The Electric Power System of

-CANADA-

cigre

For power system expertise

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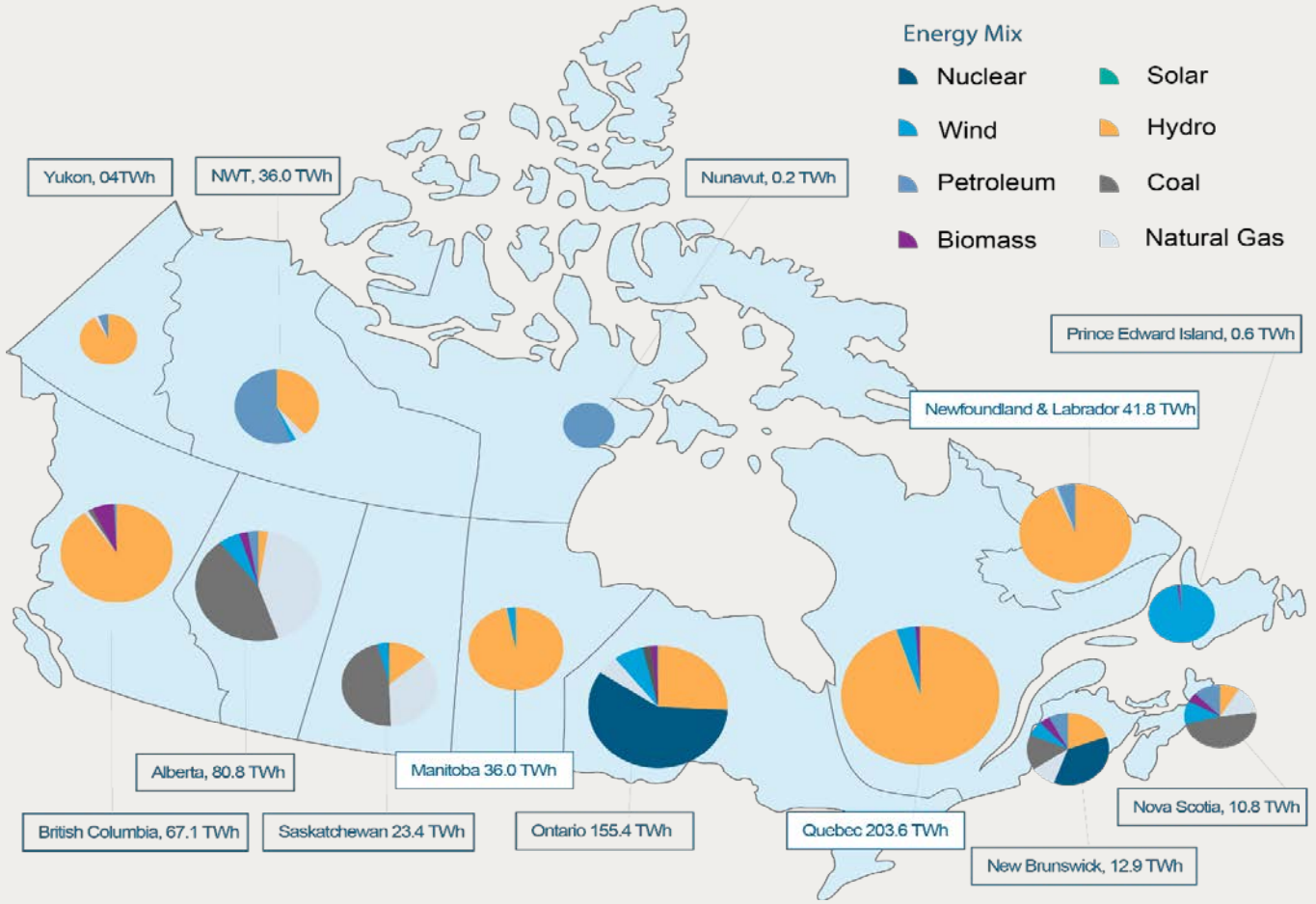
Canada - Basic Facts

- Area: 9 984 670 km² (Second largest country in the world by land mass)
- Population: 37,831,018 (October 2020)
- Number of electricity customers: 15,420,450
- Average interruption of electricity: 4.97 hours (2016)



2017 Generation Mix, NRCAN

Canada - Basic Facts

Globally,

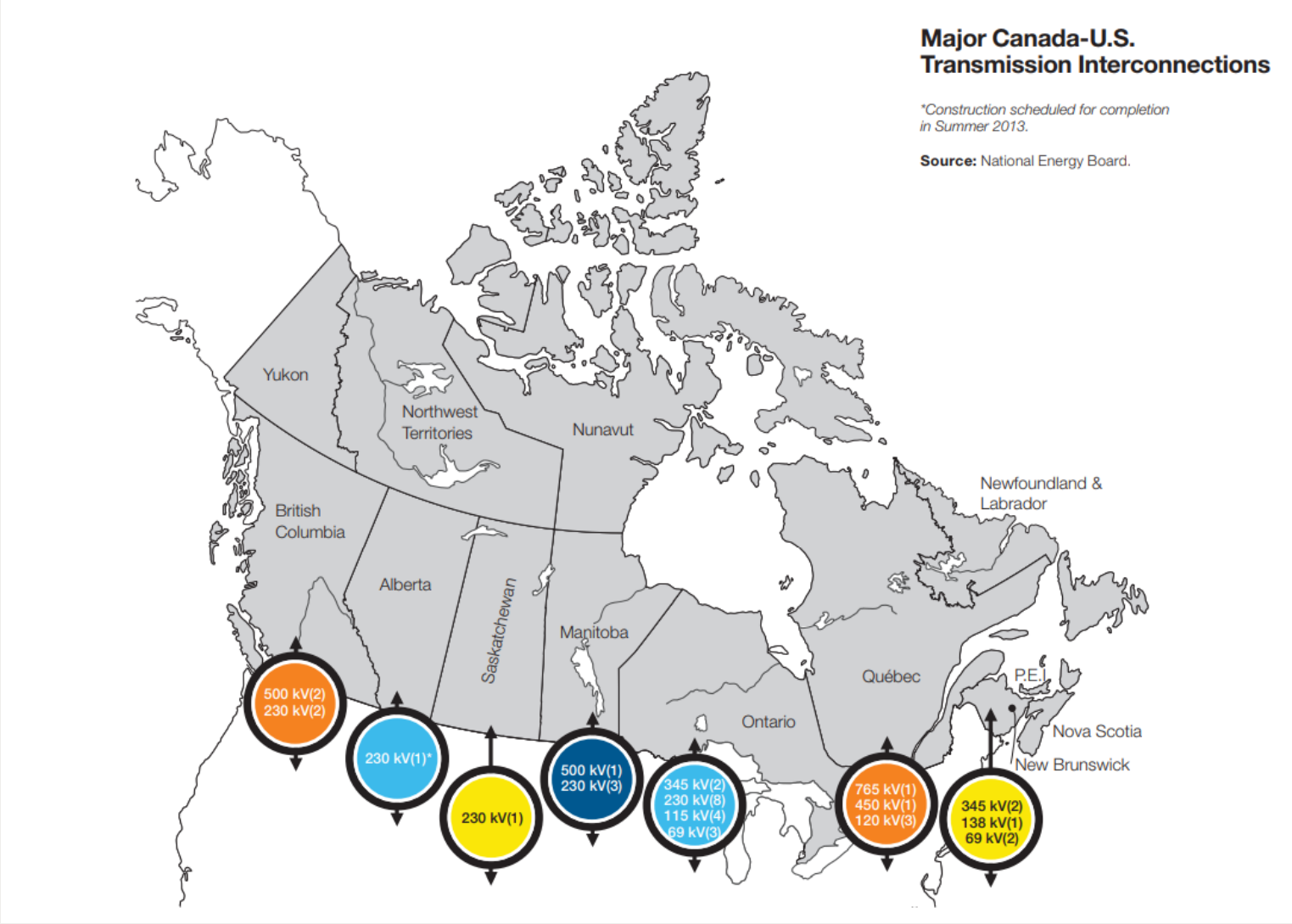
- Canada is the world's **sixth** largest electricity producer (2% of world production in 2018)
- Canada is the world's **third** largest energy exporter (8% of world export in 2018)
- All Canadian electricity trade is with the US (2019)
- Canada is the world's **third** largest producer of hydroelectricity (2020)

Domestically,

- The Canadian energy industry generated 641.1 TWh of electricity in 2018.
- 14.8% of Canada's electricity is produced from nuclear generation (2018)
- 7.4% of Canada's electricity is produced from coal (2018)
- 59.6% of Canada's electricity is produced from hydropower (2018)

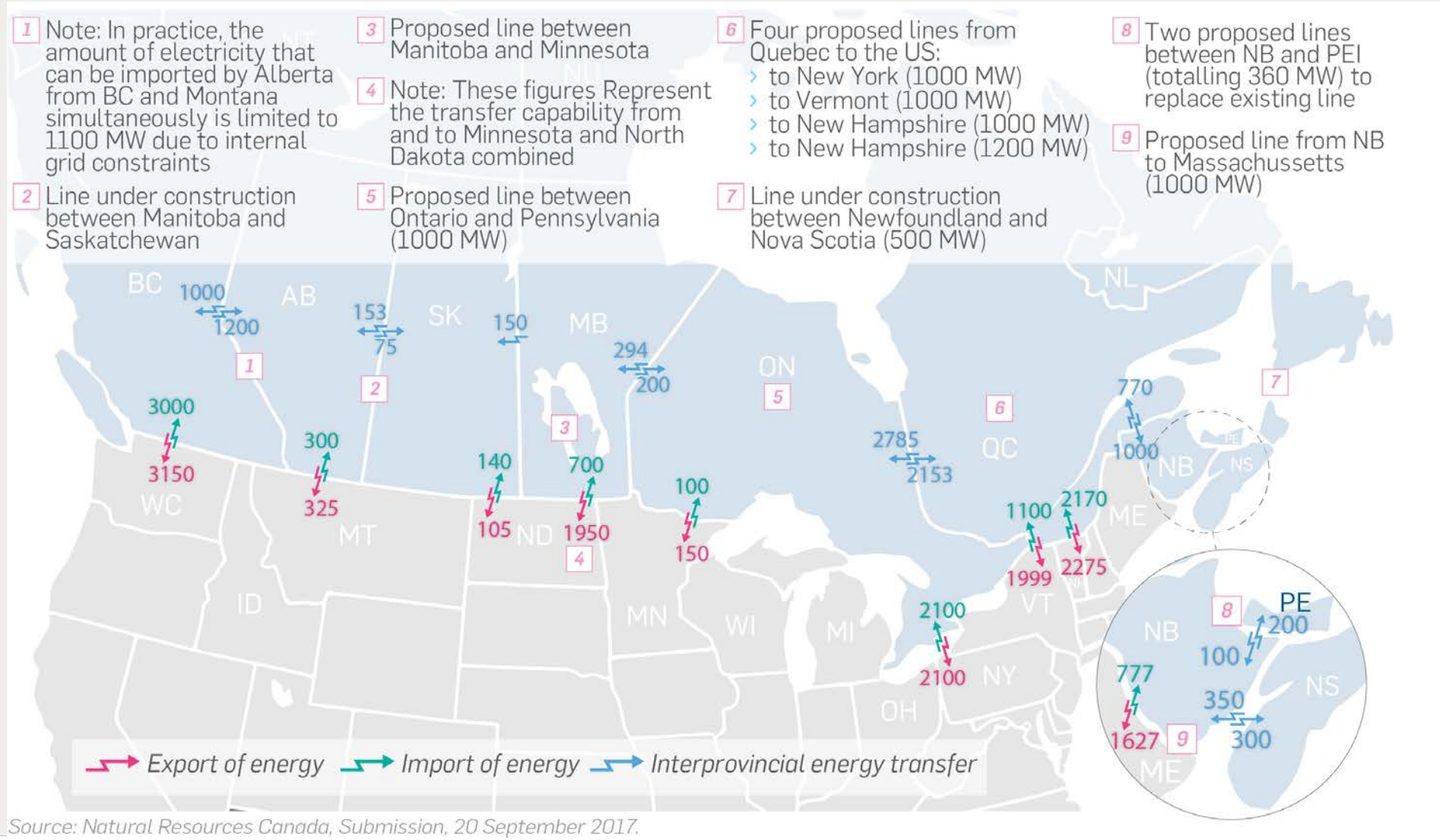
Global map of the grid and of its interconnections

- All Canadian Electricity Trade is with the US
- There are 34 active major transmission lines connecting Canada to the U.S.



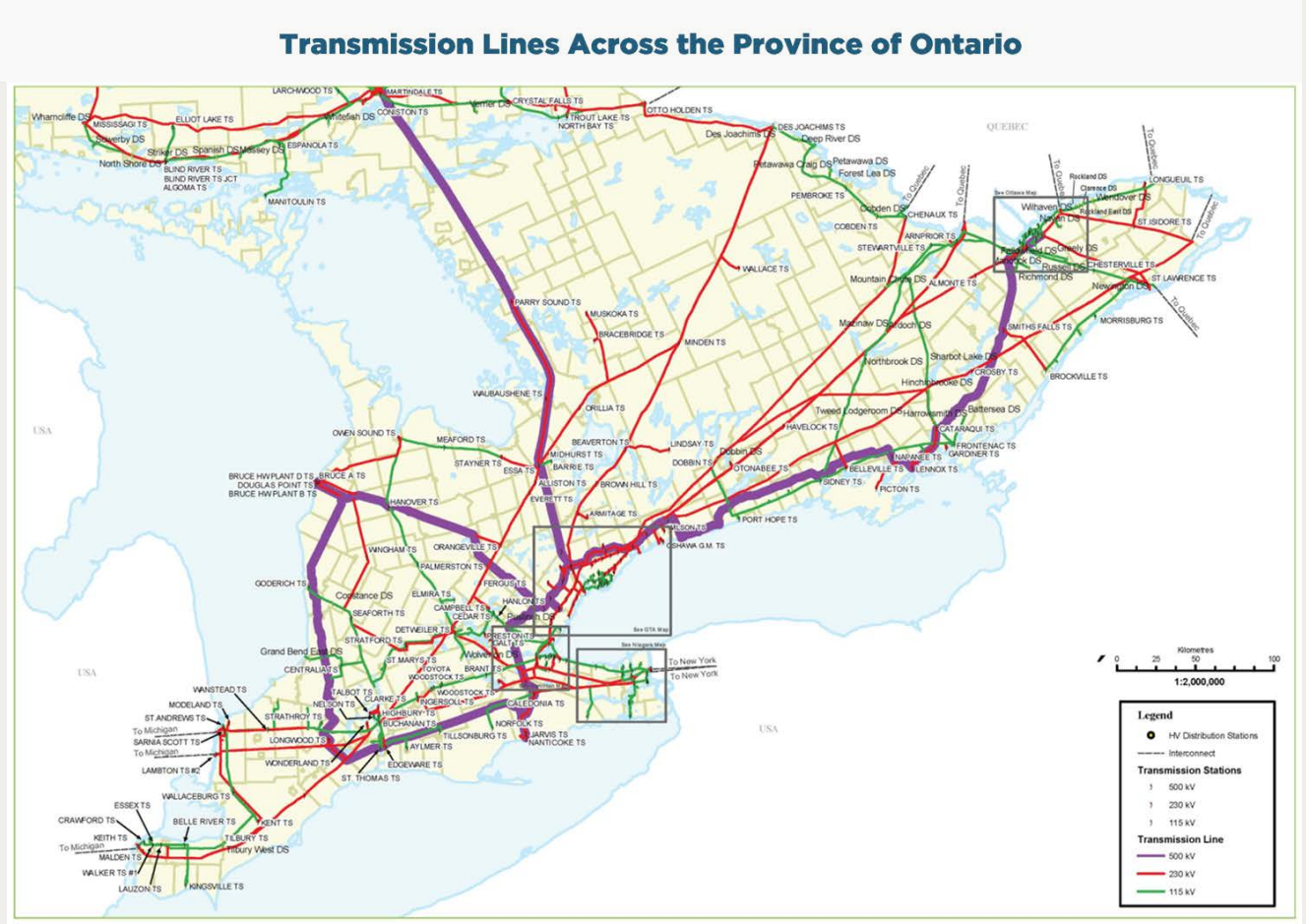
Grid Facts and Characteristics

Existing and Proposed transfer capability between Canada and the US

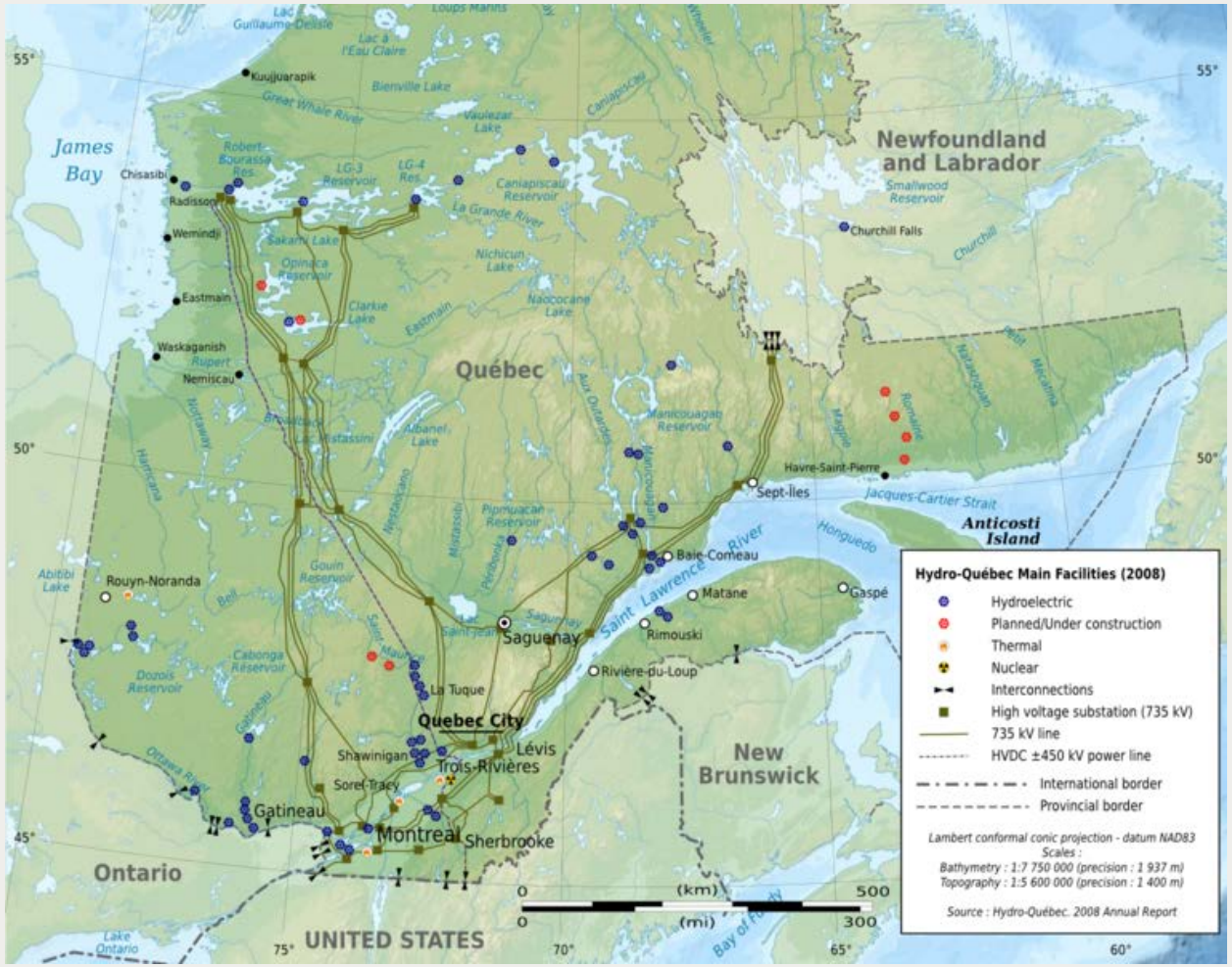


Source: Natural Resources Canada, Submission, 20 September 2017.

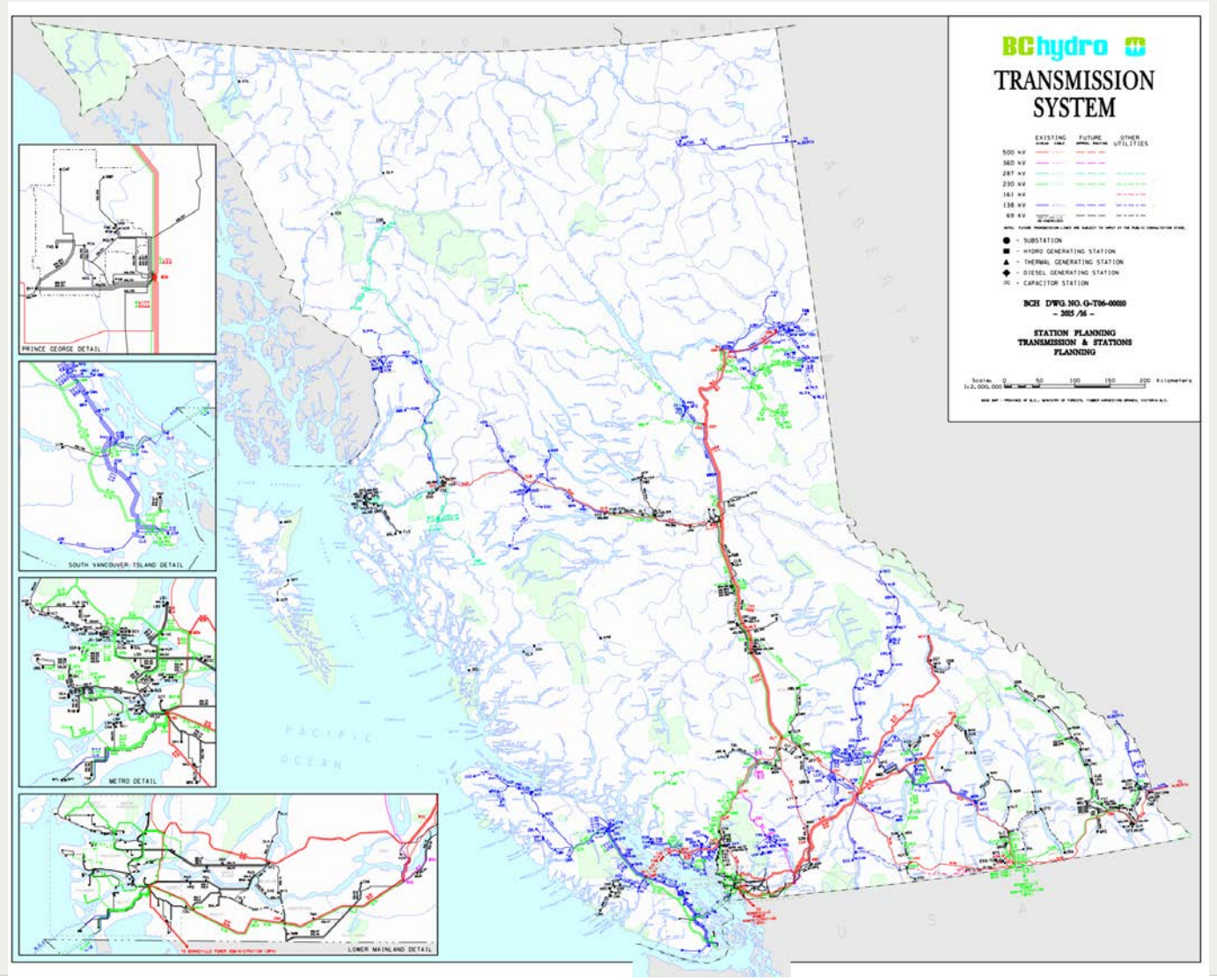
Provincial Maps - The High Voltage Grid
Ontario



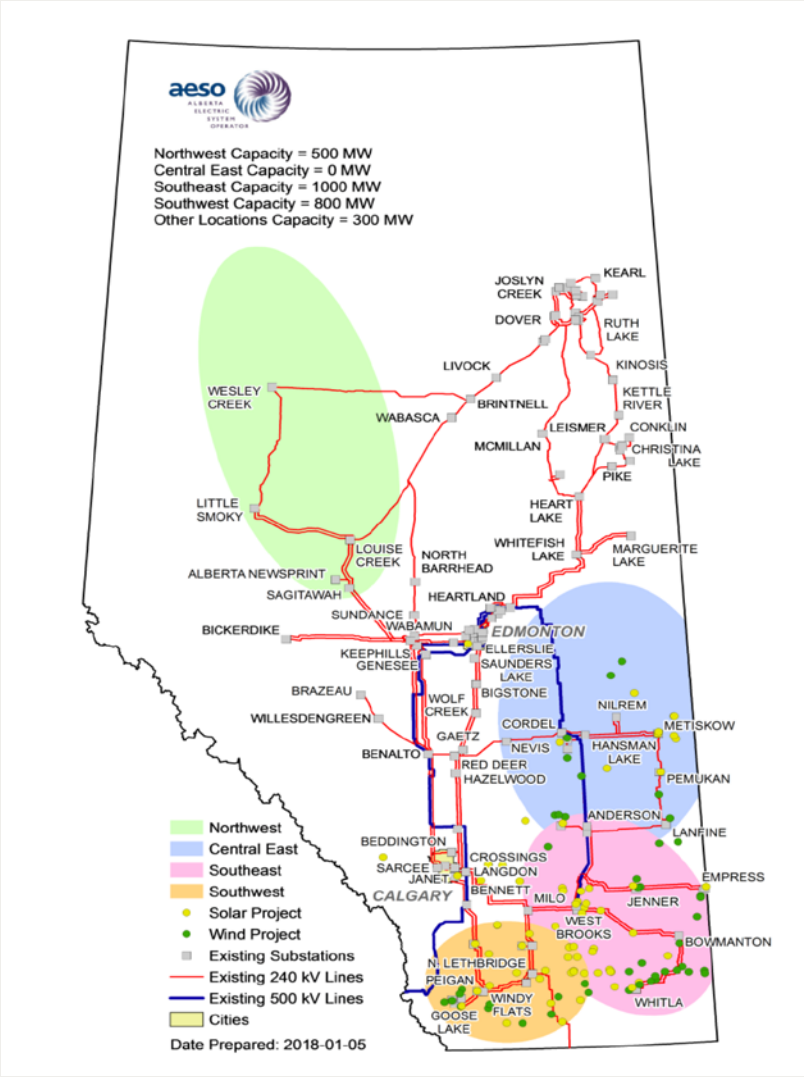
Provincial Maps - The High Voltage Grid
Quebec



Provincial Maps - The High Voltage Grid
British Columbia

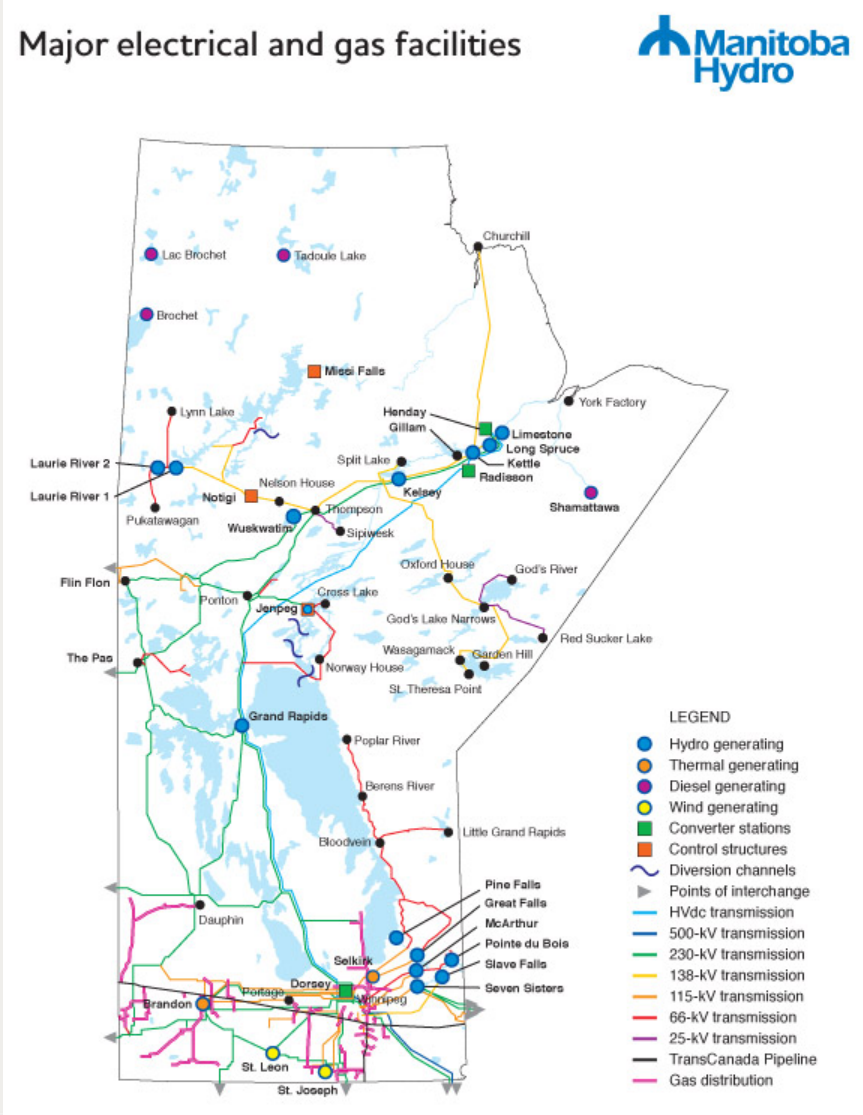


Provincial Maps - The High Voltage Grid
Alberta

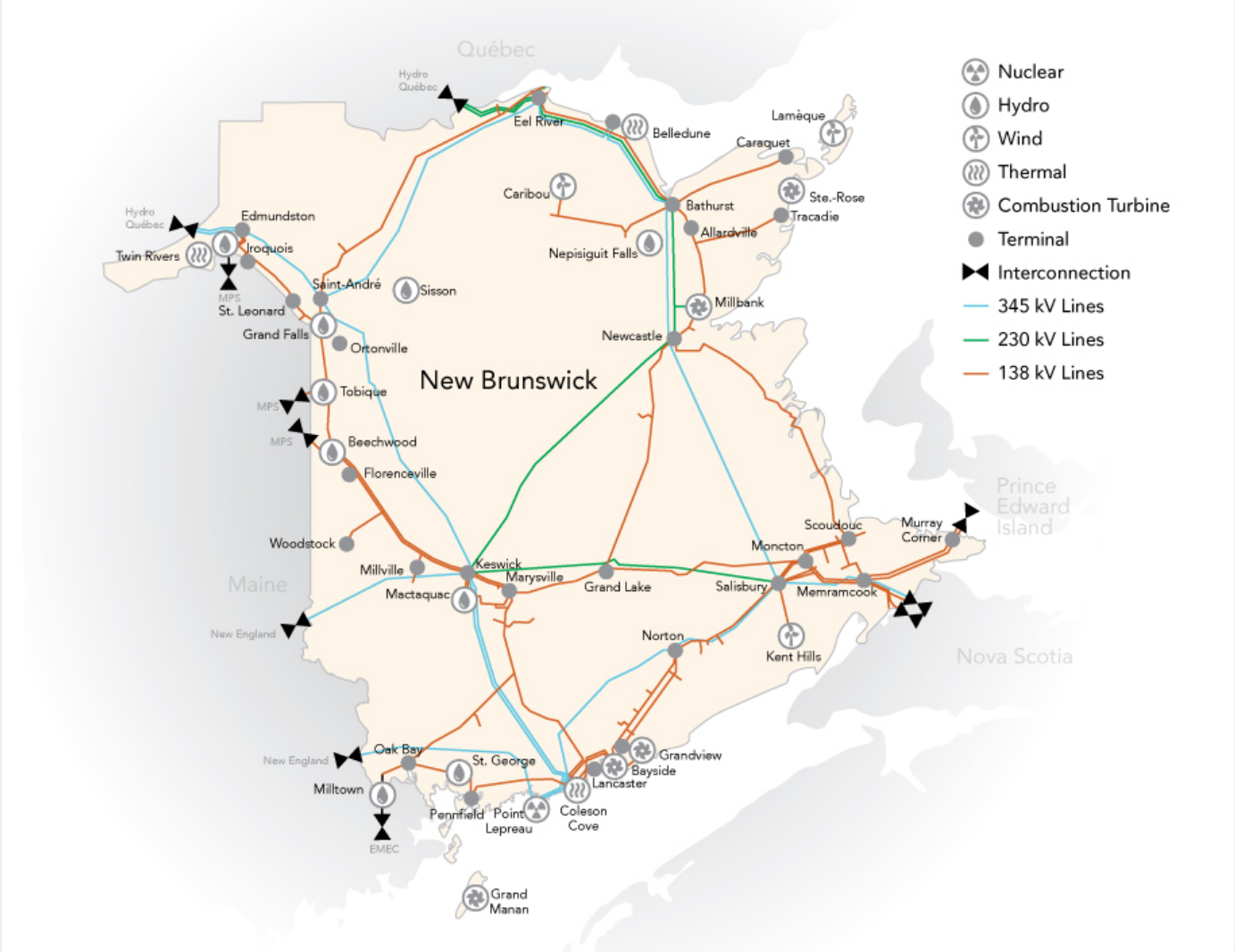


Provincial Maps - The High Voltage Grid

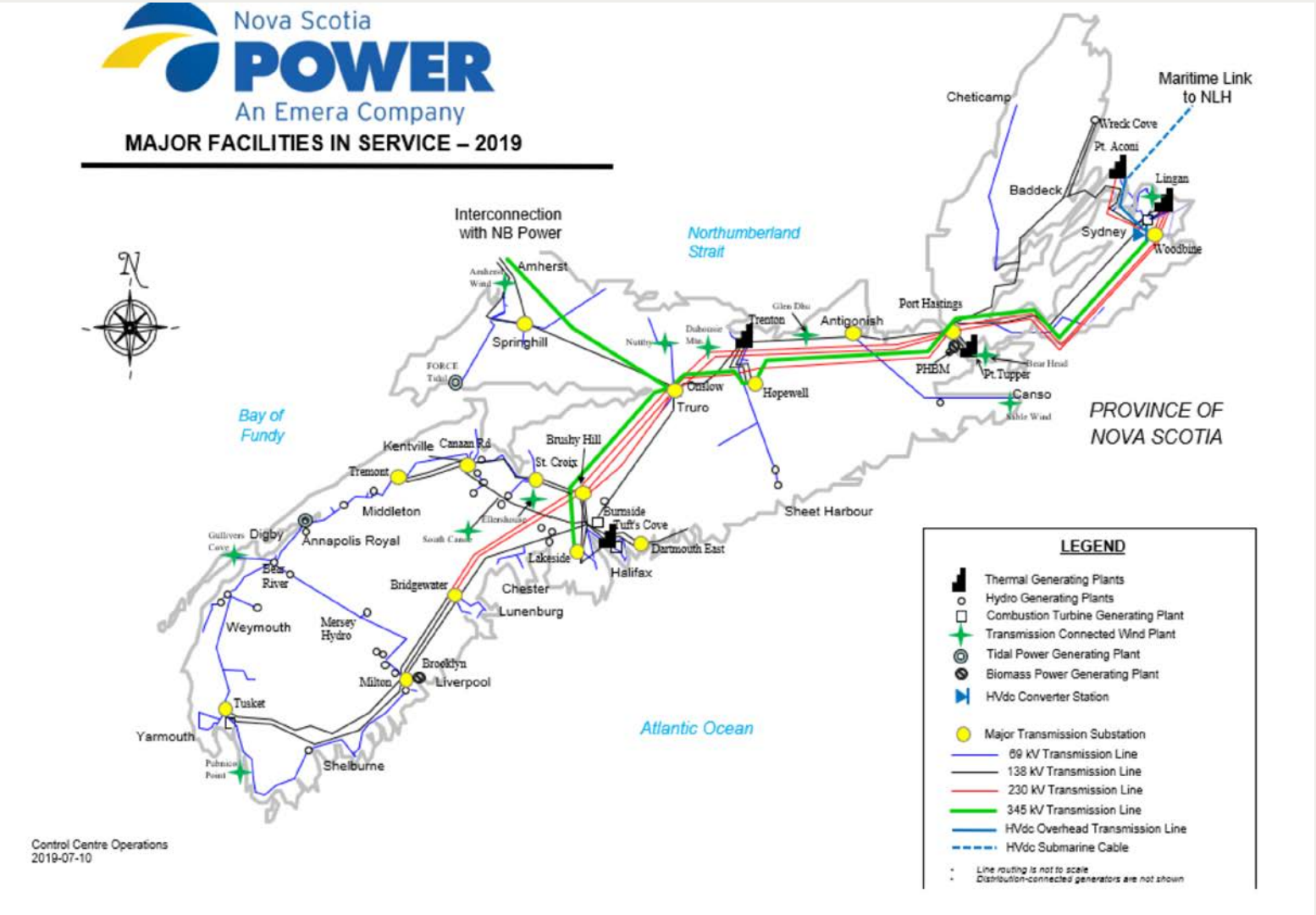
Manitoba Hydro



Provincial Maps - The High Voltage Grid
New Brunswick



Provincial Maps - The High Voltage Grid
Nova Scotia



Information on Major TFOs

Companies	Province	Website
AltaLink Management Ltd.	Alberta	http://www.altalink.ca/
ATCO Electric Ltd.	Alberta	https://www.atco.com/en-ca/
ENMAX Power Corporation	Alberta	https://www.enmax.com/home
EPCOR Utilities	Alberta	https://www.epcor.com/Pages/Home.aspx
BC Hydro	British Columbia	https://www.bchydro.com/index.html
Fortis BC	British Columbia	https://www.fortisbc.com/
Hydro One	Ontario	https://www.hydroone.com/
Maritime Electric	Prince Edward Island	https://www.maritimeelectric.com/
Manitoba Hydro	Manitoba	https://www.hydro.mb.ca/
New Brunswick Power	New Brunswick	https://www.nbpower.com/Welcome.aspx
Nalcor Energy	Newfoundland and labrador	https://nalcorenergy.com/
Nova Scotia Power	Nova Scotia	https://www.nspower.ca/
Sask Power	Saskatchewan	https://www.saskpower.com/
Yukon Energy	Yukon	https://yukonenergy.ca/

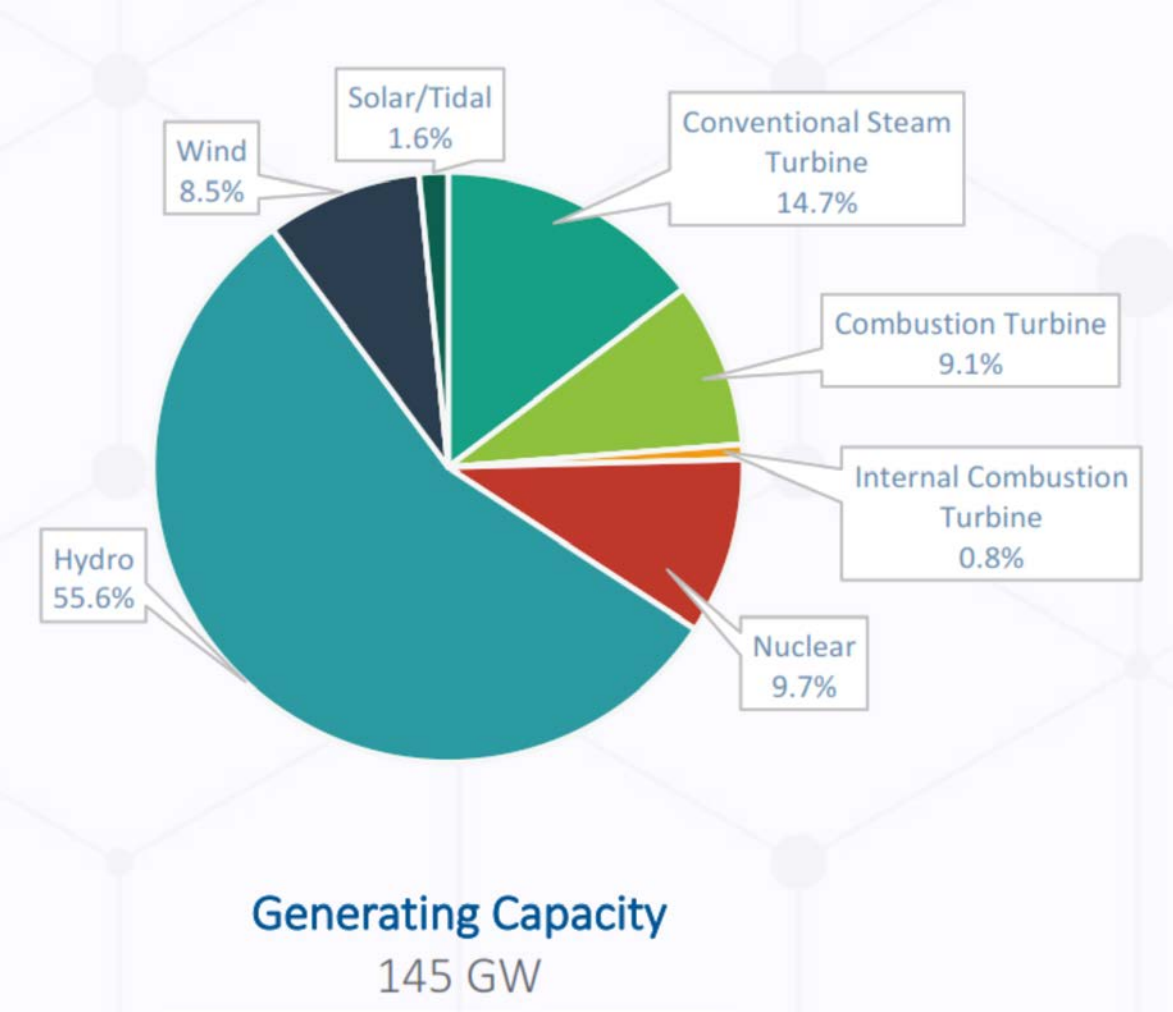
Cooperation of TFOs and DFOs
Description

- Provincial governments have control over generation and transmission of electrical energy
- Policies and power industry structure set regionally – differs from province to province
- Where disaggregated utilities exist TFO and DFO are open access and regulated as monopolies with franchise areas

Cooperation of TFOs and DFOs
Responsibilities

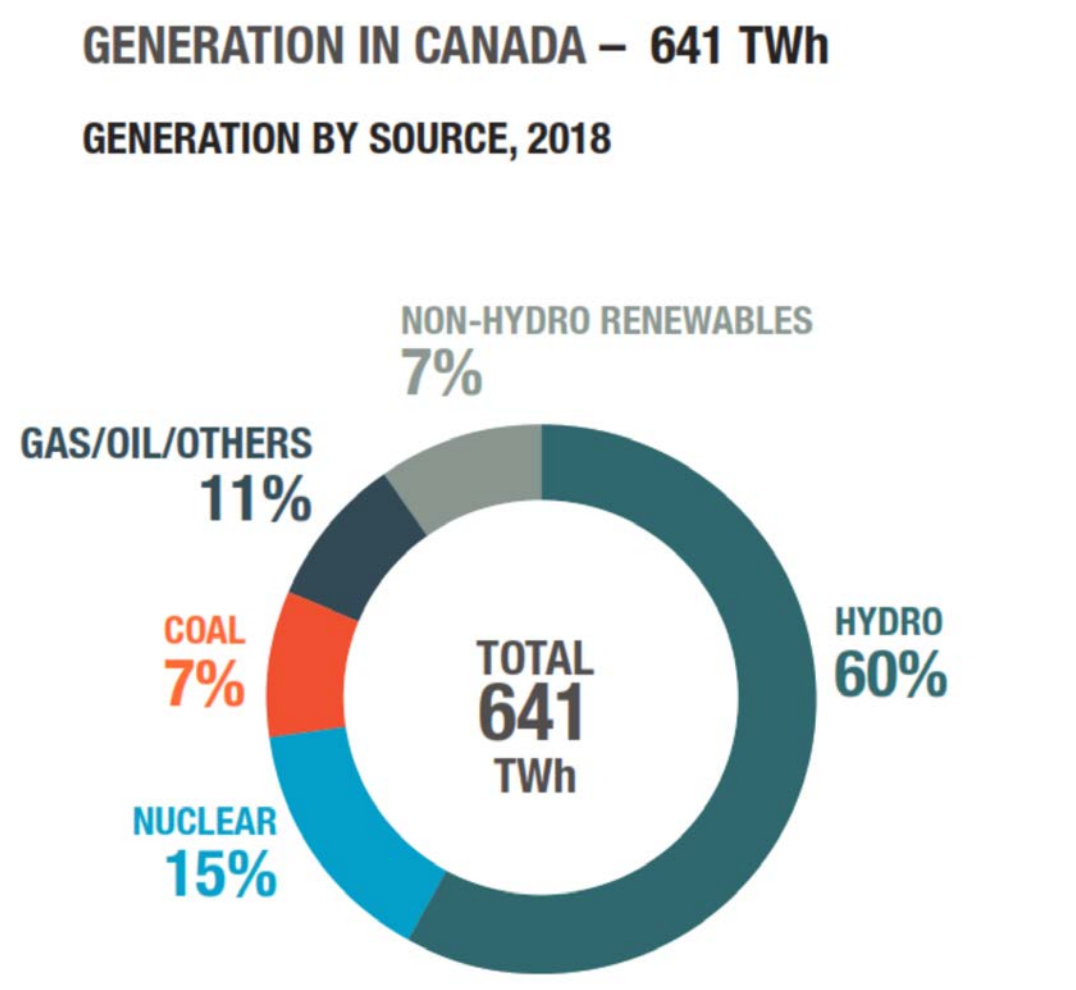
- Congestion mitigation of transmission and distribution lines
- Voltage support
- Transmission-Distribution interface

Installed Capacity With Reference to Primary Resources (2017)



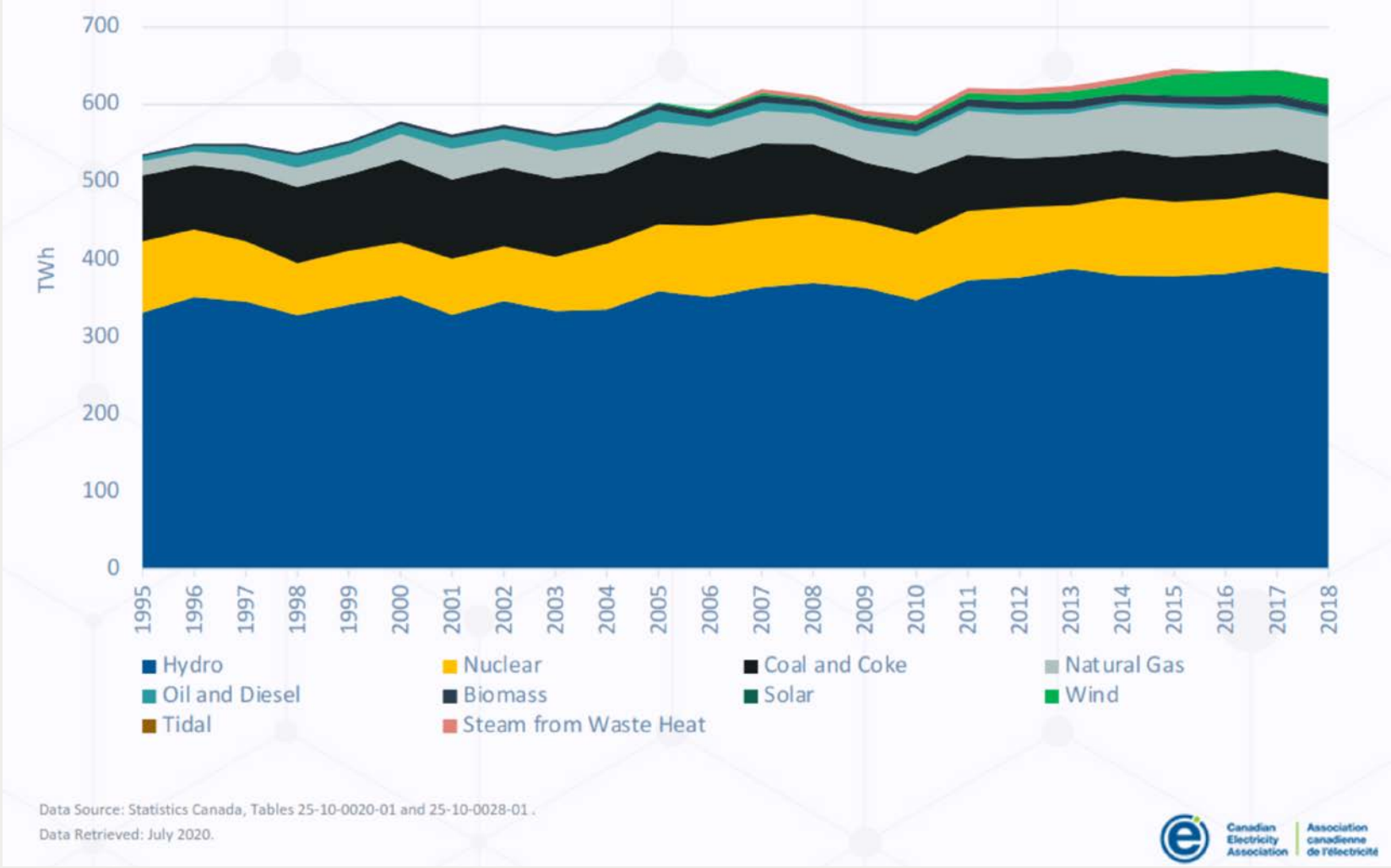
The data shown represents the latest available data from Canadian government and other trustworthy sources on the public domain

Energy Production with Reference to Primary Resources

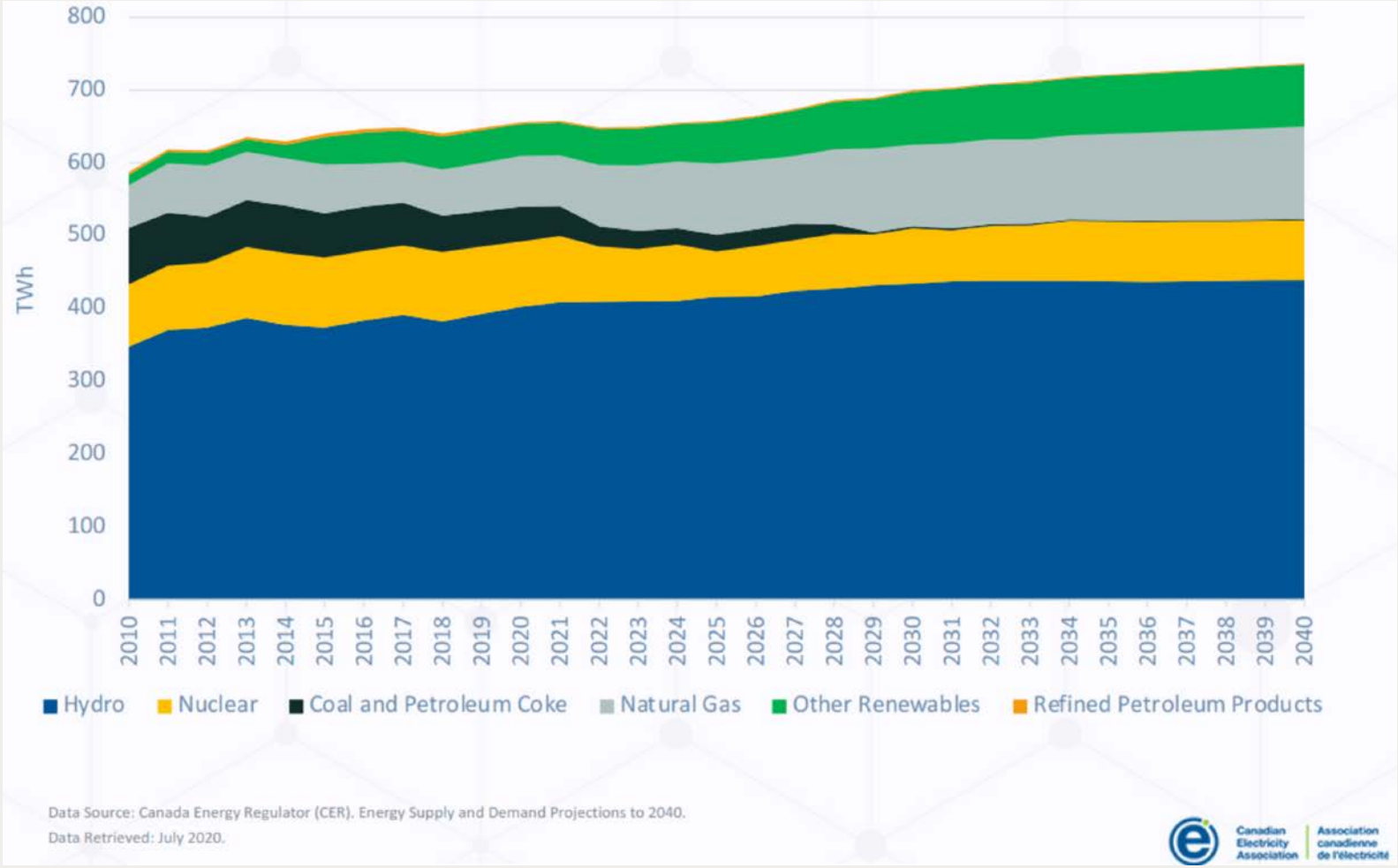


Energy Production with Reference to Primary Resources

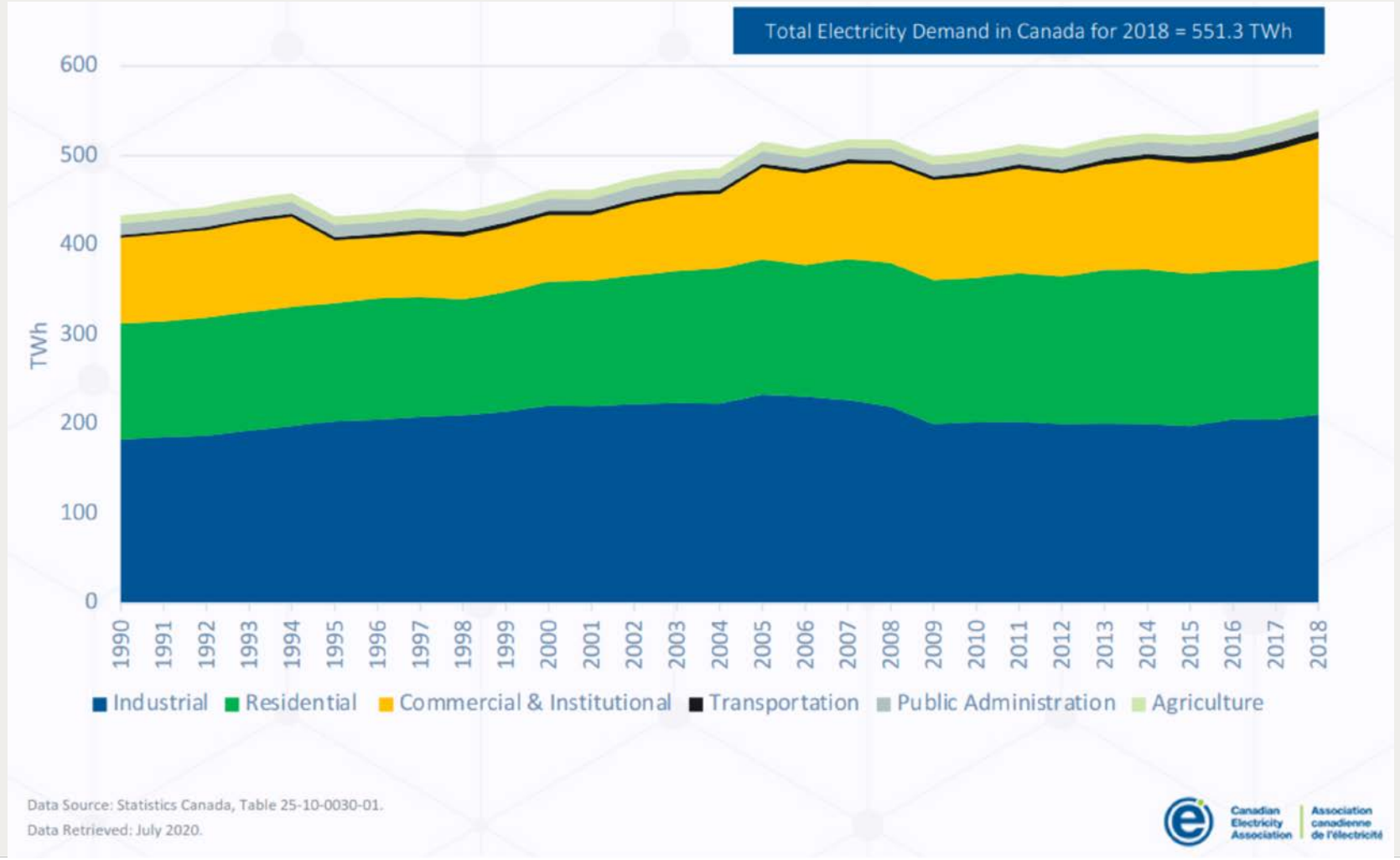
Development of energy production since 1995



Energy Production with Reference to Primary Resources
Electricity generation outlook by fuel type



Consumption per Customer Group



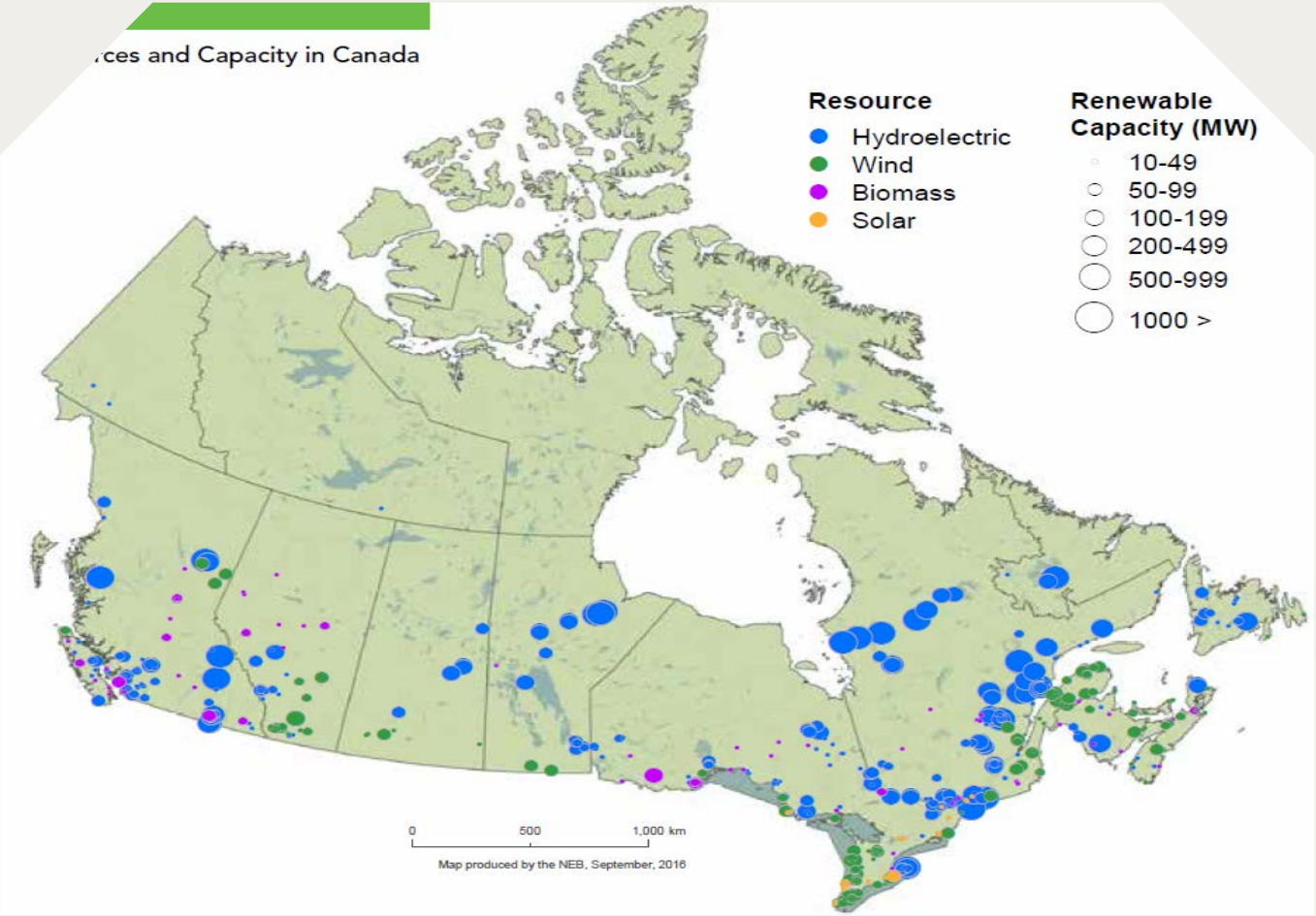
Consumption per Industrial Sector

TOTAL ELECTRICAL ENERGY USE* WAS 1,812 PJ IN 2017

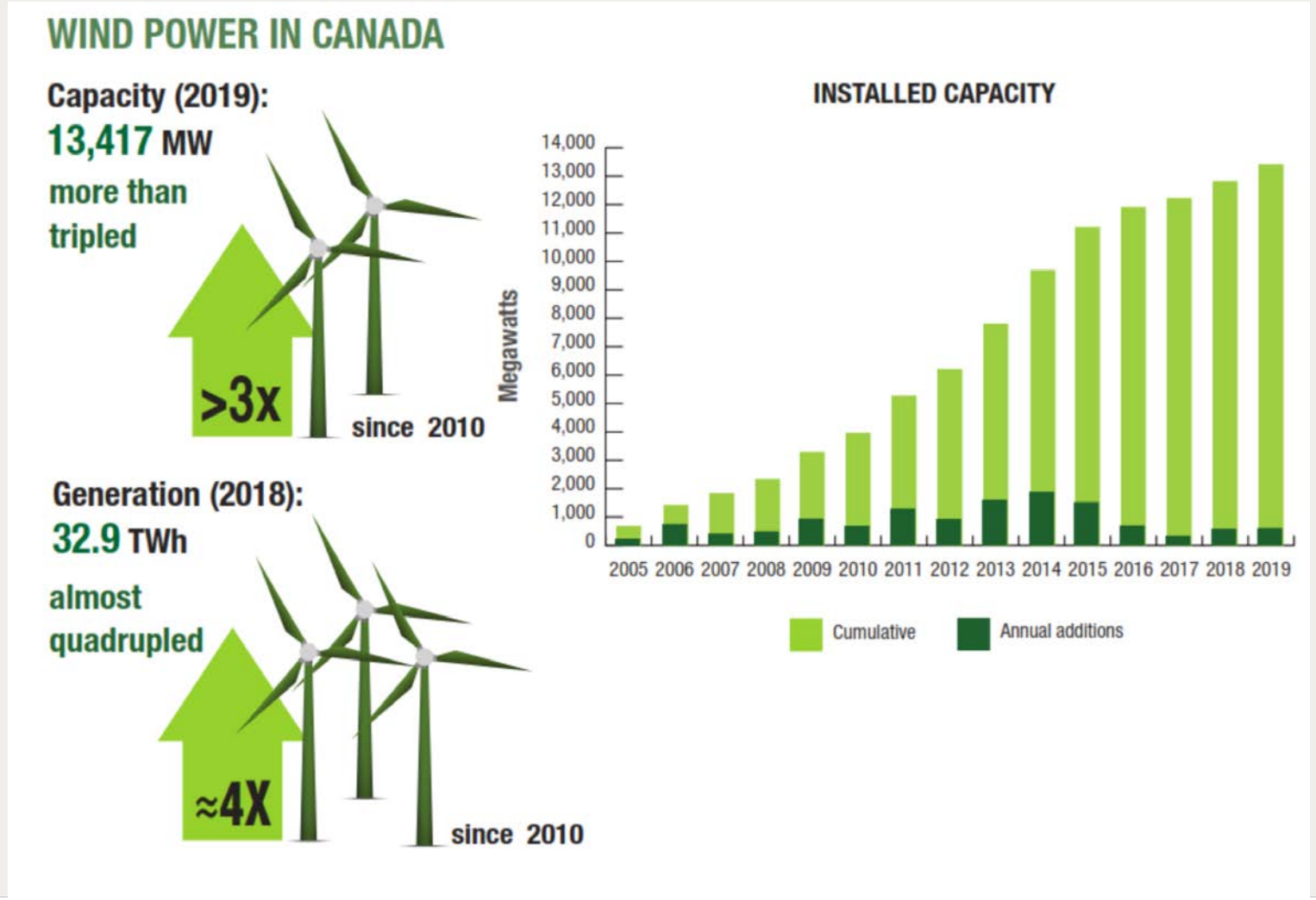
Sector	Energy use (PJ)	% of the total
Residential	604.1	33.3%
Commercial	429.7	23.7%
Industrial	739.0	40.8%
Transportation	4.4	0.2%
Agriculture	34.8	1.9%
Total	**1812.0**	**100%**

*secondary energy use

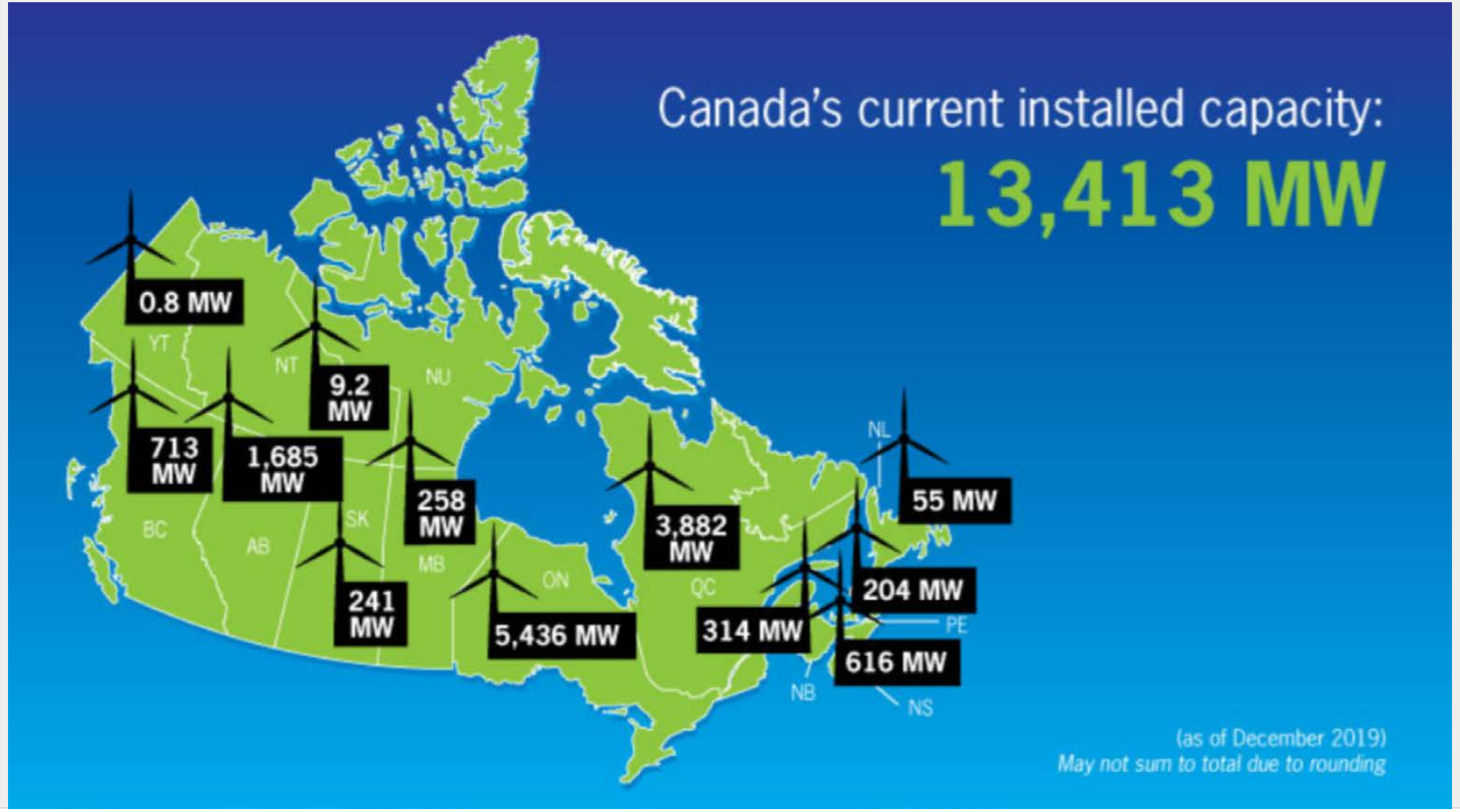
Location of Renewable Energy Sources 2016



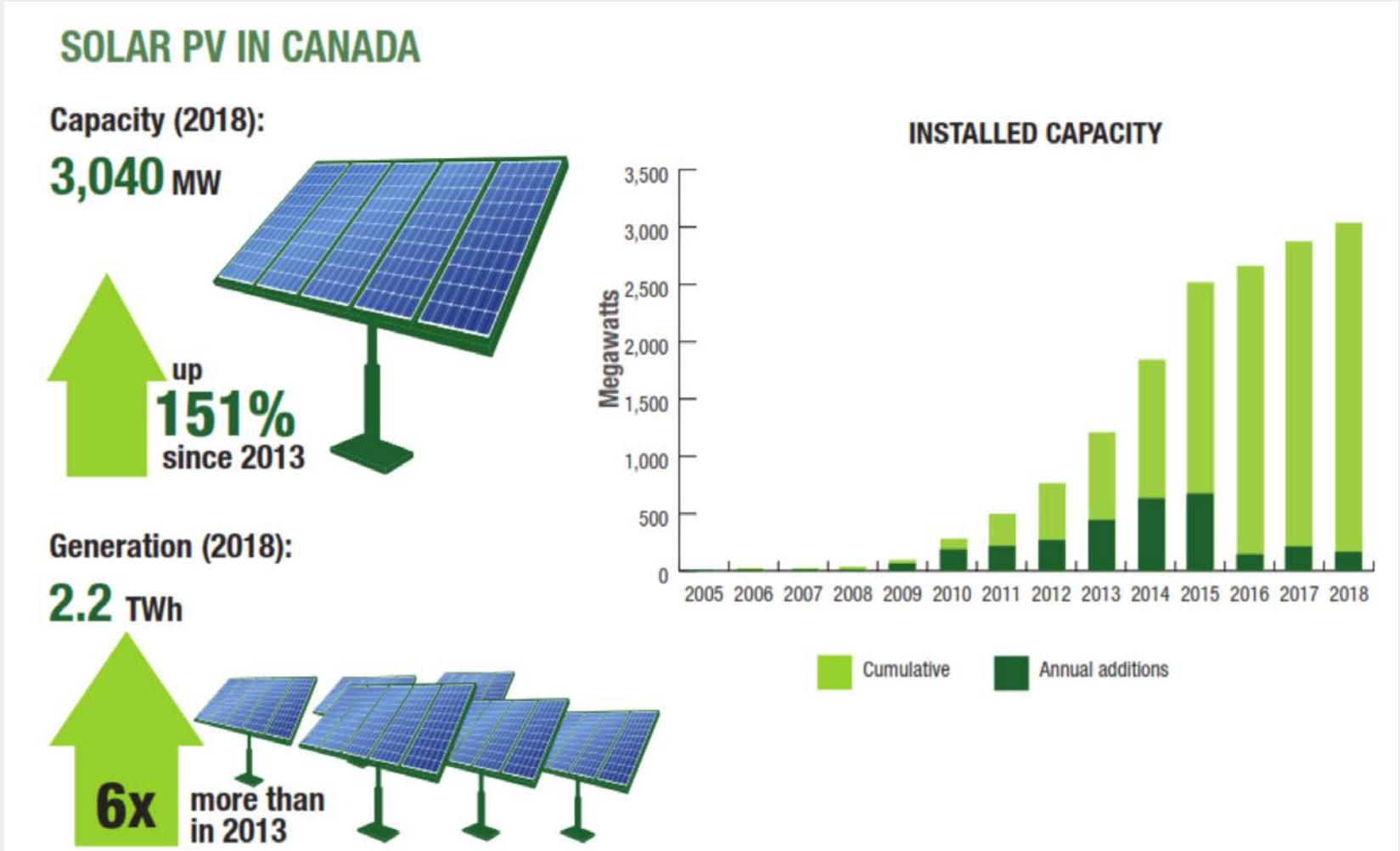
Development of Wind Power (2005-2019)



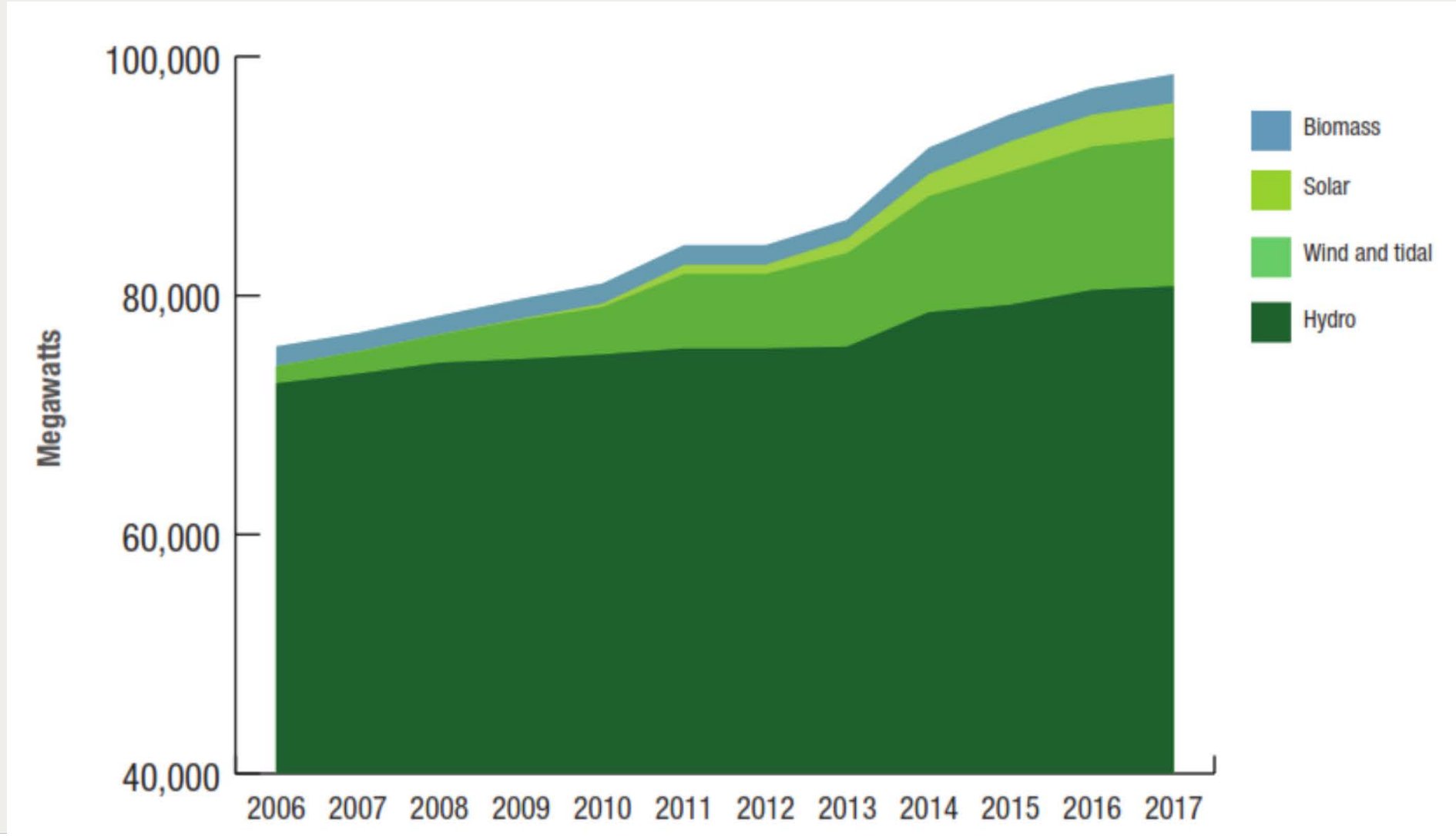
Location of Wind Power Generation as of 2019



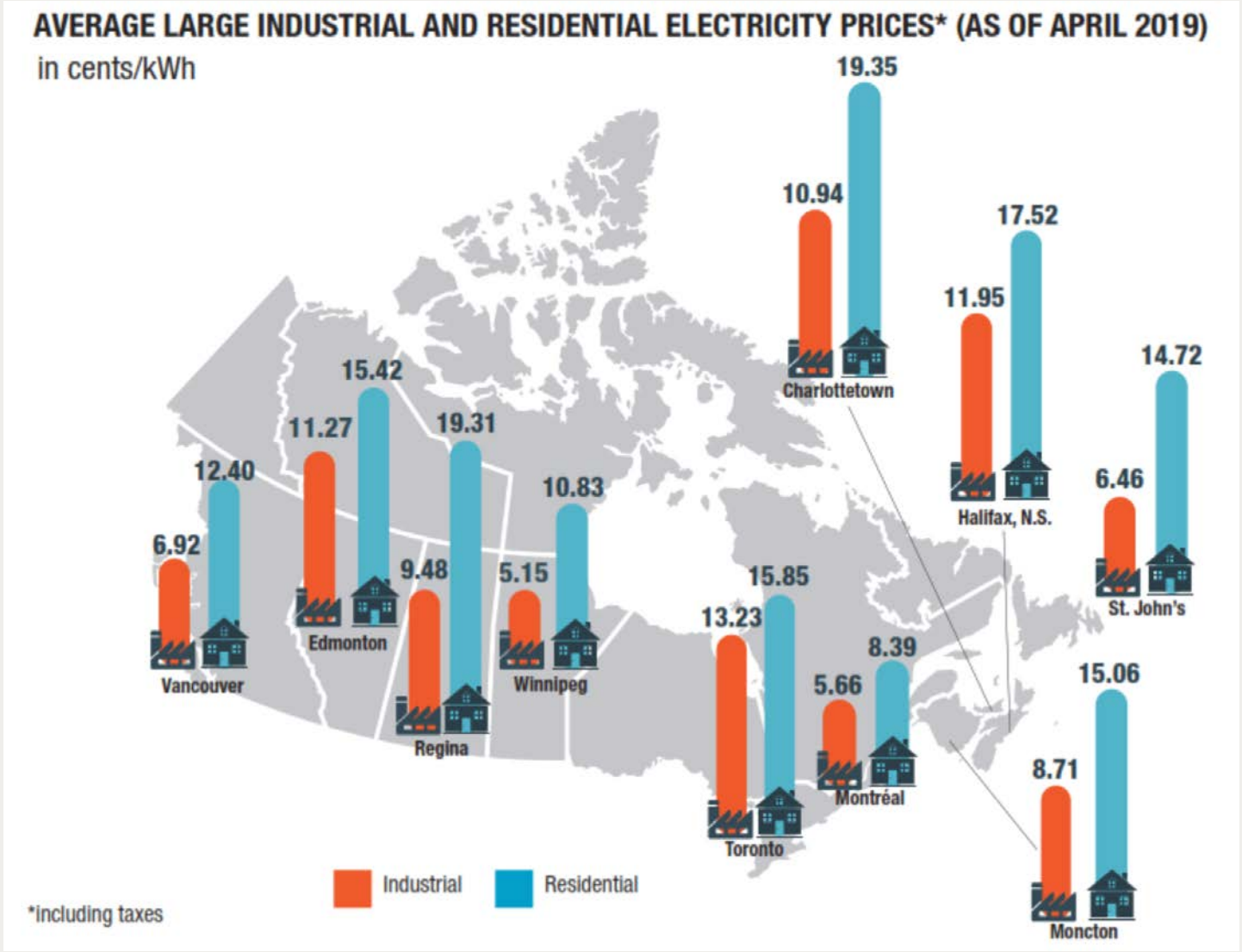
Development of Photovoltaic Power & CSP



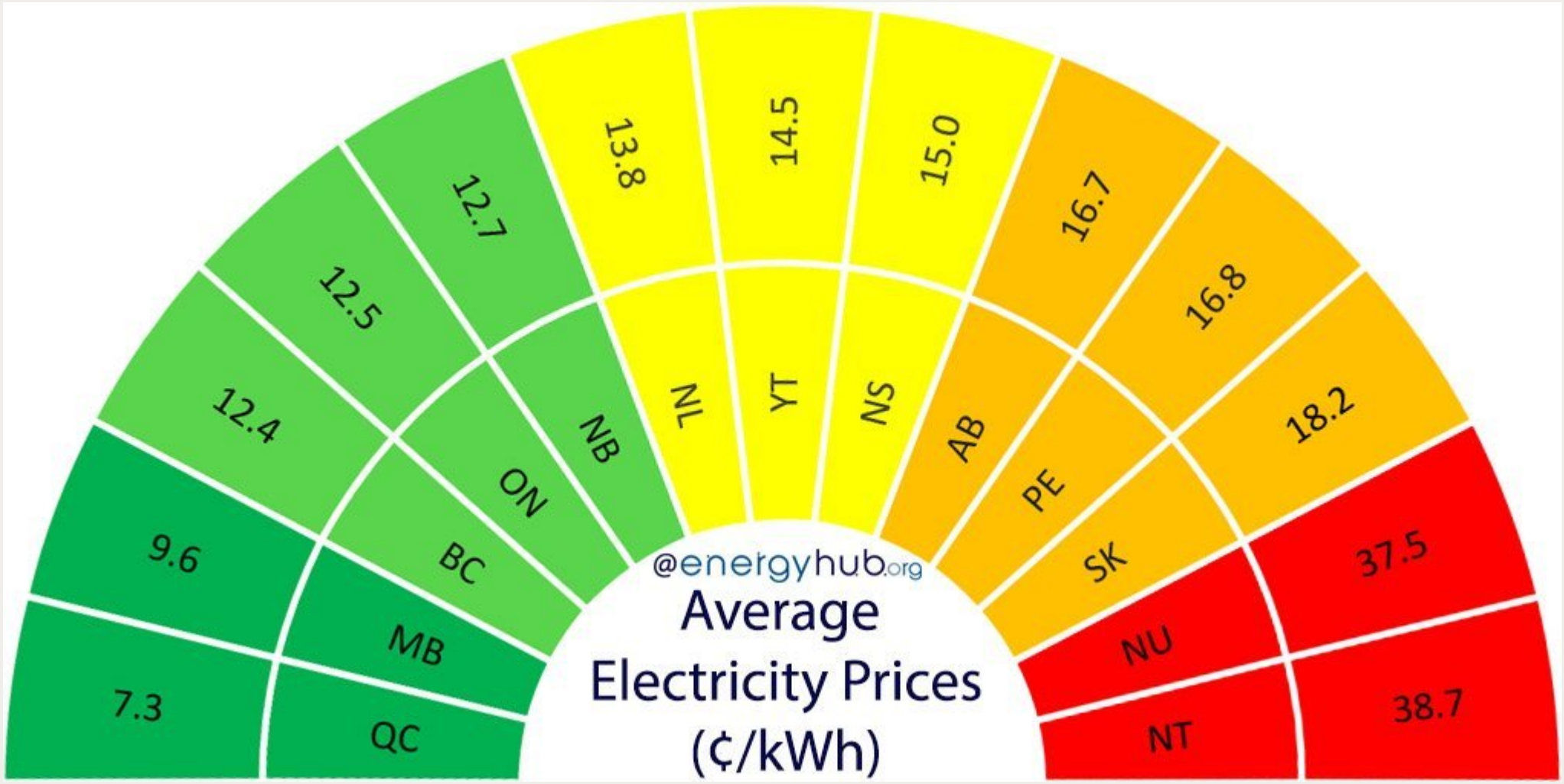
RES Installed Capacity and Production per Annum



Electricity Prices - Industrial Consumers



Electricity Prices – Households (2020)



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

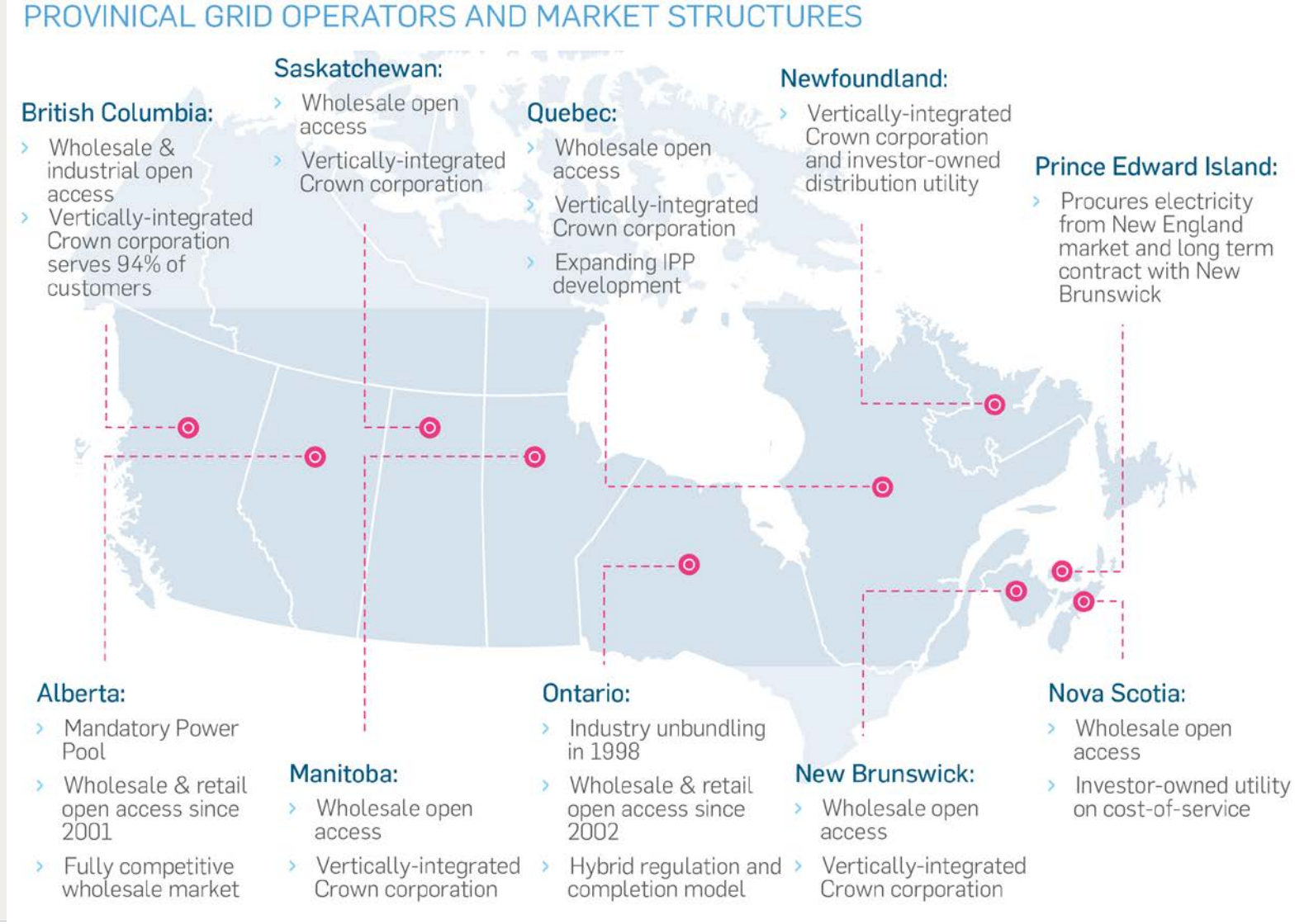
Saskatchewan

- Wholesale open access
- Vertically-integrated Crown corporation

Yukon

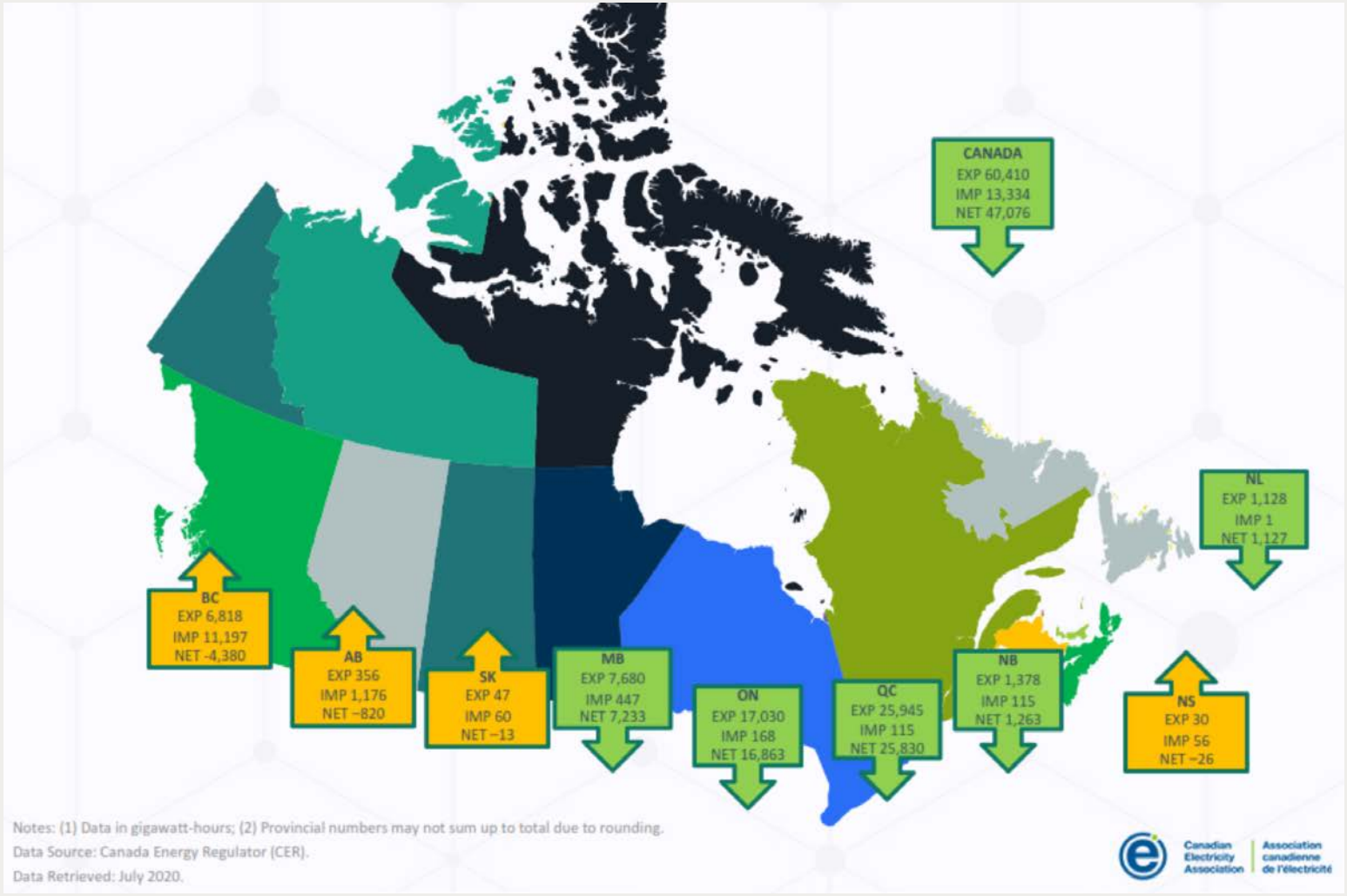
- Vertically-integrated Crown Corporation.
- Investor-owned distribution utility provides service in several communities.

Electricity Market Structure in Canada



Power Balance in 2019

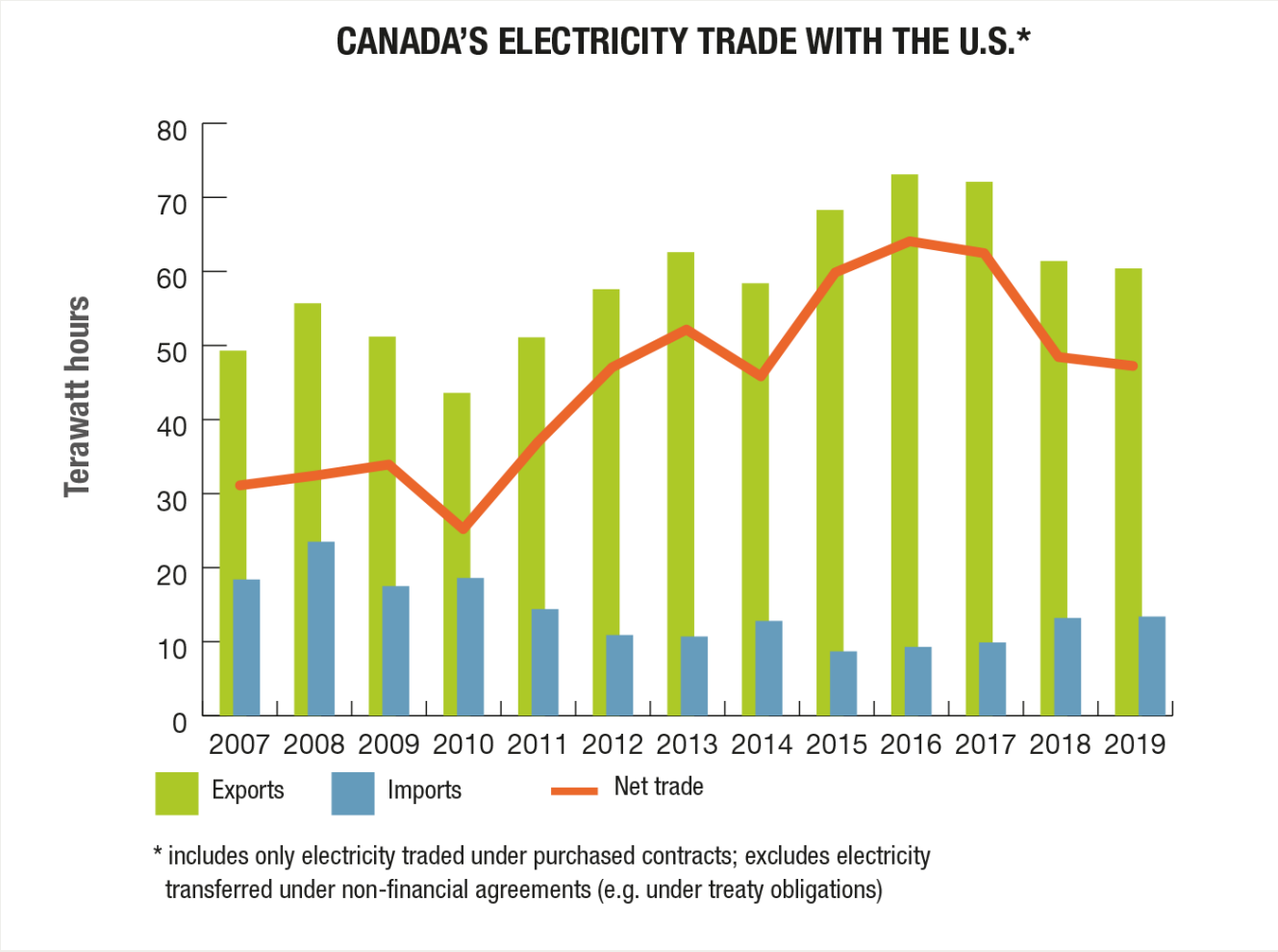
Canadian Electricity Imports and Exports by Region (2019)



Energy Exchanges in 2018 / 2019

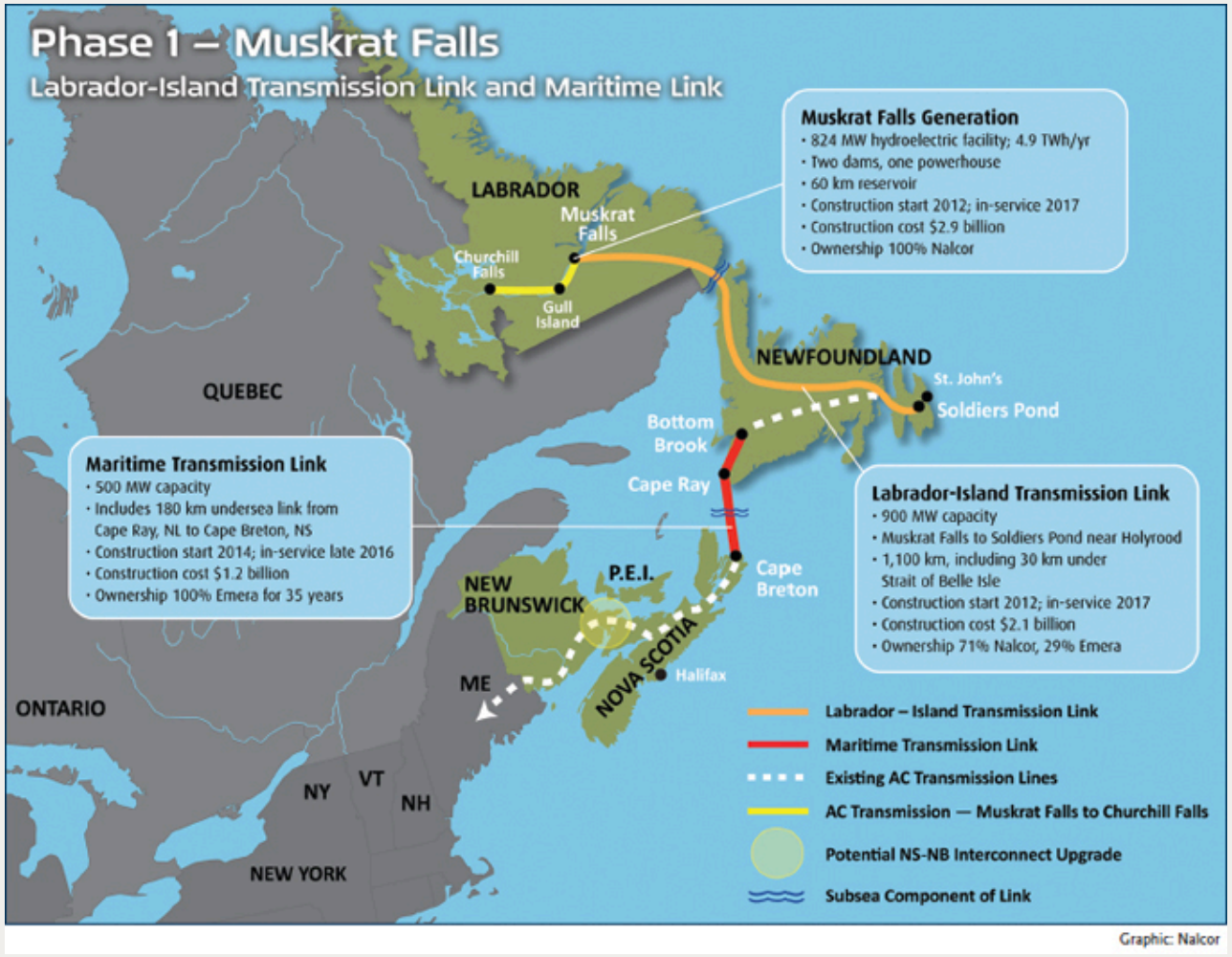
Electricity Exports and Imports between the U.S. and Canada (Terawatt-hours)

- Generation : 641.1 TWh (2018)
- Consumption :503.3 TWh (2017) (Residential 33.3%, Industrial 40.8%. and Commercial 23.7%)
- Imports : 13.4 TWh (2019)
- Exports : 60.4 TWh (2019)

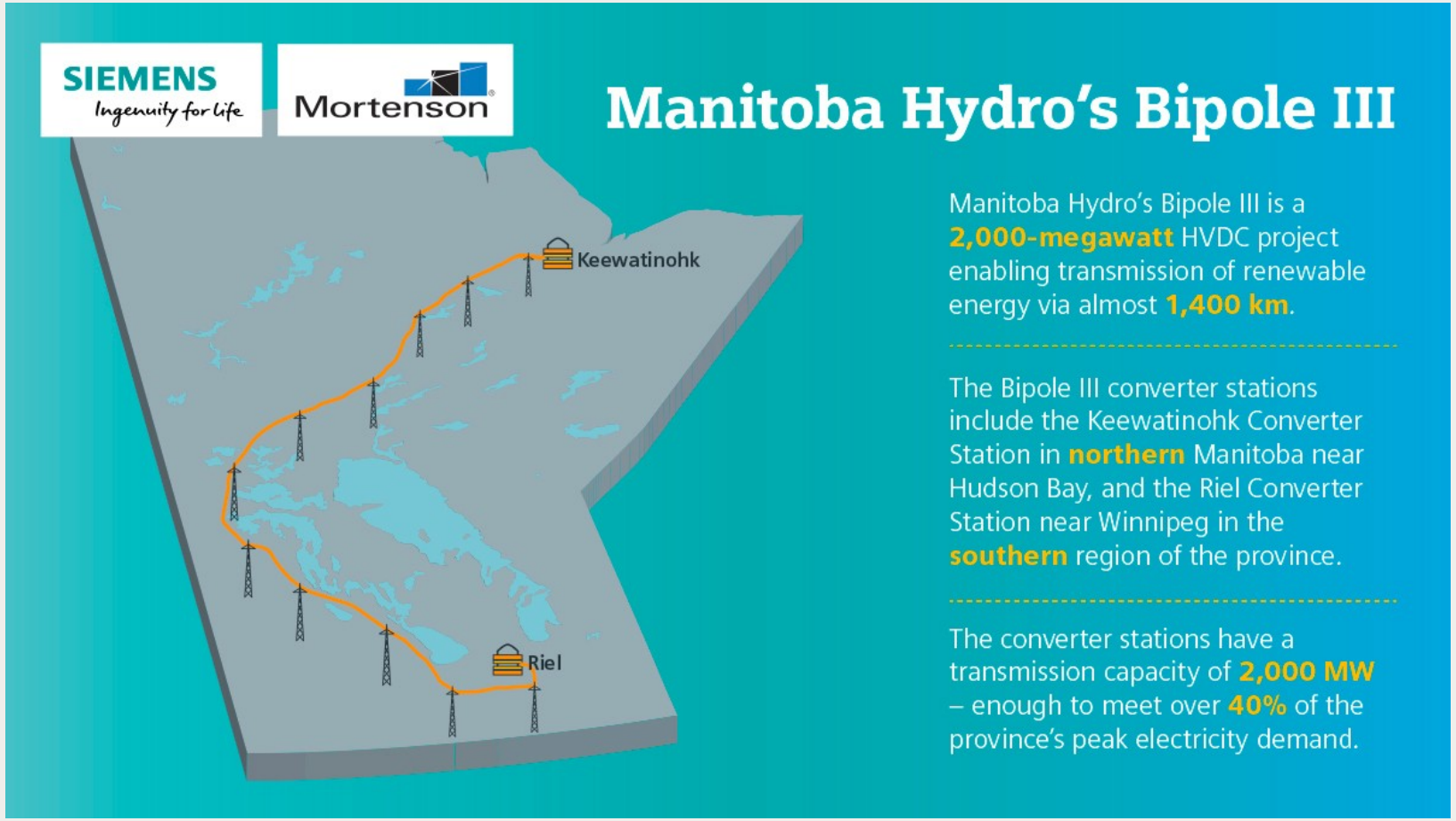


Other Aspects of the Electricity Market: Major Projects

Labrador-Island Transmission Link and Maritime Link

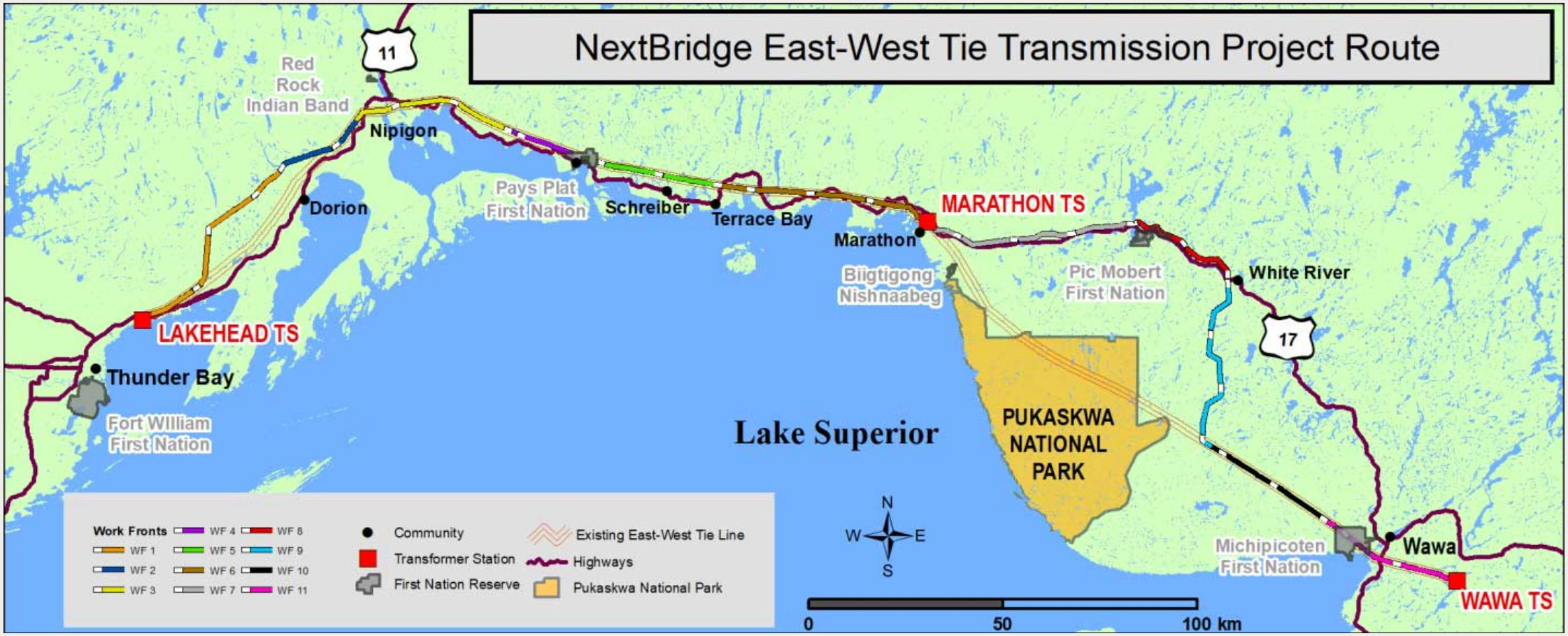


Other Aspects of the Electricity Market: Major Projects
Manitoba Hydro's Bipole III



Other Aspects of the Electricity Market: Major Projects

East-West Tie (450km, 230kV Transmission)



Other Aspects of the Electricity Market
North American Electric Reliability Council Regions (NERC)