Canada Renewable Energy Science and Policy Programs

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Outline

- Introduction
- Federal and provincial initiatives
- Integration of renewable energy in distribution networks in Canada
- Clean energy investments – smart grid and renewable energy
- Strategic planning and levers to encourage innovation
- Summary

S&T is key to achieving NRCan's Vision & Strategic Outcomes

Vision: *Improve the quality of life of Canadians by creating a sustainable natural resources advantage.*

Strategic Outcomes:

- Economic Development: Natural resources sectors are internationally competitive, economically productive, and contribute to the social well-being of Canadians.
- Environmental Responsibility: Canada is a world leader on environmental responsibility in the development and use of natural resources.
- Safety, Security and Governance: Natural resources and landmass knowledge strengthen the safety and security of Canadians and contribute to the effective governance of Canada.

Our Mission:

- Champion of Sustainable Development
- World-Class Centre of Knowledge
- Leader in Science and Policy

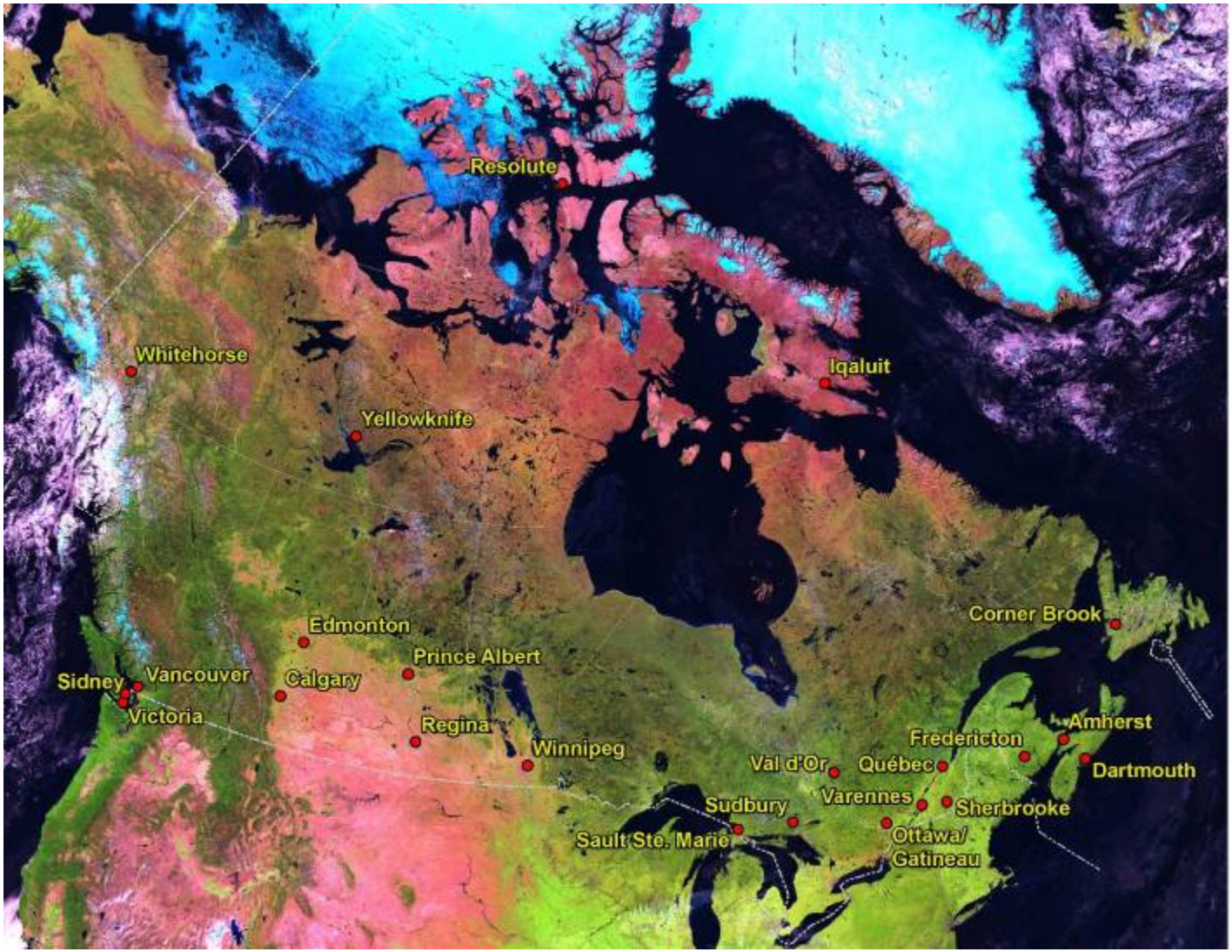
NRCan is a major science performer…

- One of the largest federal science organizations.
- $500M/year on S&T activities.
- 3000+ people working on S&T.
  - 475 Research Scientists.
- ~900 peer reviewed publications per year.
- 288 NRCan scientists hold adjunct professorships

Canada has a Long Tradition of Natural Resources S&T

1842 - Geological Survey of Canada
1898 - Canadian Forest Service
1906 - Atlas of Canada
1908 - Canada Centre for Mineral and Energy Technology (CanMET)

…with an S&T presence across Canada



Integrated approach to planning clean energy R&D

Energy Efficiency

Clean & Renewable Electricity

Cleaner Transport

Cleaner Fossil Fuels & Alternatives

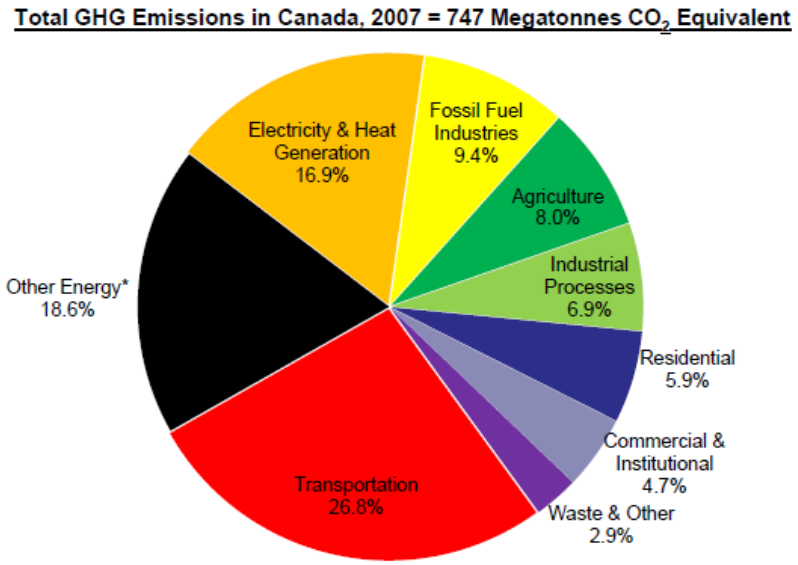
Clean Energy RD&D

Drivers

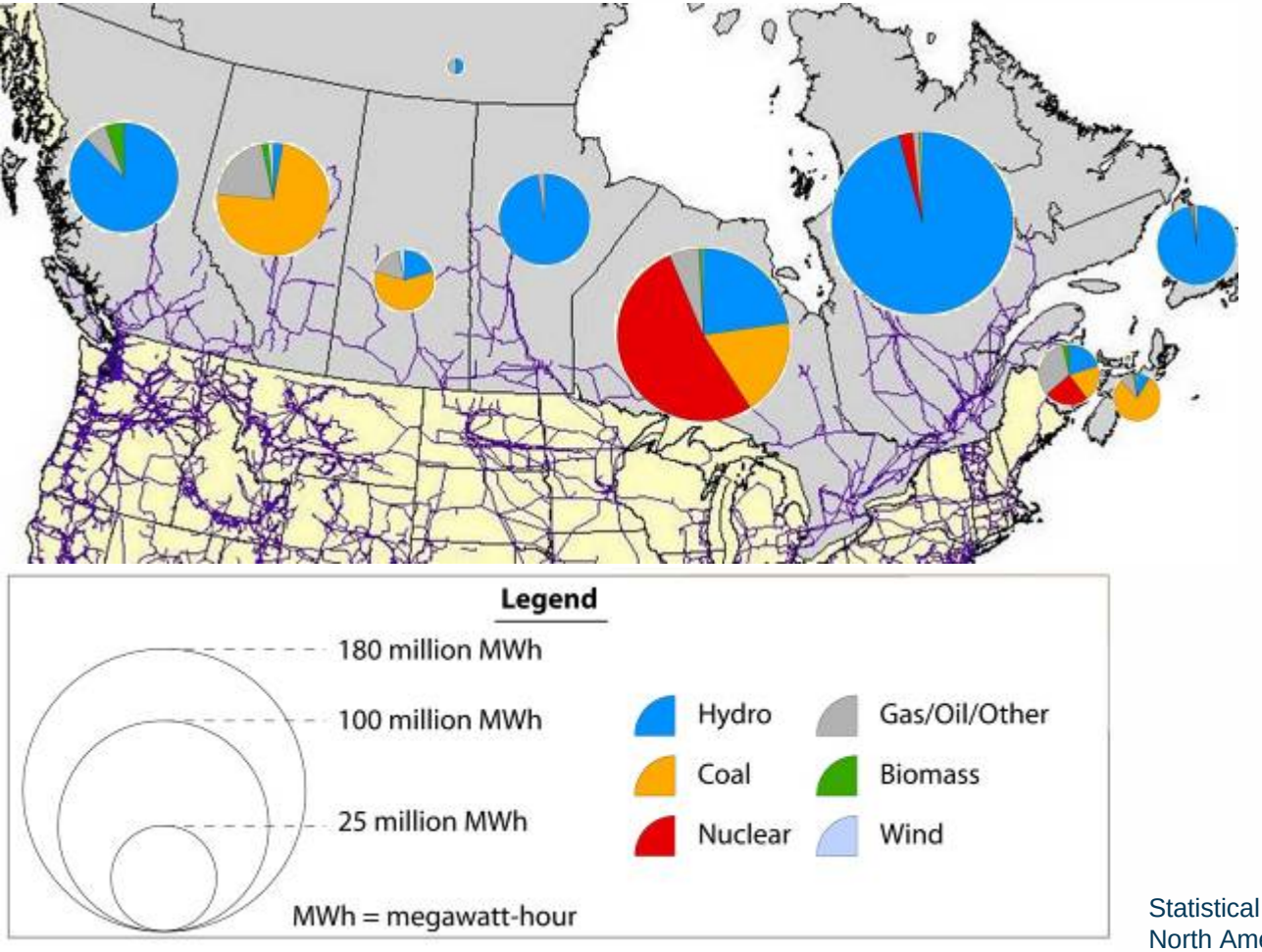
- Electricity demand continues to increase
- Public interest in renewable and low-impact technologies
- Green economy job creation
- Increasing concern about security, power quality, and reliability of the grid, including transmission and distribution losses
- High cost of building additional transmission systems as well as replacement of aging systems
- Government of Canada's GHG goals

Canada's Challenge – Policy Direction

- **Reduce Canada's GHG emissions by:**
  - **17% below 2005 levels by 2020**
  - **60% - 70% below 2005 levels by 2050**
- **Achieve 90% of Canadian electricity from Non-emitting Sources by 2020**



Canadian Electricity Supply Mix



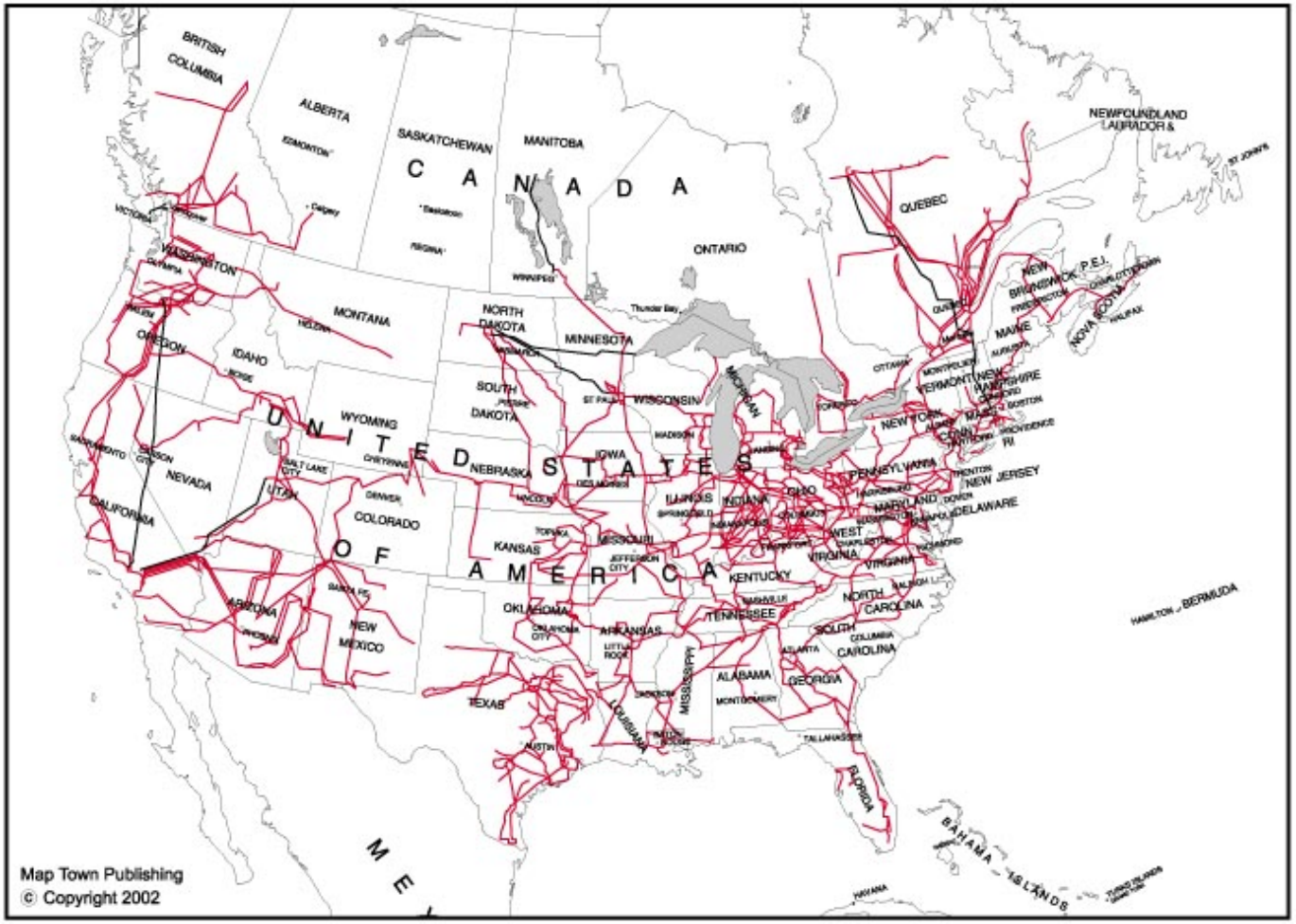
Electricity Management:

- North-South interconnected grid with the US
- Diverse resource options across country → no one-size fits all
- Varying electricity policies across provinces

Statistical Source: NRCan (provincial electricity supply), North American Electric Reliability Council (NERC, grid)
Map Source: Global Energy Network Institute (GENI)

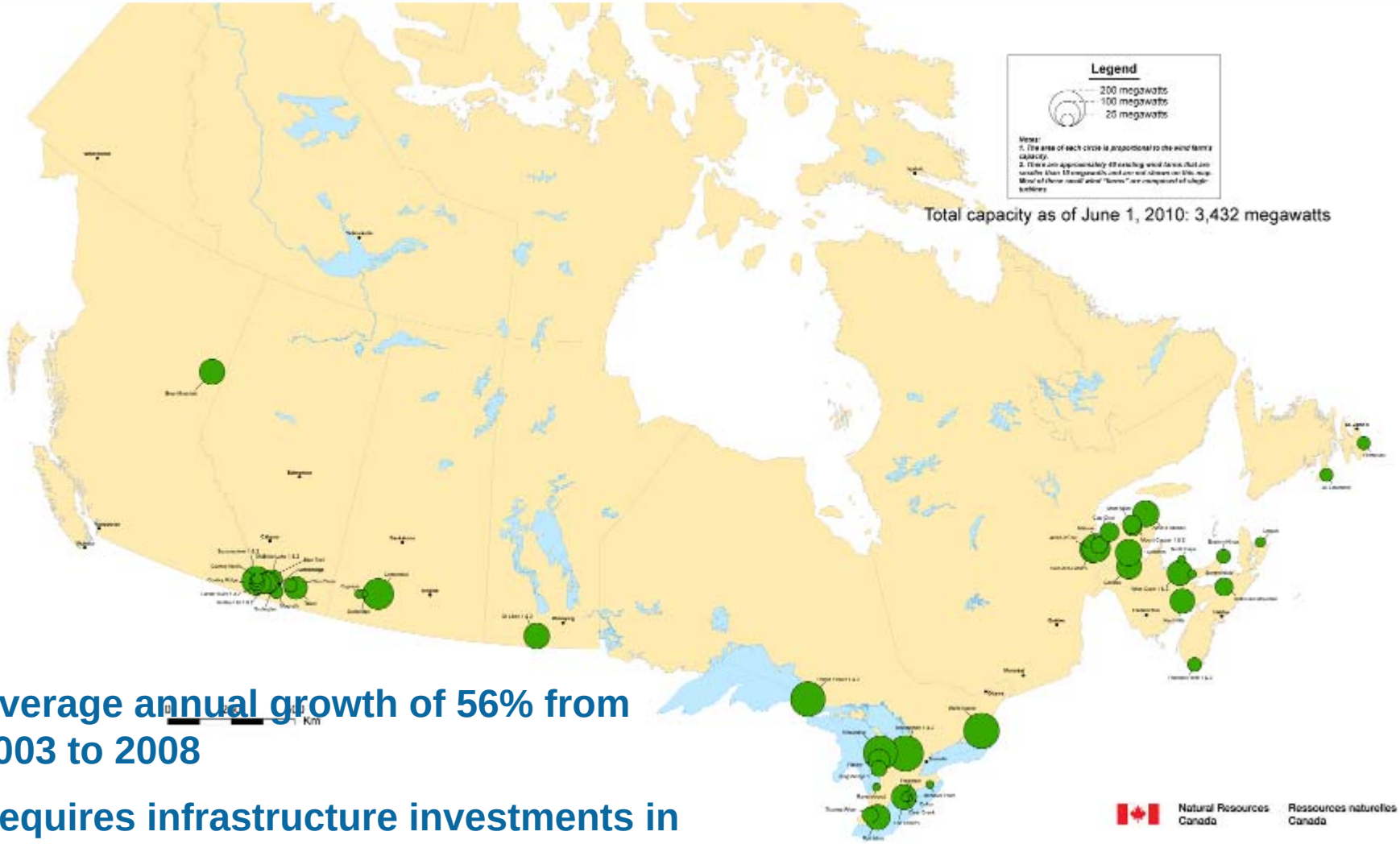
North American Electricity Transmission*

Regional System Network Improves Market Efficiencies



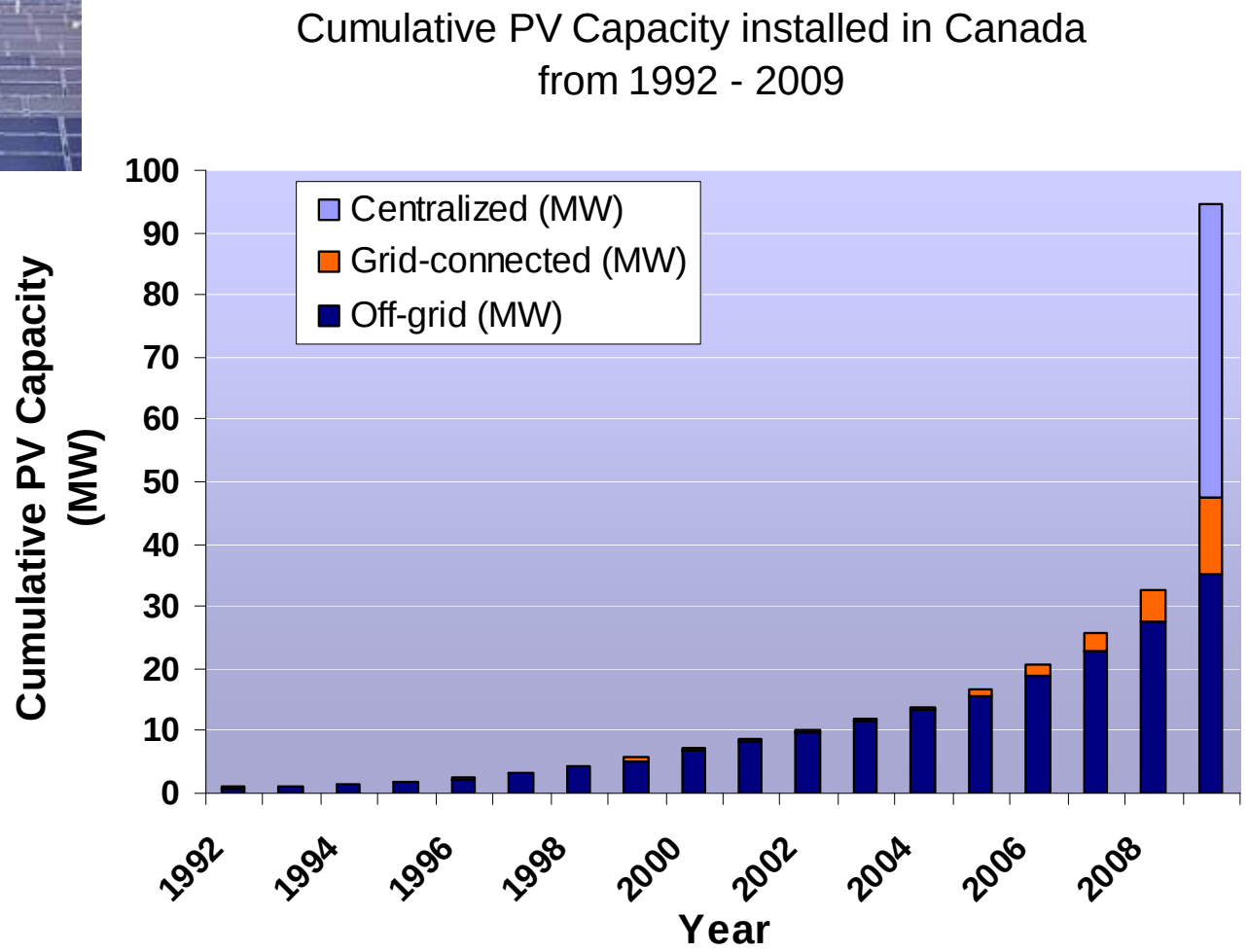
*main electricity transmission lines

Canada's Wind Capacity reached 3.4 GW



- **Average annual growth of 56% from 2003 to 2008**
- **Requires infrastructure investments in Transmission and distribution assets**

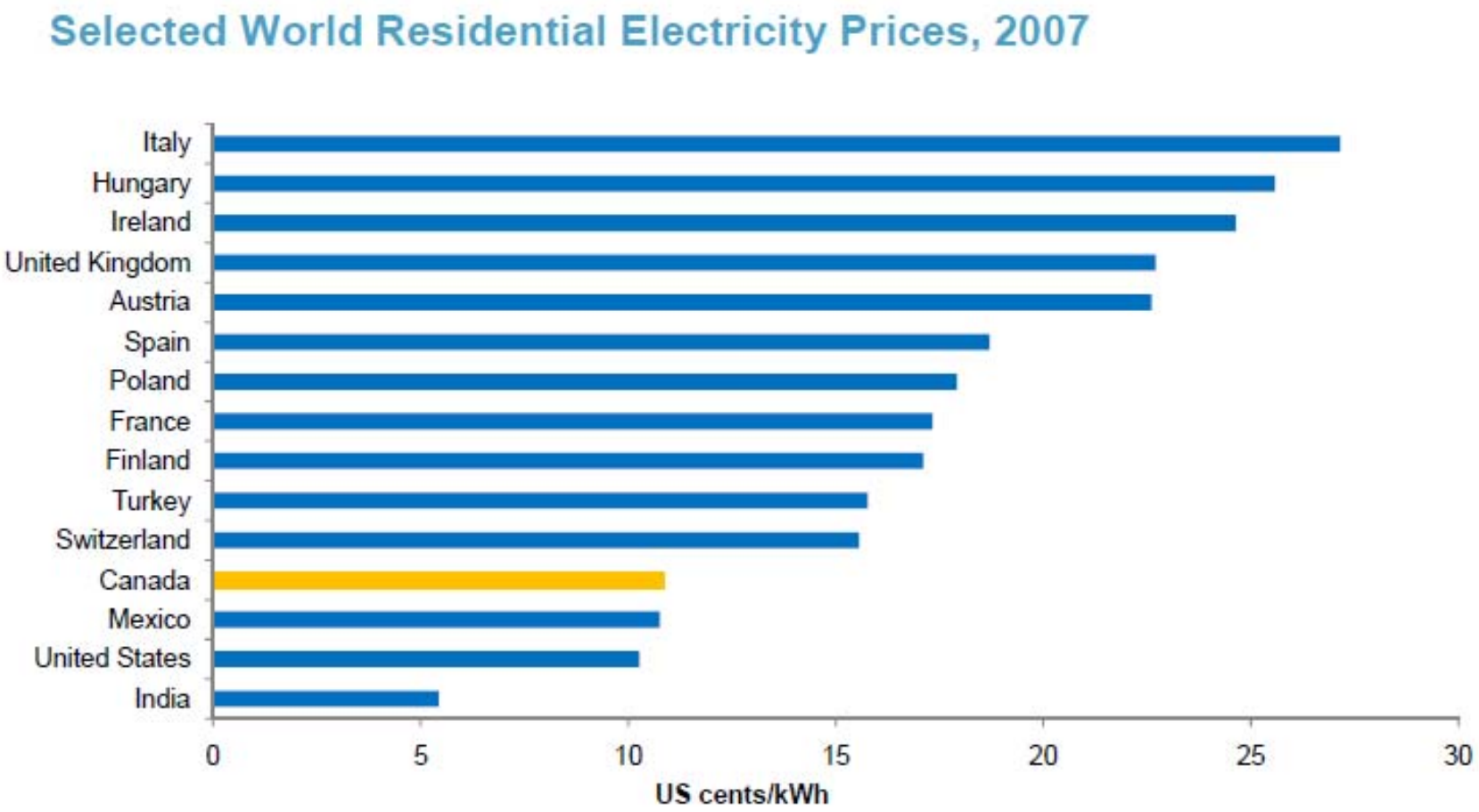
189% increase in solar photovoltaic in 2009



A wide ranging effort have been initiated by the provinces targeting renewable energy development

- **British Columbia** -Clean energy Act, 2010
- **Alberta** – Bioenergy, wind energy and transmission
- **Manitoba** wind-hydro balancing and synchrophasor
- **New Brunswick** power shift project – wind integration
- **Nova Scotia** Renewable Electricity Plan - Wind and Tidal
- **Newfoundland Labrador** Hydro power and transmission
- **Prince Edward Island** wind energy strategy
- **Saskatchewan**, wind
- **Ontario** Green Energy and Green Economy Act, 2009 – Wind, biomenergy, solar, hydro focus on job creation
- **Québec** released its Energy Strategy in 2006. Jointly with its Plan Nord objectives, more than 7 500 MW of hydroelectric power and 4 300 MW of wind power will be implemented before 2035
- **Northern territories** (Yukon, NWT, Nunavut):
  - Creating a Brighter Future
  - Reducing dependence on diesel power in remote communities
  - Geothermal, Solar, Wind

This 2007 average price of electricity did not reflect the time of day electricity costs



Source for Canada: Hydro Quebec, *Comparison of Electricity Prices in Major North American Cities*, 2007
Source for Rest of World: International Energy Agency, *Key World Energy Statistics 2008*

Transition to time of day prices that reflect the supply and demand for electricity

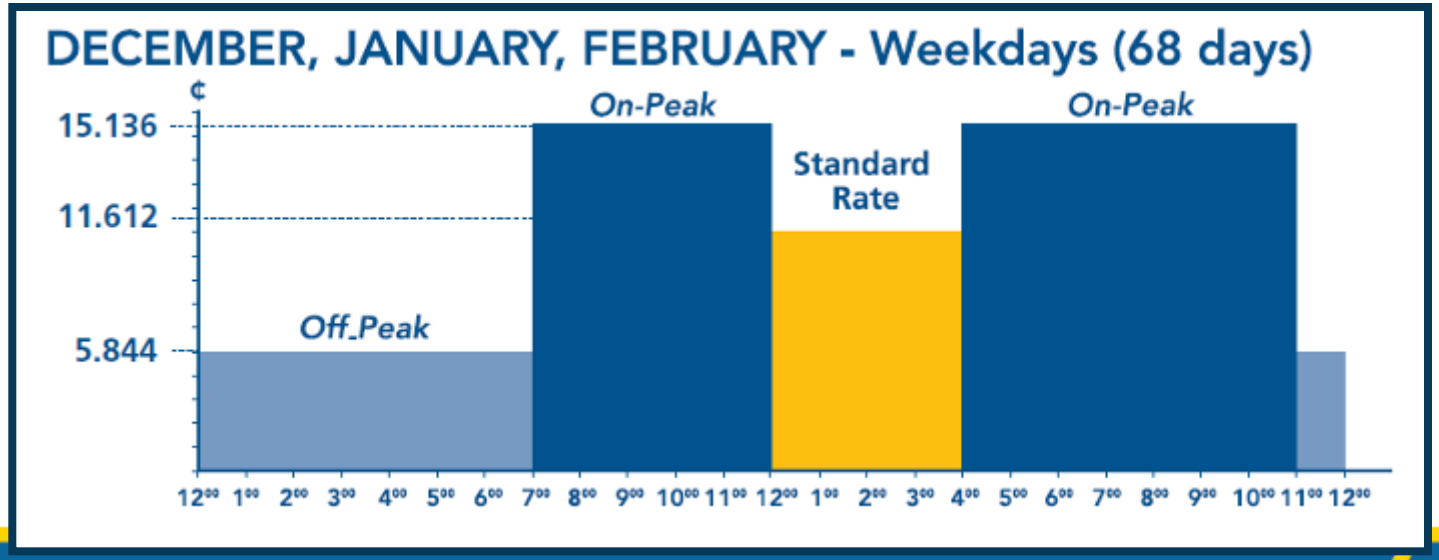
ONTARIO Energy Board TOU rate set every 6 months

Off-Peak: (when demand for electricity is lowest) 5.1 ¢/kWh	Mid-Peak: (when demand for electricity is moderate) 8.1 ¢/kWh	On-Peak: (when demand for electricity is highest) 9.9 ¢/kWh

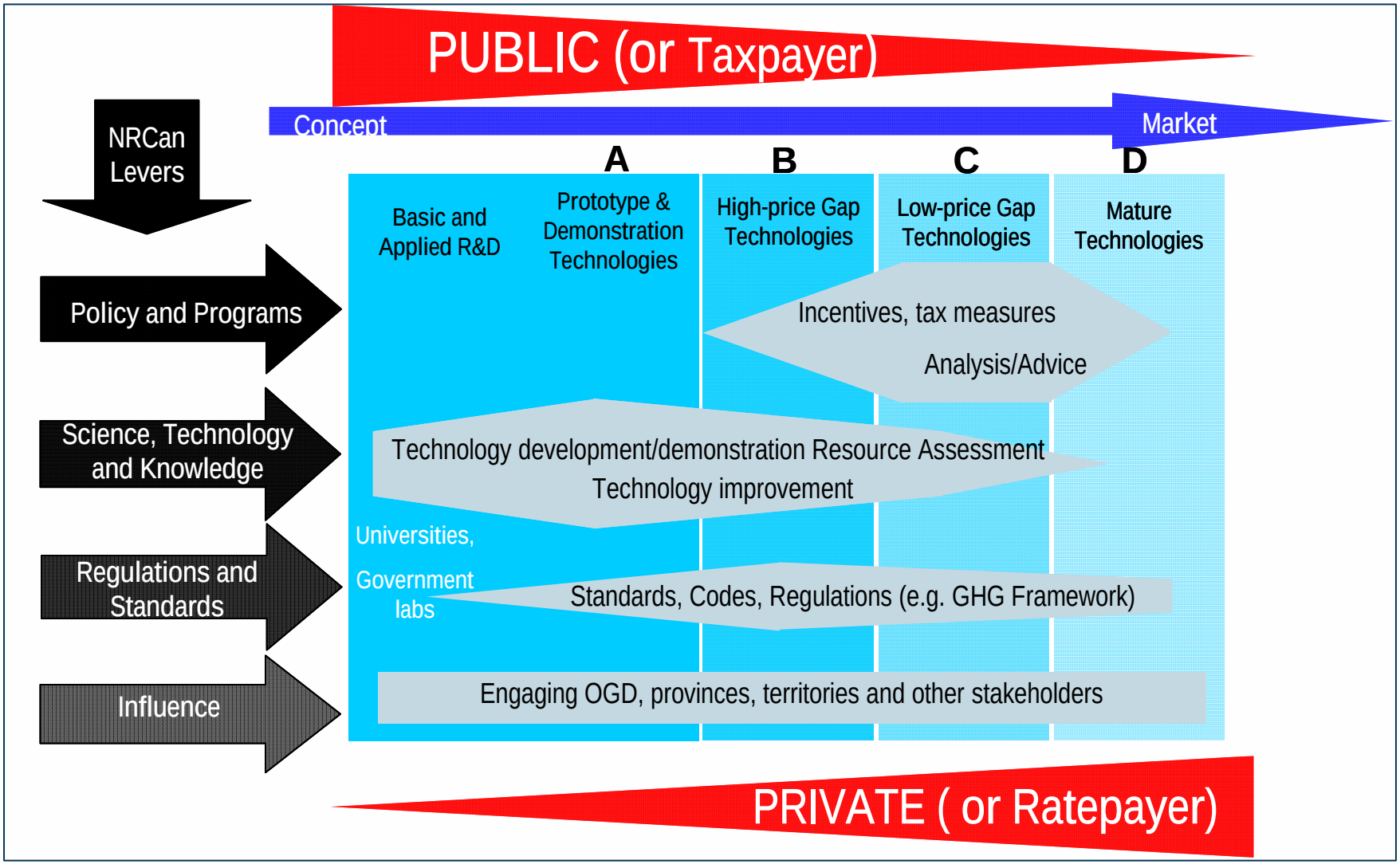
Winter (Nov 1-Apr 30) - Weekdays

Summer (May 1-Oct 31) - Weekdays

Nova Scotia TOU rate Winter months



Innovation and policy levers



Federal support for the establishments of four national research networks

www.solarbuildings.ca

(2005-2010)

SOLAR BUILDINGS RESEARCH NETWORK

RÉSEAU DE RECHERCHE SUR LES BÂTIMENTS SOLAIRES

www.PVINNOVATION.ca (2009-2014)

PHOTOVOLTAIC INNOVATION NETWORK

www.wesnet.ca (2007-2012)

Wind energy System Network

Smart Grid research network (2010-2015)

Smart Grid initiatives to modernize the electricity system

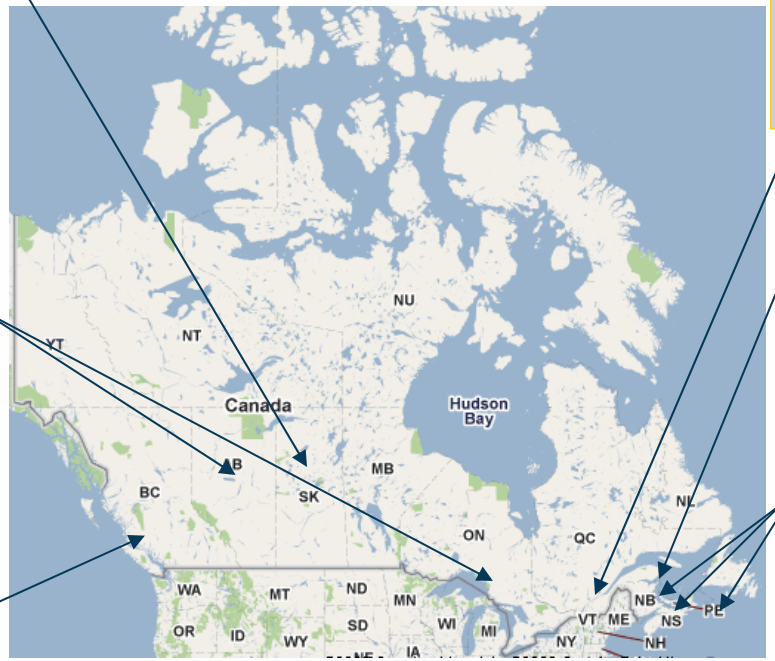
- Federal :
  - Clean Energy Fund demonstration projects
  - Smart Grid Technology and Standards Task Force
  - Wireless spectrum allocation 1800-1830MHz band
  - International Smart Grid Action Network
- Industry:
  - Smart Grid Canada participating in the Global Smart Grid Federation
  - Smart grid project implementation by electricity distribution companies
  - Manitoba Hydro project as part of the North American Synchrophasor Initiatives

Clean Energy Fund (CEF) demonstration projects

Cowessess First Nation
- First-nation managed wind/storage system.
- $5.5M project.

Power Measurement Ltd
- Load curtailment and peak shaving in large commercial buildings
- Partners include Brookfield Properties, ENMAX
- $10M project

BC Hydro
- Installation of two 1MW storage systems at two locations to support remote and weak grid systems
- $13.4M project



Hydro-Quebec-Institute de recherche
- Development of a smart zone in Boucherville including PHEV charging infrastructure
- $20M project

Wind Energy Institute of Canada
- 9MW wind-based research park combined with energy storage on a weak grid
- $25M Project

New Brunswick Power Corporation
- Project will install monitoring and control systems in 2500 buildings in PEI,NB and NS. Load control will be driven by availability of regional wind power
- 4 utilities involved
- $32M project

Transmission & Distribution

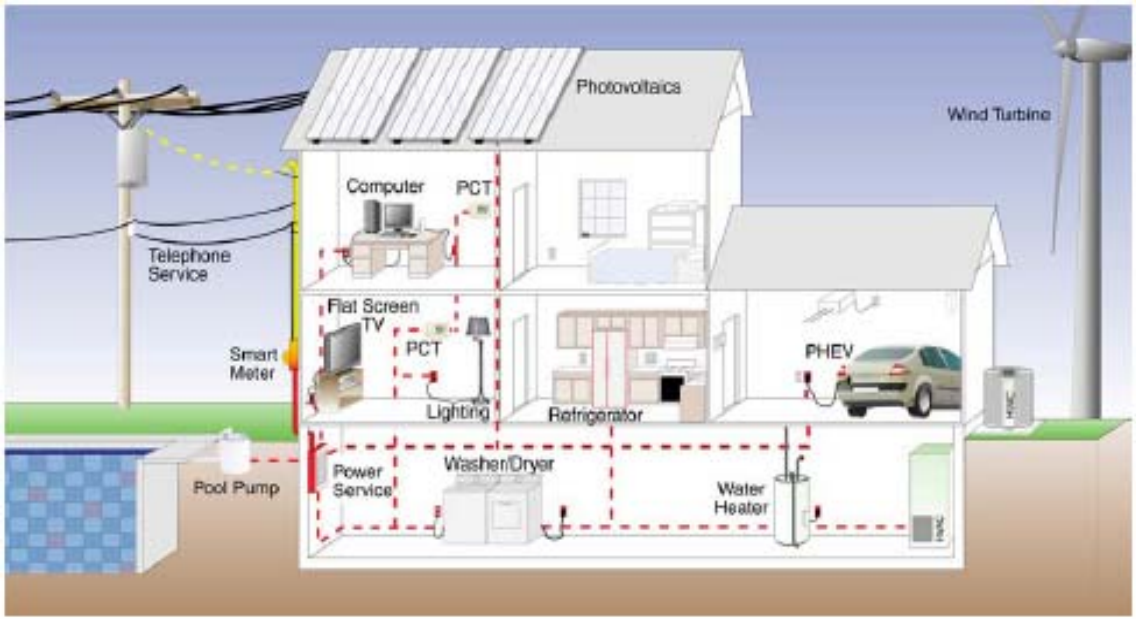
Feeder Automation

Substation Data Management unit

Utility DMS/OMS

Security & Privacy

Consumer



Actions that we can champion

- Support the establishment of a reliable and efficient electricity distribution infrastructure able to integrate renewable and distributed energy resources;
- Support and influence the development and harmonization of standards;
- Establish a consortium of leading industry/utility research centers, national laboratories, and universities and increase the pool of specialists that this industry needs to bring their products and services to the market place;
- Facilitate the market acceptance of renewable energy that will contribute to meeting Canada's policy goals.