

Fair Hydro Plan Financing Program Servicing Review

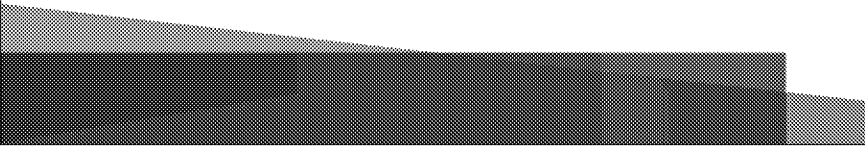
November 14 & 15, 2017.

Table of Contents

1. Independent Electricity System Operator (IESO)
2. LDC Onboarding and Administration
3. IESO's Role in the Fair Hydro Program
4. Demand Forecasting
5. IESO Information Technology Environment

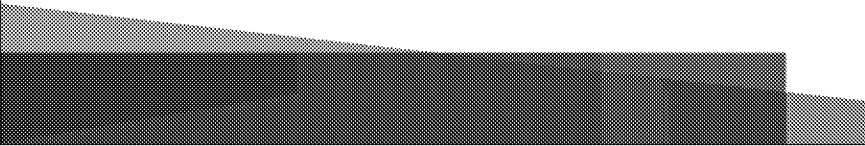
Appendix:

Historic and Projected Energy Usage

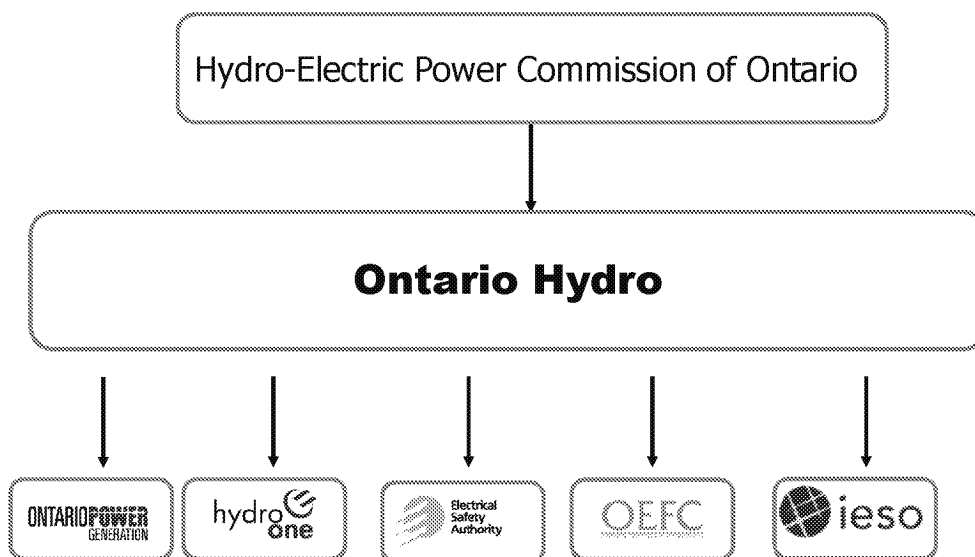


Independent Electricity System Operator

Section 1

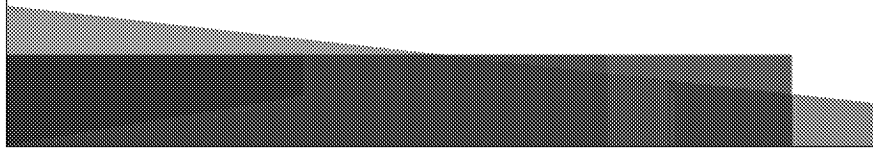


Where did We Come From?



Independent Electricity System Operator

- Not-for-profit corporation established in 1998 by the Electricity Act of Ontario and merged with the OPA in 2015
- What we do is defined by legislation
- Fee (revenue requirement) regulated by the Ontario Energy Board (annual hearing with intervenors)



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



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.

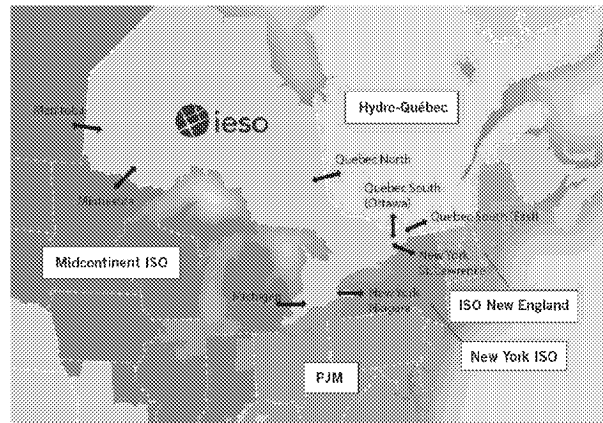
We oversee the electricity market and work with neighbouring jurisdictions to ensure reliability and cybersecurity standards.

Engaging Stakeholders and Communities

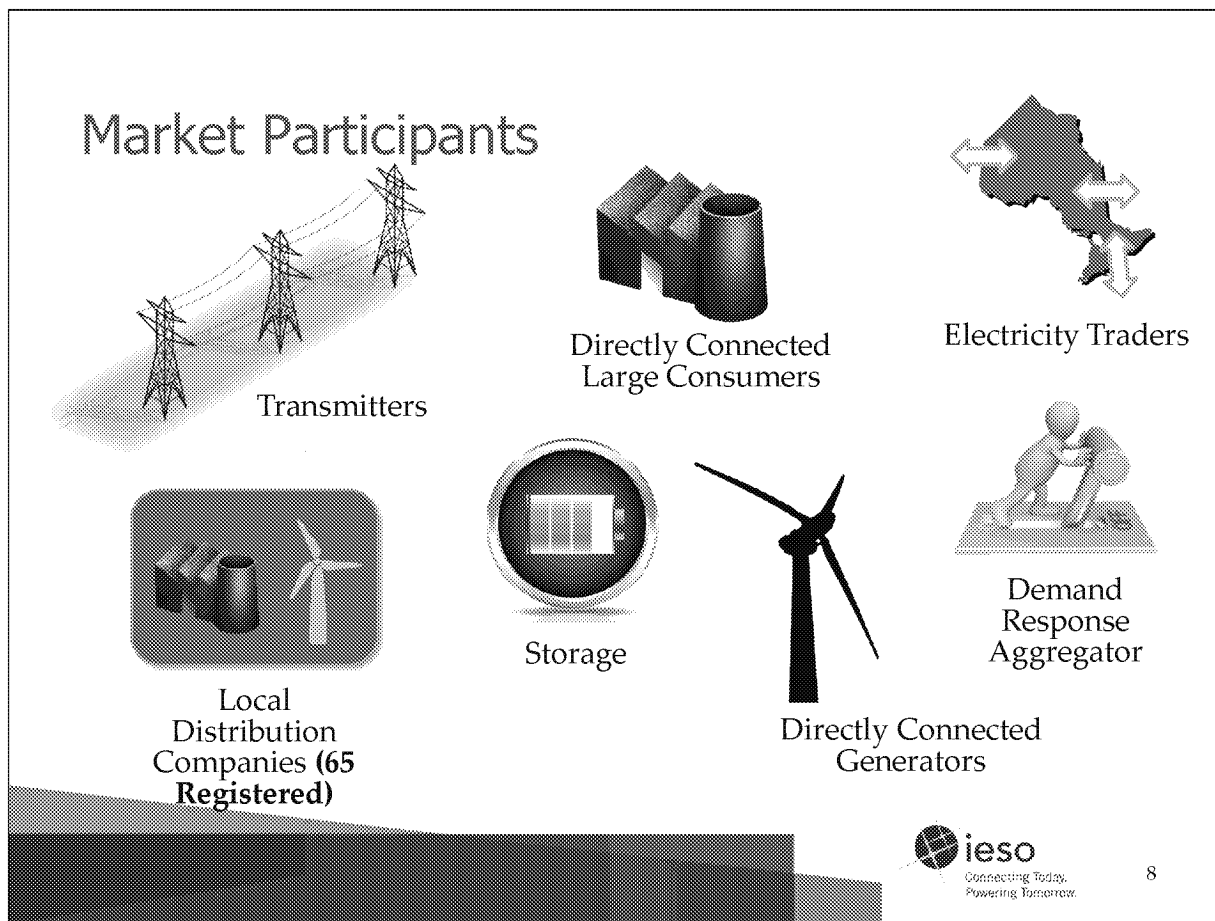
Engaging stakeholders and communities is an important part of what we do. This outreach informs our efforts to develop regional plans, to work with Aboriginal communities, and to evolve the sector in a way that benefits everyone.

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 sustainable 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.	- Evolving 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

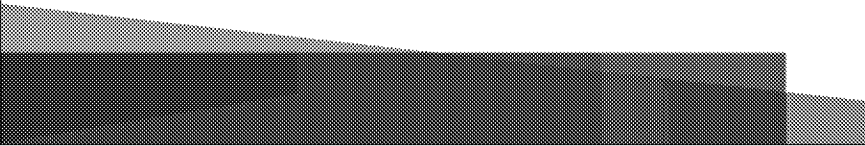
- IESO Executive Leadership Team with the oversight of the Board of Directors has established and implemented a process to manage risks effectively and efficiently across the IESO
- IESO's Enterprise Risk Management (ERM) process supports corporate governance responsibilities in providing a structured 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



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 upon Market Rules, statutes, and regulations that directs LDCs to supply appropriate information/data in the form and timing required by the IESO and OEB.
- 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. MACD supports the independent OEB's Market Surveillance Panel in monitoring, investigating and reporting on the activities and conduct of market participants and the IESO in Ontario's electricity market, for the purpose of improving market performance.

LDC Oversight

- LDCs, as market participants, must adhere to Market Rules. IESO has business processes and controls which analyze LDCs' info/data, but IESO is not obligated to conduct / perform actions to detect or prevent LDCs' errors/fraud/mistakes.
- LDCs are regulated and licensed by the OEB and are required to adhere to 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 – IESO Treasury Administration

- Markets Rules – all LDCs are required to adhere to specific rules on payments, collateral, and margin calls.
- All market participants and LDCs are required to pay (..even if a dispute is noticed) their IESO invoice by the 12th business day each month, and any margin calls within 2 business days.
- 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;
 - All market participants have login-access to monitor their IESO's financial exposures on a daily basis;

LDC – IESO Treasury Administration

- IESO does not rank LDCs based on a “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/sites/default/files/2016-consolidated-scorecard.pdf)
 - [https://www.oeb.ca/oeb/Documents/Press%20Releases/OEB_RRR_2.1.8_Arrears_PaymentAgreements_WriteOffs.pdf;](https://www.oeb.ca/oeb/Documents/Press%20Releases/OEB_RRR_2.1.8_Arrears_PaymentAgreements_WriteOffs.pdf)
 - [https://www.oeb.ca/oeb/Documents/RRR/2016_Yearbook_of_Electricity_Distributors.pdf;](https://www.oeb.ca/oeb/Documents/RRR/2016_Yearbook_of_Electricity_Distributors.pdf)

LDC – IESO Treasury Administration

- IESO Market Rules recognizes that LDCs have a lower credit risk profile than non-LDCs (e.g. mines, auto cos, steel cos etc.), and therefore the collateral requirements are materially lower than non-LDCs;
- About 15 (out of 65) LDCs have external credit ratings – e.g. Toronto Hydro, Waterloo North Hydro. Waterloo North is about 1/16 the size of Toronto Hydro. Rated LDCs comprise of about 75% of total IESO LDCs billings/invoices.
- LDCs that do not have external credit ratings are not necessary of less creditworthiness status – many do not need or rely on credit ratings for their business structure / operations. Some non-rated LDCs have good financial ratios (e.g. Newmarket-Tay current ratio 2.74, leverage ratio 0.67, and Kitchner-Wilmot current ratio 1.96, leverage ratio 0.57,);

LDCs' Payment Defaults

In general, the IESO experiences 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 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;
 - Within IESO history no LDC have been in this 3rd type;
 - IESO has had non-LDCs in this 3rd type;

LDCs' Payment Defaults

- Most LDCs' payment defaults are administrative in nature, cured by a full payment within a day or two;
- LDCs are required to pay each IESO's invoice or margin call in full as due even if an alleged error or dispute is noticed in the invoice/margin call. A dispute is handled as a separate IESO process.

IESO Cash Management Procedures and Controls

- The IESO electricity market's settlements controls processes and procedures are reviewed by E&Y every two years – CSAE 3416 Type II and SOC 2 Type II (recent Aug 2017 – unqualified opinion).
- The Market Rules specific various cash management requirements (e.g. bank accounts, settlement dates, IESO EFT only, etc) and issuing preliminary statements, issuing invoices, and disputes adjudication.
- LDCs have daily access to monitor their own specific financial exposures, margin calls, and invoices online via an IESO portal;
- IESO utilizes Treasura (Wallstreet) for treasury management system and Lawson for accounting/ledger systems.

IESO Cash Management Procedures and Controls Continued

- IESO settles about \$17billion in annual settlements/cash mgmt
- The Treasury system automatically downloads banks' balances and transactions detail daily for all accounts;
- Treasury personnel reconcile bank transactions and balances on daily basis and investigate any unreconciled items;
- Accounting personnel conducts a separate minimum monthly banks' reconciliations for bank vs. ledger, transactions;
- There are segregation of duties between the Treasury, Accounting, and Settlements groups to ensure best practices and good controls;
- The IESO Board is provided with regular separate reports regarding Treasury and cash management operations in addition to Accounting, and any Settlement matters;

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

Section 3



Regulatory Asset Accounting

- IESO is rate regulated and licensed 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
- Regulatory asset can be transferred/acquired
- For the OFHP regulatory 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 on LDCs' monthly IESO invoices
- The Fair Hydro Trust will submit its carrying costs each month for reimbursement during the four year moratorium period (prior to the Clean Energy Adjustment coming in effect in 2021)
- IESO will receive a reduced amount (RPP and Non-RPP's global adjustment modifier) from the LDCs as they pay their IESO invoices;

Creation of the Regulatory Asset

- IESO will pay all generators and the Fair Hydro Trust the amounts owed on a once per month basis;
- LDCs' shortfall and Fair Hydro Trust carrying costs will be funded by the IESO via a \$2B debt facility provided by OFA (facility term ends in 2022) – this facility is solely for fair hydro program only.
- Any debt amount utilized will be recorded as part of the fair hydro's regulatory asset;
- Fair Hydro Trust may 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

- For any purchases made by the FH Trust – the IESO will use the cash received to repay the FH debt facility
- Any interest expense incurred by the IESO for debt facility will be recorded into the variance account as part of the regulatory asset;
- Any remaining balance in the IESO's regulatory asset after the 4 year moratorium period will then become recoverable (separate from the CEA) 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

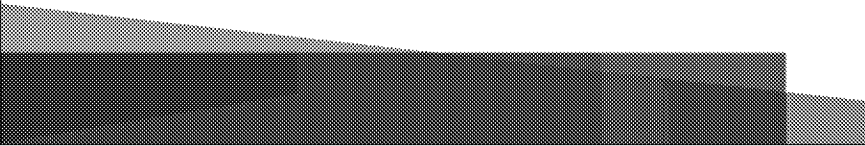
- Undertake to contact and resolve applicable issues when LDCs:
 - Do not deliver information in respect of a Billing Period where CEA were payable by Specified Consumers
 - No CEA collections are received in respect of the Billing Period
 - Has not certified that it has established the segregated account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



Three types of forecasts used at the IESO

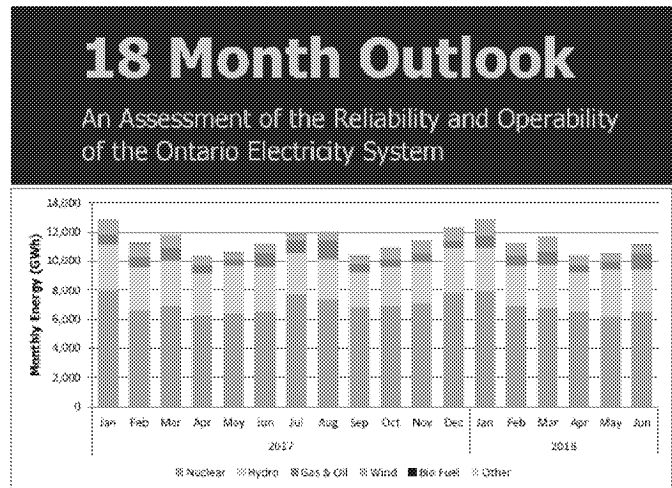
Short-term: looks ahead 5 minutes to 10 days; review forecast variances monthly

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

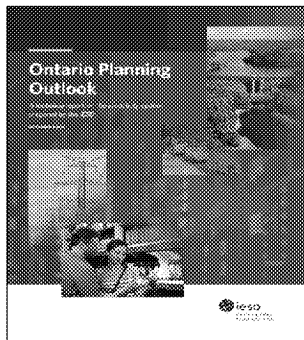
Example of Forecasting Ontario's Future Electricity Needs in Mid-Term

- 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.



- ☐ 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)



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.

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; and forests 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

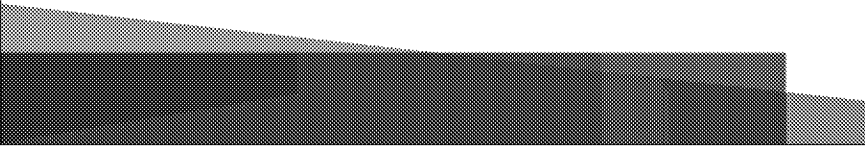
Month & Year	RPP Load Submitted by LDC's	Total Market AWEW	RPP vs. Total Market AWEW	"Gross" Accumulated IESO Variance Account ⁴	"Net" IESO Variance Balance (IESO VA less OPG Rebate) ⁴	Cumulative "Net" Interest	"Net" IESO Variance Balance (IESO VA less OPG Rebate) ⁴ including interest
	kWh Total	kWh	%	\$	\$	\$	\$
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					Total
	Tier 1	Tier 2	Off-Peak	Mid-Peak	On-Peak	
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



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

Treasure

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

Notice of Disagreements Tool

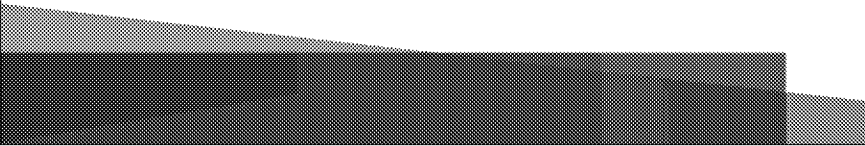
- Notice of Disagreement tool allows Market Participants to submit a Notice of Disagreement to the IESO
- Allows tracking of the submission through to completion
- Workflow application allows tracking of actions taken on identified incidents to ensure the disagreement is processed in accordance with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



Historic Electricity Demand

Some broad trends:

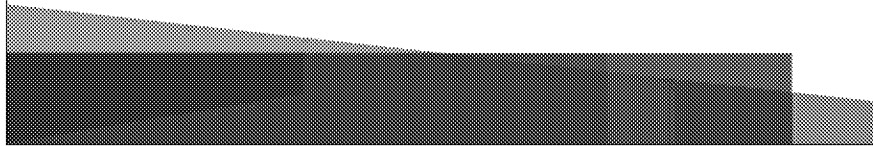
- 1940's – Mid 2000's: growth in absolute terms, but at a declining rate
- Mid 2000's – today: pronounced demand reduction (re: economy, conservation, pricing effects), now effectively flat
- Changing sectoral composition: commercial up, industrial down, residential in between



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)				Electricity Demand by End-Use (TWh)				Electricity Demand by End-Use (TWh)				Electric Vehicle (EV) Stock Forecast			
Residential Net Energy Demand by End-Use (TWh)				Commercial Net Energy Demand by End-Use				Industrial Net Energy Demand by Subsector				Thousands of EVs			
	2017	2025	2035		2017	2025	2035		2017	2025	2035		2017	2025	2035
AC Central	3.0	3.0	3.0	Space Heating	4.1	4.7	5.1	Chemicals	3.4	3.5	4.0				
AC Room	0.5	0.5	0.5	Computer Equipment	5.0	5.2	5.4	Fabricated Metals	1.9	1.9	2.0		Households	Commercial SOFT	
Clothes Dryers	2.5	2.5	2.2	Cooking	0.8	0.8	0.8	Food And Beverage	2.3	2.3	2.6	2017	5,581,089	3,305,815,503	
Clothes Washers	0.3	0.3	0.3	Cooling Chillers	1.1	1.0	1.1	Mining	6.5	7.4	7.0	2018	5,666,227	3,356,412,223	
Computers	1.1	1.3	1.4	Cooling DX	3.6	3.6	3.8	Transportation And Machinery	3.1	3.0	3.1	2019	5,749,669	3,406,188,634	
Cooking	2.5	2.2	2.3	Domestic Hot Water	0.7	0.4	0.4	Miscellaneous Industrial	4.0	4.0	4.4	2020	5,831,807	3,455,870,987	
Dehumidifiers	0.5	0.5	0.4	Elevators	0.3	0.3	0.3	Non-Metallic Minerals	1.3	1.2	1.2	2021	5,910,039	3,504,894,508	
Dishwashers	0.5	0.5	0.5	HVAC Fans Pumps	4.5	3.9	3.6	Paper Manufacturing	2.6	2.1	1.9	2022	5,980,524	3,548,806,209	
Domestic Hot Water	3.8	3.3	3.3	Lighting	19.0	19.0	19.6	Petroleum Refineries	1.7	1.8	2.0	2023	6,046,212	3,590,932,451	
Elevators	0.2	0.2	0.2	Miscellaneous Equipment	5.1	5.7	6.6	Plastic And Rubber	2.1	2.0	2.1	2024	6,107,951	3,631,662,560	
Forced Air Central Heating	1.4	1.2	1.5	Other Plug Loads	4.0	4.1	4.2	Primary Metals	4.5	3.9	3.7	2025	6,166,993	3,670,932,197	
Freezers	1.7	1.7	1.8	Refrigeration	3.8	3.0	2.7	Wood Products	1.0	0.9	1.0	2026	6,223,916	3,710,854,449	
Lighting	7.6	6.0	4.9									2027	6,279,658	3,754,051,817	
Miscellaneous	4.2	4.9	5.8									2028	6,335,207	3,798,150,194	
Baseboard Heating	6.7	5.9	5.7									2029	6,390,108	3,840,274,838	
Other Consumer Electronic	3.8	4.1	4.8									2030	6,443,694	3,881,397,857	
Refrigerators	4.4	4.4	4.6									2031	6,498,305	3,922,332,509	
Set Top Boxes	0.8	0.8	0.9									2032	6,550,344	3,964,872,528	
Space Heating Room	0.1	0.1	0.1									2033	6,600,290	4,007,469,324	
Swimming Pool Pumps	0.6	0.6	0.6									2034	6,647,466	4,050,118,742	
Televisions	2.5	2.9	3.5									2035	6,691,553	4,092,547,558	
Ventilation And Circulation	3.2	2.6	2.5												

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 ³	-2.0%	1.1%	1.4%

Notes:

¹ IESO's Base Case assumes a constant population of 14.5 million from 2015 to 2035, and a constant population of 14.5 million from 2025 to 2035.

