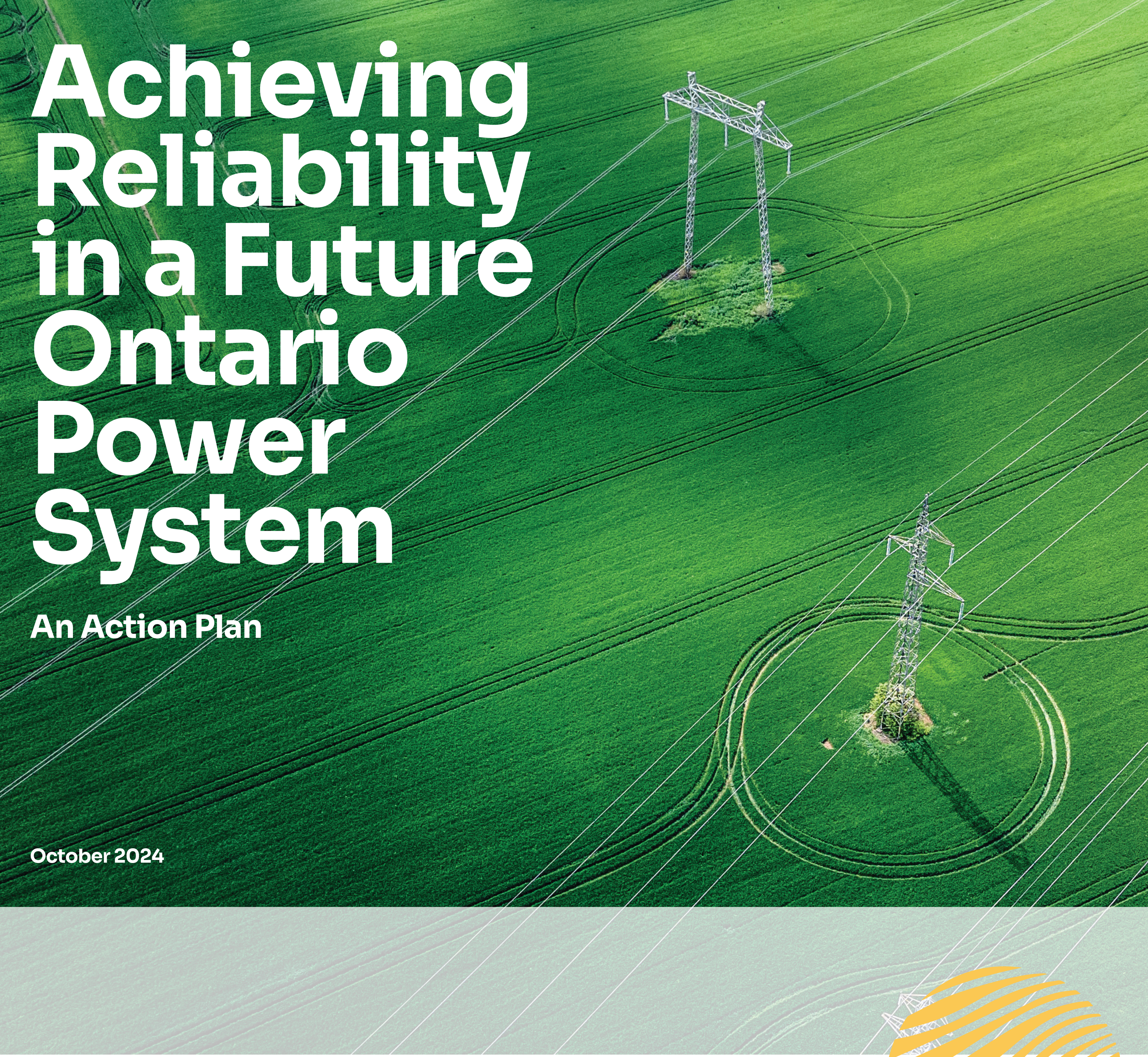
Achieving Reliability in a Future Ontario Power System

An Action Plan

October 2024



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NOTE: The contents and conclusions in this report are the responsibility of the authors and may not cover all the views of the participants or their respective organizations.

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Abbreviations

DER: Distributed Energy Resources
DSOs: Distribution System Operators
EETP: Electrification and Energy Transformation Panel
IESO: Independent Electricity System Operator
LDCs: Local Distribution Companies
NERC: North American Electric Reliability Corporation
NPCC: Northeast Power Coordinating Council
NWAs: Non-Wires Alternatives
RSA: Reliability Services Auctions
RSVC: Reactive Support and Voltage Control

Executive summary

Ontario's transition to a net-zero electricity system should embrace a comprehensive approach. It will require regulatory reforms, new business models, and technological innovation. This report establishes the need for immediate action to gain the benefits of a modernized electricity grid, and to avoid making investments in outdated and higher-cost power systems. The opportunity exists now to transition to a cleaner, more reliable, and cost-effective net-zero electricity system.

Ontario's electricity system is undergoing a transition driven by rapidly increasing demand requiring billions of dollars of new investment, as well as by technologies that can competitively provide energy sources but operate in a different way than traditional technologies. Many of these new resources will be located at the local level, thus opening up an opportunity for these new resources to also provide local services.

One thing that is not changing is the need for a reliable electricity system. Reliability is more than just supplying kWhs. Related services include ensuring stable voltage and frequency levels, balancing electricity supply and demand, and responding quickly to unexpected grid events.

The Ontario power system transition that we advocate will create new opportunities and benefits. For example, distribution-connected systems could allow capital expenditures to be deferred on expensive traditional technologies while enhancing local reliability using distributed energy resources (DERs) and non-wires solutions.

The province should capture the full range of benefits available from existing clean energy sources and from future investments.

Four urgent actions the province should take include:

1. Competitively procuring bulk-level reliability from all types of resources, including non-emitting resources
2. Clarifying the future role of LDCs in Ontario
3. Enabling development of local flexibility markets
4. Improving coordination between transmission and distribution on future methods for procurement and operations.

The authors urge the government of Ontario to move without delay on modernizing reliability services in our electricity system and positioning the province to be a leader in the rapidly evolving net-zero economy.

1 | Introduction

Over the next two to three decades, electricity will become an even more important component of economic activity in Ontario, and it will be a key enabler for achieving a net-zero greenhouse gas emissions economy.[1] As the electricity system expands, it will undergo transformative changes in consumption, generation, and distribution.

After several decades of flat or declining demand, a dramatic shift is occurring, due to the electrification of industry, buildings, and transportation, compounded by economic and population growth. Critical mineral processing, data centers, and other energy-intensive industries will also result in increased demand for electricity.[2]

Ontario's electricity system is evolving from one defined by a limited number of huge generating resources delivering power to relatively predictable supply and demand, to a more decentralized system characterized by generation from increasingly competitive wind and solar resources. The transformed system will also include 'prosumers', who consume and produce electricity. Electric vehicle owners, for instance, could manage their energy use by timing vehicle charging during periods of low electricity demand, while avoiding more costly charges during periods of high demand.

Investments in electricity generation and management technologies are responding, in part, to the decreasing costs of renewable energy, while the performance and reliability of the technologies have continuously improved. This has led to projections of higher electricity demand growth in the future.[3] Hence, the decarbonization of electricity production and the related energy system transition is central to Ontario's economic and environmental health.[4]

Getty Images/Petmal

1 See for example: International Energy Agency, Net Zero Emissions by 2050 Scenario (NZE), 2023, at https://www.iea.org/reports/global-energy-and-climate-model/net-zero-emissions-by-2050-scenario-nze and Canadian Climate Institute, The Big Switch, May 2022, at https://climateinstitute.ca/reports/big-switch/

2 IESO, Annual Planning Outlook, Ontario's electricity system needs: 2025-2050, March 2024, at https://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Mar2024/2024-Annual-Planning-Outlook.pdf

3 International Energy Agency, Electricity 2024, at https://www.iea.org/reports/electricity-2024/

4 Electrification and Energy Transformation Panel, Ontario's Clean Energy Opportunity: Report of the EETP, 2024, at https://www.ontario.ca/files/2024-02/energy-eetp-ontarios-clean-energy-opportunity-en-2024-02-02.pdf

The growth in the role of electricity will make system reliability even more important to industry and the public. But reliability means more than just supplying kWhs. Other imperatives include ensuring stable voltage and frequency levels, balancing electricity supply and demand, and responding quickly to unexpected grid events. Hence, electricity grid reliability practices and procurements at both the transmission and distribution levels must adapt as the overall system transforms. And these adaptations will create new opportunities as deferred capital expenditures and enhanced local system reliability can be achieved using distributed energy resources (DERs) and implementing non-wires solutions.

Fortunately, the transformation in the electricity system is not unique to Ontario. Many jurisdictions are studying and responding to decarbonization while maintaining and enhancing reliability. Ontario can take advantage of their learnings and experiences. In this regard, Appendix C contains a global scan of electricity markets, regulatory reforms, and business models in leading jurisdictions.[5]

In conclusion, an action plan is urgently needed for modernizing Ontario's reliability services in a transformed electricity system. To inform the development of a coherent action plan, Pollution Probe commissioned an independent study on the future of reliability. A multi-stakeholder workshop engaging key stakeholders and electricity sector experts was then held in Toronto in April 2024. The participants identified the actions required to create enhanced reliability services from non-emitting sources, as well as ways to capture the full range of benefits at all levels of the electricity system.

This report presents the results of Pollution Probe's and Net-Zero Reliability Initiative's work. It outlines plans, practices, rules, and regulations that are needed to deliver enhanced reliability and a range of benefits to Ontarians in a net-zero electricity system.

TEXT BOX A

PROJECT METHODOLOGY

The Net-Zero Reliability Initiative was informed by an Advisory Council that included members with expertise and representation from groups involved in the energy sector. Following preliminary research and technical analysis by Power Advisory (see Appendix B), an in-person workshop was held in Toronto to facilitate discussions, gather insights, and encourage stakeholder collaboration (see Appendix D). The workshop included a presentation on the transmission system reliability services needed for Ontario's power system in a net-zero future (Appendix B), as well as an overview of reliability-related initiatives in electricity markets comparable to Ontario (Appendix C). The workshop participants identified key areas of interest and the action steps that could be taken in the short, medium, and long term to achieve a reliable grid while meeting the net-zero greenhouse gas emission targets and deadlines of various governments. This report contains the authors' synthesis of information from the above-noted sources and may not fully reflect the views of particular organizations or of individuals who provided input.

5 See Appendix C at https://www.pollutionprobe.org/netzero-reliability-initiative/

2 | The evolving need for reliability

To 2.1 Current state of reliability in Ontario

Reliability means the ability to meet the electricity needs of end-use customers, even when unexpected equipment failures or other conditions reduce the amount of available power.[6] Ontarians depend on having uninterrupted electricity for communication, transportation, health, personal safety, and security, as well as for economic activity. Electricity consumers and investors expect the designers, operators, and planners of the provincial power system to ensure reliability performance approaching 100%.

Reliability on the bulk system (see Text Box B) is different than it is for reliability in the distribution system. Achieving bulk system reliability requires sufficient capacity and energy to produce and distribute electricity throughout the province. Energy refers to the amount of electricity produced over a certain period to meet demand, while capacity refers to the energy infrastructure available to deliver that electricity at a specific moment. Additional bulk system reliability services are also required, such as voltage control, frequency support, and ramping capability.[7]

Ontario must comply with reliability standards for the bulk electric system as defined by the North American Electric Reliability Corporation (NERC) and the Northeast Power Coordinating Council (NPCC), which are enforced in Ontario through market rules.[8] Reliability services are provided at both the wholesale (transmission or bulk) and distribution levels (see 2.2.3). Bulk-system reliability involves the stability and reliability of the entire electricity grid, managed in Ontario by the Independent Electricity System Operator (IESO) (see Table 1). The IESO ensures a balance between electricity supply and demand, integrates various energy sources,

Getty Images/imagebob

6 Government of Canada, Canada's Electric Reliability Framework, last modified on June 17, 2024, at https://natural-resources.canada.ca/energy/electricity-infrastructure/electricity-canada/canada-electric-reliability-framework/18792

7 Adapted from IESO, IESO Submission on the Proposed Clean Electricity Regulations, November 2, 2023, at https://www.ieso.ca/en/Sector-Participants/IESO-News/2023/11/The-IESOs-Response-to-draft-Clean-Electricity-Regulations; NERC, Essential Reliability Services, December 2015, at https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/ERS%20Abstract%20Report%20Final.pdf; ISO, New England, Capacity vs. Energy: A Primer, at https://www.iso-ne.com/about/what-we-do/in-depth/capacity-vs-energy-primer

8 Government of Canada, Canada's Electric Reliability Framework, last modified on June 17, 2024, at https://natural-resources.canada.ca/energy/electricity-infrastructure/electricity-canada/canada-electric-reliability-framework/18792

and maintains overall grid stability.[9] The IESO has been addressing future energy and capacity needs through recent long-term procurements (for example, LT1 and LT2 for procurements up to 2030).[10]

However, the future of reliability services was not addressed as part of the recent procurements.

Reliability services can be divided into three groups:

1. Services routinely available for the IESO to call on, which are provided by suppliers as a condition of their contracts and/or obligations within the IESO Market Rules (for example, inertial or frequency response)
2. Services that are procured competitively through IESO administered markets (for example, operating reserve)
3. Services that are currently procured without competitive processes (for example, reliability must-run contracts to address localized reliability needs).

TEXT BOX B

BULK AND DISTRIBUTION SYSTEMS

The electricity system is generally considered two connected systems, the bulk system and the distribution system. The bulk system is what many would see as the traditional electricity system, where large generators are connected to high-voltage transmission lines. Large generators, such as hydropower, nuclear and gas plants, are connected to the bulk system. The Independent Electricity System Operators (IESO) operates the bulk system for all of Ontario.

Below the bulk system is the distribution system. The distribution system consists of medium- and low-voltage electricity lines and delivers electricity directly to customers. In Ontario, local distribution companies (LDCs) such as Toronto Hydro, Alectra Utilities, and Hydro Ottawa, among others, manage the distribution systems in specific areas. Small generators, such as roof-top solar and some batteries, are connected to the distribution system.

9 The information was provided in an interview with an LDC on June 10th, 2024

10 IESO, Long-Term 1 RFP and Expedited Process https://www.ieso.ca/Sector-Participants/Resource-Acquisition-and-Contracts/Long-Term-RFP-and-Expedited-Process

Table 1: Bulk system reliability services managed by the IESO and their procurement methods [11]

Reliability Service	Description	Procurement Method
Inertial response (Immediately following a system event)	The inertial response is provided by resources that are electrically synchronized to the grid; that is, resources that rotate at the same speed as other resources and can quickly respond to conditions that arise in the system.	Inertial response is not specifically purchased or priced in Ontario but is provided by synchronous generators and rotating customer equipment.
Frequency response (Response within milliseconds following a system event)	Ability for a resource to respond quickly to restore system frequency and maintain 60 hertz (Hz).	Frequency response is not specifically purchased in Ontario but is provided automatically by synchronous generators as a connection requirement, managed through the market rules.
Regulation Services (seconds to minutes)	Balance of minute-to-minute supply and demand normal fluctuations caused by demand and supply variations.	Contracts[12]
Operating reserve (Response within 10 minutes or 30 minutes of a system event)	A resource that is on standby and can be called up on short notice to restore the supply-demand balance.[13]	Done through competitive markets. Generators or loads must supply energy or adjust demand as it is bid within the specified time frame (10 or 30 minutes) for up to one hour. The price is determined every five minutes, based on market offers.[14]
Reactive support and voltage control (RSVC)	Ability of resources to maintain voltage across the system to transmit power and prevent damage to customer equipment.	RSVC is provided automatically by both resources and transmission equipment connected to the grid. Where additional RSVC is required beyond normal operating parameters, it is procured through contracts.
Reliability must-run	The IESO can call on the facility to produce, if necessary, to maintain system reliability.	Contracts[15]
Black start capability	The ability of a resource to independently help restore the power system.	Contracts[16]
Load Following/ Ramping capability	Ability of resources to follow demand, which is essential to maintain the supply-demand balance in 5-minute to hourly timeframes.	While not provided directly,[17] other market mechanisms, such as a Day-Ahead Commitment Process (and Day-Ahead Market when it is introduced in 2025),[18] may cover this need.

11 Adapted from input from IESO staff, plus IESO, IESO Submission on the Proposed Clean Electricity Regulations, November 2, 2023, at https://www.ieso.ca/en/Sector-Participants/IESO-News/2023/11/The-IESOs-Response-to-draft-Clean-Electricity-Regulations and informed by IESO, Annual Planning Outlook, Ontario's electricity system needs: 2025-2050, March 2024, at https://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Mar2024/2024-Annual-Planning-Outlook.pdf unless otherwise references

12 IESO, Ancillary Services, at https://www.ieso.ca/ancillary-services

13 The IESO is obligated by NERC reliability standards to carry a minimum operating reserve at all times.

14 IESO, Operating Reserve Markets, at https://www.ieso.ca/Sector-Participants/Market-Operations/Markets-and-Related-Programs/Operating-Reserve-Markets

15 IESO, Ancillary Services, at https://www.ieso.ca/ancillary-services

16 IESO, Ancillary Services, at https://www.ieso.ca/ancillary-services

17 See Appendix B at https://www.pollutionprobe.org/netzero-reliability-initiative/

18 IESO, Day-Ahead Commitment Process, at https://www.ieso.ca/Sector-Participants/Market-Operations/Markets-and-Related-Programs/Day-Ahead-Commitment-Process

These reliability services are typically provided by Ontario's waterpower or natural gas power plants. At certain times of the year, such as during the spring freshet season when the flow of water is its highest, waterpower usually cannot provide certain services, such as operating reserve, as there are limitations on how the water can be controlled. Natural gas plants tend to supply these needed services at these times. As an example, in the 2023 spring freshet season, natural gas power plants provided almost 70% of Ontario's operating reserve requirement.[19]

In comparison to the bulk level, under the current energy structure rules, local distribution companies' (LDCs) primary responsibility for reliability is their ability to deliver electricity to end-users without interruption.[20] Reliability for LDCs focuses on minimizing outages and ensuring optimal power quality, which comprises eliminating fluctuations in the voltage or frequency of kWh delivered to customers and ensuring its compatibility with the characteristics of the electrical systems that use it). Adequate power quality is necessary for electronic equipment's safe, reliable, and efficient functioning.[21]

2.2 Future reliability

The electricity system is undergoing a transformation driven by the need for decarbonization, as well as the changes in demand and supply. While Ontario has benefited from robust systems for providing reliability, these systems will need to evolve as part of the energy transition, for three main reasons:

1. Changing electricity demand and its nature/profile will require a huge and timely amount of investment in new electricity generation, transmission, and distribution infrastructure.
2. New electricity generating resources have entered the market, many of which are based on inverters rather than spinning turbines. This has opened a wider array of options for meeting reliability needs. Thus, the system must adapt to recognize the inverters' characteristics and capabilities.
3. Many of the new resources are expected to be installed at the distribution level, creating an opportunity to contribute to reliability services currently provided by the bulk system, while also providing distribution-level services and contributing to greater reliability.

2.2.1 Changing electricity demand

Electricity demand is expected to grow significantly due to the increased electrification of buildings, transportation, and industry. Electricity demand more than doubles in most scenarios,[22] requiring significant investments in new electricity generating resources and the transmission and distribution infrastructure required to move power to consumers.

While demand is increasing, its profile will also be changing. The typical pattern of having high demand in the evenings and in the summer is expected to shift with the increasing electrification of buildings and transportation. Demand may be higher during the day, with system peaks in both summer and winter, and even into the evenings as vehicles are charged and buildings are heated. Moreover, growing industries, such as data centers and critical mineral processing facilities, further change demand profiles.[23] This change in the demand profile will add stress to the distribution and transmission infrastructure.

19 IESO, IESO Submission on the Proposed Clean Electricity Regulations, November 2, 2023, at https://www.ieso.ca/en/Sector-Participants/IESO-News/2023/11/The-IESOs-Response-to-draft-Clean-Electricity-Regulations

20 The information was provided in the Interview with an LDC on June 10th, 2024

21 IESO, Day-Ahead Commitment Process, last updated July 22, 2024, at https://engagewithus.oeb.ca/rpqr

22 IESO, Pathways to Decarbonization, 2022, https://www.ieso.ca/en/Learn/The-Evolving-Grid/Pathways-to-Decarbonization. For other models see UK Electricity System Operator, Future Energy System 2024, at https://www.nationalgrideso.com/document/322316/download and Canadian Climate Institute, The Big Switch, May 2022, at https://climateinstitute.ca/reports/big-switch/

23 IESO, Annual Planning Outlook 2024, March 2024, at https://www.ieso.ca/en/Sector-Participants/Planning-and-Forecasting/Annual-Planning-Outlook

The rise of small-scale distributed energy resources (DERs) contributing to supply will make planning for this growth more complex as this new supply needs to be considered.[24] Uncertainty about the timing and location of technology adoption poses significant planning challenges, especially since infrastructure development typically takes 10-15 years to complete.

While the electricity system needs to expand to meet the expected growth, the existing infrastructure needs to be decarbonized to achieve net-zero goals.

2.2.2 Changing electricity supply

One of the key changes anticipated in the makeup of the power system is the shift in resources from large, centralized fossil-fuel generators to non-emitting facilities of various sizes. This is a worldwide pattern. Low-emission resources – which include nuclear as well as renewables – are rapidly growing, and this growth is expected to increase in coming years.[25] In Ontario, the need to electrify GHG intensive sectors is one of the drivers, but another driver is the lower energy costs of some of the non-emitting technologies.[26]

Unlike traditional generators, many non-emitting resources, such as wind, solar, and batteries, do not have a spinning turbine that produces alternating current electricity at a specific frequency and voltage. Rather, they connect to the grid through inverters, which convert the direct current coming from solar, batteries, and other renewables to grid-compatible alternating current. Many inverters used today are grid-following. They assume that reliability services are provided by other resources, and if there is a reliability problem, they are programmed to disconnect from the system to avoid making it worse. The newer grid-forming inverters support reliability and can supply forms of frequency, voltage, and inertia that complement the services provided by traditional generators.[27] In Australia, a number of battery storage projects are under development which incorporate grid-forming inverters that provide reliability services.[28]

A wide range of new resources can provide reliability services. The rapid expansion of wind and solar, and greater use of demand response and distributed energy resources (DERs), such as solar, means there will be a growing need to identify reliability services that were previously provided by traditional generators,[29] and to explicitly procure the reliability services as the technologies change.[30]

Table 2 summarizes the potential of existing and emerging energy technologies to offer reliability services. It should be noted that these are general characteristics, and individual systems will vary. Moreover, there are additional constraints, such as the need to ensure water flow at different times of the year for hydropower. But these technologies are also increasingly used for reliability services. As an example, battery storage has been procured for reliability services in Ontario (see Text box D), and, along with energy arbitrage, reliability is now the second most common reason for investing in battery systems in the US.[31] Thus, the potential for demand response is increased by the rise of DERs such as batteries, electric vehicles, and smart home appliances that are owned by the customer.

24 International Energy Agency, Electricity 2024, January 2024, at https://www.iea.org/reports/electricity-2024/

25 International Energy Agency, Electricity 2024, January 2024, at https://www.iea.org/reports/electricity-2024/

26 International Energy Agency, Rapid rollout of clean technologies makes energy cheaper, not more costly, May 30, 2024, at https://www.iea.org/news/rapid-rollout-of-clean-technologies-makes-energy-cheaper-not-more-costly

27 Benjamin Kroposki and Andy Hoke, “Getting the Grid to Net Zero,” IEEE Spectrum, April 13, 2024, at https://spectrum.ieee.org/electric-inverter

28 Australian Renewable Energy Agency, Green light for Australia’s largest grid-forming battery, December 19, 2023, at https://arena.gov.au/news/green-light-for-australias-largest-grid-forming-battery/

29 NERC, Essential Reliability Services Task Force: A Concept Paper on Essential Reliability Services that Characterizes Bulk Power System Reliability, October 2014, https://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/ERSTF%20Concept%20Paper.pdf

30 International Energy Agency, Electricity 2024, January 2024, at https://www.iea.org/reports/electricity-2024/

31 US Energy Information Agency, Utilities report batteries are most commonly used for arbitrage and grid stability, June 25, 2024, at https://www.eia.gov/todayinenergy/detail.php?id=62405

Table 2: Reliability services offered by non-emitting resources [32]

	Reliability service capability					Costs		
	Inertia and frequency response	Regulation	Reactive support and voltage	Quick Start	OR and flexibility	Capital costs	Fixed OPEX	Variable OPEX
Nuclear	High	Low	High	Low	Low	High	Moderate	Low
Hydro**	High	High	High	High	High	High	Moderate	Low
Wind/solar	High	Moderate	High	Low	Moderate	Moderate	Moderate	Low
Storage (4 hour)	High *	High	High	High	High	Moderate	Moderate	Low
Storage (longer term)	High	High	High	High	High	High	Moderate	Low
Demand response	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Low	High

High	● (dark)
Moderate	● (light)
Low	○

* Technology dependent on ability service
** Water requirements may dictate ability to provide services at different points in the year

The new technology that Ontario has installed in recent years has the potential to provide additional benefits to reliability, but for the most part they are not being used. There have been some attempts to examine how to incorporate the new technology. The York Region Non Wires Alternatives Demonstration Project (see below), which ran between 2020 and 2022, is one example of a sizable demonstration project that tested market-based approaches for securing energy and capacity services from DERs, coordinating across both the distribution and transmission levels. The results indicate that the use of distributed resources in such a manner would likely be a net benefit to the system and would reduce costs.[33] Other examples of reliability procurement are included below. It is important to note that apart from the Energy Peak Perks program, these have remained pilot or demonstration projects and have yet to be incorporated in wider system operations. Peak Perks has already been a success, with 125,000 homes having signed up, and in 2024 was able to deliver an average demand reduction of 145 MW in summer 2024.[34]

32 See Appendix C at https://www.pollutionprobe.org/netzero-reliability-initiative/

33 ICF, IESO York Region Non-Wires Alternatives Demonstration Project: Evaluation Report, July 2024, at https://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/IESO-York-Region-Non-Wires-Alternatives-Demonstration-Project

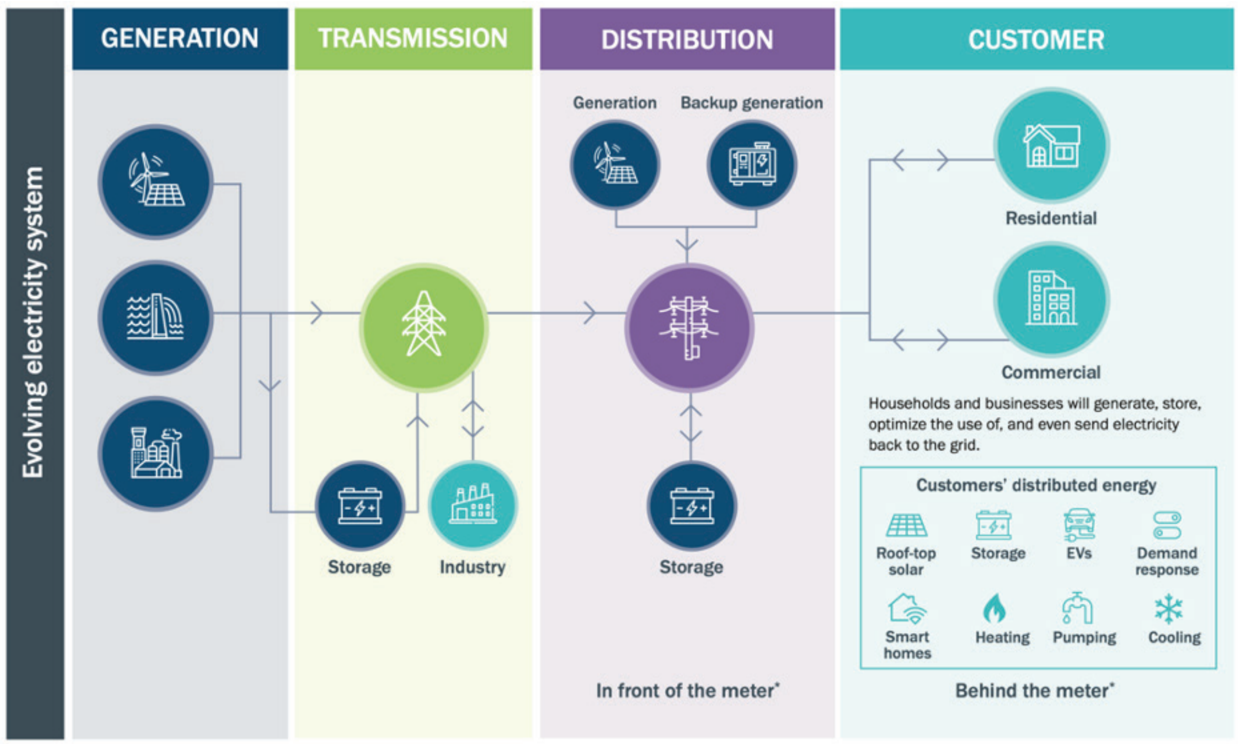
34 Energy Hub, Ontario's IESO builds Canada's largest residential virtual power plant in just six months, September 2024, at https://415845.fs1.hubspotusercontent-na1.net/hubfs/415845/Fact%20sheets/Ontario%20IESO%20VPP%20case%20study.pdf

2.2.3 Future role of the distribution system

Distribution system reliability is focused on ensuring dependable service to end-users, addressing power quality and voltage, and ensuring that equipment is maintained. It addresses voltage consistency, service interruptions, and equipment failures at the distribution level. It is managed by local distribution companies (LDCs) and emphasizes minimizing outages and maintaining the distribution infrastructure.[35]

The distribution system will become increasingly important in the future electricity system, complementing transmission-connected resources (see Figure 1). In recent UK modeling for a future energy system, all potential scenarios have increased supply at the distribution level.[36] Customers are moving from static and predictable loads into dynamic participants in the system.

Figure 1: The evolving energy system [37]



Energy system changes will make managing the electricity distribution more complex. Fortunately, new technologies and business practices are capable of providing reliability services and other benefits at lower costs than before. These benefits can be captured through using new approaches to provide for local flexibility, and through using non-wires solutions in tandem with building new grid infrastructure.

Flexibility in this context means that a resource can rapidly increase or decrease demand as required by the grid to contribute to grid stability. Such flexibility could be provided by a small-scale generator, such as a solar system providing energy when needed. Or it could be provided by demand response, where a customer could reduce or shift their usage, such as by an industrial consumer with

35 The information was provided in an interview with LDCs on June 10th, 2024

36 UK Electricity System Operator, Future Energy System 2024, July 2024, at https://www.nationalgrideso.com/document/322316/download

37 Clean Energy Canada, Reliable, Affordable, Predictable, Clean: Industry electricity needs for certainty and investment in Ontario, July 2024, at https://cleanenergycanada.org/wp-content/uploads/2024/07/WhitePaper_OntarioEnergy_2024_V6.pdf

refrigeration systems that can be controlled, or by batteries that could provide energy or recharge, governed by grid priorities.

This flexibility would support frequency, voltage, and other reliability services. Some jurisdictions already procure frequency resources from local flexible resources. As an example, the UK has introduced local flexibility markets through which small-scale distributed assets can participate in local markets to provide flexibility.[38] In 2024, system operators contracted almost 4 GW of flexible resources, 75% of which was from non-emitting resources, an increase of more than 700 MW compared to the prior year.

Procurement of flexibility in Europe is viewed as a benefit to consumers. In the European Union as a whole, modeling indicates a potential cost reduction for consumers of EUR 70 billion a year by 2030 due to flexibility, plus several indirect benefits with reducing emissions.[39] In the UK, procurement of flexibility – mostly at the distributed level – is expected to reduce energy costs for customers by GBP 10 billion a year by 2050, and to reduce the total cost of the net-zero transition by up to GBP 70 billion.[40] In 2023/24 alone, flexibility on the UK distribution system provided GBP 91 million in benefits to consumers through a reduced need for distribution network infrastructure investments, plus GBP 109 million in additional benefits in facilitating the greater use of DERs without requiring network reinforcements. These achievements have been attributed to the development of a new regulatory model in the UK, which has included a move to total costs that does not incentivize capital expenditures, and which rewards system operators for performance outcomes.[41]

Reliability in the electricity grid is not solely about having sufficient energy generation. It also hinges on the adequacy and robustness of the network of poles, wires, transformers, and other infrastructure that make up the distribution system. With increasing demand, more infrastructure will become necessary. Distributed resources can also serve as non-wires solutions, providing energy services in locations where the grid is congested or where demand is increasing, thereby reducing the need to build new infrastructure.[42]

One of the main advantages of distributed resources is their ability to provide multiple benefits, if the right regulation exists. For example, they can enhance grid reliability, serve as non-wires solutions to reduce transmission and distribution costs, and offer direct energy services to owners, thus lowering their expenses. This approach also reduces the need for large-scale generation procurement. Different systems could provide different sets of benefits. Effective coordination between the distribution and transmission system operators is required to accomplish this. The two operators, along with the regulator, would need to agree on a system whereby resources could contribute to local needs, as well as provide wider system benefits, including how the system can be compensated for all the values it provides.[43]

Managing such coordination will require distribution companies to operate in a different way. There have been extensive discussions on the future of local distribution companies (LDCs) in Ontario and whether they should become distribution system operators (DSOs), where they would have greater control over the management of the resources in their territories.[44] The distribution network operator in London, UK, named

38 See Appendix C at https://www.pollutionprobe.org/netzero-reliability-initiative/

39 DNV for smartEN, Demand-side flexibility in the EU: Quantification of benefits in 2030, September 2022, at https://smarten.eu/wp-content/uploads/2022/09/SmartEN-DSF-benefits-2030-Report_DIGITAL.pdf

40 Energy Networks Association, New figures reveal Great Britain's world beating energy flexibility market, July 4, 2024, at https://www.energynetworks.org/newsroom/new-figures-reveal-great-britains-world-beating-energy-flexibility-market

41 Energy Networks Association, UK Power Networks: DSO Performance Panel Report 2023/24, at https://dso.ukpowernetworks.co.uk

42 ACER and CEER, Challenges of the future electricity system: Recommendations and commitments, July 11, 2024, at https://www.ceer.eu/wp-content/uploads/2024/07/Future_electricity_system_challenges_2024.pdf

43 International Smart Grid Action Network, Summary of regulatory activities and conclusions of the FlexPlan project: Discussion paper, April 2023, ISGAN WG6, at https://www.iea-isgan.org/wp-content/uploads/2024/07/FlexPlan-ISGAN-report-on-final-results-3.pdf

44 This issue has been under discussion for a long time in Ontario. For one of the first, see Energy Transformation Network of Ontario, Structural Options for Ontario's Electricity System in a High-DER Future, June 2019, at https://ieso.ca/en/Sector-Participants/IESO-News/2019/06/ETNO-releases-report-on-system-options-in-a-high-DER-future

UK Power Networks, created a stand-alone distribution system operator that was separate from its broader infrastructure business. Having a separated DSO has been considered to provide benefits in integrating new non-emitting resources, and in reducing costs.[45]

At present, Ontario stakeholders are discussing two models. One is a "Market Facilitator model," in which the LDC becomes a system operator in its territory and coordinates and dispatches DERs. The second is a "Dual Participation model," in which the LDC dispatches resources for its own needs and the IESO dispatches DERs for system needs. Both options, or a combination of the two, would allow for the increased penetration and participation of DERs, though the Dual Participation model may require more complex coordination. But as of now, there is no policy direction on a future path for LDCs in Ontario.[46]

Other jurisdictions are moving into the DSO model, with Maine considering a move to DSOs to speed the deployment of DERs and to achieve state targets.[47] The Transmission-Distribution Coordination Working Group at the IESO is considering how best to design and coordinate between the two levels to better integrate DERs.[48] It is crucial to implement these changes promptly and comprehensively, as investment decisions for the 2030s are being made today.

Delaying action, taking an incremental approach, or relying on isolated incentives could cause Ontario to miss the opportunity to fully capture these benefits.

TEXT BOX C

IESO YORK REGION NON WIRES ALTERNATIVES DEMONSTRATION PROJECT

Alectra Utilities and the IESO, with support from Natural Resources Canada, between 2020 and 2022 undertook a demonstration project in the York Region to explore market-based approaches to securing local energy and capacity services from DERs. It aimed to test methods for competitive procurement and the reliability-oriented operation of DERs as Non Wires Alternatives (NWAs). The demonstration project focused on using DERs as non-wires solutions, which are resources that provide electricity services that can substitute for distribution or transmission infrastructure. By using cost-effective DERs as non-wires solutions, distribution and transmission investments can be deferred or avoided while potentially offering value to the bulk electricity system. [49]

During the project, Alectra demonstrated the role of a distribution system operator (DSO), and IESO designed and developed the rules and contracts. It was also shown that DERs provided services to distribution and transmission levels through local auctions; specifically, Local Capacity Auctions and Local Energy Auctions. The project's findings demonstrated the approach and benefits of using DERs as NWAs for distribution-level needs and potentially for transmission-level benefits. The process and tools that were developed, tested, and refined provide the groundwork for future exploration of the demonstrated concepts to increase the potential for DERs to serve as alternatives to or deferment for traditional electricity system infrastructure. The economic value of DERs, both as a local resource and as an alternative investment to traditional distribution, transmission, and generation infrastructure, was net positive in most scenarios evaluated in the evaluation report.[50]

45 UK Power Networks DSO, DSO Performance Panel Report, 2024, at https://dso.ukpowernetworks.co.uk

46 Ontario Energy Association, Distribution System Operator Study, December 2023, at https://energyontario.ca/Files/OEA_DSO_Study_Dec_13_2023_FINAL.pdf. See also EDA, Solving Grid Lock: Our Vision for a Customer-Centric Energy Transition, April 2024, at https://www.eda-on.ca/Portals/81/Vision%20Paper%202024/Solving%20Gird-Lock%20-%20EDA%20Vision%20Paper%20-%20April%202024.pdf?ver=MiokKIpVcTjxzdBZ8Q--GQ%3d%3d

47 William Driscoll, "Maine may design a distribution system operator to advance distributed energy resources," PV Magazine, June 24, 2024 at https://pv-magazine-usa.com/2024/06/24/maine-may-design-a-distribution-system-operator-to-advance-distributed-energy-resources/

48 IESO, Transmission-Distribution Coordination Working Group, at https://www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Engagements/Transmission-Distribution-Coordination-Working-Group

49 IESO, York Region Non Wires Alternatives Demonstration Project, July 2024,at https://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/IESO-York-Region-Non-Wires-Alternatives-Demonstration-Project

50 ICF, IESO York Region Non Wires Alternatives Demonstration Project: Evaluation Report, July 2024, at https://www.ieso.ca/-/media/Files/IESO/Document-Library/engage/yrnwa/YRNWA-20240723-Final-Report.pdf

3. Action plan

Although certain reliability characteristics must comply with international standards, each regional grid is unique, and each regional grid operator has to build and maintain its own unique systems for supporting and managing reliability in its control area. Although policies and projects in other jurisdictions inform this project, the solutions recommended here are intended to be specific to Ontario and its electricity system.

To help ensure that Ontario can proactively plan to meet its future electrification and economic development objectives, the province needs to be positioned to receive the full range of reliability benefits from the investments it makes in clean energy resources. As discussed by the Electrification and Energy Transformation Panel (EETP) and others, Ontario could derive significant economic benefit by embracing the changes coming in the electricity system and capturing all the values they can provide.[54]

TEXT BOX D

EXAMPLES OF ALTERNATIVE RELIABILITY PROCUREMENT METHODS IN ONTARIO

The 2017 Regulation RFP offered contracts for incremental regulation capacity of 50 MW from diverse technologies[51]

Motivation	Informed by the 2016 Operability Assessment, the IESO identified the need for an additional 50 MW of regulation service
Technology requirements	All
General overview	Capacity: 2 to 50 MW Minimum ramp rate: 7 MW/minute Contract term: 3 to 7 years
Method of procurement	The IESO offered two contracts, representing ±55 MW of regulation capacity across two new energy storage facilities in Ontario.
Status	Neither facility reached commercial operation, and their contracts were terminated. No additional regulation service capacity was developed due to the reduced need for these services.

Competitive energy storage procurement [52]

Motivation:	In 2014, the IESO initiated a competitive energy storage procurement framework that included regulation services or reactive support and voltage control (RSVC) services with a total capacity target of 50 MW. The aim was to better understand the integration of energy storage into Ontario's electricity system and market.
Eligibility	Batteries suppliers
General overview	In Phase I (2014), 9 facilities provide 28.8 MW of either regulation or RSVC service. In Phase II (2015), six facilities provided 11.75 MW of energy storage capacity.
Method of procurement	A competitive energy storage procurement framework
Status	Both phases were completed.

Energy Peak Perks Program [53]

Motivation:	The Energy Peak Perks program is a residential demand response initiative of the IESO that reduces peak demand on hot summer days to help ensure the reliability of the electricity grid. Participants get financial rewards
Eligibility	Residential electricity customers in Ontario with central air conditioning or a heat pump controlled by a smart thermostat can participate in the program.
General overview	Time-limited thermostat adjustments can be applied for enrolled participants on hot summer days to help manage peak electricity demand.
Method of procurement	Direct enrollment by participants
Status	Active. More than 100,000 Ontario residents are currently enrolled, and the program's participants can reduce demand by up to 90 MW.

51 IESO, Regulation Services Procurements, at https://www.ieso.ca/Sector-Participants/Market-Operations/Markets-and-Related-Programs/Regulation-Service-Procurements

52 IESO, Contracts, at https://www.ieso.ca/Sector-Participants/Resource-Acquisition-and-Contracts/Contracts

53 IESO, Peak Perks, last updated on February 1, 2024 at https://www.ieso.ca/Corporate-IESO/Media/News-Releases/2024/01/Peak-Perks-Program-100000-Enrollments and https://saveonenergy.ca/For-Your-Home/Peak-Perks

54 The final report of Ontario's Electrification and Energy Transformation Panel described the short-term, meaning the present day until 2030, as "A period of innovation and change during which government is needed to provide clear leadership in setting up the planning and regulatory frameworks that will be required to support the rapid but orderly transformation, much of it customer-driven, that can be expected to intensify after 2030." See page 16 of Electrification and Energy Transformation Panel, Ontario's Clean Energy Opportunity: Report of the EETP, 2024, at https://www.ontario.ca/files/2024-02/energy-eetp-ontarios-clean-energy-opportunity-en-2024-02-02.pdf

To ensure that Ontario can capture the full value of new resources being added to the grid, the province should undertake the following:

1 Ontario should competitively procure bulk-level reliability from all types of resources, including non-emitting resources

In the initial stages, this should include explicitly procuring reliability services in upcoming IESO procurements, such as Long-Term Procurement 3 (LT3), which is expected to take place in 2027. Subsequently, the IESO should hold procurements designed to attract reliability services for all types that can be commercially procured in Ontario, coordinated with but separate from capacity or energy procurements. The program should be eligible to existing resources, including those that are contracted for non-reliability services, as well as to new resources.

Reliability Services Auctions (RSA) would enable a technology-agnostic, transparent, and competitive bidding process to meet Ontario's evolving power system needs, with preference for non-emitting resources (for example, transmission-connected renewables, waterpower, nuclear power, and storage). The RSA for bulk services could be coordinated with a similar one for distributed options (see below).

To accomplish this, there needs to be greater clarity and quantification on the reliability services expected to be needed in the coming years in Ontario, and greater emphasis on the metrics for success. Many reliability services are bundled in contracts with existing large generators. Thus, it is difficult to understand the market, and the costs and benefits of competitive procurements. Building on current work in the Annual Planning Outlook,[55] clarity on the services already provided, as well as the expected demand, would be needed. This would help to ensure that the reliability value of existing non-emitting resources, such as hydropower, storage, and nuclear, along with new investments, can be fully realized.

Actions to achieve enhanced reliability:

- Define and catalogue bulk-level reliability services that are needed in Ontario (Action 1 in the Action Plan)
- Develop metrics on the state of bulk-system reliability in Ontario (Action 2 in the Action Plan)
- Conduct and publish bulk-level operability assessments (Action 3 in the Action Plan)
- Transparently procure needed bulk-level reliability services (Action 4 in the Action Plan)

2 Clarify the future role of LDCs in Ontario regarding system operation and reliability

As discussed above, a large proportion of energy investments are being made, and will continue to be made on the distribution networks. In order to ensure that the required investments are online in 2030, clarity on the regulatory framework and the role of LDCs is required in the short-term.

Discussion on the future of the LDCs has continued for many years in Ontario, and there has been progress on non-wires solutions and other issues. However, no decision, not even a general direction decision, has been made on how LDCs will operate in the future. It is critical that decisions be made soon on the scope of future LDC operations, their remuneration models, and their ability to manage and plan for DERs and other services that have implications for reliability. The decisions need to include making changes in the regulatory system to incentivize LDCs to champion investments in DERs and non-wires solutions where it makes sense for them to do so.

Actions to achieve enhanced reliability:

- Set a vision and design a new regulatory regime for local electricity markets and clarify the role of the LDCs (Action 5 in the Action Plan)
- Improve on data and develop an open data system for the distribution system (Action 6 in the Action Plan)

55 2024 Annual Planning Outlook Report, IESO, March 2024, at https://www.ieso.ca/-/media/Files/IESO/Document-Library/planning-forecasts/apo/Mar2024/2024-Annual-Planning-Outlook.pdf

3 Enable development of local flexibility markets for reliability

In parallel with the development of bulk-level reliability markets, local flexibility markets could capture the value that flexibility can provide, as seen in the UK. These markets could be developed in parallel with the RSAs discussed above. They could include, for example:

- **Local Reliability Auctions:** These could meet feeder-based needs through regular auctions for capacity to meet local constraints. They could include the ability for either the IESO or the LDC to call upon the resource for outage management or when dealing with constraints.

- **Local Voltage Stability Support**: These auctions could provide fast-frequency or stabilization services to resolve voltage issues through non-wires solutions.

Such markets could include explicit procurements or contracts with a market operator or could be done through out-of-market payments. Wherever possible, the local markets should promote projects that offer multiple benefits, such as reliability as well as infrastructure deferral. To accomplish this, workable rules on remuneration for value stacking will be needed when a distribution-connected asset is able to provide energy and reliability services economically, and when the systems can be connected. To accomplish this, more data will be needed for both the LDC and potential developers. In addition, new systems, such as Advanced Distribution Management Systems (ADMS) and Distributed Energy Resource Management Systems (DERMS), could be developed.

Clarity on the future of the LDC and related regulatory changes will be needed to gain the full value of flexibility markets. Meaningful progress is required, rather than relying on pilots or limited-time-duration programs. This will require regulatory reforms on the future of LDCs to allow the electricity system to benefit from the value these assets could provide.

Actions to achieve enhanced reliability:

- Set a vision and design a new regulatory regime for local electricity markets and clarify the role of the LDCs (Action 5 in the Action Plan)
- Improve on data and develop an open data system for the distribution system (Action 6 in the Action Plan)
- Develop local reliability markets (Action 7 in the Action Plan)

4 Improve coordination between transmission and distribution on future methods for procurement and operations

More assets that provide the full spectrum of energy services – from energy, to capacity, to reliability services – will be integrated into the distribution system. It will be critical for the IESO and LDCs to coordinate on deciding which investments are needed, how they will be compensated, and how they will be dispatched to provide services in the distribution system and the transmission system. There is a need for province-wide principles on how to calculate and remunerate market participants for services provided in a value-stacking framework appropriate for use in Ontario, so that investors and developers can be fairly compensated for the values they provide. Investment in data analytics will be required to support real-time market assessments, along with enhanced system coordination and data-sharing capabilities. These should be paired with the development of technical standards for communications and data management.

Actions to achieve enhanced reliability:

- Improve on data and develop an open data system for the distribution system (Action 6 in the Action Plan)

- Improve coordination of reliability services between bulk and distribution systems (Action 8 in the Action Plan)

Table 3: Summary of action plan for net-zero reliability [56]

Action	Description	Actors[1]
1 Define and catalogue bulk-level reliability services needed in Ontario	**Short term:** Define and catalogue Ontario's needed reliability services in near-, medium- and long-term time frames in the evolving renewables market, including quantity, required services time, the required response time, and other characteristics.	▪ IESO
2 Develop metrics on the state of bulk-system reliability in Ontario	Develop clear, effective metrics that communicate the state of Ontario's bulk system reliability and operability and publish them regularly.	▪ IESO
3 Conduct and publish operability assessments	Conduct and publish detailed near-term operability assessments to understand strengths and gaps, building on existing processes already underway at the IESO. **Medium to long term:** Mandate, conduct, and publish more robust assessments of future operability requirements in various timeframes, expanding substantially on what is currently provided as part of the Annual Planning Outlook or a comparable long-term planning product.	▪ IESO
4 Transparently procure needed bulk-level reliability services	**Short term:** Design existing procurement contracts, and those for upcoming RFPs (capacity and/or energy), to consider the capability to deliver needed reliability services as part of the assessment criteria. **Medium to long term:** Develop Reliability Services Auctions (RSAs), and open and transparent bulk power system markets for reliability services from non-emitting resources	▪ IESO
	Distribution System	
5 Set a vision and design a new regulatory regime for local electricity markets and clarify the role of the LDCs	**Short term:** Set a vision and develop policies on the future business structure of LDCs and their role in planning, creating, and/or operating local markets. **Short term:** Design and execute a regulatory regime for new business structures and policies that allow for local markets.	▪ Ministry of Energy ▪ OEB ▪ LDCs
6 Improve on data and develop an open data system for the distribution system	**Short term:** Develop an open data system to ensure data availability and visibility in the distribution system and make it accessible and shareable with market participants (e.g., provide rate-based funding to support this open data system).	▪ OEB ▪ LDCs
7 Develop local reliability markets	**Medium term:** Develop markets or other transparent procurement mechanisms for technology-neutral RSAs at the distribution level.	▪ LDC ▪ OEB
	Bulk and Distribution levels	
8 Improve coordination of reliability services between bulk and distribution systems	**Short term:** Define the methods required for coordinating local reliability services with bulk system services, specifying responsible parties and milestone dates. **Short term:** Initiate real-world tests and trials of value-stacking models in coordination with the other actions above. **Medium term:** Develop enhanced distribution systems, including the use of distribution reliability metrics coordinated with bulk system reliability, commensurate with their increased role in electrification and the energy transition.	▪ IESO ▪ LDCs ▪ OEB

56 A more detailed Action Plan is available in Appendix A.

4 | Conclusions and discussion

As part of the global transition towards a net-zero future and Canada's emissions reduction commitments, Ontario, like other jurisdictions, is experiencing profound changes in electricity supply and demand, in the cost and performance of new technologies, and in the ability for distributed resources to meet customer and system needs.

The future of a net-zero grid will be judged as much on its reliability as on the amount of new clean energy resources that are added. A clean system that is unreliable would not be acceptable.

The current systems for ensuring reliability in Ontario make extensive use of large transmission-connected assets, including waterpower and nuclear power.[57] While these assets will continue to provide value, the transformative changes now underway in the electricity sector are opening new ways to economically secure reliability services.

In addition to the current transmission-connected, non-emitting assets, such as waterpower, that provide reliability, a combination of renewable energy, energy storage, and demand management on both

57 IESO, Decarbonization and Ontario's Electricity System, Assessing the impacts of phasing out natural gas generation by 2030, October 7, 2021, at https://www.ieso.ca/-/media/Files/IESO/Document-Library/gas-phase-out/Decarbonization-and-Ontarios-Electricity-System.ashx

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the transmission and distribution systems can cost-effectively deliver reliability services. These new methods for achieving reliability have the benefit of providing additional value on local distribution systems, such as deferring capital expenditures and addressing local reliability issues. As demonstrated in the UK, Australia, and other countries,[58] increasing flexibility at the consumer level through renewable energy, energy storage, and enhanced demand management, particularly with EVs, can provide great value to the system, lowering costs for all while reducing GHG emissions.

Many observers, including the Electrification and Energy Transition Panel, have stressed the importance of the increased certainty that comes from policy clarity.[59] Continuing uncertainty about the future of the sector and its market mechanisms will raise costs for all consumers and will delay decarbonization. Failing to embrace the transition and to recognize the benefits of the transition will likely result in higher costs, as has been seen in the PJM market.[60]

To ensure that Ontarians benefit from the transition, the ways in which reliability services are planned, procured, deployed, operated, and remunerated will need to be updated to reflect the ongoing changes in the electricity system. In general, market participants, stakeholders, and developers want transparency about reliability needs and opportunities to meet those needs, as well as fair compensation for the benefits they provide.

Action must start now. Ontario is committed to investing in a growing number of assets that could provide additional value in the electricity system. In the absence of action, Ontario will continue to rely on bi-lateral, short-term, or potentially more expensive procurement mechanisms. This will lead to higher costs, continue the dependence on natural gas plants, and deny investors the opportunity to reduce electricity costs.

The action plan contained in this report, which resulted from engagements with stakeholders and experts, and with the guidance of members of the Advisory Council to the Net-Zero Reliability Initiative, should be a key component of a reliable and clean electricity system. But reliability is only one part of a clean energy system. Ontario must prepare for the energy system of the future. A concerted plan of action is required to gain the full range of benefits that will come with the huge investments required to modernize the provincial electricity system.

Similar to the UK's approach, it will be essential to create a regulatory framework that rewards performance, promotes cost-sharing, and supports market participation. Without timely reforms, LDCs will face barriers in leveraging distributed resources, flexibility markets will falter, and customers will bear unnecessary costs. The changes Ontario makes must be holistic, with a focus on innovative remuneration models, robust technical standards, and fair market rules that ensure a resilient, efficient, and cost-effective energy future.

58 See Appendix C at https://www.pollutionprobe.org/netzero-reliability-initiative/

59 Electrification and Energy Transition Panel Report, 2024, page 62 Ontario's clean energy opportunity, December 2023, https://www.ontario.ca/files/2024-02/energy-eetp-ontarios-clean-energy-opportunity-en-2024-02-02.pdf

60 Kleinman Centre for Energy Studies, University of Pennsylvania, The High Price of Failing to Transition to Clean Energy, August 2, 2024, at https://kleinmanenergy.upenn.edu/news-insights/the-high-price-of-failing-to-transition-to-clean-energy/

Appendix A: Full Action Plan for net-zero reliability

Action	Central purpose	Short-term actions	Medium to long term	Actors[61]
		Bulk system		
1 **Define and catalogue bulk-level reliability services needed in Ontario**	To prepare as many resources and suppliers as possible to understand what participation in the reliability market may mean for them, and to identify their capability and costs.	Define Ontario's needed reliability services in short-, medium- and long-term time frames in the evolving market, including quantity, characteristics, the ability of different technology types to supply each service and method of acquisition, and update at least annually.		* IESO
	NOTES: *This will build on the IESO's existing practice of publishing Operating Reserve prices / scheduling amounts daily, along with publishing regulation service needs in the Annual Planning Outlook (APO), and the requirements in the Market Rules. Understanding that many reliability services are currently provided through existing market contracts, clarity would be needed on current status of reliability services and future requirements.*			
2 **Develop metrics on the state of bulk-system reliability in Ontario**	To encourage resources and suppliers to focus their efforts on the most beneficial areas and prepare to enter the market.	Develop clear, effective metrics that communicate the state of Ontario's bulk system reliability and operability, and publish them on a regular basis.		* IESO * LDCs (for distribution assets)
	NOTES: *This recommendation builds on and expands current work being done by the IESO's Operability and Transformation team*			
3 **Conduct and publish operability assessments**	To build an industry that is ready and capable of focusing on meeting reliability needs as they change.	Conduct and publish detailed near term operability assessments to understand strengths and gaps, building on existing processes already underway at the IESO.	Mandate, conduct and publish more robust assessments of future operability requirements in various timeframes, expanding substantially on what is currently provided as part of the Annual Planning Outlook or similar long term planning product.	* IESO
	NOTES: *These assessments need to include information on what resources are currently providing needed reliability services and support for operability. The data should be sufficient to properly inform market-based investment in the full range of reliability services including those from clean energy resources. For example, past operability assessments examined impact upon reliability of increased quantities of variable energy resources and the impact of increased penetration of DERs. The publication schedule will vary according to the type of assessment, but should be dependable and transparent in terms of process.*			

61 * With input from market participants and stakeholders

Action	Central purpose	Short-term actions	Medium to long term	Actors[61]
4 Design a transparent procurement process for bulk-level reliability services	To encourage market participants to identify and develop the reliability-related components of their competitive offers.	Design existing procurement contracts, and those for upcoming RFPs (capacity and/or energy) to include requirements for clean energy resources to have the capability to deliver needed reliability services.	Develop Reliability Services Auctions (RSAs), open and transparent bulk power system markets for reliability services from non-emitting resources	* IESO
	Based on information and engagement from Actions 1-3, the IESO should develop Reliability Services Auctions (RSAs) for needed essential reliability services. In the early stages (such as for LT3), essential reliability services can be included in the energy and capacity RFPs but not explicitly procured. For later RFPs (such as LT4 and on), RSAs should be held for essential reliability services in the transmission grid. These can also be coordinated with local RSAs (see below). While the IESO has started work in this area, it now needs to be specifically mandated, expanded, and carried out relatively quickly.			
		Distribution System		
5 Set a vision and design a new regulatory regime for local electricity markets and clarify the role of the LDCs	Develop the future business model of the LDC, including scope of operations for the LDC related to providing local and bulk-level reliability services and managing local markets. * Ministry of Energy	Set vision and policies on the future business structure of LDCs and their role in planning, creating and/or operating local markets.	Design a regulatory regime for new business structures that allow local markets.	* OEB * LDCs
	The aim of the new business structure should focus on the following: ▪ Removing the capital expenditure bias of regulated utilities (vs. operating expenditures) ▪ Introducing economically appropriate incentives to develop non-wires solutions ▪ Reward LDCs for the value they provide with benefit sharing with customers as such creating the right financial drivers to unlock value for LDCs and their shareholders ▪ Promoting the better integration of non-emitting resources ▪ Reducing costs for customers. This decision can be based on developments in peer jurisdictions, as well as informed from previous work on the local utility conducted in Ontario and consider such questions as to the “Total DSO” or “Dual Participation” models, as well as consultation and discussion on the future regulatory regime. Policy clarity is urgently needed here as the amount and type of investment in the distribution system is contingent on the business model and regulatory regime.			
6 Develop an open data system for the distribution system	To improve the efficiency of investment and competitive markets by systematically disseminating data useful to market participants.	Develop an open data system to ensure data availability and visibility in the distribution system, which is accessible and shared with market participants		* IESO *OEB * LDCs
	This data should be developed to: **1** Ensure that the local utility can better plan and operate distribution assets and to gain appropriate visibility **2** Quantify the amount and the value of the services needed **3** Ensure that the local utility can publicly provide required information to developers, along with information on the full range of grid services needed, for them to propose solutions. Developing the data system could be placed on the rate base to secure funding.			

Action	Central purpose	Short-term actions	Medium to long term	Actors[61]
7 Develop local reliability markets	In parallel to the RSA at the bulk level, local RSA are needed to transparently procure reliability services and non-wires solutions.		Develop markets or other transparent procurement mechanisms for technology-neutral RSAs at the distribution level.	* OEB * LDCs
	The size of the market will likely depend on the specific local utilities. These markets could include: ▪ Local Reliability Auctions: This could meet feeder based needs through regular auctions for capacity to meet local constraints. It could include the ability for either the IESO or the LDC to call upon the resource for outage management or when dealing with constraints. ▪ Local Voltage Stability Support: These auctions could provide fast-frequency or stabilization services to resolve voltage issues through non-wires solutions. Such markets could include explicit procurements or contracts with a market operator, or be done through out-of-market payments. Wherever possible the local markets should promote projects that offer multiple benefits, such as reliability as well as infrastructure deferral. To accomplish this, workable rules on remuneration for value stacking in circumstances when a distribution connected asset is able to economically provide energy and reliability services will be needed.			
Bulk and Distribution levels				
8 Improve coordination of reliability services between bulk and distribution systems	To ensure system integrity and maximize internal efficiency.	Define the methods required for coordinating local reliability services with bulk system reliability services and set ambitious targets specifying responsible parties and milestone dates. Initiate real world tests and trials of value stacking models in coordination with the other actions above	Develop enhanced distribution systems, including the use of distribution reliability metrics coordinated with bulk system reliability, commensurate with their increased role in electrification and the energy transition.	* IESO * OEB * LDCs
	Steps would include: (1) Developing a framework and method for categorizing sections of distribution systems as essential, and (2) defining applicable reliability metrics for them.			

Appendix B: Report on the reliability services needed for Ontario's power system in a net-zero future by Power Advisory

See https://www.pollutionprobe.org/netzero-reliability-initiative/

Appendix C: Innovative Policies for Increasing Reliability Services: Jurisdiction Scan

See https://www.pollutionprobe.org/netzero-reliability-initiative/

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