
Innovation Roadmap

HOW WE DEFINE INNOVATION

For the purposes of this report, innovation is the development of new solutions to important challenges that support the IESO's focus on reliability and cost-effectiveness.

INNOVATION CAN TAKE SHAPE IN A VARIETY OF WAYS:



New business models



Emerging technologies



New practices, regulatory or policy constructs



Existing solutions that are used in novel ways

Preparing for the Future

Jurisdictions around the world are grappling with how to manage significant change in the electricity sector - and Ontario is no exception.

Emerging technologies, increased digitization, and changing consumer behaviour and expectations, are quickly disrupting familiar business models. New thinking about how electricity grids and markets should function today, five, 10 and even 20 years from now, is also having an enormous impact on the sector.

As Ontario's system operator, the IESO recognizes this is a watershed moment for the energy sector. It will take a pragmatic mindset and strategic collaboration with stakeholders, industry, research partners, and others to capitalize on the opportunities in front of us - and to remove the barriers that stand in our way. The need has never been greater to enhance competition in Ontario's electricity markets, drive down the cost of delivering electricity, increase affordability for consumers, and ensure the long-term resiliency and sustainability of Ontario's electricity system. Together, we must welcome change and make it happen.

Our first Innovation Roadmap is a starting point. It reflects the feedback collected through engagements with stakeholders from over 100 organizations. These ideas serve as a counter-balance to what the IESO has learned through its unique vantage point at the heart of Ontario's electricity sector.

I'm looking forward to continuing our work together to ensure the cost-effectiveness and reliability of Ontario's electricity system - now and into the future.



Peter Gregg
President and CEO
IESO

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“At the IESO, we’ve never been driven by innovation for innovation’s sake. As the province’s electricity system operator, our goals are aligned with our mandate: to prepare for electricity sector evolution that can support reliability and reduce costs.”

TERRY YOUNG

VICE PRESIDENT, POLICY, ENGAGEMENT AND INNOVATION
IESO

The Case for Innovation:

UNDERSTANDING THE OPPORTUNITIES AND CHALLENGES

The electricity sector is changing quickly and dramatically. Less than a decade ago, the impact of distributed generation on Ontario’s electricity system was negligible. Today, under certain operating conditions, distributed energy resources (DERs) have become the IESO’s largest single contingency – meaning the IESO must plan for a loss of supply from these resources by ensuring sufficient capacity to replace them if needed.

Combine this with the rapid growth of other potentially disruptive technologies, an evolving portfolio of resources and shifting policy directions, and system operators everywhere are challenged both with keeping on top of the pace of change, and taking advantage of the opportunity to shape it. Simply put, we need to become better at innovation – and we need to do it quickly.

That’s where the IESO’s Innovation Roadmap comes into play. Broadly speaking, sector transformation means shorter technology and project cycles, more agile thinking and an understanding that business as usual is no longer an option. This Roadmap is designed to help ensure we can continue to provide a cost-effective and reliable electricity system into the future. It positions the IESO to act on the priorities that will enable us to deliver on our mandate, while undertaking, funding or participating in projects that will benefit the sector overall, and result in the lowest cost to consumers.

Our Methodology

To develop the Roadmap, we followed a four-step process, which started with soliciting the input of stakeholders and concluded with developing a work plan encompassing the projects and initiatives that will guide our efforts.



DIALOGUE

Facilitate dialogue on the evolution of Ontario's electricity and broader energy sector as it relates to the IESO's mandate



PRIORITIZATION

Identify and prioritize key areas of focus for learning, capability building and enabling the innovation of others



SITUATIONAL ANALYSIS

Assess existing and emerging challenges and opportunities facing the IESO and the broader electricity sector



ACTION

Develop a multi-year work plan to focus and coordinate IESO and sector efforts



FACILITATING A DIALOGUE: CONSULTING WITH STAKEHOLDERS

Creating a Roadmap that will help us deliver on our core mandate, while offering broader value doesn't happen overnight – and it doesn't happen in isolation. In keeping with the IESO's commitment to engaging stakeholders on all priority projects, the IESO launched an engagement on the Roadmap in 2018.

This dialogue was aimed at identifying key barriers and challenges to advancing innovation in the electricity sector, calibrating areas of focus and clarifying the role of the IESO in this evolution. Feedback from more than 100 organizations, as well as the IESO's own Stakeholder Advisory Committee, was used to inform our role in enabling sector innovation and to help prioritize our areas of focus.

WHAT WE HEARD

When asked who should take the lead in modernizing Ontario's electricity sector, the overwhelming majority of stakeholders participating in IESO engagement sessions on the Roadmap said innovation should be a collective effort. That said, stakeholders identified four key roles for the IESO:

- Demonstrating leadership in enhancing markets, creating sector standards and driving thought leadership
- Sharing information by improving access to data
- Improving IESO operations to facilitate innovation
- Sending clear information to the markets

KEY TAKEAWAYS

- New grid operations was identified as the greatest opportunity resulting from electricity sector disruption, with visibility into grid resources, localized pricing and demand response and enabling of aggregated resources on the grid established as top considerations
- Cost was identified as the chief barrier to innovation, followed by lack of communication among stakeholders. Along with demonstrating leadership, many suggested the IESO had a critical role to play in sharing information across the sector
- The need to better understand the drivers of consumer behaviour was recognized as a major gap in preparing for change, as was unlocking the value of resources to meet distribution needs and understanding the potential impact of new technologies on the sector

"The IESO's central position in Ontario's electricity sector gives it an important role to play in enabling the innovation necessary to improve grid reliability. The IESO's work to help customers better understand and manage their electricity use has helped organizations like Loblaw reduce its electricity consumption on an annual basis, resulting in reduced demand on the grid."

MARK SCHEMBRI

VICE PRESIDENT, SUPERMARKET SYSTEMS & STORE MAINTENANCE
LOBLAW PROPERTIES LTD.



UNDERSTANDING SYSTEM NEEDS, ESTABLISHING PRIORITIES

DEVELOP

scenarios to determine how the system needs to evolve

IDENTIFY

challenges and opportunities to inform areas of focus

ESTABLISH

areas of focus to guide the IESO's innovation efforts

PRIORITIZE

areas of focus based on the impact on the IESO's mandate

DETERMINE

which activities the IESO can undertake or enable

"At the IESO, we witness the impact of new policies, new sources of energy, and emerging technologies every day. Our goal is to leverage our unique vantage point and expertise to facilitate the innovation that will ensure we can continue to meet today's needs while anticipating and planning for the system of the future."

PETER GREGG
PRESIDENT AND CEO
IESO

The IESO created the Roadmap using a number of possible future scenarios to provide a lens through which to identify and assess key challenges and opportunities. Once identified, these informed the development of the nine core "areas of focus"¹ – for learning, capability building and enabling the innovation of others – that determine how we will direct our efforts.

These areas of focus were prioritized based on their impact on the IESO's ability to maintain a reliable and cost-effective system, the likelihood of developments within the area of focus materializing within the time frame of the Roadmap, and the point within this time frame that developments will impact the sector.

With these timelines established, specific projects that support our goals are set out in a multi-year work plan that focuses and coordinates IESO and sector efforts. For a full list of projects (in progress, planned or proposed), and how they will contribute to maintaining system cost-effectiveness or reliability, visit ieso.ca/innovation.

¹ In each of these areas of focus, our success will depend on two enablers: having the in-house talent and expertise to meet our innovation needs and the leadership to champion the policy and regulatory changes that will be required to enable innovation in support of system-wide reliability and cost-effectiveness.

Areas of Focus for Innovation

Classified as highest priority, core to the IESO mandate, or for monitoring or support, these areas of focus prioritize our efforts to solve the challenges and capitalize on the opportunities facing the electricity sector.

HIGHEST PRIORITY FOR RESOURCE ALLOCATION & ENGAGEMENT

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| <p>1 Unlock the value of new and existing resources</p> | <p>Enable increased competition in IESO-administered markets where unnecessary barriers limit the ability of some resources to provide cost-effective grid services, e.g., address challenges that prevent resources from competing to provide energy, capacity and ancillary services and explore new participation models for DERs.</p> |
| <p>2 Provide leadership to mitigate emerging cybersecurity risks</p> | <p>Provide leadership and coordinate with electricity sector partners to prepare for emerging cybersecurity risks, e.g., address threats associated with the growing integration of consumer-level devices and establish standards for their integration into electricity system operations.</p> |
| <p>3 Increase the transparency and visibility of resources operating on the distribution system</p> | <p>In conjunction with local distribution companies (LDCs) and other stakeholders, explore new ways to obtain appropriate levels of visibility with respect to DER operations at the distribution level, e.g., assess the need to collect information about distribution-connected resources, including behind-the-meter resources and resources operating as part of an aggregation.</p> |
| <p>4 Build new capabilities to collect, store, share, analyze and use data</p> | <p>Determine how best to leverage electricity data to deliver a more efficient energy system, e.g., investigate opportunities to combine, share and/or standardize data sets to improve their value to the IESO and others in the electricity and broader energy sector.</p> |

IMPORTANT AREAS CORE TO IESO MANDATE

- | | |
|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>5 Address challenges associated with the growth in intermittent resources, DERs and variable loads on grid operations</p> | <p>Working with stakeholders, investigate and advance new methods for operating a grid with increased intermittent resources, DERs and variable loads, e.g., engage with suppliers, large load customers and aggregators to explore options for new products and services and/or opportunities for new and existing resources to provide existing services.</p> |
| <p>6 Inform new distribution system operations and business models to support bulk market efficiency and reliability</p> | <p>Engage with the sector to develop a shared understanding of new business and operating models for distribution systems, e.g., explore new concepts, such as distribution system operators (DSOs)/independent DSOs, load-serving entities, and future interoperability requirements.</p> |

MONITOR OR SUPPORT ACTION OF OTHERS

- | | |
|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>7 Prepare for an increase in customer- and LDC-led DER deployment</p> | <p>Enable the sector to prepare and plan for issues related to the increase of DERs that may not participate in IESO-administered markets, and consider the impact with respect to supply and resource planning, stranded assets and reducing load on the system.</p> |
| <p>8 Anticipate and prepare for changing consumer choice</p> | <p>Prepare for the effects of growing consumer empowerment on IESO markets and operations, e.g., explore different models for consumers to secure electricity supply, such as community choice aggregation, bilateral contracting or peer-to-peer transactions, and the impact of new third-party products and services on consumers.</p> |
| <p>9 Design alternative approaches to provide system resiliency</p> | <p>Explore new approaches to providing grid-level resiliency, e.g., investigate opportunities for the distribution system to provide local resiliency services through, for example, microgrids, power electronics and energy storage.</p> |

The IESO's Path Forward

Throughout the development of the Innovation Roadmap, we focused on being able to share information with other stakeholders in the energy sector. This will help ensure money allocated to innovation is invested strategically, and avoid costly duplication of public efforts and resources.

THE IESO'S ROLE IN FACILITATING A PATH FORWARD FOR THE SECTOR WILL FOCUS ON:

ENABLING

the innovation of others, consistent with our mandate (e.g., sharing our time, expertise and data, providing funding)

MONITORING

and being aware of innovation-related activities in the sector

LEVERAGING

the IESO's central role within Ontario's electricity sector to drive affordability, reliability, resiliency and sustainability for the people of Ontario

IMPROVING

the efficiency and effectiveness of IESO operations to support innovation

The work plan for the IESO's Innovation Roadmap is divided into four components:



CASE STUDY

Understanding the impact of changing consumer behaviours

There's no question that consumers are increasingly opting to take control of both their energy costs and supply with energy-efficiency measures and behind-the-meter solutions. In fact, global research suggests that utilities may be significantly underestimating the impact of consumer empowerment on the need to innovate when it comes to meeting evolving expectations.

This holds true in Ontario – and across North America. More and more, electricity consumers are leveraging technology to act as both consumers and suppliers and pursue new ways to customize their energy use. Not surprisingly then, participants at IESO engagement sessions on the Roadmap reinforced the need to put changing consumer behaviours and preferences at the forefront of our innovation agenda.

Today, thanks to innovation, consumers have more options than ever to change how they use the grid, modify their behaviour in response to electricity rates, or explore solutions that reflect their commitment to sustainability. What's less clear, as our stakeholders pointed out, is the relative importance of the factors driving decision-making. This requires research into how consumers will react to as-yet-unknown disruptions, how quickly they will adopt new technologies and how likely they are to lessen dependence on the grid, even if they decide not to disconnect entirely.

With this in mind, in 2019 the IESO will develop a white paper exploring consumer preferences with respect to generation source and type, willingness to pay for these preferences, and interest in participating in energy storage or generation, as well as the impact of emerging consumer technologies on energy use and potential adoption rates. In the longer term, insights from this research will help increase customer choice and improve IESO forecasting and planning – both of which support our broader cost-effectiveness and reliability goals.

Residential consumers and businesses are engaged in a mutually reinforcing relationship where residential consumers' interest in reducing their carbon footprint – and in using digital technologies to help them do so – is leading many businesses to develop and deploy new tools for monitoring and reducing energy consumption, evolve their energy management policies and practices, explore expanding their use of renewable energy sources, and integrate their resource management programs more closely with their operations.

DELOITTE INSIGHTS: DELOITTE RESOURCES 2018 STUDY
DELOITTE CENTER FOR ENERGY SOLUTIONS



1. RESEARCH & WHITE PAPERS

PURPOSE

To create a shared, fact-based understanding of emerging issues (economic, technical, social and environmental) that are likely to affect the electricity sector and use this to inform policy, planning and investment decisions, and address barriers to market participation arising from lack of transparency around or access to data.

FUNDING

IESO Operations & Maintenance (O&M) budget (per IESO fee submission)



2. DEMONSTRATION/EVALUATION PROJECTS

PURPOSE

To identify and evaluate the potential of new solutions to improve electricity system reliability and cost-effectiveness, and understand both barriers (market, system, policy, regulatory) to implementation, and solutions to enable the participation of new resources.

FUNDING

IESO Grid Innovation Fund (up to \$9.5 million/year and minimum matching funding from non-IESO sources of 25-50% per project)



“Ontario’s hospitality industry is the life-blood of local economies all across the province. The IESO’s Grid Innovation Fund helped us secure regulatory changes that have enabled our members to better manage their energy costs, maintain the great customer service Ontarians have come to expect from our restaurants, hotels and motels, and reduce strain on the grid - win, win, win.”

TONY ELENIS

PRESIDENT & CEO
ONTARIO RESTAURANT HOTEL & MOTEL ASSOCIATION

CASE STUDY

Enabling Innovation: set-point change leads to long-term savings

PICTURED:
Haley Whitaker, General Manager of Toronto’s The Abbot on Eglinton, which was able to achieve energy savings following an IESO-led research project on freezer set-points.

A demonstration project that received support through the IESO’s Grid Innovation Fund (formerly the Conservation Fund) in 2016 is one of hundreds of projects that underscore the role the IESO will continue to play in driving innovation in Ontario’s electricity sector going forward.

Like any research project, this one began with a question: What if the North America-wide regulation that requires the set-point in commercial freezers to be -18 C is actually too low? Could raising it by three degrees ensure food safety and quality, while simultaneously reducing energy use? If it could, then restaurants, hotels, and other businesses that store frozen food would stand to significantly reduce their energy consumption along with their energy costs - a win for them and for the provincial power grid.

Brickworks Communication, in collaboration with Toronto Public Health, Toronto Hydro-Electric System Limited and the Ontario Restaurant Hotel & Motel Association (ORHMA), decided to find out. Field trials were conducted at over two dozen freezers in various small businesses and institutions in Toronto. Each freezer was equipped with a sub-meter to measure energy consumption.

It turns out the adjustment to a slightly higher set-point did reduce freezer energy consumption by on average 10 percent, with no negative impact on food safety and quality for the vast majority of foods.

In July 2018, *O. Reg 493/17 - Food Premises* was updated to simply state that frozen food must be kept frozen until sold or prepared. Now, the IESO is working with ORHMA, and other parties, to communicate the savings opportunity to business owners.



3. CAPITAL PROJECTS & PROCESS IMPROVEMENTS

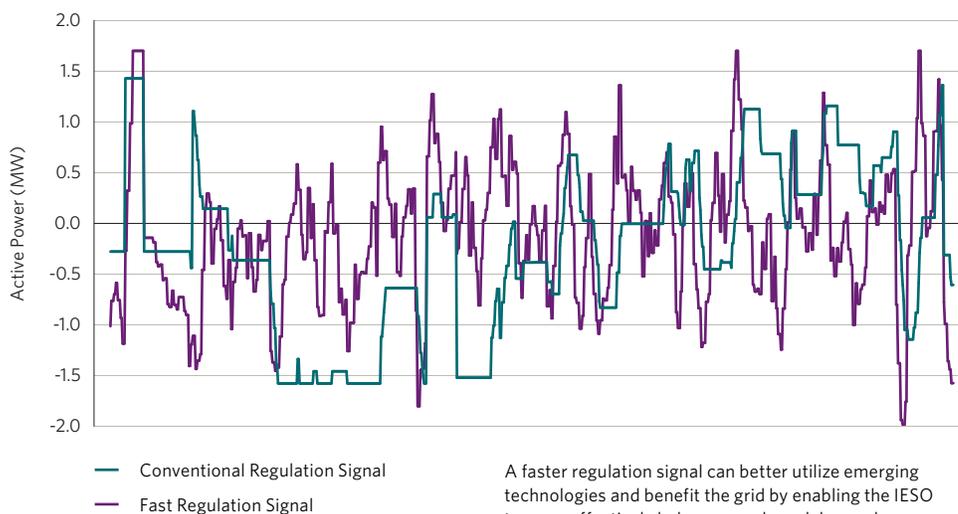
PURPOSE

To update tools, market rules and processes that will enable fair competition in IESO-administered markets and improve the effectiveness and efficiency of the IESO's internal capabilities.

FUNDING

IESO capital budget and O&M budget (per IESO fee submission)

FAST REGULATION SIGNAL VS. CONVENTIONAL REGULATION SIGNAL (60-MINUTE SAMPLE)



A faster regulation signal can better utilize emerging technologies and benefit the grid by enabling the IESO to more effectively balance supply and demand on a second-to-second basis.

CASE STUDY

New pilot test will determine if faster is better

The IESO has taken a major step forward in determining whether the rapid speed with which energy storage facilities respond to control signals can deliver a more cost-effective form of “regulation service” than other, more conventional, technologies. If it can, then September 25, 2018 will go down in history as the day when fast regulation was first tested for use in Ontario, in a live field experiment.

Regulation service balances the electricity system and maintains consistent system frequency on a second-to-second basis. Most electricity markets across North America use fast regulation service technologies that respond to set-point signals more quickly than conventional generation facilities. Because

many types of energy storage, and some types of generation facilities (wind and solar) can respond rapidly to sudden changes in dispatch or regulation signals, and also because of the increased number of these resources in the province, researchers want to test their potential in real-time, on the Ontario grid.

The study, in collaboration with the University of Waterloo, will determine if faster-responding facilities are more effective than what is currently used, reducing costs to the market and consumers. Data will be used to help model the potential cost savings and reliability impacts of a wider-scale rollout of fast regulation, which could one day lead to a permanent wholesale market product.

Connecting the dots between increased affordability, long-term reliability, and faster regulation service has become a critical issue. The U.S. Energy Information Administration suggests that renewable distributed generation will grow at an annual rate of 5.6 percent to 6.7 percent each year to 2050, making the IESO's research into its impact on the grid especially critical.



4. PARTNERSHIPS & CAPABILITY BUILDING

PURPOSE

To share the cost and risks associated with learning, capability building and enabling innovation, and promote full-scale deployment or integration of proven solutions.

FUNDING

IESO O&M budget
(per IESO fee submission)



CASE STUDY

Partnership opens door to sector-wide cybersecurity offensive

In 2019, the IESO became the first system operator in North America to pursue a sector-wide partnership for the purpose of building even greater resiliency into the electricity grid. With the launch of its new data-sharing service, the IESO is now able to alert participating utilities from across the province to threats facing the sector in near real-time.

The service is the result of a first-of-its-kind partnership between the IESO and the Cyber Centre, which operates under the Communications Security Establishment (CSE) – Canada’s central trusted government source of cybersecurity information, advice and guidance.

The partnership allows the Cyber Centre to pull information from the IESO’s systems for analysis, sharing any red flags with the IESO’s cybersecurity team, which in turn reviews and produces advisories, adding sector context and uploading them to an information-sharing portal. On the basis of this information, the IESO determines if any alerts are warranted for the entire sector, or for individual utilities. Alerts might relate to a potential loss of power to the whole grid, part of it, or an individual utility, or to a data breach affecting customer information, day-to-day operations, or payment systems.

Based on the premise that there is strength in numbers, and that shared information can be a powerful defense, the IESO is hoping that all 67 electrical utilities in Ontario will decide to join the province-wide initiative and make cybersecurity a top priority.

Get Involved

Participate in IESO
stakeholder engagements
ieso.ca/engagements

Share your work on innovation
in the sector by contacting us
at engagement@ieso.ca

Make an application through
the IESO's Grid Innovation Fund
ieso.ca/grid-innovation-fund

Download DER test cases at
ieso.ca/innovation to determine
if your organization can contribute
to our ongoing research



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