



Toronto's Solar PV Generation

Report to Toronto City Council
September 6, 2013

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Executive Summary

This report, Toronto's Solar PV Generation, documents Toronto Hydro's comprehensive residential and commercial solar energy installation strategy. The report covers enabling infrastructure and investments with comments on achievements to date and future work.

The original target for renewable generation from the City's 2009 Strategy, Power To Live Green, was 500MW by year 2020, of which Solar PV accounted for 166MW by year 2020. There are currently 20MW of aggregate Solar PV projects in-service across Toronto, with an additional 65MW of committed Solar PV projects in progress.

While uncertainty exists for development projects that make up the remaining target in the 2017 – 2020 period, we believe, based on current market take-up and continued FIT contracts from OPA, that the 166MW target is achievable for year 2020.

To date, Toronto Hydro has enabled 505 microFIT connections (each under 10kW capacity) totalling over 2.7MW of generation which accounts for an estimated 7% of rooftop microFIT solar PV installed in Ontario. An additional 253 microFIT projects (1.65 MW) are in progress with an expected connection date within the next 12 months.

Toronto Hydro has enabled 105 FIT connections (each greater than 10kW capacity) totalling over 17.2MW of generation which accounts for an estimated 15% of rooftop FIT solar PV installed in Ontario. An additional 83 FIT projects (18.8MW) are in progress with an expected connection date within the next 12 months.

Toronto Hydro continues to actively support renewable generation in key areas:

- Direct investment in Solar PV projects
- Joint development/investment in Solar PV projects with City of Toronto
- Dedicated connection team and streamlined process
- Investment in enabling infrastructure projects which address grid technical constraints
- Energy centre to monitor/forecast/dispatch generation resources across Toronto
- Education and outreach programs to stakeholders

Context

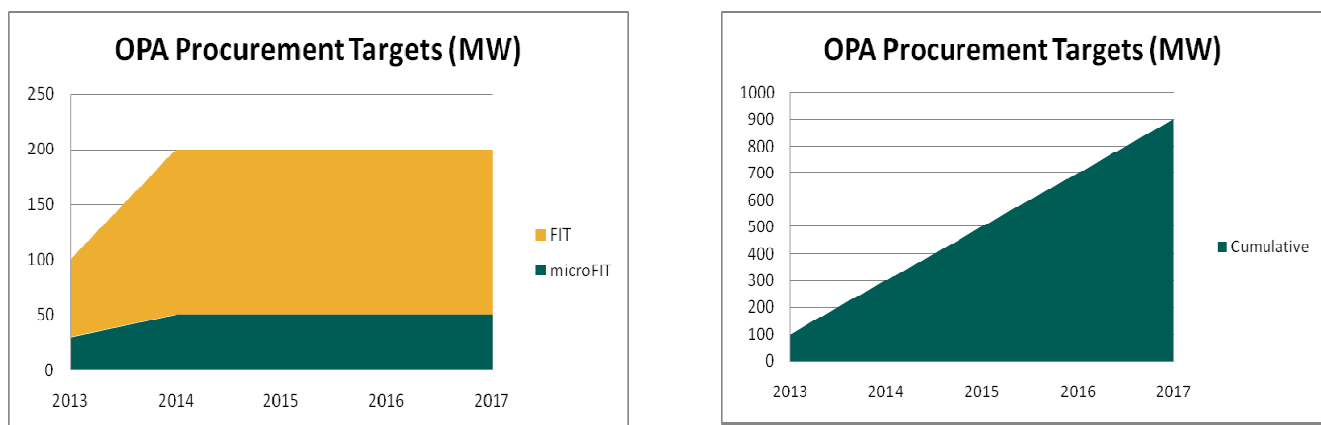
Toronto Hydro has been supporting renewable generation across Toronto by **enabling infrastructure** and **investing in development projects**, consistent with the City's Shareholder Direction and various Council authorizations. The following sections describe these two approaches for supporting renewable generation and report on progress towards goals established in the Power To Live Green Report released by the City in 2009.

On May 14, 2009, the "Green Energy Act (GEA)" was passed into law by the Ontario government. The intent of Act was to boost investment in renewable energy projects and increase conservation, creating green jobs and economic growth. One of the major components of the GEA was the introduction of the Feed-in-Tariff Program, which was launched in September 2009. The program is a guaranteed funding structure that combines stable, competitive prices and long-term contracts for energy generated using renewable resources. The Ontario Power Authority's (OPA) Feed-In-Tariff (FIT) program is divided into 2 streams: **microFIT** ($\leq 10\text{kW}$) - Very small projects typically at a home or small business and, **FIT** ($>10\text{kW}$ to $\leq 500\text{kW}$) - Larger projects typically for commercial buildings, schools, community centres, etc. The goal of the program was to phase out coal-fired electricity in Ontario by the end of 2014. This initiative is one of the largest climate change initiatives in the world.

Recently, the OPA awarded 951 FIT 2.0 contracts to Ontario business owners and developers. From this allocation, customers in the Toronto Hydro service area received 352 contracts, totalling over 42 MW of generation. This accounts for over 30% of the OPA's procurement target for FIT 2.0. These FIT 2.0 projects are expected to be connected to Toronto Hydro's distribution grid within the next 2-3 years.

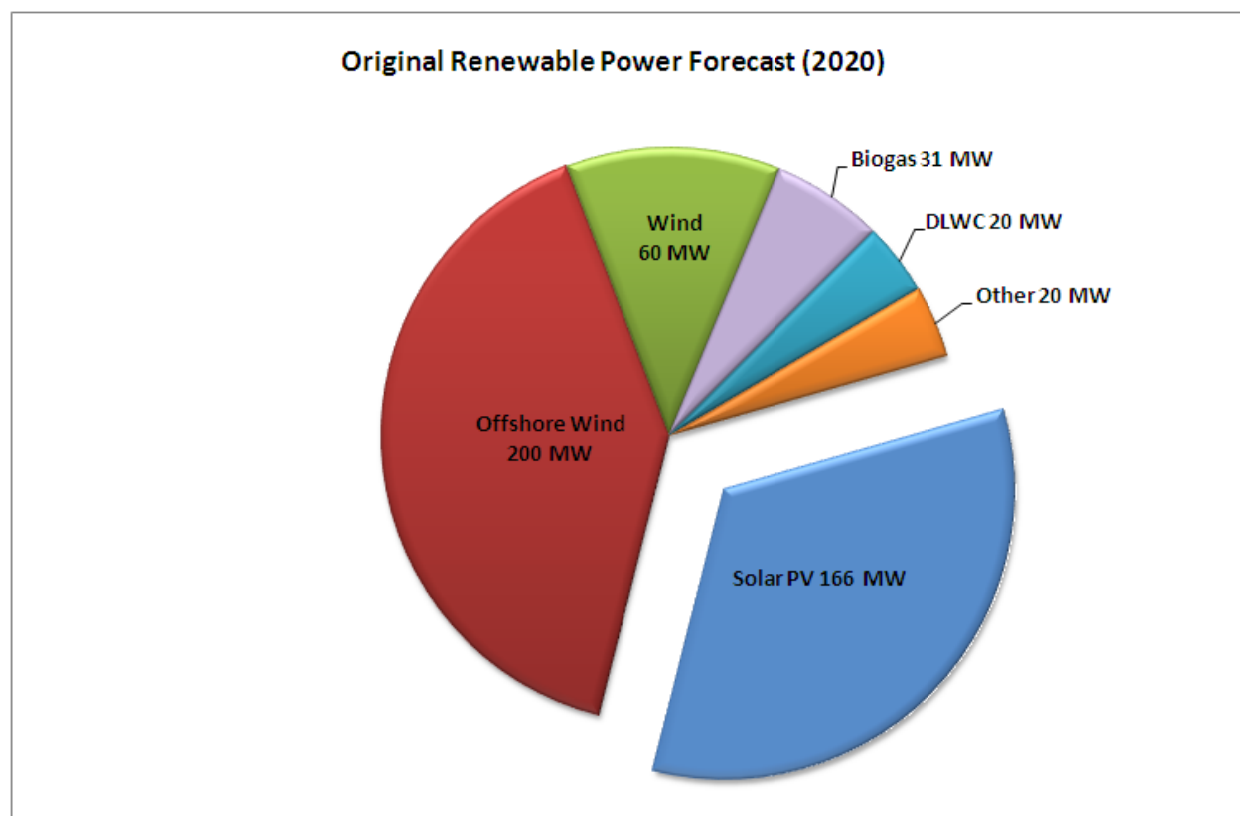
The directive issued by the Minister of Energy, on June 12, 2013 extends the FIT program for an additional four years, based on the strong uptake and interest of green energy in Ontario. **Municipal owned projects will have preferential status and allocated capacity set-asides which will increase Toronto's project share.** Changes include setting annual procurement targets of over the next four years, replacing the Large FIT program with a new competitive procurement process and working with municipalities and Aboriginal communities to help identify appropriate locations and siting requirements, strengthening municipal and public sector participation and annual pricing updates.

Figure 1: OPA Renewable Generation Procurement Targets



In 2009, the City of Toronto Executive Committee adopted a sustainable energy strategy titled **The Power to Live Green**. The goal of the Power to Live Green is to develop an energy strategy that builds on the City's sustainable energy foundation by significantly conserving, renewing, and smartly distributing electricity and natural gas to bring us closer to an 80 percent reduction in greenhouse gas emissions from 1990 levels by 2050, while maintaining energy reliability and affordability. The strategy outlines a variety of different goals and targets, including installing 500MW of renewable generation by 2020 and reaching 1000MW of renewable generation by 2050. The components within this forecast were based on information available in 2009 and included offshore wind, onshore wind, biogas, deep lake water cooling (DLWC), solar photovoltaic (PV) and other technologies.

Figure 2: Power To Live Green Renewable Generation Targets



Enabling Infrastructure

Achievements

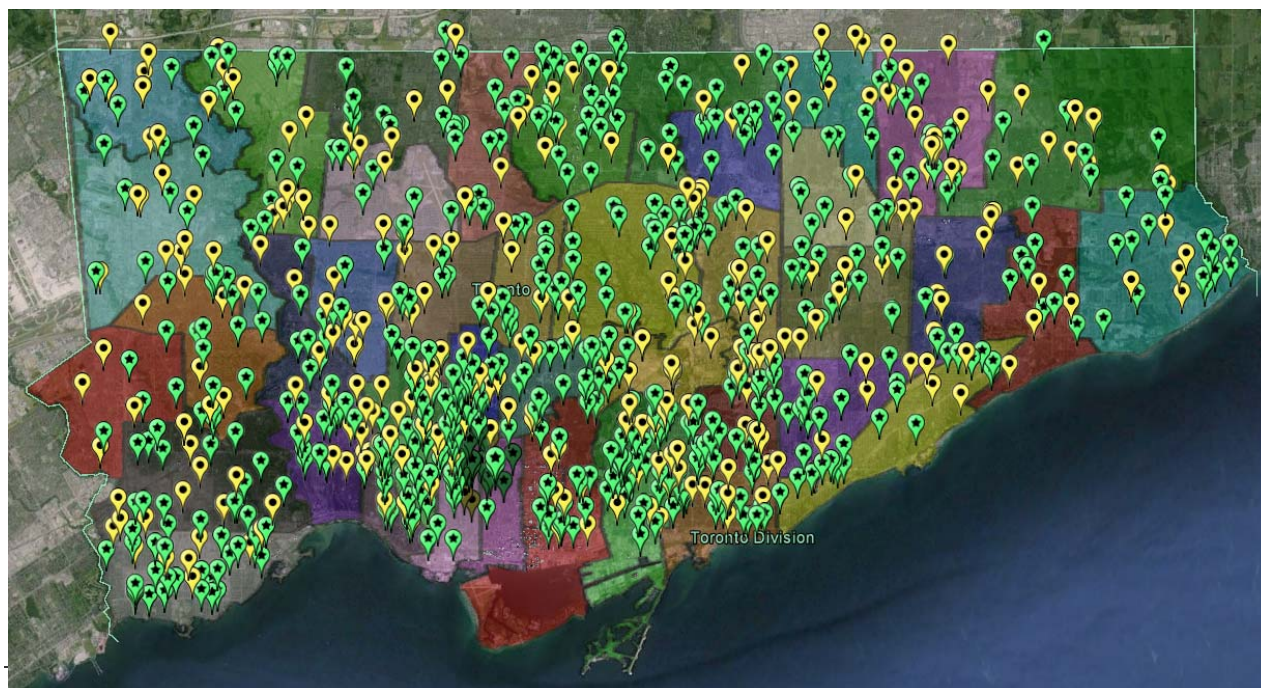
Since the inception of the FIT program, Toronto Hydro has helped over 600 homeowners, business owners, and private developers connect renewable generation within the City of Toronto. The types of connections have ranged from solar photovoltaic (PV) power, wind, biomass and biogas, which has resulted in over 20 MW of renewable generation on the distribution grid as shown in Table 1 and Figure 1. In conjunction with other conventional distributed generation projects, over 100MW of generation has been connected in the City of Toronto, which accounts for approximately 2% of Toronto Hydro's 5000MW peak load.

As of June 30, 2013, Toronto Hydro has enabled 505 microFIT connections totalling over 2.7MW of generation. This accounts for roughly 7% of the rooftop solar PV installed in all of Ontario. There is also an additional 253 microFIT projects (1.65 MW) currently in progress which are expected to be connected to the grid within the next 12 months. Toronto Hydro has also enabled 105 FIT connections in the period totalling over 17.2MW of generation which accounts for an estimated 15% of rooftop FIT solar PV installed in Ontario. An additional 83 FIT projects (18.8MW) are in progress with an expected connection date over the next 12 months. The vast majority of project connection requests to Toronto Hydro have been technically feasible.

Table 1: Toronto Hydro Connected Projects microFIT & FIT

Program	No. of Connections	Connected Capacity (MW)	Ontario Rooftop PV Solar Market Share	No. of Projects in Progress	In Progress Capacity (MW)	Customer Pre-Assessment Requests Rejected due to Capacity Constraints
microFIT	505	2.72	7%	253	1.65	<5%
FIT	105	17.2	15%	83	18.8	<2%

Figure 3: Toronto Hydro Connected Projects microFIT & FIT



Support to Industry and Customers

THESL is an active member of CanSIA, a national trade association that represents approximately 650 solar energy companies throughout Canada. Some of the roles Toronto Hydro has within CanSIA are as follows:

- Leader of CanSIA Working Group - ***Single Phase Inverters on Three Phase Systems***
- Leader of CanSIA Working Group - ***Three Phase Inverters***
- Contributed to CanSIA research report ***“Impact and Sensitivity Studies of PV Inverters Contribution to Faults based on Generic PV Inverter Models”***

Toronto Hydro is also a member of technical subcommittees, such as:

- CSA C22.2 #107.1 Subcommittee
- CSA ICPV Working Group 290 - PV Combiner Boxes
- CSA ICPV Working Group 3 - IEC 62109

Toronto Hydro holds leadership positions various working groups;

- Leader of ESA/ HONI-LDC Distribution Generation Working Group
- Leader of ESA Generation Connections Standards Working Group
- Member of Electricity Human Resources Canada “Renewing Future - Renewable Energy Starring” Committee
- Member of City of Toronto Renewable Energy Group Committee

Toronto Hydro ensures all projects that are approved by the OPA are connected in a timely fashion and all relevant information is provided to each stakeholder. Once an application is received, we perform a site visit and complete an engineering study. We then provide the customer with a report and connect the project to our grid.

Toronto Hydro actively encourages potential customers or developers to consult prior to submitting an application to the OPA. This allows THESL to mitigate potential application rejections due to capacity later on in the process and it saves the customer time and potential investments. Toronto Hydro has multiple options that customers can use for inquiries and questions. THESL has a dedicated web page, e-mail address and phone line that customers can use. In addition, THESL actively promotes distributed generation enablement services at various community events.

Toronto Hydro works with the OPA to identify new projects, update the status of current projects, and performs distribution availability tests.

Toronto Hydro manages the relationship with HONI and IESO directly. This is after the customer application has been submitted. THESL actively works with HONI to manage and address transmission capacity restraints in order to enable the connection of the maximum amount of renewable projects.

Toronto Hydro works with the ESA to ensure that projects meet the Ontario Electrical Safety Code before connecting to the grid. Toronto Hydro also provide technical and policy advice to the OEB/MOE with respect to changes in the Distribution System Code and process related to connecting distributed generation.

THESL takes seriously the Health and Safety of its Stakeholders. Ongoing efforts by THESL personnel ensure that assets connected in its system adhere to the following:

- Loss of power from the grid will initiate a shutdown of the inverter to prevent islanding
- When maintenance to utility grid is to be conducted, crews may operate exterior disconnects to isolate the generation supply
- All project sites adhere to THESL labeling requirements
- Detailed single line diagram of generation connection is posted for reference

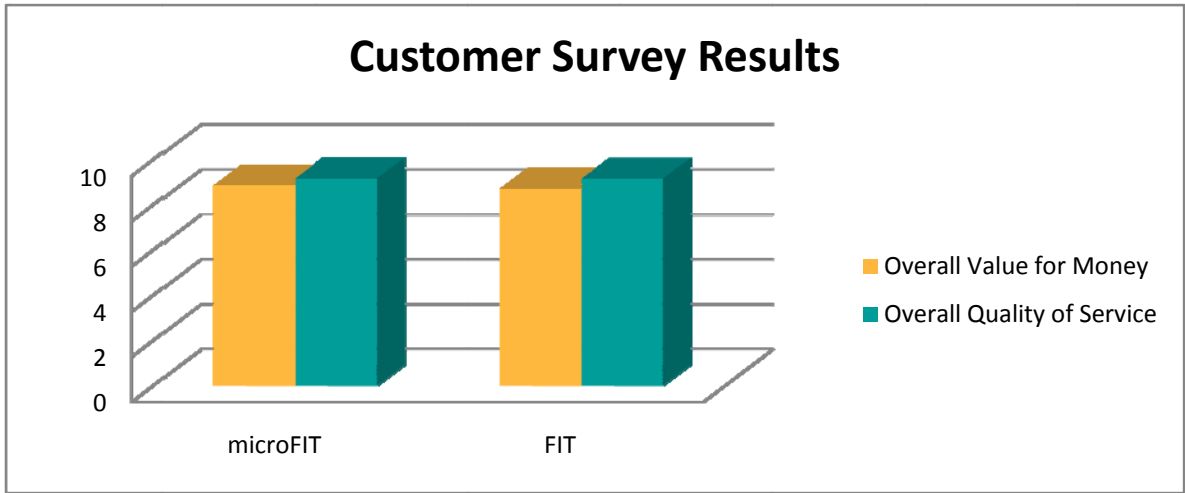
Generation Planning group has performed presentations for various groups within THESL to communicate the following:

- Health and Safety issues related to connection of DG to the system
- Engagement and Communication outlining FIT and microFIT processes, practises and status updates (current and future)

Communications and Outreach

Toronto Hydro has enabled solar project connections for the past three years and continues to engage customers to encourage the integration of renewable energy sources. At the end of each project Toronto Hydro sends out customer satisfaction surveys. For both microFIT and FIT programs, Toronto Hydro has sent out over 300 survey request to customers. Customers were asked 22 questions regarding various aspects of their interaction with Toronto Hydro. This helps ensure that we have addressed the customer needs and provided a value-added service. To date, Toronto Hydro is rated highly in Quality of Value & Quality of Service (scoring 9 out of 10 for both microFIT and FIT programs).

Figure 4: Customer Survey Results for Period 2010 through 2012



"On behalf of Grasshopper Solar, we would like to opportunity to express our gratitude towards you and your team for your contributions and commitment over the past year."

- Grasshopper Solar Project Team (April 2nd, 2013)



"Toronto Hydro's FIT Team is one of the best groups to deal with in the province. They are helpful, collaborative, and reasonable. The level of support we receive is excellent."

- Fidel Reijerse, President, RESCo Energy Inc.

Toronto Hydro recognizes the public needs for up to date renewable energy information and dedicates efforts towards enhancing the communication feedback loop. A broad public awareness campaign is targeted to launch in the fourth quarter of 2013. The following messages are planned:

Message Highlights

- Toronto Hydro efforts to connect projects & application procedure
- Ongoing renewable energy efforts
- Dedicated team to facilitate connections to THESL system
- Availability to provide assistance with project proposals
- Fact sheet of programs enabled and upcoming initiatives
- Milestones achieved with positive customer collaboration testimonials
- Toronto Hydro's focus on customer service and satisfaction
- Toronto Hydro's duty to facilitate generation connections

In recognizing Toronto Hydro's customer needs and encouraging renewable developments, the external stakeholder engagement plan will consist of the following communication techniques:

➤ **Two way communication to educate public and increase media presence**

- Social Media (Facebook, Twitter, Youtube)
- Engage with City of Toronto Livegreen Initiative
- Face to Face (host forums/panels/discussion)
- MicroFIT: Residential Rate Payer
- FIT: Developers and Consultants
- Developers/local CANSIA membership
- Large Electrical Contractors (ie. Toronto Electrical Contractor Association)
- Workplace Lunch and Learn

➤ **One way communication to foster public awareness**

- Bill Inserts & Emails (Existing customers)
- Radio Ads (680News, CBC News - Broad public)
- Toronto Hydro logo branding on site projects



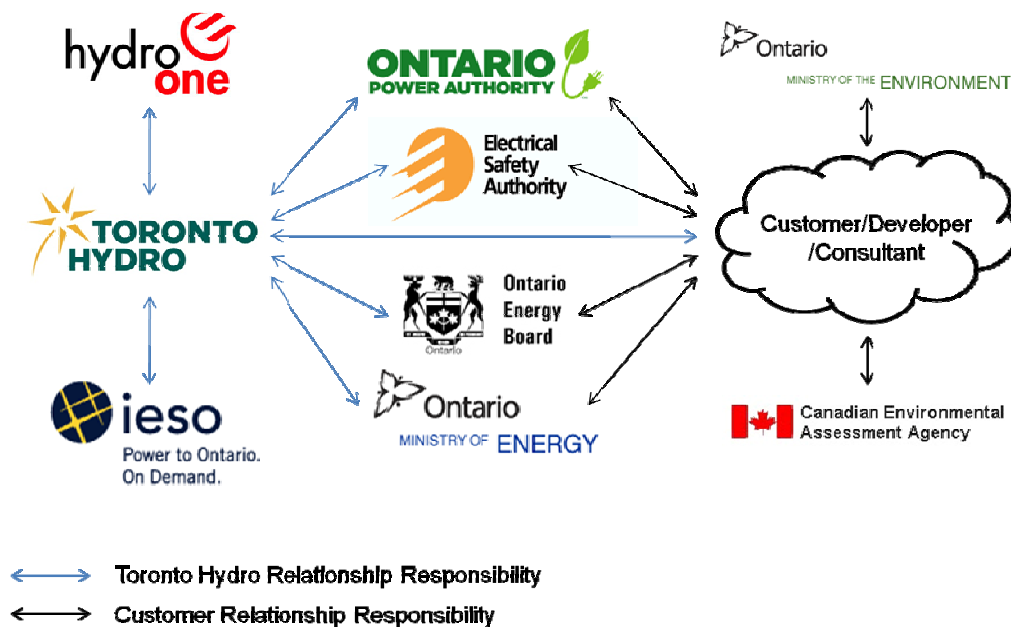
Media Partners:         

*Seek inclusion of IESO/OPA/Hydro One message

Streamlined Process

Toronto Hydro has worked very closely with customers, developers and communities to help enable and promote renewable energy in the City of Toronto. Members of Toronto Hydro have presented and spoke at conferences regarding the enablement of renewable generation. One-on-one meetings with developers/customers and information sessions with community groups were also held by Toronto Hydro where issues relating to renewable energy was discussed. Employees of Toronto Hydro are also active members of various trade associations and standards organizations such as CanSIA, ESA, CSA and Human Resources Canada.

Given the complex landscape, Toronto Hydro also plays a vital role in helping customers and developers connect their project to the grid, from beginning of the project to the very end. Prior to even applying to the OPA for a FIT or microFIT contract, applicants are advised to request a pre-assessment capacity check from Toronto Hydro. This extra step, which is not performed by most LDC's in Ontario, informs the customer up-front if capacity exists on the distribution grid. This is very helpful for the customer because it eliminates the need for unnecessary applications and deposits to the OPA.

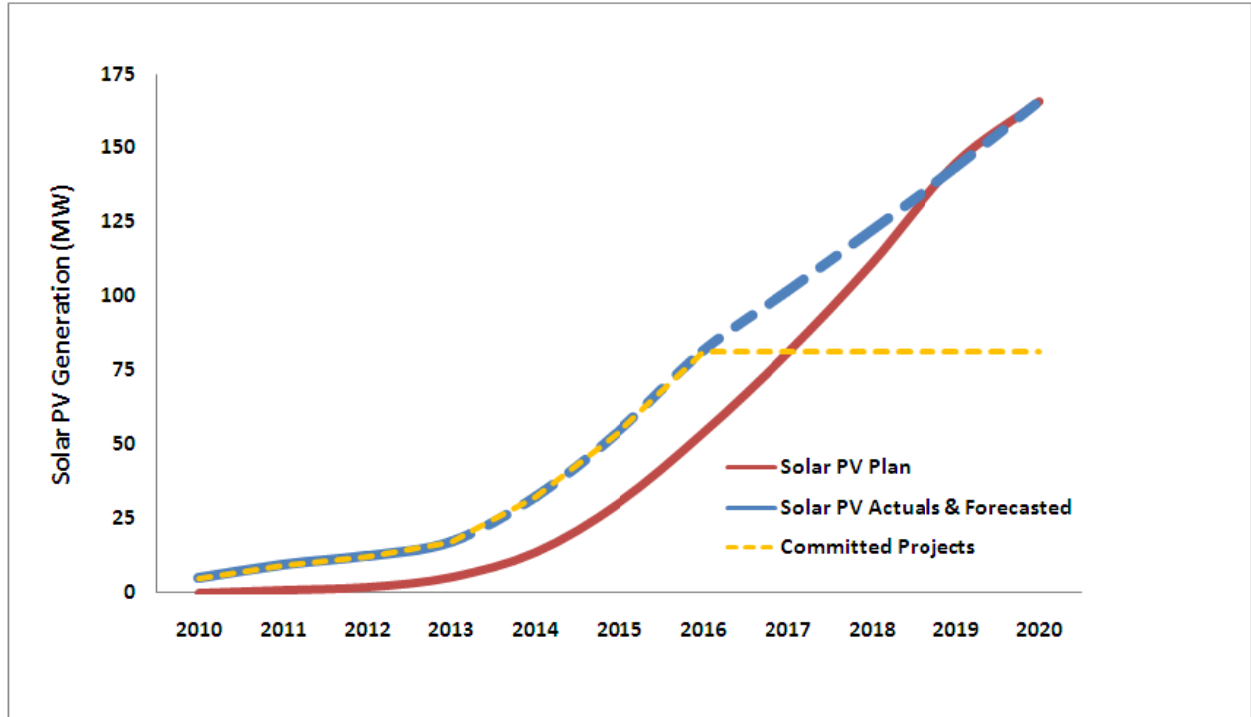


Toronto Hydro continues its assistance to enable renewable energy projects subsequent to the customer successfully receiving an OPA contract. Toronto Hydro employees work closely with applicants to ensure proficient designs and well-organized connections. This is accomplished by Toronto Hydro's insistence to visit each project location with the customer/consultant to review project design and scope. Meetings are then followed with a detailed site visit report outlining project information. This is yet another step not performed by most LDC's in Ontario.

Forecast Solar PV Projects

An additional 65MW of committed Solar PV projects are expected to be in-service by 2017, but uncertainty exists for development projects in the 2017 – 2020 period. At this time, THESL has responded to over 3000 enquiries from customers and developers through FIT and microFIT pre-assessments. A wide range of proponents have submitted project applications, including the Toronto District School Board (TDSB), Toronto Catholic District School Board (TCDSB), Toronto Community Housing Corporation (TCHC), Canadian Apartment Properties Real Estate Investment Trust (CAPREIT), Loblaws, Home Depot and OzzSolar. Based on current market take-up and continued FIT contracts from OPA we forecast that the 166MW target is achievable for year 2020 as shown below.

Figure 5: Solar PV Projects Forecast vs. Plan



Some needed transmission system infrastructure investments (Leaside/Hearn/Manby Breakers) will be completed by end 2014 which will help relieve some technical grid constraints across Toronto. There are also distribution technical grid constraints in specific areas across Toronto. Toronto Hydro’s planning group has targeted associated investments in infrastructure for years 2015-2019 which will support connection of renewable (and conventional) generation projects across Toronto. These infrastructure projects are included in our Consolidated Distribution System Plan, which is a comprehensive investment subject to Ontario Energy Board approval.

Future Work and Benchmarks

Toronto Hydro's Generation Planning group will continue to work with HONI to identify and help create new capacity within the City of Toronto. One way to accomplish this goal is to develop and seek out new techniques to enable technology. Toronto Hydro must also ensure ratepayer does not bear any economic burden due to renewable generation enablement. The Generation Planning group must also work to develop policy, procedures and training for Toronto Hydro personnel to facilitate safe working environment for staff and public. Toronto Hydro is developing an Energy Centre to actively monitor, forecast and dispatch generation resources across Toronto and report aggregate results to the system operator, IESO.

In order to successfully connect renewable generation to the distribution grid, Toronto Hydro must meet the following benchmarks and timelines:

- OEB mandated Customer Service Guidelines as outlined in the Distribution Systems Code
- Complete FIT CIA's within 60 days of receiving complete CIA application request
- Issue microFIT Offer to Connect to customer within 15 days
- Provide microFIT connection date to the OPA within 5 days of receiving proper information

Achievements

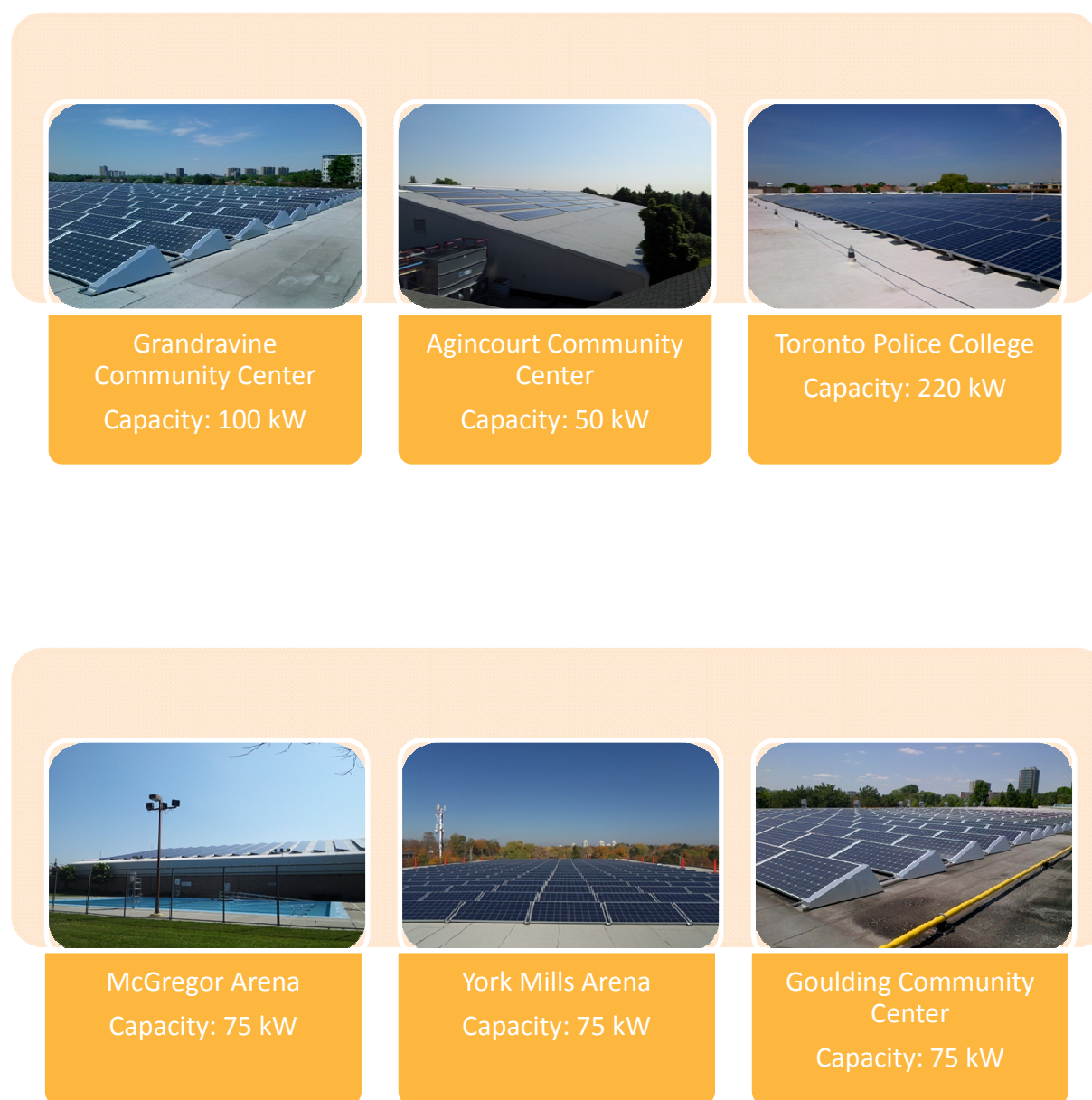
Toronto Hydro's Generation Group has been working on solar projects since the FIT 1.0 program was announced by the OPA in 2009. Toronto Hydro installed a pilot 36kW solar PV system at its 500 Commissioner's facility in 2006. The first two large solar PV projects developed by Toronto Hydro which were awarded FIT contracts achieved Commercial Operation in 2011. These projects include the 250kW solar project at 500 Commissioners St. and the 250kW solar project at Exhibition Place.

Figure 6: Solar PV Projects at 500 Commissioner's St. (top) and Exhibition Place (bottom)



THESL formed a partnership with the City of Toronto in 2010 to develop solar PV projects on City owned facilities. The first group of City Solar projects achieved Commercial Operation in early 2013. This group consisted of 9 projects on community centres across the city totalling 810kW of capacity. The last remaining City Solar project from this group of FIT 1.0 projects required structural reinforcement (Malvern). It is currently under construction with Commercial Operation expected in Q1 2014 adding another 210kW of capacity.

Figure 7: Solar PV Project Investments by City / Toronto Hydro



The 9 City Solar projects that are currently in operation have achieved 393MWh of production to date with 99% availability after 4 months of operation. The weather-adjusted budget for this time period was 377MWh. Therefore the actual production was at 104% of the planned target to date.

Over 50 City facilities have been reviewed for feasibility for solar PV systems. Facilities were reviewed for electrical interconnection, roof age, roof condition, roof obstructions, and structural capacity. The first group of sites were the ten best facilities for solar PV development at the time FIT 1.0 was released. Over time, City buildings are getting reroofed which can also alleviate the structural capacity constraints because of the modern practice of using lighter roof materials.

As part of the next group of City Solar projects FIT 2.0 applications were submitted to the OPA for 17 sites totalling 2.78MW in late 2012. These applications were rejected by the OPA in early 2013 but will have opportunity to reapply during the FIT 3.0 window, expected late fall in 2013. The probability of application success under FIT 3.0 is much higher for municipal projects than under FIT 2.0. This is because OPA have allocated capacity for these type of municipal projects over the next four year period.