
Smart Grid Fund, Green Investment Fund and Microgrids

February 8, 2017

Overview

- Ontario's Smart Grid Policy included two main initiatives:
 - 1) A 2010 Directive to the OEB to promote the smart grid and provide guidance to utilities undertaking smart grid activities.
 - 2) The 2011 launch of the Smart Grid Fund, a \$50M competitive program to support smart grid technology capacity building and demonstrations.
- The Smart Grid Fund was first announced in Budget 2009 as a means to kick-start the testing and demonstration of technologies necessary for developing a smart grid in Ontario.
- A corollary goal was to place Ontario as an innovation leader for smart grid solutions – this is why commercialization is a key objective of the fund.
- By supporting these projects, Ontario gains valuable insights into the cutting edge solutions and also the barriers for implementing a smart grid.
- Several SGF projects are microgrids, and with the Green Investment Fund and recent Climate Change Action Plan commitments, there are linkages between SGF and microgrids.
- There are also some smart grid technologies that could support conservation initiatives such as grid voltage control.

Smart Grid Fund – Policy Program

Green Energy Act, 2009 - Set the objectives and framework for smart grid to “improve the flexibility, security, reliability, efficiency and safety” of the electricity grid.

Smart Grid Fund launched in 2011 – Very strong response rate in funding rounds. Sector consultations and various public reports advocate for ongoing innovation support.

LTEP 2013 – Committed to expanding the Smart Grid Fund based on strong stakeholder feedback and alignment with government policy (economic development, jobs, Ontario as innovation leader).

Navigant Report on Ontario’s Smart Grid Roadmap (2015) – Confirmed the value of implementing smart grid technology over the long term. Identified technologies that have high value.

Smart Grid Fund round 3: Focused on innovation projects that aligned with the high value technologies identified in the Navigant Report (slide 6).

Electricity Sector – Drivers for a Smarter Grid

- A modern smart grid is driven at different planning levels by a range of actors and pressures

LONG TERM ENERGY PLAN

Bulk System

- **Key Players** – IESO, OEB, Transmitters, Large Generators
- **Key Pressures** – Regional reliability standards (NERC), domestic regulatory framework, supply / demand changes, efficiency improvements, security

Distribution

- **Key Players** – IESO, OEB, Local Distribution Companies (LDCs), Municipalities, New Entrants / Innovators
- **Key Pressures** – Distributed generation, rate design / recovery, technological change, consumer choice / control, LDC transformation

Customers

- **Key Players** – IESO, OEB, LDCs, Retailers, Other Service Providers, New Entrants / Innovators
- **Key Pressures** – Price increases, Time-of-Use, Conservation / Demand Management, energy independence, more customer control, “Internet of Things”

Smart Grid Fund – Objectives and Outcomes

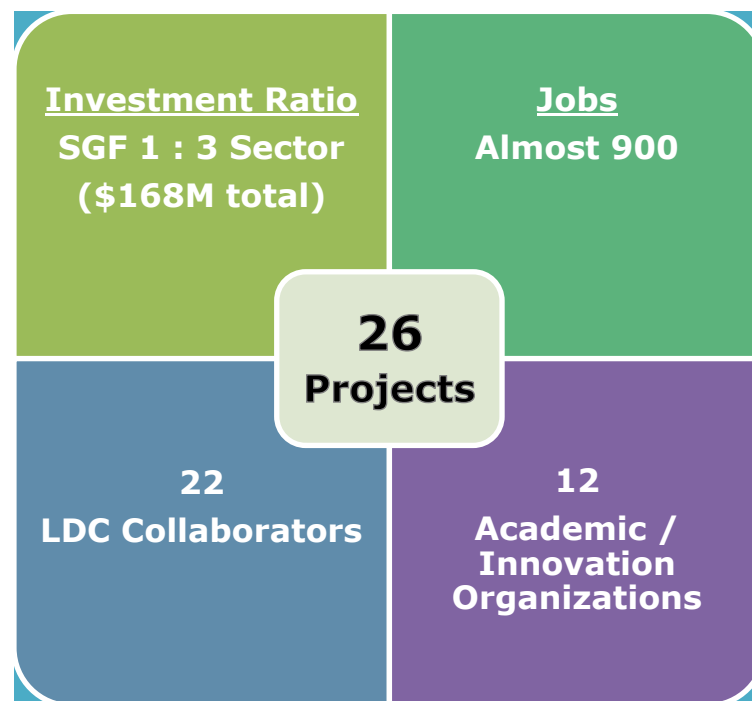
FUND OBJECTIVES

- 1. Advance one or more of the smart grid objectives** in the focus areas of consumer control, power system flexibility and adaptive infrastructure.
- 2. Create economic development opportunities**, including jobs, for Ontario organisations seeking to commercialize SG technologies.
- 3. Reduce risk and uncertainty of electricity sector investments** by enabling utilities and other electricity industry stakeholders to develop, test, and evaluate SG technologies and business models.

EXPECTED OUTCOMES

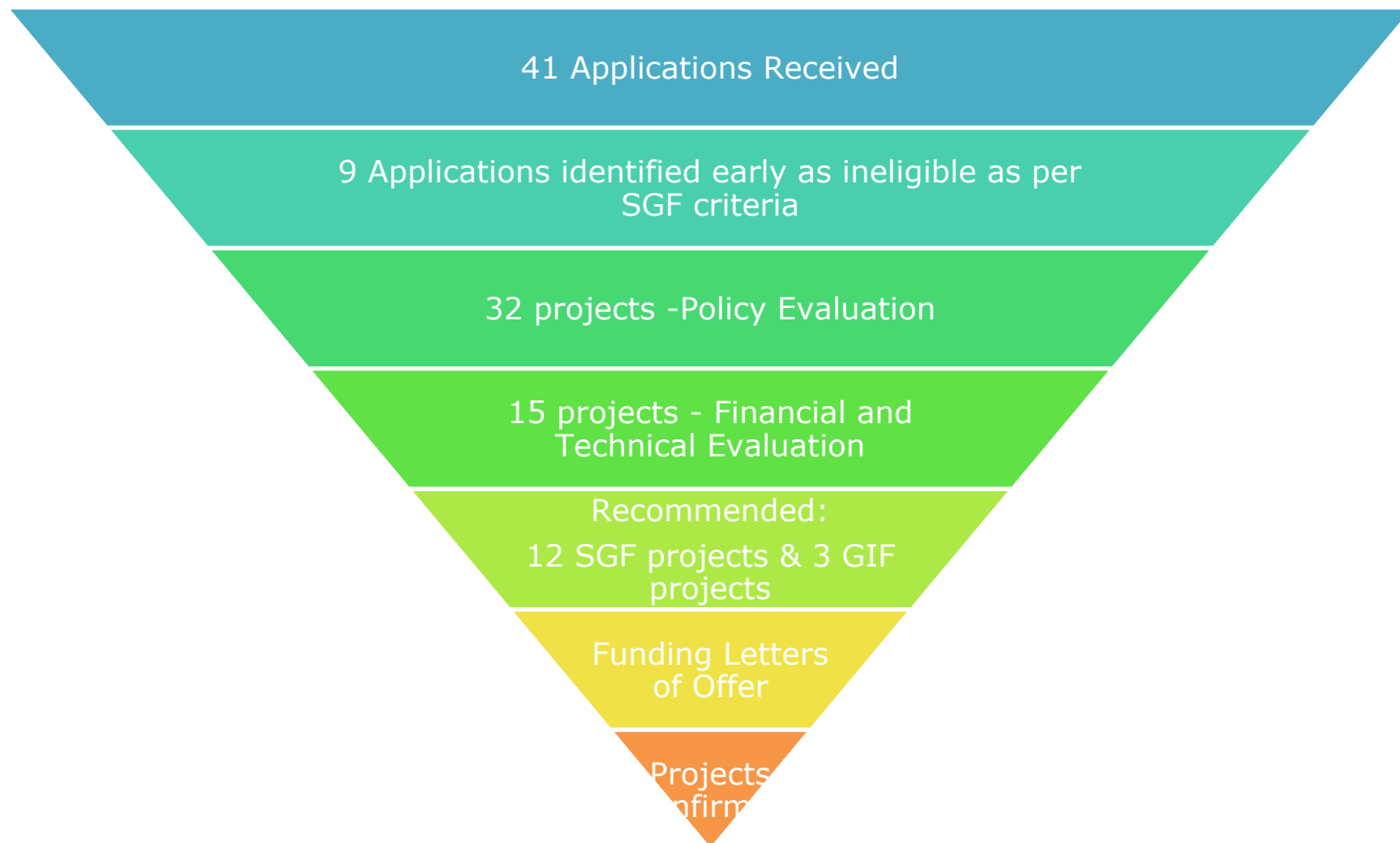
- Identify smart grid solutions for Ontario
- Accelerate technology commercialization
- Establish Ontario as a global smart grid leader
- Ensure a coordinated approach to smart grid development, and encourage information-sharing within industry

Key SGF Metrics*

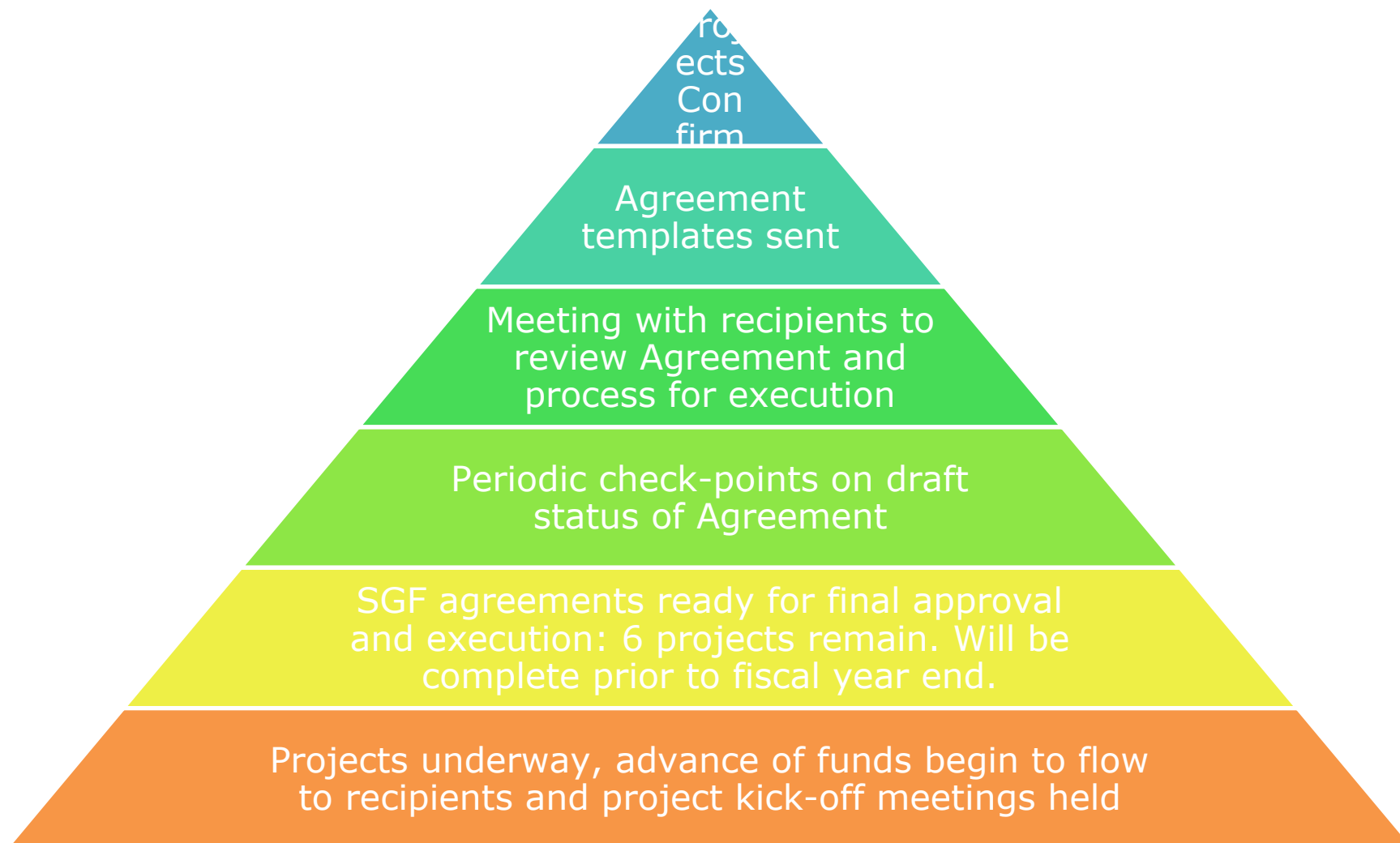


*These program figures represent Round 1 & 2. Round 3 projects are not fully contracted. Figures will be updated following year end.

SGF Round 3 - Overview of Evaluation Process



SGF Round 3 - After Project Confirmation



* To be confirmed with MOECC

SGF Projects

*Completed

	Grid Automation	Home Energy Mgmt	Data Analytics	Energy Storage	Electric Vehicle	Microgrid
Round 1	• dTechs • GE* • Prolucid	• Energate – Consumer Engagement*	• Essex Energy* • IBM* • N-Dimension*			
Round 2	• Grid 20/20* • Opus One • Varentec	• Energate – Dynamic Pricing* • McMaster • Rogers		• eCamion - Smart Energy Storage • Ryerson University	• FleetCarma* • Tech Mahindra • University of Ottawa	• Canadian Solar • eCamion - microgrid • Panasonic
Round 3	• Hydro Ottawa • Kinectrics • SPARQ • Alectra • Burman Energy • Green Power Labs		• Utilismart • Survalent	• Renewable Energy Systems		• Solantro • Opus One Solutions • ARDA • OPG • Canadian Solar 1) Keewaywin 2) Weenusk
Total	12	4	5	3	3	9

Unsolicited Projects: Advanced Energy Centre, Team Ontario Smart Home, oPower, Ryerson Smart Grid Lab, and Green Button.

12 SGF Projects Approved for Funding

Applicant	Total Project Cost	SGF Funding Recommended	Project Type
ARDA Power	\$ 1,124,977.00	\$290,000	Microgrid
Burman Energy	\$216,538.00	\$80,769	Automated Voltage Control
Green Power Labs	\$1,401,200.00	\$695,300	Microgrid, Enhanced Fault Protection, Automated Voltage Control, Distributed Energy Resource Monitoring & Control
Horizon	\$348,000	\$148,000	Enhanced Fault Protection
Hydro Ottawa	\$1,354,000	\$481,000	Microgrid, Automated Voltage Control, Dynamic Capacity Rating, Distributed Energy Resource (DER) Monitoring & Control
Kinectrics Inc.	\$5,995,000	\$2,000,000	Self-healing grid, Microgrid, Enhanced Fault Protection, Automated Voltage Control, DER Monitoring & Control
Opus One Solutions	\$2,942,000.00	\$1,096,000	Microgrid, Self-healing grid, DER Monitoring & Control
RES Canada	\$4,064,000	\$1,905,000	Self-healing grid, Microgrid, Enhanced Fault Protection, Automated Voltage Control, DER Monitoring & Control
Solantro Semiconductor	\$3,237,180	\$1,199,565	Microgrid, Automated Voltage Control, DER Monitoring & Control
SPARQ Systems	\$4,541,450	\$1,504,026	Microgrid, Automated Voltage Control, DER Monitoring & Control
Survalent	\$303,000.00	\$151,500	Distribution Management System Fault Location, Isolation and Service Restoration
Utilismart	\$1,966,000	\$982,450	Self-healing grid, Microgrid, Enhanced Fault Protection, Automated Voltage Control, DER Monitoring & Control, Advanced Metering Infrastructure
	\$27,493,345	\$10,533,610	

Results to Date

- Positive feedback from industry / innovators to continue providing innovation support – Ministry has surveyed recipients and collaborators on program views, commercialization barriers, etc.
- Several LDCs participating in multiple projects as part of adaptation / transformation efforts (e.g. create new business lines)
- Recent reports recognize the value of continued investment in a smarter grid, consistent with LTEP commitment:

1) Ontario Smart Grid Forum

- Broad analysis of different avenues / focus areas for continued innovation support

2) Navigant Consulting

- Cost-benefit analysis found high value of continuing smart grid investments beyond 2020

Ontario Smart Grid Assessment
and Roadmap



NAVIGANT

3) Canadian Electricity Association

- Recommended ongoing innovation funding to stimulate modernization



Canadian
Electricity
Association

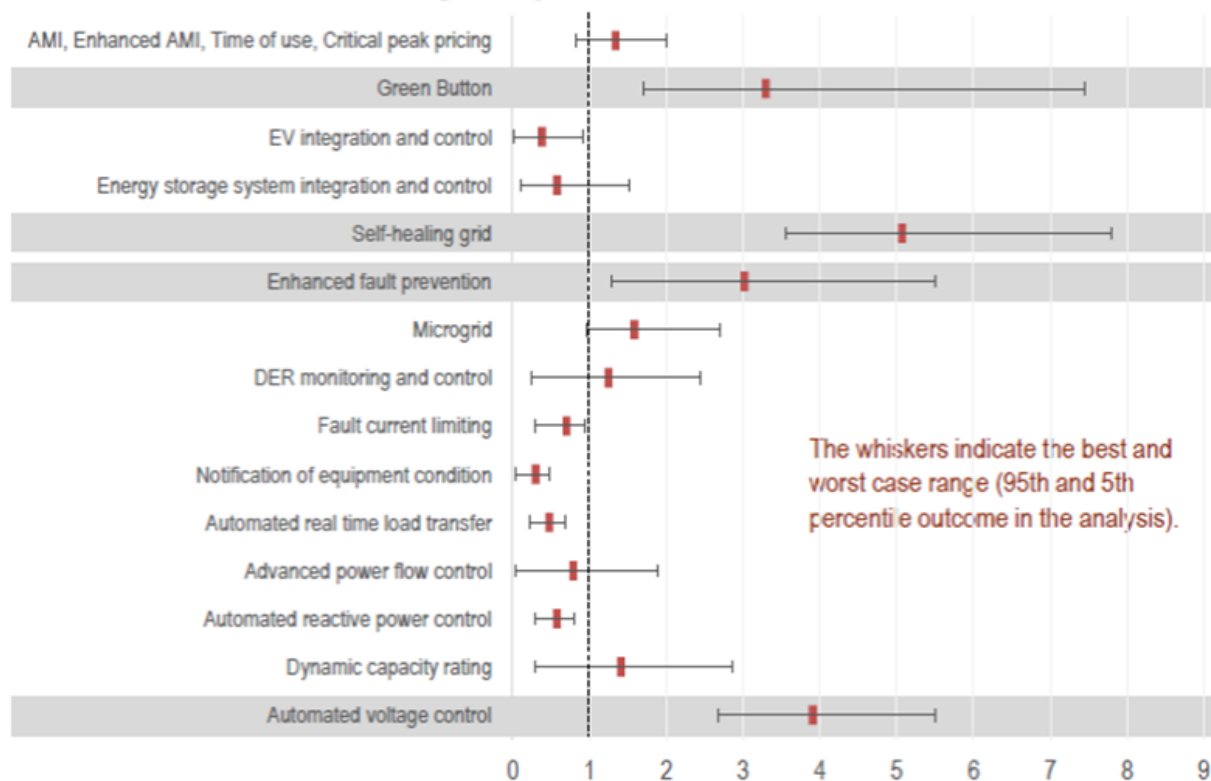
Association
canadienne
de l'électricité

Navigant Smart Grid Roadmap - Snapshot

Select Findings

- If Ontario continues to invest in smart grid through 2035, there is the potential to deliver a net benefit of \$6.3 billion (\$3.8 – 9.0 billion, depending on investment scenario)
- Some technologies demonstrate clear present value, while others may need more growth to show demonstrable benefit across the system
- Several barriers – immature technology, diffuse benefits v. concentrated costs – impede the development of a smart grid in Ontario

Benefit-cost ratios for smart grid capabilities



SGF Next Steps

- All SGF funding has been allocated.
 - The last application window was heavily oversubscribed.
 - Technical consultants suggested that this 3rd round included some of the most impressive smart grid solutions to date.
- The 2013 LTEP committed to expanding the SGF. The pathway for achieving this commitment is still being explored.
- Through the LTEP process, the Ministry is also considering changes to the SGF guidelines to align with Grid Modernization policy and learnings to date.
 - Over five years, the Ministry has developed in-depth knowledge and insight into cutting edge technologies and leveraged its learnings to identify both barriers to and opportunities to support distribution grid modernization. This knowledge would instruct how best to focus future investments.
 - The SGF can also be broadened to do more than electricity distribution innovation, helping to meet other government policy initiatives (e.g. climate change mitigation and adaptation, fuel switching, district energy systems).

Green Investment Fund - Overview

- On November 26, 2015, Ontario announced the creation of a \$325 million Green Investment Fund (GIF) in 2015–16 in its Fall Economic Outlook and Fiscal Review Statement.
 - GIF is a down payment on the province's cap and trade program to strengthen the economy, create jobs and reduce greenhouse gas (GHG) emissions.
- GIF includes a number of funding commitments to support implementation of Ontario's Climate Change Strategy (see appendix).
- ENERGY is leading the \$6M investment to develop advanced microgrid solutions in First Nations communities.
 - These projects will show how renewable generation and energy storage can displace diesel fuel as a source of power, reducing GHG emissions and improving reliability for customers. There are currently three GIF projects related to microgrid developments in First Nations communities (see appendix).
- Potential GIF reporting requirements include:
 - Environmental and climate change– greenhouse gas emission reductions
 - Requirement for third party review of GHG reduction achievement

GIF Projects

- Funding offers were made to projects in First Nation communities that were submitted during the SGF application window. This included three off-grid advanced microgrid projects.
- The OPG project agreement was signed last year and the project is underway.
- The Canadian Solar project agreements have not been signed. There have been delays due to recipient expectations for cost recovery and community engagement.

Applicant	Total Project Cost	SGF Funding Request	SGF Funding Offer*
Canadian Solar - Keewaywin	\$4,330,743	\$2,000,000	\$2,000,000
Canadian Solar – Weenusk	\$4,668,672	\$2,000,000	\$2,000,000
OPG	\$5,872,341	\$2,000,000	\$2,000,000
Total	\$14,871,756	\$6,000,000	\$6,000,000

Microgrid solutions in First Nations communities

Alignment with other Initiatives

- There are 4 remote First Nations that have been identified as not economic to connect to the provincial transmission system – Fort Severn, Weenusk, Whitesand and Gull Bay.
- In the 2013 Long Term Energy Plan (LTEP), Ontario committed to exploring solutions to reduce diesel use in these communities.
- All four communities are now working towards the development of renewable solutions to reduce their dependency on diesel fuel:

Gull Bay	Microgrid with solar PV / storage / smart controls, supported through Smart Grid Fund / Green Investment Fund
Weenusk	Microgrid with solar PV / storage / smart controls, supported through Smart Grid Fund / Green Investment Fund
Fort Severn	Microgrid with solar PV and wind, support provided through Northern Ontario Heritage Fund Corporation
Whitesand	Biomass cogeneration and pellet plant, Power Purchase Agreement in development between Whitesand and IESO.

- The IESO recently launched the Energy Partnerships Stream which includes a funding stream for the four remote First Nation communities to support renewable solutions to reduce diesel (up to \$500,000 per community)

Climate Change Action Plan: Microgrid Program

The CCAP committed to working with First Nation governments and organizations to develop a program for low or no carbon energy powered microgrids and other alternative energy projects, to reduce diesel use in remote First Nations.

Current Status:

- ENERGY is proposing a program to support renewable generation and microgrid technology projects that reduce diesel reliance with a focus on the four unconnectable communities. ENERGY is awaiting further direction with respect to GGRA funding availability in 2017/18.

Considerations:

- ENERGY has reviewed the technical and logistical context for implementing this type of program and conducted an environmental scan of existing projects and programs.
- Program design options were discussed and generally agreed upon between MIRR, MOECC, and ENERGY. Because the initiative will focus on a small group of communities, it is expected that planning and implementation of the initiative will be done in close collaboration with those First Nations.
- Microgrids and innovative technology is one theme that was discussed with First Nations during LTEP, and many communities had an interest in participating in renewable generation and microgrid projects, in particular projects to offset community energy use (diesel reduction for remote communities) and provide more local control/autonomy/resilience.

Next Steps:

- Cabinet Minute directs that ENERGY/MIRR/MOECC develop an implementation plan and report back in 2016 on how to work with First Nation governments and organizations to develop a program. Once a funding decision has been made, ENERGY will consult with First Nations and prepare a submission to Cabinet to move forward with implementation.

Appendix 1: Ontario's Smart Grid Policy

Smart Grid and the *Electricity Act, 1998*

- The *Green Energy and Economy Act, 2009* amended the *Electricity Act, 1998*, in order to define a smart grid.
- Subsection 2(1.3) of the *Electricity Act, 1998*, defines smart grid as:
 - "...the advanced information exchange systems and equipment that when utilized together improve the flexibility, security, reliability, efficiency and safety of the integrated power system and distribution systems, particularly for the purposes of:
 - a) enabling the increased use of renewable energy sources and technology, including generation facilities connected to the distribution system;
 - b) expanding opportunities to provide demand response, price information and load control to electricity customers;
 - c) accommodating the use of emerging, innovative and energy-saving technologies and system control applications..."
 - Subsections 2(1.3)(a),(b), and (c) map to and support three ENERGY focus areas:
 - 1.3 (a) Power system flexibility
 - 1.3 (b): Customer control
 - 1.3 (c): Adaptive infrastructure

Smart Grid and 2010 Ministerial Directive

- On November 23, 2010, the Minister of Energy directed the Ontario Energy Board (OEB) to take a number of steps for the “establishment, implementation and promotion of a smart grid...”
- The Directive outlined a set of objectives for the OEB to use guide LDCs and regulated entities in establishing smart grid plans and investments:
 - Power system flexibility:
 - Facilitate a flexible system that promotes distributed renewable generation, enable improved grid control and automation, improve network visibility, and maintain power quality.
 - Customer control:
 - Provide greater access to data, improve visibility of information, offer customers better control over consumption, enable their participation in renewable generation, improve channels of customer interaction and choice, and provide education for customers on smart grid.
 - Adaptive infrastructure:
 - Add flexibility to the grid incorporate future applications like storage, ensure forward compatibility to minimize the chance of stranded assets, encourage innovation in smart grid planning, and maintain a pulse on innovation through information sharing.

Appendix 2: Advanced Microgrid GIF Projects

Appendix: Canadian Solar – Keewaywin

Canadian Solar is a global company with the manufacture and installation of solar energy solutions as its core business. Microgrids are a relatively new business unit.

Collaborators	Keewaywin First Nation Keewaywin Independent Power Authority NCC Development LP	Total Project Cost	<u>\$4,330,743</u>
Technology Functionality	Microgrid	SGF Funding	\$2,000,000
Location	Keewaywin First Nation	Jobs	10
Project Description	The solar rooftop and battery storage microgrid containerized solution will enable Keewaywin First Nation to install solar on dedicated rooftops long-term, while housing the inverter, batteries and controller within a climate controlled container. This will manage the power as a local distributed energy system that enhances the performance of the local microgrid and is scaled with enough capacity to conserve diesel use for when it is most needed. The system features inverters, controls and communication systems that will link to the Keewaywin First Nation Multipurpose Center rooftop.		
Notes	• Containerized solution will support transportation of the solution to remote locations, easier maintenance through having the same components within each system and support a new manufacturing facility to put the containerized solutions together. • Canadian Solar has developed a relationship with NCC over the years. Part of their approach to these development projects is a 3 phase approach: 1) solar installation; 2) microgrid; 3) scale up of the system for greater diesel reduction. <u>Solution includes:</u> • 250kW solar PV (rooftop) • 300kWh battery		

Appendix: Canadian Solar – Weenusk

Canadian Solar is a global company with the manufacture and installation of solar energy solutions as its core business. Microgrids are a relatively new business unit.

Collaborators	Weenusk First Nation Weenusk Independent Power Authority NCC Development LP	Total Project Cost	\$4,630,600
Technology Functionality	Microgrid	SGF Funding	\$2,000,000
Location	Weenusk First Nation	Jobs	14
Project Description	The Containerized Microgrid Solution (CMS) is a solar ground mount and containerized mobile power management microgrid that enables remote communities to readily bring 225kW of ground mount solar into their local microgrid distributed energy system to enhance its performance, scale its capacity and conserve diesel use for when it is most needed. The system includes a self-contained, mobile container which houses all of the equipment and smart communications needed to manage its 20kW solar system. Solar panels are also mounted on top of the container and the mobile component can be positioned in one fixed array as will be developed in this project, scaled-up or distributed to various locations in the community as needed.		
Notes	• Weenusk First Nation is 1 of the 4 remote First Nation communities deemed to be 'uneconomic to connect' to the transmission grid. • <u>Solution includes:</u> • 245kW PV solar (ground mount) • 330 kWh battery storage		

Appendix: Ontario Power Generation – Gull Bay

Ontario Power Generation (OPG) is a commercial company wholly owned by the Government of Ontario. Generation facilities include nuclear, hydroelectric, wind, gas, biomass. Microgrids are a new business area for OPG.

Collaborators	Gull Bay First Nation Hydro One Remote Communities Inc. ABB Inc. MaRS Advanced Energy Centre	Total Project Cost	\$5,872,341
Technology Functionality	Microgrid, Distributed energy resources monitoring and control	SGF Funding	\$2,000,000
Location	Gull Bay First Nation	Jobs	8
Project Description	The project will be an isolated micro grid serving Gull Bay First Nation, integrating solar generation, energy storage, diesel generators and a micro grid control system. A renewable generation micro grid at Gull Bay will demonstrate the benefits of integrating renewables in a small off-grid distribution system, reduce reliance on diesel and its associated negative health and environmental effects, and promote economic development in a Northern Ontario remote First Nation community.		
Notes	• Gull Bay is 1 of the 4 remote First Nation communities deemed to be 'uneconomic to connect' to the transmission grid. • OPG has stated their interest in developing microgrids as a new business line for them. Their commercialization strategy has not been developed yet, however as the project moves forward they will be working to develop one. • <u>Solution includes:</u> • 500kW of PV • 400kW of battery storage (2 hour supply capability) • Microgrid control system		

Appendix 3: Microgrid Overview

Appendix: Microgrids

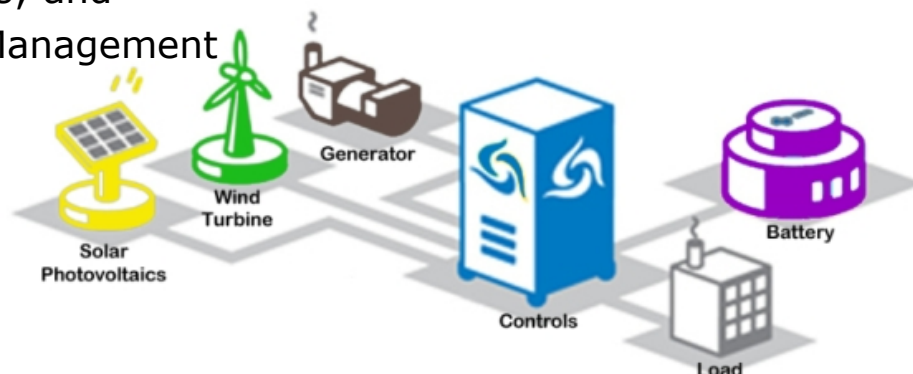
Microgrids combine various distributed energy resources to form a whole system that's greater than its parts. Microgrids are generally *defined by their function, not their size*, though there is no consensus on the official definition of a microgrid .

Defining components of a microgrid are generally:

- Distributed Generation Points; and
- A Control System / Energy Management

They may also include:

- Utility Interconnection
- Energy Storage
- Renewable Fuels



- Microgrids generally use smart grid technology to manage system operation.