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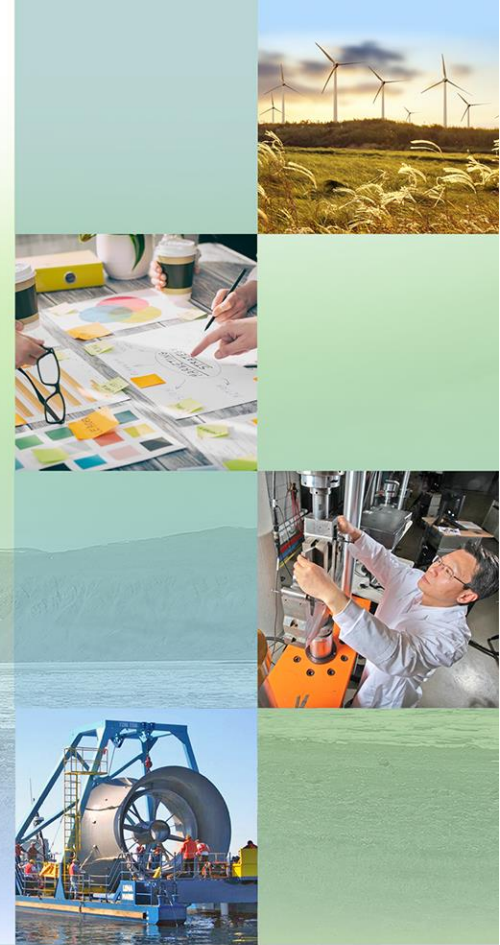
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# Recent Developments in Smart Grid Investments in Canada

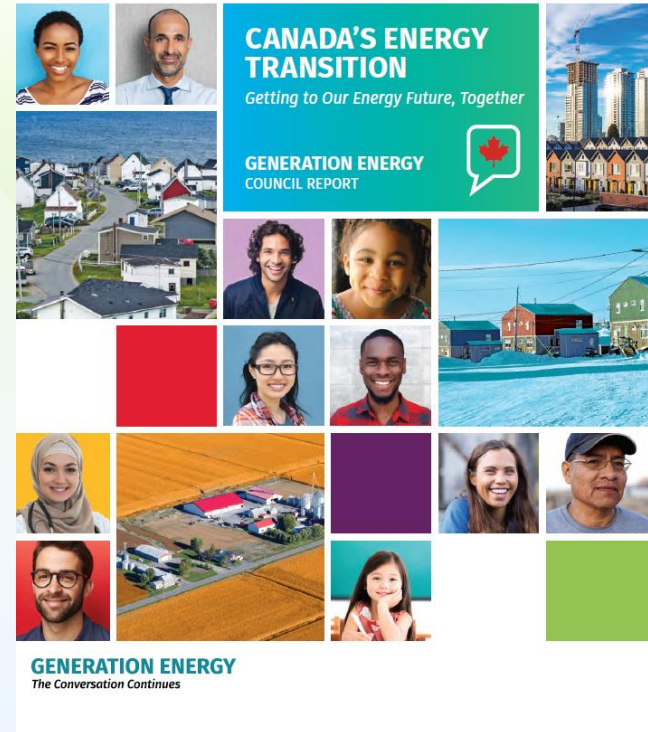
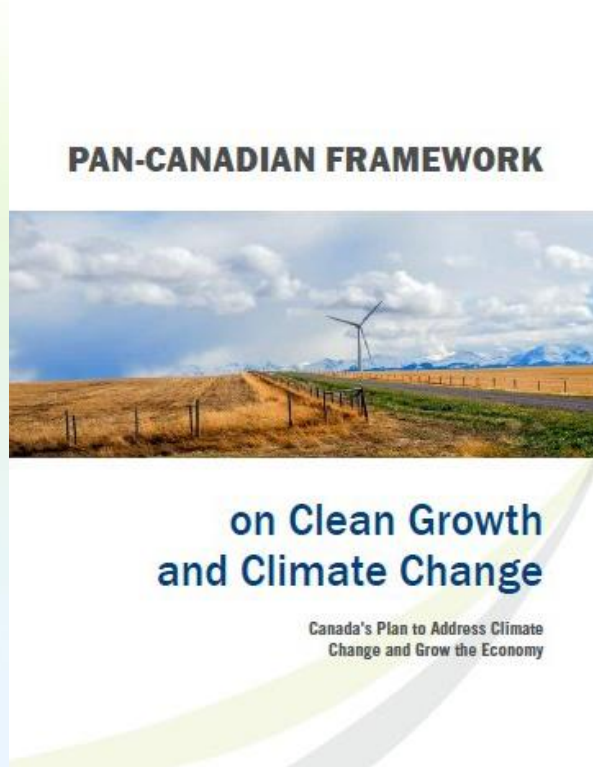
**Josef Ayoub and Anjali Wadhwa**

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

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



# Framework for Support Mechanisms



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The electricity sector is key to meeting Canada's target of reducing GHGs by 30% from 2005 levels by 2030

Put Canada on a path to move from 80 % towards 90 % non-emitting sources by 2030

Reduce emissions from electricity generation

Currently 11 % of total emissions

Secure emissions reductions through efficiency and electrification of other sectors

## Action

Create an incentive for use of non-emitting electricity

Regulation:  
Pricing carbon pollution starting in 2018 at \$10/tonne, rising to \$50/tonne in 2020 (ECCC)

1. Low-Carbon Energy Supply
2. Power Systems Infrastructure
3. Grid Modernization
4. Remote Electricity Supply + Demand
5. Transportation Demand
6. Buildings & Communities Demand



# Budget 2017 Funded Programs

## Electricity | Transportation | Buildings

### (1) Emerging renewables deployment (\$200M)

*e.g. offshore wind, geothermal, tidal*

### (2) Smart grids (\$100M)

*e.g. micro-grids, grid monitoring and automation, data management and automation, and distributed energy resource management*

### (2) Reducing reliance on diesel use in off-grid, northern, and remote communities (\$220M)

Demonstrations and deployments of renewable energy for electricity and heat

*e.g. solar and wind, bioenergy, community capacity building*

### (4) Northern REACHE (\$54M)

For proven renewable energy technology projects in diesel-reliant off-grid Indigenous and northern communities

*e.g. solar, wind, energy storage, hydro, biomass heating, residual heat recovery and LED lighting*

### (5) Arctic Energy Fund (\$400M)

Energy security for communities north of 60°, delivered through IBAs with PTs

*e.g. diesel generator refurbishment*

### (7) Impact Canada—Clean Technology Stream (\$75M)

Support for innovative approaches to solving tough challenges in clean technology.

*e.g. prizes, challenges*

### (8) Electric vehicles and alternative fuel infrastructure (\$120M)

To deploy electric vehicle and alternative fuel (natural gas, hydrogen) infrastructure + demonstrate next-gen charging technology

### (9) Energy efficient buildings (\$182M)

Includes co-funding opportunities for RD&D, construction and retrofit practices, and recommissioning



# Green Infrastructure Phase II: Smart Grid Projects and other NRCan Programs

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	Project types	Recipient Types	Smart Grid Scope Considerations	Other requirements
<a href="#">Smart Grid Program</a>	Demo, Deploy, Hybrid	Utilities, system operators	Grid benefits, grid integrated or microgrid	
<a href="#">Clean Energy for Rural &amp; Remote Communities</a>	Demo, Deploy, Hybrid	Any in Canada	Reduction of diesel use for heat & power in remote communities and/or industrial sites, as well as bioheat for rural locations.	Preference for Indigenous-led and/or supported projects; minimum RE generation requirements for deployment
<a href="#">Clean Growth</a>	R&D, FEED, Demo, up to first commercial installations	Any in Canada	Call is tech agnostic; Must reduce impact on air, land, water; Eligible SG tech includes: new generation tech, storage; alternative fuels	Requires funding from Province / Territory; Must benefit mining, energy or forestry sectors; TRL levels 3-9
<a href="#">Emerging Renewable Power Program</a>	Deploy	Any in Canada	Utility-scale renewable generation	Commercial tech not yet in Canada; Demonstrated but not deployed
<a href="#">Electric Vehicle Infrastructure</a>	Demo	Any in Canada	Grid management of EV charging infrastructure	
<a href="#">Electric Vehicle and Alternative Fuel Infrastructure</a>	Deploy	Any in Canada	EV fast chargers	Applicant must be engaged with the relevant energy supplier
<a href="#">Energy Efficient Buildings</a>	R&D, Demo	Any in Canada	Behind the meter technology	

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# GI Phase II: Smart Grid Deployment & Demonstration Program

## \$100 million for smart grid deployment and demonstration projects

- 4 year program starting 2018/2019
- **\$35 M: Demonstration projects** are higher risk, and may be implemented on a trial basis for the purposes of **proving innovative technologies** or concepts
- **\$65 M: Deployment projects** are typically implemented on a wider scale, on a more permanent basis, with funding aiming to **close a market gap**

## Technology Readiness Levels

DEPLOYMENT

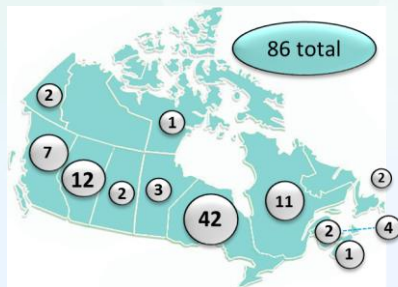
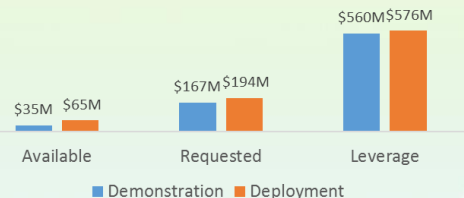
- Level 9: Actual technology proven through successful deployment in an operational setting.
- Level 8: Actual technology completed and qualified through tests and demonstrations.

DEMONSTRATION

- Level 7: Prototype ready for demonstration in an appropriate operational environment.
- Level 6: System/subsystem model or prototype demonstration in a simulated environment.
- Level 5: Component and/or validation in a simulated environment.
- Level 4: Component and/or validation in a laboratory environment.
- Level 3: Analytical and experimental critical function and/or proof of concept.
- Level 2: Technology concept and/or application formulated.
- Level 1: Basic principles of concept are observed and reported.

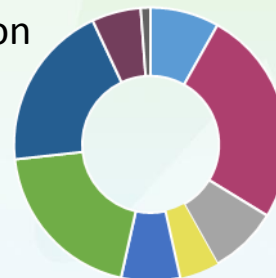


# GI Phase 2: Smart Grid Demonstration & Deployment Proposal Evaluation



\$100M/4 years for demonstrations and deployments of key, low carbon enabling smart grid technologies that target:

- GHG reductions
- Job creation (especially for women)
- Improved cybersecurity



- Data management and communication
- Distributed Energy Resource Management Systems
- Energy storage
- EV integration
- Generation (out of scope)
- Grid monitoring and automation
- Microgrid grid-connected
- Microgrid off-grid
- Renewable Integration

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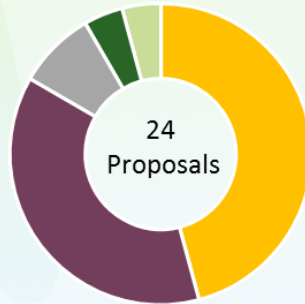
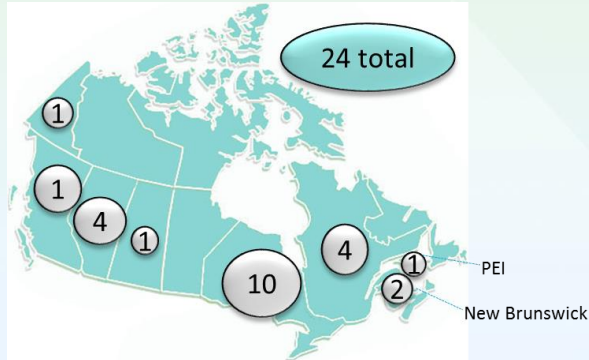
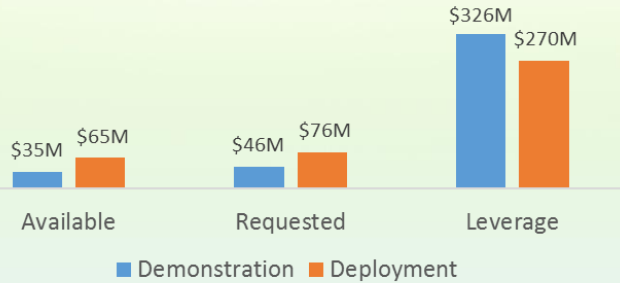


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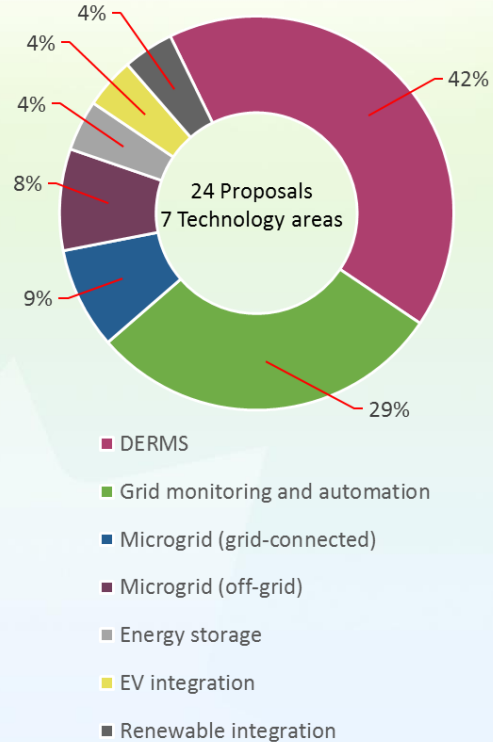
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# Smart Grid Demonstration & Deployment Selected Projects



- Utility (public) (9)
- Utility (private) (1)
- System Operator (1)
- Distribution (public) (11)
- Distribution (private) (2)



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# Integrating Distributed Generation into Secondary Networks in Large Urban Centres

**Lead Proponent:** ENMAX Power Corporation  
**Location:** Calgary, Alberta  
**SG Contribution:** \$ 1.426 Million  
**Project Total:** \$ 2.852 Million  
**Strategic Area:** Smart Grid technology  
**Project Partners:** Alberta Smart Grid Consortium.

## Project Summary and Objectives

- In the City of Calgary, generators are not allowed to export energy onto secondary or spot networks.
- Using a combination of advanced monitoring and controls as well as protective relay configuration changes that allow for export, the proposed project will demonstrate how solar PV can be safely integrated into secondary and spot networks.



<https://www.enmax.com/home>

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# Smart Grid Investments in Canada



**\$696M**  
TOTAL PROJECT VALUE



**\$241M**  
PUBLICLY INVESTED



**124**  
PROJECTS

- STORAGE
- MICROGRID
- GRID MONITORING AND AUTOMATION
- EV INTEGRATION
- DISTRIBUTED ENERGY RESOURCE MANAGEMENT
- DEMAND MANAGEMENT
- CUSTOMER ENABLING



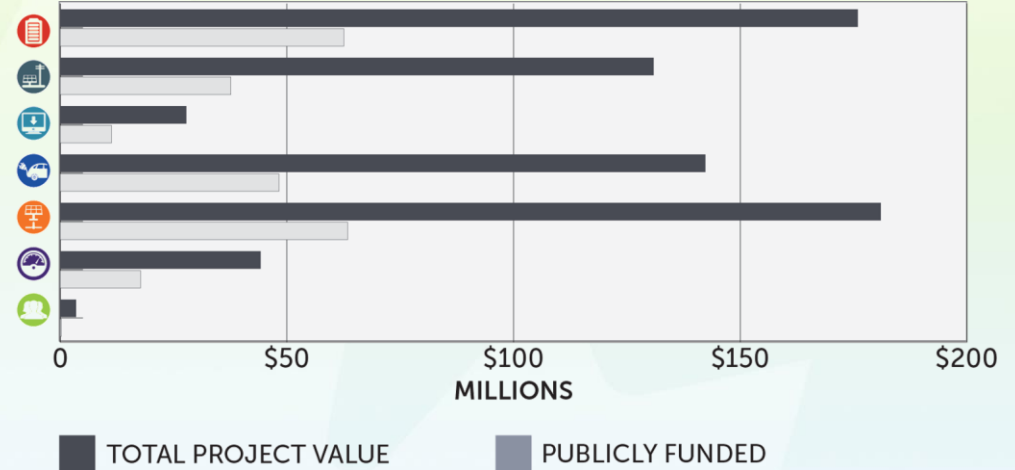
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Data as of October 1, 2018

1. Infographic does not include academic funded networks  
 2. The Ministry of Natural Resources Canada Smart Grid Fund is not included due to commercial sensitivity.



# Public Investment Details



Data as of October 1, 2018

1. Infographic does not include academic funded networks.
2. The Ministry of Ontario Energy, Northern Development and Mines Smart Grid Fund is not included due to commercial sensitivity.

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# Varenes SmartZone



Within the Varenes smart zone, there are thousands of monitoring and control points on the grid. AI will process this data, issuing commands to grid assets and negotiating with customer loads to better manage the grid.

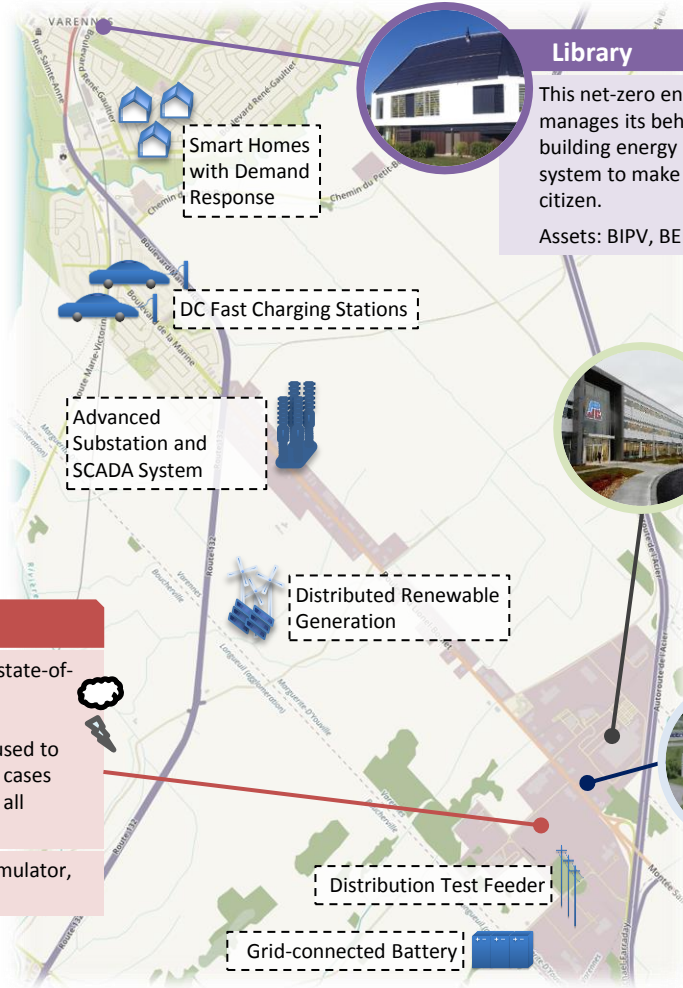
Benefits: Capital investment deferral, reduced grid energy losses, improved renewable utilization



## IREQ (Laboratory)

IREQ's selection of various state-of-the-art equipment is assessed to see what it can offer to the grid. AI is used to develop the numerous test cases required to ensure value in all feasible grid conditions.

Assets: Battery, EVs, grid simulator, solar PV/T, etc.



## Library

This net-zero energy building manages its behaviour through a building energy management system to make it a good grid citizen.

Assets: BIPV, BEMS



## Commercial Enterprises

AI minimizes energy demand charges while managing the needs of the businesses, e.g., complex inventory management systems

Assets: HVAC, flexible loads



## CanmetENERGY

AI, integrated into the building's energy management system, operates generation, load, and storage to maximize renewable energy use, minimize energy costs, and maintain occupant comfort.

Assets: Controllable generation (PV) and loads (HVAC, EVs, and ice bank)



# For follow-up...



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