

Power Perspectives

TODAY'S CHALLENGES,
TOMORROW'S OPPORTUNITIES

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and CEO,
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Introduction

The electricity sector is in the midst of unprecedented change – a level of transformation not seen since Ontario’s electricity market opened in 2002.

The traditional one-way, top-down structure dominated by large, centralized generating facilities and electric utilities is being replaced by a much more decentralized and dynamic electricity system – the result of rapid technological advancements, an increasingly engaged consumer, growth in local electricity resources and climate change policies, among other factors. The process of planning and operating the grid is also more interconnected than ever before, making collaboration and resource sharing even more critical.

The IESO is committed to building a strong foundation to support the ongoing evolution of the sector. For over a decade, it has helped to change the way Ontarians think about their energy consumption, encouraging them to find ways to conserve electricity and, in this way, avoid the need for investments in new generation. Through the current (and predecessor) Save on Energy, Industrial Accelerator Program (IAP) and Conservation Fund suite of energy conservation programs, electricity consumers in Ontario saved 68 billion kilowatt-hours of electricity between 2006 and 2017, and did so cost-effectively. That’s about as much electricity as Toronto-area customers would consume over roughly two and a half years (based on 2016 consumption).

The IESO is also working to enable innovation in Ontario’s electricity sector. The financial support it provides for pilot programs to test new technologies, the work being done today to prepare the wholesale electricity market for the world of tomorrow, and the many discussions it both leads and contributes to on a range of policy issues are all examples of the organization’s openness to doing things differently.

The IESO plays a central role in forecasting, planning and managing the supply and demand of electricity. Through its work to broaden participation in the sector, and to protect the cyber assets that are critical to reliability, as well as through ongoing collaborations with sector partners, the IESO is well-positioned to manage change, provide thought leadership, and enable the sector to adapt.

This publication describes what the IESO is doing to seize the opportunities brought about by change. It is partly an update on what the IESO is already doing to ensure Ontario’s power system functions reliably today and will continue to do so into the future. But in addition to that, it is a look-ahead that illustrates how the sector is responding to the changes on the horizon.

This is a pivotal time for Ontario’s electricity sector. To capitalize on the changes that are underway, the IESO is evaluating all aspects of its business to ensure it is well positioned. That includes having the right people in place. Through the efforts of a highly skilled employee base, a strong Executive Leadership Team, and a diverse Board of Directors with considerable experience in economics, finance, business, electricity, gas and technology, the IESO intends to deliver value to Ontarians for years to come. ●



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Collaboration and the Many Roads to Decision-making

Navigating Complexity: An Interview with Peter Gregg

Peter Gregg joined the IESO as President and Chief Executive Officer in June, 2017.

During his 14-year career in the electricity sector, he has seen Ontario's electricity market open, coal plants close, renewable generation increase and energy conservation accelerate. He has witnessed customers' growing interest in the sector, including their desire to have more of a say in community and regional energy planning, as well as greater involvement in the deployment of distributed energy resources.

He's seen a lot of change. But Gregg says that's not the half of it. In this interview, he shares his observations about what's coming next, and how the IESO will ensure the electricity sector is ready to seize the many opportunities that lie ahead.

Q
How would you describe the change that's currently underway in Ontario's electricity sector?

I would say it's a pretty exciting time to be leading an organization like the IESO. We're right in the thick of the action – in a place where we can truly make a difference and also help the sector to make a difference. The decisions

we make together to support the ongoing evolution of the sector will shape the future for our children's children, and so it's critical we get it right.

Q
What are some of your key priorities?

I would say the Market Renewal project is a top priority for us. An independent study commissioned by the IESO indicated this project will help to significantly reduce future market costs, up to \$5.2 billion in efficiency improvements over a 10-year period. >>

BY THE NUMBERS

Most viewed tweet in 2017:
Peter Gregg speaking at the
APPRO conference



33,432

impressions

IESO Board is comprised of

55%
women



Peter Gregg,
President, and
Chief Executive Officer

What needs to happen to get us there? The market design we have today is essentially what we started with in 2002. It wasn't designed for 2025 or even 2018, and it needs to evolve to accommodate the needs of 2050. There are inefficiencies that need to be rectified, assets whose usage can be optimized and new features like the incremental capacity auction that need to be added. Fresh thinking must continue to happen, especially given the rapid increase of distributed energy resources and other changes underway in the sector.

High-level design work on a number of the initiatives for Market Renewal is underway, and in 2018 we will see a good portion of this work completed.

Q
Will there be changes within the IESO to ensure the organization is aligned and positioned for this brave new energy world?

This is happening now. We are focusing our attention on enabling an inclusive and innovative energy sector. Obviously, we can't do this alone. To provide reliable, efficient and sustainable energy options that advance prosperity and growth for the people of Ontario, we'll be looking at even more engagement, even more collaboration, with other players in the energy sector. That's what happens when top-down structures get flattened. The old ways of doing things changes, and hopefully new ideas and new opportunities present themselves.

We have also had a recent organizational realignment. Our new structure consists of business units that reflect the IESO's key priorities, and corporate resource functions that support the entire IESO in the execution of its mandate. We are in the process of moving to a more robust, values-based culture – all tuned to the present and to the future.

One of the new business units includes policy development, and I'm excited by this. Our internal subject matter experts have deep experience in many areas, and I think it makes sense for us to offer up that expertise, in an advisory capacity, to policy makers. We are also well informed by the many stakeholders in our sector.

In my opinion, there's a strong correlation between organizational success and employee engagement. In that vein, we're also developing an HR strategic roadmap to ensure IESO employees have the tools and skills they require to manage change. We're actively exploring ways we can support our employees more effectively, which, in turn, will enable them to deliver on our corporate objectives.

Q
What does innovation mean for the IESO and why is one of the new business units focused specifically on innovation?

From my perspective, innovation creates opportunities

and it also enables change. For example, innovation can introduce more competition and drive market costs down. It can open up new ways for consumers to manage their electricity use and interact more proactively with the grid. It can help keep critical assets safe and secure from unanticipated external events, which in turn supports the system's overall resilience. Advanced technologies are being developed all the time. Our job is to understand them and work with everyone in the electricity sector to leverage them to their full potential and help the sector to continue to evolve.

Q
What are you most proud of since your tenure at the IESO began?

I have great respect for IESO employees. They are the people who collectively achieve the organization's mandate, serving its customers and helping to keep the lights on. We will continue to invest in them, and in the processes and tools they need, in order to ensure we can effectively meet the needs of our evolving sector. My goal is to keep them engaged, united in purpose, and productive. That will help to ensure the IESO is inclusive, agile, transparent and responsive. I don't think this is a stretch goal. I think we're already well on our way. ●

Organizational realignment puts focus on agility, responsiveness and growth

The IESO's broad mandate includes long-term planning, resource acquisition, operating the power grid, overseeing the electricity market, and promoting conservation. To ensure the organization is working toward common goals, the IESO announced a corporate realignment.

Planning, Acquisition and Operations – This team works to deliver and operate a reliable and efficient province-wide power system both today and in the future. Among other priorities, this group is driving the IESO's Market Renewal project (see page 15).

Policy, Engagement and Innovation – This group works to support the policy objectives of the IESO and Ontario's electricity sector. It does this by fostering innovation, engaging stakeholders and communities in critical discussions and decisions, promoting and enabling energy conservation, and by developing and delivering conservation programming.

Corporate Resources – This team supports the entire IESO in the execution of its mandate including:

- **Human Resources** – responsible for strategies to attract, engage, develop, compensate and retain IESO employees, in support of a culture of high performance.

- **Finance** – responsible for financial planning and analysis, treasury and pension operations, settlements as well as project management.
- **Legal** – responsible for legal services, support for the IESO's Board of Directors, contract management and the creation and maintenance of market rules.
- **Information and Technology Services** – responsible for IT solutions, strategies, cybersecurity, as well as oversight of the Smart Metering Entity.

How Advanced Technology is Shifting the Balance of Power

Research and development is driving change in the electricity sector in ways that were once unimaginable. What once seemed far-fetched is gradually becoming reality – and it's happening faster than anticipated.

"We have a unique opportunity to re-shape the market and lay a really strong foundation for our energy future."

Terry Young
Vice-President, Policy,
Engagement and Innovation





Imagine a future where flexible solar films and spray paints generate electricity. A future where artificial intelligence and drone technology are used to reinforce grid resilience. A future with a full menu of electricity pricing options that allow customers to choose the one that's right for them, based on their unique lifestyle. A future where communities, commercial vehicle fleet owners and transit authorities invest in hydrogen fuel-based transportation to help reduce greenhouse gases and lessen the impact of climate change.

This isn't sci-fi. This is Ontario's energy future and it's already here. With the proliferation of advanced technologies that support the smart grid (think: battery storage, electric vehicles, sensors and controls, and distributed energy resources), the long-standing model of one-way, top-down electricity planning and distribution is quickly shifting to a more decentralized construct. Consumers now have more choices – and also more decisions – to make about when to use electricity, what to use it for, and how to use it efficiently.

"This is an exciting time for Ontario's energy sector," said Terry Young, the IESO's Vice-President, Policy, Engagement and Innovation. "The decisions we make today as an organization, and as a sector, will have a tremendous impact on how electricity is used,

stored and generated tomorrow. The technologies that are chosen to keep the grid reliable and secure, and the way consumers interact with the grid, everything is shifting. We have a unique opportunity to reshape the market and lay a really strong foundation for our energy future."

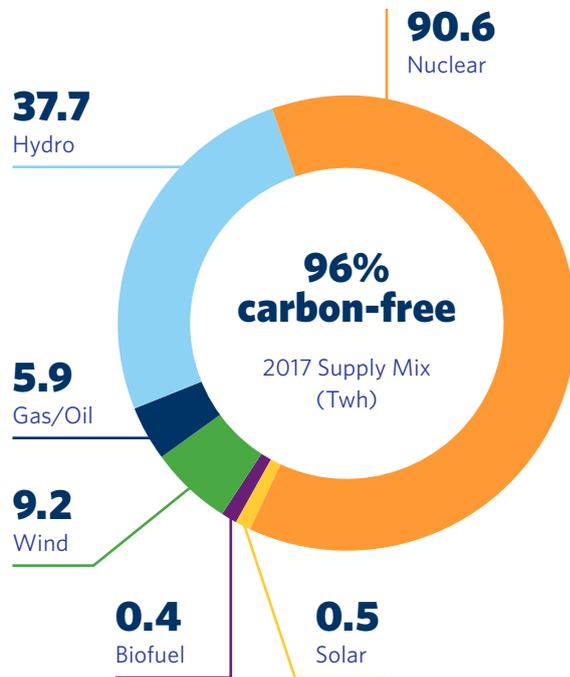
Distributed energy resources (DERs) are one example of the changes that are fundamentally transforming the sector. Ontario has over 4,300 megawatts (MW) of distribution-connected resources in service or under development, over half of which are solar. These resources are causing distributors and generators to think very differently about everything from new pricing models to regional planning options. Prior to integrating them more fully into the province's bulk electricity system, there are planning protocols to consider, as well as regulations and policy-driven incentives to factor in. The IESO also needs to understand how they can contribute to grid reliability needs and meet consumer demand over different timeframes.

While the IESO has a keen interest in enabling and integrating DERs, these resources bring with them a complex set of operational, regulatory and policy issues. Before major decisions can be made, the sector needs to come together and work them out collaboratively.

TESTING THE POTENTIAL, AND THE LIMITS, OF ADVANCED TECHNOLOGIES

With a transmission-connected supply mix based heavily around nuclear and hydroelectric power, Ontario's electricity system is approximately 96 percent carbon-free. In 2017, wind and solar energy met roughly seven percent of Ontario's supply needs, and gas output contributed about four percent. There were also more than 3,880 MW of contracted embedded generation within local distribution systems.

As more clean ("non-carbon-emitting") resources are integrated in the province's supply mix, the IESO is looking at ways to balance out the intermittent nature of this type of generation. "Advanced technologies offer great potential, particularly when it comes to renewables," said Katherine Sparkes, the IESO's Director of Innovation, Research & Development. "Our priority is to find ways to enable the testing and development of these technologies and ensure they are safe, reliable and cost-effective." >>



< This four megawatt battery storage facility, owned by RES Canada, provides regulation service to Ontario's electricity grid. This specialized service, referred to as regulation service, maintains second-by-second balance on the electricity grid, supporting the IESO's day-to-day operation of the system and market.

Two new facilities – Loyalist 1 (Hecate Energy Storage VII, LP) and Owen Sound Regulation Services Project (Saturn Power Inc.) – seem to hold great promise. They were selected through a competitive process in late 2017 to provide a grid-balancing service called “regulation.” Together, they will deliver a combined 55 MW of regulation service to help balance the grid by correcting for short-term changes in supply and demand. This incremental regulation capacity complements the 100 MW of regulation capacity that is typically scheduled every hour to help ensure the reliable operation of the power system despite unexpected changes to grid conditions.

Importantly, the contracts awarded to these facilities represent one of the largest reductions in per unit cost for regulation service since the market opened in 2002 – a strong endorsement for emerging technology’s ability to compete with more traditional services.

For projects that are not yet commercialized, there are currently two IESO funding streams available. A third stream, still in development, is the Renewable Distributed Generation Integration Fund. It will support further testing of DERs and evaluation of their potential impacts on the transmission grid.

The Conservation Fund is an incubator that tests new and emerging technologies, programs and research to acquire information that can be used in future programming and strategy development. Since 2005, this stream has provided funding for over 200 projects. One recent

recipient of funding is Enersion Inc., which has developed a technology that utilizes a proprietary nano-porous material to convert thermal energy (heat) into cooling power without the use of harmful refrigerants. The company’s president, Dr. Hanif Montazeri, says that for manufacturing facilities and data centres with conventional compression-based chillers that consume large amounts of electricity, this low-cost absorption cooling technology could reduce the amount of electricity used for cooling by up to 70 percent.

“We are in the pilot phase, pre-commercialization, and because we don’t yet have a business case with reliable data, potential investors have lots of questions for us,” said Montazeri. “The IESO funding is not only helping with pilots in a manufacturing facility and a data centre, it’s also being used to hire independent third-party reviewers to evaluate our data. From my perspective, the best part about receiving IESO funding is that it’s given us instant credibility. The IESO is a well-known and trusted organization, and their confidence in us is really helping when we make our pitch to investors.”

The second funding stream is the LDC Innovation Fund, for conservation pilots initiated by local distribution companies (LDCs). This fund enables the testing of innovative conservation programming and delivery. Approximately 25 pilots across different sectors have been funded and close to \$20 million has been committed to these projects.

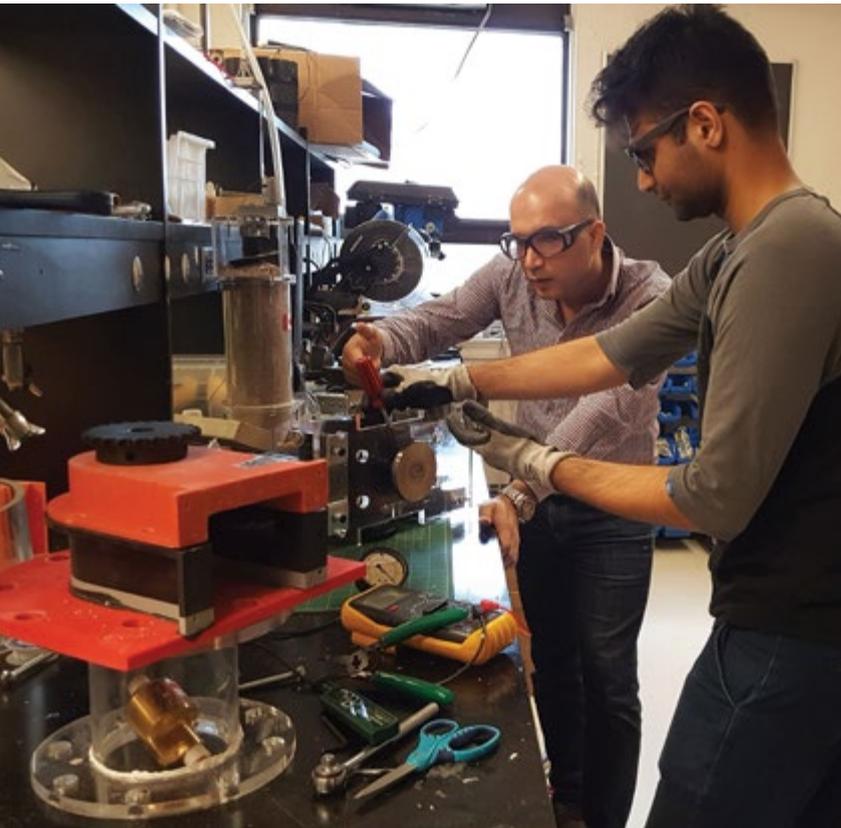
In addition to examining the results from various pilot projects and research before making its decisions, the IESO invites input from a wide variety of stakeholders on the potential these technologies represent.

“We study the hard data and also seek input from a wide variety of stakeholders. It’s all about collaboration,” said Young. “The industry is increasingly interconnected and requires an ongoing dialogue where we can all share our unique perspectives and, together, effectively meet the needs of the sector.”

As an example, he points to the IESO’s role in enabling the development of a smart electricity grid. Organizations from the utilities sector (including the IESO), industry associations, non-profit organizations, public agencies and universities, are all putting their heads together to establish a provincial smart grid that will meet tomorrow’s energy needs and deliver value to customers and industry alike. ●

- ▼ With support from the IESO’s Conservation Fund, Enersion is developing a flexible, innovative absorption-based chiller series that will range from 5 tons to more than 50 tons of cooling power, and suit multiple cooling applications.

PICTURED BELOW LEFT TO RIGHT:
Dr. Hanif Montazeri, CEO
of Enersion;
Vignesh Krishnamurthy,
Design Engineer of Enersion



Pilot Aims to Boost Adoption of Electric Vehicles

✓ In this first of a kind initiative, the Markham Civic Centre provides 16 Level 2 EV charging stations available for program participants, plus one Level 2 charging station for public use.

Photo courtesy of City of Markham

The Alectra Drive for the Workplace pilot is the first program of its kind in Ontario to assess the impact on the electricity grid of electric vehicles (EVs) charging at work, during work hours. Alectra Utilities and the City of Markham launched the two-year pilot program at the Markham Civic Centre in late 2017. A broad cross-section of public and private-sector partners, including the IESO, came together in support of this program.

The pilot currently involves 23 Level 2 EV charging stations at two workplaces in the Greater Toronto Area. EV drivers are provided with enough battery charge to meet or exceed their daily commute requirements during the time they are at the workplace, helping to reduce battery range anxiety for participating drivers, while charging is managed to minimize strain on the local grid. Over the longer term, the program supports the province's goal of increasing EV sales to five percent of all new passenger vehicles sold by 2020.

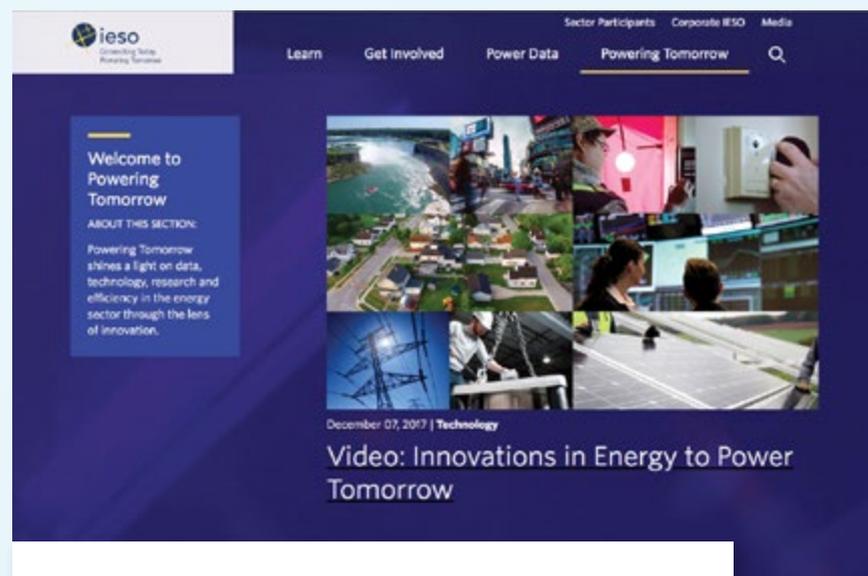


“As the use of EVs becomes more common in Ontario, the increased load from vehicle charging will need to be managed in order to reduce costs to building owners and utilities,” said Terry Young, the IESO’s Vice-President, Policy, Engagement and Innovation. “Understanding the impact of daytime EV charging at workplaces will help us to manage peak demand on the provincial electricity grid and reduce future electricity infrastructure investments.”

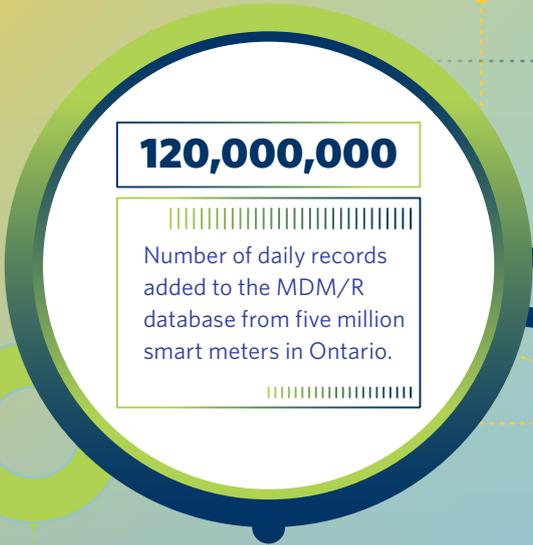
Shining a Light on Data, Technology, Research and Efficiency Through the Lens of Innovation

Powering Tomorrow (www.ieso.ca/powering-tomorrow) is a window into the energy world of tomorrow.

Designed to spark a conversation with the online community about the role new technology is playing to transform the province’s electricity sector, Powering Tomorrow brings together feature articles, interviews with industry experts, videos and illustrations, inviting viewers to imagine how different tomorrow’s energy world will be. Plain language is used to explain complex topics such as distributed energy resources, battery storage and hydraulic air compression, among others. Powering Tomorrow also provides a snapshot of some of the many projects for which the IESO has provided funding through the Conservation Fund.



“Advanced technology has created so much potential to revamp our relationship with electricity,” said Jessica Savage, Director of Corporate & Indigenous Relations. “We want people to know what the IESO is doing to seize those opportunities and engage with sector partners.”



120,000,000

Number of daily records added to the MDM/R database from five million smart meters in Ontario.

HOW SMART METER DATA CAN HELP DRIVE INNOVATION

The IESO is exploring ways to leverage the vast amount of smart meter data it has stored in its Meter Data Management/Repository (MDM/R).

Every day, over 120 million records from approximately five million smart meters province-wide are added to the MDM/R database. Aggregating the data and analyzing the patterns it contains could represent a significant opportunity to further transform Ontario's electricity system through the innovative use of "de-identified" consumption information.

De-identified information is collected and stored in the MDM/R in accordance with privacy guidelines established by Ontario's Information and Privacy Commissioner. The guidelines are designed to protect electricity consumers' privacy and confidentiality by ensuring their identity cannot be linked to the data sent by their smart meter.

According to Sorana Ionescu, the IESO's Director, Smart Metering Entity, the energy consumption data from the MDM/R can be translated into insights, information and knowledge that will enable further industry transformation. "To create value for rate-

payers, it makes sense to start leveraging the data we have in a thoughtful and strategic way," said Ionescu.

Aggregated smart meter data could lead to the development of:

- Electricity baselines to help improve efficiency, encourage energy conservation and support the ongoing transition to renewable energy
- Electricity consumption load profiles to predict greenhouse gas impact on Ontario's power system
- Priority areas within municipalities, in support of programs that drive greater energy efficiency, conservation and distributed generation
- More informed decision-making related to regional planning.

BY THE NUMBERS

Local distribution companies (LDCs) integrated into the Meter Data Management/Repository (MDM/R):

67

Daily reports delivered to LDCs via the MDM/R:

2,300

Service Delivery Points for MDM/R data:

4.6 million

Residential customers



0.4 million

Small General Service customers

GULL BAY FIRST NATION MICROGRID FIRST OF ITS KIND IN CANADA

An innovative diesel offset project in Kiashke Zaaging Anishinaabek (KZA)/Gull Bay First Nation, north of Thunder Bay, will be Canada's first fully-integrated microgrid to use a combination of battery energy storage and solar panels as a clean energy source to replace costly diesel generation.

"The KZA Solar Micro Grid project reflects our peoples' connection with the land and our responsibility as caretakers on behalf of all living things for seven generations. The project is a game changer, as Canada's first fully-integrated solar energy storage system in a remote community," said Chief Wilfred N. King. "Through KZA's ownership of the microgrid, we shall replace thousands of litres of dirty diesel fuel with clean solar power. We would be honoured to share our experiences with off-grid Indigenous communities across Canada."

There are 97 on-reserve houses in Gull Bay First Nation, with a population that varies seasonally, ranging from 300 to 800 people. A series of approximately 1,000 ground-mounted solar panels, wired to a central microgrid controller and battery energy storage system, will provide clean energy to these homes, circumventing the community's existing diesel generator at times. When diesel is required, the microgrid's control system can initiate the process to switch seamlessly back to diesel, with no disruption in the power supply.

With the new microgrid, Gull Bay First Nation will not only benefit environmentally from having access to a cleaner fuel source but will also assume full ownership of a valuable economic asset. The community foresees the microgrid as a catalyst for economic development in the form of new social enterprises and new revenue.

Gull Bay is one of four remote communities that are not currently economic to connect to the provincial grid. "The IESO is proud to support Gull Bay First Nation on this project," said Tabatha Bull, the IESO's Senior Manager, First Nations & Métis Relations. "For remote communities, diesel generation used to be the only fuel option. Today, with advanced technologies, communities like Gull Bay can displace this fossil fuel and take steps to ensure they thrive over the long term, both environmentally and economically. The IESO looks forward to continuing to support other Indigenous communities with similar aspirations."

The KZA Solar Micro Grid is a collaborative project of Gull Bay First Nation and Ontario Power Generation, along with other key parties. The IESO provided over \$670,000 in funding for the project through the Aboriginal Community Energy Plan program, the Education and Capacity Building program and the Energy Partnerships Program.

Environmental assessments were completed in October 2017, work to clear the land began in April 2018, and the project is expected to be constructed by the end of 2018.



^ Following the launch ceremony at the proposed project site, KZA community members take part in a drum circle to open the meal, celebrate the project and give thanks for the day's festivities.

PICTURED ABOVE: KZA Chief Wilfred N. King addresses the crowd at the proposed microgrid site.

Keeping the Lights On: New Challenges Call for New Approaches

Advanced grid technologies, changing supply and demand patterns, more extreme weather and cybersecurity threats all have one thing in common: They're adding multiple layers of complexity to the already complex work of power system operators worldwide. It's no longer enough to plan for what can reasonably be forecasted to happen. Our engineers and operators also need to prepare for what comes completely out of left field.



Leonard Kula
Vice-President, Planning,
Acquisition and Operations,
and Chief Operating Officer

BY THE NUMBERS

Total market
participants:

524

New market
participants
in 2017:

32



Consider the 72-hour ice storm that engulfed large parts of Ontario in freezing rain, snow, ice pellets and high winds in mid-April 2018. According to Dave Devereaux, the IESO's Senior Manager, Market Forecasts and Integration, while the IESO planned for the worst, the storm's impact was minimized thanks to the team approach taken by the energy sector as a whole. "We knew the week before the storm hit that extreme weather was coming. Several days before it arrived, we began working with Hydro One to take actions that would minimize potential impacts on the high-voltage grid," said Devereaux. "Generators agreed to postpone planned maintenance in order to ensure we had enough power when and where it was needed. During the ice storm, staff at local distribution companies worked tirelessly to restore power. Electricity system operators for New York and Michigan were on standby to help as needed. This was one big team effort."

If it sounds like a well-oiled machine, Devereaux says that everything the Operations team – and the sector as a whole – did during the ice storm was based on previous experience with extreme weather events. "Every time something unpredictable happens, you learn and you carry that learning forward with you for the next time. We practice, we train, we forecast, but we're also implementing a whole bunch of lessons learned from the time before."

Fortunately, ice storms are not everyday occurrences. The same cannot be said for distributed energy resources (DERs) such as embedded wind and solar, and other technologies that enable electricity to be injected,

withdrawn or stored at the local distribution level. As the pace at which these resources are embedded into the electricity grid accelerates, they are creating more than a mere blip on control room screens. They have the potential to transform the province's centralized electricity grid into a system that is more decentralized. And as more of these resources come on stream in the coming years, the IESO is predicting big changes ahead.

Research by the North American Electric Reliability Corporation indicates that the penetration level of distributed energy in North America will double within the next four years, jumping to just over 40 gigawatts (GW) in 2021 from just under 20 GW of installed capacity in 2017. The U.S. Energy Information Administration, meanwhile, suggests in its most recent Annual Energy Outlook that distributed generation will continue to grow at an annual rate of 4.9 percent to 5.8 percent each year to the year 2050, with renewable segments skewing even higher.

"The IESO is not the only system operator to be faced with the rapid jump in DERs," said Leonard Kula, the IESO's Vice-President, Planning, Acquisition and Operations, and Chief Operating Officer. "The North American electricity grid is highly interconnected, and because of that, there are many issues that North American system operators like the IESO need to figure out in terms of the impact DERs will have on the bulk electricity system. We might need to change the way we do our modelling and planning. Even some conventional assumptions may need to be revisited. It's all part of adapting to change and preparing for the future." >>

DISTRIBUTED ENERGY RESOURCES: HOW THEY WORK

1. SMART HOMES

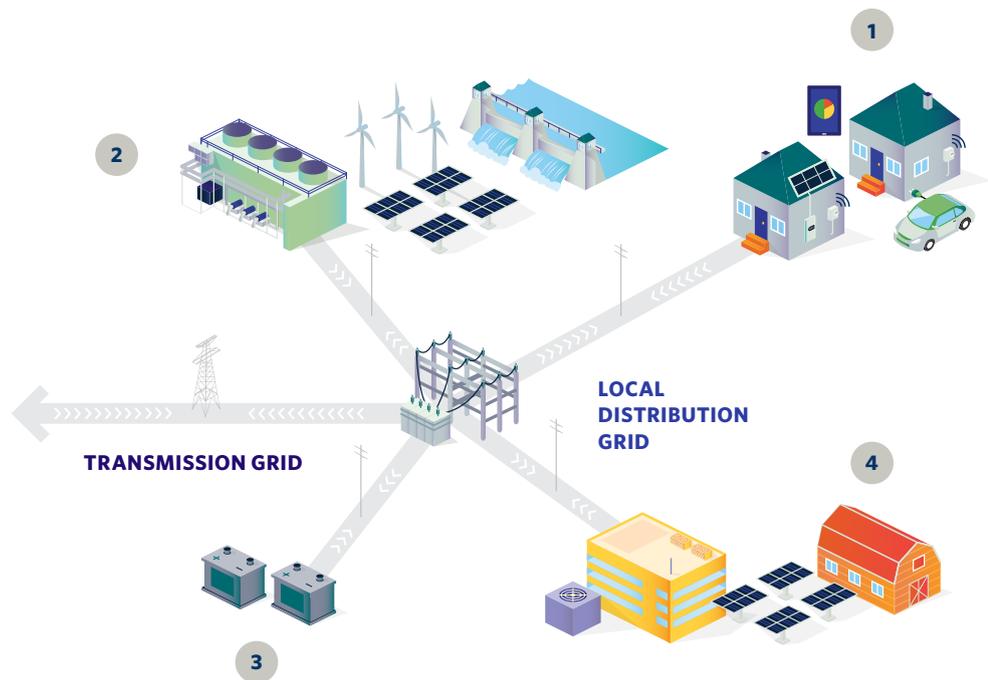
Consumers can better control their energy use at home with smart lighting and appliances. On-site generation and energy storage can help shift energy use at home or enable consumers to sell to the grid. Several homes can even be aggregated to provide electricity services back into the grid.

2. GENERATION

Small scale generation such as solar, wind, hydro, bioenergy and combined heat and power are connected to the distribution grid.

3. STORAGE

Storage technologies such as batteries can withdraw electricity from the grid when prices are low, store it, and release the energy back into the grid when prices are higher.



4. CUSTOMERS WITH GENERATION AND CONTROLLABLE EQUIPMENT

Some businesses use a combination of energy efficiency, demand response techniques, as well as on-site generation to manage their energy use and costs. Equipment such as heating and cooling pumps can be controlled to ramp up or down depending on electricity prices. They can also generate and/or store their own electricity to use or sell to the grid.



“We take cybersecurity issues very seriously. There is no doubt the sophistication of cyber threats will continue to evolve.”

Alex Foord, Vice-President, Information & Technology Services, Chief Information Officer

CYBER-PROTECTION FOR ONTARIO'S ELECTRICITY GRID

When it comes to protecting Ontario's electricity grid from cyber threats, Alex Foord believes the best defence is a good offence.

As the IESO's new Vice-President, Information & Technology Services, and Chief Information Officer, Foord's job is to help protect the electricity grid from cyber attacks and ensure the lights stay on in customers' homes and businesses, even if a breach occurs. To do that he is taking a multi-pronged approach. His cybersecurity team, led by Supervisor of Information Security, Ben Blakely, is not only collaborating with the world's leading cybersecurity policy experts to share best practices, it's also working closely with the Communications Security Establishment – Canada's cryptographic agency – as well as ensuring 24/7 real-time cybersecurity monitoring to assist with incident detection and response. The ultimate goal, he says, is to continuously strengthen the IESO's security posture – and that of Ontario's electricity sector as a whole.

“We establish smart relationships, both to enable and facilitate innovative solutions to defend our sector and its infrastructure,” said Foord. “In addition to working with our industry and government partners, we rely strongly on input from local distribution companies, especially through our Cybersecurity Forum. Because the energy sector is so interconnected, there are lots of different opinions. Getting to consensus can be a complex, multi-layered process.”

The Cybersecurity Forum is an IESO standing committee that drives forward innovation and collaboration on cybersecurity matters within Ontario's electricity industry. “This forum is designed to improve cybersecurity within Ontario's electricity sector. It develops and shares best practices that address emerging or existing cybersecurity issues, with the ultimate goal of improving each organization's cybersecurity programs,” says Blakely. As needed, it may also provide support to other electricity-specific forums in Ontario, such as the Energy Transformation Network of Ontario (formerly the Ontario Smart Grid Forum) and the IESO Emergency Preparedness Task Force.

The Cybersecurity Forum's primary goals are to:

Increase awareness around national cybersecurity initiatives	Develop and collaborate on best practices	Review current information about incidents, threats and vulnerabilities that have been analyzed by trusted experts
Discuss information and awareness about emerging technology with an emphasis on possible vulnerabilities and risks	Share information concerning information security management practices	Leverage lessons learned and expert advice

“We take cybersecurity issues very seriously. There is no doubt the sophistication of cyber threats will continue to evolve,” said Foord. “That's why it's crucial that we work together as an industry to ensure our cybersecurity capabilities are consistently and effectively applied, not only to the IESO, but the organizations that make up our industry.” ●

Tracking the Solar Eclipse



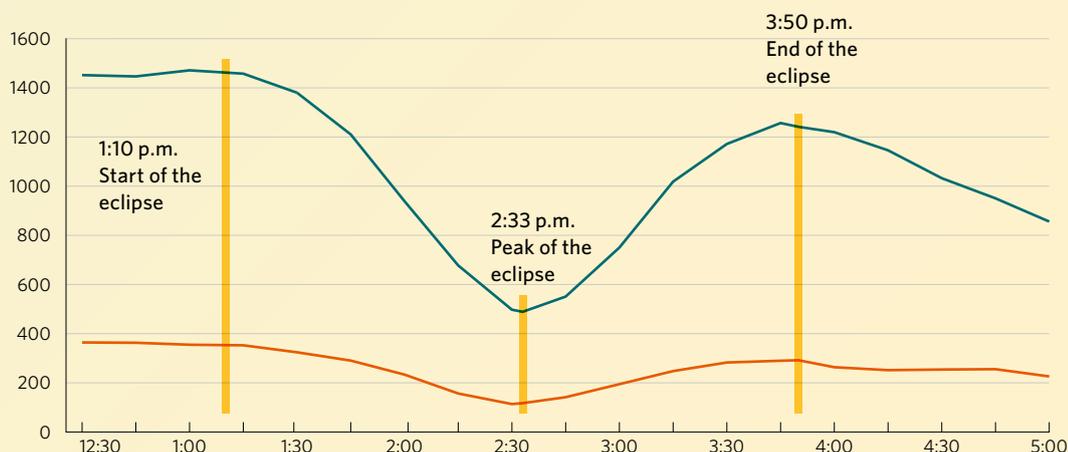
While North American solar eclipse watchers kept an eye on the afternoon sky on August 21, 2017, system operators in the IESO's control room kept theirs on the ebb and flow of electricity supply and demand, to ensure their forecasts for the day were on the mark and Ontario had an adequate supply of electricity.

What made their calculations so important that day was the fact that this was the first solar eclipse to take place since large amounts of solar generation had been installed across North America. (There are approximately 2,300 MW of solar generation in Ontario - roughly the same amount of power needed to meet peak summer electricity demand for Ottawa and Brampton combined.

About 2,000 MW are embedded in local distribution networks, with the remainder connected to the transmission system).

"The planning for this unique celestial event absolutely paid off," said Leonard Kula, the IESO's Vice-President, Planning, Acquisition and Operations, and the organization's Chief Operating Officer. "There were no surprises, no reliability issues. As we predicted, industrial usage declined when large consumers avoided using energy during the peak hour, solar generation output was reduced as per the IESO's forecast, and by the end of the eclipse, we watched as embedded solar generation recovered to exactly where it should have been."

SOLAR GENERATION OUTPUT ON AUGUST 21, 2017 (MW)



— Distribution-Connected Solar Output
— Grid-Connected Solar Output

Prior to the beginning of the event, output of embedded solar generation was approximately 1,470 MW with transmission-connected solar generation at approximately 350 MW. Consistent with the IESO's forecast, solar generation output at the peak of the eclipse was reduced to approximately 490 MW for embedded solar generation and approximately 115 MW for transmission-connected solar generation. By the end of the eclipse, embedded solar generation had recovered to approximately 1,250 MW with transmission-connected generation recovering to approximately 280 MW.

The total reduction in solar generation output

1,220 MW

about 67 percent of the pre-eclipse solar generation output.

Simulating the Unpredictable



Airline pilots use flight simulators. Office workers practice evacuation drills. But how does an organization like the IESO, whose core business is operating one of the largest electricity systems in North America, prepare for events that are in some cases unpredictable?

It all starts with a team of highly experienced control room operators who share an ability to adapt quickly to change - an agile team skilled at working through different emergency preparedness responses until restoration is achieved after a simulated event. Their training culminates in a

real-time Control Room Simulator where they learn and practice the principles for delivering superior reliability in a changing environment. In support of this requirement, the IESO is currently working on developing the second phase of its simulator project, which will allow operators to simulate a wider range of contingency events in a training environment. This will help them to hone their skills and be ready to respond in situations they have not encountered before.

Where Innovation Intersects with Competitiveness, and Why It Matters

It's understandable for energy users to assume that when they flip the switch, the lights will go on and stay on. But what may not be as top-of-mind for them is the continuous improvement that goes on behind the scenes to ensure the lights stay on reliably and cost-effectively.

BY THE NUMBERS

Eligible participants
in 2017 under the
Industrial Accelerator
Program (IAP):

60

Increase in
contracted IAP
energy savings:

50%



2016 2017



“In the electricity world, innovation is definitely driving us towards more cost-effective solutions, and towards a grid that functions more cost-effectively,” said Peter Gregg, the IESO’s President and Chief Executive Officer. “That’s important for ratepayers. It’s one of the reasons why innovation is reflected in our realigned corporate structure.”

The Market Renewal project represents the most significant suite of reforms since the electricity market was designed in the late 1990s and opened in 2002. It will help to ensure that Ontarians have a stable and reliable supply of electricity at the lowest cost, while those working in the sector can rely on a robust and stable market that is prepared for the future.

“We believe that now is the right time to renew the market and create one that is more responsive and ready to meet the challenges of today, while still being flexible enough to adapt to future changes,” said Leonard Kula, the IESO’s Vice-President, Planning, Acquisition and Operations, and Chief Operating Officer. “It’s time to rebuild the foundations of Ontario’s wholesale electricity markets. This will be a collaborative effort.”

Market Renewal initiatives affect the way the IESO procures and schedules energy resources. It’s partly about doing things that have been done since 2002 much more efficiently; it’s also about changing the way requirements are defined for resources and how they are acquired. In doing so, a framework is set that better enables the electricity grid to adapt to the changes that are fundamentally changing the sector.

.....
**Market Renewal
to deliver significant
efficiencies up to
\$5.2 billion
(over 10 years)**
.....

Kula notes Market Renewal will deliver significant financial efficiencies, up to \$5.2 billion over a 10-year period. “The benefits are expected to extend well beyond this timeframe. In the end, we will have a marketplace that is more agile, more adaptable and more aligned with market forces than ever before.”

A more efficient market means the IESO can maintain reliability in a more cost-effective manner, says Barbara Ellard, the IESO’s Director, Markets and Procurement. Ellard foresees a redesigned market where the right signals for the right products are sent to those participating in the market. “We need to unbundle the services that are required to operate the grid reliably. This includes energy, capacity and other grid services,” said Ellard. “In this way, we’ll be able to send accurate price signals and let the market determine what the best solutions are to meet those needs. Meeting our system needs through open and competitive markets will encourage innovative solutions and ensure emerging technologies can compete with conventional ones on a level playing field.”

Kula says the incremental capacity auction will improve the way Ontario acquires electricity supply to meet medium- and long-term needs. A competitive auction, in which a wide range of technologies can compete, will have multiple benefits, such as: creating a competitive market for suppliers; increasing the system’s ability to adjust to changing supply and demand dynamics; and attracting low-cost, non-traditional capacity resources. These benefits are unlikely to be identified in the absence of a competitive auction. “Auctions are a very effective way to secure the services we need. For suppliers, capacity auctions provide enduring and transparent mechanisms to get paid for the capacity they supply. For consumers, they ensure capacity is secured at lowest cost.” >>

The Market Renewal project is working on four key initiatives:



“Change is everywhere. It permeates our professional lives as well as our personal lives. If we want our employees to deal with these changes effectively, we need to provide them with the right tools and support.”

Marcia Mendes-d’Abreu

Vice-President,
Human Resources



The demand response (DR) auction is a good example of how competition and transparency are driving costs down, and how new frameworks for acquiring resources open the door to new, innovative solutions. There were 15 successful participants in the IESO’s third annual DR auction in 2017, up from seven successful participants in the first DR auction in 2015. Together, these resources will be able to reduce the province’s electricity load by up to 570 MW during the summer of 2018 and up to 712 MW during the winter of 2018/19. The price for participants’ contributions is 16.6 percent lower than the results from the first DR auction in 2015.

It is significant to note that of those successful bidders, eight were electricity aggregators, large transmission-connected loads and local distribution companies – a broad cross-section of bidders that wasn’t well represented when the first auction was held in 2015. Their participation points, again, to how the DR auction is levelling the playing field and helping to make the market more competitive.

In addition to identifying ways to ensure the electricity market functions as cost-effectively as possible, the IESO is also looking inwardly at its own practices for ways to improve. In 2016, the Operations Readiness Initiative (ORI) started to examine several of the processes and tools that

staff use on a daily basis for overall efficiency. As a result of the ORI, the IESO is introducing enhancements to demand forecasting, power system analysis tools, inertia scheduling tools and processes, as well as a number of other process improvements in the control room – all with a goal of reducing the time formerly spent on manual data entry tasks. “This is about helping our operations staff stay ahead of change,” said Nicholas Ingman, Director, Enterprise Change. “By reducing manual effort, improving processes and increasing our productivity, we will be better able to manage the new operational challenges of tomorrow.”

Innovation within the IESO’s workforce is certainly not limited to Market & System Operations. Instead, Vice-President of Human Resources, Marcia Mendes-d’Abreu wants innovation to flourish across the organization. With that in mind, she’s focused on working with peers across the organization to develop and nurture a corporate culture that encourages employees to propose innovative solutions to existing and emerging challenges. “Operating within Ontario’s highly regulated electricity sector, the IESO is subject to a broad range of policies, processes and compliance obligations,” said Mendes-d’Abreu. “We can’t change that. What we can do, however, is provide our people with the freedom to innovate within this framework.”

In a rapidly changing business environment, resilience takes on particular importance. Just as the IESO is building its organizational resilience Mendes-d’Abreu plans to work collaboratively to identify ways to build employees’ own resilience. “Change is everywhere. It permeates our professional lives as well as our personal lives. If we want our employees to deal with these changes effectively, we need to provide them with the right tools and support.” ●

What is the Conservation First Framework?

The **2015-2020 Conservation First Framework (CFF)** maps out Ontario’s energy conservation goals and emphasizes a coordinated effort within all stages of conservation planning, including strong collaboration among sector partners, particularly with local distribution companies (LDCs).

The goal of the CFF is a total reduction of 7.4 terawatt-hours (TWh) from conservation programs delivered by LDCs and the IESO to residential and business customers across the province by December 31, 2020. An additional 1.3 TWh of energy savings are expected to be achieved through conservation projects with transmission-connected customers through the Industrial Accelerator Program.

NET PERSISTING ENERGY SAVINGS (TWH)



MANAGING COSTS THROUGH CONSERVATION

It's been 14 years since local electricity distribution companies in Ontario launched their first energy conservation programs, and in that time, not only have the number of programs multiplied, the cost to deliver those programs has also decreased by approximately one-half, to just over two cents per kilowatt-hour.

Conservation continues to be the most cost-effective resource for meeting the province's electricity needs.

Terry Young, the IESO's Vice-President, Policy, Engagement and Innovation, attributes much of the success of provincial Save on Energy programs to hard work and collaboration within the sector. For residential programs in this framework alone, some 50 million energy-efficient devices have been purchased either through redeeming coupons or instant rebates at any of the more than 1,300 participating retailers. "There has been a tremendous sector-wide effort to raise awareness of the Save on Energy programs," he said. "It's important that we get consumers in-store with coupons and instant rebates, help business owners understand the programs and opportunities available, and build momentum for our expanding conservation culture. We're seeing very promising results of that work through our mid-term review of the Conservation First Framework."

Since 2006, Ontarians have saved more than 68 billion kilowatt-hours through their conservation and energy-efficiency efforts – about the same amount as Toronto-area customers would consume in two and a half years.

It gets better. Local distribution companies are meeting their prescribed goals and are under budget at the half-way mark of the current framework, which ends in 2020. Savings of approximately four terawatt-hours of electricity have been achieved through Save on Energy and Industrial Accelerator Programs since the beginning of 2015. Also, programs offered through local distribution companies are being delivered at half the cost of the next lowest generation supply and are lower than through the previous conservation framework. Results of a stakeholder engagement to review progress of the Conservation First Framework are positive.



Young is quick to add, however, that there's more to the conservation story than consumer programs and incentives. The IESO takes a wide-angle view of the energy conservation landscape, he says, providing funding for innovative stand-alone projects as needed. The TowerWise energy efficiency project (phase two) is an example of this approach. A ground-breaking \$9-million initiative launched by The Atmospheric Fund in 2017, with support from Natural Resources Canada and the IESO, TowerWise will demonstrate how older, mostly multi-unit, buildings can reduce urban carbon emissions through deep energy retrofits. The goal is to achieve a minimum of 40 percent energy and emission savings through energy retrofits that include equipment replacements, improved insulation and heat pumps.

"TowerWise represents the kind of innovation and market transformation the IESO seeks to enable on a broad scale," said Young.

BY THE NUMBERS

Save on Energy programs available in 2017:

15
province-wide programs

28
local/regional programs

SAVE ON ENERGY
POWER WHAT'S NEXT



Collaboration and the Many Roads to Decision-making

Ontario's power system is facing challenges on all fronts. It's not just that the issues are complex and evolving rapidly. It's that no one person, or organization, can possibly have all the answers. That's why the IESO's President and Chief Executive Officer, Peter Gregg, feels that two heads are significantly better than one.

2017 BY THE NUMBERS

Total attendance
at 118 engagement
meetings:

> 5,300

Total attendance
at five regional
forums:

> 500

Indigenous communities
and councils with whom
the IESO engaged:

93

First Nation communities

18

Métis councils

“Understanding the issues from every possible angle and seizing opportunities that will allow us to build a more innovative, competitive and efficient market requires collaboration across the sector. No one can do this alone,” says Gregg.

Engaging with stakeholders and communities is a critical part of the IESO’s business model. It’s how the organization receives feedback and reaches decisions, and for that reason, the IESO casts an extremely wide net – engaging proactively with generators, transmitters, local distribution companies, large-scale industrial customers, First Nations and Métis peoples, community organizations, academic institutions, emerging technologies and the general public. All are invited to feed into the IESO’s engagement process, providing advice and sharing ideas that will inform policy and shape programs.

Opening the door to greater opportunity for First Nations and Métis peoples is a key priority for the IESO, according to Gregg. An extensive engagement in 2017 with First Nations and Métis people from across the province was instrumental in helping the IESO understand the barriers Indigenous peoples face when it comes to current energy conservation programming. It also helped the organization understand how the IESO can improve its current suite of Indigenous

Energy Support Programs. The engagement included the following initiatives:

- Regional meetings (Thunder Bay, Sudbury, London, Vaughan)
- Indigenous Community Energy Symposium (Toronto)
- Nishnawbe Aski Nation Climate Change Coordinators meeting
- Métis Nation of Ontario Councils meeting
- IESO’s Aboriginal Energy Working Group (AEWG)
- A province-wide webinar with 80 attendees registered

In partnership with the Ministry of Energy, the IESO organized the Indigenous Community Energy Symposium – a first-time event designed to encourage a province-wide dialogue about how energy can be used to help build strong, sustainable Indigenous communities in Ontario, as part of the same engagement.

Over the two-day meeting, more than 300 attendees shared ideas, experiences and expertise related to community energy planning. First Nations youth representatives, industry stakeholders and leading community energy experts were all well represented, and 92 percent of participants who responded to the post-event survey indicated the symposium was either beneficial or very beneficial.

“The IESO will continue to engage First Nations and Métis peoples regularly to ensure programs are accessible and effective,” said Tabatha Bull, the IESO’s Senior Manager of First Nations & Métis Relations. “To encourage knowledge transfer, the IESO will also provide opportunities for Indigenous successes in electricity to be celebrated so that other communities and organizations can learn from their peers.”

Another important public engagement began in 2017. This engagement will help the IESO and various stakeholders, including government, municipalities, utilities, universities and research institutions, figure out how to unlock the value of “de-identified” smart meter data being stored in the IESO’s warehouse of smart meter data known as the Meter Data Management/Repository (MDM/R). This information could be used in everything from establishing baselines for long-term regional planning to the development of new energy conservation programs (see page 8).

“Non-emitting resources” including nuclear, hydroelectric, solar and wind generators, as well as energy storage, are playing an increasingly important role in providing Ontario’s energy supply needs. In renewing the Ontario market, it is important for the sector to understand the unique drivers and considerations of non-emitting and emerging technologies. For that reason, at the end of 2017 the IESO initiated an engagement process to hear their views and consider their input on market design. >>



BY THE NUMBERS
300

Attendees at the
Indigenous Community
Energy Symposium
representing
72 communities and
20 organizations

"Non-emitting resources represent an important stakeholder group for us," said Tom Chapman, Chair of the Non-emitting Resources Sub-Committee and Senior Manager, Market Development and Strategy for the IESO. "We think it's important to bring as many of them as possible into the conversation and see if there are ways in which these resources can participate in the market, on an equal footing with other types of generators."

The IESO established a subcommittee of the Market Renewal Working Group to learn how to integrate non-emitting resources into the market and also evaluate how they might affect market outcomes. The Canadian Wind Energy Association (CanWEA) is one stakeholder that was eager to have its voice heard. As a member of the Non-emitting Resources Subcommittee, CanWEA says that because Ontario has the largest wind fleet in the country, representing over 4,900 MW of supply, there was no question that representatives from the wind industry should be at the table. "The IESO was very proactive about engaging Ontario's wind industry in the Market Renewal project," said Brandy Giannetta, CanWEA's Regional Director, Ontario. "We have been very encouraged by the IESO's willingness to listen to our ideas about market design and changes to enable greater integration of non-emitting resources. It's especially great that input is happening before decisions are made, rather than after the fact."

The IESO is also heavily involved in engagements that focus on regional electricity planning (for electrical purposes, the province is divided into 21 planning regions). Jessica Savage, the IESO's Director of Corporate & Indigenous Relations, notes that taking an integrated approach is critical in order to understand the emerging and long-term electricity needs of a particular region.

"For regional engagements, we work closely with local electricity distributors and the local transmitter," said Savage. "Because of the scope

of some of the issues, we are also keen on public participation. As much as possible, we look for broad representation from the region, which might include Indigenous communities, municipalities, individuals and business groups. The process isn't set in stone but we do have engagement principles and follow best practices. We learn every time we meet with a different group, and we try to continuously improve."

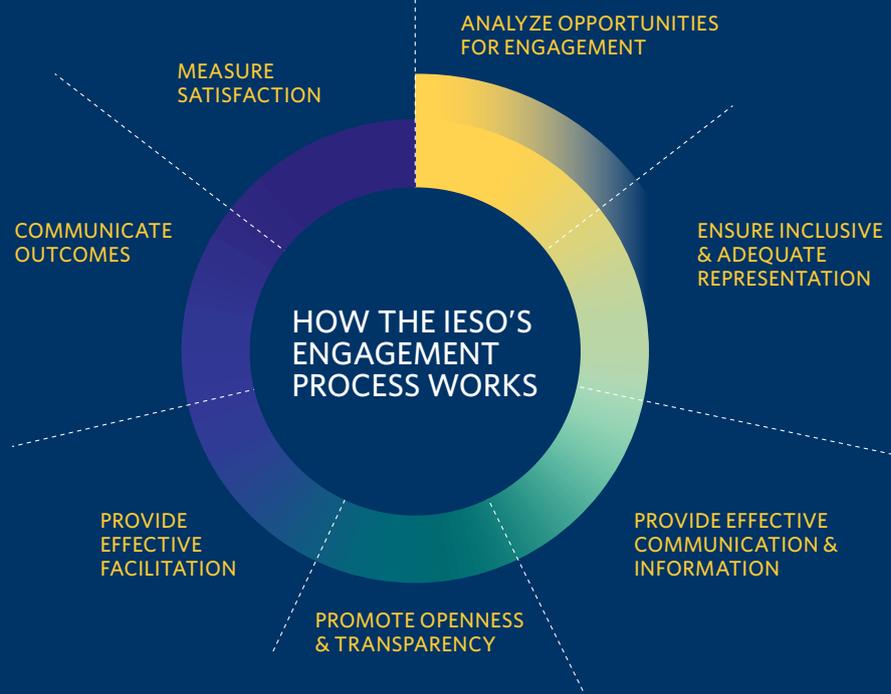
The IESO's regional planning engagement initiatives focus on issues such as:

- Integration of electricity planning with municipal planning
- Impacts of local electricity conditions on economic development
- Improvements to local electricity reliability
- Barriers to the implementation of innovative technologies and fuels
- Programs that meet customer and regional needs.

Savage points to a recent series of Regional Forums as an example of how the IESO reached out to include a broad spectrum of participants in its engagement process. A first-time initiative, the forums brought together a cross-section of representatives from municipalities, Indigenous communities, local distribution companies, local advisory committees, and associations. The goal of the full-day events in London, Vaughan, Ottawa, Thunder Bay and Sudbury was to explore the future direction of the electricity sector and engage in discussions about how electricity can be harnessed to support the growth, resiliency and vibrancy of these communities. Over 500 people attended the sessions.

"We hold hundreds of meetings, workshops, webinars and outreach sessions every year as a means to engage," said Terry Young, the IESO's Vice-President, Policy, Engagement and Innovation. "It's not only part of the IESO's DNA, it's how we develop the thought leadership that's needed to deal with today's complex issues." ●

To capture the range of views held by these various stakeholders and communities in a way that ensures inclusiveness, neutrality, respect and fairness, the IESO adheres to the following engagement principles:



The Role of Advisory Committees

Understanding the energy needs of residential and business customers is a key outcome of the IESO's engagement process, which encourages a broad range of stakeholders to provide input on everything from market development to energy conservation to regional planning. The IESO's advisory committees include representatives from a variety of industries and span a number of disciplines.

Advisory groups, standing committees, technical panels and other advisors all feed into the information-gathering process, as do members of the IESO's Local Advisory Committees, the Aboriginal Energy Working Group and the Stakeholder Advisory Committee (SAC). The SAC provides advice on market development, conservation, planning and other issues directly to the IESO's Board of Directors and Executive Leadership Team.



Avia Eek is the owner of Eek Farms, an 85-acre carrot and onion farm located in Holland Marsh. Eek is a member of the IESO's York Region Local Advisory Committee (LAC) and a Councillor for Ward 6 in King Township. According to Eek, decisions made in Ontario's electricity sector have a direct impact on the province's agricultural sector.

"Being a member of the York Region LAC allows me to advocate for positive outcomes in the electricity system for my industry and my constituents in King Township."



Falguni Shah is Acting Vice-President, Operations for Veridian Connections. She is also a member of the Grid-LDC Interoperability Standing Committee where the IESO, local distribution companies and other stakeholders are working closely to explore sharing information on DER activity, and how DERs can effectively be integrated into the power system.

"Distributed energy resources signal a new paradigm for the electricity grid. Harnessing DERs can improve operational efficiencies, reduce carbon emissions and enable customers to have greater control over their energy costs."



Mark Schembri is Vice-President, Supermarket Systems and Store Maintenance for Loblaw Companies Limited. He is also a member of the IESO's Stakeholder Advisory Committee (SAC).

"I advocate for large retail consumers, like the Loblaw network of retail banners," he said. "Representing one of the largest consumers in Ontario, I also work with the IESO to find solutions that promote energy conservation and cost control."



Connecting Today. Powering Tomorrow.

The Independent Electricity System Operator (IESO) works at the heart of Ontario's power system. The IESO delivers key services across the electricity sector including: managing the power system in real-time, planning for the province's future energy needs, enabling conservation and designing a more efficient electricity marketplace to support sector evolution.

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