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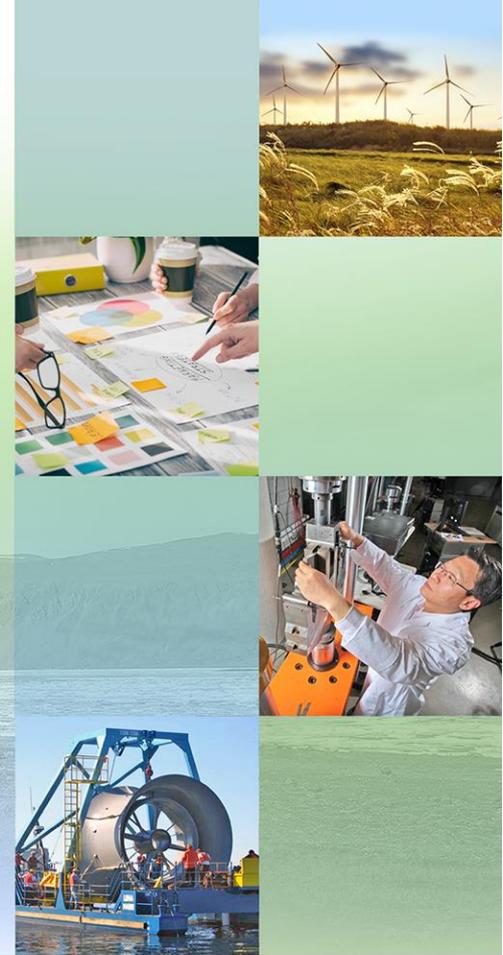
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# Overview of Canada's Clean Energy Framework

**Josef Ayoub and Anjali Wadhera**

*8<sup>th</sup> International Conference on Integration of Renewable  
and Distributed Energy Resources*

*October 16 – 19, 2018, Vienna, Austria*



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# Canada has a diverse energy portfolio

## Renewables

- 7<sup>th</sup> in wind power capacity
- 2.5 GW Solar PV



## Hydro

- 2<sup>nd</sup> largest hydro producer
- 63% of Canadian electricity

## Nuclear

- 2<sup>nd</sup> largest uranium producer
- Ownership of nuclear reactor technology (CANDU)



## Crude oil

- 5<sup>th</sup> largest producer
- 3<sup>rd</sup> largest proved reserves



## Natural gas

- 4<sup>th</sup> largest producer
- \$10.6B net exports

## Energy efficiency

- \$37B in energy costs saved in 2012
- GHG reductions equivalent to emissions of more than 27M cars



## Energy technology innovation

- \$3.3B invested in energy RD&D
- >50,000 employed in clean tech sector employs and is growing 4X faster than rest of economy

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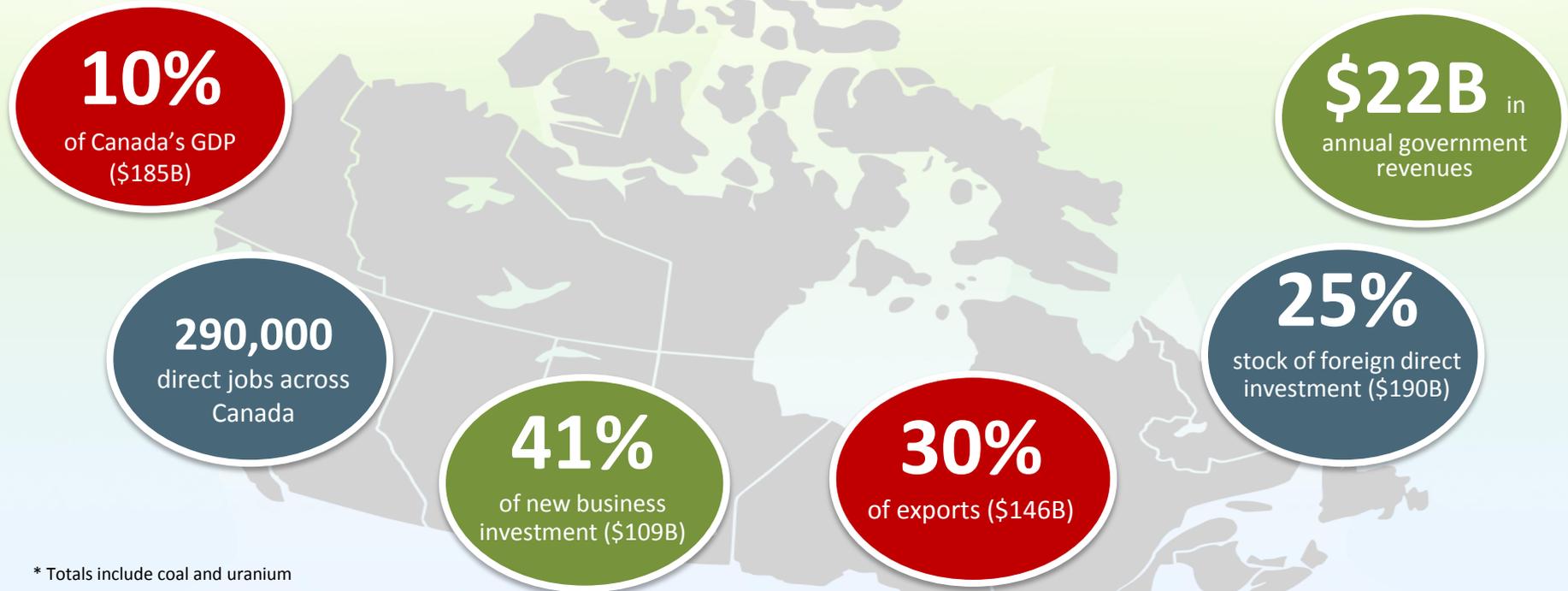


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# Energy is a significant source of economic activity in Canada



\* Totals include coal and uranium

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# Both federal and provincial governments have energy responsibilities

## FEDERAL

- International energy
- Interprovincial energy  
e.g. pipelines, transmission lines
- Trade and investment
- Nuclear energy and uranium
- Offshore, Nunavut and federal lands

## SHARED

- Environmental regulation of new energy projects, including Aboriginal consultation
- Scientific research & development
- Offshore petroleum in Atlantic Accord Areas
- Infrastructure security and resiliency
- Energy efficiency

## PROVINCIAL

- Regulation of natural resources development on provincial lands
- Land-use and project planning
- Royalty design and collection
- Intra-provincial energy resources infrastructure, distribution, storage

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*The federal government and Natural Resources Canada (NRCan) are committed to transformative and innovative clean-growth partnerships that bolster Canada's productivity and competitiveness.*

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## Federal Policy Landscape

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# Top-down engagement

## *Action Items to reducing emissions in the electricity sector*

- 1) Peoples and northern and remote communities Increasing the amount of electricity generated from renewable and low-emitting resources
- 2) Connecting clean power with places that need it
- 3) Modernizing electricity systems
- 4) Reducing reliance on diesel working with Indigenous Peoples
  - Commitment to accelerating and intensifying efforts to demonstrate and install hybrid or renewable energy systems
  - Partnership with Indigenous Peoples and businesses
  - Significant benefits for communities
  - Improve air quality and energy security
  - Creating the potential for locally owned and sourced power generation.

## PAN-CANADIAN FRAMEWORK



## on Clean Growth and Climate Change

Canada's Plan to Address Climate  
Change and Grow the Economy

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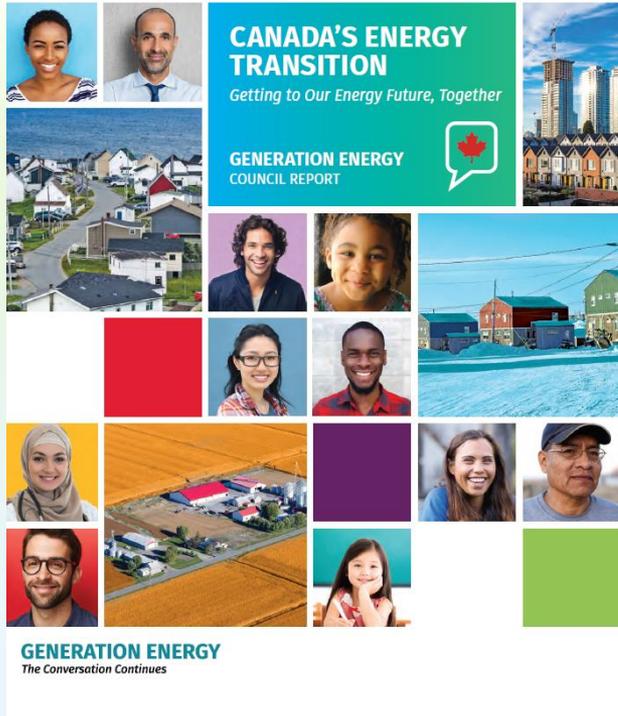


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# Generation Energy



## Bottom-up engagement

Beginning on April 21, 2017, over 380,000 people joined a national dialogue on Canada's energy future to find out how Canadians want to meet Canada's climate goals, create jobs and keep energy affordable.



**175**  
Days



**339,270**  
Online  
Engagements



**61**  
Engagement  
Sessions



**31,500**  
Social  
Interactions



**648**  
Forum  
Attendees



# The Council has identified four pathways that collectively will lead to the affordable, sustainable energy future



WASTE  
LESS  
ENERGY



CLEAN  
POWER



RENEWABLE  
FUELS



CLEANER  
OIL & GAS

- One-third of Canada's Paris emissions commitment could be achieved by improving energy efficiency.
- Complete the transformation to a nearly carbon-free electricity grid by switching more of Canada's heating systems, transportation and industrial processes to electricity - "clean electrification."
- Reduce the impact of liquid and gas fuels in transportation, heating and cooling, and some industrial processes by expanding Canada's capacity to produce and use cleaner fuels — biofuels and biogas from plants and waste with much less carbon footprint.
- Cutting both costs and greenhouse gas emissions by improving efficiency, using clean power and cleaner fuels, and introducing new technologies to capture and store carbon emissions.

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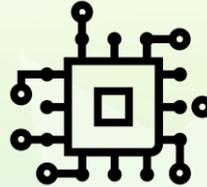
# Policy Supporting the Power System of Tomorrow: reliable, resilient, affordable, efficient and non-emitting



## Low-carbon

Non-emitting electricity generation like wind and solar have a greater share of the supply mix, supported by various types of energy storage.

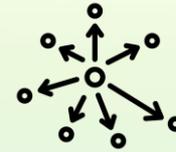
Affordably integrating intermittent renewables into the system is a challenge, as is their variability.



## Digitalised

Numerous sensors collect data at key points of the grid via a robust information-communication infrastructure for machine assisted system optimization.

Cyber security and data privacy are top of mind.



## Decentralised

Various and numerous energy assets like solar photovoltaics, electric vehicles, energy storage, wind turbines, are dispersed along the grid. Energy and information flows are no longer unidirectional.

Market structures will be challenged as the grid topology evolves.

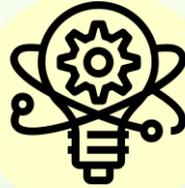
# Funding to advance policy: NRCan's Flagship Initiatives

## Driving Innovative Electricity Sector Partnerships



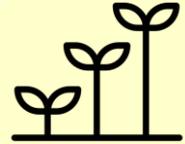
### Green Infrastructure Programs

- \$822M from 2018-2023 for five streams
- Building a cleaner and better connected electricity system, and supporting the demonstration and deployment of renewable energy technologies.
  - Smart Grids - \$100M
  - Clean Energy for Rural and Remote Communities - \$220M
  - Electric Vehicle Infrastructure Demonstration & Deployment - \$120M
  - Emerging Renewable Power - \$200M
  - Energy Efficient Buildings - \$182M



### Green Infrastructure Programs

- \$53M per year
- Supporting energy technology innovation through research, development and demonstration of clean and efficient energy production and use.



### Clean Growth in Natural Resources Sectors Program

- \$155M from 2018 to 2022 for clean technology research, development, and demonstration projects in energy, mining, and forestry.
- Advancing emerging clean technologies toward commercial readiness.

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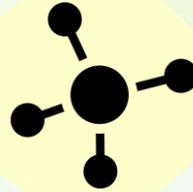
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# Flagship Initiatives Driving Innovative Electricity Sector Partnerships



## CanmetENERGY Research Labs

- CanmetENERGY is Canada's leading research and technology organization in the field of clean energy.
- The four laboratories are located in Alberta, Ontario, and Quebec.
- Areas of specialization include renewables, building energy efficiency, transportation, energy storage, and smart grids.



## Clean Growth Hub – NRCan & ISED

- The Clean Growth Hub is the government's focal point for clean technology.
- The Hub helps companies and researchers pursuing clean technology projects identify the federal programs and supports most relevant to their needs.

<https://www.ic.gc.ca/eic/site/099.nsf/eng/home>

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# Provincial and Territorial Policy Landscape

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# Provincial Policy Landscape – Key Highlights

- **British Columbia: Energy Plan**
  - Reach 100% self-sufficient electricity supply, 90% of this supply from renewable, clean energy resources
  - Initiatives in EV infrastructure & clean energy projects
- **Alberta: Climate Leadership Plan**
  - Support 5 GW of renewable energy to replace fossil fuels to meet targets for 30% renewable energy generation by 2030
  - 2 more rounds of RE procurement by end of 2018
  - Lowest RE pricing in Canada for Round 1 in 2017 where 600 MW wind contracted at 0.037 CAD/kWh
- **Quebec: 2030 Energy Policy Action Plan**
  - Increase overall renewable energy output by 25% and enhance energy efficiency by 15%
  - Reduce the amount of petroleum products consumed by 40% and eliminate the use of thermal coal
  - Support clean transportation with the plan of a DC fast charging network and adoption of a Zero Emissions Vehicle (ZEV) standard for manufacturers to sell/lease an increased percentage of ZEVs
- **New Brunswick: Climate Change Action Plan**
  - Committed to reduce GHG emissions
- **Nova Scotia: Electricity Plan 2015-2040**
  - Approval for \$133 M province-wide smart meter roll out

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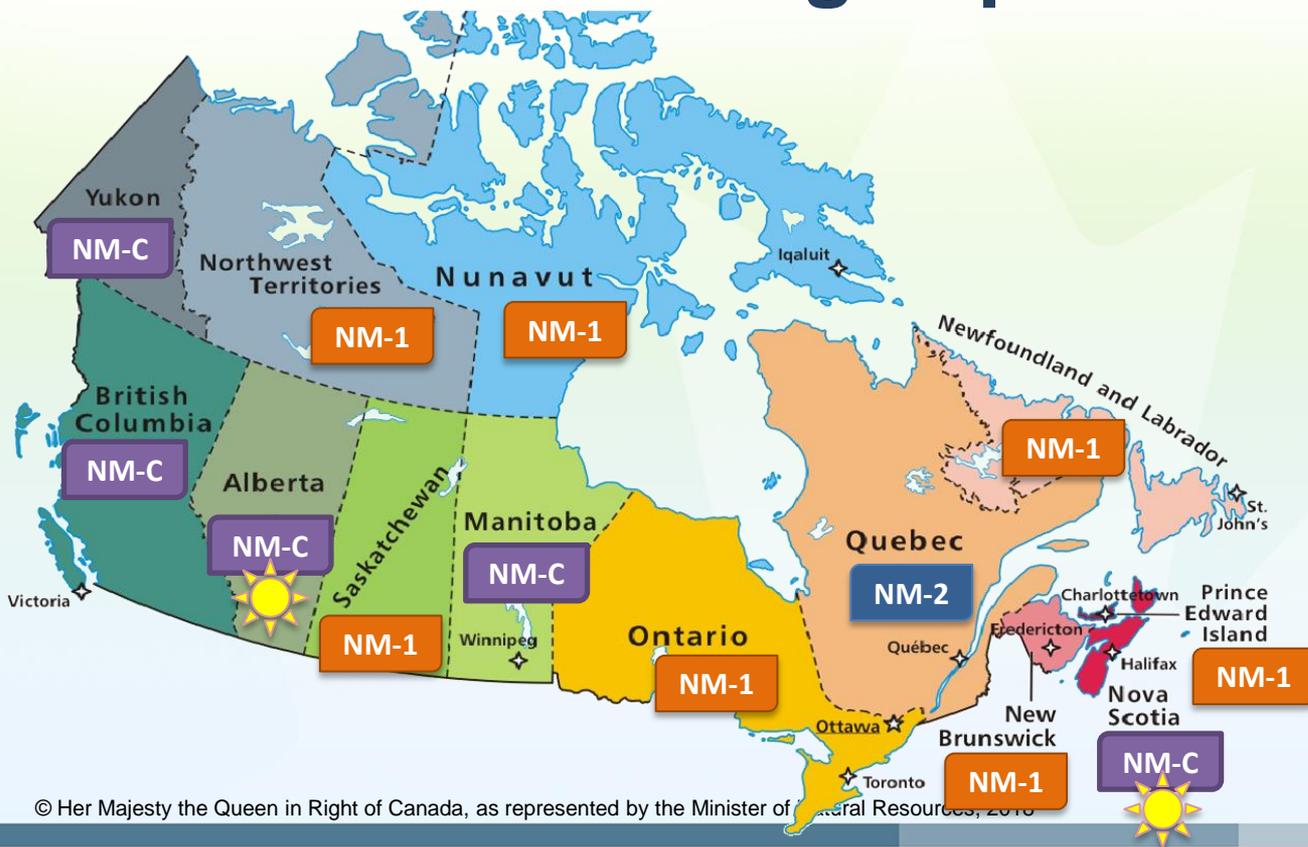
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# Territorial Policy Landscape – Key Highlights

- **Yukon Territories: 2020 Energy Strategy**
  - Micro-generation policy provides opportunities for locally-generated and renewably-sourced electricity.
- **Northwest Territories: 2030 Energy Strategy**
  - Reduce GHG from road vehicles and electricity generation .
- **Nunavut:**
  - Launched Net Metering Program to allow customers to add renewable energy systems up to 10 kW.



# Net Metering Implementations



NM-1

Net metering over 1 year, then surplus is lost

NM-2

Net metering over 2 years, then surplus is lost

NM-C

Net metering over 1 year, then credit applied



Virtual net metering

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## SOLAR PV

**2.10 GW<sub>AC</sub>**  
distributed out of  
**2.48 GW<sub>AC</sub>**  
installed grid-connected capacity

Data as of December 31, 2017



## WIND

**0.96 GW<sub>AC</sub>**  
distributed\* out of  
**12.70 GW<sub>AC</sub>**  
installed capacity

Data as of July 1, 2018



## EV

**72.8 k**  
BEVs and PHEVs  
on road

**>850**  
Level 3  
charging outlets

**>5.8 k**  
Level 2  
charging outlets

Data as of July 31, 2018

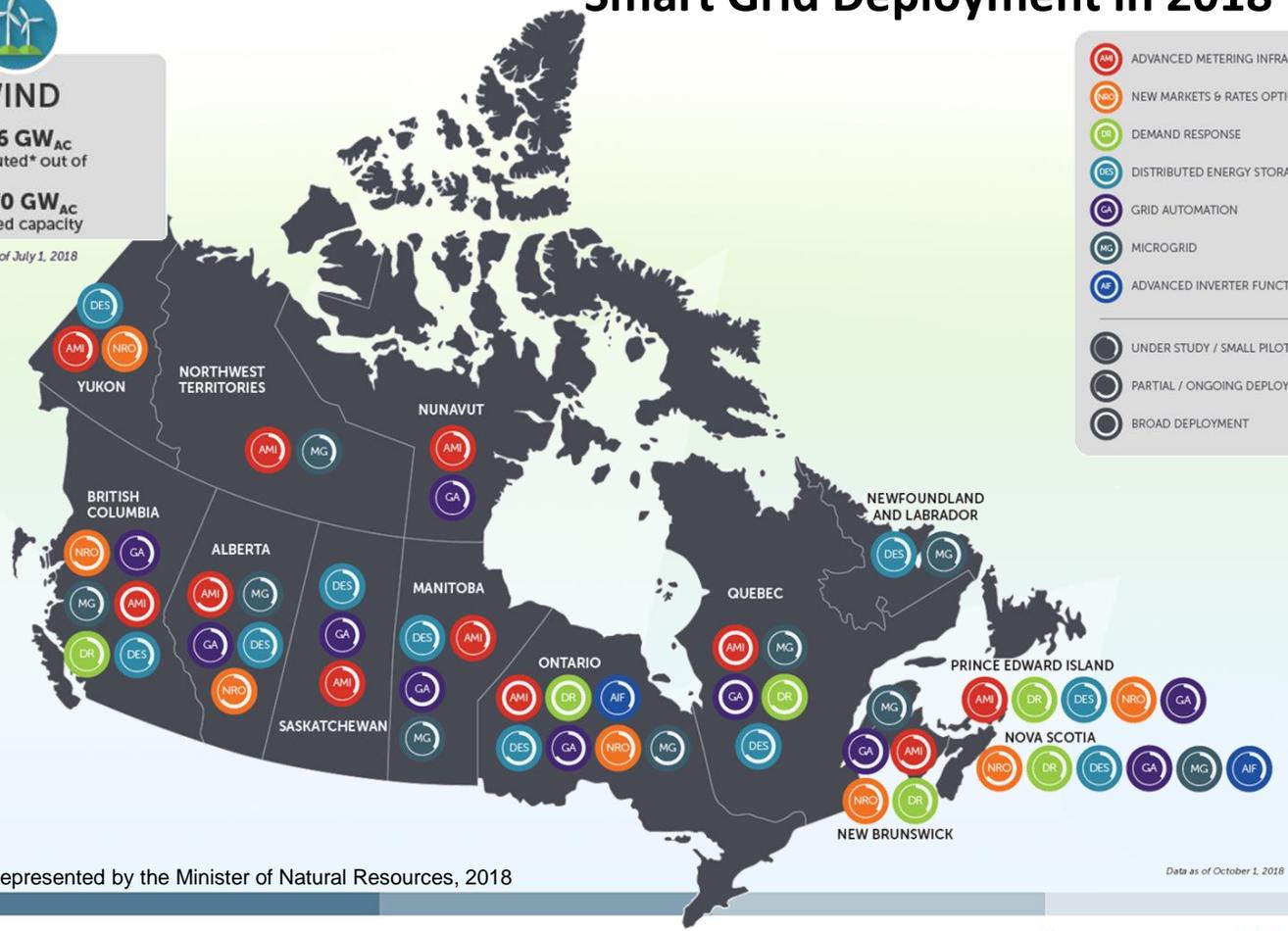


## SMART METER

**>81%**  
of meters are smart

Data as of August 17, 2018

- ADVANCED METERING INFRASTRUCTURE
  - NEW MARKETS & RATES OPTIONS
  - DEMAND RESPONSE
  - DISTRIBUTED ENERGY STORAGE
  - GRID AUTOMATION
  - MICROGRID
  - ADVANCED INVERTER FUNCTION
- 
- UNDER STUDY / SMALL PILOTS
  - PARTIAL / ONGOING DEPLOYMENT
  - BROAD DEPLOYMENT



Data as of October 1, 2018



# For follow-up...



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