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# Power Perspectives

TODAY'S CHALLENGES,  
TOMORROW'S OPPORTUNITIES

## Renewing Ontario's Electricity Markets

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Innovation, Emerging  
Technologies & Reliability

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Resilience & Ontario's  
Power System

## The Promise of Big Data in the Electricity Sector

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# Leveraging the IESO's Position at the Centre of the Industry

From the importance of innovation in the electricity marketplace to the challenges of grid modernization, IESO President and CEO Peter Gregg shares his perspective on priorities for the IESO – and the sector as a whole.



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**Peter Gregg**  
President and CEO

## Q: What changes in the energy landscape are having a major impact on the IESO's priorities now?

There are so many changes happening simultaneously in the energy sector that it's tough to point to any one in particular as having more impact. That's what makes this stage in the sector's transformation so exciting and, at times, so daunting.

Take distributed energy resources (DERs), which are reshaping the way we manage market and system operations. DERs currently make up 10 per cent of the province's total installed capacity and are expected to increase in the years to come. As they do, there will be important implications for the reliability and affordability of our electricity system. It's critical that we manage any operability issues that arise, but it's just as important that we explore potential reliability-related services that DERs might offer to support the provincial grid and help keep costs down.

Another priority for us is cybersecurity. We've made great strides in recent months developing strategic relationships across the security ecosystem. We've also seen the value of providing information, intelligence and advice to other sector players with a view to protecting our integrated systems. In a nutshell, we're focused on reliability, affordability and security, especially as they contribute to resilience.

## Q: You spoke a little about innovation in the 2018/19 issue of *Power Perspectives*. Can you fill us in on what's happened since then, and why innovation has become so central to what the IESO does?

The entire sector is rallying around innovation. It's become deeply ingrained in our thinking and our actions. As the landscape has evolved in recent years with the emergence of new products, services, technologies and business models, I think we've all realized everyone has a part to play in fostering innovation. We've worked closely with our industry partners, who have suggested the IESO's role in enabling innovation should include the following: leadership, information sharing, improving IESO operations and sending clear information to the market.

In early 2019, the IESO set out a very clear framework for demonstration projects, pilots and white papers in our first-ever Innovation Roadmap. As part of that work, we're developing a series of white papers that are intended to deepen the sector's understanding of emerging economic and technical issues that could transform the future of Ontario's electricity markets. The papers will explore specific areas of focus, including DER integration and transmission-

distribution interoperability, and inform future discussions on how local utilities, the IESO, DER owners, the OEB and other entities can work together to support reliability and affordability.

Our Grid Innovation Fund supports projects that either enable customers to better manage their energy consumption or that reduce the costs associated with maintaining reliable operation of the province's grid. Through the fund, we're investing in some really promising projects, such as an electrification of transportation pilot at York University and a transactive energy network in collaboration with three local distribution companies. We're also in the process of developing a new Data Excellence Strategy that will enable us to leverage the enormous volumes of data available to the IESO.

### Q: More than three years into the project, is the IESO's work on market renewal set to deliver on its promise?

Yes, absolutely. The whole thrust of the Market Renewal Program is to improve the way the IESO prices, schedules and procures electricity. It's about doing things more efficiently, increasing competition among resources, and finding new ways to deliver value.

With the completion of high-level designs for three core initiatives in the energy work stream, we recently passed an important milestone in the transition to a more dynamic and efficient energy market. After an exhaustive assessment of current inefficiencies in the market, we estimate that about \$800 million in net benefits could be realized in the first 10 years.

Despite these achievements, it hasn't all been smooth sailing. Given recent forecasts that suggest Ontario will have a limited need for new capacity if existing resources are re-acquired when their contracts expire, the IESO halted further work on the incremental capacity auction, one of the key deliverables in the original market renewal plan. Although course corrections are never easy, the industry appreciated our responsiveness and reacted favourably to our change of plans.

### Q: Beyond innovation and market renewal, what other areas of focus will be on your agenda in the year ahead?

Supporting competition is a key area of focus – and that's why we're gradually enabling more resource types to take part in upcoming capacity auctions. We're also looking at a competitive transmission procurement process that will enable new transmitters to participate in Ontario's electricity market and encourage Indigenous community participation in the electricity sector. Competition will drive down costs, whether that's by reducing barriers to competition, exploring new ways to acquire resources, or unlocking the value of new and existing resources.

Another key area of focus is business transformation. As an organization, the IESO must be aligned and ready to meet the challenges ahead. Our multi-year HR Strategic Roadmap calls for us to continue building the foundation for a high-performing and agile workforce and supports the development of highly effective managers and leaders who can help the IESO deliver on its mandate.

## Building a Framework for Improvement

Organizational risk comes in many shapes, and from many directions – operational, financial, environmental, reputational and regulatory, to name just a few.

Ontario's energy sector has undergone a sweeping transformation in recent years, driving the IESO to reassess emerging threats and risks to its business. As part of that work, the organization has sharpened its focus on enterprise risk to support continuous improvement and knowledge transfer.

"Ensuring the reliability and cost-effectiveness of Ontario's power system is our number one priority," explains Barbara Anderson, Vice-President of Corporate Services and Chief Financial Officer. "The work

done to advance these goals can take many different forms, and involve different business units across the IESO, but the absolutely critical thing for all of us to keep in mind is the importance of managing and mitigating the risks facing our business."

In late 2017, the IESO's Enterprise Risk Management (ERM) Program was independently assessed according to eight key risk components: leadership, governance and culture; risk appetite and tolerance; risk policy and strategy; people; ERM framework and tools;

risk monitoring and reporting; risk management processes; and performance and outcomes.

The review identified four areas that required a greater investment of time and resources which, in turn, prompted the IESO to reassess its entire risk framework and long-term organizational planning process, including policies and principles, in 2018. Through this work, the IESO developed a five-year strategic plan, which provides direction to the organization and the sector on how the IESO will realize its

vision, and evolve its business planning process to better align with changes to the internal and external environments.

"The number of risks to the IESO and to the sector as a whole continues to increase," Anderson notes. "Working with stakeholders and partners, we are constantly monitoring the situation, and adjusting our course as needed, to ensure identified risks are appropriately mitigated."

**Q: Cybersecurity is something you feel passionately about. Why is that?**

I've been saying for a few years now that today's interconnected world brings both challenges and opportunities. While it's great that many household and business devices are now connected to the internet, enabling consumers to interact with them, and with the power system, in new ways can have unintended consequences. As grids become "smarter," and more networked, and the number of access points increases, we become more vulnerable to attacks. When it comes to cybersecurity and the electricity grid, there's a lot of truth to the old adage that we are only as strong as our weakest link.

To strengthen sector-wide defences, Ontario's electricity sector is coming together to address the changing threat landscape. The IESO is collaborating with stakeholders and partners - not just in Canada but across North America and other parts of the world - to prepare for, thwart and recover from cyberattacks. And while IT departments are generally on the front lines of cyber issues, cybersecurity is everybody's business.

**Q: You've spent a significant part of your career in the energy sector, so you're no stranger to dealing with change. What is your biggest learning since you became CEO at the IESO?**

My biggest learning has to do with change itself. Change in the industry is happening quickly, and new technology means we're constantly watching, evaluating, testing and learning how to harness new ideas to help us fulfill our mission. It's fast-paced and challenging.

People don't change as quickly as technology. In our case, creating a cohesive corporate culture that fully leverages the strengths and capabilities of all employees requires time and focus. I've learned that while change might be uncomfortable, it's incredibly gratifying when everyone leans in and delivers. For example, our Market Renewal Program has brought together subject matter experts from across the organization - operations, market design and development, stakeholder engagement, IT, compliance, settlements and more. They are quite literally creating the markets of tomorrow - and working together in a way that leverages everyone's strengths. ●



## Getting the Right Fit

Ask Robin Riddell, the IESO's Vice-President of Human Resources, to identify the traits that are sought in current and future IESO employees and she'll highlight a few adjectives like agile, strategic, customer-focused, collaborative, analytical and curious. "Curiosity is a great attribute," she explains. "A curious employee wants to dig deep and know more. And in this sector, there is always more to know!"

Riddell speaks passionately about the recently developed HR Strategic Roadmap, a critical document that underpins the organization's efforts to attract, retain and reward the highly skilled employees that it relies on to achieve corporate objectives and drive business transformation.

Figuring out what skills, competencies and personal attributes will be required in the future is both an art and a science. It's one area where Riddell and her team are investing time by conducting a comprehensive environmental scan, both internal and external, to see what sort of employees will be best suited to help the IESO deliver on its mandate to ensure a reliable, cost-effective supply of electricity to Ontarians.

Riddell is taking a holistic approach to talent and focusing on the entire employee lifecycle - from hire to retire - to ensure the IESO hires and retains the right people with the right skills at the right time. That means looking at relationships with educational institutions, the role of social media, training opportunities, career development, succession planning, and many other factors.

The IESO's current workforce profile suggests the organization has been successful in attracting younger - and more diverse - employees, but this demographic shift requires consistency of approach and flexibility of practices - which can be quite a challenge. For example, while the average age of an IESO employee is 41, and the average length of service is nine years, there is a significant age gap between the IESO's youngest employees and its oldest. Creating a corporate culture in which employees at both ends of the age spectrum can feel engaged, valued and respected is no easy task.

That said, regardless of age, education, ethnicity, gender or other variables, IESO employees generally have one thing in common: a deep commitment to public service. "It's important that our employees be aligned with our corporate values," Riddell explains. "In my opinion, having a workforce driven by a shared social purpose is one of the IESO's greatest strengths."



# Protecting Critical Assets

Resilience is a hot issue in electricity circles and is becoming even more topical as extreme weather events happen more often and cyberthreats grow in number and sophistication.



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Just a few months before three tornadoes touched down in the Ottawa area, destroying a 230/115 kV transformer station, IESO control room operators were exposed to the same situation using a power system simulator - an interactive training tool that replicates real-life emergency scenarios.

When Hurricane Dorian slammed into the Bahamas in early September, control room operators who thought they'd seen the worst with Hurricane Sandy and Hurricane Maria could be forgiven for looking on in disbelief at the destruction caused by the Category 5 hurricane that left millions without power and caused unprecedented loss for residents.

Hurricanes, ice storms, forest fires, torrential rain and flooding are occurring more frequently and causing more extensive damage to lives and property than ever before. The Insurance Bureau of Canada says insured damage for severe weather events across the country totalled \$1.9 billion in 2018. A new report from the United Nations Office for Disaster Risk Reduction states that the last 20 years have seen direct economic losses from climate-related disasters rise by 151 per cent. Between 1998 and 2017, disaster-hit countries reported direct economic losses of US \$2,908 billion, of which climate-related disasters accounted for US \$2,245 billion, or 77 per cent of the total.

A 2018 report from the U.S. Council of Economic Advisors paints a similarly bleak picture about the economic impact of cyberattacks. The report claims that in 2016, malicious cyber activity cost the U.S. economy between \$57 billion and \$109 billion. This activity was directed at private and public entities, appearing as denial of service attacks, data and property destruction, business disruption (sometimes



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The IESO works with  
sector partners to  
ensure reliability and  
enhance the resilience  
of Ontario's power  
system  
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“Ontario has billions of dollars invested in energy infrastructure assets. Making these assets more resilient is a high priority.”

David Robitaille  
Director, Market Operations

for the purpose of collecting ransoms) and theft of proprietary data, intellectual property, and sensitive financial and strategic information.

In Canada, businesses spent \$14 billion to prevent, detect and recover from cybersecurity incidents in 2017 (Statistics Canada). During this period, just over one-fifth of Canadian businesses reported being affected by a cybersecurity incident. Thirty-eight per cent of those identified the motive as an attempt to steal money or demand a ransom payment. Productivity was negatively affected in a majority of cases, with roughly 54 per cent claiming the event kept employees from doing their jobs.

If ever there was a time to invest in “hardening” critical infrastructure – industry jargon for making grids more resilient – the time is now. David Robitaille, the IESO’s Director, Market Operations, points to work the IESO is undertaking to help the sector understand and respond to the need for greater resilience.

“It’s really important to identify where the sector as a whole should focus its efforts to effectively enhance resilience,” says Robitaille. “Our collective goal must be to reduce the magnitude and duration of disruptive events. This means being better able to anticipate, absorb, adapt to, and rapidly recover from potentially disruptive events. Ontario has billions of dollars invested in energy infrastructure assets. Making these assets more resilient is a high priority.”

To protect these assets from low-probability, high-impact events such as hurricanes, tornadoes and winter storms, the IESO is working with transmitters and local distribution companies to develop a set of power system resilience best practices that will guide investment and system design decisions going forward.

“Extreme weather-related events like the tornadoes that caused significant damage to the transmission system in Ottawa last year, the flooding that blacked out much of Toronto in 2013, or the ice storm that wreaked havoc across the province several years back are testing the resilience of power systems everywhere,” says Robitaille. “The question is not if, but when, our systems will be put to the test again.”

The IESO has always made resilience a top priority, viewing it as a key aspect of its reliability mandate. To that end, the organization’s representatives sit on committees, such as the North American Electric Reliability Corporation’s (NERC) Reliability Issues Steering Committee, to stay on top of emerging issues. “One of the take-aways from these discussions is the importance of lessons learned. Whether it’s a cyberattack or extreme weather, every event is different,” says Robitaille. “This means there is always an opportunity to revisit, update and refine processes and procedures, and train staff as necessary, so when there is a next time, everyone is prepared.” ●

## Resilience or Reliability?

Resilience and reliability are often used interchangeably. But they actually mean very different things.

### RELIABILITY

The IESO’s mandate is to ensure electricity is delivered where and when it’s needed, which means operating the provincial electricity grid in accordance with specific industry-wide rules and standards. For the IESO and its counterparts across North America, the focus is on maintaining the integrity of the interconnected system to prevent widespread blackouts and cascading outages across broad regions that could disrupt local customer service. This is referred to as reliability.

### RESILIENCE

Resilience is the ability to reduce the magnitude and duration of disruptive events, to bounce back more quickly and more strongly, and to adapt and be prepared for potential future events.

There are well-defined metrics for measuring reliability but none, at this time, for resilience. The IESO is a strong advocate for developing best practices that would increase the sector’s overall resilience.





## THE BEST CYBERSECURITY DEFENCE IS STILL GOOD OLD-FASHIONED INFORMATION SHARING

No one knows for sure how many cyberthreats are aimed at electricity systems around the world every year. Or if they do know, they're not telling. What the experts will say is that constant vigilance, open communication and trusted partnerships are the best defences against the ever-present risk of cyberattacks on critical infrastructure.

**"Y**ou could have the best cyber strategy in the world on paper, but if good communication with partners from across the sector, and around the globe, doesn't take place, the strategy isn't worth much," says Jason Hammerschmidt, the IESO's Supervisor of Security Architecture, Technology and Access Management. "We live in a connected world, with few industries more connected, physically and digitally, than the electricity business. The volume and velocity of cyberthreats is increasing exponentially but we've developed some effective mechanisms for information-sharing to help protect the grid."

One forum where Ontario utilities can share ideas, best practices and war stories alike is GridEx - a biennial exercise where participants have an opportunity to demonstrate how they would respond to, and recover from, simulated coordinated cyber and physical security threats and incidents, strengthen their crisis communications and relationships, and share lessons learned. The session is managed by the North American Electric Reliability Corporation (NERC), the organization that develops many of the standards and operating practices to which North American utilities must adhere.

Hammerschmidt likens GridEx to an industry-wide fire drill that challenges participants to improve the way they recover from severe threats, share their procedures and responses in real-time with others, and develop strategies that may help to mitigate the risk next time. Two years ago, more than 6,500 participants from 450 organizations took part in GridEx.

"The last GridEx was very instructive," says Hammerschmidt, adding that it brought to light key areas where utilities could strengthen their supply chains. He says it also led NERC to introduce some new standards, which utilities will be expected to implement starting in January 2020.

Information-sharing is also the major focus of a data-sharing service the IESO introduced to provide participating utilities with better real-time situational awareness of potential or actual threats. Launched as part of its expanded cybersecurity mandate, the service is the result of a first-of-its-kind partnership between the IESO and the Canadian Centre for Cyber Security. With this initiative, the IESO established an online portal that serves as a one-stop shop for cybersecurity information for Ontario's electricity sector.

Evan Noble, the IESO's Supervisor of Threat Risk and Governance, maintains that the more information is shared, the more reliable and resilient the electricity grid becomes, both in Ontario and beyond. For that reason, the IESO has established relationships across the sector, and at the highest levels. "The relationships we have with our counterparts enhance our intelligence, our tools and technologies, and our innovation capabilities beyond what we could do alone, enabling us to more effectively meet the challenges of today's cyberthreat landscape," Noble says. "The speed of change in the cyber environment is a big challenge, but we will continue to forge partnerships where they make sense and deliver value to Ontario."

A new partnership with the Canada-Israel Industrial Research & Development Foundation (CIIRDF) is a good example of the strategic importance of tapping into and sharing ideas with cyber experts around the world. "Our partnership with the Foundation supports the overall security of Ontario's electricity system and helps expand our connections as an industry globally," says Alex Foord, the IESO's Chief Information Officer and Vice-President of Information & Technology Services.

In addition to exchanging operational insights and best practices on an ongoing basis, the IESO and CIIRDF will assist each other in establishing strong lines of communication and relationships with leading participants across Ontario's and Israel's cybersecurity ecosystem.

## Growing Pains

Customers, utilities and industry partners come together to manage increased demand for electricity in southwestern Ontario – and help drive economic growth in their communities.



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New infrastructure – including a transmission line from Chatham to Leamington and a new switching station – is just one part of an integrated strategy to address the area's energy issues.

Exceptional times call for exceptional measures. And when a challenge is so unique that the only viable option is to look outside the proverbial box for a solution, then it's time to pivot.

That's what is happening in southwestern Ontario's Windsor-Essex region. Along with other business owners, local greenhouse operators in the Leamington-Kingsville area are clamouring for more electricity to support their long-term economic development plans. At roughly 1,300 megawatts, the pent-up anticipated demand is nearly double the electrical load for the city of Windsor alone. Compounding the situation, this unprecedented growth began largely within the last three years – and is expected to continue into the near future.

When regional planners last reviewed the electricity needs for Windsor-Essex, rapid growth was not an issue. How times have changed. To ensure local needs for electricity are met, the IESO took a good look at its toolkit, and used every available option to try and meet the region's energy needs. That included implementing short-term interim measures to connect customers before permanent reinforcements were in place, and engaging in highly targeted community outreach.





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A shared commitment  
to problem-solving  
supports greenhouse  
sector growth in  
Windsor-Essex  
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“From a system planning perspective, the challenge today is to address customers’ immediate concerns in a way that also reinforces reliability for the surrounding area, and the entire system, over the long term, while adhering to the principles of cost-effectiveness.”

**Megan Lund**  
Manager of Transmission  
Planning – South

“Managing the load growth in this area provides a really good example of how the IESO is thinking differently and recognizing that local needs require local solutions,” says Peter Gregg, the IESO’s President and CEO. “This ability to switch gears quickly is exactly what’s called for during this time of rapid, sector-wide transformation.”

## REGIONAL PLANNING SUPPORTS FUTURE GROWTH

The current energy shortfall (and associated connection issues) in Leamington-Kingsville, dubbed the greenhouse capital of North America, didn’t happen overnight, but was dramatic when compared to the sector as a whole. In 2015, when the IESO completed a review and assessment for Windsor-Essex (which includes the Leamington-Kingsville area), and published a multi-year integrated regional resource plan (IRRP), forecasts of electricity demand in the region were more or less flat. There was no indication a spike was imminent. In the intervening years, however, the local indoor agricultural market underwent significant structural change. New facilities were built to accommodate fruit, vegetable and flower production; high-intensity lighting became more common, especially during winter months; and a new energy-intensive cannabis market emerged.

Grow lights are one of the driving forces behind the increase in energy demand. Many growers in the region have shifted to year-round operations instead of seasonal production, resulting in sustained peaks at many greenhouses during the winter months. In addition, Ontario’s greenhouse growers tend to prefer high-pressure sodium lights – whose performance is well understood – over more energy-efficient LED lights, which are still considered an emerging technology in the greenhouse sector.

With regional economic plans calling for steady growth in this sector, it became clear in 2018 that immediate action was warranted. The regional planning process enabled the IESO and

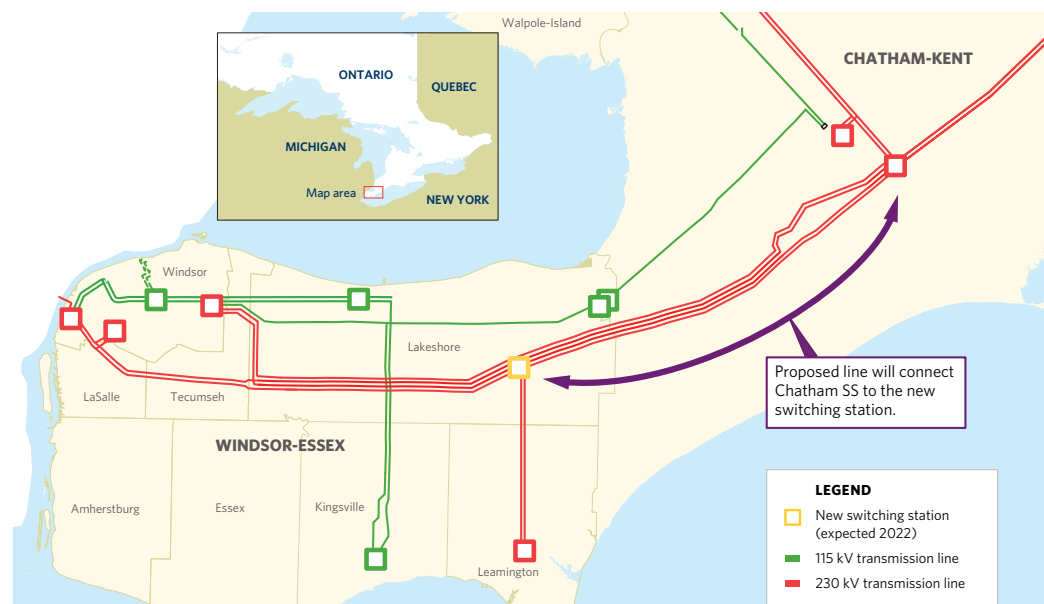
its partners to start work on a new plan earlier than anticipated to alleviate some of the pressure on the local system and support requests for grid access.

“Customers were calling on Hydro One to add more capacity, and it was pretty clear there was a good business case for it. In response, Hydro One decided that a new regional planning cycle, starting with a new needs assessment, should begin two years earlier than usual,” says Megan Lund, the IESO’s Manager of Transmission Planning – South at the time. “From a system planning perspective, the challenge today is to address customers’ immediate concerns in a way that also reinforces reliability for the surrounding area, and the entire system, over the long term while adhering to the principles of cost-effectiveness.”

## DEVELOPING A MULTI-FACETED SOLUTION

The IESO’s Planning team did a 360-degree review of the region’s electrical needs and explored multiple options to arrive at the best possible solution in a way that balanced cost and reliability with the in-service date. New infrastructure is just one part of an integrated strategy to address Leamington’s energy issues. In June 2019, the IESO requested that Hydro One develop and construct a transmission line and switching station to meet increasing electricity needs in the Windsor-Essex region. The new transmission line will run from Chatham to north of Leamington, allowing greater amounts of electricity to flow into southwestern Ontario from other parts of the province. Gregg points out the new line will help to ensure Ontario businesses and communities have the electricity they need to grow and prosper today, while also meeting the region’s future needs.

This two-part “wires solution” will take time to implement – completion of the switching station is scheduled for 2022 and the transmission line is estimated to be ready in 2026. In the meantime, interim measures coming into service in 2020 will ensure near-term needs are met.





## ONTARIO'S GREENHOUSE SECTOR: QUICK FACTS



In 2018, greenhouses consumed

**752,000 MWh for lighting**

which is more energy than all other greenhouse electricity uses combined

Over the next five years, greenhouse electricity demand is forecast to

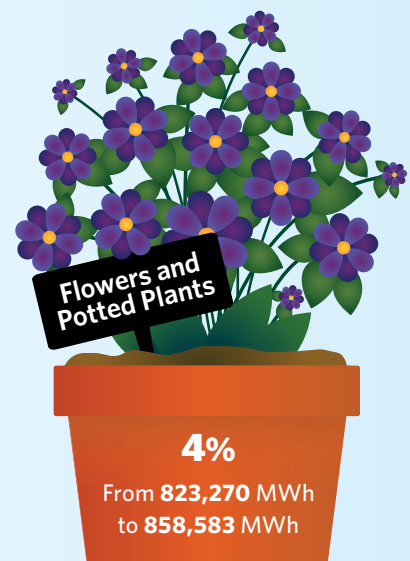
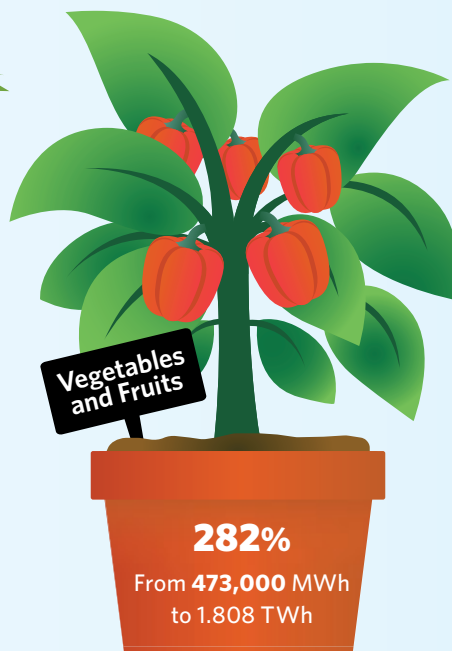
**grow 180% from 1.4 TWh to 3.9 TWh**

Growers can achieve potential electricity savings of

**230-550 GWh a year**

by 2024 if new grow lights use LED instead of high-density discharge (HID) lighting

Over the next five years, total greenhouse electricity consumption is expected to increase by:



### Ontario has the largest greenhouse sector in Canada

In 2017, Ontario represented

**60% of total national greenhouse area**

and contributed 70% of market value

In 2016, the Ontario greenhouse sector contributed

**\$3.2 billion**

to gross domestic product and supported over 80,000 jobs

Southern Ontario's prime growing regions

📍 **Essex** 📍 **Norfolk** 📍 **Chatham-Kent** 📍 **Niagara**



## What is the Grid Innovation Fund?

**The Grid Innovation Fund (GIF) identifies innovative opportunities to achieve electricity bill savings for Ontario ratepayers and funds projects** that either enable customers to better manage their energy consumption or that reduce the costs associated with maintaining reliable operation of the province's grid.

**The GIF makes investments in specific projects – not companies – with clear objectives.** It supports projects that validate the performance and business case of promising new technologies, practices and services. It also supports projects that identify and mitigate market barriers, or otherwise accelerate the adoption of competitive cost-effective energy solutions.

Since 2005, the GIF (and its predecessor funds, the Technology Development Fund and the Conservation Fund) have **provided financial support for more than 200 innovative energy projects** across the province.



The IESO issued a targeted GIF call for projects focused on reducing electricity demand from indoor agriculture during local and bulk system peak periods,

with a submission window open from November 2019 to February 2020. The maximum funding amount varies by project type, with \$2.5 million in total funding available for approved projects. For additional information or to propose a project, contact [gridinnovationfund@ieso.ca](mailto:gridinnovationfund@ieso.ca).

## CONSENSUS BUILDING DRIVES SUCCESS

Susan Harrison, the IESO's Supervisor of Regional & Community Engagement, describes the Windsor-Essex IRRP process as a great example of how meaningful engagement can help drive solutions to meet the unique needs of a region, and under an extremely compressed timeline.

The IESO implemented a tailor-made engagement approach that brought to the table key stakeholders and communities in order to find solutions for the region's very specific needs. In addition to seeking input from a local advisory committee comprising key stakeholders and community representatives, including the greenhouse sector, Harrison says the IESO team engaged with a broader audience of approximately 600 people to hear their views on the issue and potential options. While the IESO's engagement process was certainly not unique to this initiative, the customized approach encouraged a targeted dialogue and delivered outcomes that are truly representative of the community.

"The situation in Windsor-Essex really is a perfect storm, but in a positive way," says Terry Young, the IESO's Vice-President of Policy, Engagement and Innovation. "It's an opportunity for us to engage differently with the local community and deliver an innovative solution. It's also an opportunity for us to explore different scenarios and figure out if the solution to unlocking more capacity for this region is best addressed through new wires infrastructure alone, or if it can be tailored to include energy conservation, distributed energy resources, or a combination of these. This is something we've been able to explore through engagement."

To develop the next IRRP, the IESO established a cross-functional team that reflected this new mindset. Led by Transmission Planning staff, it also included representatives from Resource Planning, Engagement, Energy Efficiency, and the Grid Innovation Fund. Listening to input from the community, the team ensured that all needs were considered before the next planning document, and associated recommendations, was released in September 2019.

The Grid Innovation Fund team's involvement in the regional planning exercise is another new twist (see sidebar). "The situation in Leamington-Kingsville is a learning opportunity, and we're embracing it," says Mima Micic, a Senior Analyst in the IESO's Innovation, Research and Development department. "We've issued a targeted call for proposals for non-wires solutions from Ontario's indoor agricultural sector that will help us expand our knowledge base and provide a test bed for new technologies and models. The solution for Windsor-Essex may come from the market, rather than internally. We think the Windsor-Essex challenge certainly warrants this new approach."



## IMPACT ON THE LOCAL COMMUNITY

When Peter Neufeld, the Municipality of Leamington's Chief Administrative Officer, talks about how important electricity is for the economic development of the Leamington area, he doesn't mince words. "We were behind the eight ball before. With the tremendous growth in the greenhouse sector these past few years, our long-term economic growth will be completely handcuffed unless we get more electricity into this area," he says.

In September 2018, Neufeld met with representatives from the IESO during a visit to Leamington to see for themselves why the municipality was so concerned. "The IESO definitely heard us. The takeaway from that meeting was that the need was urgent."

Nathan Warkentin has also been in regular contact with the IESO, in his role as Energy & Environment Analyst for the Ontario Greenhouse Vegetable Growers (OGVG), which represents the interests of about 220 members who grow greenhouse tomatoes, cucumbers and peppers.

"We've been very pleased with the IESO's engagement with growers," says Warkentin. "They understand that the sector's competitive position is really dependent on having reliable

electricity, and more of it now than ever before. Together, we're exploring all kinds of wires and non-wires solutions. There have been many fruitful discussions and we've definitely seen movement on issues that are important for our growers."

Noting that energy costs are second only to labour costs, Warkentin says his members are keen to find ways to manage their energy consumption and costs. With that in mind, OGVG is also funding a number of research projects focused on ways to enhance the energy efficiency of members' facilities. Semi-transparent rooftop solar cells are one such area of interest. Unlike conventional solar photovoltaic installations, which would block the sun from reaching plants in the greenhouse, this new model would enable energy generation and reduce operating costs while, at the same time, facilitating plant growth.

"We're having some very interesting conversations about distributed energy resources, LED lighting and energy efficiency, which for some of our members, can be tricky," Warkentin states. "But it's all good stuff because we're working collaboratively, and also independently, to develop the right plan for our area." ●

## Regional Electricity Networks

Engaging with communities is a high priority for the IESO. Each and every relationship is important, especially if it provides insight into the electricity issues that matter most to end-users.

For this reason, the IESO has launched five regional electricity networks to engage people from across Ontario, and to help identify and address the electricity needs that matter most within their community and region, and Ontario as a whole. This continuous dialogue will help support IESO efforts to plan a reliable and affordable future electricity system.

"Different regions have different needs, interests and priorities," says Terry Young, the IESO's Vice-President of Policy, Engagement and Innovation. "By joining the network in your region, you can count on the IESO to provide information on a regular basis and to host an annual regional electricity forum that brings together experts from across the sector."

**FOR MORE INFORMATION,**  
visit the regional electricity  
networks web page on [ieso.ca](http://ieso.ca)  
or contact  
[communityengagement@ieso.ca](mailto:communityengagement@ieso.ca)

# Powering Change

The IESO's Community Energy Champion Program drives skills development in Indigenous communities, supporting personal growth and local economic development.



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To complement in-class sessions, trainees in the IESO's Community Energy Champion Program travelled to Kiashke Zaaging Anishinaabek - Gull Bay First Nation to acquire hands-on experience that included energy audit training.

Peter Klyne is looking forward to being back in the classroom.

As the new Community Energy Champion at Seine River First Nation, near Thunder Bay, Peter is excited to have the opportunity to learn more about home energy audits and has already started thinking about what he will say at the next Band Council meeting when asked how his work will benefit the community.

For now, though, he's focused on a training program that will take him to Toronto for two days of intensive presentations and hands-on work that the IESO has organized as part of its suite of Indigenous Energy Support Programs (ESP).

"I want to absorb as much information as I can about energy efficiency and energy management. I also want to learn how to put homeowners at ease, so they won't hesitate to invite me into their homes to do an energy assessment. That's one of the biggest hurdles I see right now in our community."

The CEC Program has proven to be very popular, with 28 communities and organizations signing up since its launch in May 2018. The IESO's First Nations and Métis Relations (FNMR) team facilitated the first CEC training session in June 2019 in Thunder Bay. With nine CECs from across Northern Ontario participating, the curriculum included modules on how to establish energy usage baselines, identify building retrofit options, and work with a community to develop an energy plan.





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Building capacity in  
Indigenous communities  
is an effective way to  
accelerate economic  
development and deliver  
improved social outcomes  
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^ The IESO's First Nations Energy Symposium brings together people like Milton Wawia, a member of Red Rock Indian Band, to further their knowledge of Ontario's energy sector and learn about the IESO's Indigenous Energy Support Programs.

In addition to classroom-style learning, the training also included a day-trip to Kiashe Zaaging Anishinaabek (sometimes referred to as Gull Bay First Nation) for hands-on training to complete an energy audit on a community's home. Champions also toured the community's advanced microgrid, which uses a combination of battery energy storage and solar panels as a clean energy source to replace diesel generation.

When participants meet again for their training in Toronto as part of the IESO-led First Nations Energy Symposium, they'll pick up where they left off, adding to their knowledge about how the energy sector works. Sessions will cover a range of topics such as project management, asset management, community energy plans and certification options.

### ACHIEVING COMMUNITY ENERGY GOALS

When he's in Toronto, Peter will likely bump into Allison Land, the Community Energy Champion for Wabigoon Lake Ojibway Nation near Dryden. Since taking on her new role in June, Allison has jumped at the opportunity to add to the training

provided by the IESO. This has boosted her confidence in her own ability to help homeowners learn how to use less energy.

"I did some training with a local engineering firm a few weeks ago, and that definitely added to my base of knowledge," she says. "I also got funding for some great tools, including a nifty device that helps to detect heat loss and a moisture detector, along with a comprehensive list of questions for homeowners and a tip sheet on energy savings opportunities. A new program on my computer will help me identify what energy problem I'm dealing with, and what the best solution is for each home. I can't wait to get started because what I do will help bring us closer to achieving the goals described in our community energy plan."

Training the next generation of energy workers is a key element of Peter's long-term energy plan for Seine River. "I applied for funding from the IESO through the Education and Capacity Building Program," he explains. "This additional funding is meant to help our community become more self-sufficient and manage our own energy future. My goal is to have two trained workers by the end of the funding period."

## Indigenous Energy Support Programs

The IESO administers several funding programs that are designed to promote broad Indigenous participation in Ontario's energy sector. The programs support community energy planning and renewable energy project development, enhance energy knowledge and awareness, and foster skills development related to energy projects.

At this time there are four programs: the Community Energy Champion (CEC) Program, the Indigenous Community Energy Plan Program, the Indigenous Energy Projects Program and the Education and Capacity Building (ECB) Program.

### SINCE THE INCEPTION OF THE PROGRAMS MORE THAN 10 YEARS AGO:

**123**

Indigenous communities and

**34**

Indigenous organizations have received ESP funding

**59**

community energy plans have been completed

**68**

projects have been supported under the ECB Program



“The more we can do to facilitate positive change for First Nations and Métis people, through open and ongoing dialogue, the better. The more we talk, the more we learn about the types of programs the IESO can develop to support these communities in meeting their energy goals.”

**Brett Smith**  
Senior Manager of First Nations and Métis Relations

## SUPPORT FOR COMMUNITY-BUILDING EFFORTS

In-class training is one of several ways the IESO works with First Nation and Métis communities to enable them to achieve their energy-related objectives. There are others, equally important, that take a different form.

Consider the Wataynikaneyap (Watay) transmission project in northwest Ontario near Pickle Lake. The IESO has been working with affected First Nation communities and other partners for more than a decade. When completed in 2023, the project will not only connect 17 First Nation communities to the grid for the first time, but is expected to save hundred of millions of dollars in diesel generation costs, significantly reduce greenhouse gas emissions, improve local living conditions, and spur economic development.

The IESO played a key role in providing technical advice and economic analysis for the project and helped to develop a funding framework between the Government of Ontario, the Government of Canada, and Wataynikaneyap Power. The landmark framework was announced in March, 2018. By the end of 2018, the first community – Pikangikum First Nation – had been connected to Ontario’s transmission system as part of this project.

“In connecting these communities to the power grid for the first time, the Watay project will be life-changing,” says Brett Smith, the IESO’s Senior Manager of First Nations and Métis Relations. “The more we can do to facilitate this type of positive change for First Nations and Métis people, through open and ongoing dialogue, the better. The more we talk, the more we learn about the types of programs the IESO can develop to support these communities in meeting their long-term energy goals.”

## What is the Community Energy Champion Program?

The Community Energy Champion (CEC) Program provides funding to First Nation and Métis communities and organizations to hire a designated champion to help plan, implement and evaluate energy-related priorities.

Community Energy Champions are eligible to receive up to \$50,000 per year for up to three years, provided adequate progress is demonstrated.

The CEC Program accepts submissions on an ongoing basis, with application submission dates spread throughout the year. Applications are evaluated based on the candidate’s qualifications, as well as the community’s needs and anticipated benefits, and projected outcomes of the proposed plan. For more information about the program, including application review dates, visit [ieso.ca/cec](https://ieso.ca/cec).



While in Kiashe Zaaging Anishinaabek – Gull Bay First Nation, CEC trainees had a chance to visit the community’s microgrid project, which combines solar power, battery storage and smart grid technologies.

## TAILORED ENERGY-EFFICIENCY PROGRAMS

The IESO delivers a number of energy-efficiency programs for Indigenous customers that are designed to help improve the overall quality and comfort of homes and shared spaces, and contribute to more affordable electricity costs. These programs include:

### First Nations Conservation Program

Provides direct-install measures to residential customers within IESO-grid connected First Nation communities.

### Conservation on the Coast Home Assistance Program and Small Business Lighting Program

Available to residential and business customers in three remote fly-in First Nation communities: Attawapiskat, Fort Albany and Kashechewan.

### Remote First Nations Energy Efficiency Pilot Program

Will be available to four remote communities in northwestern Ontario that will soon be connected to the grid. The IESO designed the program and has partnered with the Nishnawbe-Aski Nation as the service provider. ●

# Stiff Competition

The IESO is working with stakeholders to revamp market design and find new efficiencies that will save hundreds of millions of dollars.



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Competition is at the heart of the IESO's efforts to shape the marketplace of the future, whether that means integrating new resources into our markets, removing barriers to their full participation or introducing new mechanisms to procure services at the lowest cost.

Opening up Ontario's electricity markets to greater competition will be great news for customers and for the sector as a whole.

Capacity auctions, transmission procurement and energy-efficiency programs reflect a significant shift in thinking and are just a few of the projects the IESO is currently undertaking. In collaboration with stakeholders and partners, the goal is to deliver an end-state that is more agile, more adaptable and more aligned with market forces than ever before, while at the same time supporting long-term reliability and affordability.

## RENEWING THE MARKET

The IESO's Market Renewal Program (MRP) represents the most significant suite of reforms since Ontario's electricity markets were designed in the late 1990s and opened in 2002. The MRP will improve how the IESO supplies, schedules and prices electricity to meet Ontario's future needs at the lowest cost, while ensuring the markets are well-positioned for the future.

In a redesigned electricity marketplace, price signals will accurately reflect system conditions, which will drive down costs, leading to investment and operational decisions that support system reliability. The system - and ultimately consumers - can also expect to reap the benefits of new efficiencies associated with improvements to the way resources are priced and





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A new emphasis on competition is expected to enhance market efficiency and drive down costs  
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“It’s important that stakeholders have confidence in our capacity acquisition processes.”

**David Short**  
Director of Capacity  
Market Design

scheduled. A recent business case estimates that implementing these changes to the energy market will deliver about \$800 million dollars in net benefits in the first 10 years.

## NEW MECHANISM FOR SECURING CAPACITY

Capacity auctions can serve as a springboard to more competitive markets: they allow resources to compete to provide future capacity and enable the IESO to meet the province’s electricity needs in an effective and reliable manner.

Leonard Kula, the IESO’s Vice-President, Planning, Acquisition & Operations and Chief Operating Officer, says through capacity auctions, Ontario will acquire capacity from resources that can respond to system needs in those small handful of hours each year when electricity demand peaks. “The IESO has to ensure Ontario has enough capacity to meet the highest electricity demands of the year,” Kula says. “Our intent is for these auctions to maintain downward pressure on costs over the near, medium and long terms.”

The IESO is counting on the lessons learned from its annual demand response (DR) auction to expand participation in an upcoming capacity auction. Introduced in 2014, the predecessor DR auction resulted in a 42 per cent drop in prices in just four years.

“Competition in the former DR auction resulted in reduced prices year over year as the market matured and more organizations participated,” says David Short, the IESO’s Director of Capacity Market Design. “Auctions benefit Ontario consumers because the IESO obtains capacity at the lowest cost. For capacity providers, the auction offers transparency and certainty.”

The upcoming capacity auction will enable dispatchable generators with expired contracts, as well as demand response, to compete to meet Ontario’s capacity needs. Subsequent auctions will allow more resources to participate, such as system-backed imports and energy storage.

Despite the many strengths and benefits of a capacity auction, especially if it’s a made-in-Ontario solution, the IESO recognizes the model doesn’t work for everyone. “We’ve seen that one size does not fit all resources and we’ll begin discussions with stakeholders later this year to identify complementary procurement approaches,” says Short. “It’s important that stakeholders have confidence in our capacity acquisition processes.”

## A Collective Approach to Informed Decision-Making

The IESO works with stakeholders, communities, industry partners and end-use consumers to ensure views, ideas and recommendations from across the sector are considered before decisions are made.

Stakeholders voiced concerns about IESO governance and decision-making processes, which they felt needed improvement, given the large scope of changes being proposed through the Market Renewal Program.

In response, the IESO Board appointed an advisory group in August 2018, which came back with 14 recommendations for procedural enhancements in three areas: transparency, inclusiveness and market participant remedies. They ranged from the publishing of previously unreleased materials, such as specific material related to the work of the IESO Board, to new commitments for engagement such as the forming of a new Market Development Advisory Group.

Jessica Savage, the IESO’s Director, Corporate & Regulatory Affairs and project co-lead, calls the engagement process a success. “We were trying a different approach and being more responsive to stakeholders, and they respected that. In addition, an independent facilitator allowed us to demonstrate impartiality, and that gave us a lot of credibility.”

Michael Lyle, the IESO’s Vice-President, Legal Resources & Corporate Governance, agrees. “It shows we are an organization that is striving to be more transparent about our work. We should always be examining our current processes, and looking to make things better in the future for everyone involved.”



By the end of Q2 2019, the IESO had implemented several of the 14 recommendations to enhance its decision-making process, including those related to market evolution.



## ENERGY EFFICIENCY REVISITED

The IESO is also experimenting with a new type of auction that would secure capacity from energy-efficiency resources. Supported, in part, by the IESO's Grid Innovation Fund, an upcoming energy-efficiency auction pilot program is planned for launch in mid-2020 (for capacity delivery in late 2021).

The auction is designed to reduce the cost of procuring energy efficiency by having customers and aggregators compete on the basis of the cost per kilowatt/kilowatt-hour of savings delivered. The auction would only be open to new energy-efficiency measures that deliver permanent peak demand reduction during defined peak periods.

Ontario's energy-efficiency sector has matured in recent years, and there is some interest in creating opportunities for more competition in the delivery of programs that achieve provincial objectives. The IESO, which currently has responsibility for the centralized delivery of energy-efficiency programs, is focused on meeting new energy savings and demand savings targets – 1.4 terawatt-hours and 189 megawatts respectively – by the end of 2020.

### WHAT IS A CAPACITY AUCTION?

A capacity auction is a competitive mechanism through which the IESO will eventually secure capacity – the ability to provide electricity at a future point in time – from different resource types. It supports reliability and cost-effectiveness by enabling different providers to offer their capacity at different price points and the IESO to select the lowest-cost options to meet forecast demand for electricity.

## INTRODUCING COMPETITION TO BUILD TRANSMISSION

Enabling market forces to determine who can build transmission facilities is a relatively new model for Ontario, and the IESO has begun work on developing a new competitively based transmission procurement process. The change reflects similar moves in other Canadian and U.S. jurisdictions.

"Competition will encourage innovation throughout the lifecycle of transmission facilities," says Kula. "It will create opportunities for new transmitters to participate in Ontario's electricity market, and establish additional opportunities for Indigenous community participation in the sector." ●



## Enhancing Competitiveness Through Energy Efficiency

Small, medium and large businesses around the province have learned that investing in energy efficiency can deliver significant value and boost the bottom line. Just ask Andrew Hejnar, Global Energy Manager for 3M.

Based in London, Ontario, Hejnar has seen strong results from the energy-efficiency projects his team started implementing in 2004. Since 2005, the company has achieved a 29 per cent energy reduction at its seven Canadian manufacturing sites. At the London facility, Hejnar has been able to reduce peak demand by nearly 50 per cent through energy-efficiency measures.

"Energy is a large part of the plant's overall operating costs," Hejnar says. "My goal is to keep looking for opportunities to reduce demand. What our team does has a direct bearing on our plant's competitiveness and how well 3M competes globally."

Under the Save on Energy (SOE) brand, the IESO delivers energy-efficiency programs for business customers and provides opportunities for low-income customers and Indigenous communities.

SOE programs have delivered 16.5 terawatt-hours of energy savings since 2006, equivalent to powering 1.8 million homes over one year, reducing costs for consumers and delivering value at the provincial, regional and local levels.

Even with these achievements, energy efficiency continues to evolve. In keeping with its focus on increasing competition, the IESO has developed long-term energy-efficiency objectives to help reduce the cost of meeting system needs and realize savings for consumers.

"Energy efficiency is a valuable resource," says Nik Schruder, the IESO's Director of Energy Efficiency. "Reducing energy consumption means Ontario can defer or avoid the costs associated with building new infrastructure, while strengthening our economic position."

## Small Resources, Big Impacts

Distributed energy resources – like solar panels, energy storage, smart appliances and electric vehicles – are challenging the energy sector's established ways of doing things, while demonstrating the potential to deliver new services to consumers, local utilities and system operators alike.



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With the rapid expansion of DERs creating both challenges and opportunities for system operators, a panel at the IESO's 2019 Electricity Summit explored different viewpoints on emerging and evolving roles and responsibilities with respect to DER ownership, operation and local market administration.

**D**istributed energy resources (DERs) tend to get people talking. And lately, at least some of the talk focuses on how technologies that didn't even exist 15 years ago can be leveraged to enhance reliability at the local distribution and provincial electricity system levels.

Some of the buzz focuses on the benefits that will come from DERs, including their ability to give consumers more choice. Small generation and storage technologies that enable consumers to choose how and when they use electricity, and perhaps even pay less for their energy as a result, are a hot topic. At the same time, there's a lot of interest in seeing the extent to which cost-effective DERs can help system planners avoid the significant costs associated with large-scale infrastructure construction.

A recent report from the Energy Transformation Network of Ontario takes things a step further and asks the important question of who should be able to own, operate, buy and sell services related to DERs.

Ask Katherine Sparkes, the IESO's Director, Innovation, Research and Development, to interpret all the good, the bad and the pie-in-the-sky talk about DERs, and she'll tell you it's mostly upside. "The DER train has left the station, no question, and there's no turning back," she says. "From our perspective, this is not a runaway train by any means. It's a positive development because DERs are providing more options for consumers to meet their needs and giving the IESO – as the grid operator – more tools to





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Small-scale resources  
are helping to meet  
local, regional and  
provincial energy needs  
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maintain reliability. It means the electricity sector will need to evolve to be more in sync with what consumers want, how they live and what's important to them. Yes, there are potential downsides. We know that, and we're doing our due diligence. Our key priority, as always, is to manage the risks."

## MEETING LOCAL AND SYSTEM NEEDS

For system operators, and for many local distribution companies, DERs are an attractive option for a number of reasons. Unlike the traditional generation facilities that serve most of Ontario's electricity demand, their small scale means they can be deployed quickly to address emerging electricity needs. At the same time, costs to develop and deploy DERs are falling. Compared to most "wires solutions," they are expected to become even more economical with the passage of time. Their lower capital costs (and in many cases modular nature) mean they avoid the high fixed costs of traditional infrastructure, providing flexibility to respond to the inherent uncertainty of future electricity demand. They can also meet a range of customer needs and provide a variety of services to the grid. Greater affordability, coupled with consistently reliable and flexible power, is the great DER promise.

Electricity costs around the world are increasing as grid operators work to protect electricity systems from the challenges of increased cybersecurity threats, more frequent and unexpected extreme weather, and the impacts of more intermittent resources on the grid. But there is reason to be hopeful that DERs can help mitigate these cost increases.

What makes DERs unique in their promise to improve electricity affordability is the ability of single technologies to offer distinct benefits to multiple buyers - so the costs and benefits of the technology are shared.

Take a smart thermostat for example. Homeowners may buy and install a smart thermostat because they value its ability to control the heating and cooling of the home remotely. A local distribution company could offer to pay a large number of homeowners to use their thermostat to reduce electricity use for heating or cooling during peak electricity use times to offset investment in traditional distribution system infrastructure. And a wholesale electricity market administrator (like the IESO) could pay those same homeowners for helping to reduce province-wide peak electricity use. In Ontario, approximately 4,400 megawatts (MW) of DERs have been contracted or installed over the past 10 years, representing nearly 10 per cent of Ontario's electricity capacity. In the United States, the Energy Information Administration suggests that renewable distributed generation will grow at an annual rate of 5.6 per cent to 6.7 per cent each year to 2050. To test the theory that DERs will be the economic boon the energy sector anticipates, several demonstration projects are underway, including those described on pages 25 and 26.

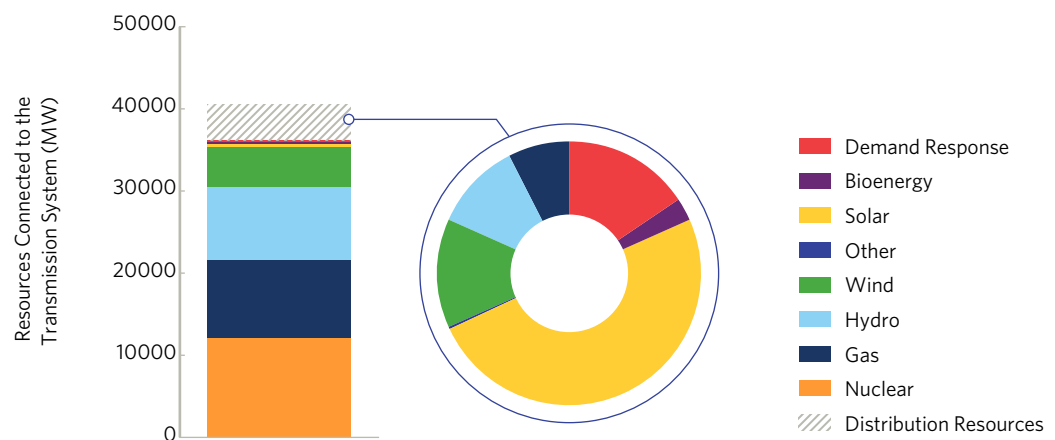
## EMERGING OPERATIONAL CHALLENGES

Although DERs are connected to local distribution systems, their impact is not isolated to these networks. Instead, they are adding new layers of complexity to the way the IESO plans and operates the bulk power system. In fact, according to the IESO's recently published operability assessment, "under certain operating conditions, DERs have become the IESO's largest single contingency, meaning it must plan for a loss of supply from these resources by ensuring sufficient capacity to replace them if needed."

### ~4,400 MW

DERs contracted or installed over the past 10 years represent nearly 10 per cent of Ontario's electricity capacity

### DER PENETRATION IN ONTARIO (MW)



Includes projects that are in service and under development (November 2019)



“At a very granular level, we need to figure out how transmission and distribution systems should work together, what the interfaces should be, and how information is exchanged.”

Tam Wagner  
Senior Manager of  
Operational Effectiveness

Tam Wagner, the IESO’s Senior Manager of Operational Effectiveness, knows this first-hand. As a former member of the IESO’s control room team, she says it’s critical to be aware of the potential impact DERs could have on the provincial electricity system.

“Transmission-connected generation facilities and larger DERs are required to remain connected through the course of any transmission faults, which can, and do, happen. But most smaller DERs behave differently. They automatically disconnect as soon as voltage and/or frequency variations are out of their normal operating ranges. With the number of DERs increasing, this could have a very significant impact on grid reliability, so we have to plan accordingly,” she says.

In its June 2019 report, *Review of the IESO-Controlled Grid’s Operability to 2025*, the IESO points to work it is undertaking with the Ontario Energy Board to amend the Distribution System

Code in order to ensure that all resources, including DERs, support the reliability of Ontario’s power system. This includes new standards that require these resources to have adequate voltage and frequency “ride-through” capabilities during and after transmission faults.

Wagner contends the other great challenge, from an operations perspective, lies in knowing where DERs are located and how they are behaving. Like other system operators, the IESO is trying to determine how much information is required about these resources to conduct accurate long-range forecasting and maintain system reliability. “Knowing all this is hugely important,” she notes. “At a very granular level, we need to figure out how transmission and distribution systems should work together, what the interfaces should be, and how information is exchanged.”

The IESO is launching Ontario’s first-ever local electricity market in York Region in an effort to save costs and find affordable alternatives to building new transmission infrastructure.

## ONTARIO’S FIRST LOCAL ELECTRICITY MARKET

The IESO, in collaboration with Natural Resources Canada, recently announced a new pilot that will allow distributed energy resources like solar panels, energy storage and demand response to offer their supply into a competitive auction, creating the framework for the province’s first-ever local electricity market.

The market will leverage existing resources in York Region, an area north of Toronto where electricity demand is expected to grow and exceed system capability within the next 10 years. The IESO has selected Alectra Utilities, the local distribution company in York Region, to act as a service provider on this project.

Terry Young, the IESO’s Vice-President, Policy, Engagement and Innovation, explains that the new market is all about consumer choice. “When we’re out talking to communities, one

common theme we hear is a desire to have more choice in how their electricity needs are met. This pilot will help us learn if we can provide that choice, while also reducing costs for Ontarians.”

Officially referred to as the IESO York Region Non-Wires Alternative Demonstration, the project’s ultimate goal is to better understand the potential of using DERs in place of traditional infrastructure by watching them operate in real-world applications. Development of the project will be informed by two IESO-led white papers, one of which will describe how transmission and distribution systems will need to function and interact with each other in a high-DER future. The second paper will consider different market-based approaches for procuring DERs, explore how the resources can operate to meet local and wholesale market needs, and determine the coordination required to ensure they can do both without adversely impacting reliability.



Rendering by Dayluxe Gallery for architect Hunt Design Associates Inc. and developer Marshall Homes.

^ Through a combination of solar power, energy storage and advanced controls, homes in the Altona Towns project will enhance community resilience and reduce homeowners' energy bills.

## MARSHALL HOMES PUTS DER THEORY INTO PRACTICE

**T**rying to persuade Craig Marshall and Dugald Wells that DERs are the way of the future is like preaching to the converted.

For Marshall, who is President of Marshall Homes, and Wells, the General Manager of Marshall Homes' new Altona Towns project, talking about the potential of DERs is old news. All that's really left to do is to start building, so consumers can see for themselves how much they will actually benefit from being part of a DER-enabled community.

"We're a non-traditional builder and we've always tried to lead the way when it comes to developing homes with low environmental impacts, including net-zero homes," says Marshall. "We aren't afraid to innovate, especially if it results in lower electricity costs and fewer greenhouse gas emissions coming from the homes we build."

When the new Altona Towns project, located in Pickering, Ontario, is ready for occupancy in 2020, homeowners will move into a community of 27 townhomes that are managed by a standard condominium corporation. A solar array will stand on the roof of one of the townhouse blocks, connecting it to a Tesla Powerpack located at the perimeter of the project. The Powerpack (a battery capable of storing 250 kW/500 kWh of energy) will store the power produced by the solar array until it is needed – for example, during a power outage. Half of the battery's storage capacity will be reserved for the community,

while the remainder will be reserved for providing regulation services. (Regulation services include frequency control and operating reserves that are used to maintain grid stability and security.)

"We have an agreement with our local distribution company, Elexicon, that any power the array produces that is used to displace power from the traditional grid will have a specific value. That amount will be returned to the condo corporation, and distributed to unit owners as a reduction in their condo fees to help offset their hydro costs," says Wells.

What the Altona Towns project amounts to is essentially a community microgrid, with the flow of energy back and forth between homeowners and Elexicon being managed by Canadian software developer Opus One. Taking the energy storage/energy generator scenario one step further, Marshall also plans to install a Tesla Powerwall in one of the townhomes that can be charged during off-peak hours (when electricity is cheaper), for use during the day when rates are higher.

A pay-for-use, fast-speed electric vehicle charging station in the complex will further add to the condo corporation's overall revenues.

"It's an exciting demonstration project because it will provide real-world data that the hydro company and the IESO can use to figure out if distributed energy can improve reliability and resilience while, at the same time, bringing down the cost of electricity. I hope it helps people use energy more wisely," says Marshall. ●



## ABOUT DISTRIBUTED ENERGY RESOURCES (DERS)

The National Association of Regulatory Utility Commissioners defines a DER as “a resource sited close to customers that can provide all or some of their immediate electric and power needs and can also be used by the system to either reduce demand (such as energy efficiency) or provide supply to satisfy the energy, capacity, or ancillary service needs of the distribution grid. The resources, if providing electricity or thermal energy, are small in scale, connected to the distribution system, and close to load. Examples of different types of DERs include solar photovoltaic, wind, combined heat and power, energy storage, demand response, electric vehicles, microgrids and energy efficiency.”



# The Great Data Tsunami

The electricity sector is at a technological tipping point, immersed in the data produced by today's complex systems, technologies and devices. What will it take to ride the wave?



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With electric vehicles poised to rewrite the book on transportation, the IESO is getting ready for the impact of their growth on the electricity system - and the potential opportunities they bring to the grid.

Every time you shop online, consult a mobile app for directions, post a comment on a social media site, check your bank statement on your smartphone, flip on a light switch in Ontario, you cross an imaginary line. It's the line that transforms you from being a consumer into a producer of data, and ultimately of new information. By using technology to accomplish these everyday tasks, you're contributing your own series of zeros and ones to the reams of other zeros and ones - digital data - in which the world is currently awash. Data volumes have increased exponentially over the past decade - in the last two years alone, we've collectively generated 90 per cent of all the data that the entire human race has ever produced.

The scope of the digital transformation is staggering. According to Gartner, one of the world's largest research and advisory companies, over 12 billion consumer devices will be connected to the Internet of Things by 2020, including smart appliances, internet-enabled TVs, digital set-top boxes and other devices - all of which collectively produce mountains of data.

And that's not all. A Navigant Research report claims the global market for electric vehicle equipment sales and installation will grow from over \$13 billion in 2019 to more than \$63 billion by 2030. Charging infrastructure is expected to reach more than 12 million units in 2030, growing from 1.4 million in 2019. All of those cars and chargers also produce data.



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Deriving maximum  
value from Ontario's  
energy data is a  
long-term proposition  
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Number of smart meters  
estimated to be installed  
globally in the near future

**1 billion**

The electricity sector is fully immersed in this surge in data. Global installations of smart meters grew at an accelerated pace in the past five years and soon there will be one billion smart meters on the planet. Canada is a small player in the big scheme of things, but has the early mover advantage of know-how and innovation, especially in Ontario where smart meter penetration is virtually 100 per cent and aligns with other advanced European or North American jurisdictions.

Sorana Ionescu leads the IESO's Smart Metering team and manages the IESO's big data strategy, which includes responsibility for recommending how the billions of data points that are housed in the Smart Metering Entity and elsewhere in the organization are used. "It's an exciting and opportune time to be working in the area of big data and advanced analytics, especially in the energy sector," says Ionescu. "How we treat our data as an asset, how we govern it, and ultimately how we use it and enable others to leverage it will unlock meaningful opportunities. These include better forecasting, improved regional planning, faster response in the event of cyberthreats and extreme weather events, better decisions across the organization, and overall, a better customer experience. This is a pivotal moment for our industry."

That data has an intrinsic value, and the fact that it is becoming even more precious, means that data markets aren't far behind, says Ionescu. "In the next few years, we're going to see a really interesting culture shift. More organizations will assign a value to their data on internal balance sheets, analytics will become an essential core competency, and data scientists will be required to adhere to professional codes of conduct to help ensure data and artificial intelligence are used in an ethical way. As the electricity system operator, we definitely have a role in shaping this conversation."

Machine learning also has the potential to deliver other fundamental changes, allowing companies to use data to make their operations more cost effective, reduce risk, improve health and safety, and even enhance the skillset of their workforces. Early results show considerable promise. National Grid, the power system operator serving the UK, is using artificial intelligence and machine learning to improve forecasts of energy production from solar panels and wind turbines in its territory. Working in partnership with The Alan Turing Institute, employees have developed predictive methods that have helped deliver a 33 per cent improvement in solar forecasting, enabling the National Grid to operate the system more economically and efficiently.

The IESO and its partners are working hard to keep the energy sector on higher ground despite the rising tide of data. Here are a few examples of how big data may support regional planning and enhance system reliability.

## IESO DATA EXCELLENCE PROGRAM

To determine the best ways to leverage the vast amount of data it collects and processes, the IESO recently launched a multi-year Data Excellence Program that will encourage the organization to treat data as an asset and enable opportunities for meaningful ratepayer and organizational value creation.

Through implementation of the program, the IESO will develop a data management and analytics framework to support internal IESO business needs and provide access to data and information by other industries in Ontario. The initiative is a coordinated enterprise-wide effort, with the following objectives:



### Good Data Governance

Improve the usability, integrity and management of data across the enterprise. Develop policies and procedures that will help govern data. Reassess access and control mechanisms to maintain security compliance and minimize risk.



### Modern Data Architecture

Establish a common understanding of data architectural principles in order to maintain a unified data vision. Encourage common data usage between different groups and technologies to drive better analytical capabilities.



### Data Operational Excellence

Enhance the IESO's analytical maturity. Leverage best-in-class standards, and ensure data and analytical capabilities work in unison, creating value for stakeholders by delivering tangible results.



\$20 million

Amount Oxford County will save in utility costs

Decrease in greenhouse gas emissions annually in Oxford County

41,000 tonnes

The infographic features a central blue circle with a white box containing the text '\$20 million' and 'Amount Oxford County will save in utility costs'. To the right, a purple circle contains the text 'Decrease in greenhouse gas emissions annually in Oxford County' and '41,000 tonnes'. The background is white with a network of colorful dashed lines and circles in shades of blue, green, yellow, and purple.

Amount Oxford County will save in utility costs

Decrease in greenhouse gas emissions annually in Oxford County

41,000 tonnes

With smart meters sending hourly data to the province's local distribution companies (LDCs) and to the IESO's repository for storing, processing, validating and managing consumption information, Ontario boasts one of the largest shared systems in the world.

## SMART METER DATA AND PLANNING

The IESO currently collects more than 120 million records every day from over five million smart meters installed in homes and small businesses across the province. In 2016, the IESO was mandated by the Ontario Energy Board to more fully leverage smart meter data for other, non-billing purposes.

Until a few years ago, identifying ways to unlock the value of that smart meter data, determining who could have access to it, and deciding how the data should be used, were all open questions. But in 2017, the IESO established a Data Strategy Advisory Committee to probe stakeholders for their views on how to enable access to this aggregated, non-personal information. This outreach led to a number of pilot projects, including one in southwestern

Ontario's Oxford County where smart meter data is now helping to support the community's goal of transitioning to a low-carbon, sustainable energy future.

In need of granular data about how electricity was being used, and when periods of high demand were occurring, the County approached the IESO's Smart Metering Entity and received four years of aggregated electricity consumption data from smart meters installed in residential locations and small businesses in the region, for the purpose of conducting a pilot.

The plan was to establish a baseline and analyze shifts in energy consumption by correlating smart meter data with other data sources, including municipal property assessments, spatial land use analysis and cumulative information on the use of different fuels. With this information, the County plans to engage local residents in a range of energy-efficiency initiatives. If everything goes according to plan, electricity consumers in Oxford County will eventually enjoy lower energy bills, the County will save more than \$20 million in utility costs, and greenhouse gas emissions in the region will fall by 41,000 tonnes annually by 2050.

According to Patrick Darby, Senior Energy Engineer at WalterFedy, an engineering firm working with Oxford County on this project, the smart meter data provides a gold mine of information that otherwise would not be available. "Through analysis of this data, we can identify, in the moment, how electrical loads change as people transition to more energy-efficient solutions, and quantify the positive effects of the shifts we're aiming to make within our society."

"Smart meter data allows us to create strategic action plans and initiatives targeted to specific demographics. Instead of having a blanket approach to everyone in the community, we can gear our programs and policies to certain areas or sectors. To do this, however, we need to paint a picture of overall energy use throughout the County. Currently, we track electricity and fuel use in areas such as agriculture and in the water and wastewater space, but residential and small business use has always been the missing piece. The smart meter data lets us close that gap."

Patrick Crockett  
Chief Administrative Officer, Oxford County

“If grids are going to prove themselves to be economically viable over the long term, they have to be relevant and address consumer uses and preferences. If there is no customer, all the data they’re collecting will be useless.”

**Dean McKeown**  
Associate Director,  
Global Master of Management  
Analytics at Smith School of  
Business at Queen’s University

## SMART GRIDS, ANALYTICS AND RELIABILITY

Dean McKeown has a few words of advice about using analytics to transform today’s electricity grids into tomorrow’s energy powerhouses. Be careful what you wish for, says the Associate Director, Global Master of Management Analytics at Smith School of Business at Queen’s University.

“With more consumers showing a desire to decrease their bills and reduce their environmental footprint by purchasing solar panels, electric vehicles, smart appliances and other connected devices, hydro companies are going to have to figure out how to make electricity grids tough enough to withstand fluctuations in demand. The same thing goes for building grids that can stand up to unpredictable weather. If grids are going to prove themselves to be economically viable over the long term, they have to be relevant and address consumer uses and preferences. If there is no customer, all the data they’re collecting will be useless.”

Sensors are one way in which electricity companies have added tremendous value to their systems. They not only detect faults on transmission and distribution lines (and isolate them in order to restore power after an outage), but the data they produce can be fed into algorithms that allow system operators to predict everything from where faults will appear on wires, where wildlife is likely to damage lines or transmission stations, and even whether oil from a damaged transformer has accumulated in an underground vault. In other words, sensors and other data-driven devices are critical pieces of infrastructure and contribute in myriad ways to overall system reliability.

System operators also use analytics to identify the greatest need for repairs or new equipment. In this way, data can be extremely helpful in mitigating the risks of making expensive capital investments where lesser investments might suffice.

Being able to predict events, and manage their outcomes, is an important aspect of the IESO’s mandate. Elyas Ahmed, who works as a Senior Analyst in the IESO’s Innovation, Research and Development department, says the information provided by smart meters and distributed energy resources, coupled with Supervisory Control and Data Acquisition (SCADA) software, Geographic Information System (GIS), weather, and other relevant data, can allow utilities to deliver better real-time information for distribution operators, distribution engineers, and planners. “In theory, this data would help system operators make more informed decisions in their day-to-day activities. It may also help with long-range forecasting.”

Sensor-enabled grids, or smart grids, produce reams of valuable information. But that same value can be wiped out when these assets are damaged by a cyberattack or an extreme weather event. Some experts have gone so far as to say that the software side of the grid – the technology used to detect, predict, and analyze – is becoming as vulnerable as the hardware side, making it even more critical to develop risk mitigation and risk management plans that protect both.

On pages 4-7, *Power Perspectives* looks at what the IESO is doing to ensure the provincial electricity grid is well prepared for predictable, low-risk events, as well as unexpected, high-risk occurrences. ●

## The Art and Science of Demand Forecasting

Andrew Trachsell may not keep a crystal ball in his office but he still spends much of his time pondering what the future holds.

Trachsell, the IESO’s Senior Load Forecaster, has seen the demand forecasting function undergo a wholesale evolution since he joined the organization in 2000. Today, he and his team are using more data from more sources than ever before. “Better data enables better analysis,” he explains. “And better analysis enables better outcomes.”

Using different types of data – weather, demographics, labour force, real estate, economic and so forth – Trachsell builds complex models that enable him to forecast demand for electricity over multiple time frames, from five minutes before the energy is needed to 20 years out.

One major challenge is predicting the output of renewable sources

of generation like wind and solar, especially resources connected at the lower voltage distribution level and managed by local utilities such as Hydro Ottawa, Toronto Hydro-Electric System or the 60+ other local distribution companies. Located at sites across the province, where local weather conditions are constantly changing, these units are characterized by variable output. Accurately forecasting this output is becoming increasingly important because, from the IESO’s vantage point, energy produced by these generators is perceived as a drop in demand for grid-connected energy.

While the increased data volumes are posing new challenges to the IESO’s current analytical tools and capabilities, Trachsell is keen to

get more granular data to refine his models further. “If we can’t reliably forecast wind and solar output, we end up carrying more of a buffer than we really need,” he says.

“Better demand forecasting will enable us to reduce our capacity margins which, in turn, will lead to a more efficient and cost-effective system.”









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## Connecting Today. Powering Tomorrow.

The Independent Electricity System Operator ensures the reliability of Ontario's power system on behalf of all Ontarians. As part of our unique and critical responsibilities, we work with stakeholders, government, Indigenous and other communities to provide an efficient supply of electricity when and where it is needed.

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