



Government  
of Canada

Gouvernement  
du Canada

# Long-Term Energy Scenarios in Canada's Clean Energy Transition

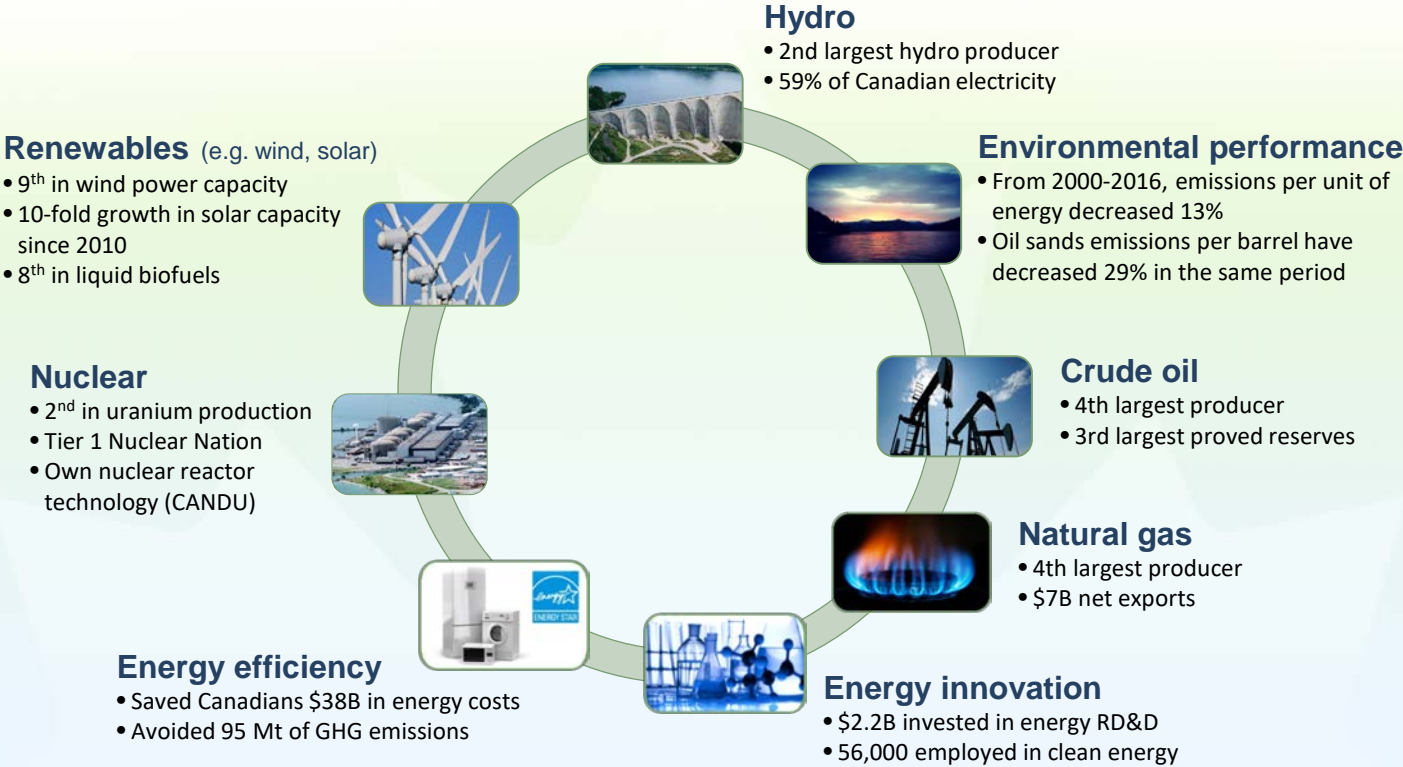
Canada

# Outline

- Canada's Energy Context
- Modelling Work in Canada
- Conclusions



# Canada is a global energy leader with world-class assets and expertise...



# ... working towards ambitious decarbonization targets...

## GHG emission reduction ambition

↓ **30%** by 2030\*

↓ **80%** by 2050\*

\* Below 2005 levels

## Between 2000 and 2016

Canada's GHG emissions decreased by

↓ **4%**

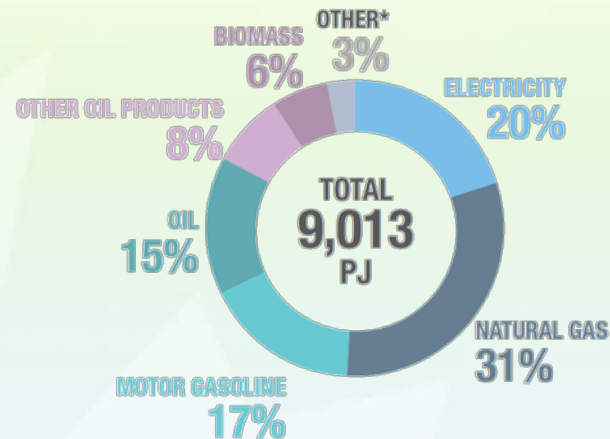
Emissions from electricity production decreased by

↓ **39%**

While GDP increased

↑ **36%**

CANADA'S SECONDARY ENERGY USE BY FUEL TYPE, 2015



\* "Other" includes coal, coke, coke oven gas, NGLs and steam and waste



...through a comprehensive suite of measures...



# ...in a federal context of shared responsibility

## FEDERAL RESPONSIBILITIES

- International engagement and negotiations
- Trade and investment
- Interprovincial and international energy (pipelines, power lines)
- Nuclear energy, waste and uranium
- Offshore, Nunavut and federal lands

## SHARED RESPONSIBILITIES

- Environmental regulation of new energy projects
- Scientific R&D
- Offshore petroleum in Atlantic Accord Areas
- Interprovincial energy (transmission lines)
- Infrastructure security and resiliency
- Energy efficiency

## PROVINCIAL AND TERRITORIAL RESPONSIBILITIES

- Electricity generation, transmission and distribution, including rates
- Regulation of natural resources development within the province
- Land-use and project planning
- Royalty design and collection
- Intra-provincial energy resources infrastructure, distribution, and storage

## INDIGENOUS

- Role in energy project assessment and review, as well as decision-making, monitoring and active participation in projects
- Ownership and management of energy systems
- Self-determination of communities

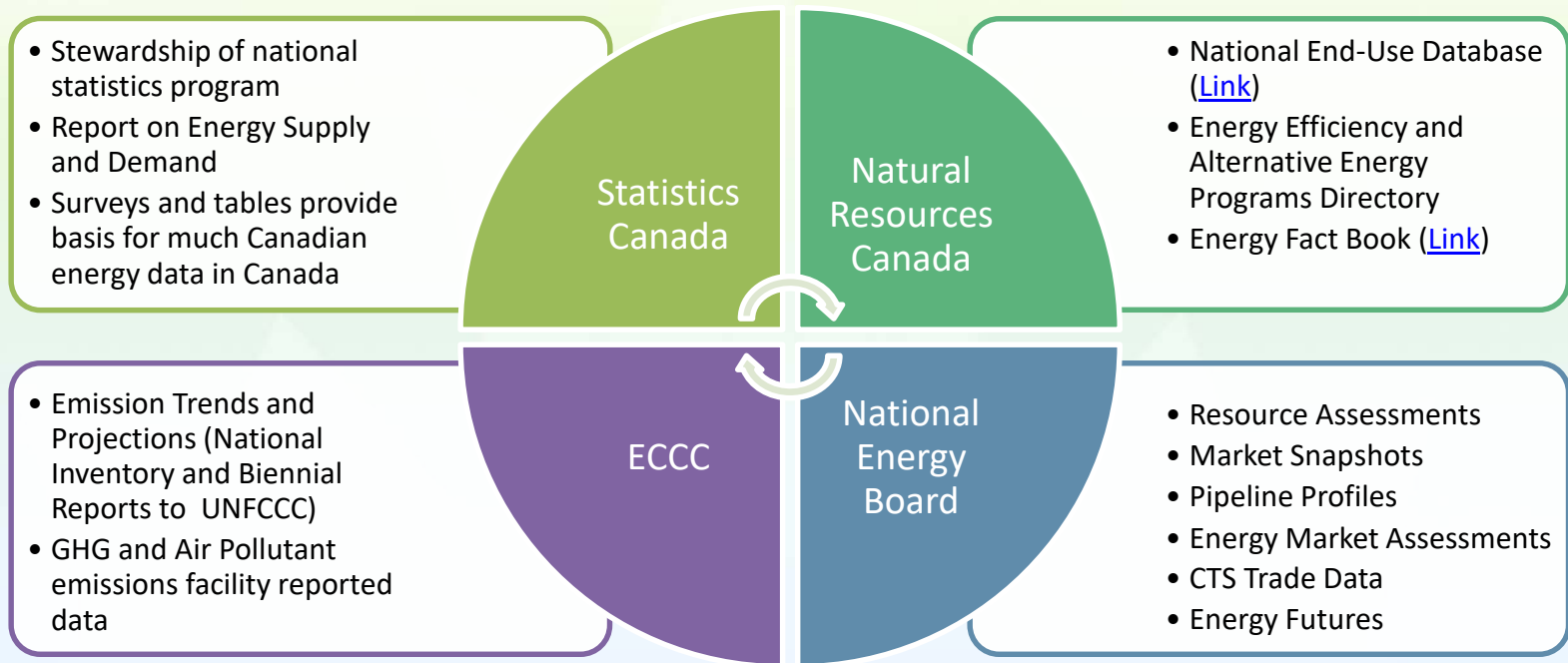


# Modelling Work in Canada

- Modelling work at Government of Canada
  - **National Energy Board:** Modelling Canada's energy future
  - **Environment and Climate Change Canada:** A GHG perspective to energy modelling
- Provincial Governments
- Academia/Private companies



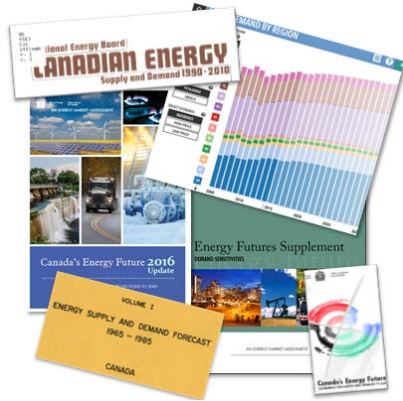
# Federal Energy Information Framework





# The National Energy Board and *Energy Futures*

- An independent quasi-judicial regulatory tribunal established in 1959
- Reports to Parliament via the Minister of Natural Resources Canada
- Two primary functions:
  - Regulatory Mandate
  - Energy Information Program



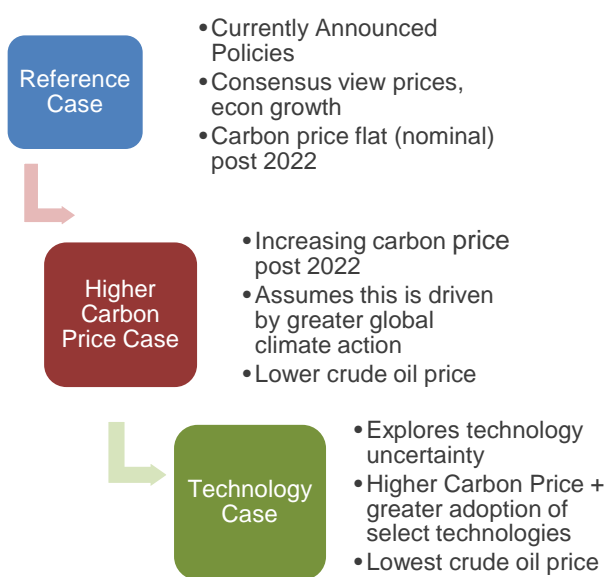
- *Energy Futures* is the Board's flagship energy information product; published since 1967
- Historically produced every four years, bi-annually since 2007
- Released annually since 2016

# Energy Future Scenarios

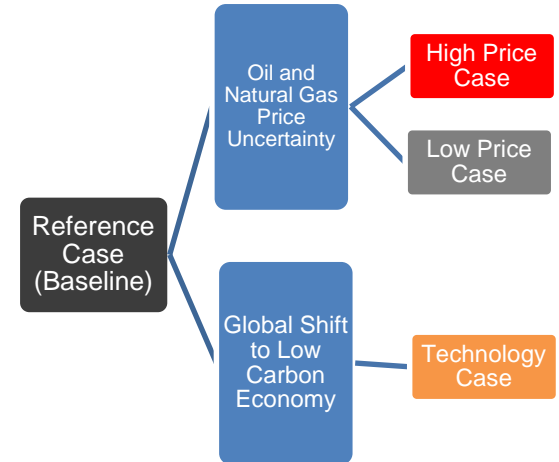
## EF 2016 Scenarios



## EF 2017 Scenarios

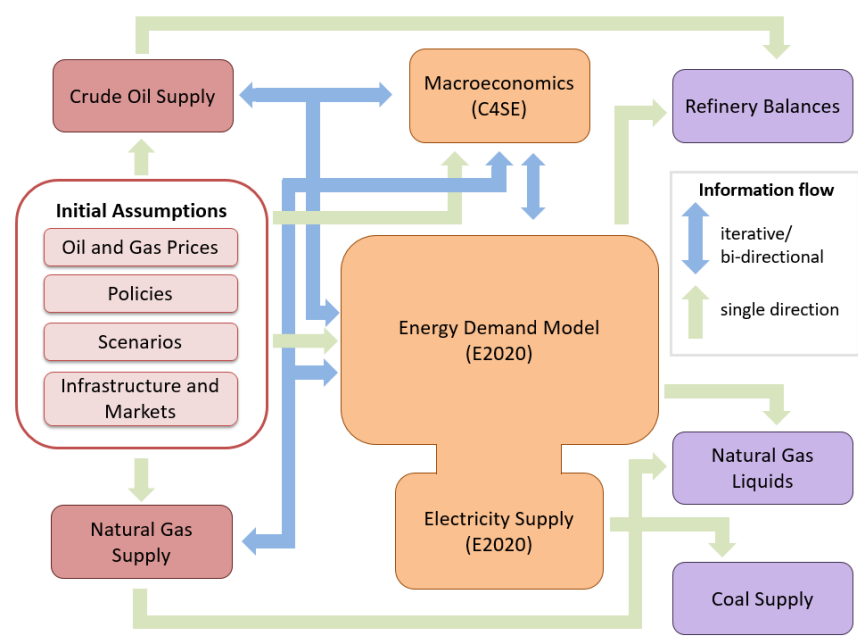


## EF 2018 Scenarios



# NEB Modeling System

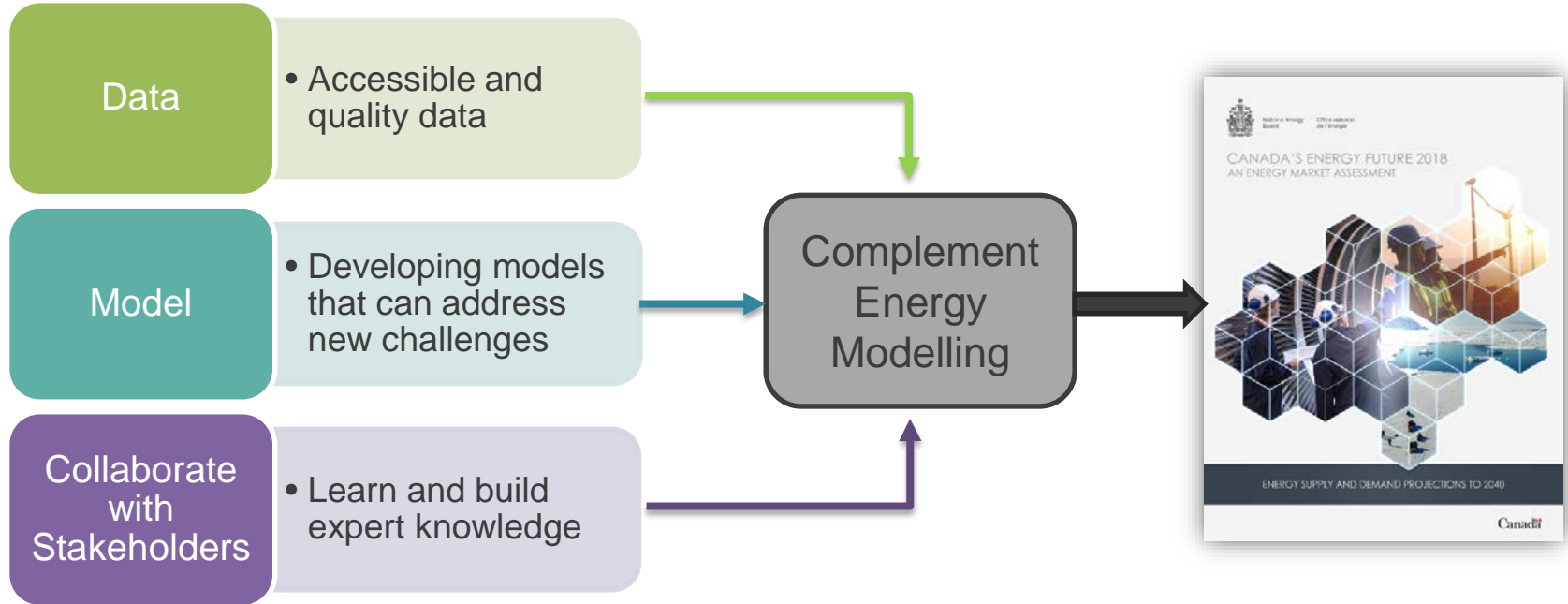
- Energy Demand and Electricity Model: ENERGY2020
- Hybrid model balancing bottom-up detail with top-down behavioural components
- Model also used by ECCC
- Detail for all 13 provinces and territories
- Four primary demand sectors: residential, commercial, industrial, transportation (all with detailed subsectors)
- Electricity production defined for utility and industry across numerous technologies



# Electricity Supply Modeling

- Historical electricity supply data is obtained primarily from Statistics Canada. Information on future electricity units is based on data produced by provincial utilities and electric system operators. The model also includes U.S. electricity supply data, which is based on the U.S. Energy Information Administration (EIA) Annual Energy Outlook.
- Each unit has its own parameters such as heat rate, capacity factor, and cost information (although cost info usually generic assumptions)
- In longer term and scenario analysis, capacity additions determined by economics, considering various constraints

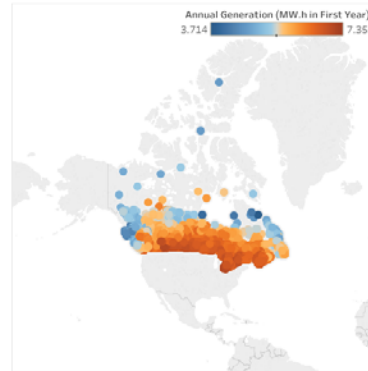
# Renewables Modeling Improvements



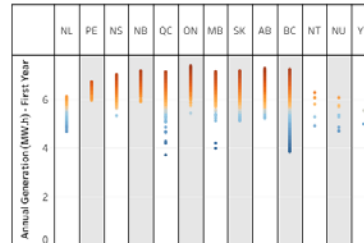
# The Economics of Solar Power in Canada

- Recent on-line only study/dashboard tool
- Looks at the solar resource for 20,000 communities in Canada
- Assesses the economics for residential, commercial, and utility scale projects at various cost levels (current, near future, low-cost future) and if there is time of use pricing available or not

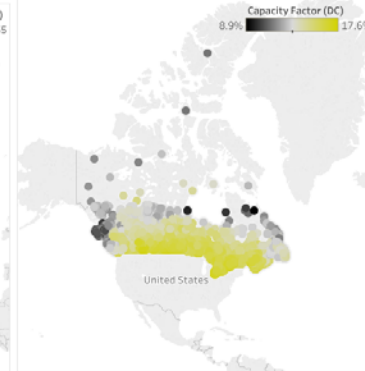
Map of Typical Solar Generation by Array Type



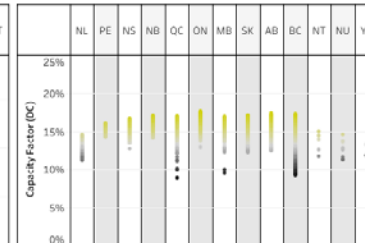
Annual Generation by Community and Province or Territory



Map of Capacity Factors



Capacity Factors by Community and Province Or Territory



**Array Type**

- Residential (5 kW)
- Commercial (200 kW)
- Community (200 kW)
- Utility Fixed (50 MW)
- Utility Tracker (50 MW)

**Geographical Name**

**Province - Territory**

- AB
- BC
- MB
- NB
- NL
- NS
- NT
- NU
- ON
- PE
- QC
- SK
- YT

# Other NEB Energy Information Products

## PROVINCIAL & TERRITORIAL ENERGY PROFILES



### Canada's pipeline system portal

The NEB is committed to increasing the amount of energy and pipeline information available to the public, and this new Pipeline Portal complements information already published by the NEB. This includes a recently launched interactive Pipeline Map, a regularly updated [Safety and Environmental Performance Dashboard](#), and detailed financial analysis of Canada's Pipeline Transportation System.

[Pipeline Profiles](#)



[Interactive Pipeline Map](#)



[Canada's Pipeline Transportation System 2016](#)

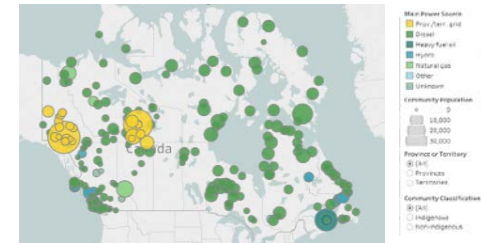


### Market Snapshots



Regular energy information updates illustrate emerging trends in various segments of the energy market. They provide topical energy information to Canadians.

### Feature Article: Overcoming the challenges of powering Canada's off-grid communities



# Modelling at Environment and Climate Change Canada

- Modelling: GHG emissions, air pollutants, energy sector
- Feeding into : emissions projections reports, cost benefit analysis for regulations, Canada's Mid Century Strategy, etc.
- Where possible the suite of models are used in complementary ways.

Used to:

- develop projections of energy and associated GHG emissions and air pollutants.
- conduct analysis to respond to key policy questions.





# Modelling at Environment and Climate Change Canada

## E3MC

- For energy and emissions reference case projections
- For policy and regulatory analysis

## EC-Pro

- To assess the impact of environmental policies on:
  - GDP, sector output, competitiveness
  - Employment, welfare

## EC-MSMR

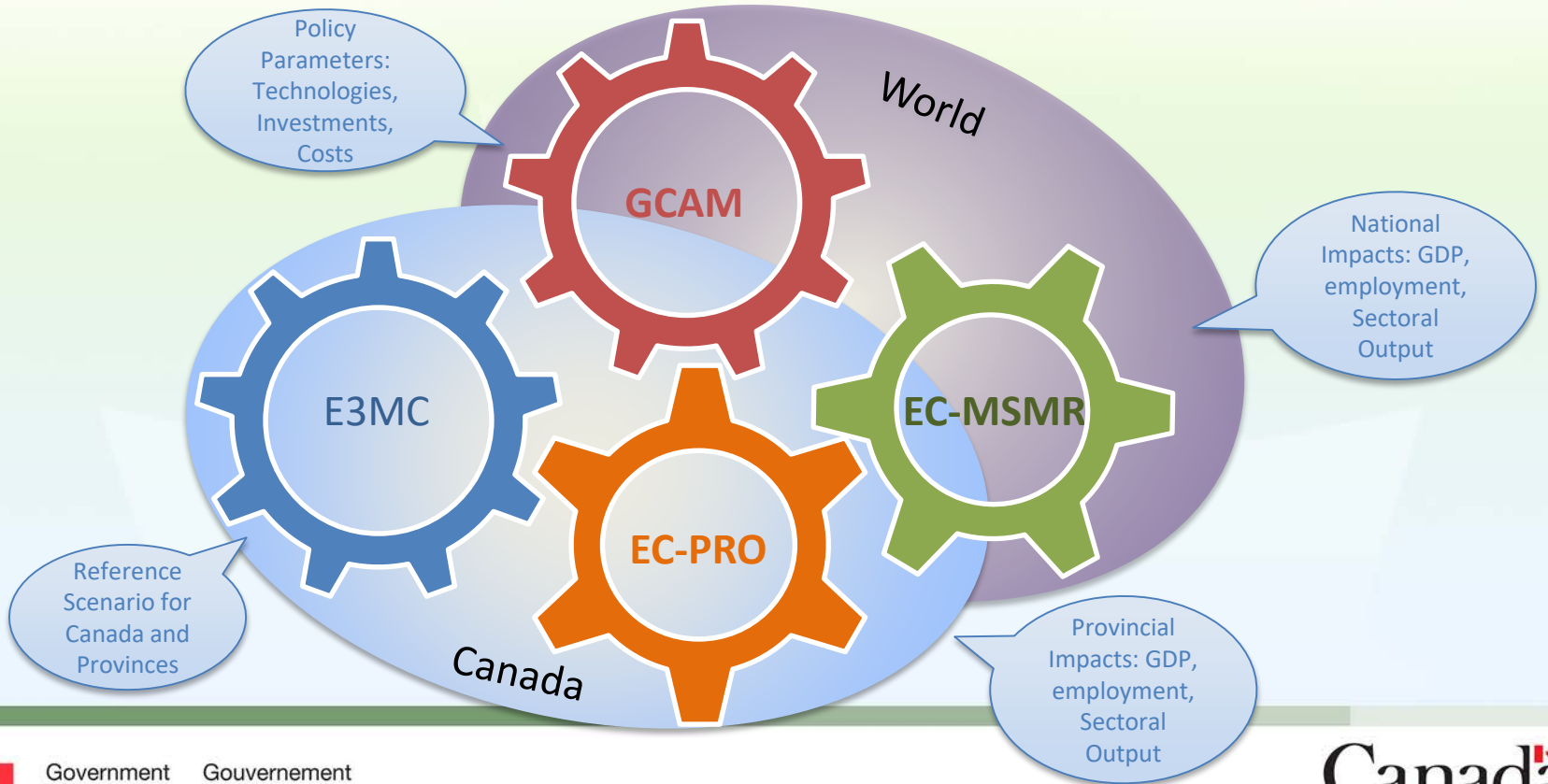
- For international impacts of policy options (Competitiveness, investment leakage)

## GCAM

- To assess longer-term policy issues related to changes in temperatures.



# Modelling for Canada's Mid-Century Strategy at ECCC



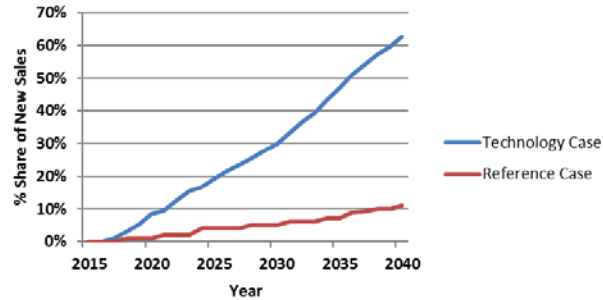
# Modeling Clean Technology in Canada's GHG Projections

- GHG projections sensitive to assumptions (oil & gas prices, GDP growth, technology)
- High interest in clean technology case to inform policy-making to meet 2030 target
- Canada's 2018 Emission Projections included a technology case with similar technological assumptions to the NEB's case.
- Technology case provides an indication of sensitivity of projections to faster technological progress

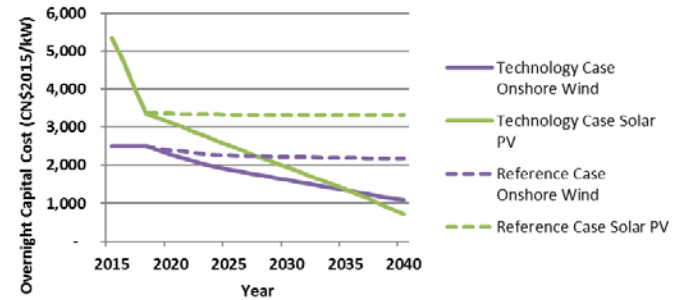


# Canada's 2018 Emission Projection Technology Assumptions

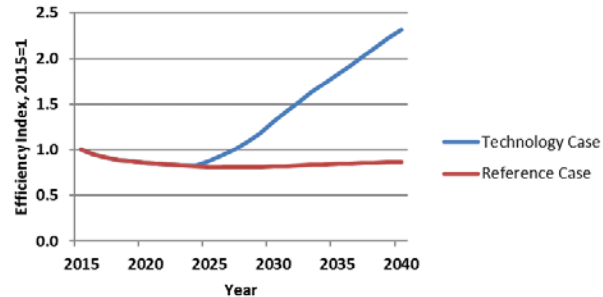
### % EVs in New Passenger Vehicles Sales



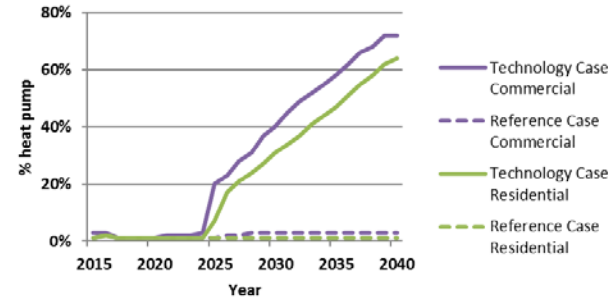
### Renewable Generation Capital Costs



### Avg SAGD Oil Sands Efficiency

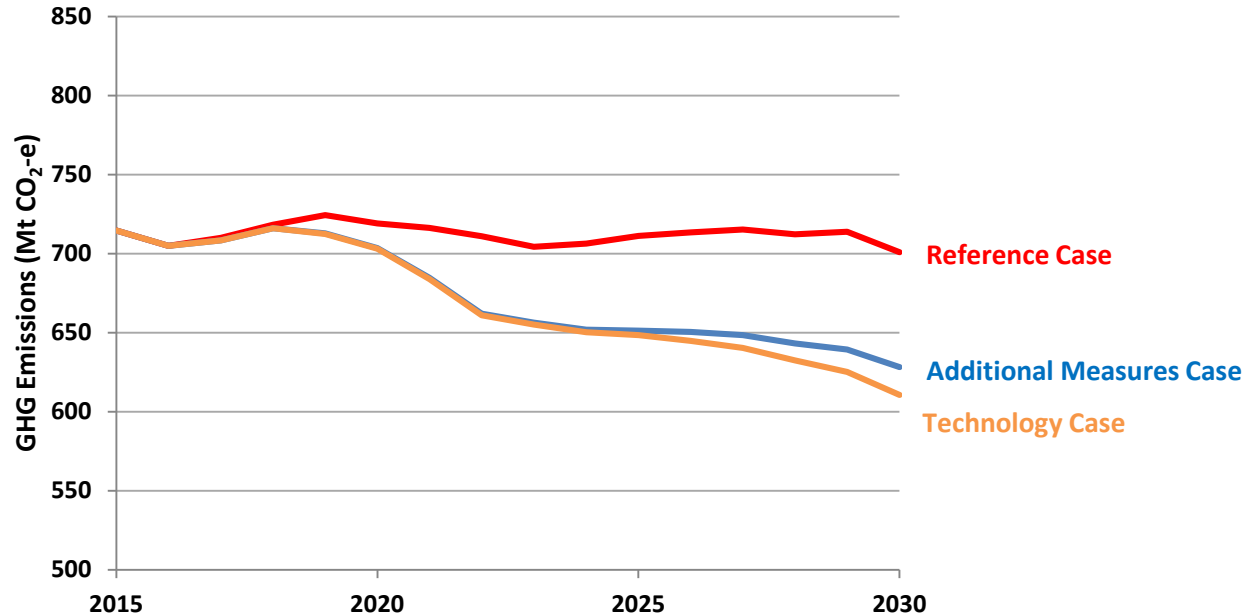


### % Heat Pumps in New Space Heating

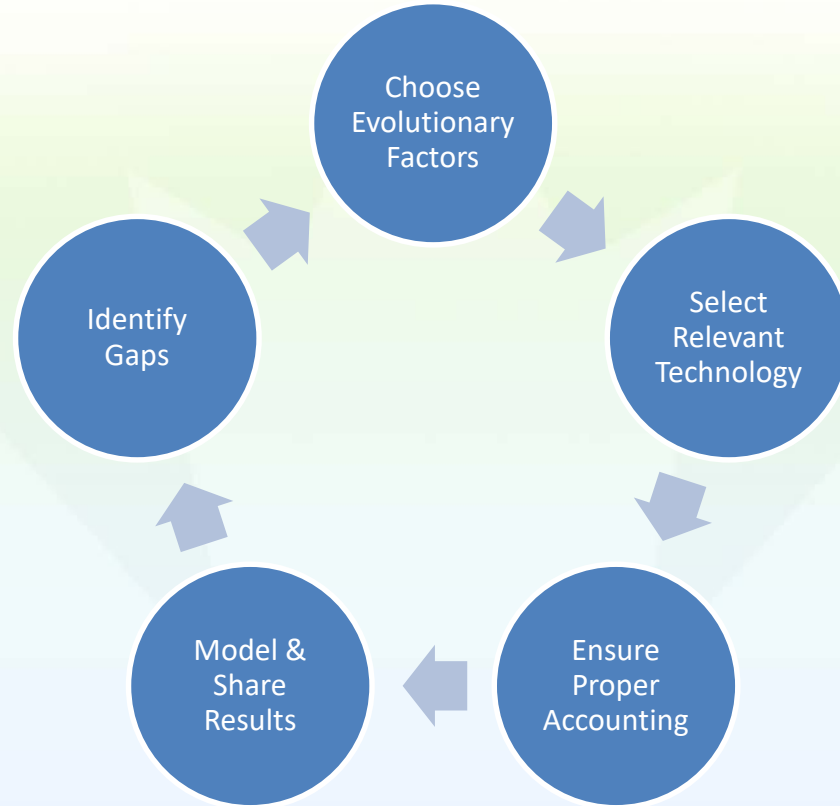


# Scenario Development

## Canada's 2018 GHG Projections



# Incorporation of Clean Technology



# Summary/Conclusions

- Canada's approach to modelling long-energy futures is a coordinated effort among the federal government family with NEB and ECCC playing an important role
- Using modelling tools to respond to hard energy/climate change policy questions is often challenging.
- Developing useful scenarios to inform those decisions is also challenging – impact of disruptive technologies, renewables cost and CCUS.
- Important to continue improving modelling tools to capture new development in technology, policy, behaviour etc.



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