing Risk

Five Year Rolling Averages



As more and more severe weather events occur, major event (ME) interruptions are on the rise.



Source: Electricity Canada, Service Continuity Committee
Data Retrieved: Aug. 2023; Visual Created by the Electricity Canada

GDP Contribution

Electric Power(Generation, Transmission, Distribution) to Canada's GDP (2010-2022)

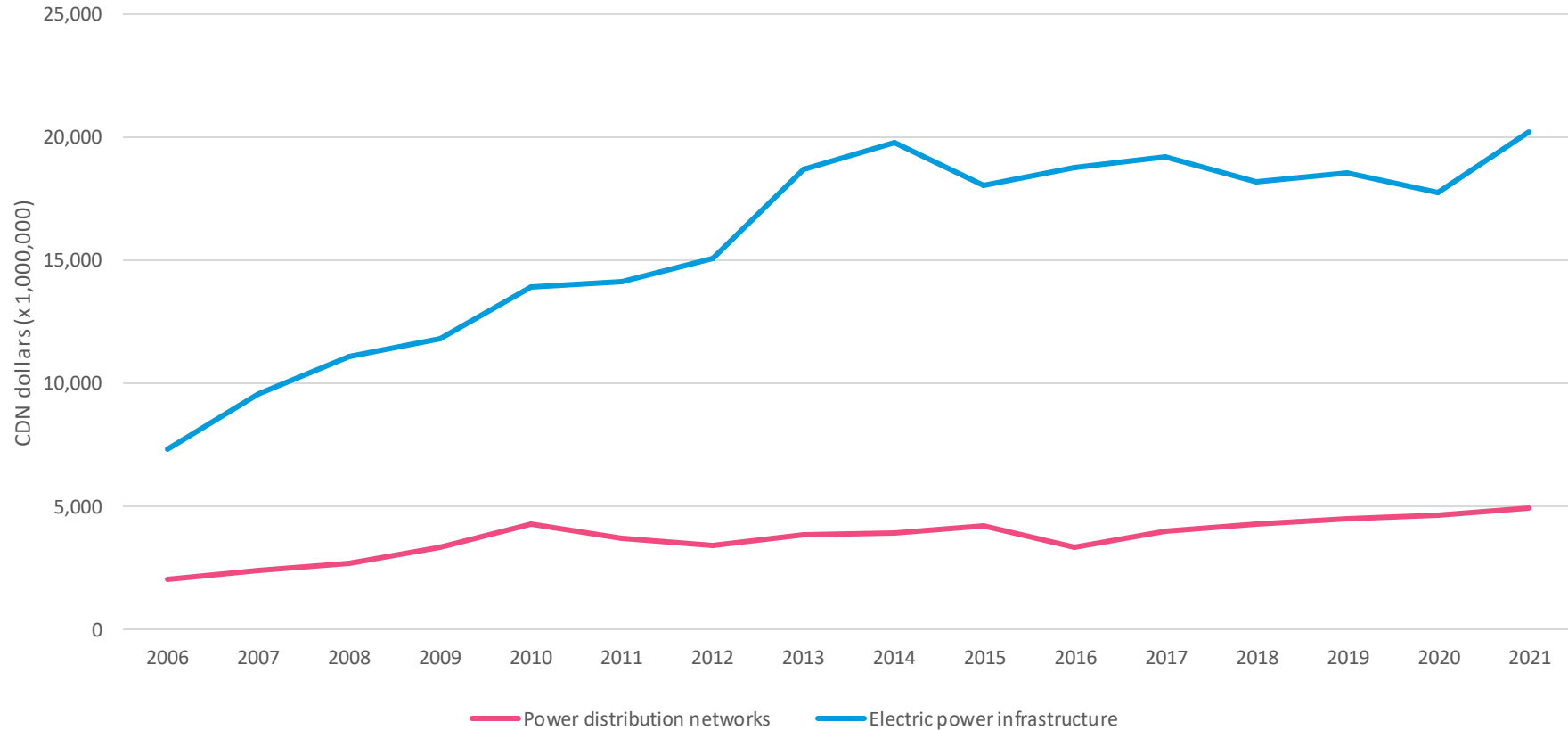


Data Source: Statistics Canada. [Table 36-10-0434-06 Gross domestic product \(GDP\) at basic prices, by industry, annual average, industry detail \(x 1,000,000\)](#)

Data Retrieved: Aug. 2023; Visual Created by the Electricity Canada

Utility Investments

Annual Capital and Repair Expenditures



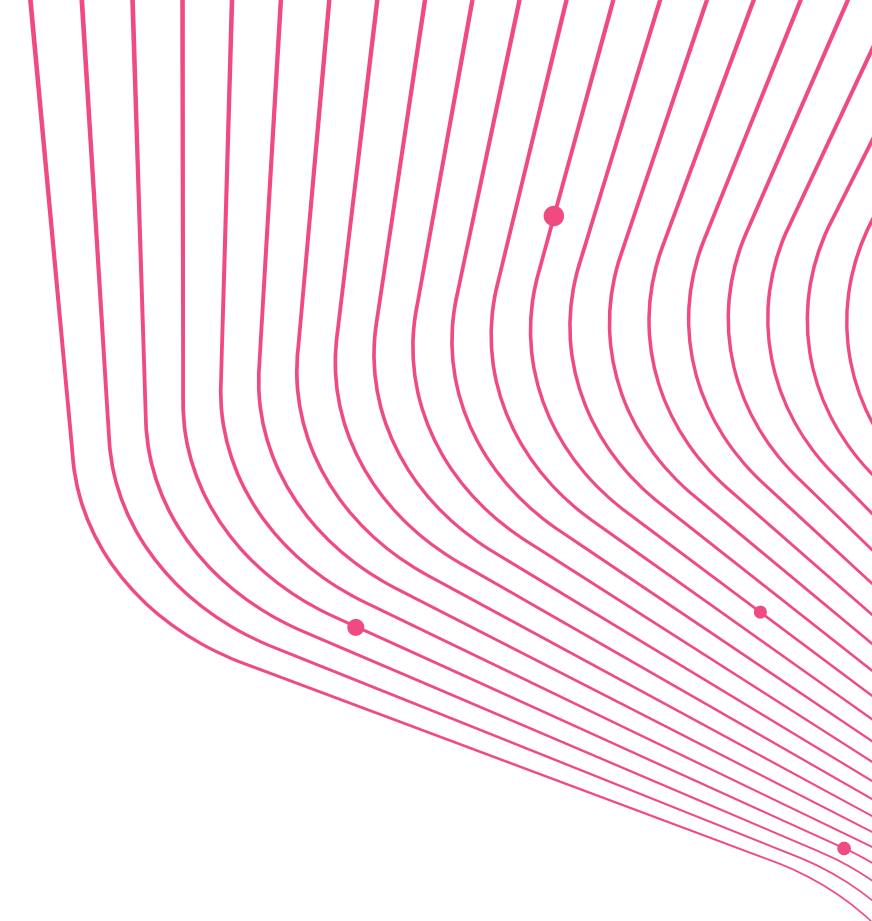
Data Source: Statistics Canada. [Table 34-10-0063-01 Capital expenditures, non-residential tangible assets, by type of asset and geography \(x 1,000,000\)](#)

Data Retrieved: Aug. 2023; Visual Created by the Electricity Canada

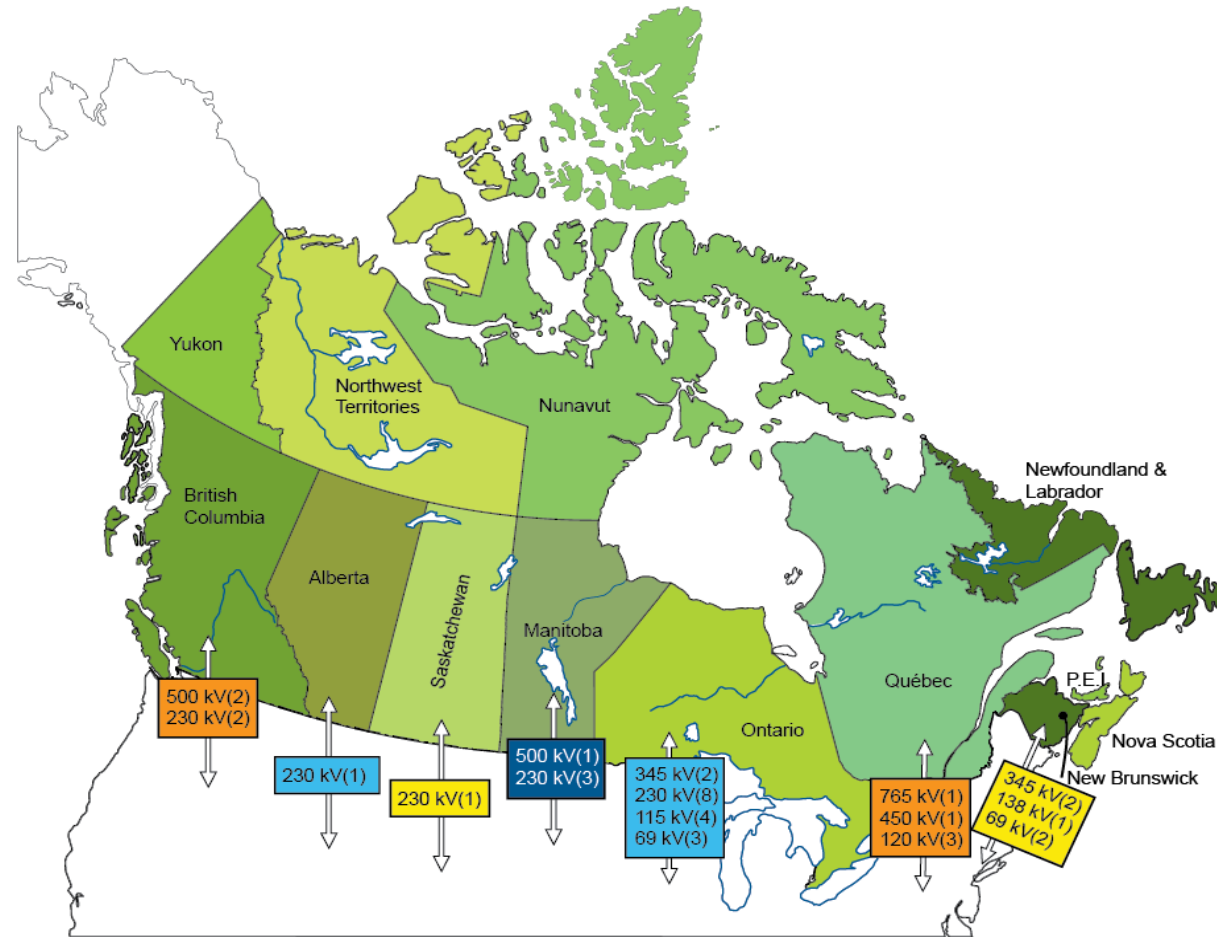
Trade

ELECTRICITY TRADING BETWEEN CANADA AND
THE USA BEGAN IN 1901.

- [Major Canada-U.S. Transmission Connections](#)
- [Canadian Exports-Imports by Region](#)
- [Trade Volume](#)
- [Trade Prices](#)
- [Trade Revenue](#)

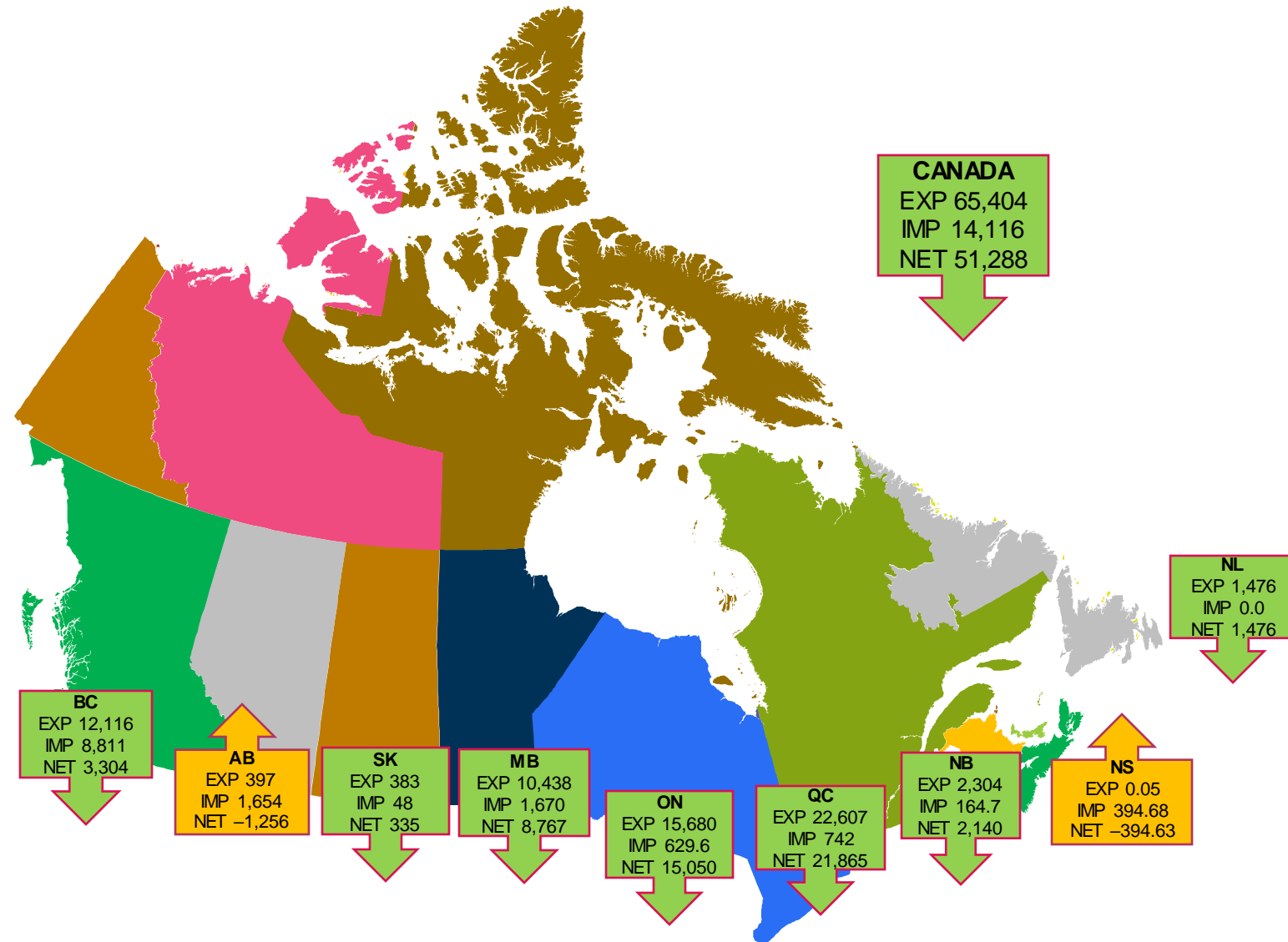


Major Canada-U.S. Transmission Connections



Data Source: Canada Energy Regulator (CER).
Data Retrieved: July 2016.

Canadian Electricity Imports and Exports by Region (GW.h) (2023)



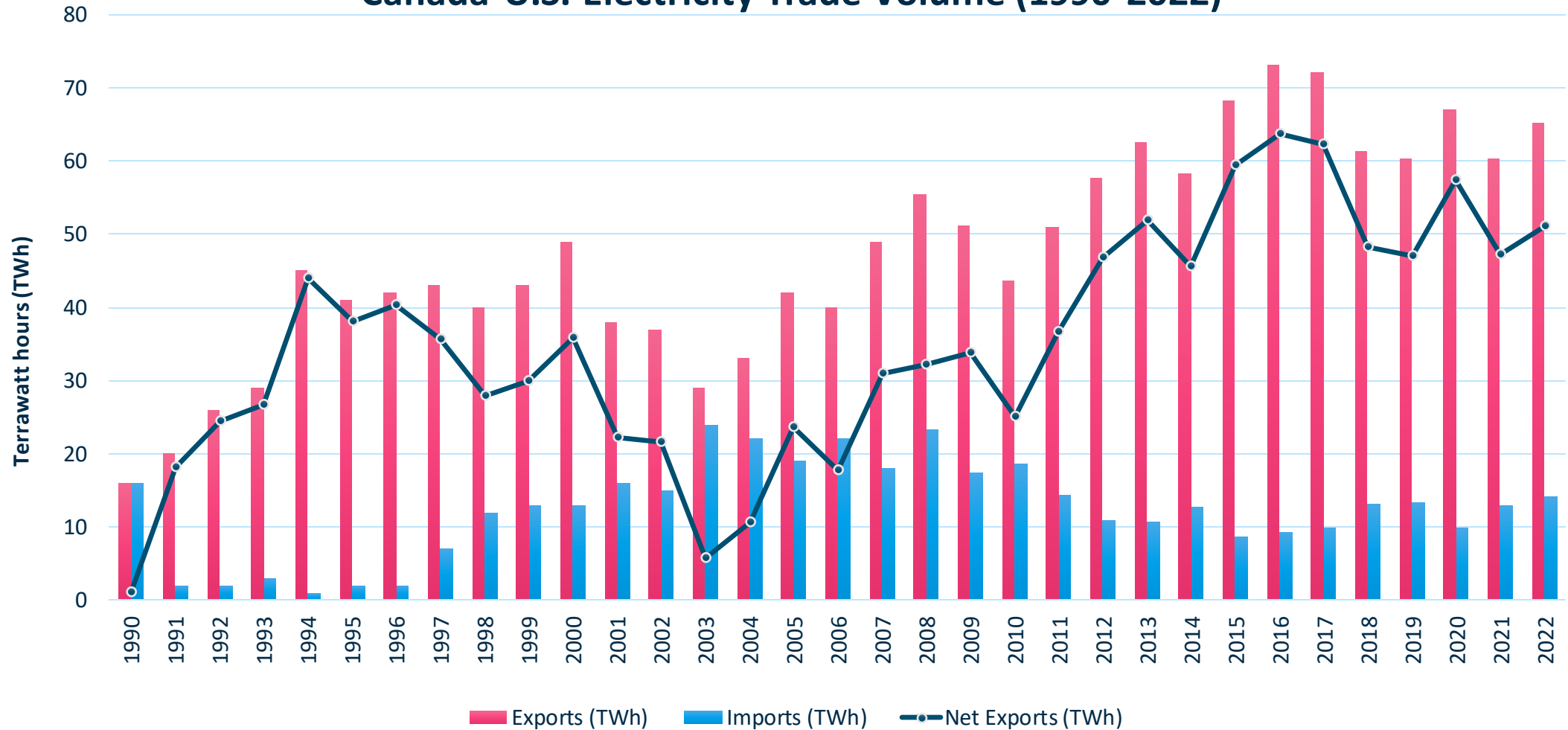
Notes: (1) Data in gigawatt-hours; (2) Provincial numbers may not sum up to total due to rounding.

Data Source: Canada Energy Regulator (CER), apps.cer-rec.gc.ca/CommodityStatistics/Statistics.aspx?language=english

Data Retrieved: Aug. 2023; Visual created by Electricity Canada.

Trade Volume

Canada-U.S. Electricity Trade Volume (1990-2022)

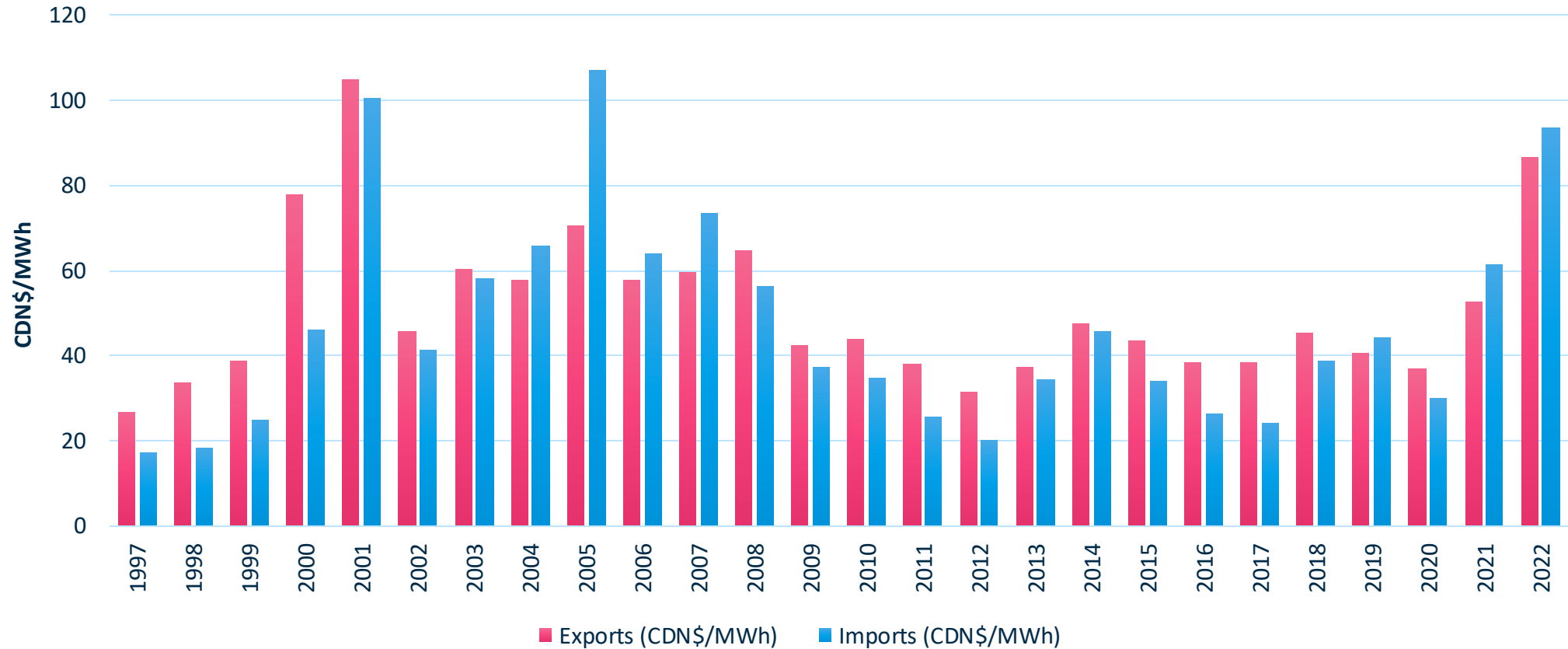


Data Source: Canada Energy Regulator (CER), [CER – CER – Electricity Trade Summary \(cer-rec.gc.ca\)](https://www.cer-rec.gc.ca)

Data Retrieved: Aug. 2023; Visual Created by Electricity Canada.

Trade Prices

Canada - U.S. Electricity Trade Prices (1997-2022)

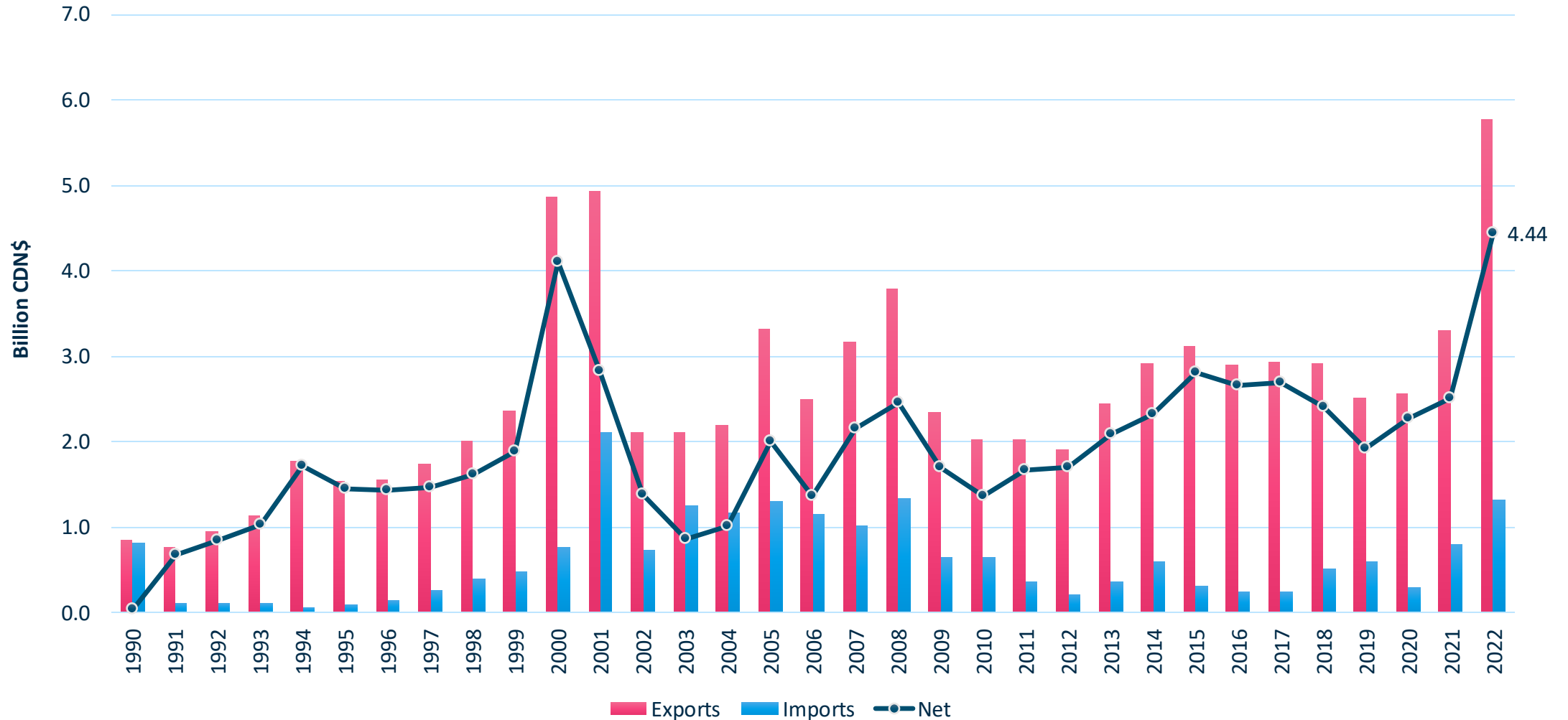


Data Source: Canada Energy Regulator (CER), [CER – CER – Electricity Trade Summary\(cer-rec.gc.ca\)](https://www.cer-rec.gc.ca)

Data Retrieved: Aug. 2023; Visual Created by Electricity Canada.

Trade Revenue

Canada - U.S. Trade Revenue (1990 -2022)



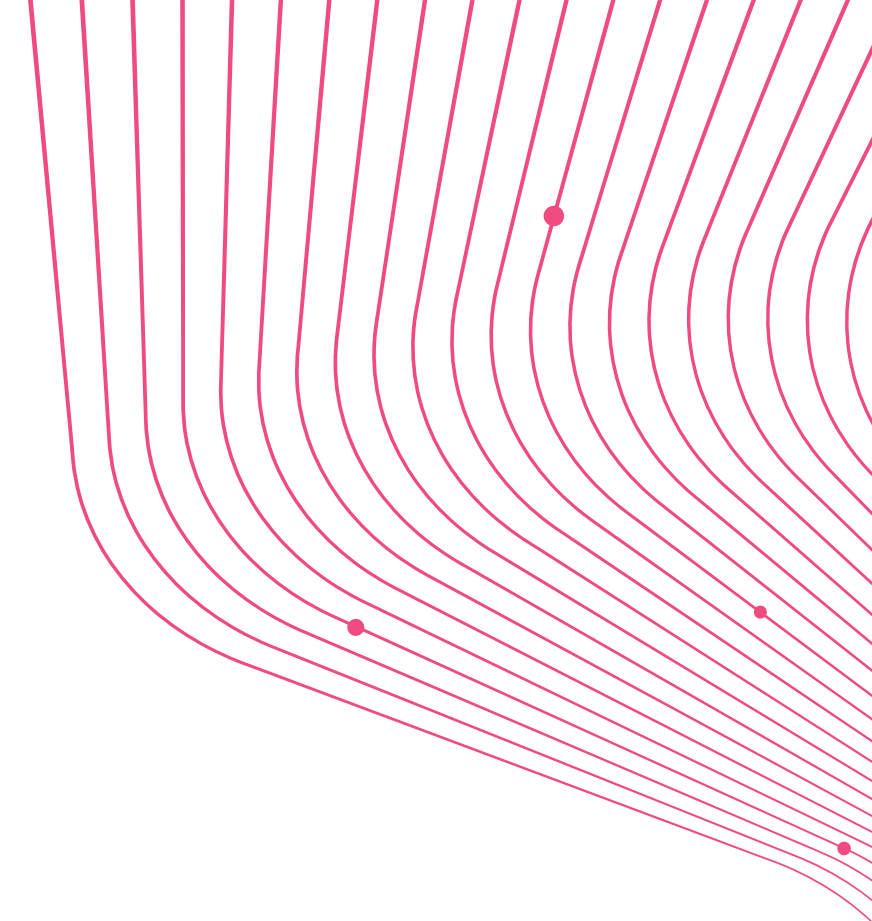
Data Source: Canada Energy Regulator (CER).

Data Retrieved: August 2023; Visual Created by Electricity Canada

Supply and Demand

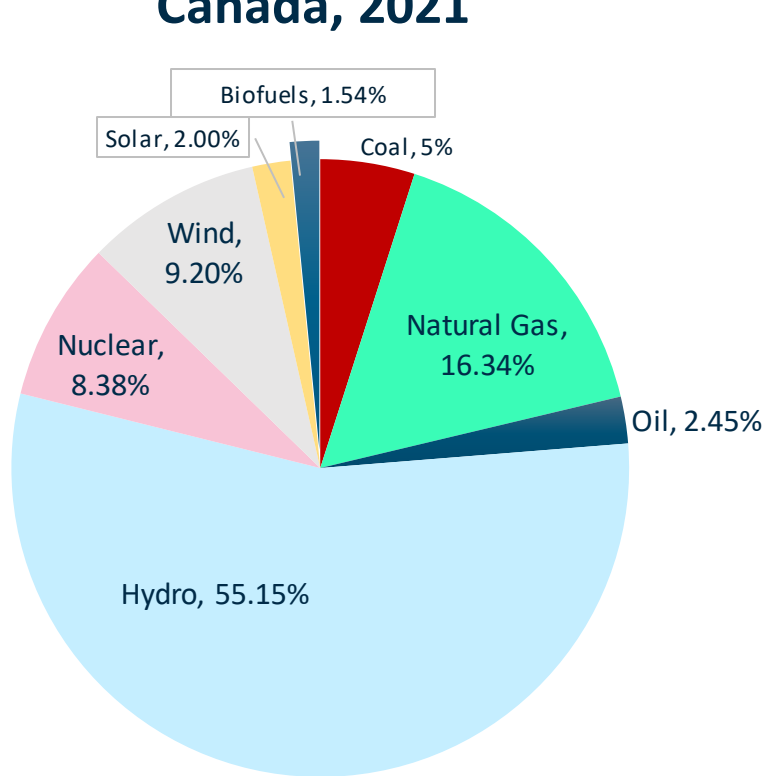
The electricity industry is over 80% non-emitting.

- [Generation Capacity \(Canada vs. United States, 2021\)](#)
- [Electricity Demand by Sector in Canada, \(1990-2021 Trend\)](#)
- [Electricity Demand by Sector in Canada \(Stacked % bar chart\)](#)
- [Electricity Generation by Fuel Type, \(1995-2021 Trend\)](#)
- [Supply, Industry and Utilities by Province in TWh \(2021\)](#)



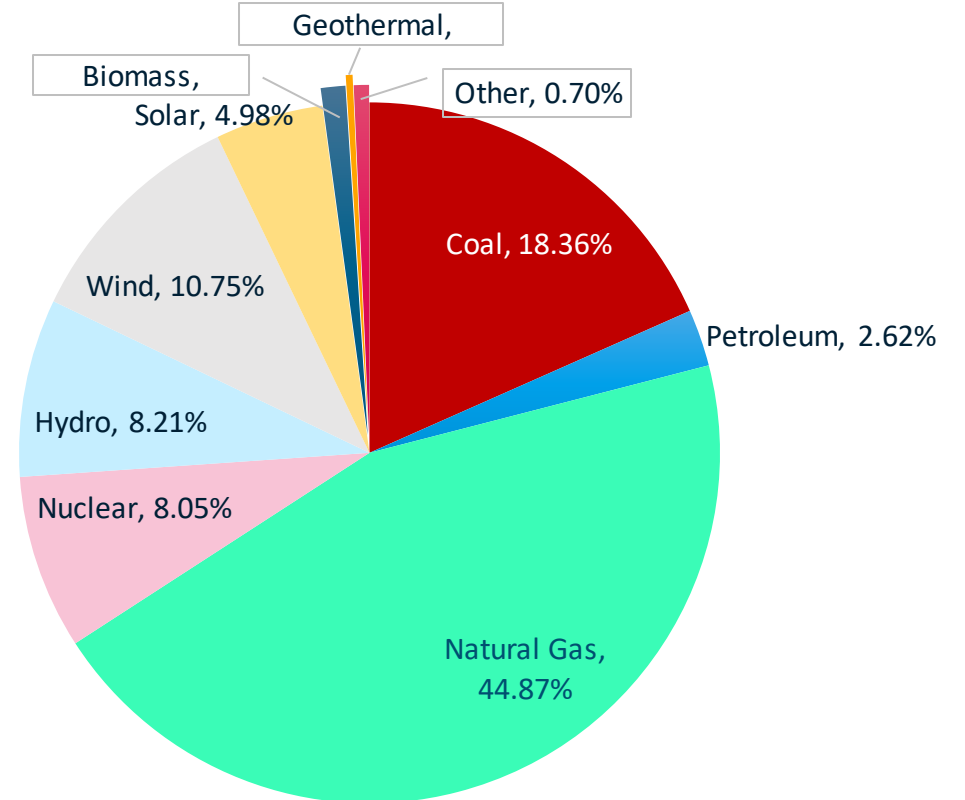
Generating Capacity

Canada, 2021



Generating Capacity
149 GW

United States, 2021



Generating Capacity
1,242 GW



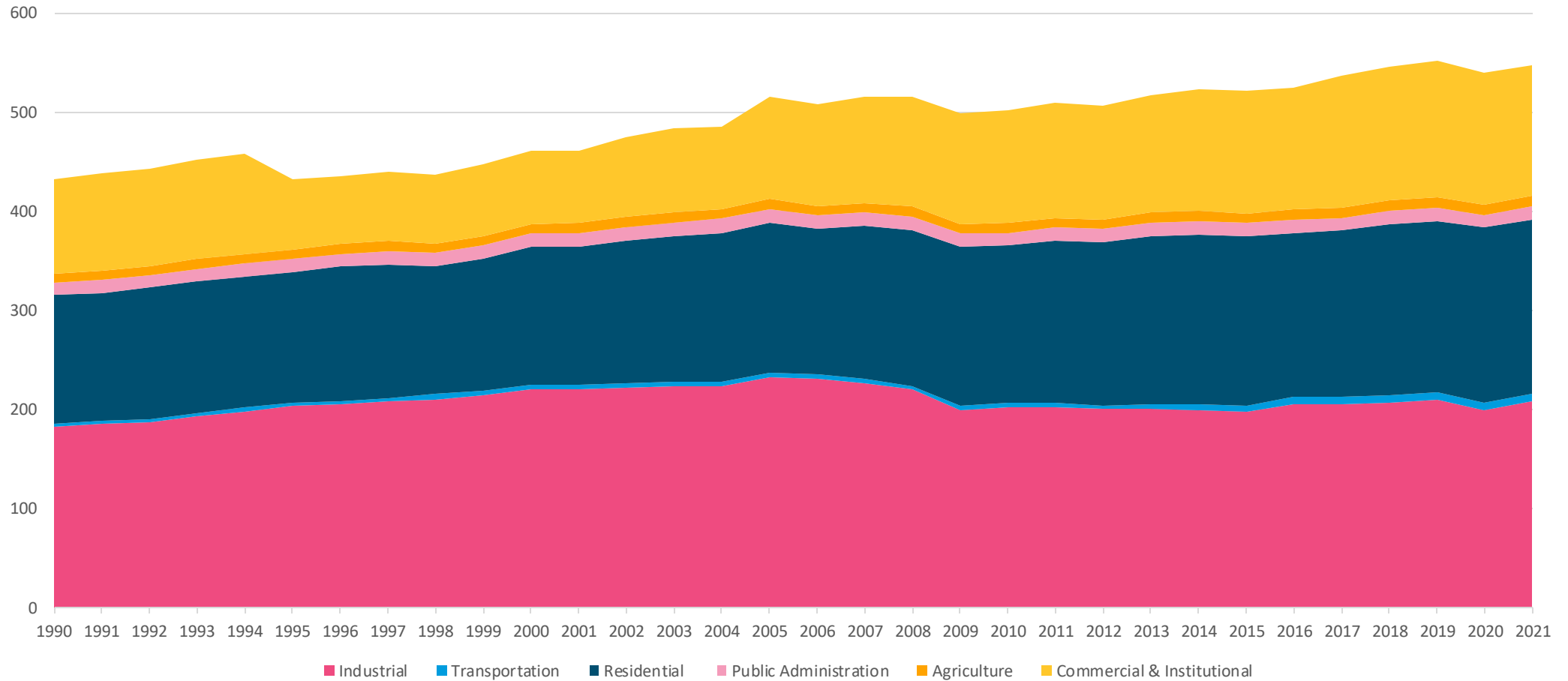
Data Source: Canadian data from Statistics Canada, Table 25-10-0022-01, CER – Canada's Energy Future 2021 Fact Sheet : Electricity (cer-rec.gc.ca)

U.S. data from the U.S. Energy Information Administration, SAS Output (eia.gov)

Data Retrieved: Aug. 2023.; Visual created by Electricity Canada

Electricity Demand by Sector in Canada, 1990 -2021

Total Electricity Demand in Canada for 2021 = 547.38 TWh

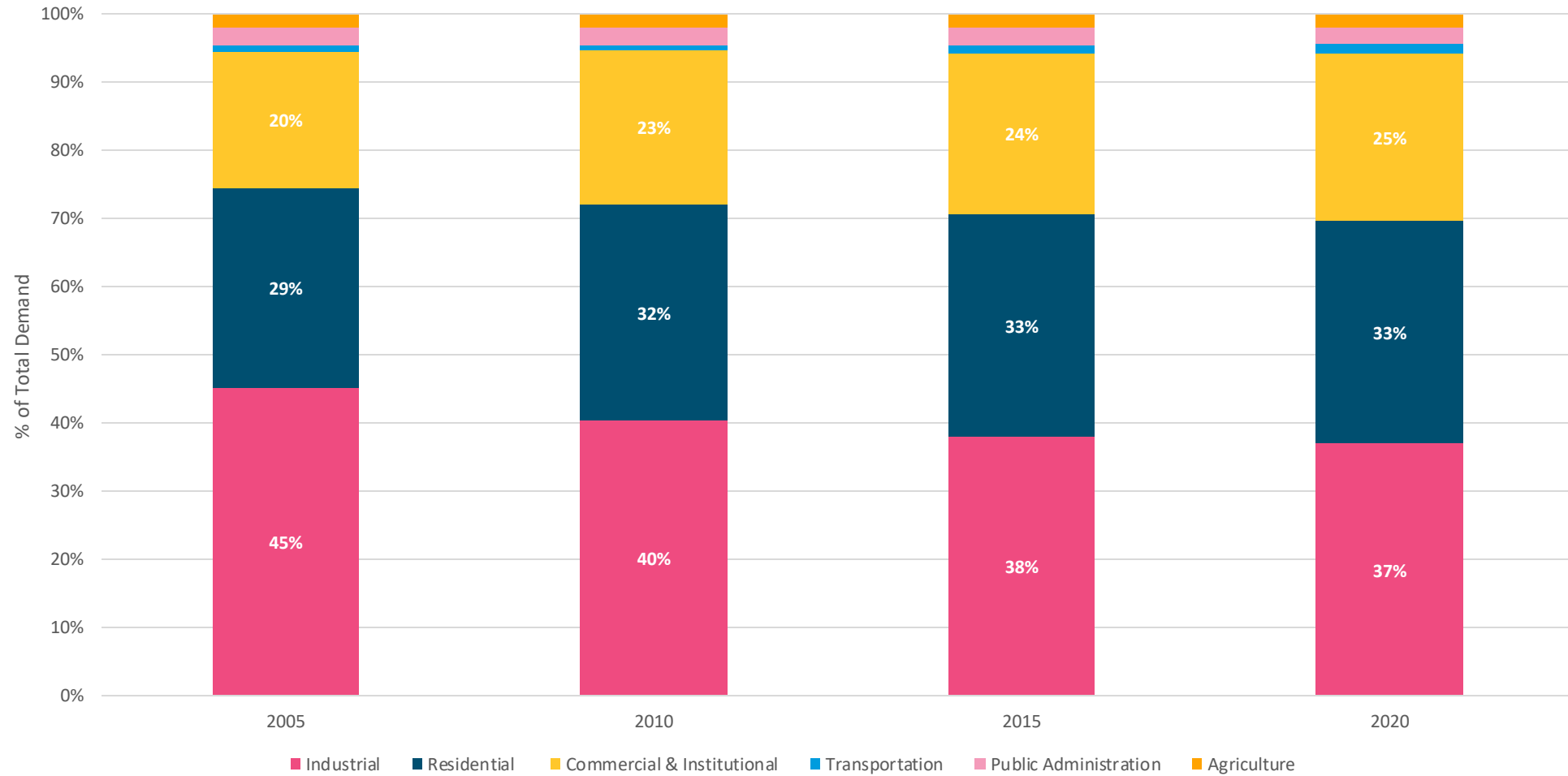


Data Source: Statistics Canada, Table 25-10-0030-01 (<https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=2510003001>)

Data Retrieved: Aug. 2023; Visual created by Electricity Canada.

Electricity Demand in Canada by Sector

(sectoral demand as a share of total demand)

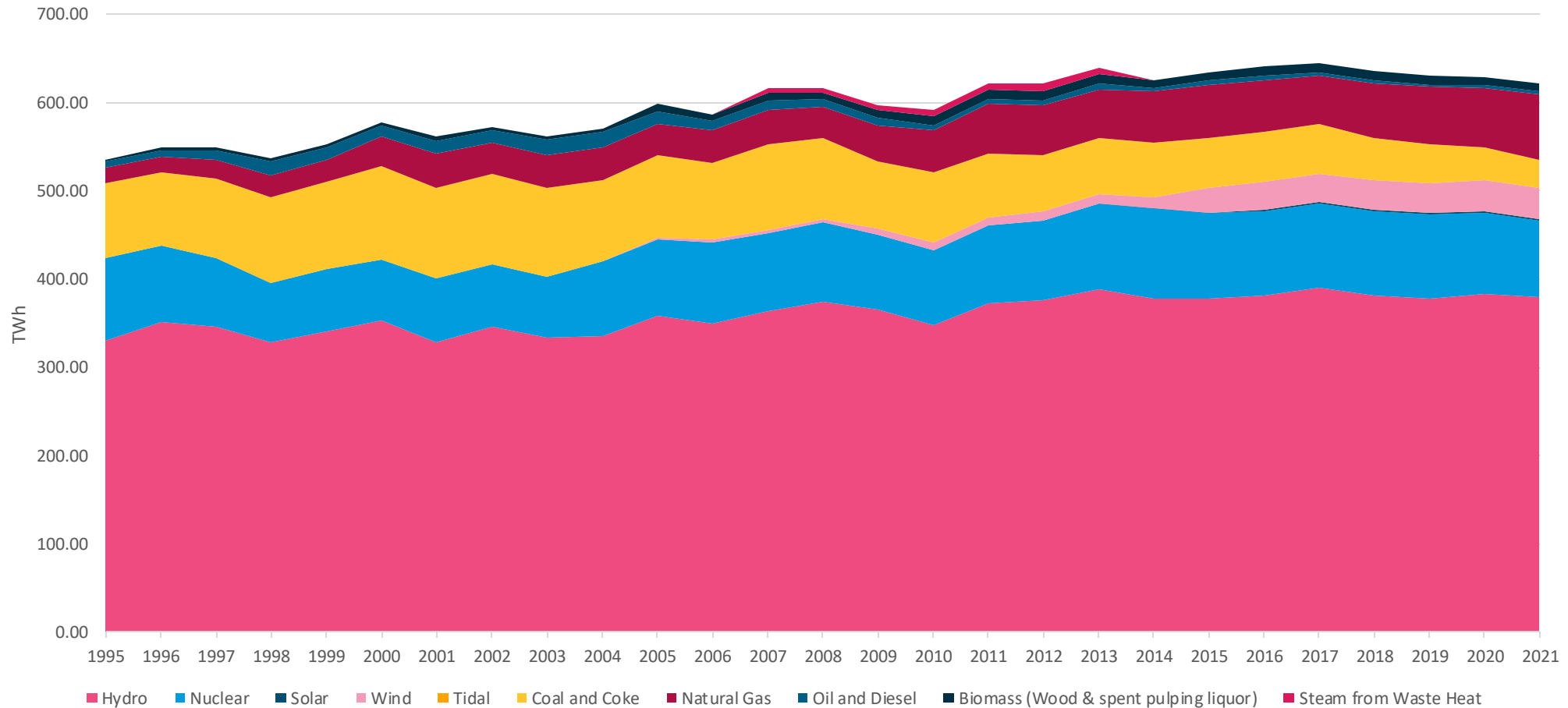


Data Source: CEA calculations based on Statistics Canada data, Table 25-10-0030-01.

Data Retrieved: Aug. 2023; Visual created by Electricity Canada.

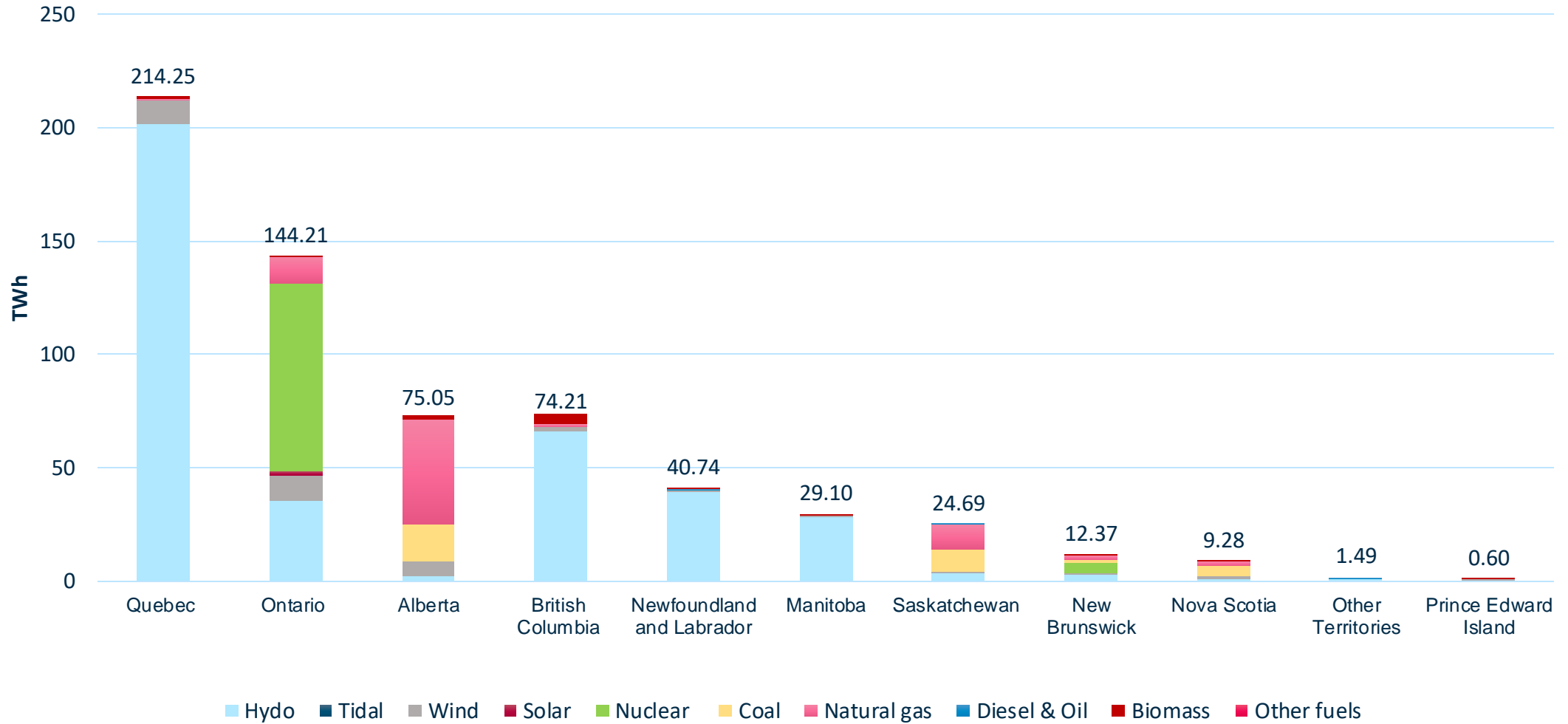
Electricity Generation by Fuel Type, 1995-2021

(Electric Utilities and Industry)



Data Source: Statistics Canada, Tables 25-10-0020-01, 25-10-0028-01 and 25-10-0019-01
Data Retrieved: July 2023.; Visual Created by Electricity Canada.

Supply by Province (Industries and Utilities - 2021)



Data Source: StatsCan, Table: 25-10-0020-01, [Add/Remove data - Electric power, annual generation by class of producer \(statcan.gc.ca\)](https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=2510002801)

Table 25-10-0028-01, <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=2510002801>

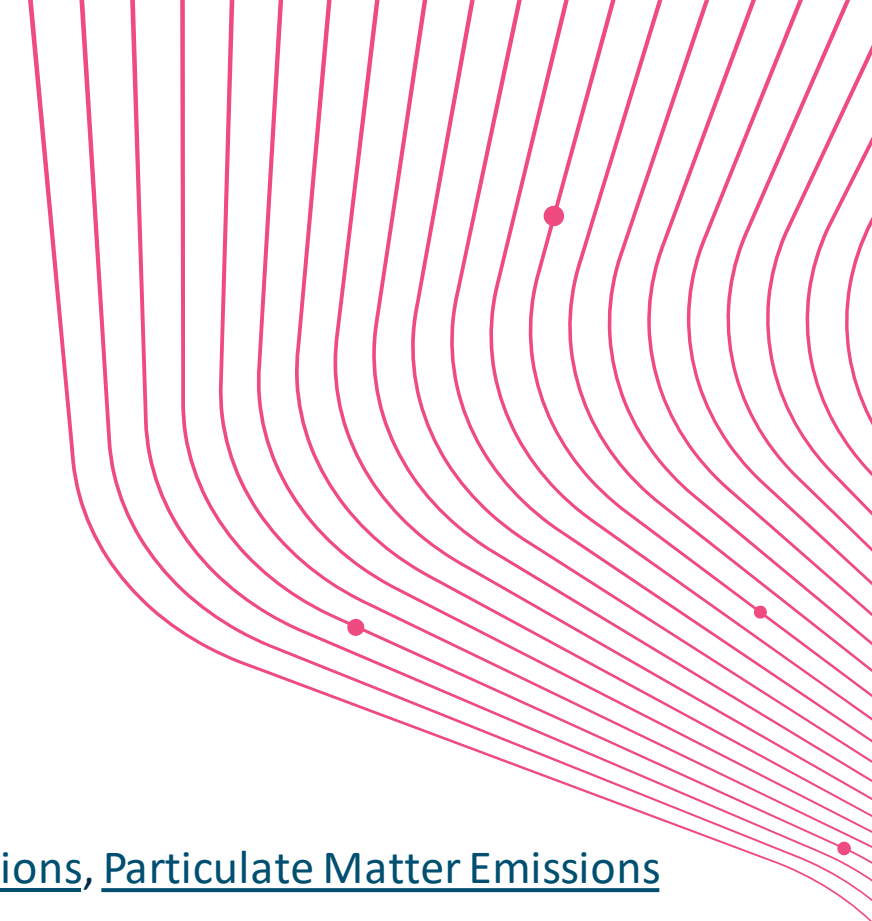
Data Retrieved: July 2023.; Visual Created by Electricity Canada.

Environmental Sustainability

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

ALBERT EINSTEIN

- [Low Emissions Technologies](#)
- [Nitrogen Oxide Emissions, Sulphur Oxide Emissions, Mercury Emissions, Particulate Matter Emissions](#)
- [GHG Equivalent Emissions from the Electricity Industry](#)
- [Emissions by Economic Sector](#)
- [Emission by Economic Sector, Trend](#)
- [Canadian Coal Fleet Profile by 2040](#)
- [U.S. Greenhouse Gas Emissions](#)

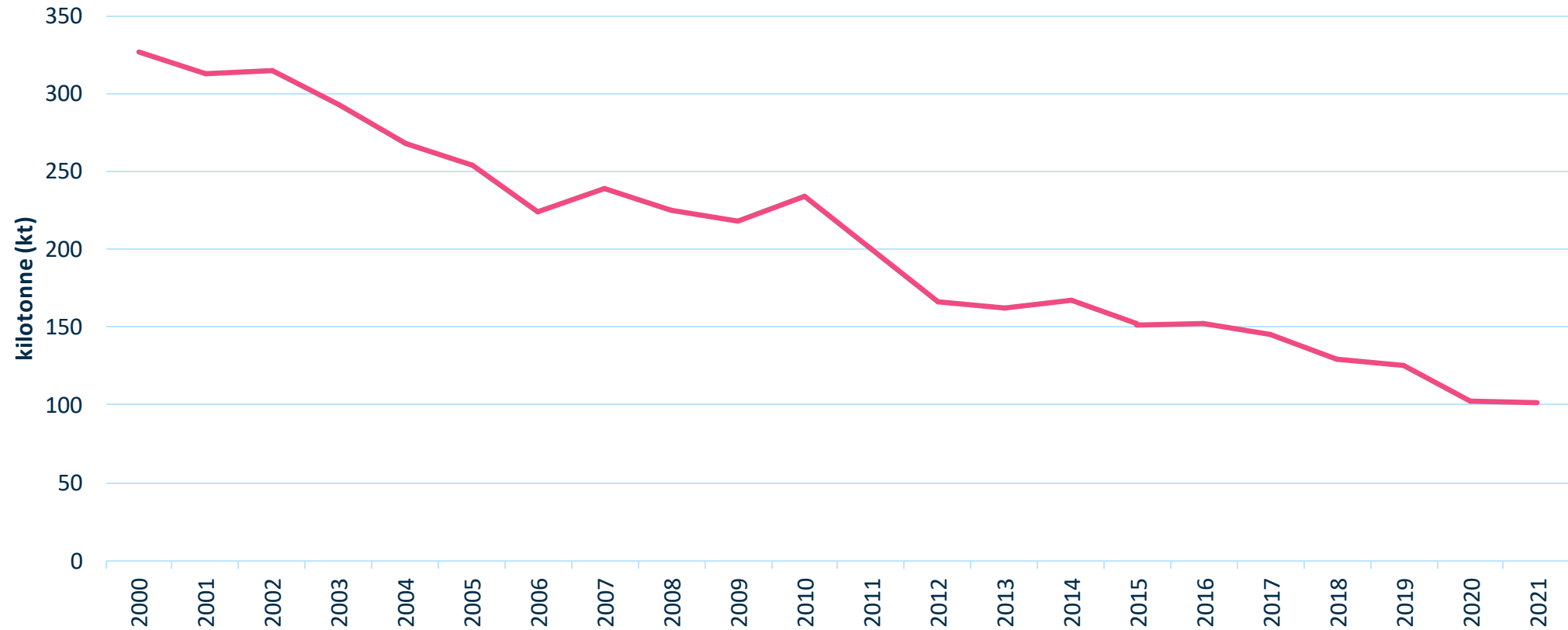


Low Emission and Sustainable Technologies

Resource	Advantages	Challenges
Wind Power	Needing no fuel, after the initial capital investment wind has a near-zero marginal cost of energy and essentially zero emissions or waste products from operation.	Electricity production from wind is variable and requires additional equipment to manage power quality. Potential impacts on avian populations, as well as noise, visual and land use concerns.
Small Hydro	There are relatively low capital costs, many potential sites in Canada, well established technology. Small hydro is able to meet small incremental capacity needs, with near-zero GHG emissions and good reliability characteristics.	Regulatory approval and gaining access to the grid can be costly, time consuming and uncertain. There can be significant opposition to new development, and there are impacts on fish, wildlife and local water systems.
Biomass	Biomass fuel – including landfill gas, wood pellets, forestry slash and various waste products – can be burned to create electricity. Where fuel sources are renewable, the GHG emissions can be negligible, and there is potential for negative (below-zero) GHG emissions where carbon capture, utilization and sequestration are employed.	High capital equipment and fuel costs. Significant investments may be needed to build infrastructure to supply sufficient biomass. Large biomass generators require a large land area to supply enough biomass for continuous operation.
Geothermal Energy	Reliable source of power, low fuel and operating costs, clean and renewable source of energy. Very low land requirements, and feasibility studies have shown promising sites in many provinces and territories.	Geothermal is relatively new in Canada, with few projects under development. Technical challenges remain. Depending on where the resource is located, connecting to the grid can be difficult.
Solar Photovoltaic (PV)	Needing no fuel, after the initial capital investment solar PV has a near-zero marginal cost of energy and essentially zero emissions or waste products from operation. Costs for the equipment continue to decline.	Times of peak sunshine often do not correspond with times of peak electricity demand, especially in winter. Grid connections can be problematic, and additional equipment is needed to mitigate power quality problems when connecting to a grid.
Ocean Energy	Tides and wave energy can provide predictable energy with little to no associated greenhouse gas emissions. Canada has a large coastline with many potential sites.	The technology has not yet reached commercial scale. There is the potential to impact marine ecosystems. While the energy is predictable, it is not available on-demand.
Fossil Fuel	<p>Modern fuel-based combustion technologies (such as natural gas, coal, and oil) are well suited for on-demand electricity generation, and complement variable renewables like wind and solar. Fuel supply chains are secure.</p> <p>For high-utilization (“baseload”) units, carbon capture, utilization and sequestration (CCUS) can be added to prevent climate change-inducing carbon dioxide emissions from entering the atmosphere.</p>	<p>Fossil fuel development, extraction and use has environmental consequences, including contributing to climate change.</p> <p>CCUS is not feasible for every type of thermal generating unit. CCUS projects can have high up-front costs and require infrastructure to transport and sequester CO₂ in products or in appropriate geological formations.</p>
Fission	Existing units provide large amounts of safe, reliable baseload electricity with little to no carbon emissions. New designs for small modular reactors (SMRs) promise greater flexibility and lower cost. Fuel supply chains are secure.	High up-front capital costs for existing large units. Spent fuel requires storage and eventual disposal.



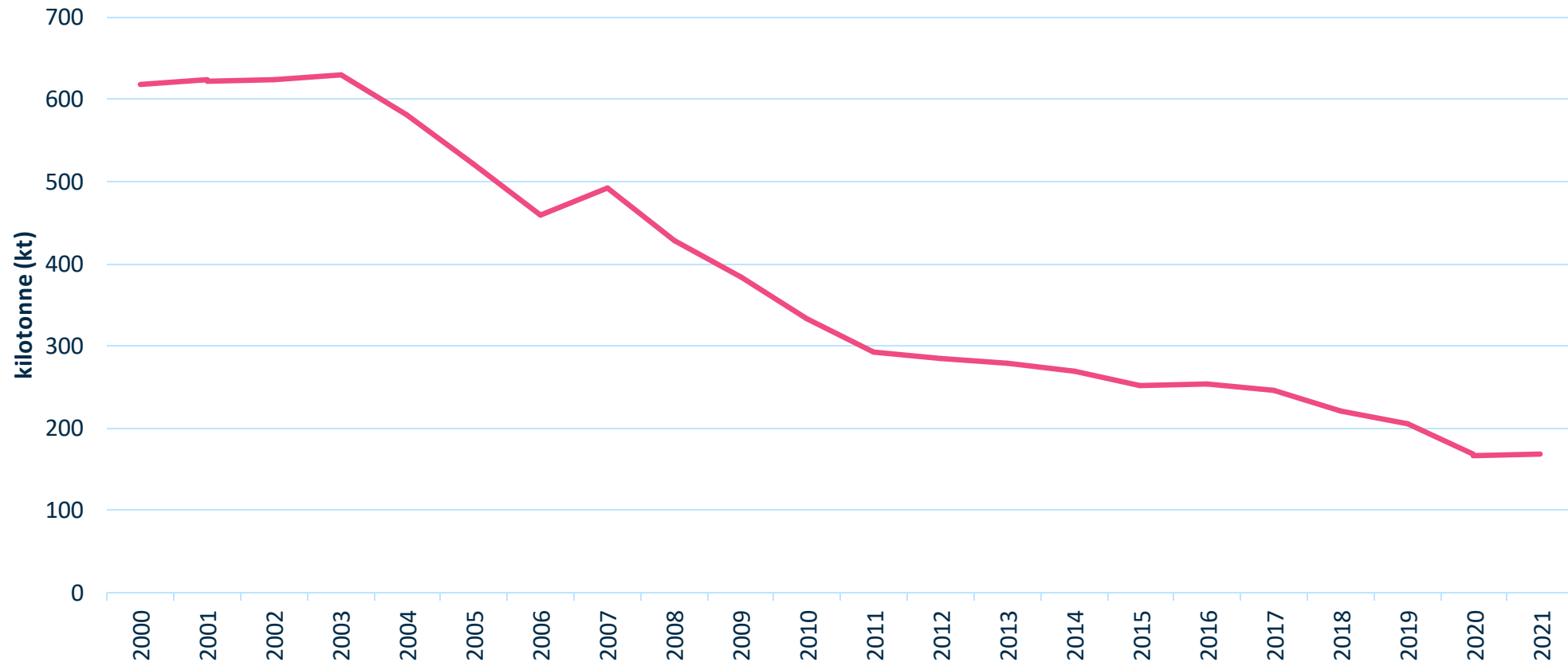
Nitrogen Oxide (NOx) Emissions Canadian Electricity Sector, 2000-2021



Since 2000, the Canadian electricity industry has reduced its NOx emissions by 69%.



Sulphur Oxide (SOx) Emissions Canadian Electricity Sector, 2000-2021

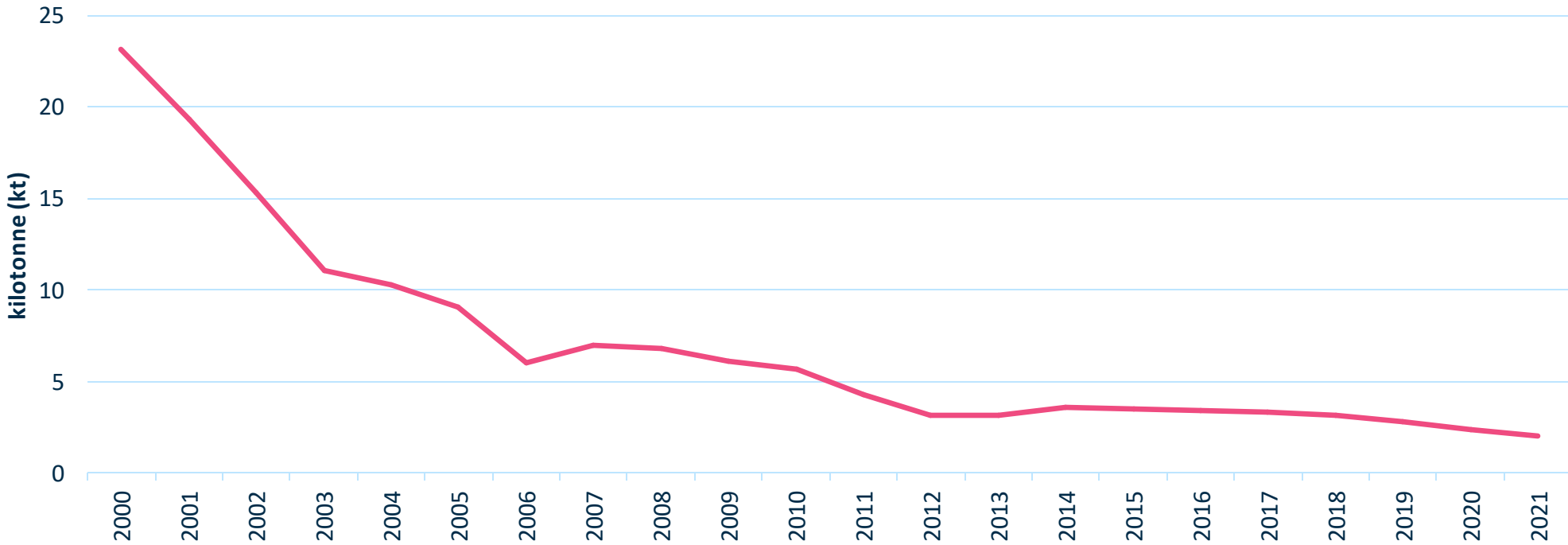


Since 2000, the Canadian electricity industry has reduced its SOx emissions by 73%.



Particulate Matter_{2.5} Emissions Canadian Electricity Sector, 2000-2021

Fine particulate matter (PM2.5)

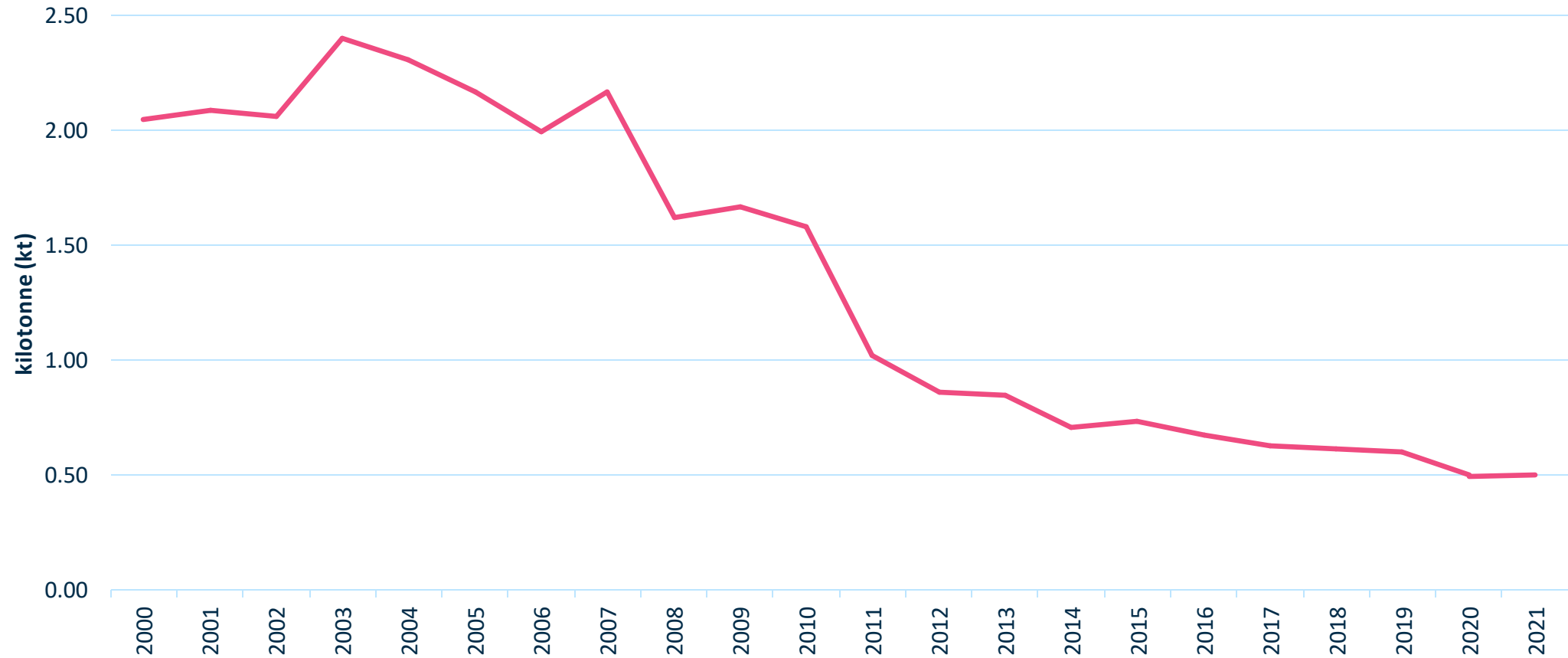


Since 2000, the Canadian electricity industry has reduced its particulate matter emissions by 91.4%.



Data Source: Environment and Climate Change Canada, [Air pollutant emissions - Canada.ca](https://www.ec.gc.ca/air-pollutant-emissions)
Data Retrieved: July 2023; Visual created by Electricity Canada.

Mercury (Hg) Emissions Canadian Electricity Sector, 2000-2021



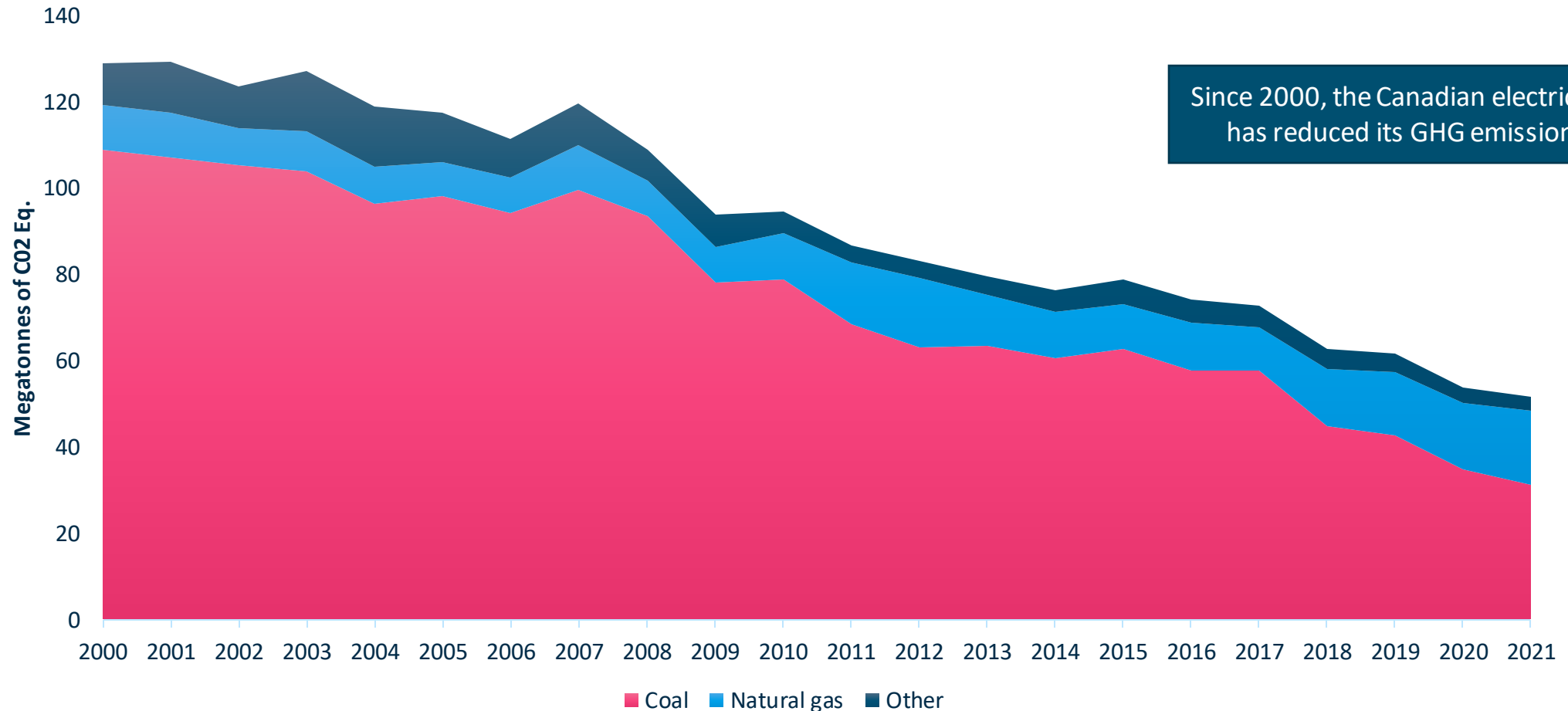
Since 2000, the Canadian electricity industry has reduced its Hg emissions by 76%.



Data Source: Environment and Climate Change Canada, [Canada's Air Pollutant Emissions Inventory Report 2023: chapter 2.9 - Canada.ca](https://www.ec.gc.ca/air-pollution-reports)

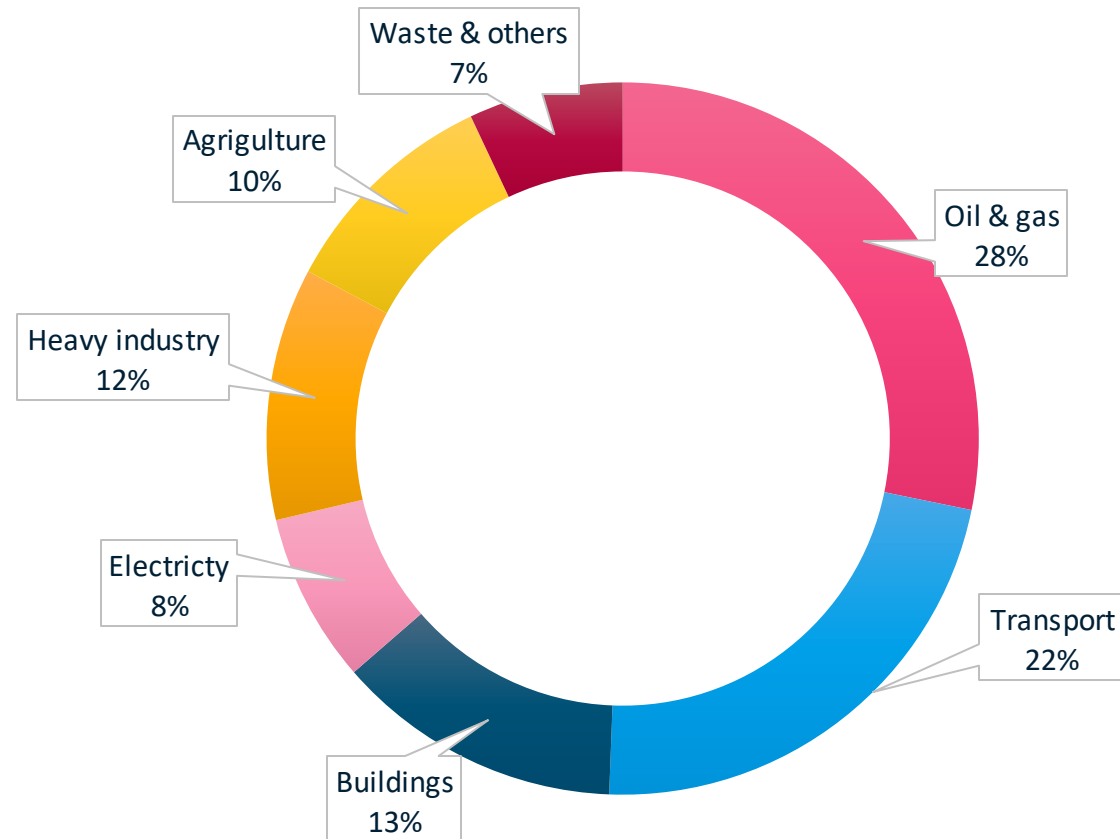
Data Retrieved: July 2023; Visual created by Electricity Canada.

Greenhouse Gas (GHG) Emissions Canadian Electricity Sector, 2000-2021



Data Source: Environment and Climate Change Canada, [Greenhouse gas emissions - Canada.ca](https://www.ec.gc.ca/gg/eng/00000000-0000-0000-0000-000000000000/greenhouse_gas_emissions_-_canada.ca)
Data Retrieved: July 2023; Visual created by Electricity Canada.

Greenhouse Gas (GHG) Emissions by Economic Sector in Canada, 2021



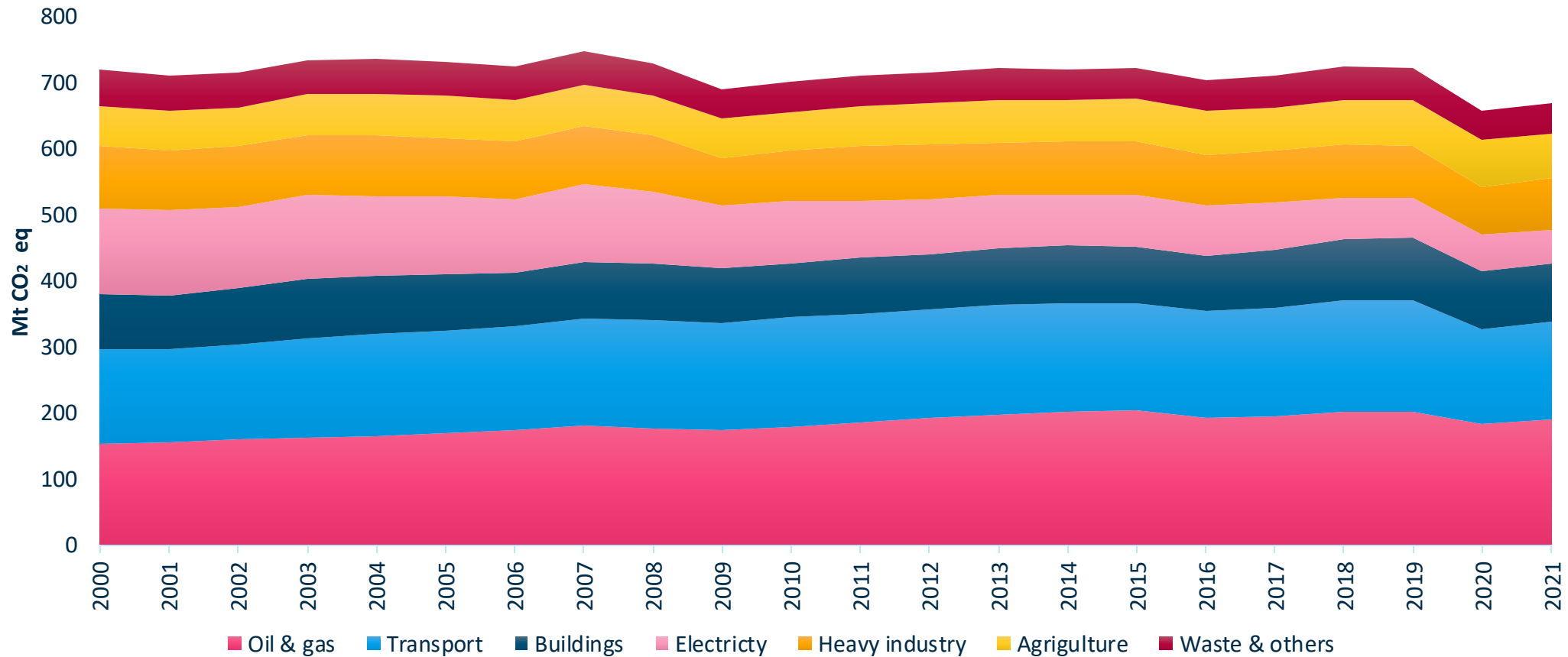
In 2021, GHG emissions in Canada totaled 670 megatonnes of CO₂ eq.



Data Source: Environment and Climate Change Canada, [Greenhouse gas emissions - Canada.ca](https://www.ec.gc.ca/greenhouse-gas-emissions-canada.ca)

Data Retrieved: July 2023; Visual created by Electricity Canada.

Greenhouse Gas Emissions by Canadian Economic Sector (1990 – 2021)



In 2021, GHG Emissions by Sector totaled 672 Mt CO₂ eq.

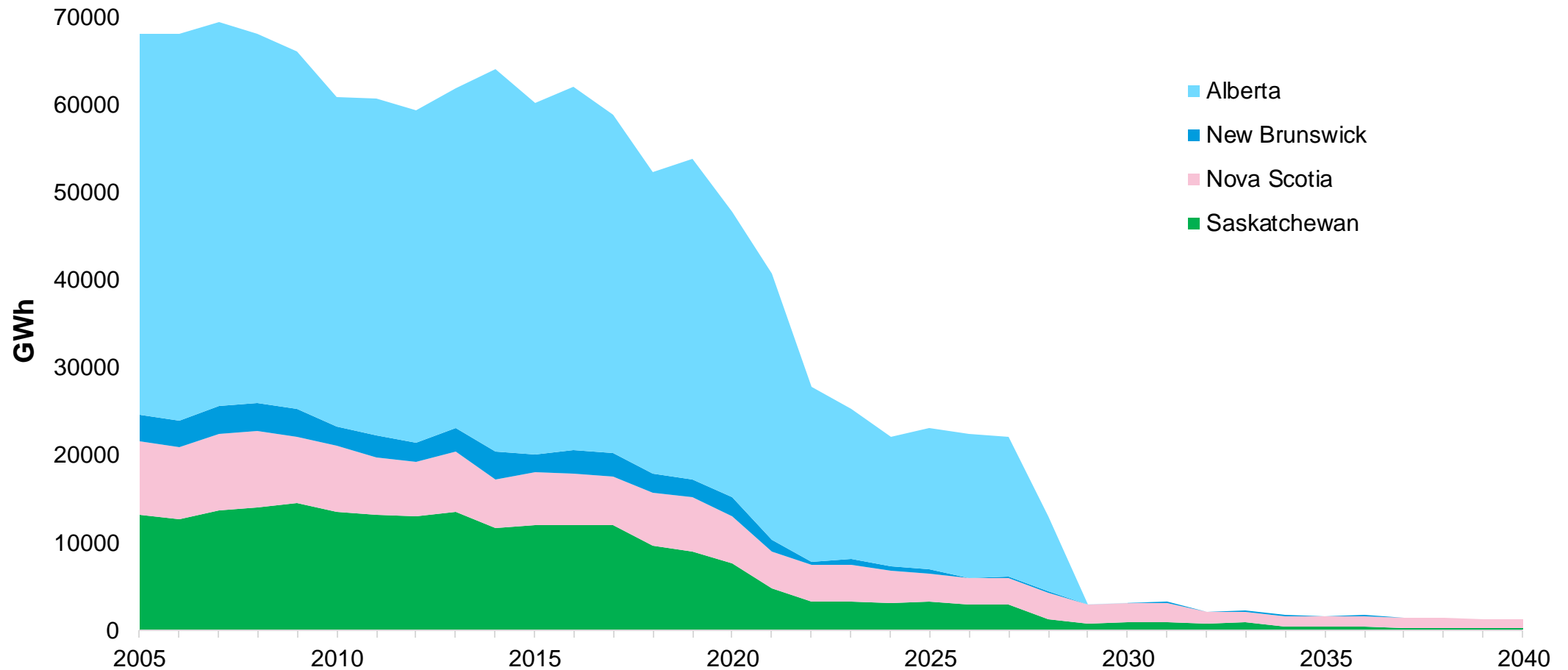


Data Source: Environment and Climate Change Canada, [Greenhouse gas emissions - Canada.ca](https://www.ec.gc.ca/ghe/ghe-eng/)

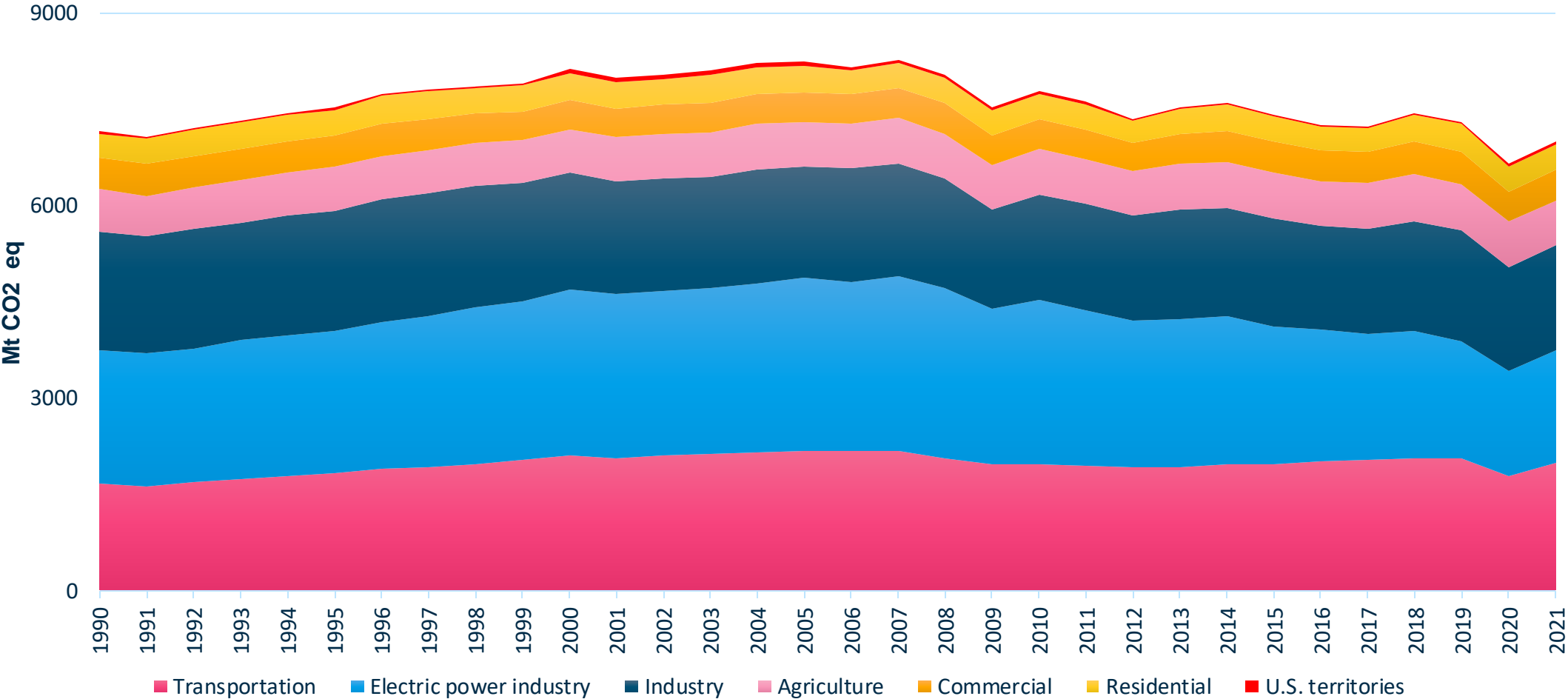
Data Retrieved: July 2023; Visual created by Electricity Canada.

Coal Fleet Profile

Canadian coal electricity generation by region to 2040



U.S. Greenhouse Gas Emissions Trends (1990-2021)

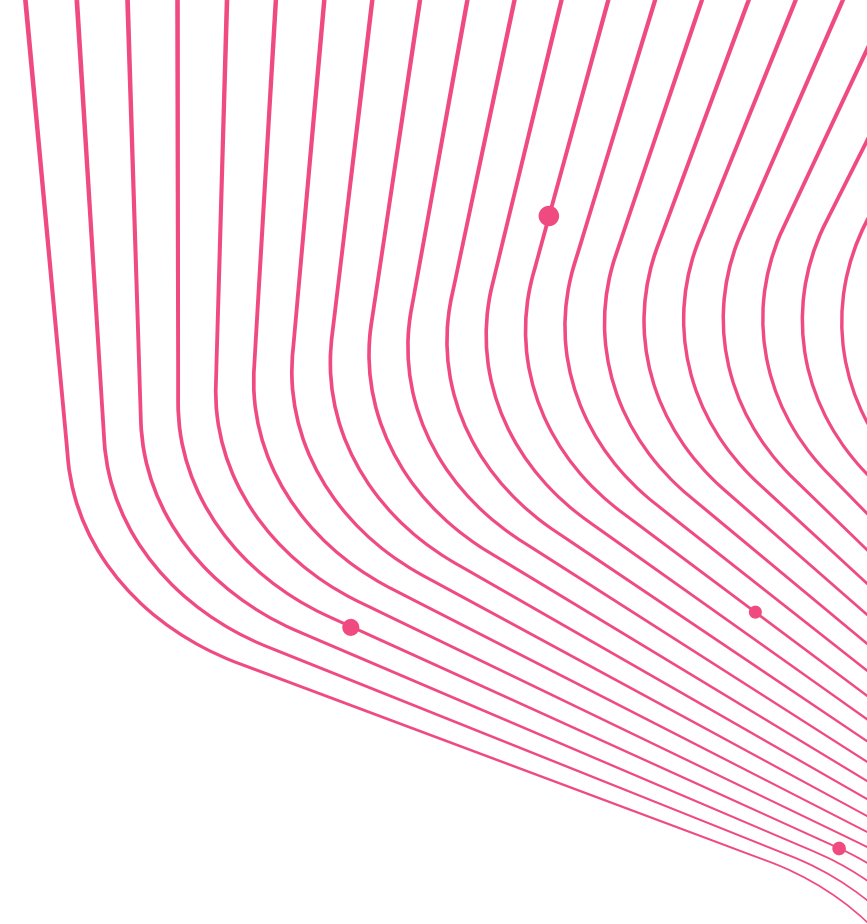


Source: U.S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions Allocated to Economic Sectors (1990-2021): [Greenhouse Gas Inventory Data Explorer | US EPA](https://www.epa.gov/greenhouse-gas-inventory-data-explorer)
 Data Retrieved July 2023; Visual created by Electricity Canada

Price and Customers

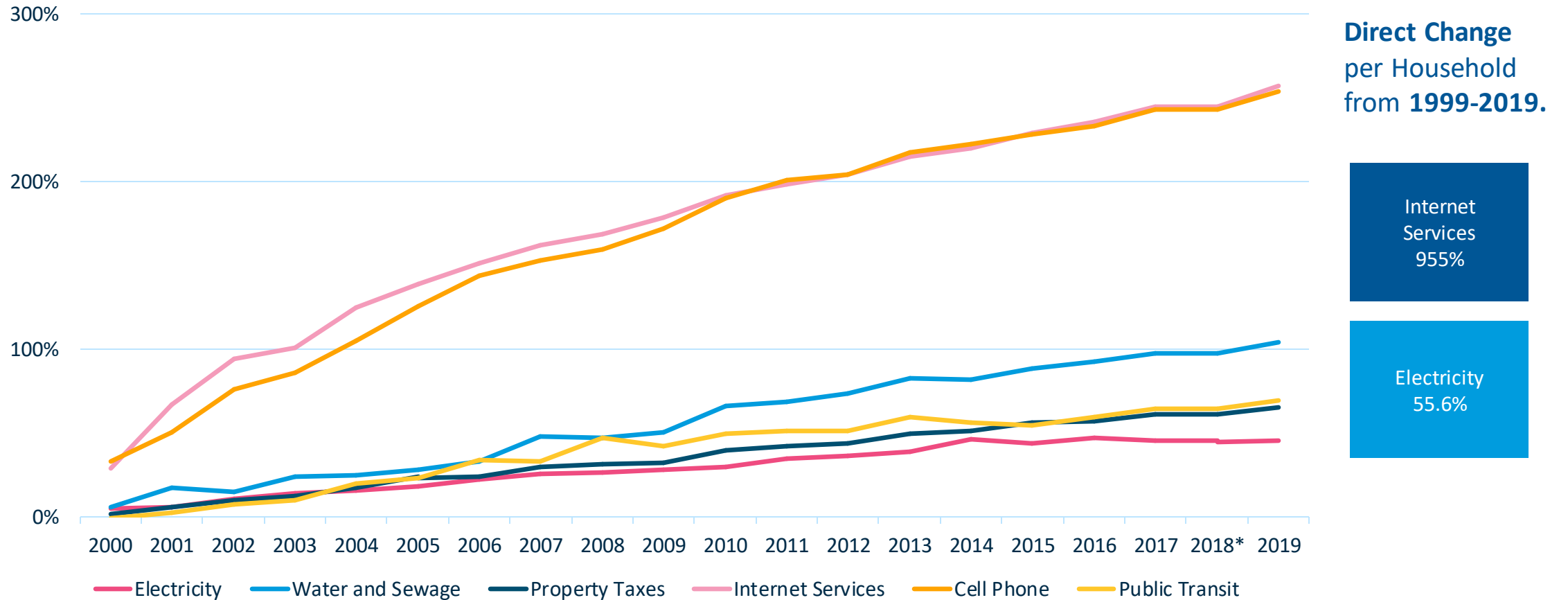
THERE IS A FUNDAMENTAL COST FOR PROVISIONING ELECTRICITY FOR A NATION.

- [Household Spending, 1999-2019](#)
- [Household Spending, 1999 vs. 2019](#)
- [Household Spending, 2010 vs. 2019](#)
- [Multinational Residential Pricing \(bar chart\); Multinational Residential Pricing \(scatterplot chart\)](#)
- [Canadian Urban Centre Prices](#)
- [Multinational Industrial Pricing \(bar chart\); Multinational Industrial Pricing \(scatterplot chart\)](#)
- [Electric Vehicle Sales](#)



Household Spending (1999 - 2019)

Household Spending Cumulative Change from 2000-2019

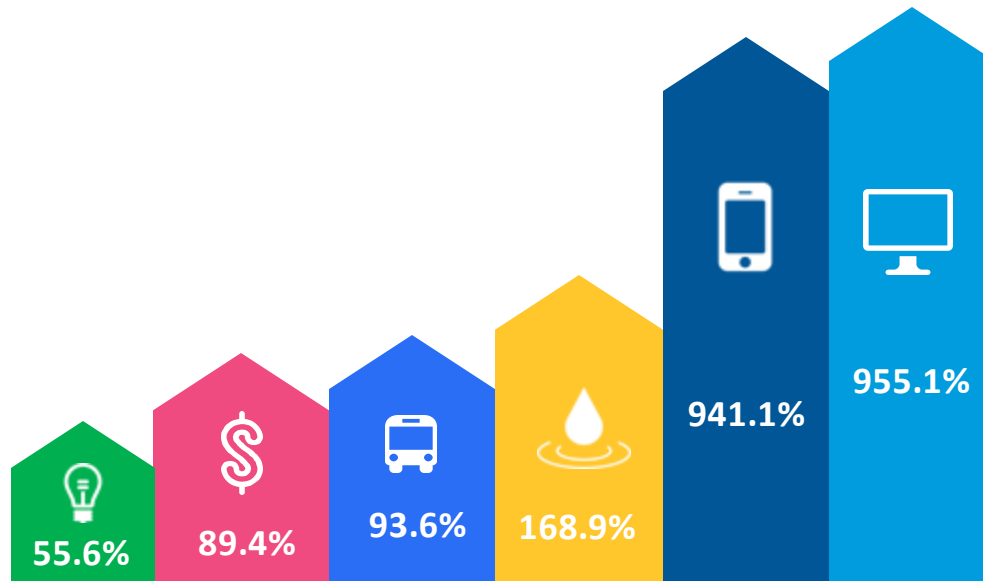


Data Source: StatsCan, Table: 11-10-0222-01, [Household spending, Canada, regions and provinces \(statcan.gc.ca\)](https://www150.compendexplus.com/abstract/11-10-0222-01)

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

Retrieved: July 2023; 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
- Property Taxes
- Public Transit
- Water and Sewage
- Cell Phone Services
- Internet Services



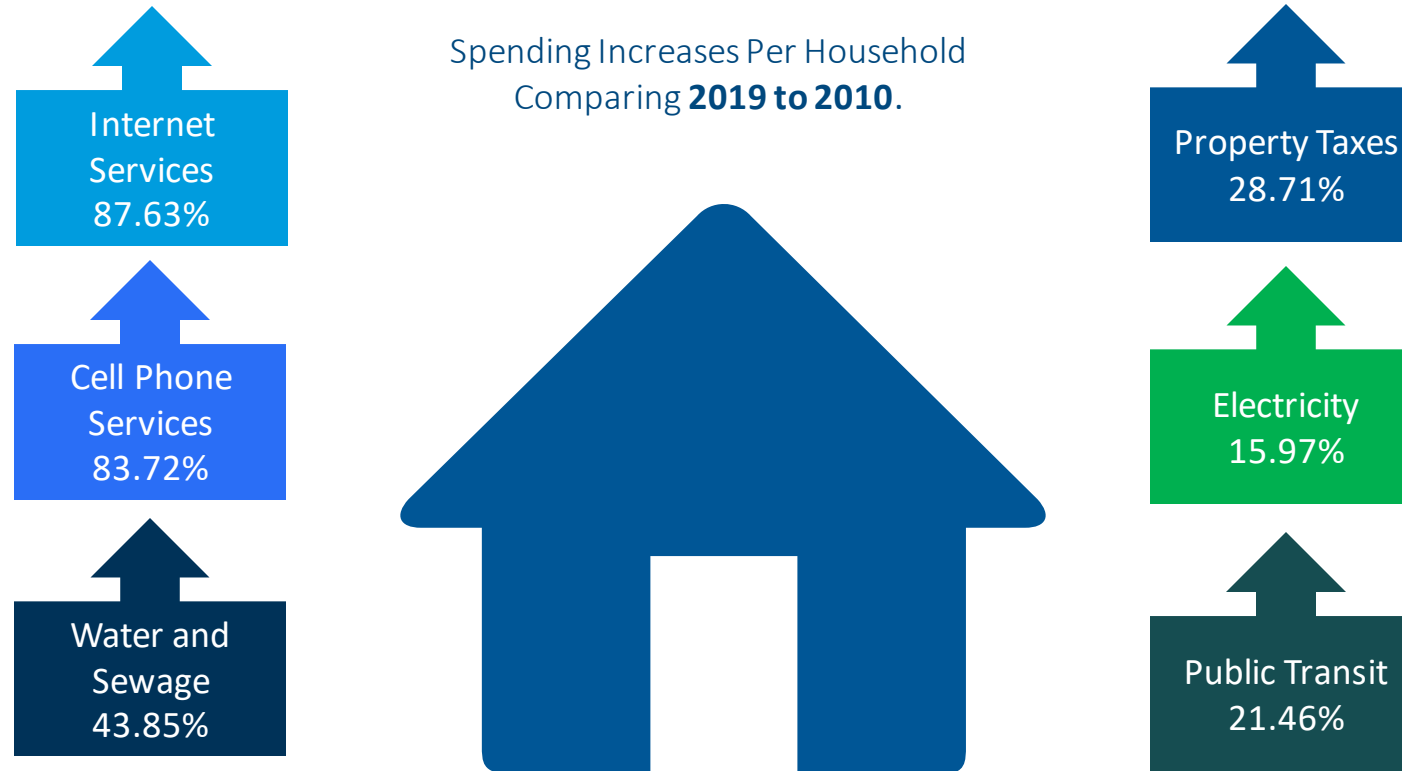
133.5 TW.h
Residential Demand in 1999



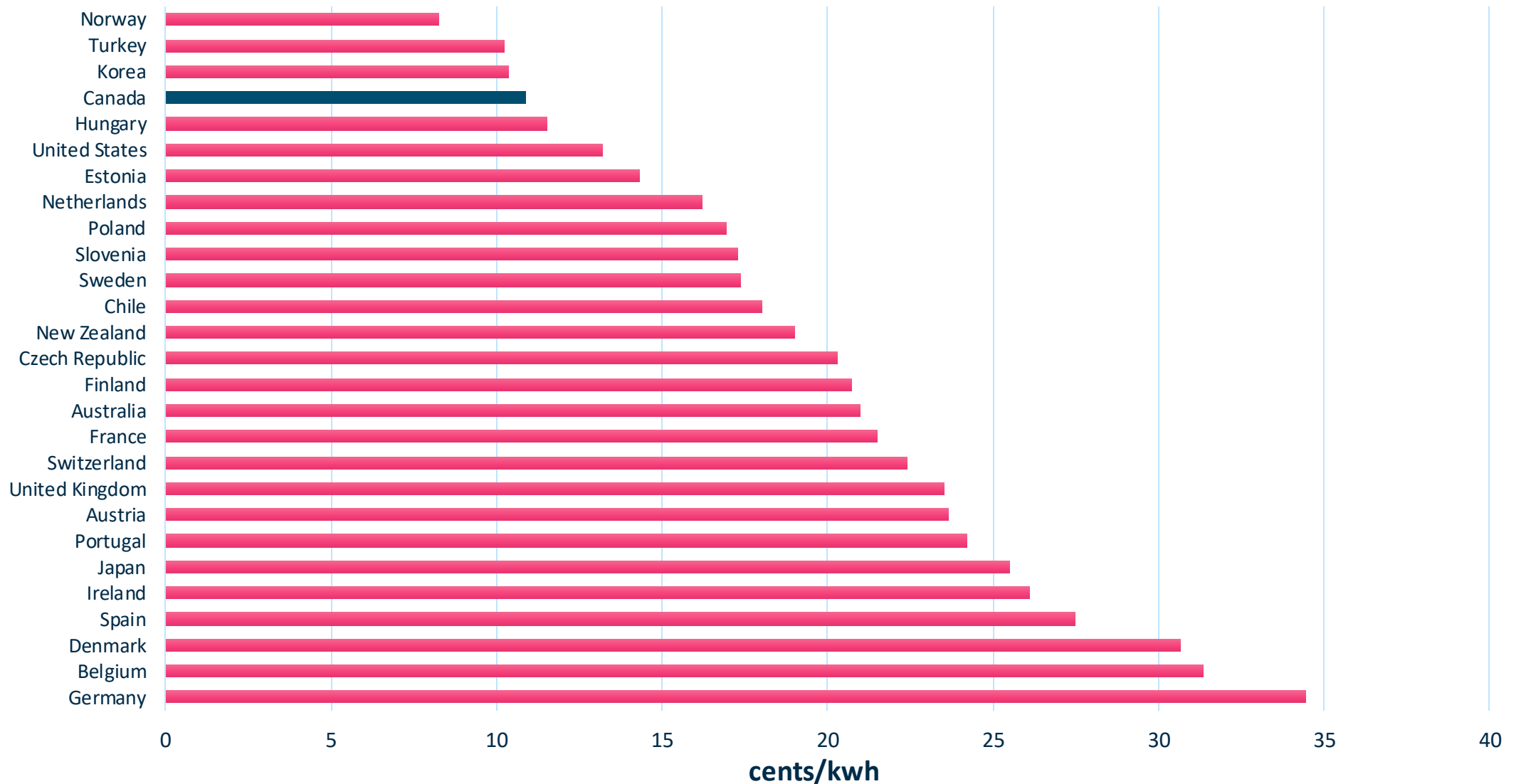
172.3 TW.h
Residential Demand in 2019



Household Spending (2010 vs. 2019)



Multinational Comparison (Residential Pricing - 2021)



Data Source: World Energy Statistics 2021, IEA : [Prices – Key World Energy Statistics 2021 – Analysis - IEA](#)

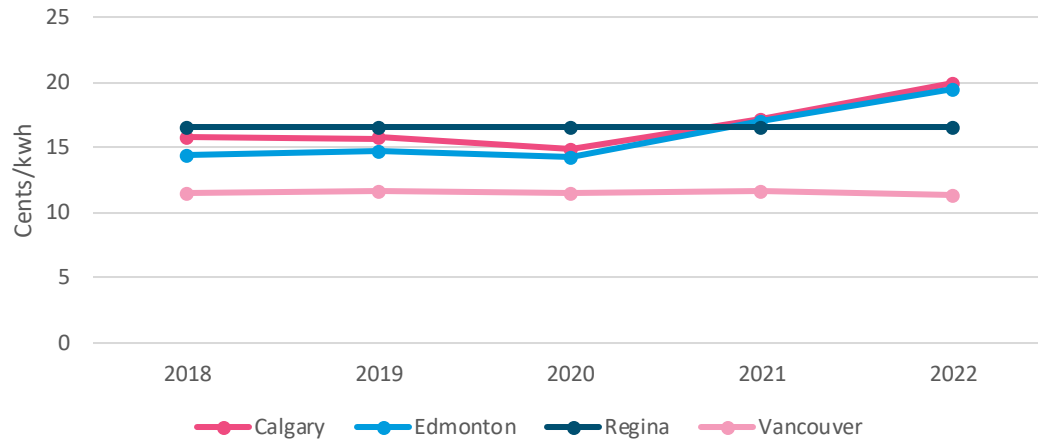
Data Retrieved: August 2023; Visual Created by the Electricity Canada, [World Bank Open Data | Data](#)

Multinational Comparison (Residential Pricing -2021)

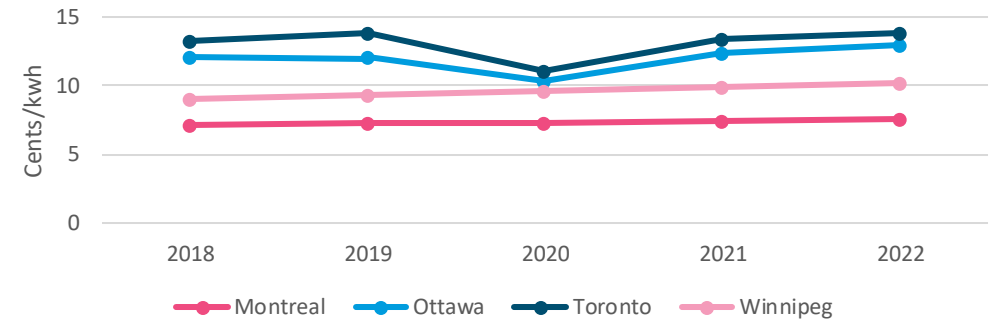


Canadian Urban Centers Comparison (Residential Pricing)

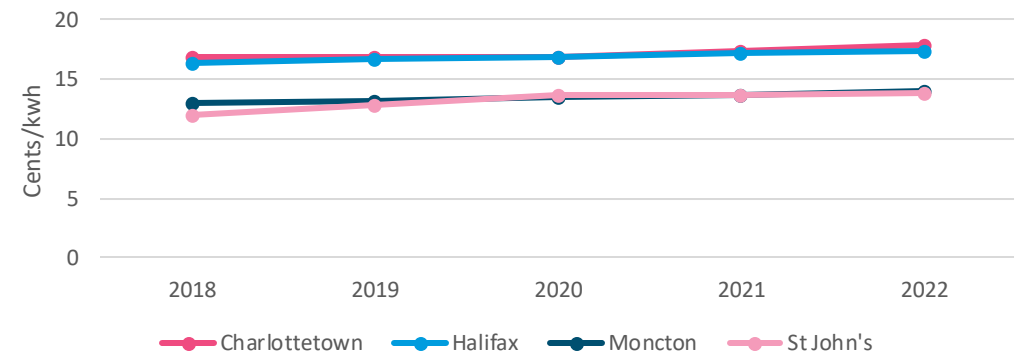
Western Urban Centre Electricity Prices (1000 kwh consumption)



Central Urban Centre Electricity Prices (1000 kwh consumption)



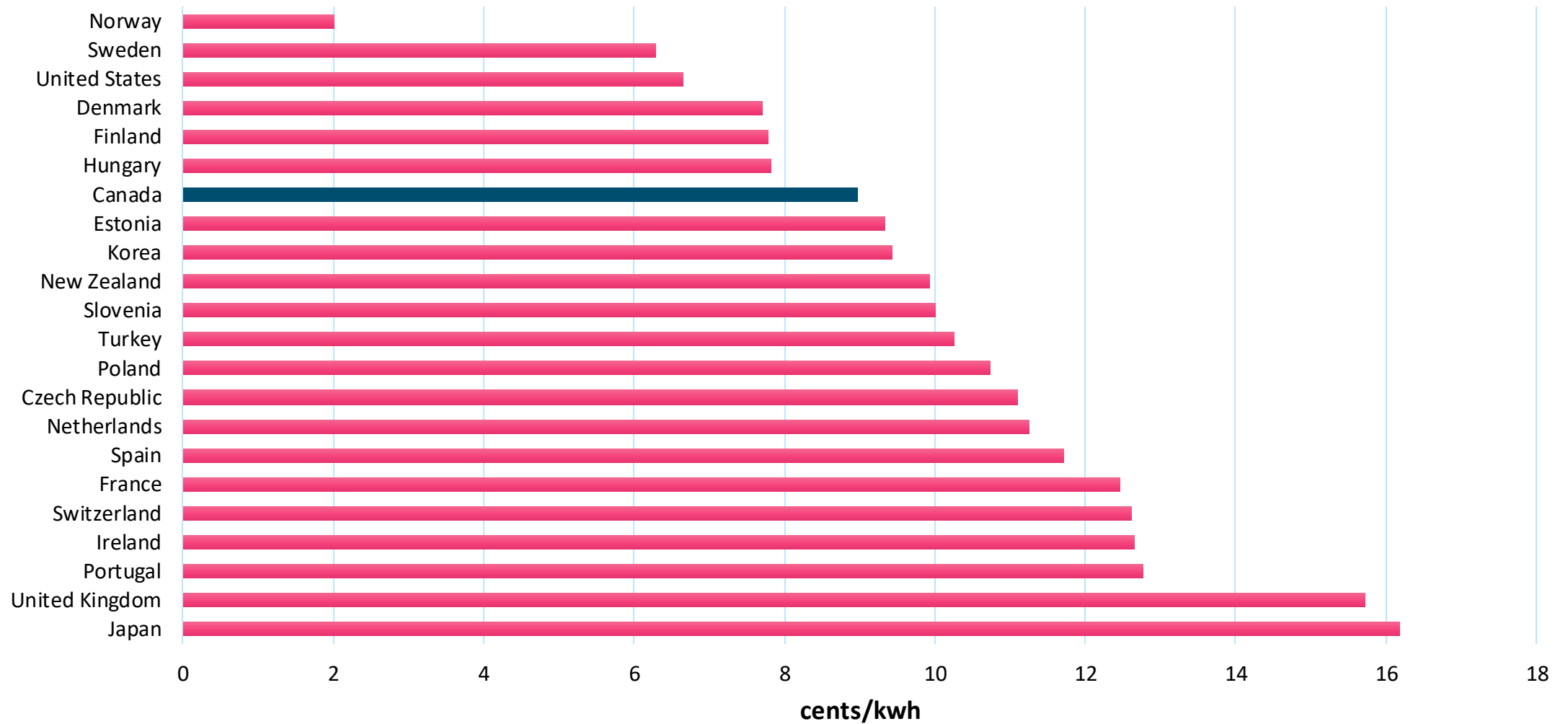
Eastern Urban Centre Electricity Prices (1000 kwh consumption)



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



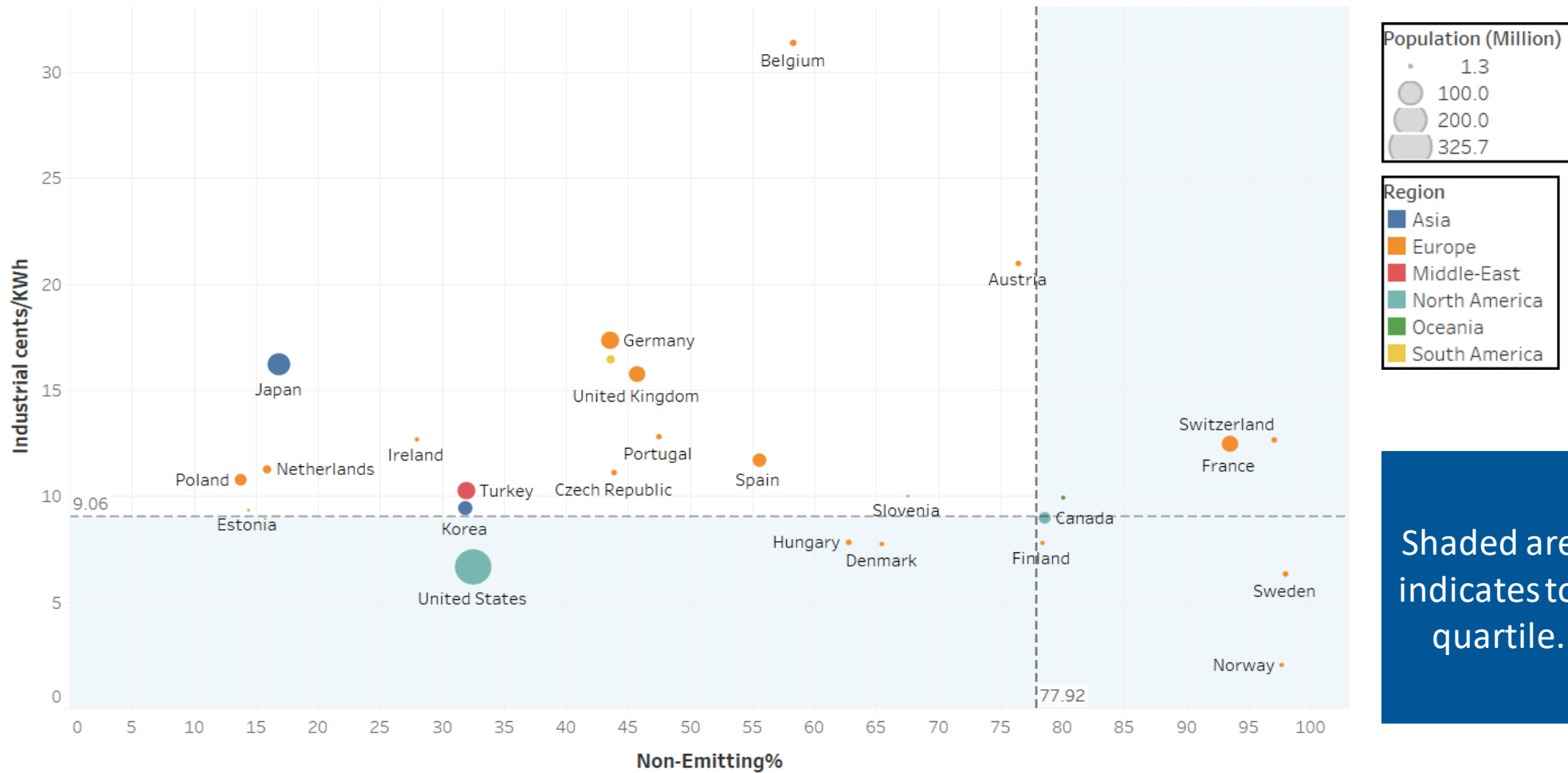
Multinational Comparison (Industrial Pricing - 2021)



Data Source: World Energy Statistics 2021, IEA, : [Prices – Key World Energy Statistics 2021 – Analysis - IEA](#)

Data Retrieved: August 2023; Visual Created by the Electricity Canada.

Multinational Comparison (Industrial Pricing-2021)

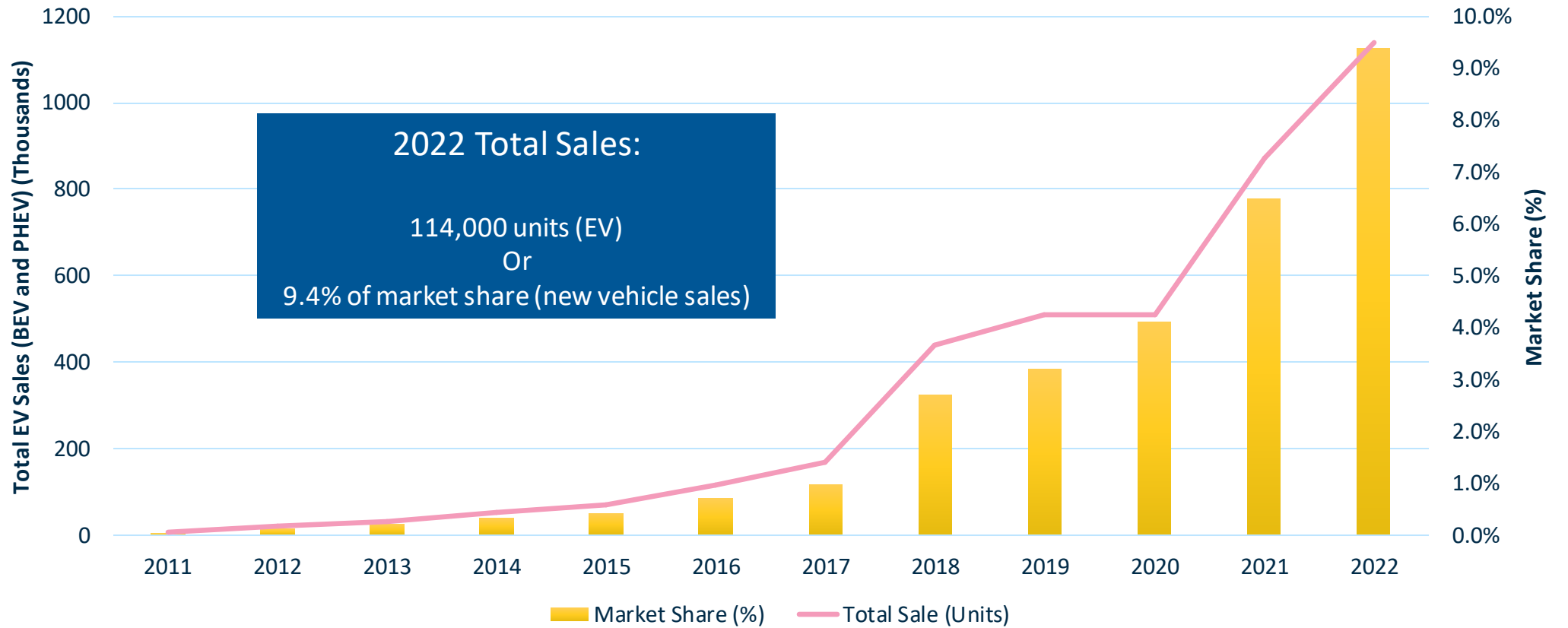


Shaded area indicates top quartile.



Electric Vehicle Sales (Canada)

Electric Vehicle Market share and Sales Growth (2010-2022)



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