



NATURAL RESOURCES CANADA - INVENTIVE BY NATURE

Microgrids in Canada Overview

Alexandre Prieur

International Microgrids Symposium
Aalborg, Denmark
August 28-29, 2015



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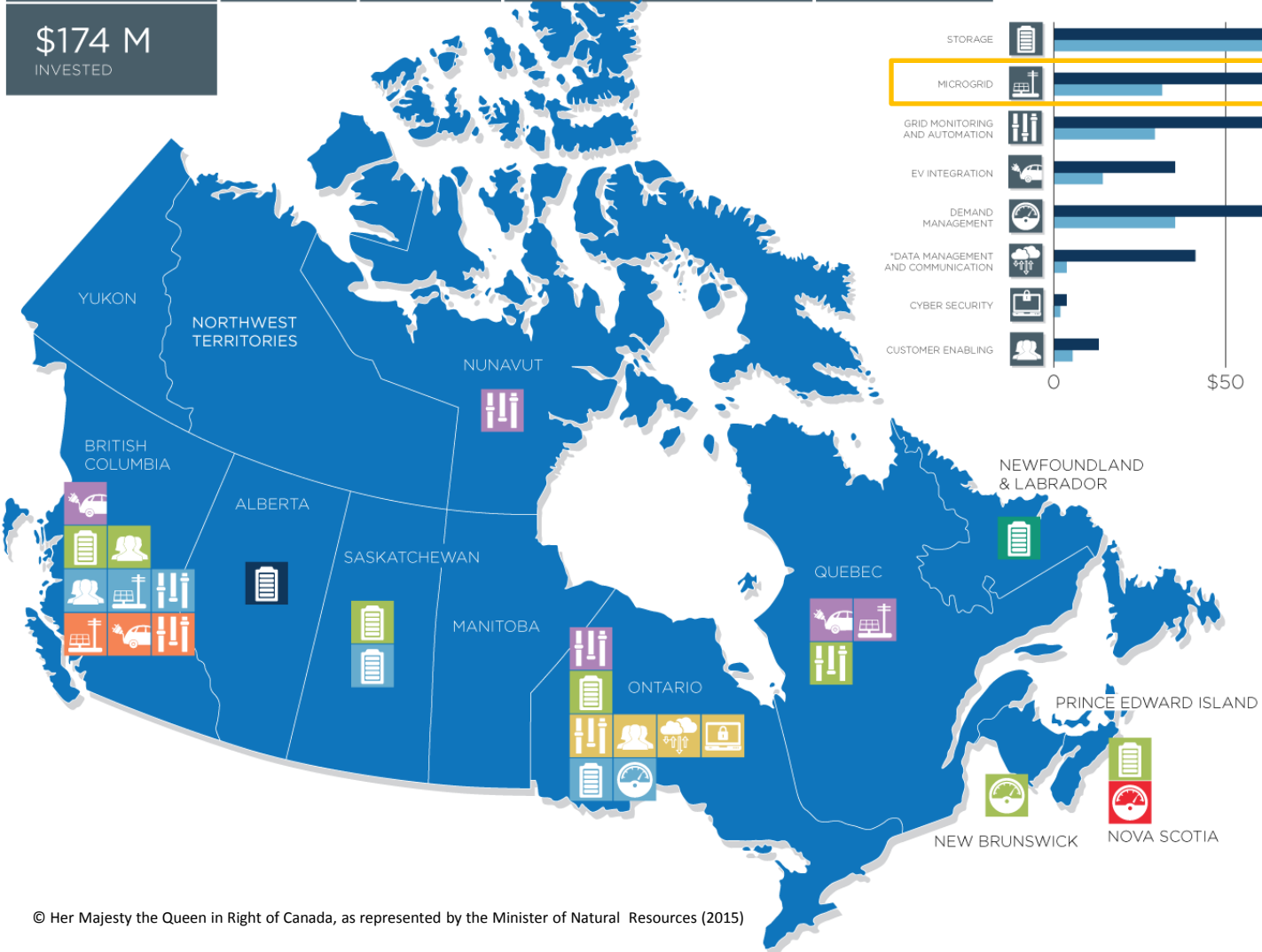
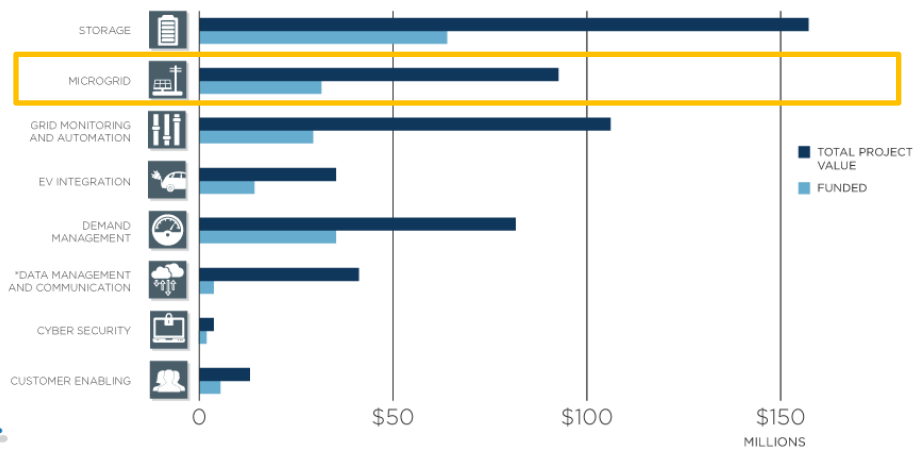
PUBLICLY FUNDED SMART GRID DEMONSTRATIONS AND PILOTS IN CANADA

Microgrid projects investment ranking : 3rd highest

\$535 M IN DEMO PROJECTS	72 PROJECTS	45 COMPANIES	15 UTILITIES	2 INSTITUTIONS	1 FIRST NATIONS
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\$174 M
INVESTED

SMART GRID PROJECT VALUE BY TECHNOLOGY AREA 2005 - 2014



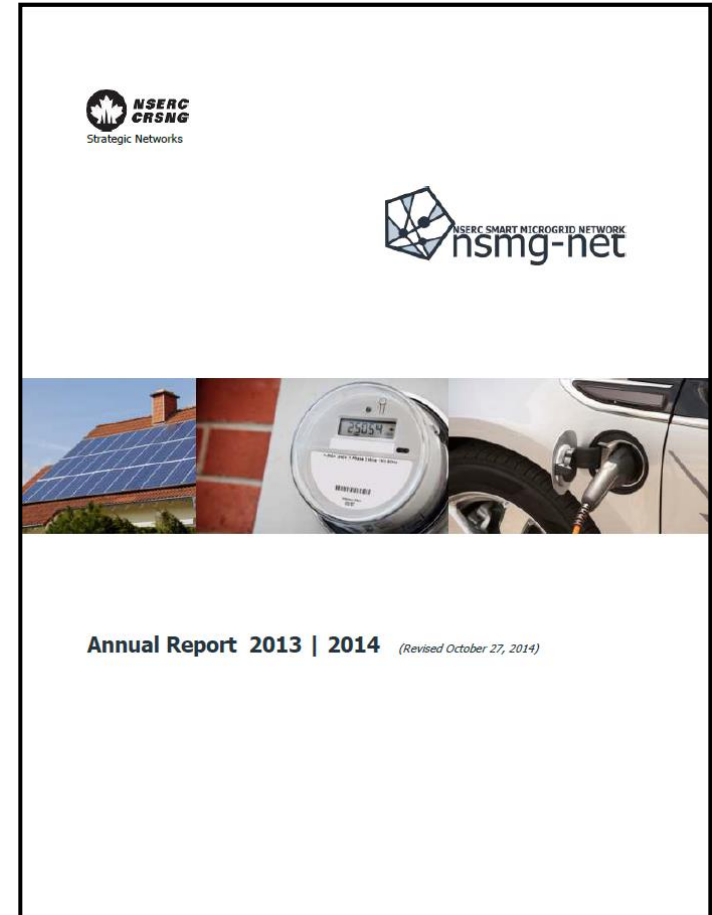
- ecoEII NRCan - ecoEnergy Innovation Initiative
- CEF NRCan - Clean Energy Fund
- SDTC Sustainable Development Technology Canada - SD Tech Fund
- GMF Federation of Canadian Municipalities - Green Municipal Fund
- ICE BC - Innovative Clean Energy Fund
- CCEMC Alberta - Climate Change Emissions Management Corporation
- SGF Ontario Smart Grid Fund
- AIF Atlantic Innovation Fund

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Canadian Smart Microgrid Research Network (2010-2015)

- 12 research projects - Trained over 80 graduate students over 5 years
- Theme 1: Microgrid Operation and Control (Prof. Iravani, U. Toronto)
- Theme 2: Microgrid Planning, Optimization and Regulatory Issues (Prof. Joos, U. McGill)
- Theme 3: Communication and information Technologies (Prof. Meng, U. New Brunswick)

→ Invitation: 2015 SmartGrid Canada Meeting Markham, Ontario, October 5-7.



Source: Annual Report Canadian Microgrid Research Network

<http://www.smart-microgrid.ca/wp-content/uploads/2011/08/NSMG-Net-Annual-Report-2014-public.pdf>



Microgrid Technology 2015 Forum

Challenges & Opportunities

Ontario Smart Grid Forum – Industry led initiatives

New Ontario Microgrid Project approved:

- **CANADIAN SOLAR INC, Guelph Ontario**
Microgrid test facility - integrating renewable energy resources at high levels of penetration in both off-grid (remote) and grid-tied remote Ontario environments.
- **eCAMION, Woodstock Ontario**
Sixteen residential and commercial loads will be supported by a microgrid to test smart metering technology, energy storage, renewable distributed generation and electric vehicles.
- **Panasonic Eco Solutions Canada**
'Grid-tied' microgrid at The University of Ontario Institute of Technology (UOIT) campus in Oshawa, designed to operate as backup power during a utility power outage and provide seamless disconnection and reconnection from the main grid.



Source: <http://www.marsdd.com/wp-content/uploads/2015/07/MaRS-AEC-Microgrids-Today-Outcomes-Report.pdf>



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Renewable Energy Microgrid Testing Centre

- Address problems associated with remote and islanded Microgrids, including high and continually increasing diesel cost, low efficiency, low power security and environmental risks associated with the use of diesel.

\$2,934,000 funded
- Canadian Solar Inc.
- University of Waterloo
- NCC Development LP
- Kinectrics Inc
- Electrovaya Inc
- Guelph Hydro Inc
- Hydro One Remote Communities Inc

<http://www.energy.gov.on.ca/en/smart-grid-fund/smart-grid-fund-projects/canadian-solar/>



Microgrid Research and Innovation Park – UOIT

Develop and demonstrate a functioning 'grid-tied' microgrid

- 500kW Lithium ion (Li-ion) battery energy storage system,
- Inverter system,
- 50kW solar PV generation,
- Microgrid controller/optimizer,
- 1.6MW diesel
- 2.4MW Combined Heat and Power (CHP) generation plants

\$3,829,000 funded

- Panasonic Eco Solutions Canada, Inc.
- GE Digital Energy
- UOIT Faculty of Engineering and Applied Sciences
- OPUC
- Hydro One

Completion of construction Nov 2015
Commissioning plan for March 2016

<http://www.energy.gov.on.ca/en/smart-grid-fund/smart-grid-fund-projects/panasonic-eco-solutions-canada/>



Woodstock Whites Lane Smart MicroGRID for Utility and Residential Application

- Introducing various emerging smart grid technologies into the realm of a typical 120/240 volt distribution network
- Concept of PowerMatching, by matching customer loads with renewable energy generation and energy storage technologies.
- eCAMION
- Woodstock Hydro Services Inc.
- Arntjen North America
- Fanshawe College

\$309,317 funded

<http://www.energy.gov.on.ca/en/smart-grid-fund/smart-grid-fund-projects/ecamion/>



Invitation to 7th International Conference on Integration of Renewable and Distributed Energy, October 24-28, 2016, *Niagara Falls Marriott Gateway, Ontario, Canada*

- The IRED conference series was formed through the cooperative efforts of government, industry and academia to develop and deploy technologies for grid connection of renewable energy and distributed energy sources, and for smart communities and smart grids.
- The first conference was held in Belgium in December 2004, and it has since been held every two years in either a European country or the United States. IRED 2012 took place in Germany, and Japan was selected to host IRED 2014, the first conference in the series to be held in Asia. IRED 2016 will be hosted in Niagara Falls, Canada.





To learn more about CanmetENERGY Smart Grid Research go to our webpage:
www.nrcan.gc.ca/energy/electricity-infrastructure

For more information, contact :

Alexandre Prieur, Eng, M.A.Sc.

Smart Grid Project Engineer

NRCan / CanmetENERGY

Email: aprieur@nrcan.gc.ca

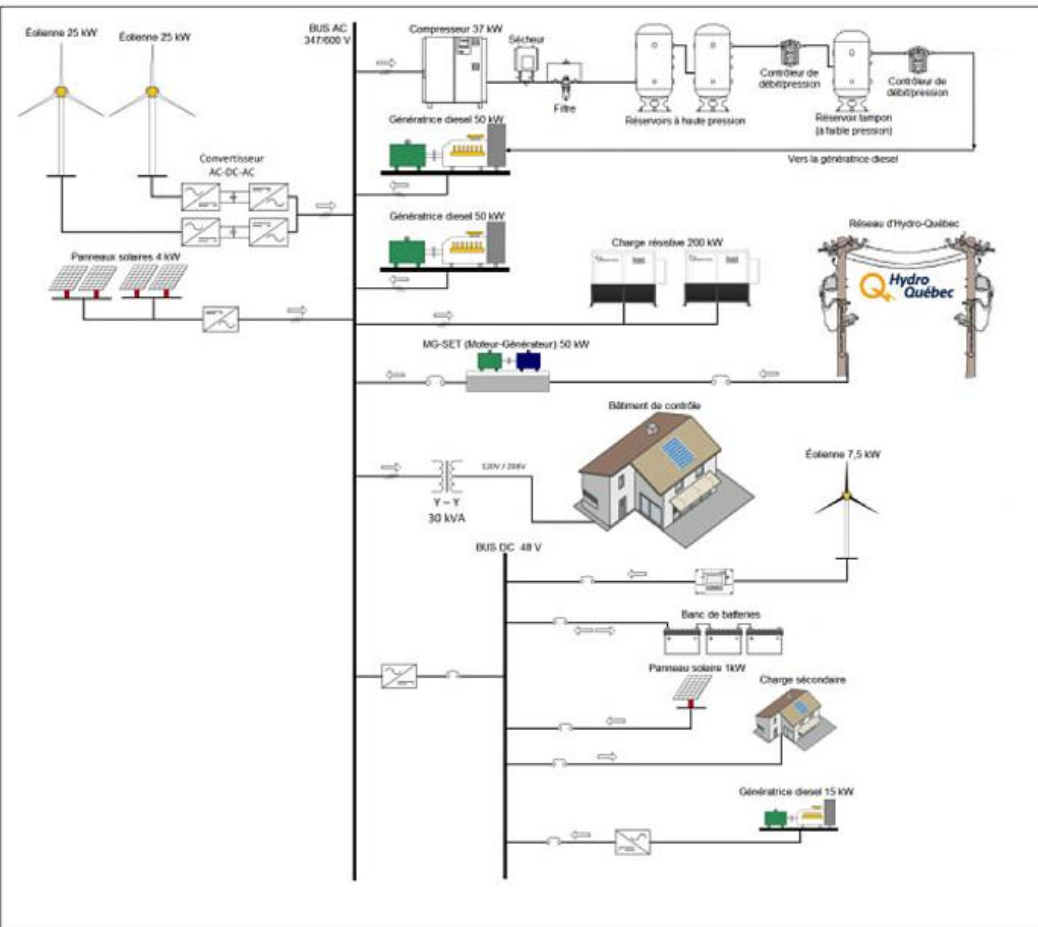
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Reference

- Smart Grid in Canada 2014 Report
<https://www.nrcan.gc.ca/energy/electricity-infrastructure/smart-grid/4565>
- NSERC Smart Microgrid Network- Publication List:
<http://www.smart-microgrid.ca/publications/>
- [MICRO]GRIDS TODAY - Themes and Outcomes
<http://www.marsdd.com/wp-content/uploads/2015/07/MaRS-AEC-Microgrids-Today-Outcomes-Report.pdf>
- TechnoCentre éolien (TCE)- Publication
<https://www.eolien.qc.ca/en/documentation-en/scientifics-publications.html>





Characteristics:

Two interconnected buses AC and DC.

The microgrid is designed to permit the emulation of:

- 1) a power plant whose output is distributed via a direct connection to the Utility Distribution Power System (Hydro-Québec) North American grid;
- 2) an off-grid system powering a northern village; and
- 3) and isolated (island) grid powering a telecommunication station or a local consumer.

Instrumentation:

- 1 wind power plant
- 1 photovoltaic power plant
- 1 diesel power plant
- 1 compression, cooling and compressed air storage chain
- 1 heat exchanger
- 1 resistive load
- Secondary loads
- 1 battery bench
- Measurement instruments and a data acquisition system
- 1 power flux command and management system
- 1 remote monitoring system
- 1 motor-generator that is used to control the voltage and frequency of the micro-grid
- Other equipment such as: control cabinets, interface modules for the diesel electrical power plant, the wind turbines, solar panels, and surplus energy, etc.

Microgrid Technology Challenges & Opportunities – Ontario Report

MICROGRID TECHNOLOGY

Current Challenges

Riskier Than Status Quo

- Technology is viewed as risky and not seen as 'mainstream'

High-Cost

- Price of generation technology, especially when operating without an integrated system

Complex and unfamiliar technologies

- Rapidly advancing technical complexity

Cybersecurity

- Highly interconnected networks providing critical public service creates risk

Opportunities and Potential Actions

- **Support system restart** following blackout or disruption
- **Improve reliability** for customers by providing storage for backup along with intelligent control technologies
- **Provide a linkage** between electricity and other forms of energy (e.g. natural gas) at a small-scale that can arbitrage on price for a consumer
- **Communication** between microgrids for a powerful network of controllable loads and generation (and an opportunity for them to be controlled at a higher level)



Source: <http://www.marsdd.com/wp-content/uploads/2015/07/MaRS-AEC-Microgrids-Today-Outcomes-Report.pdf>



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12 Publicly Funded Microgrid Demonstration Projects

				Companies	Institutes	Utilities	
				Project Lead	9	1	2
Location	Province	Technology	Project	Project Lead			
Whapmagoostui	Quebec	Wind/storage	Front End Engineering and Design Study: Whapmagoostui – Wind Hybrid Power Plant	Nimschu Iskudow Inc.			
Iqaluit	Nunavut	Grid monitoring and automation	First arctic smart grid system	Qulliq Energy Corporation			
Maritimes	New Brunswick / Nova Scotia / PEI	Virtual Power Plant	Load management and wind integration	PowerShift Atlantic			
Hartley Bay	British Columbia	Demand Management	Energy Management Software Development and Implementation	Pulse Energy Inc			
Bella Coola	British Columbia	Hydro / Storage	Hybrid Renewable Energy Systems Microgrid	General Electric (Microgrid)			
British Columbia	British Columbia	Microgrid Controls	Next generation Clean Tech Smart MicroGrid technology to integrate clean energy resources and enable electricity conservation.	Corinex Communications Corp			
Burnaby	British Columbia	Microgrid Controls	Intelligent micro-grid.	BC Institute of Technology			
Nunavik	Quebec	Wind/storage	Glencore RAGLAN Mine Renewable Electricity Smart-Grid Pilot Demonstration	TUGLIQ Energy Co.			
Guelph	Ontario	Test Centre	Renewable Energy Microgrid Testing Centre	Canadian Solar Inc			
Woodstock	Ontario	Virtual Power Plant	Woodstock Whites Lane Smart MicroGRID for Utility and Residential Application	eCAMION			
Ville St Laurent	Quebec	Nanogrid	Self-forming dynamically scalable renewable energy nanogrids	Solantro Semiconductor			
Ramea Island	Newfoundland	Wind/storage	Ramea Island Wind / hydrogen / Diesel microgrid	Nalcor / Frontier Power Systems			

