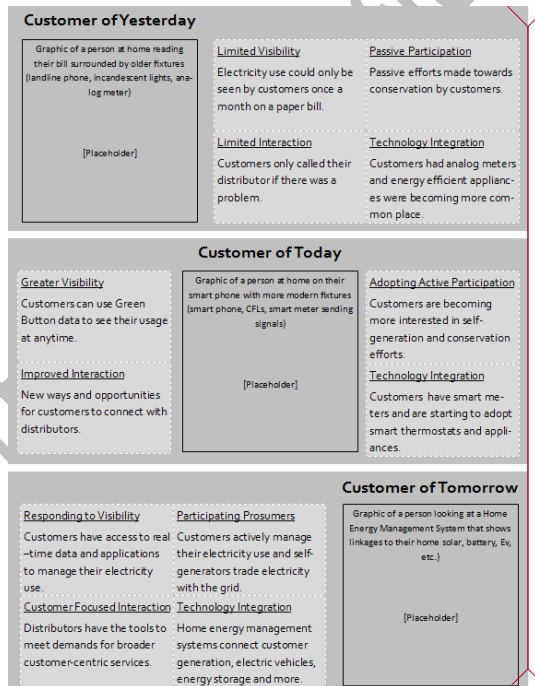


Delivering Fairness and Choice LTEP 2017

Chapter 5. Innovating to Meet the Future

Modernizing the System

The way we deliver and use electricity is changing. New technologies allow us to capture, store, and use energy locally and deliver it in new and innovative ways. Clean, distributed energy resources are powering our economy and coming closer to home. New tools and devices are appearing on smartphones and in homes, harnessing the power of data and giving customers greater choice and control over their energy use. This is a pressure that is not going away, because customers' expectations of their utilities are increasing.



Commented [JM1]: I would recommend eliminating the customer of today box to make the change more dramatic. Besides, most of today's customers fit your definition of the customer of the past

Innovative Pricing Plans

Together with the Ontario Energy Board, the Province is working on giving consumers more choice in their electricity price plans. The OEB is using pilot programs to test innovative time-of-use price structures, as part of its review of the Regulated Price Plan (RPP). Ontario is already a world leader in this area, offering time-of-use electricity prices to most of its residential and small business electricity customers.

The pilots will test a variety of innovative price structures, including:

- different ratios between on-peak and off-peak prices;
- different times for on-peak and off-peak periods;
- prices that kick in during critical peaks – the short time periods with extremely high demand; and
- seasonal pricing plans that have a flat rate for spring and fall, and on-peak and off-peak price periods for summer and winter.

Some of the pricing pilots will be combined with smart technologies, like smart thermostats, energy use apps, and electric vehicles, to give customers further ability to manage their electricity use.

The pilots will help inform future OEB decisions on potential new price plans that could match a customer's lifestyle and give them more control over their electricity costs.

In addition to these pilot programs, the OEB is also examining changes to the way Global Adjustment (GA) is charged to mid-sized commercial and industrial consumers, otherwise known as non-RPP Class B consumers. For these consumers, the GA is a fixed charge that is the same regardless of the time that they consume electricity. As outlined in the OEB's RPP Roadmap, a GA charge that varies with the time of use could result in a more equitable cost recovery and lower prices for Class B consumers as a whole, including residential and small business consumers who are on the Regulated Price Plan.

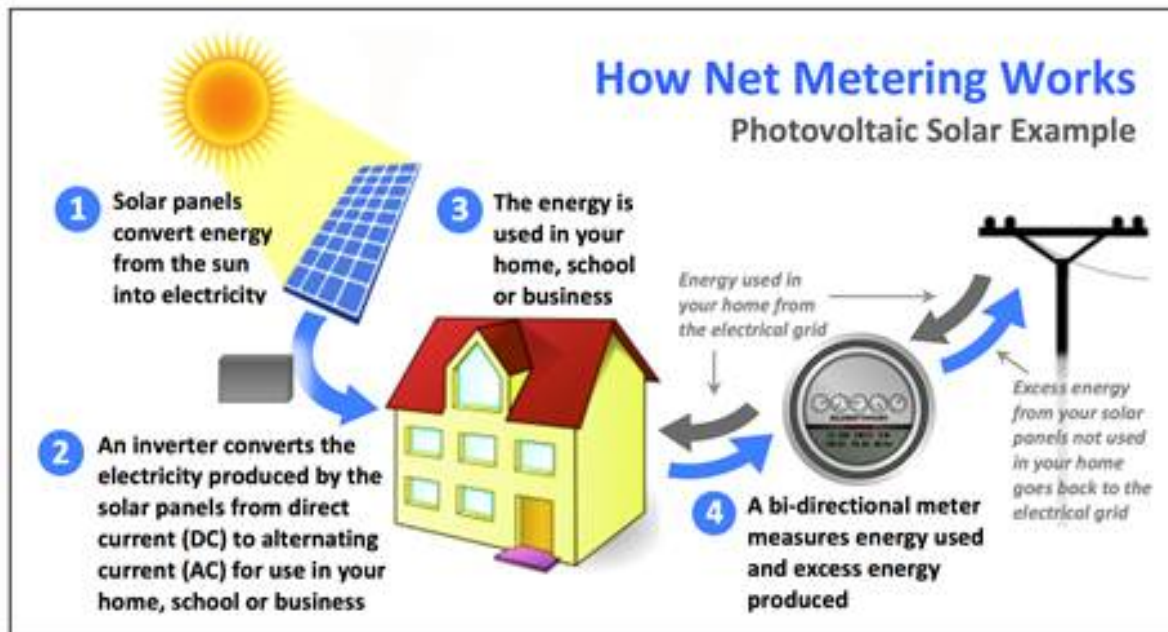
[CASE STUDY: TOU pilot]

Providing consumers choice

Content: a description of existing TOU pilot]

Net Metering

A net-metered customer can generate their own renewable electricity on-site while still being able to draw power from the local distribution network when needed. Any surplus electricity the customer has generated can be sent to the utility for a credit on their electricity bill. The is valid for a year.



The graphic shows how net metering works for a typical residential rooftop solar project.

- the electricity generated is first used on-site to power the house.
- Net-metered customers receive a charge on their electricity bill for the electricity they draw from the local grid when their electricity needs cannot be met by the on-site generation.
- The monthly electricity bill is based on the difference between the dollar value of any electricity used from the local grid, and the dollar value of electricity sent to the grid.

Other types of renewable energy installations are also eligible in Ontario for net metering.

Ontario has recently taken steps to increase net metering by removing the limit on the size of eligible generation systems and allowing it to be paired with energy storage technologies. The Ministry will also allow third parties to own and operate net-metered generation.

In order to better understand virtual net metering, where renewable generation is sited away from a customer but customers still get a credit to offset their electricity bills, the Ministry and the IESO will support the near-term deployment of demonstration projects for virtual net metering demonstration projects.

Taken together, these enhancements put the province at the forefront of renewable energy integration in Canada and provide a platform for future innovation in clean, distributed energy.

POWER.HOUSE

Alectra Utilities, with support from the IESO's Conservation Fund, launched the POWER.HOUSE pilot in 2015. The innovative residential solar storage program outfitted twenty homes with solar panels, an energy storage device, and digital devices that allowed the homes to communicate with the utility.

Alectra could treat the 20 homes as a single, virtual power plant to provide services for the local and provincial grid. The homes provided enough energy together to make the case for delaying upgrades to the local distribution network by several years. This resulted in savings for all Alectra's customers. Alectra believes POWER.HOUSE could be expanded to include 30,000 homes in York Region alone. (Fact check forthcoming)

Energy Storage

Energy storage is a game-changing technology. Sometimes, it acts like a home or business, consuming electricity from the grid. At other times, it acts like a power plant, sending electricity out when needed.

Since 2013, the Ministry has made it a priority to understand the value of energy storage for Ontarians. This includes:

- procuring 50 MW of different types of energy storage to test how they can support Ontario's electricity network;
- supporting several energy storage projects through the Smart Grid Fund to test the full range of their capabilities on distribution systems; and,
- undertaking important studies that take a close look at capturing the different values of storage.

The IESO published a study in March 2016 that showed there are significant opportunities for using on-site storage at factories, industrial facilities, and in large commercial facilities¹. More recently, the government commissioned Essex Energy to produce a similar report on the benefits of storage for distribution grids.

The game changing nature of energy storage means that some of the rules governing the electricity system may be outdated and act as barriers to the adoption of this technology. The government will amend its own regulations and work with the IESO and OEB to do the same in situations where energy storage is unfairly disadvantaged by these rules.

¹ Independent study commissioned by the ministry. Not yet public.

Callout box: Essex Energy Storage Study

- In its report, Essex Energy determined that the single most effective measure to improve the economic case for distribution connected energy storage would be to reform the way in which Global Adjustment charges are applied to energy storage facilities.
- The report also noted that one application of energy storage already has a strong business case. It could be used by large customers to reduce peak demand and the associated peak demand charges.

Electric Mobility

To curb climate change, Ontario is moving forward to increase the use of low-emission transportation. This is critical to establishing a green economy and a carbon-free Ontario.

The continued adoption of electric vehicles (EV) will have an impact on our distribution networks. If enough electric vehicles in a neighborhood charge at the same time, important parts of the distribution system can be damaged. As the uptake of EVs continues, our distribution networks will need to be upgraded to ease the pressure.

Utilities and EV owners can work together to minimize these impacts. FleetCarma and Toronto Hydro have already successfully tested how to do this in partnership and Burlington and Oakville Hydro² are testing how to do this with smart chargers.

Commented [JM2]: Be more specific. How does this impact EV owners?

The government wants to provide utilities with more options for integrating EVs into their grids at the lowest cost. The OEB will support this goal by looking at how utilities can invest in cost-effective technologies that provide benefits to all customers, including smart charging for EVs.

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The ministry will also work with its agencies and partners to share information and data on EV usage, and to collaborate on policies and programs that support electric mobility. While the focus is often on personal EVs, we want to broaden that to include other types of mobility, including electrified transit.

Vehicle-Grid Integration

Vehicle-grid integration is a perfect example of what grid modernization can achieve, providing more choice for customers while giving utilities the information and tools to optimize their systems.

² Citation forthcoming

A car is parked 95% of the time.³ For electric vehicles, some of that time is dedicated to charging; other times, it sits, waiting for its next trip. When plugged in, an EV acts like any other appliance in your home or business. Vehicle-grid integration presents an opportunity to make an EV much more valuable than just an appliance.

In the future, the battery of an electric vehicle could deliver electricity to the home in the event of an outage. It could also deliver electricity back to the community, or even the entire grid. Essentially, the EV becomes a distributed energy resource, one that can help avoid system upgrades and reduce costs for everyone.

The ministry will engage with stakeholders to develop a Vehicle-Grid Integration Roadmap that will look closely at this technology and what it could mean for Ontario.

Grid Modernization

Electricity distribution is a critical piece of Ontario's grid. Ontario's utilities are the final step in a system that delivers electricity from large generators to our homes and businesses. Ontario leads the world in deploying the smart grid through our early investment in smart meters.⁴ They continue to provide a significant amount of data to utilities, allowing them to locate and respond more quickly to power outages, monitor their systems, and plan better for the future; all to the benefit of Ontario's customers⁵

Now is the time to build on our investments in smart meters and the smart grid to build a modern grid for Ontarians. An independent study found in 2015 that modernizing the grid over the coming decades would deliver \$6.3 billion in economic, environmental, and reliability benefits to Ontario's consumers and businesses.⁶

³ <http://fortune.com/2016/03/13/cars-parked-95-percent-of-time/>

⁴ Source forthcoming

⁵ Information provided to the ministry.

⁶ [Navigant Roadmap](#), p.2.

GRID MODERNIZATION PLATFORM

Grid modernization is a digital platform will enable the seamless integration of new technology into our distribution networks when it makes sense. The platform uses digital information to get full value out of energy investments made by utilities, homes and businesses. For you, it means that the grid will be ready when you want to buy an electric vehicle or install a battery. For your utility, it means better system planning and more opportunities to partner with you - opportunities that can save us all money.

Digital - the key difference between today and tomorrow is that the grid will be digital - moving both electricity to power our homes, and information to power our choices.

Software - data is not enough. Software and computing power turns data into information so that utilities and customers can make the right decisions.

Communications - data from sensors and smart meters require communications infrastructure to provide the data needed to make sound decisions.

Sensors - throughout the grid, sensors consistently feed data back to the utility on the health of different components of the grid, the flow of electricity, and report any outages.

Ontario's early investment in smart meters provides the basic communications infrastructure and data that acts as the foundation for the platform.

FUTURE

TODAY

DRAFT

Outcome #1: Choice for you.

The platform provides the information required for home energy management systems, smart electric vehicle chargers, even energy apps on your smart-phone. It can help you decide when to best use your in-home battery, or the right time to turn down your thermostat. It can even enable new opportunities for you to participate in the electricity marketplace, like joining a community microgrid, renting solar and storage services, or partnering with your utility to provide support for the grid from your car as you sleep overnight. Grid modernization is all about greater choice for you.

Outcome #2: Real-time Data

Currently, many utilities do not have visibility into much of their system. The sensors within the platform will generate a wealth of data on health of the grid - at nearly every point, in real-time. Software will help your utility turn this data into information - information that can quickly identify outages and increase reliability. In the long-run, this data will help utilities better plan their system - meaning more reliable and cost-effective service for you.

Outcome #3: Optimizing the Entire Grid

New distributed energy resources are becoming cheaper and more efficient - and stand poised to change how electricity is generated and delivered. Solar panels, electric vehicles, and energy storage are just some of the technologies that stand poised to change how the grid works. These technologies bring the promise of cost-effective ways to generate and store electricity locally - and the complexity of many more devices connected to the system. A modern grid uses data to optimize the operation of these technologies to get full value out of our investments, while maintaining a safe and reliable system.

PLACEHOLDER FOR GRAPHIC ON GRID MODERNIZATION, ONE PAGE SPREAD – PROOF OF CONCEPT:

Commented [JM4]: I think we can get rid of the picture of today's network, and just concentrate on the future. I would like to be able to edit the text in this graphic.

A modern grid will be more resilient to the effects of climate change, giving utilities the real-time visibility they need to respond to problems and even address them before they happen. A modern grid will give customers more choice, ranging from dynamic pricing models to home energy management to EVs. A modern grid will make sure that distributed resources like solar power, storage, and microgrids can be integrated in the most efficient way possible. Above all, a modern grid will help to drive down costs for customers.

Renewing the Smart Grid Fund

The Smart Grid Fund was launched in 2011 to support innovation in Ontario's electricity sector. Through the Fund, we are learning how technologies can be applied to distribution grids and address their problems and challenges. Utilities are gaining experience with new technologies on their systems and a deeper understanding of their potential benefits. Ontario's businesses have found the support they need to turn a pilot into a commercial success. We've created jobs and growth for all Ontarians⁷.

The Smart Grid Fund has enable a broad range of technologies to be developed in areas such as home energy management, grid automation, energy storage, microgrids and cyber security. Now companies in the smart grid sector are moving away from focusing on single technologies to building integrated solutions that bring greater benefits to utilities and customers.

As part of Ontario's grid modernization strategy, it is the right time to renew the Smart Grid Fund. A renewed Smart Grid Fund will focus on ways to encourage a culture of innovation within the electricity sector, look at innovative processes, explore solutions that integrate many technologies, test new business models, and generate new ideas for advancing grid modernization.

Smart Grid Fund Success Stories

⁷ Internal data confirms these facts.

Control for You - FleetCarma

With the support of the Smart Grid Fund, FleetCarma developed a system that lets utilities control when an electric vehicle is charged, helping them protect their local grid infrastructure. FleetCarma's solution also taking the needs of EV owners into account. They can opt-out on a day-to-day basis and set a minimum, guaranteed charged for the morning commute.

FleetCarma is a great example of Ontario exporting its expertise: After participating in several trade programs FleetCarma announced In April 2017 that the New York City utility, Con Edison, will be using their system.

Real-time Data - Essex Energy and Utilismart

With the support of the Smart Grid Fund, Essex Energy and Utilismart have developed and deployed SmartMAP, a software application that uses smart meters to pinpoint power outages and areas where the local system is under stress.

Utilities can combine SmartMAP with other tools to analyze and optimize their current system and model the effect of any changes before the purchase of costly equipment. This promotes sound planning and asset investment and saves customers money.

Optimizing the Entire Grid – Prolucid

Prolucid has developed a solution that gathers data from utility assets, distributed generation resources, and smart grid devices and provides real-time feedback on system conditions.

During demonstration at Toronto Hydro, data was reported in one minute intervals. When linked with software that forecasted demand, the utility was able to get full value out of several distributed generators.

Distributed Energy Resources

A Distributed Energy Resource (DER) is a decentralized energy resource that provides electricity services to individual customers, or to the wider system close to where it is located.

Specific examples of DER include:

- Distributed Generation: electricity generation embedded in the distribution system for self-consumption and/or export to the distribution grid.
- Energy storage: energy stored for use close to where it is needed.
- Microgrid: a mini electricity grid or network that can operate independently when it is disconnected from the main electricity grid.
- Demand Response: a temporary reduction or shift in demand in response to higher prices and requests from a system operator.

Each DER offers benefits individually. However, their true value occurs when utilities use smart communications systems to integrate these technologies across their distribution network.

Renewable Distributed Generation

Renewable generation systems, such as solar Photo Voltaic (PV) panels, are increasingly being deployed on the distribution system since they can be built to almost any size and sited in a wide variety of locations. While it is generally understood that renewable distributed generation can benefit utilities and give customers greater energy choices, their full value is not well understood and their optimal integration is still a challenge.

The Ministry and the IESO, will develop a funding program to strategically deploy renewable distributed generation systems, and pair them with other distributed energy resources and smart grid technologies, to demonstrate their value to customers and utilities. The data gathered from these innovative demonstration projects will be used to assess the broader adoption and better integration of distributed energy resources in Ontario.

Barriers to Innovation

Ontario's approach to grid modernization is to create the right environment for utilities to make the best decisions for their systems and their customers. To get there, we need to address the barriers to innovation. Many of these barriers are a legacy of the old way of doing things, when power only flowed one way and the technologies were simple and straightforward.

However, times are quickly changing. The Ministry will work with the OEB, utilities, and stakeholders to encourage, where cost appropriate:

- the equitable treatment of energy storage;
- utility participation in residential smart charging;
- the deployment of distributed generation and other distributed energy resources;
- the use of innovative, non-wires solutions;
- clarity in the OEB's expectations when utilities seek innovative solutions that have broader benefits for sector;
- cost-sharing between utilities and customers to optimize assets;
- partnerships between utilities and their customers.

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Commented [JM6]: What does this mean?

These efforts seek to encourage a culture of innovation throughout the sector. As part of this effort, utilities will report on their efforts to transform their grids and their businesses for the future.

Building on the Renewables Revolution

The tremendous growth of Ontario's clean tech and renewable energy sectors has attracted billions of dollars in investment to Ontario and led to the creation of thousands of new jobs. Ontarians can expect these economic benefits to continue. The renewables sector is expected to contribute nearly \$5.4 billion dollars to Ontario's GDP and create 56,500 jobs between 2017 and 2021.⁸

Exporting Ontario's Energy Expertise

"As climate action picks up speed and the costs of renewables continue to fall, the prospects for the future of the clean energy industry are very strong. The question is, will Ontario take advantage or be left behind?" – Renewable Energy Alliance of Ontario

The firms that participated in Ontario's expansion of renewable energy are now poised to export their expertise and products to foreign markets.

For example, Ontario based hydroelectric component manufacturers have been successfully exporting to the United States for years. Many of Ontario's solar manufacturers are also reporting increased export activity to the US, despite strong global competition. And wind component manufacturers have developed expertise that will help them access nearby American markets that have strong renewable energy targets

Ontario's energy innovators, experts in smart grid, renewables, nuclear and other technologies, are using the solid base they established in Ontario to export to other jurisdictions in North America and around the world.

Canadian Solar, a Global Success Story

Headquartered in Ontario, Canadian Solar Inc. is one of the world's largest solar power companies, with subsidiaries in 24 countries on 6 continents, and over 8,900 employees.

The company has invested more than \$800 million Canadian in research and development. Canadian Solar operates three state-of-the-art research centres for PV cells, modules and systems, one of them in Guelph.

⁸ Market Analysis of Ontario's Renewable Energy Sector, Compass Renewable Energy Consulting Inc., June 2017

A Northern Ontario Success in Manufacturing Renewable Energy

Heliene Canada has been manufacturing solar photovoltaic (PV) panels in Sault Ste. Marie since 2010. Heliene currently exports over half of its modules to US markets.

Heliene's manufacturing facility utilizes state of the art technologies from around the world, including Japanese robotics, a Spanish lamination machine, glass from the United States and solar cells from Thailand.

Heliene Canada collaborates with other industry players and universities, such as the Rotman School of Business at the University of Toronto, to create a link between academic research and industrial applications.

Ontario continues to be committed to the dynamic and innovative business climate that made this possible. The Ministry will expand its role in supporting Ontario energy companies that want to export their goods, services and expertise, by:

- working with other provincial and federal government partners, industry associations and companies to develop and support trade initiatives that strengthen international relationships and create new business opportunities;
- developing market intelligence that determines which foreign markets hold the most promise for Ontario's energy goods and services;
- participating in energy-related trade missions abroad; and,
- promoting Ontario's technical expertise at appropriate international forums

The Ministry, in collaboration with other ministries, will develop a pilot program that supports the demonstration of made-in-Ontario technologies abroad. Through \$10 million in pilot funding, the program will help Ontario energy companies get a foothold with utilities and buyers in global markets. In designing this program, the ministry will seek to collaborate with the federal government, which announced several investments in the cleantech sector in the 2017 budget.

"Ontario can lead globally on development of clean and low-cost remote energy systems ... Emerging global economies, including India, are demanding these solutions and Canadian entrepreneurs are poised to seize that opportunity." – MaRS Cleantech

Callout Box: *Laker Energy Products is a leading supplier of nuclear-class pipes and fittings for the CANDU nuclear power industry. The Ontario company is building on this success to export its precision-tooled products around the world.*

Laker recently purchased a new 65,000 sq. ft. facility to handle the more than \$85 million in contracts it has helping refurbish the Bruce and Darlington nuclear reactors. The

facility will also support Laker's sales to international markets, including existing and new-build projects in Argentina, Romania, China and the UK

From our own backyard, Laker has become a world leader in the provision of fully integrated, high-precision machining, assembly and testing of CANDU-related products.

Nuclear Innovation

Nuclear energy doesn't only power our homes. It has enabled Canada to be a world leader in nuclear research and nuclear medicine, saving lives and bringing peace of mind to countless numbers of cancer and heart patients around the world.

Ontario is keenly interested in collaborating with the federal government, universities and industry partners to continue to support the nuclear industry for both energy and non-energy applications. Ontario can help create new export opportunities for our "home-grown" nuclear innovations, such as;

- **Small Modular Reactor (SMR) Technology:** SMRs are a new generation of nuclear power reactors that have smaller footprints than conventional reactors and promise economies of scale through mass production.
- **Nuclear Fuel Research:** Technological innovations could lead to the reprocessing or recycling of used nuclear fuel or the use of thorium to power nuclear reactors.
- **Hydrogen:** Ontario's nuclear technology could be used for the large-scale production of hydrogen. Hydrogen is a low-carbon energy source that could in the future replace gasoline for transportation or natural gas for heating.
- **Isotopes:** Isotopes are as used in applications such as nuclear medicine and space exploration. They supply heat and power for Mars Rovers. Research is underway into expanding Ontario's role in the production and use of isotopes.

Medical Isotopes

Isotopes from Ontario's power reactors are used in both the diagnosis and treatment of life-threatening diseases and the sterilization of medical equipment and food products.

Currently, 70% of the world's supply of the medical-grade Cobalt-60 isotope is produced in nuclear reactors at Chalk River, Pickering and Bruce. The isotope is used for 10 million cancer therapy treatments each year around the world and for medical imaging, equipment sterilization and non-invasive brain surgery.

Recently, Cobalt-60 harvested from the Bruce reactor has been used in the Sterile Insect Technique or SIT, to combat the spread of Zika, West Nile and Dengue viruses.

The medical health-sciences company, Nordion is exploring opportunities to expand the production of Cobalt-60 to the Bruce A and Darlington reactors in the future.