Fair Hydro Plan Financing Program

Servicing Review

November 14, 2017

ieso
Independent Electricity System Operator

Table of Contents

Independent Electricity System Operator

Section 1

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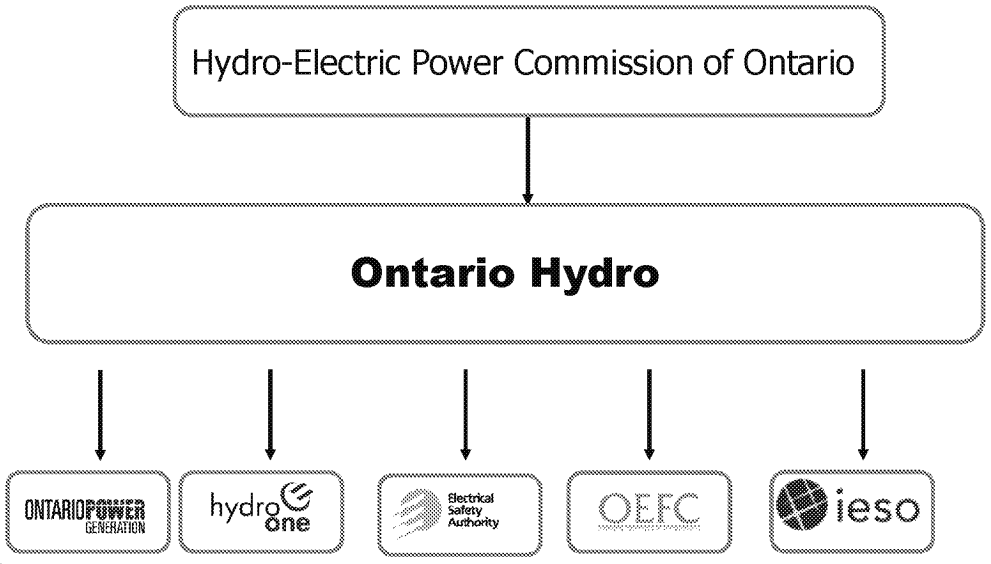
Where did We Come From?



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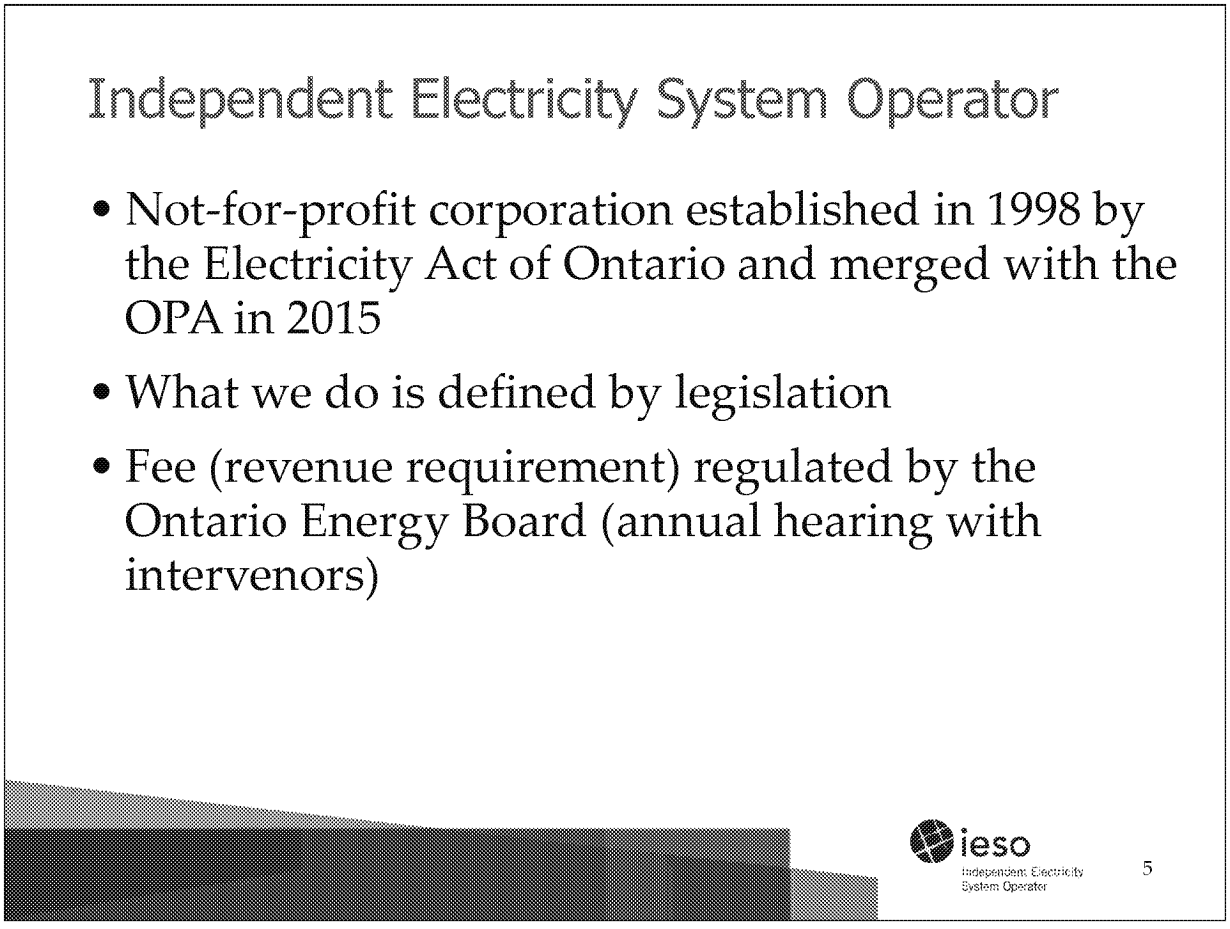


Millions of dollars a day
Don't keep the money everything we take goes back out

Legislation – take out coal, manage wind (first wind was not dispatchable)

Fee – get fee
Funded by rate payers
Ontario Hydro was the official name from 1974 of the Hydro-Electric Power Commission of Ontario which was established in 1906 by the provincial Power Commission Act to build transmission lines to supply municipal utilities with electricity generated by private companies already operating at Niagara Falls.

Ontario Hydro
It soon developed its own generation resources by buying private generation stations and then becoming a major designer and builder of new stations. As most of the readily developed hydroelectric sites were exploited, the corporation expanded into building first coal fired generation and then nuclear power. It had become one of the largest, fully integrated electricity corporations in North America by the 1990s.

In 1999, Ontario Hydro was split up into 6 successor companies.

Ontario Power Generation
Ontario Power Generation (OPG) produces almost half of the electricity that Ontario homes, schools, hospitals and businesses rely on each day.

At Dec. 31, 2016, OPG's generating portfolio had an in-service capacity of 16,177 megawatts.
We own and operate:
2 nuclear stations
Pickering
Darlington
66 hydroelectric stations on 24 river systems
2 biomass stations
Atikokan GS has been converted from coal to use biomass
Thunder Bay GS, which was the last station to run on coal, now uses advanced biomass as fuel.
1 thermal station
Lennox Generating Station
Canada's largest oil/gas-fuelled electricity generating station
1 wind turbine
Located at the Pickering Nuclear Generating Station
1.3 million distribution customers
Hydro One
Hydro One Limited owns and operates essential energy infrastructure that powers Canada's biggest and most diverse provincial economy
29,000 circuit kilometres of transmission lines

Electrical Safety Authority
The Electrical Safety Authority (ESA) is an administrative authority mandated by the Government of Ontario to enhance public electrical safety in the province. We are both a safety regulator and advocate.

Ontario Electrical Finance Corporation
Managing its debt, financial risks and liabilities, including the debt of the former Ontario Hydro;
Managing the former Ontario Hydro's contracts with non-utility generators (NUGs);
Receiving all payments and administering other assets, liabilities, rights and obligations of the Corporation that were not transferred to another of the former Ontario Hydro successor corporations and disposing of any of these items as it deems appropriate or as directed by the Minister of Finance;
Providing financial assistance to the successor corporations of Ontario Hydro;
Entering into financial and other agreements relating to the supply and demand management of electricity in Ontario; and
Performing any additional objects specified by the Lieutenant Governor in Council.

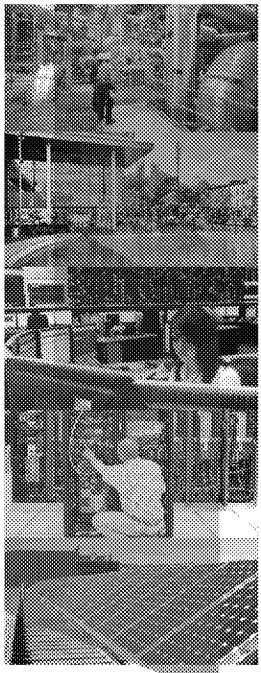
OPA
They ensure that electricity needs are met for the benefit of Ontario both now and in the future. They plan and procure electricity supply from diverse resources and facilitate the measures needed to achieve ambitious conservation targets.

On January 1 2015 OPA and IESO merged

What We Do

The Independent Electricity System Operator (IESO) works at the heart of Ontario's power system – ensuring there is enough power to meet the province's energy needs in real time while also planning and securing energy for the future. It does this by:

- Planning
- Enabling Conservation
- Ensuring Supply
- Operating the Grid
- Engaging Stakeholders and Communities



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Planning

The IESO forecasts and assesses Ontario's current and short-term electricity requirements, as well as the adequacy and reliability of the integrated power system.

We also forecast energy demand for up to 20 years and ensure plans are in place to meet that demand.

Enabling Conservation

The IESO coordinates the province's conservation efforts by supporting various programs, building market capability, and promoting innovation.

Ensuring Supply

The IESO ensures supply through contracts with a range of suppliers, from grid-scale generators to individuals with small-scale projects. We also ensure supply through market-based mechanisms and are currently developing auctions for capacity and demand response.

Operating the Grid

The IESO maintains the reliability of the grid in real time, balancing the supply and demand for electricity on a second-by-second basis.

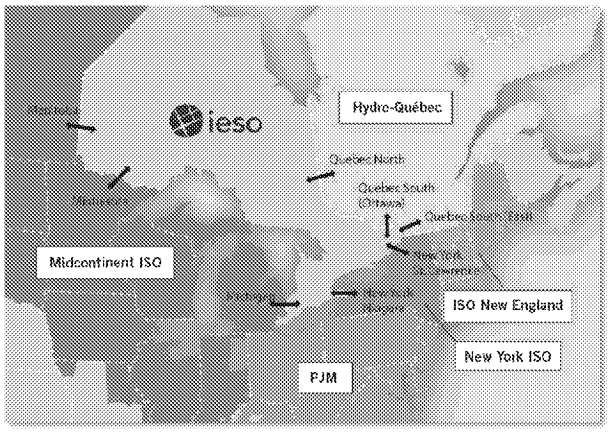
We oversee the electricity market and work with neighbouring jurisdictions to ensure reliability and cybersecurity standards.

Engaging Stakeholders and Communities

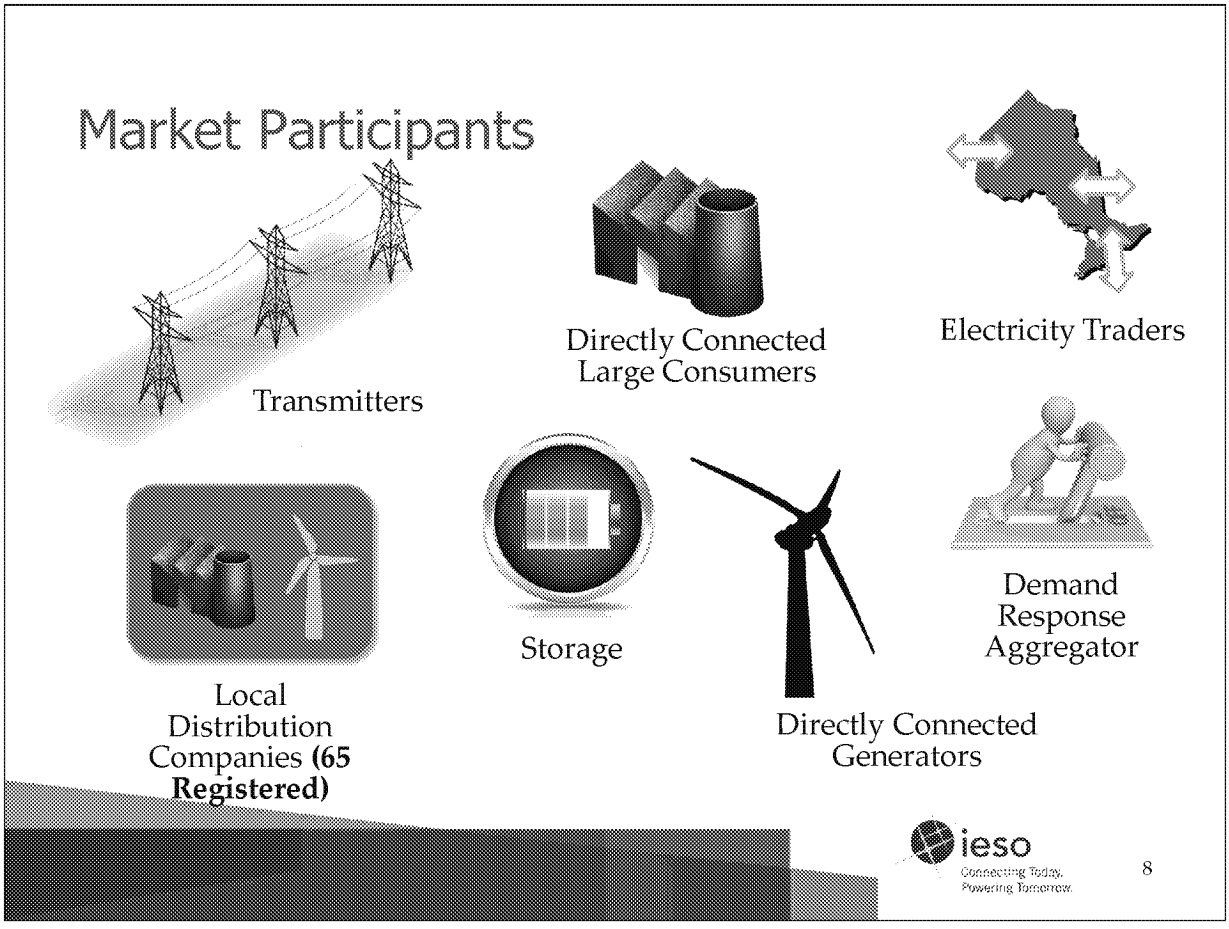
Engaging stakeholders and communities is an important part of what we do. This outreach informs our efforts to develop regional plans, to work with Aboriginal communities, and to evolve the sector in a way that benefits everyone.

Ontario at a Glance

Installed Capacity	36,853 MW (Sept 2017)
Record Summer Peak	27,005 MW (August 1, 2006)
Record Winter Peak	24,979 MW (December 20, 2004)
Total Annual Energy Consumed	137 TWh (2016)
Energy Savings Through Conservation (2016)	1.2 terrawatt-hours (TWh)
Customers	4.9 million
Ontario Import Capability	6,500 MW
Transmission Lines	30,000 km
Interconnections	New York, Quebec, Manitoba, Michigan, Minnesota



The IESO is the reliability coordinator for Ontario and works closely with other jurisdictions to ensure energy adequacy across North America.



So who are the participants in our market? On our web site (www.IESO.ca) we maintain a listing of all companies who are registered with us.

In general, our market includes directly connected loads and generators, as well as a number of participants located outside of our province. These later are generally energy traders who move electricity into and out of the province.

Within the Local Distribution Company's networks, we have now two types of consumers – Those on the fixed price and those who are either charged or paid the wholesale price.

OEB sets a Regulated Price Plan rate for some consumers:

Will reflect the true cost of power over time

Current low volume and designated customers covered until Nov 1, 2009

After Nov 2009, only residential and general service customers under 50 KW covered by the RPP

Rates are set for one year to April 30, 2006. After that, they may change every six months

Replaced by:

Regulated rates for some OPG assets (part of Provincial Benefit)

A fixed price for a portion of the remaining assets until April 30, 2006 which may result in a rebate

IESO Business Overview

- Approved 2017 operating budget is $191.4M
- IESO operates in a unionized environment
- Currently approved staffing level is 712
- Third party services are used for specialized expertise as required – professional & consulting services comprise $17.8 million or approximately 9% of IESO's operating budget

Review and Update of Strategic Priorities Underway by New CEO

Themes What we do	Providing public value		Respecting and valuing our communities, customers and stakeholders	Building corporate resilience
Goals What we want to achieve in the next five years	Deliver superior reliability performance in a changing environment	Drive to a more efficient and competitive marketplace	Be recognized as a trusted advisor, informed by engagement	Invest in our people and processes to meet the needs of the sector
Strategic Objectives How we will achieve our goals	• Plan and manage the power system so Ontarians have power when and where they need it. • Enhance reliability and efficiency through coordination of IESO- and LDC-controlled resources. • Promote robust cybersecurity practices across the sector.	• Evolve the IESO markets to increase market efficiency and value for consumers. • Foster an open and competitive electricity marketplace with broad participation.	• Enhance public confidence in the IESO and the sector to facilitate informed customer choice. • Work effectively with government to support policy development and IESO's excellence in implementation. • Seek out and respond to input from communities, customers and stakeholders to inform IESO decisions.	• Strengthen the development and engagement of our employees. • Attract and retain the best talent. • Be a focused and flexible organization positioned to support the ongoing transformation of our industry.

IESO Control Framework

- Environment reflects the mindset, awareness and actions of the IESO's Board of Directors, management and other stakeholders concerning the importance of internal control and the emphasis placed on control in the company's policies, procedures, methods and organizational structure
- The Executive Leadership Team, which includes the President and CEO, meets regularly to discuss all areas of IESO's business
- This team is responsible for establishing corporate policies and procedures and for creating and maintaining a control conscious environment

IESO Risk Assessment

- IESO Executive Leadership Team with the oversight of the Board of Directors has established and implemented a process to manage risks effectively and efficiently across the IESO
- IESO's Enterprise Risk Management (ERM) process supports corporate governance responsibilities in providing a structured approach to identifying, assessing, managing and monitoring potential events that may affect the achievement of its organizational objectives

IESO Staffing

- Recruiting, developing and retaining highly skilled staff is an ongoing priority
- Low annual rate of voluntary turnover at 2.4% in 2016 and, in 2017 is trending below 1%
- IESO provides competitive salary, benefits and defined benefit pension
- Actively and materially supports continuous learning, career development, health and safety, work/life balance, and a professional, respectful work environment
- The IESO does not use offshore resources

LDC Onboarding and Administration

Section 2

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LDC Onboarding

- There are current 65 LDC registered to participate in the IESO Administered Markets
- New LDC introduction at the IESO level is unlikely
- Recent experience has been amalgamation
  - 2017 Alectra Utilities Corporation created from Horizon Utilities Corporation, PowerStream Inc, Enersource Hydro Mississauga Inc, and Hydro One Brampton Networks Inc
- LDCs are required to adhere to the IESO's Market Rules which dictates how errors, mistakes and disputes are to be adjudicated

LDC Onboarding

- IESO relies on market rules, statutes and regulations that directs LDCs to supply information in the form and timing requested
- The IESO's MACD group may enforce fines and penalties on market participants including LDCs for market rules violations and market gaming activities – including a general conduct rule adherence

LDC Oversight

- IESO is not obligated or tasked to conduct / performance actions on LDCs to prevent and detect errors, fraud, mistakes
- LDCs are regulated by the OEB and are required to adhere various key OEB codes:
  - Standard Supply Service Code: https://www.oeb.ca/oeb/_Documents/Regulatory/Standard_Supply_Service_Code.pdf
  - Retail Settlement Code
  - https://www.oeb.ca/sites/default/files/Retail_Settlement_Code_RSC.pdf
  - Distribution System Code
  - https://www.oeb.ca/oeb/_Documents/Regulatory/Distribution_System_Code.pdf
  - Electronic Business Transactions Standards for Retail Settlement
  - https://www.oeb.ca/oeb/_Documents/Regulatory/Ontario_EBT_Standards_v4.pdf

LDC Treasury Administration

- IESO conducts daily monitoring of all market participants' electricity market financial exposures including LDCs
  - Collateral calls may be issued based on actual exposures and/or collaterals' expiries
  - Margin calls may be issued based on actual exposures;
- IESO does not rank LDCs based on their risk profile. The OEB provides annual reports/scorecards to compare LDCs' performance, various metrics, and bad debt expenses

https://www.oeb.ca/utility-performance-and-monitoring/what-are-electricity-utility-scorecards/electricity-utility;

https://www.oeb.ca/sites/default/files/2016-consolidated-scorecard.pdf;

https://www.oeb.ca/oeb/_Documents/Press%20Releases/OEB_RRR_2.1.8_Ar...ess_PaymentAgreements_WriteOffs.pdf;

LDC Treasury Administration

- IESO does not rank LDCs based on their risk profile
- The OEB provides annual reports/scorecards to compare LDCs' performance, various metrics, and bad debt expenses
- All market participants must adhere to IESO prudential (collateral) requirements – as detailed in IESO Market Rules

LDC Treasury Administration

- The Market Rules recognizes that LDCs have a lower credit risk profile than non-LDCs, and therefore the collateral requirements are materially lower that non-LDCs.
- Some LDCs (typically larger size) have external credit ratings while most do not have external credit ratings
- Those LDCs that do not have credit ratings are not necessary of less creditworthiness status – many do not need or rely on credit ratings for their business structure to operate

LDC Default

In general, the IESO may experience the following three types (or severities) of payment defaults:

- defaults that are administrative in nature and are cured quickly within a few days
- defaults that involve significant delays in payment and requires IESO action(s)/effort(s) to resolve but are ultimately cured without drawing upon the MP's collateral
- defaults that involve non-payment from the MP resulting in a draw on the MP's collateral by the IESO is needed, which may include issuance of a default levy if all collateral is exhausted

LDC Default

- Most LDCs' default is administrative in nature, cured by full payment within days without drawing on any of their posted collateral
- IESO has not incurred a loss due to LDCs default

IESO Cash Management Procedures and Controls

- All payments received from Market Participants are paid to the IESO bank via electronic funds transfer or wire transfer on the date specified for invoicing
- The Treasury system automatically downloads bank balances and transactions detail daily
- Finance personnel reconcile the bank balances and transactions on a monthly basis, and investigate any unclear or unreconciled items

IESO Cash Management Procedures and Controls Continued

- The Treasury Analyst then submits the IESO's market Accounts Receivable file to Lawson in a pending state
- Finance personnel subsequently post the associated journal entries in Lawson to clear the Cash Clearing account
- On a monthly basis, Finance personnel reconcile the Electronic Funds Transfer (EFT) outbound payment file with the payment invoices on Accounts Receivable and Accounts Payable reports

IESO's Role in the Fair Hydro Program – Creation of the Regulatory Asset

Section 3

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Regulatory Asset Accounting

- IESO is rate regulated by the OEB
- Rate regulated entities can establish regulatory assets and liabilities
- Regulatory asset represents the right to be reimbursed for costs in the future
- Regulated asset can be transferred/acquired
- For the OFHP regulated asset the IESO will maintain as required by the OFHP Act an internal record of the variance account balance that is determinative at the time of recording

Creation of Regulatory Asset

- LDCs submit monthly to the IESO all OFHPA bill reduction amounts for specified consumers which are reflected as reduction to monthly IESO invoices
- The Fair Hydro Trust submits carrying costs monthly for reimbursement during the four year moratorium period (prior to the Clean Energy Adjustment coming in effect)
- IESO will receive a reduced amount (RPP and Non-RPP's global adjustment modifier) from the LDCs

Creation of the Regulatory Asset

- IESO will pay the generators and the Fair Hydro Trust the amount owed
- LDC shortfall and Fair Hydro Trust carrying costs will be funded by IESO in the interim via debt facilities and will be recorded as part of a regulatory asset
- Fair Hydro Trust will purchase all or part of the regulatory asset as outlined in the MTSA
- This will transfer the risks and rewards associated with the regulatory asset from the IESO to the Fair Hydro Trust

Creation of the Regulatory Asset

- IESO will use the cash received from the transfer of the regulatory asset to repay the debt facilities
- Any interest incurred by the IESO for debt facilities also will be recorded in the variance account as part of the regulatory asset and recovered in a subsequent transfer of the regulatory asset
- Any remaining balance in the IESO's regulatory asset after the moratorium period will then become recoverable from the market

Clean Energy Adjustment Amounts

- LDCs will establish and certify a segregated account into which Clean Energy Adjustment (CEA) collections from Specified Consumers are to be deposited as required by Regulation
- Guidance with respect to the establishment of procedures for the invoicing amounts in respect of the CEA, the identification, deposit and segregation of CEA collections, the remittance of CEA collections and reporting will be provided

Clean Energy Adjustment Amounts

- LDCs will submit information of CEA billed to Specified Consumers in line with current submission requirements within 12 business days of the end of each billing period
- Complete a review the information received for material manifest discrepancies, including any discrepancy between the collections reported and the amount received by LDCs

Clean Energy Adjustment Amounts

- Undertake to contact and resolve applicable issues when LDCs:
  - Do not deliver information in respect of a Billing Period where CEA were payable by Specified Consumers
  - No CEA collections are received in respect of the Billing Period
  - Has not certified that it has established the segregated account required by Regulation

Clean Energy Adjustment Amounts Received

- Receive CEA collections from LDCs
- Held in trust in segregated account for the benefit of the Issuer
- Provide notice of collection at least 10 days before remittance
- Transfer any cash and/or any investments to the Issuer

Demand Forecasting

Section 4

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Three types of forecasts used at the IESO

Short-term: looks ahead 5 minutes to10 days; review forecast variances monthly

Mid-term: looks ahead 18 months, econometric approach; review of forecast variance month and quarterly

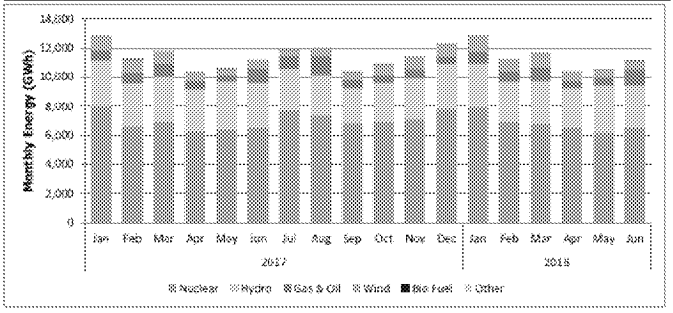
Long-term: looks ahead 20+ years, end-use approach, scenario-oriented; review forecast variance, 1- 3 years

Example of Forecasting Ontario's Future Electricity Needs in Mid-Term

- The IESO plans and prepares for Ontario's future electricity needs by conducting forecasts and assessments of Ontario's current and short-term electricity requirements, as well as the adequacy and reliability of the integrated power system.
- Decisions made over the past decade mean that Ontario demand supply picture will remain positive for the foreseeable future.

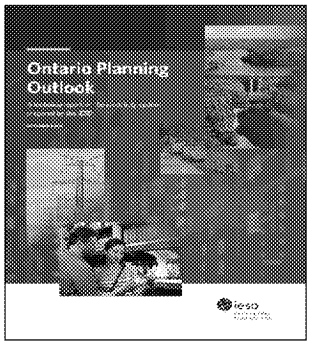
18 Month Outlook

An Assessment of the Reliability and Operability of the Ontario Electricity System



- ❑ Adequate supply from a diverse supply mix
- ❑ Demand expected to remain flat for the long term
- ❑ Growth to be offset by conservation savings

Example of Forecasting in Long-term



The IESO's Ontario Planning Outlook:

- Provides a 10-year review (2005-2015) and a 20-year outlook (2016-2035) for Ontario's electricity system
- Responds to a June 10, 2016 request from the Minister of Energy for a technical report on the adequacy and reliability of Ontario's electricity resources
- Provides insights and considerations for the operational needs associated with implementing low-carbon resources, electrification and the growth of distributed energy resources
- Serves as a key input to the government's Long-Term Energy Plan (industry and public consultations are underway)

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Powering Tomorrow.

37

On September 1, 2016, the IESO provided the Minister of Energy with the Ontario Planning Outlook, an independent report analyzing a variety of planning scenarios for the future of Ontario's energy system.

This report is expected to serve as the foundation for the government's next Long-Term Energy Plan, which is scheduled to be released in 2017.

As part of this process, consultations with consumers, businesses, stakeholders and Indigenous communities began in late October.

Here are a few high-level findings of the OPO:

Because of current and past investments, Ontario is well-positioned to meet provincial needs until the mid-2020s, while continuing to adapt to significant change across the sector.

Implementation of the province's climate change policies will have an impact on the demand for electricity, including through greater electrification of the economy.

There are a lot of variables, but our models suggest that electrification could result in long-term provincial electricity demands that are up to 40% higher than today.

In higher demand outlooks, additional investments in new resources (conservation, generation and transmission) would be required to meet the increase in demand. However, opportunities for increased conservation will also vary with increases and decreases in demand.

Conservation will play an increasing role in reliability, with long-term targets achieved through a combination of formal conservation programs as well as improvements to building codes and equipment standards

Ontario has the flexibility to adapt to the evolving sector.

CCAP

In June of this year, the government released its Climate Change Action Plan.
This plan and the cap-and-trade program form the backbone of Ontario's strategy to cut greenhouse gas pollution to 15 per cent below 1990 levels by 2020, 37 per cent by 2030 and 80 per cent by 2050.
Action areas include transportation; buildings and homes; land use planning; industry and business; collaboration with Indigenous communities; research and development; government; agriculture; fand orests and lands
Every action area described in the CCAP has implications for Ontario’s electricity sector.
The IESO’s role in enabling some of these initiatives remains unclear at this time but work is underway to clarify roles and responsibilities.

Specified Consumers Forecast

- The IESO's role to date has been providing annual TWh demand to the OEB for their use in setting RRP rates (Tiered and TOU)
- Monthly and annually the IESO provides information to the OEB based on actuals for rate updates and forecast analysis
- Specified consumers go beyond the RPP eligible
- We are collecting monthly data on specified consumers as part of the GA deferral recognition
- We will have four years of data to develop forecasts for Clean Energy Adjustment rates

Example of the Monthly OEB RPP Variance Account Report

Month & Year	RPP Load Submitted by LDC's	Total Market AQEW	RPP vs. Total Market AQEW	"Gross" Accumulated IESO Variance Account[4]	"Net" IESO Variance Balance (IESO VA less OPG Rebate)[4]	Cumulative "Net" Interest	"Net" IESO Variance Balance (IESO VA less OPG Rebate)[4 including interest]
	kWh Total	kWh	%	$	$	$	$
Oct-16	4,529,048,317	10,321,447,273	44.16%	$676,854,013.85	$73,058,109	-$6,563,177.52	$66,494,931
Nov-16	4,371,745,587	10,492,527,220	44.18%	$70,224,836.60	$70,224,837	$11,022.06	$70,235,859
Dec-16	4,713,221,033	11,689,726,329	44.10%	-$27,637,063.96	-$27,637,064	$51,431.79	-$27,585,632
Jan-17	5,335,304,962	11,828,819,703	44.36%	-$6,002,338.17	-$6,002,338	$101,065.18	-$5,901,273
Feb-17	4,979,491,689	10,417,870,348	44.43%	-$29,244,185.66	-$29,244,186	$79,819.65	-$29,164,366
Mar-17	5,198,153,131	11,408,408,037	44.18%	-$66,756,693.44	-$66,756,693	$69,434.54	-$66,687,259
Apr-17	4,435,407,154	9,695,799,202	44.15%	-$18,568,705.33	-$18,568,705	$61,273.68	-$18,507,432
May-17	4,401,035,843	10,013,011,756	44.22%	$114,034,880.00	$114,034,880	$9,224.92	$114,044,105
Jun-17	4,316,533,813	10,477,034,607	44.29%	$136,510,260.51	$136,510,261	-$2,833.07	$136,507,427
Jul-17	4,810,997,307	11,355,300,033	44.37%	$139,258,989.16	$139,258,989	$72,109.96	$139,331,099
Aug-17	4,997,167,274	11,139,446,944	44.24%	$194,389,126.61	$194,389,127	$209,413.08	$194,598,540
Sep-17	4,661,892,190	10,497,819,588	43.88%	$181,526,277.37	$181,526,277	$338,578.91	$181,864,856
12 month Total	56,749,998,299	129,337,211,040	43.88%	$1,364,589,398	$760,793,493	-$5,562,637	$755,230,856

Example of RPP Actual Data Provided Annually to OEB

Month & Year	RPP Load Submitted by LDC's					
	kWh					
	Tier 1	Tier 2	Off-Peak	Mid-Peak	On-Peak	Total
Jan-16	637,976,003	464,204,706	2,636,399,973	657,938,514	710,262,746	5,106,781,942
Feb-16	595,724,594	525,880,527	2,699,953,177	687,596,504	752,207,397	5,261,362,199
Mar-16	597,533,357	480,748,952	2,854,666,780	699,022,293	760,033,065	5,392,004,447
Apr-16	550,093,929	394,249,578	2,444,294,636	649,011,891	692,002,948	4,729,652,983
May-16	536,991,396	361,830,793	2,271,112,686	631,127,296	642,343,305	4,443,405,475
Jun-16	459,807,948	453,145,981	2,245,584,988	627,783,522	626,357,836	4,412,680,275
Jul-16	505,538,987	504,035,509	2,610,264,925	721,816,971	756,455,872	5,098,112,263
Aug-16	524,532,869	592,724,382	2,978,511,701	854,694,883	955,019,790	5,905,483,625
Sep-16	445,790,365	485,187,893	2,681,804,343	778,185,207	886,297,264	5,277,265,073
Oct-16	473,630,840	381,853,178	2,300,875,221	668,235,067	704,454,012	4,529,048,317
Nov-16	507,879,719	382,854,290	2,222,797,673	633,096,983	625,116,921	4,371,745,587
Dec-16	656,156,035	343,293,598	2,342,419,219	649,809,799	721,542,383	4,713,221,033
12 month Total	6,491,656,041	5,370,009,387	30,288,685,321	8,258,318,930	8,832,093,539	59,240,763,218

IESO Information Technology Environment

Section 5

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IESO Information Technology Environment

- IT executes the delivery of products and services through IESO personnel based on documented roles, responsibilities and performance standards or via contracts with external suppliers
- Core Business Areas:
  - Information Technology consists of three core IT units:
    - Business Solutions
    - Technology Services
    - IT Operations
  - Organizational Governance Support

IESO Information Technology Environment

- Business Solutions Department is responsible for development, maintenance of all business solutions:
  - Maintain, support and develop requirements for enhancements to Power System, Electricity Market and Corporate business solutions
  - Plan replacement and major upgrades of application systems
  - Manage contracts for vendors who provide support for Power System, Electricity Market and Corporate business solutions
  - Provide second and third tier (external vendors) support to all application systems
  - Develop web solutions for Power System, Electricity Market and Corporate business solutions
  - Business Analysis Services
  - Develop business processes for internal IESO business processes
  - Provide integration services for business solutions acquired or developed

IESO Information Technology Environment

- The Technology Services Department is responsible for the delivery, administration, and maintenance of the technical infrastructure of the IESO including:
  - All server hardware/software (Unix, Linux, Windows)
  - Database management system
  - Desktop and laptops definition and deployment infrastructure
  - Mass storage and backup infrastructure
  - Local and Wide Area Networks
  - Telephony and communications
  - All electronic wallboard displays
  - Common corporate tools such as Exchange Mail and Aspen file server

IESO Information Technology Environment

- The IT Operations Department is responsible for the 24x7 operation of the production environment and the IESO data centers with specific responsibilities for:
  - 7x24 Shift Operations
  - 7x24 IT Service Desk Support (Tier 1 support)
  - 7x24 Data Integrity
  - 7x24 IT Security Support (Monitor the virus alerts, monitor for NERC advisories and Alerts
  - Incident Management
  - High Level reporting on Service Desk Management.

IESO Information Technology Environment

- Organizational Governance Support provides the governance framework for the delivery and support of IT systems and support:
  - Overall security policies and IT security oversight including development and coordination to implement the IT security framework (policies, standards, guidelines, procedures)
  - Change, release, baseline, records and information management as well as, advising, tracking, reporting and providing metrics for each process
  - Support of the IESO's business continuity management program
  - Establishing and promoting project governance and project management standards and methodologies across the IESO.

IESO Backup and Recovery

- The IESO operates redundant backup servers, one each at the primary site and the backup operations center site.
- All critical data is replicated in real-time from the primary site to the backup site
- Requirements for the recovery of business functions following a contingency are established
- Business units establish and exercise plans to meet these requirements
- Redundancy for critical information systems is provided at a physically remote backup site
- Ability to operate those redundant systems is tested periodically

Incident Management

- The IESO has implemented a formal incident management (malfunctions) process based on the ITIL framework
- Processes provide the framework to prioritize service failures, assign and escalate to designated IT support, record investigation and resolution
- Processes also provide guidance on how IT personnel are required to create incidents based on IT issues detected from various systems monitored by the IT department
- Incident management process has been documented in policy and procedural documentation which are available on the IESO website

Disaster Recovery

- The IESO conducts regular failover testing of information technology systems and services to provide assurance that our disaster recovery capabilities are robust and that the critical systems can be recovered in a timely manner in support of IESO business
- Recovery includes regaining access to applications, data, communications, work space and other IT services and functions
- Complete test of financial and critical systems September 2017 (financial systems tested once/yr. and critical systems twice/yr.)

Primary Applications Used With LDC Settlement

- Commercial Reconciliation System
- Lawson
- Treasura
- Notice of Disagreement Tool
- Market Participant Portal Access

Commercial Reconciliation System - (Replacement Project Underway)

- Collects data from other IESO systems
- Calculates the settlement amounts for the IESO-defined charge types
- Processes user-entered settlement adjustments (i.e. manual line items)
- Generates financial exposure information for Market Participants
- Generates settlement statements for IESO-administered markets

Lawson

- General Ledger, Accounts Payable and Accounts Receivable applications
- Applications handle the generation of invoices, as well as the maintenance of market accounts, and maintenance of Market Participant historical payment information
- Lawson also creates electronic transfer files for payments

Treasura

- Collects and records cash receipts from, and make payments to, Market Participants
- Used for the market cash management functions of the IESO and interfaces directly with Lawson and the IESO's bank
- Used to manage daily cash and create reports necessary to manage and report on the market-related cash management activities
- Treasura is hosted by a third party vendor, Wall Street Systems.

Notice of Disagreements Tool

- Notice of Disagreement tool allows Market Participants to submit a Notice of Disagreement to the IESO
- Allows tracking of the submission through to completion
- Workflow application allows tracking of actions taken on identified incidents to ensure the disagreement is processed in accordance with the timelines required

Market Participant Portal Access

- Portal is the starting point to access IESO information and software applications
- Users can securely upload, share and revise data used in settlement calculations
- Web portal provides greater flexibility and security than a normal website and is currently used by Market Participants to submit and view settlement data

Historic and Projected Energy Use

Section 5

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Independent Electricity System Operator

Historic Electricity Demand

Some broad trends:

- 1940's – Mid 2000's: growth in absolute terms, but at a declining rate
- Mid 2000's – today: pronounced demand reduction (re: economy, conservation, pricing effects), now effectively flat
- Changing sectoral composition: commercial up, industrial down, residential in between

Historic Electricity Demand

Some broad trends continued:

- Declining intensity of electricity use in residential sector
- Since early 2000's, shift to a predominantly summer peaking system
- Peakier annual load shape

Projected Energy Usage

Electricity Demand by Sector (TWh)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Residential	52	52	52	51	51	50	50	50	50	49	49	49	49	50	50	50	50	50	51
Commercial	52	52	52	51	51	51	52	52	52	52	52	52	52	52	52	52	53	53	54
Industrial	34	35	34	35	35	35	34	34	34	34	34	33	34	34	34	34	34	34	35
Transportation [1]	0	0	0	0	1	1	1	2	2	3	3	4	4	5	6	7	7	8	9
Other [2]	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Notes:

[1] Transportation includes Electric Vehicles and Transit

[2] Other = Agriculture, Remote Communities, Generator Demand, Industrial Electricity Incentive, and Street Lighting

Electricity Demand by End-Use (TWh)

Residential Net Energy Demand by End-Use (TWh)

	2017	2025	2035
AC Central	3.0	3.0	3.0
AC Room	0.5	0.5	0.5
Clothes Dryers	2.5	2.5	2.2
Clothes Washers	0.3	0.3	0.3
Computers	1.1	1.3	1.4
Cooking	2.5	2.2	2.3
Dehumidifiers	0.5	0.5	0.4
Dishwashers	0.5	0.5	0.5
Domestic Hot Water	3.8	3.3	3.3
Elevators	0.2	0.2	0.2
Forced Air Central Heating	1.4	1.2	1.5
Freezers	1.7	1.7	1.8
Lighting	7.6	6.0	4.9
Miscellaneous	4.2	4.9	5.8
Baseboard Heating	6.7	5.9	5.7
Other Consumer Electronic	3.8	4.1	4.8
Refrigerators	4.4	4.4	4.6
Set Top Boxes	0.8	0.8	0.9
Space Heating Room	0.1	0.1	0.1
Swimming Pool Pumps	0.6	0.6	0.6
Televisions	2.5	2.9	3.5
Ventilation And Circulatior	3.2	2.6	2.5

Electricity Demand by End-Use (TWh)

Commercial Net Energy Demand by End-Use

	2017	2025	2035
Space Heating	4.1	4.7	5.1
Computer Equipment	5.0	5.2	5.4
Cooking	0.8	0.8	0.8
Cooling Chillers	1.1	1.0	1.1
Cooling DX	3.6	3.6	3.8
Domestic Hot Water	0.7	0.4	0.4
Elevators	0.3	0.3	0.3
HVAC Fans Pumps	4.5	3.9	3.6
Lighting	19.0	19.0	19.6
Miscellaneous Equipment	5.1	5.7	6.6
Other Plug Loads	4.0	4.1	4.2
Refrigeration	3.8	3.0	2.7

Electricity Demand by End-Use (TWh)

Industrial Net Energy Demand by Subsector

	2017	2025	2035
Chemicals	3.4	3.5	4.0
Fabricated Metals	1.9	1.9	2.0
Food And Beverage	2.3	2.3	2.6
Mining	6.5	7.4	7.0
Transportation And Machinery	3.1	3.0	3.1
Miscellaneous Industrial	4.0	4.0	4.4
Non-Metallic Minerals	1.3	1.2	1.2
Paper Manufacturing	2.6	2.1	1.9
Petroleum Refineries	1.7	1.8	2.0
Plastic And Rubber	2.1	2.0	2.1
Primary Metals	4.5	3.9	3.7
Wood Products	1.0	0.9	1.0

Electric Vehicle (EV) Stock Forecast

	2017	2025	2035
Thousands of EVs	15	450	2,401

	Households	Commercial SQFT
2017	5,581,089	3,305,815,503
2018	5,666,227	3,356,412,223
2019	5,749,669	3,406,188,634
2020	5,831,807	3,455,870,987
2021	5,910,039	3,504,894,508
2022	5,980,524	3,548,806,209
2023	6,046,212	3,590,932,451
2024	6,107,951	3,631,662,560
2025	6,166,993	3,670,932,197
2026	6,223,916	3,710,854,449
2027	6,279,658	3,754,051,817
2028	6,335,207	3,798,150,194
2029	6,390,108	3,840,274,838
2030	6,443,694	3,881,397,857
2031	6,498,305	3,922,332,509
2032	6,550,344	3,964,872,528
2033	6,600,290	4,007,469,324
2034	6,647,466	4,050,118,742
2035	6,691,553	4,092,547,558

Growth and Economic Assumptions

Driver	2005-2015	2015-2025	2025-2035
Annual growth in number of residential households [1,2]	1.4%	1.3%	0.8%
Annual growth in commercial floor space [1,2]	1.9%	1.4%	1.1%
Annual growth in Ontario industrial GDP [1]	-2.0%	1.1%	1.4%

Notes:

[illegible] StatsCan, Hemson May 2015, Informetrica Jan 2011, and IHS Nov 2015.

[illegible] from 2025 to 2035.

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