

An Introduction to the IESO

For discussion with Secretary of Cabinet
Steve Orsini

October 28, 2016



IESO: Who We Are and 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

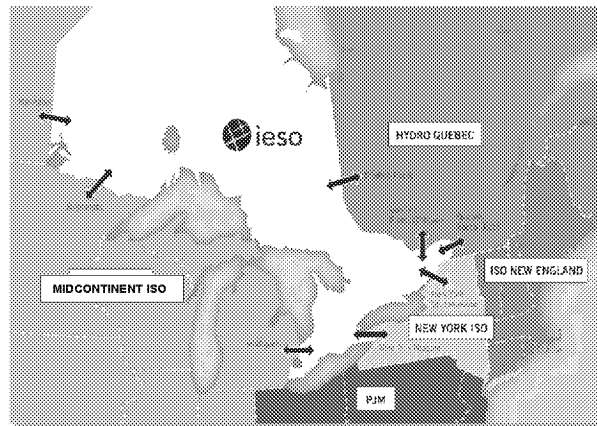
We do this by:

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



Ontario at a Glance

Installed Capacity	35,221 MW (December 2015)
Record Summer Peak	27,005 MW (August 1, 2006)
Record Winter Peak	24,979 MW (December 20, 2004)
Total Annual Energy Consumed	137 TWh (2015)
Energy Savings Through Conservation (2011-2014)	6,553 gigawatt-hours (GWh)
Customers	4.9 million
Ontario Import Capability	4,800 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.

Ontario currently has an installed TX capacity of 35,221 MW

Ontario's record summer and winter peaks were in 2006 and 2004, respectively.

Ontario demand is consistently lower than it used to be, which I'll speak about later on.

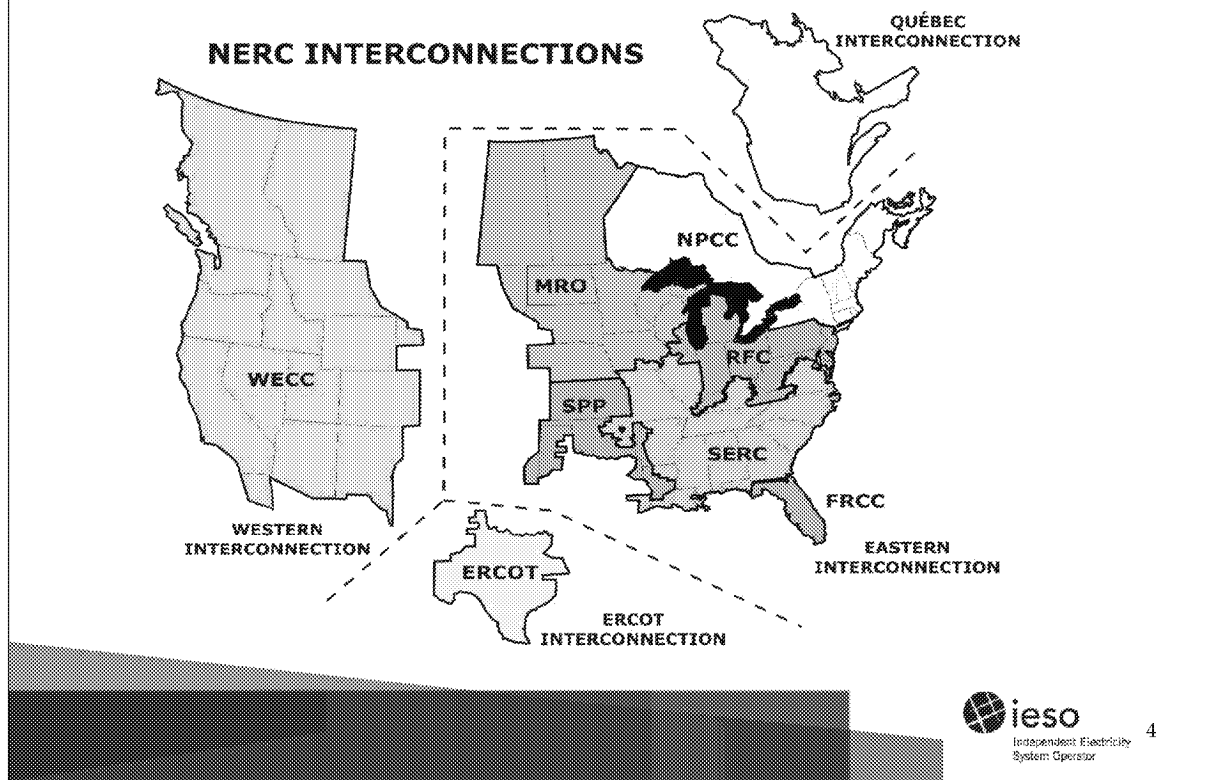
We have a number of neighbouring jurisdictions with whom the IESO works closely with.

Intertie capacity refers to the capacity of the transmission lines that go across Ontario's borders.

Our intertie capacity is 4,800 MW – although in reality it is much lower because of local transmission constraints, for example, in and around Ottawa, that prevent us from using the interties to their full capacity.

The IESO needs to keep at least 700 MW free at all times for emergency situations., called Operating Reserve.

North American Interconnections



The IESO manages the reliability of Ontario's grid. We do this by working closely with our neighbours in real time and by working together and influencing new standards.

Many of the reliability standards apply North America-wide.

IESO is responsible for monitoring and enforcing reliability standards in Ontario

IESO's Market Assessment and Compliance Division (MACD) monitors, investigates, and enforces Ontario Market Rules and North American reliability standards

IESO represents Ontario's interests as member of North American Reliability Corporation (NERC) and Northeast Power Coordinating Council (NPCC)

IESO is audited by its peers on a regular basis

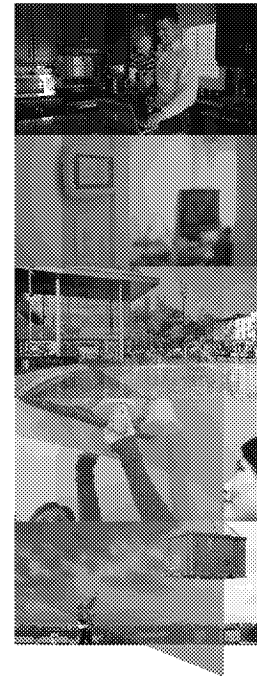
A Quick Look Back

- Coal retired, new biomass
- Wind providing effective and flexible contributions
- Continued positive resource availability
- Growing impact of embedded generation
- No growth in demand due to conservation and embedded generation
- Demand response integrated into the market through DR auctions



Enabling Conservation

- Conservation provides a clean and cost-effective alternative to building new generation
- Conservation can also lower peak demand, allowing the IESO to defer or avoid the need to build new infrastructure
- Conservation is expected to offset almost all demand growth until 2032
- Under the Conservation First Framework, the IESO aims to reduce electricity consumption by 8.7 TWh – the equivalent of powering nine cities the size of Sudbury for a year – by December 31, 2020
 - IESO responsible for evaluation, measurement and verification, marketing, market transformation
 - LDCs responsible for program delivery and cost-compliance



Ontario's Long-Term Energy Plan projects that conservation will offset almost all demand growth until 2032. The cheapest MW is the one that we don't use.

The province began a six-year conservation plan this year that aims to reduce electricity consumption by 8.7 TWh – the equivalent of powering Mississauga and Sudbury for a year.

Conservation provides the cleanest and most cost-effective alternative to building new generation

There are many different conservation programs being offered across the province by local distribution companies

And the High Performance New Construction initiative provides design assistance and incentives for building owners and planners who design and implement energy efficient equipment within their new space.

Electricity consumption data is being used in new and exciting ways to drive conservation

For example, social benchmarking programs can allow people to compare their own electricity use with their neighbours'

Planning for and competitively procuring the resources that meet Ontario's electricity needs today and tomorrow

Large Renewable Procurement

Feed-in Tariff

microFIT

NUGs

Energy from Waste

BPRIA

Combined Heat and Power

Hydro Contract Initiative

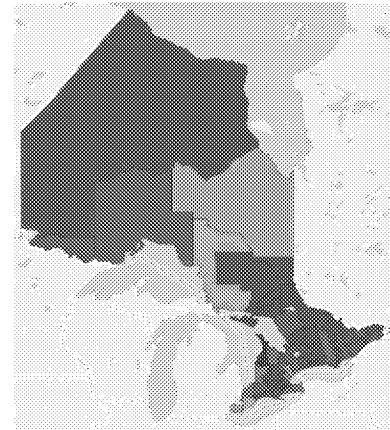
CHPSOP

Biomass Energy Supply

Clean Energy Supply

- IESO manages over 25,000 contracts, with a combined capacity of about 23,400 MW
- This capacity is spread across eight fuel types, including renewables, natural gas generation, hydroelectric and nuclear
- By 2025, 20,000 MW of renewable energy will be online, representing about half of Ontario's installed capacity
- The IESO continues to work to further enhance the use of market-based mechanisms to address rapidly changing electricity conditions and to procure needed resources in a transparent and competitive manner

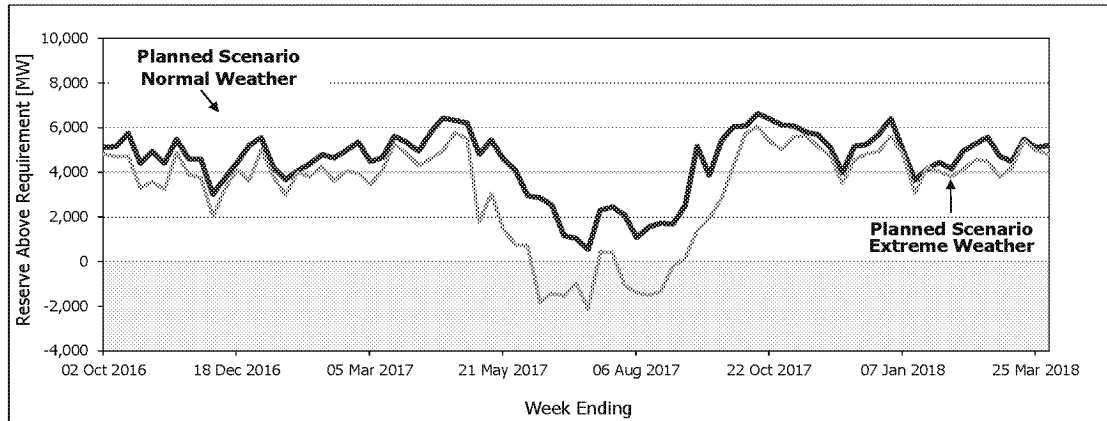
Map of Total Contracted Capacity in Ontario



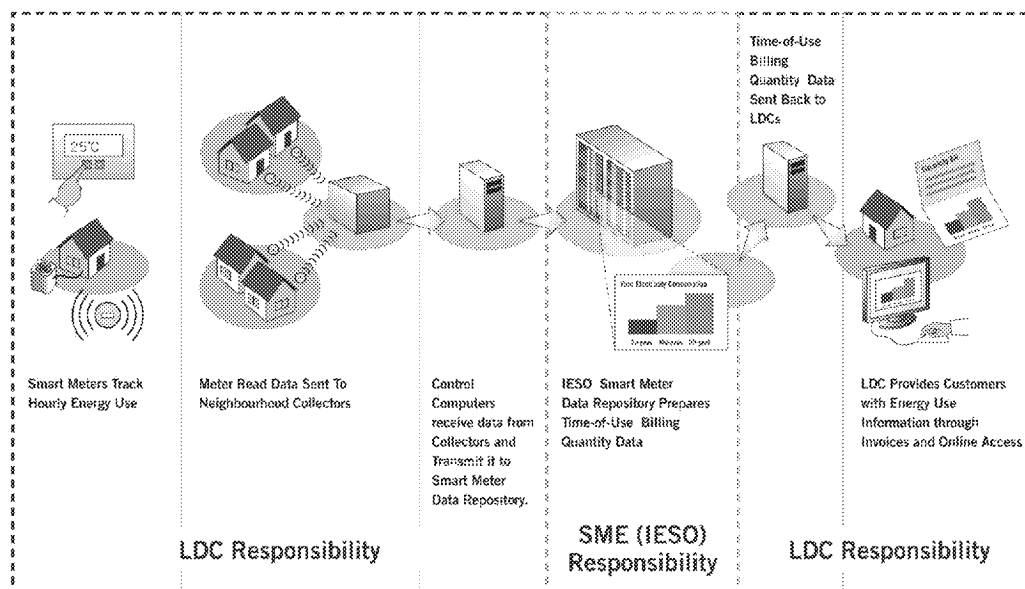
Contract Capacity (MW)
7 3,600

Planning

- Through a regional planning process, the IESO invites municipalities, community groups, stakeholders and the general public to provide input into the development of their region's electricity plan.
- The IESO also publishes a quarterly *18-Month Outlook* assessing the reliability of Ontario's electricity system over the short term, and forecasts up to 20 years ahead



Meter Data Management and Repository (MDM/R)

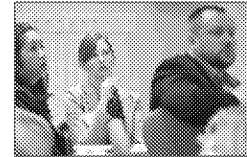


As Ontario's Smart Metering Entity, the IESO is responsible for the design, operation and maintenance of the MDM/R, a central platform for processing, storing and managing all smart meter data in the province.

Seeking and acting on input from our communities, customers and stakeholders

Stakeholder and community engagement is integral to the IESO's decision-making process:

- The **Stakeholder Advisory Committee** – stakeholder representatives provide advice and recommendations on market development, conservation and planning decisions directly to the IESO's Board of Directors and Executive Leadership Team
- **Stakeholder Engagement Initiatives** – sessions on a range of topics designed to provide open, two-way dialogue with stakeholders to help the IESO understand the views of stakeholders about proposed changes that may affect them
- **Engagement Forums** – collection of forums including Technical Panel, Standing Committees, Working Groups, Change Management
- **Community Engagement in Regional Planning** – through the development of the Integrated Regional Resource Plan (IRRP), the IESO invites municipalities, community groups, stakeholders and the general public to provide input into the development of their region's electricity plan



Engagement Principles

1. Analyze Opportunities for Engagement
2. Ensure Inclusive and Adequate Representation
3. Provide Effective Communication and Information
4. Promote Openness and Transparency
5. Provide Effective Facilitation
6. Communicate Outcomes
7. Measure Satisfaction



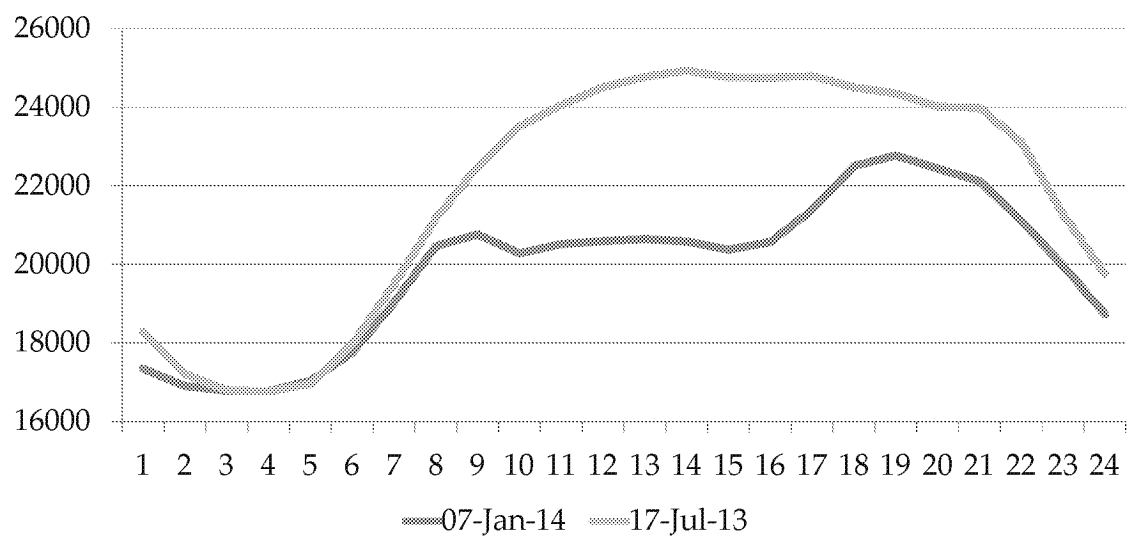
Independent Electricity
System Operator

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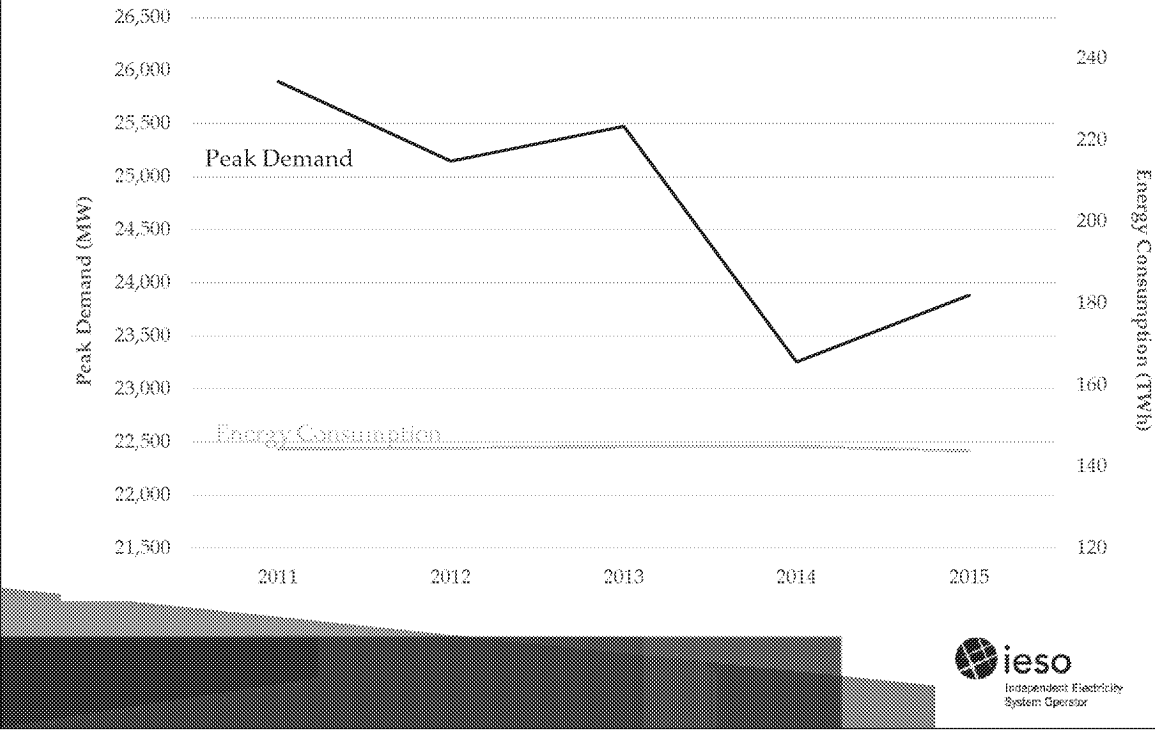
One of the IESO's new corporate and strategic objectives.

Demand

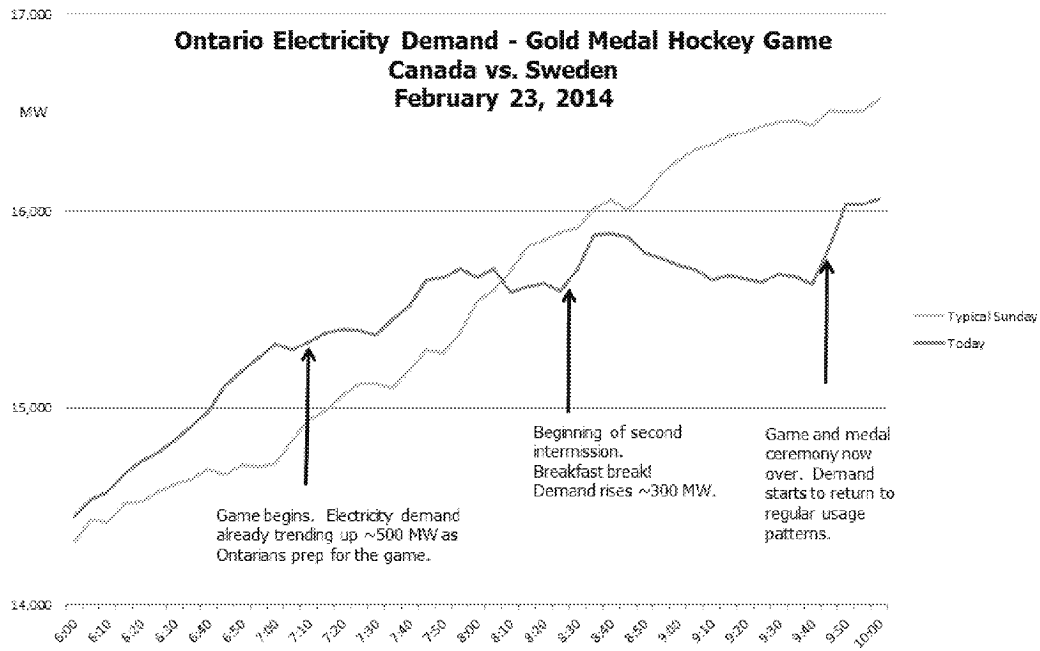
Summer vs. Winter Demand



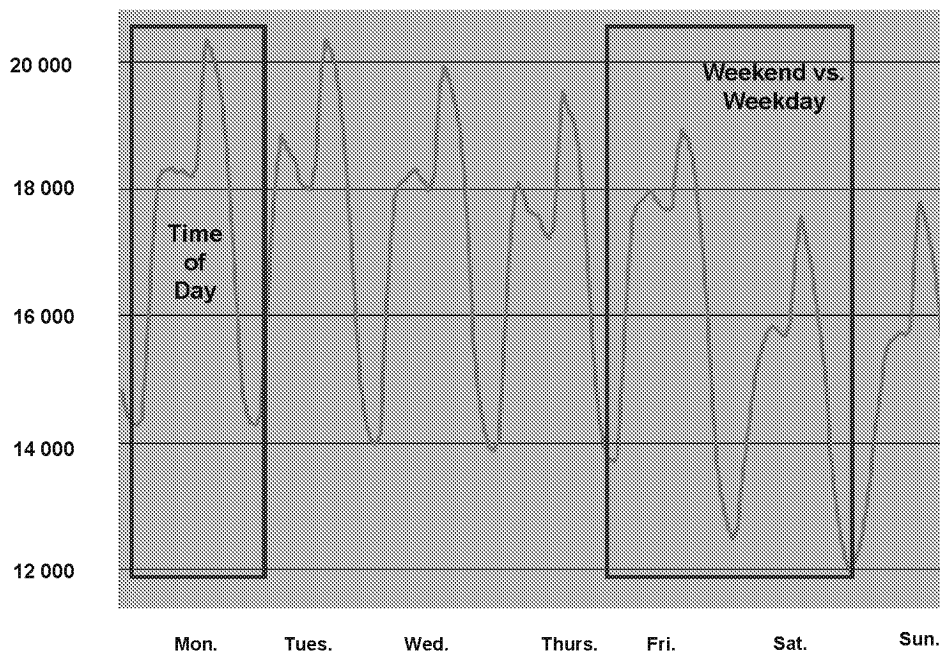
Peak Demand 2011-2015



Demand for Electricity: The Impact of Consumer Behaviour



Demand Varies Considerably



Spring Time Week

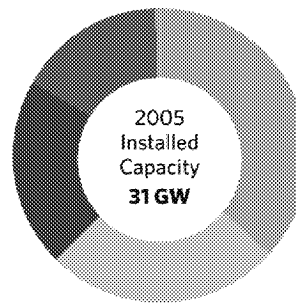
One is that demand is much lower on Saturday and Sunday than it is during the work week –
Holidays also have an effect

The other is that demand fluctuates a lot depending upon time of day. Demand is lowest typically at around 3 or 4 in the morning. Demand is often highest at around 7 or 8 at night in the winter due to overlapping commercial operations with people making dinner and doing laundry at home. In the summer, it tends to be earlier, around 4 or 5 in the afternoon when air conditioning load peaks

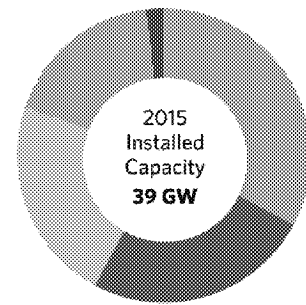
Supply

State of the system: 10-year review

- Demand has been on a declining trend driven by increased conservation efforts and changes in Ontario's economy
- Coal-fired generation has been retired and at the same time Ontario saw additions in non-carbon emitting and natural gas-fired generation
- Reliability concerns of a decade ago have been addressed
- Greenhouse gas emissions in Ontario's electricity sector have been reduced by more than 80 percent
- Current and planned investments will meet the province's electricity needs well into the next decade



Nuclear	37%
Water	26%
Coal	21%
Natural Gas	16%
Solar/Wind/Bioenergy	<1%



Nuclear	33%
Natural Gas	25%
Water	22%
Solar/Wind/Bioenergy	18%
Demand Response	2%

Ontario's electricity system has undergone significant transformation in the last decade

Demand has been on a declining trend driven by increased conservation efforts and changes in Ontario's economy

Coal-fired generation has been retired and at the same time Ontario saw additions in non-carbon emitting and natural gas-fired generation

These resources combined with investments in conservation and transmission:

Have addressed the reliability concerns of a decade ago

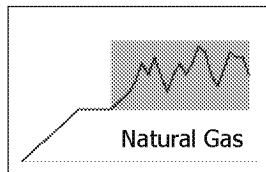
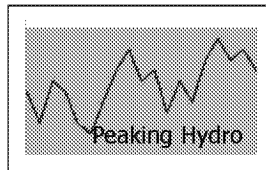
Reduced greenhouse gas emissions in Ontario's electricity sector by more than 80 percent

With current planned investments, will meet the province's electricity needs well into the next decade

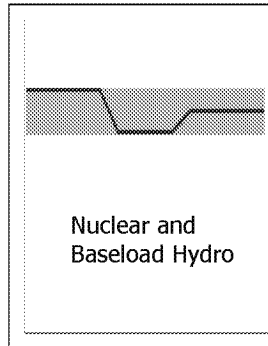
Ontario's Generation Fleet: Operating Characteristics

Each generation type has its own unique operating characteristics. The IESO has developed tools and processes to manage them reliably.

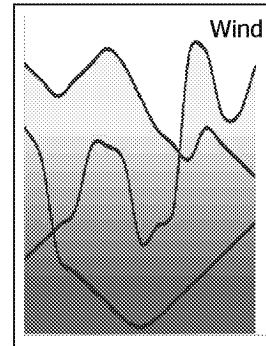
Dispatchable



Baseload



Variable



Flexibility is needed to:

- Provide load following
- Provide ramping
- Manage surplus baseload generation (SBG)

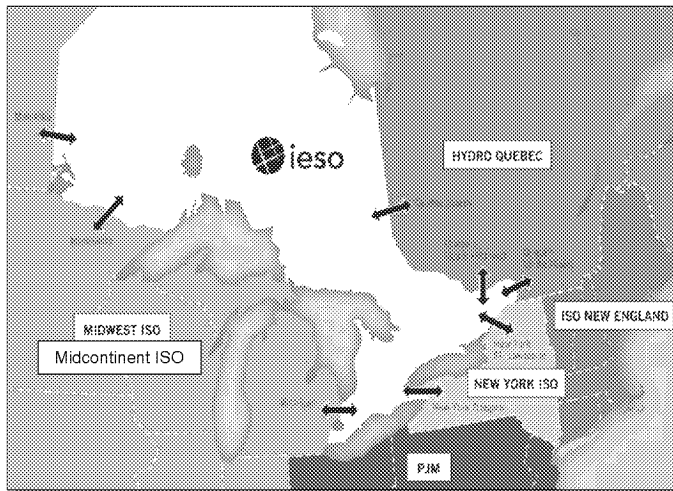
Ideally every resource is highly flexible with unlimited fuel but the reality in Ontario (and every other jurisdiction) is a mix of resources having different operating characteristics

We cannot economically have every resource highly flexible, nor can we have the entire fleet in-flexible acting like baseload generation.

So looking at Baseload.....Variable.....Dispatchable....

Interjurisdictional Trade

- Ontario currently exports and imports electricity between adjacent jurisdictions as part of the regular operation of its electricity market:



- **Imports** compete with domestic generation allowing the least expensive resources to be scheduled to supply electricity to the system
- **Exports** assist with managing surplus conditions and provide revenue that contributes towards reducing costs that otherwise would have had to be paid for by Ontario consumers

From a reliability perspective:

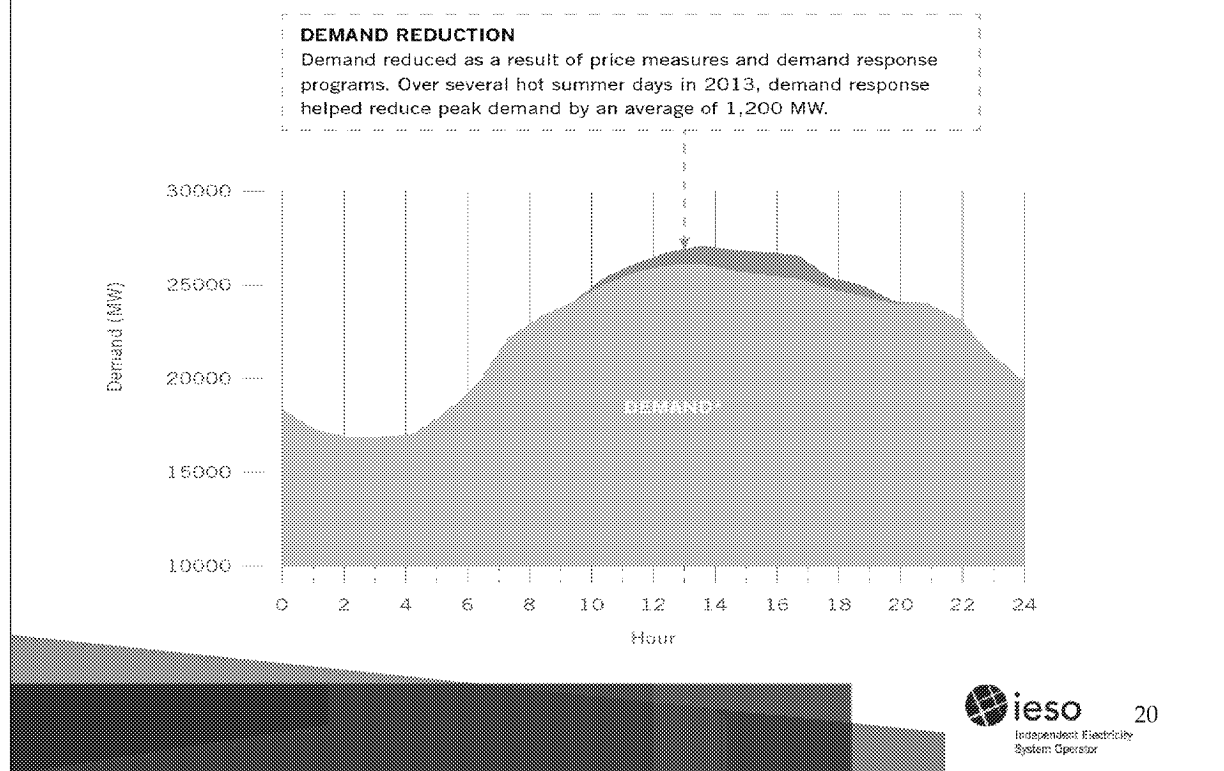
the IESO works with other system operators to use these resources to maximize reliability within the province.

From an economic perspective:

the Ontario wholesale electricity market is designed to constantly seek out the least cost supply to meet Ontario's electricity needs – including imports

Most uplifts apply to exports (except RRA, DRC and OPA fee)

Demand Response



Demand response, which enables consumers to reduce their electricity consumption in response to prices and system needs, is playing an increasing role in Ontario's electricity sector

It has already had a significant impact on energy demand and helped reduced peaks, providing a valuable and cost-effective resource to the system

The opportunities for demand response are growing and will provide consumers with more control over their energy use, while at the same time contribute to system reliability

The province aims to have DR meet 10% of peak demand by 2025, the equivalent of ~2,400 MW under forecast conditions

By optimizing the use of infrastructure that already exists, DR enables the province to defer or avoid the costs associated with new generation or transmission assets.

Whether it is a factory, hospital or an electric car plugged in at home, these facilities can also be leveraged to support the grid. This makes demand response an efficient approach to meeting energy needs.

The graph here shows how demand response reduced peak demand by an average of 1,200 MW over several days in 2013.

Electricity at the peak is the most expensive electricity – if you remember, offers from suppliers are taken from lowest to highest cost.

Diversity in supply is key to ensuring a secure and reliable electricity system in Ontario. Not all resources must have all the desired characteristics but the entire supply mix must have sufficient amounts of each.

Robust

- Satisfies adequacy requirements – capacity & energy
- Deliverable
- Dependable

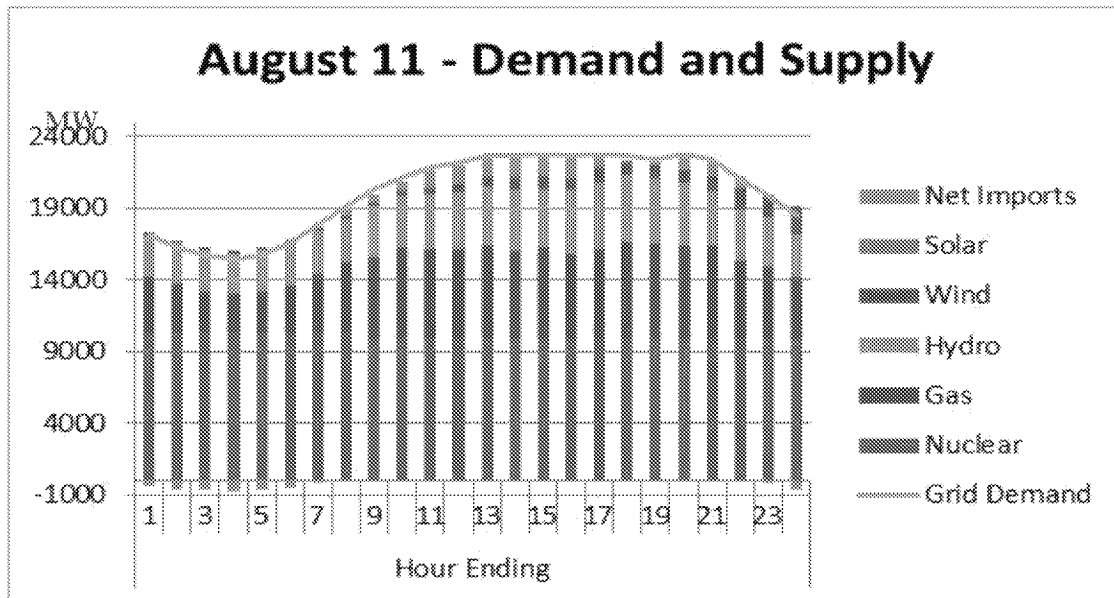
Flexible

- Ramping and load following capabilities
- Provision of ancillary services
- Potential to provide other essential reliability services

Balanced

- Fuel diversity
- Geographic diversity
- Can address local and/or broader reliability needs

Gas facilities were fully utilized this summer to meet peak demands. On August 11, all available gas-fired generation (~8500 MW) was required to meet energy & operating reserve requirements.

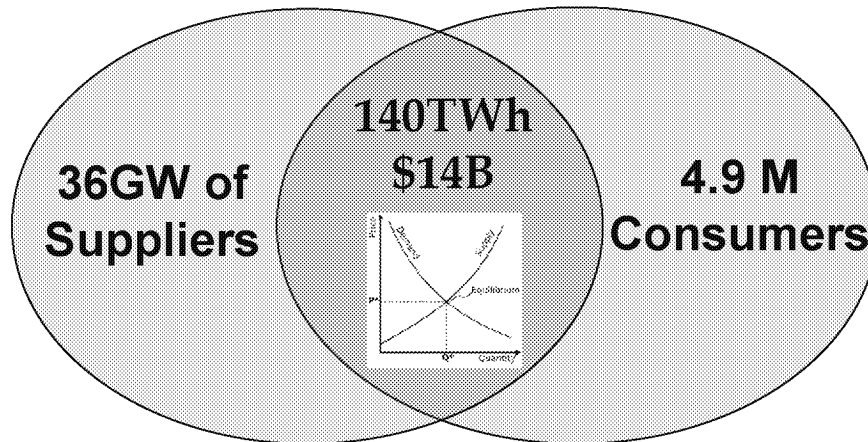


The Market

The Wholesale Electricity Market

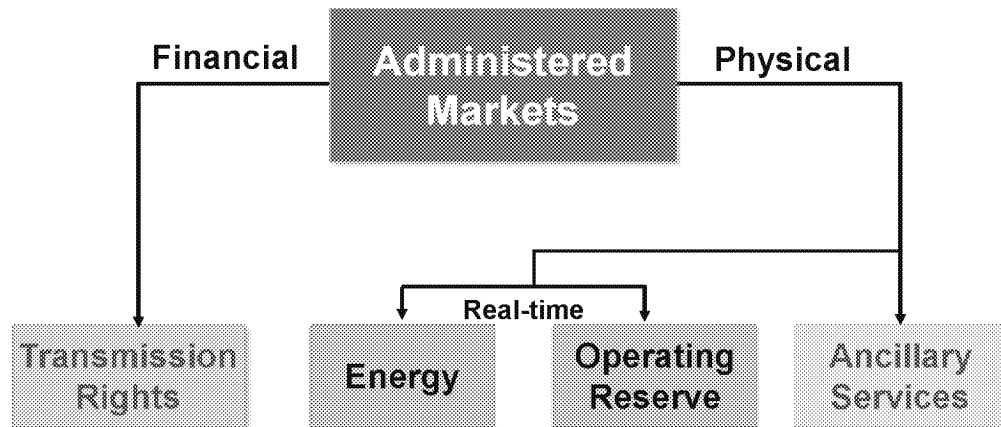
- Primary role of the spot market - the **efficient dispatch** of resources to meet system demand based on maximizing gains from trade
- The market helps to maintain the reliability of the electricity system by enabling the efficient allocation of resources.
- Produces a **transparent, efficient price signal** that reflects the incremental cost of energy
- **Competition** amongst resources encourages resources to offer reflecting their marginal cost of production, lowering costs for consumers
- Wholesale market includes the economically efficient **scheduling of energy** between Ontario and neighbours (imports and exports)

The Wholesale Electricity Market: A Dynamic Marketplace



- The wholesale market connects Consumers and Suppliers in real time and allows for competition amongst resources
- Advances in technology are enabling even greater competition through resources such as **energy storage** and **demand response**

IESO Markets



Requirement for Operating Reserve (OR) determined by IESO (approx. 1600MW) . MPs offer OR

- Dispatchable generators and imports offer to generate
- Dispatchable loads and exports offer to reduce their demand

An MCP is set for each class of OR and paid to MPs with offers at or below the price. The cost of OR is recovered through uplift.

Operating Reserve is scheduled to ensure that spare energy is available if a contingency should occur. Operating Reserve is activated when a contingency does occur.

Ancillary Services:

Automatic Generation Control –Typically schedule approx. +/-100MW. Min ramp = 50MW/Min

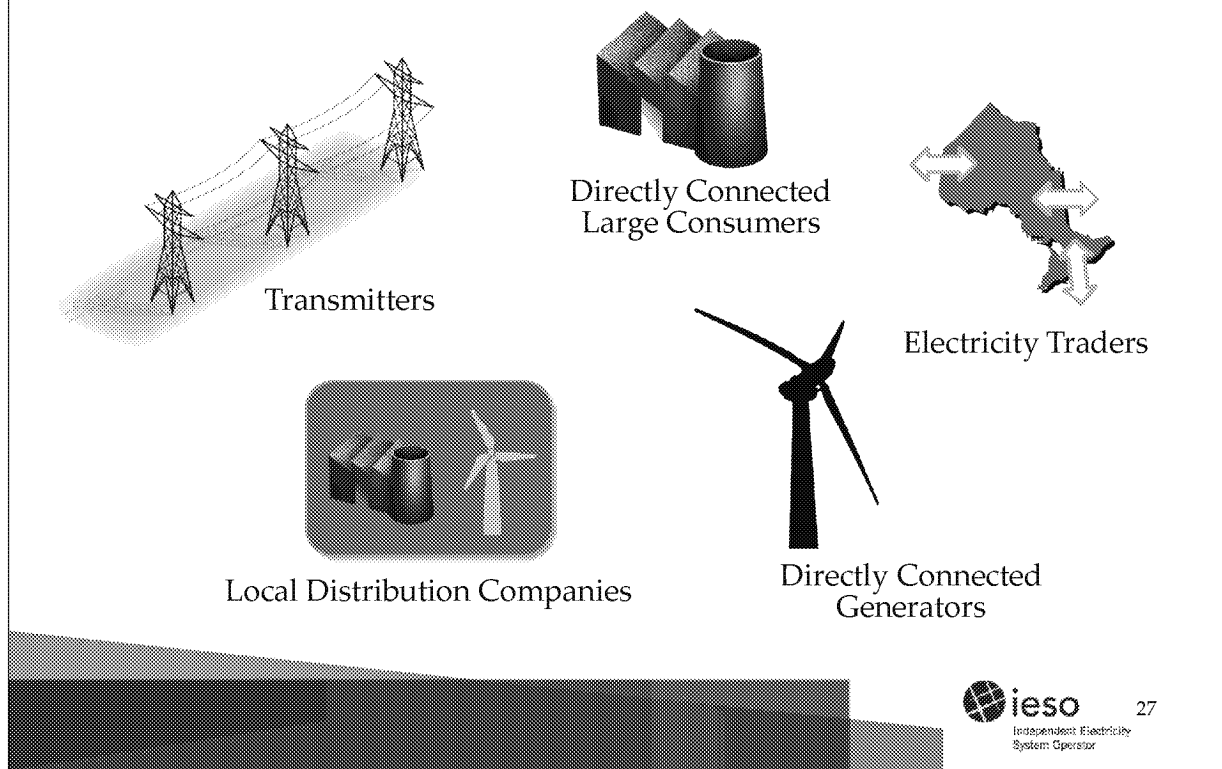
Reactive Support and Voltage Control –

Black Start –Monthly fixed payments – must be supplying within 30 minutes if hydro, 60 minutes if boosting a fossil from a diesel gen.

Emergency Demand Response Program –demand response available in an emergency. No requirement to respond. Paid only if respond. Min response time 2.5 hours

Must-Run –MRs allow us to identify facilities that we might need Must-run contracts with and then enter into negotiations with them. Allows us to require a facility to offer into the market in order to be scheduled to support local reliability. Must give at least 3 days notice

Market Participants



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

Types of Market Participants

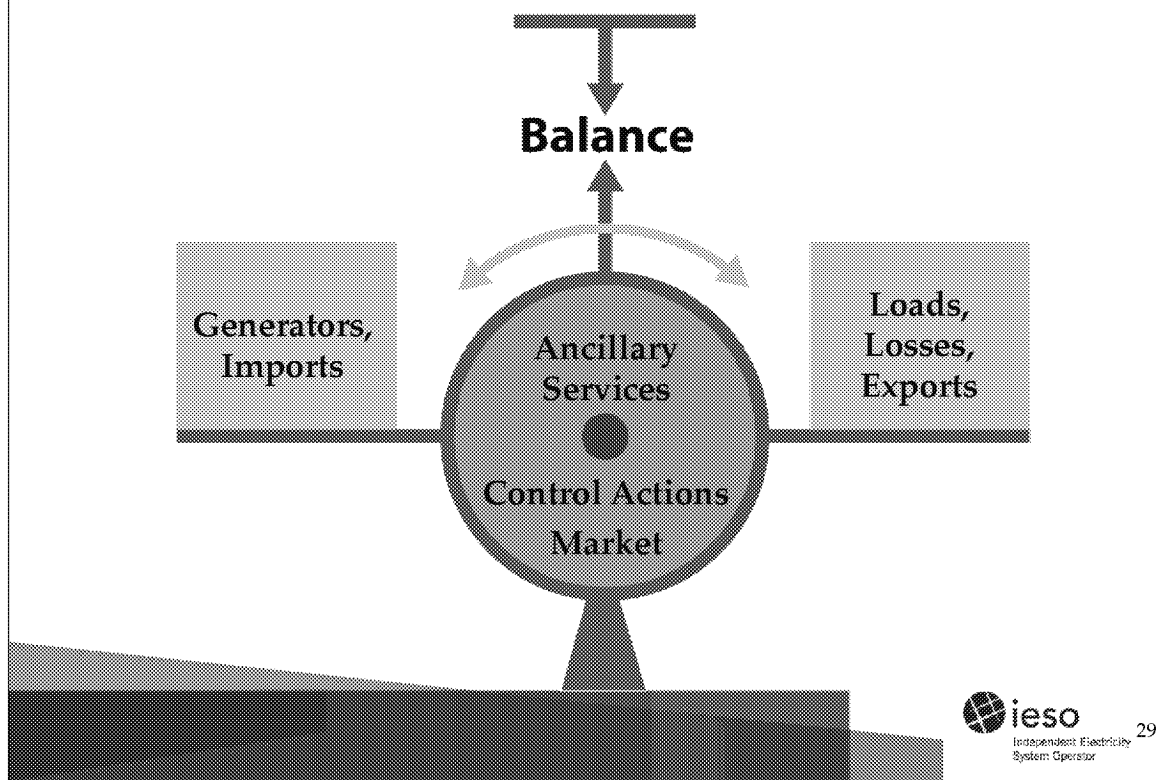
Dispatchable

- Submit Bids/Offers
- Adjust operations based on dispatch instructions received from the IESO

Non-Dispatchable

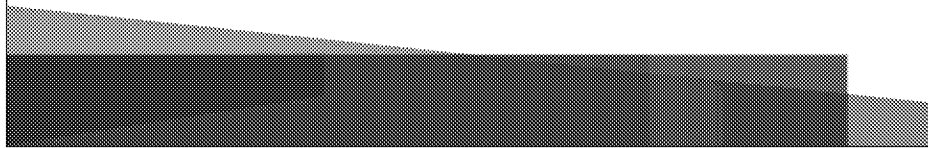
- Accepts market price
- Consume or produce without dispatch instructions

Balancing Supply and Demand



What Influences the Market Price?

- **Supply**
 - Available generation (fuel type) in Ontario
 - Imports
 - Number and size of generator or transmission outages
- **Demand**
 - Weather
 - Weekdays vs. weekends and holidays
 - Time of day
- **Unexpected changes in system conditions**



Which leads me to my next topic – What influences the Wholesale Price. Why can price fluctuate so much from day to day, hour to hour, and even 5-minute interval to 5-minute interval?

The basic answer, not surprisingly perhaps, is supply and demand – Anything that affects these two will influence price.

On the supply side, there are two main influencers –

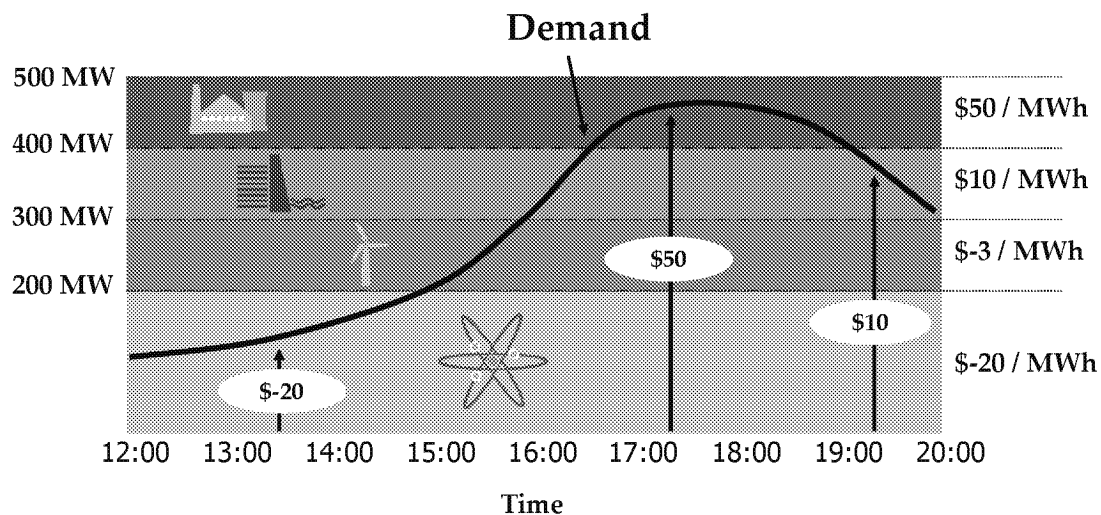
The total supply of energy available both within Ontario and regionally, and

The type of available generation, as different generators have different cost structures

Price Sensitivity

- Dispatchable and some non-dispatchable participants submit *dispatch data* that reflect their price sensitivity:
 - A **generator** will define at what price they wish to **produce** electricity and how much they wish to produce at that price.
 - A **load (consumer)** may want to **purchase** additional electricity if the price decreases.

Demand and Price



Price is set by stacking offers from lowest to highest cost. The lowest cost resources are chosen first until the demand for electricity is satisfied.

Every five minutes, we determine where the demand curve crosses the supply stack. Where supply and demand meet, we set the market clearing price.

In this example, the demand at 13:30 is about 60MW. This can be entirely satisfied by GEN 1. Therefore, GEN 1 is dispatched to 60MW. GEN 2 and GEN 3 are out of the money, and are not dispatched. MCP is set at \$15. This is a uniform price – All generators in Ontario are paid this price and all loads are charged this price

By 17:30, demand has increased to about 225MW. Therefore, GEN 1 is dispatch to 125MW, GEN 2 is dispatch to 50MW, GEN 3 is dispatch to 50MW, and MSP is set at \$38.

By 19:30, demand has dropped to about 175MW. Therefore, price is set at \$25. This means that GEN 1's \$38 offer is out of the money. Therefore, GEN 1 is dispatch to 100MW, GEN 2 is dispatch to 50MW and GEN 3 is dispatch to 25MW.

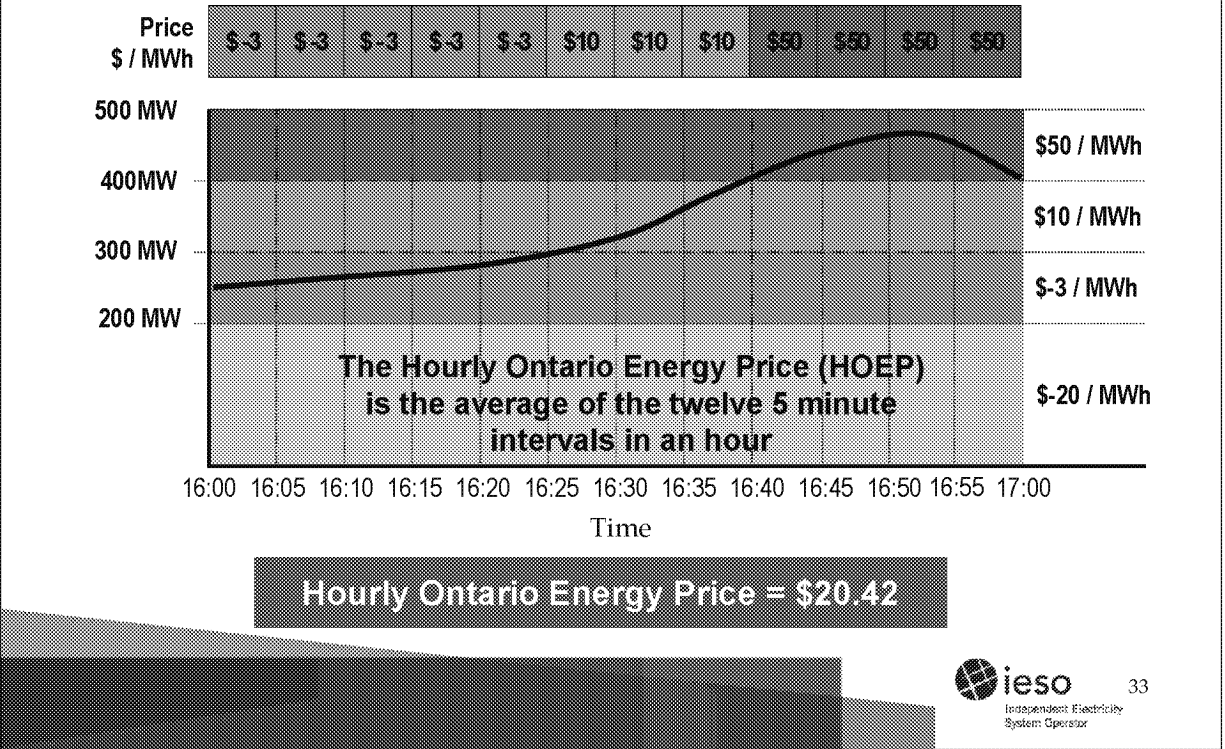
Prices are set every 5-minutes, however, non-dispatchable loads are charged an hourly price. This price is called HOEP and is the arithmetic average of the prices over the hour.

Generators will offer as low as possible in order to be scheduled

Tested in other markets

Ran simulations and found massive inefficiency in economic dispatch as everyone tried to figure out what the highest possible price would be

Market Clearing Price (MCP) and Hourly Ontario Energy Price (HOEP)

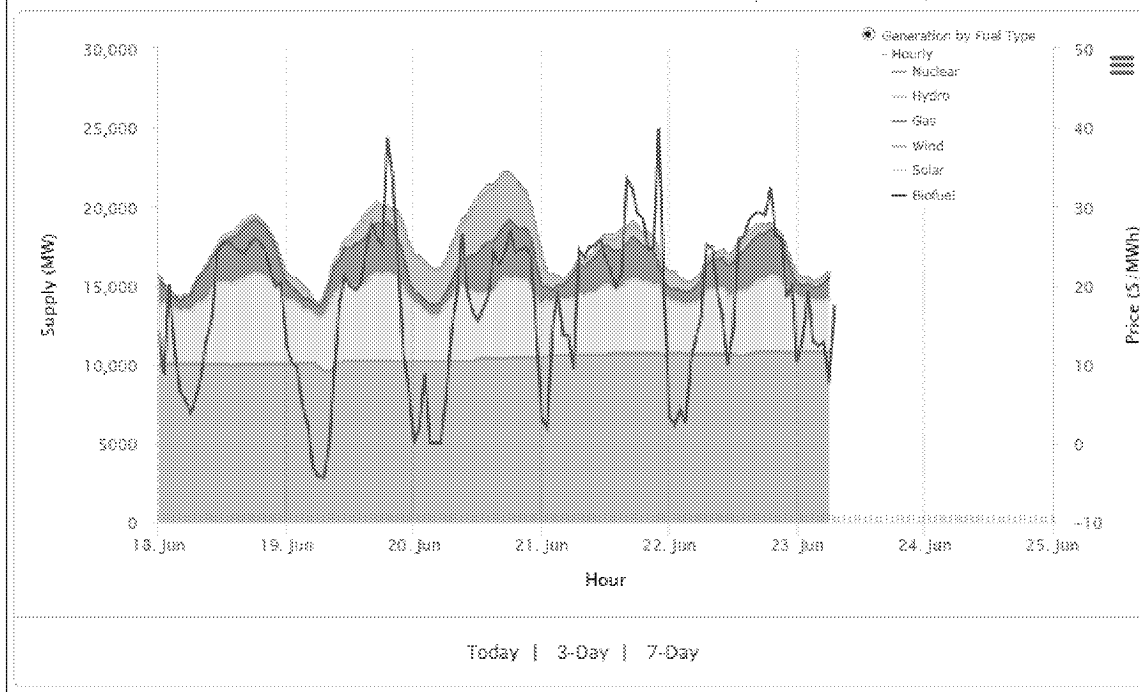


Supply, Demand and Price in Real Time

Download: [XML](#)

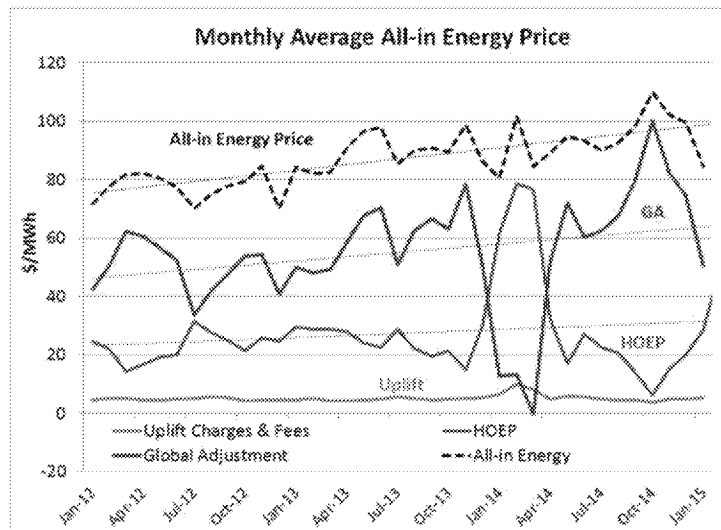
Market Demand
At 7:00am EST June 23, 2016

17,421 MW



All-In Price of Electricity

- Global Adjustment and HOEP (*the market price*) have inverse relationship
 - As HOEP decreases, costs recovered through Global Adjustment must increase
 - Costs not recovered through HOEP revenues are recovered through Global Adjustment
- $GA + HOEP = \text{All-in Energy Price}$
- Uplift charges recover costs for other services that ensure reliability



Note: consumers must also pay for other charges, like distribution and transmission

When generators recover costs through the market, they need to recover less through the Global Adjustment

$GA + HOEP = \text{the All-in Price for electricity}$

Uplift charges include things like:

Energy losses

Intertie Offer Guarantees (IOG) – the real-time price can change from the point when we secure an import to when it is scheduled to be imported

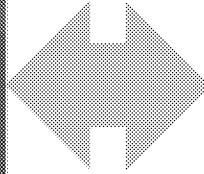
Congestion Management Settlement Credits (CMSC) – payment to generators and large consumers when they are instructed to take specific actions to avoid possible overloads of the transmission system, or to maintain the balance of supply and demand

Operating Reserve Prices

Market Price and Global Adjustment

Market Price

- Signals current supply and demand situation
- Covers operational costs of electricity production – such as fuel
- Impacted by consumption, weather, time of day, season, and sometimes contracts
- Set every 5 minutes

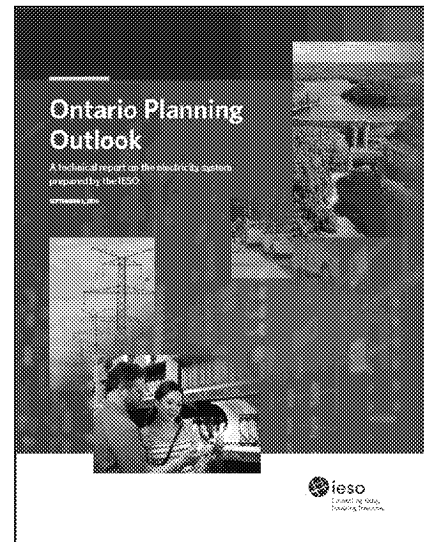


Global Adjustment

- Fixed investment or capacity costs to build or refurbish infrastructure
- Revenues that are not recovered through market price
- Includes contracts, and regulated rates to generators, as well as conservation
- Set on a monthly basis

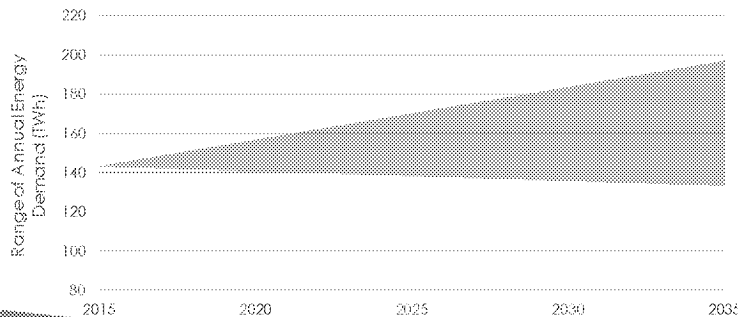
Ontario Planning Outlook

- The OPO is a technical report on the adequacy and reliability of Ontario's electricity resources in support of the development of the government's Long-Term Energy Plan.
- It was submitted to the Minister and published on September 1, 2016.
- The report provides planning context for policy makers and industry stakeholders and serves as an early input into the government's LTEP consultation process.



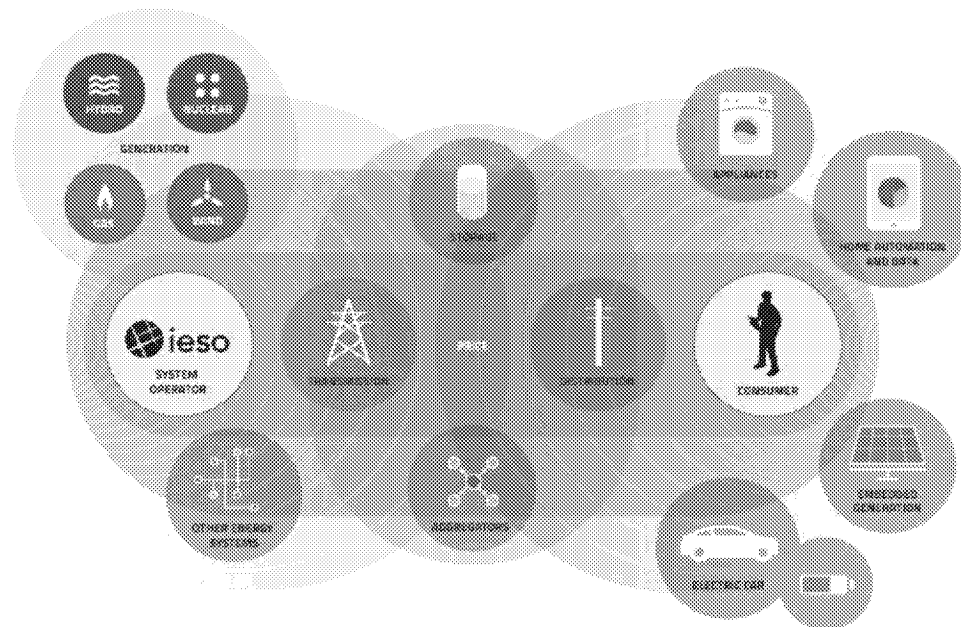
Electricity system 20-year outlook: Demand outlook

- The demand for electricity is the starting point used in assessing the outlook of the electricity system
- There is uncertainty in any demand forecast, as future demand will depend on the economy, demographics, policy and other considerations - planning explicitly recognizes the uncertainties in any of these drivers by addressing a range of potential futures.
- The demand for electricity used in preparing this report covers a range from about 130 TWh to about 200 TWh in 2035 – compared to 143 TWh in 2015.



The IESO is annually required to provide to the North American Electric Reliability Corporation (NERC) a 10 year reliability outlook. Many jurisdictions, including Ontario, also develop integrated resource outlooks for longer time periods such as 20 years to inform infrastructure investment planning.

An Evolving Electricity System



The smart grid is ushering in a new area of distributed control over the power grid

Third party control centres, consolidated LDCs, and even your home, vehicle and end-use devices will eventually have the capability of making sophisticated optimization decisions over energy consumption, storage and production

This distribution of control is driving changes in the way the IESO operates the grid

For example, if the Ontario government's electric vehicle targets are met by 2020, over 8,600 MW of battery storage capacity could be connected to the electricity system, creating up to 1,800 MWh of daily load shifting capacity

New market entrants and new technologies are being enabled by the smart grid and changing the nature of what it means to be in the electricity sector

For example, an aggregator market participant role is starting to be widely recognized as a critical link between wholesale markets, end-use consumers and the rest of the smart grid

Interoperability will play an important role in making the smart grid work

Technological standards – particularly in the area of behind-the-meter services – threatens to become one of the biggest barriers to the timely development of the smart grid

These changes will require revisions to regulatory instruments (codes, licences, etc.) and government policy

Interest in Ontario is growing at a rapid rate

For example, over the past few years the IESO has been approached by various companies with various technologies wishing to explore the possibility of integrating a grid-scale energy storage solution with the IESO-administered markets

We are also starting to identify some of the changes that would be required to Market Rules, registration and enrolment, business processes and documentation, tools and systems to eventually accommodate new participants

While it won't necessarily be an easy fix, we see significant upside potential in trying to integrate these new technologies:

Create new markets and areas of economic activity for Ontario

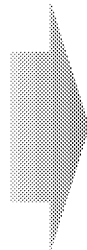
Greater wholesale market liquidity

Market efficiency gains
Absorb SBG and reduce Global Adjustment
Congestion relief and peak load trimming

Times Have Changed....

Ontario market was designed at a time when...

- Energy markets were “new”
- Dominated by traditional forms of generation
- Mostly passive consumers
- Belief that a real-time energy-only price was all that was needed
- Interaction with neighbouring markets focused on energy imports



Today...

- Energy markets and solutions are well established
- Supply is increasingly distributed and variable
- Consumers are more active and engaged in the market
- Capacity has emerged as a distinct product
- Greater opportunities (and need) for coordination with neighbouring markets

In 2002 there was no accepted “best practice” for energy market design.

Markets were developed to provide reliable electricity supply from a known and established supply mix

Customers had little experience (or desire) to manage electricity costs in response to market conditions

Energy-only markets were seen as the panacea and all that was required to manage the system

Today, Ontario has shown the world it is possible to retire coal-fired generation, which used to provide as much as 25% of supply, with cleaner forms of generation

However, the supply mix is more complex and distributed than it was in 2002

More than 24,000 generators, from the large Bruce nuclear generating stations to the thousands of rooftop solar installations, combine to power Ontario.

As a result we see increased variability - both in supply at the grid level, but also in the demand that the grid must satisfy

Consumers are far more active - ranging from large industrial facilities reducing strain on the power system on high demand days to individual homeowners changing their consumption in response to time of use pricing

But I believe we have only scratched the surface - customers are looking for even more opportunities to manage their electricity costs and provide benefit to the system.

The coordination of all of these different factors efficiently requires finding a way to make sure the right information gets to both generators and consumers at the right time to inform effective decision making – this is where markets can help

However, the market design we have today was developed at a time when the landscape was far different from what it is today

Now is the Time to Modernize

- IESO is now moving forward on market changes while Ontario is in a period of stability
 - Ontario can benefit from the experience and best practices of other markets
 - Moving forward with change now will mean that Ontario is well-positioned to handle future needs (growth of distributed resources, contract expiries etc.)
- Market mechanisms with transparent price signals have proven critical in managing a reliable system and effectively bringing suppliers and consumers together, allocating risk, and supporting efficient decision making

Now is the right time to move forward on market changes while we are in a period of stability and surplus

The system needs in Ontario are common to many jurisdictions across North America

Ontario can learn from the experience of other markets to understand how to apply these lessons to our own system

In a way this is an opportunity to take best practice and build on their efforts

Moving forward with change now will mean that the market is well-positioned to handle future needs

We have seen how effective markets can be in other jurisdictions

We don't pretend that they are always easy – they are often complex, contentious and frustrating

We know there will be issues

But we also know they bring transparency to the market and, if designed well, enable suppliers and consumer to interact efficiently

We have time to get it right and we have a duty to do our best to put in place the best possible mechanisms to serve our system in the future – when needs emerge and reliability depends upon the efficient operation of the marketplace

The time is right since we are in a period of stability and surplus and can learn from the lessons of other jurisdictions

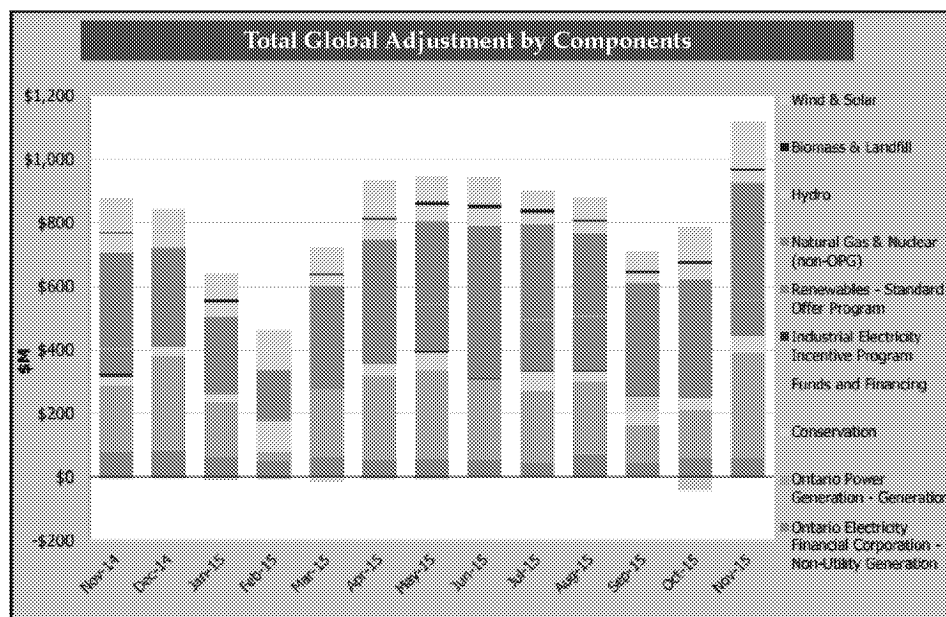
Evolving the Market: Market Renewal Initiative

- The IESO is currently engaging stakeholders on its Market Renewal initiative, a series of projects that will occur over the next few years
- Purpose is to address known market inefficiencies and lay the foundation for a more dynamic market in the future
 - Improve efficiency and transparency
 - Send effective prices signals to enable informed decision making
 - Lower barriers to greater participation
 - Open to new and emerging technologies

Appendix

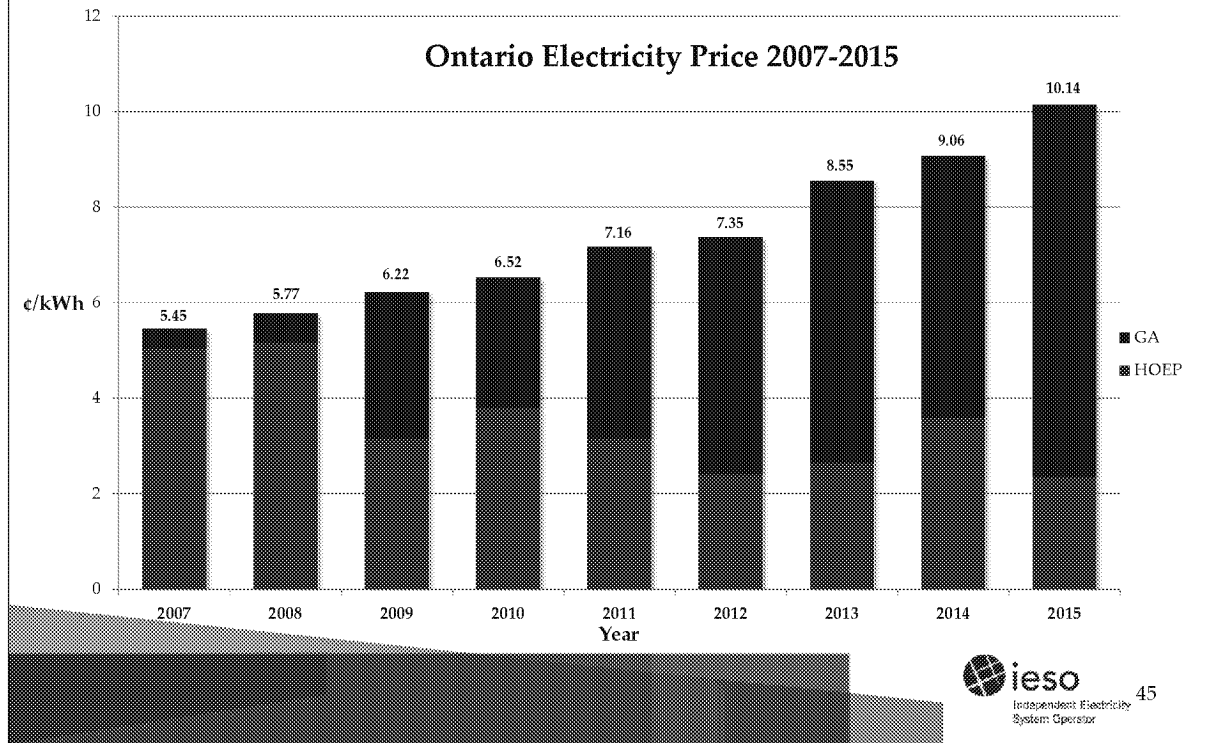


Global Adjustment



Source: IESO Monthly Market Report | November 2015

Electricity Pricing Trends



Electricity prices have been rising over the past few years and will continue to do so over the next few years

Prices have been rising because the province has needed to make a lot of investments to upgrade our electricity system, and because of our move from coal to a cleaner supply mix

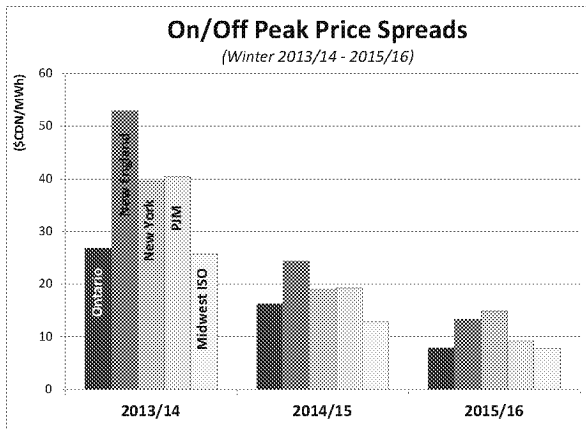
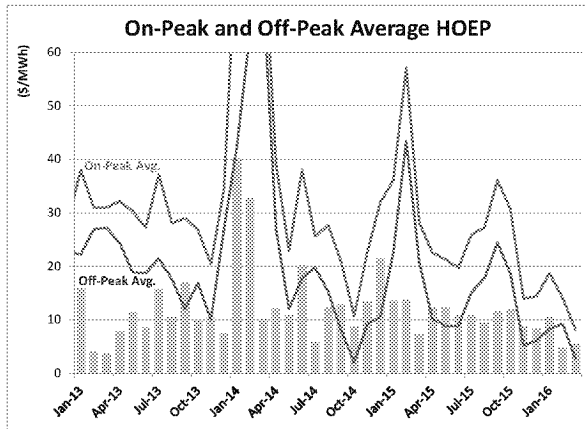
Ontario used to be a net importer of electricity

The government has tried to offset rising prices by introducing measures like the Ontario Electricity Support Program, which is helping low-income families with their bills.

For large consumers there is the Industrial Electricity Incentive that provides electricity at about 50% the normal rate for companies that expand their operations and create new jobs.

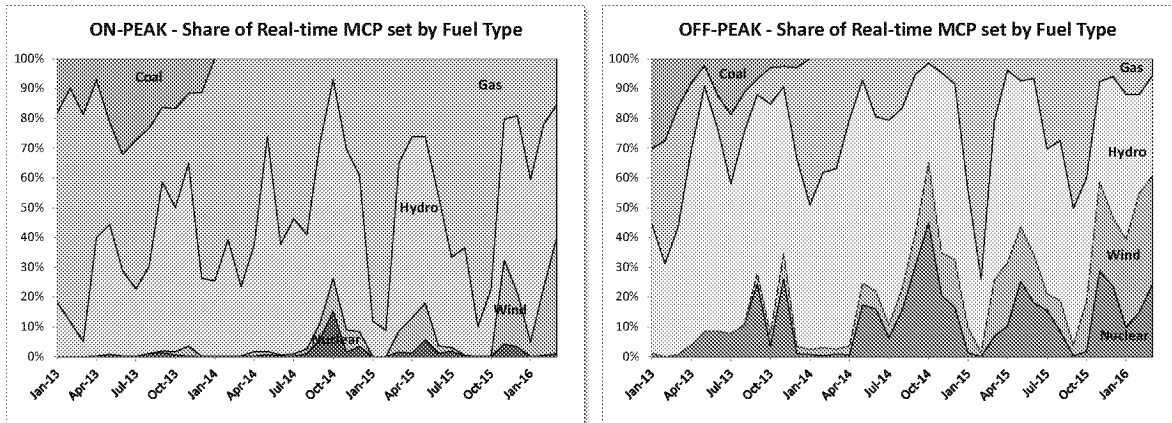
One example: Detour Gold is saving \$20 million in electricity costs for expanding what will be one of the largest gold mines in Ontario

On-Peak and Off-Peak Prices



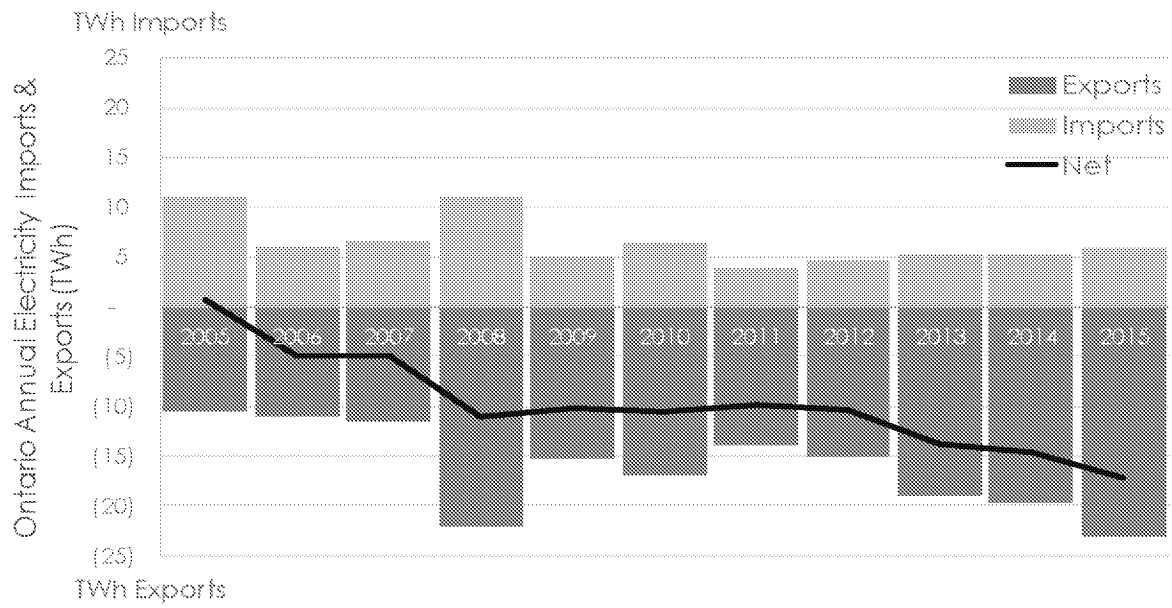
The spread between on an off-peak pricing was relatively small this winter, significantly reducing the incentive and value of shifting electricity production from on to off-peak.

Marginal Resource

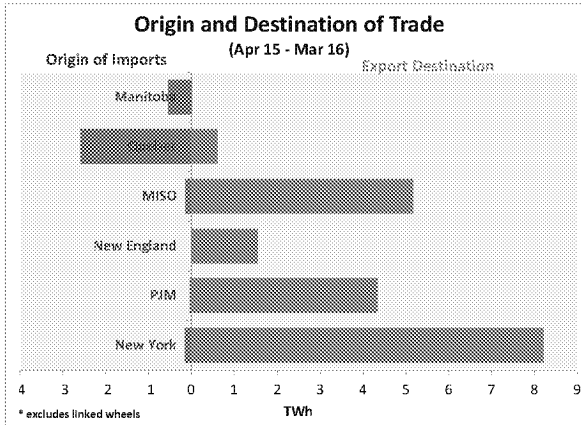
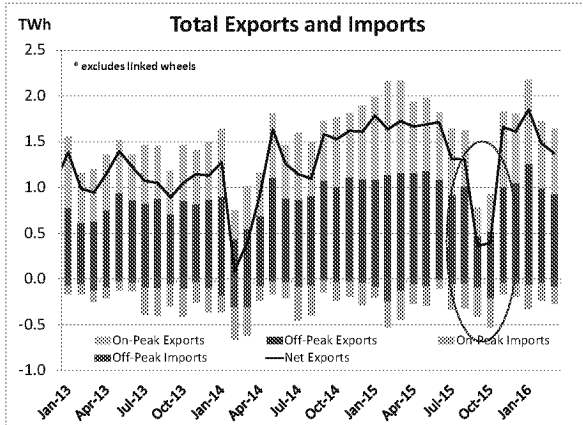


Renewables set energy prices more frequently this winter and less often this fall compared to seasonal trends.

Import and Export Trends



Import and Export Trends Cont'd



High energy prices in the fall of 2015 led to a reduction in export volumes and in one-quarter of all hours, Ontario was a net importer of electricity.

CCAP Implementation

Summary

With its experience, capability and established networks to deliver on ambitious targets IESO is well-positioned to work with the “Green Bank” to quickly and effectively deliver on CCAP goals; opportunity also exists to have Green Bank merge with IESO Conservation responsibilities/resources into one entity at a later date

- **Positive customer experience** – IESO will leverage established province-wide delivery partners to bring customers a full suite of low and ultra-low carbon energy solutions (electricity conservation, fuel-switching and renewables) within 3-6 months
- **Public value** – by integrating CCAP technologies and solutions and existing IESO programs, IESO will leverage both the trust/recognition that Ontarians cite in the Government’s conservation programs and a \$3B investment in conservation to efficiently drive GHG and energy reductions. IESO is a not-for-profit organization driven to deliver results that serve public interests.
- **Proven results** – with cost-effective, results-driven programs, and industry best practices in measurement and verification, IESO can ensure that CCAP funds result in maximum GHG and energy reductions and credible results

Climate Change Action Plan: Considerations/Challenges for Implementation

- ***Time to launch is critical*** – implementing organization(s) should be identified, empowered and programs and operating procedures in place in-time to make use of 2017 cap and trade funding.
- ***Positive customer experience with a trusted brand/program provider*** – to drive program participation and results, programs must be convenient, accessible through a single window and offered by a trusted source to all customer segments
- ***To keep costs down, the organization needs to leverage existing corporate and administration support structures*** and have experience with established accounting and savings measurement/ verification protocols.
- ***Strong accountability and regular reporting to government will be essential requirements*** of the implementing organization(s) given the level of committed finances and placement within the government's overall strategic objectives.
- ***The implementing organization needs to be able to quickly coordinate action across sectors and ministries***, be responsive to government direction, and have continuous intake of expert / stakeholder opinions.
- ***Will need a wide range of skills***, including technical expertise, financial and accounting and program delivery/ design and customer/ results focus.

IESO coordination of energy efficiency/electrification can leverage existing partnerships, programs and delivery infrastructure to enable quick, reliable and cost-effective results

- Expedient deployment of customer-focused programs by leveraging existing province-wide program delivery infrastructure
 - Integrate ultra-low carbon measures and existing programs to reduce overall administrative costs and focus funding on investments in ultra-low carbon/energy efficient technologies and services
- Better customer experience – less confusion through coordination of new initiatives with existing programs
 - Leverage extensive existing partnerships between IESO and LDCs, Building Owners and Managers Association (BOMA), Home Depot, Lowes – and the relationships these organizations have with customers/stakeholders
- Existing government (Cabinet) directive authority over the IESO
- Design and delivery of energy efficiency, fuel-switching and renewable energy programs to all customers through an integrated one-window approach
 - Minimize administration costs through fully integrated programs; coordination of energy efficiency and renewables enables customers to reduce use then address residual use with renewables
- Coordination with electricity system planning to ensure clean resources for “efficient electrification” of system
 - Leverage existing community engagement in planning process
 - Ensure that electrification is energy efficient, takes full advantage of existing electricity supply resources and does not result in potential supply shortfalls

Potential for Canada's First Integrated Energy and Emissions Efficiency Entity

- Ability to deploy **ultra low carbon** technologies/solutions (energy efficiency and renewable energy) to **all Ontarians**
- Operate on the principle that lowest cost/best environmental/economic result comes from **first reducing energy use**, then meeting residual needs with **renewable energy**
 - Delivery agents that can offer customers both energy efficiency and renewables
- Build on existing province-wide energy efficiency programs and delivery infrastructure for **expedient, cost-effective, verifiable results**
 - Add fuel switching and renewable self-generation to existing programs
 - Province-wide delivery system, partnerships, measurement and verification program, technology validation, capability building, tracking and reporting systems
 - Leverage planned \$3B investment in energy efficiency by 2020
- Partner with proposed "Green Bank" and existing financing agencies to offer financing through existing delivery channels and **leverage existing customer relationships**
 - Potential partnerships with Toronto Atmospheric Fund; Heating, Refrigeration & Air Conditioning Institute
 - Existing IESO relationships with Industrial customers (AMD, GM, Vale, others)
- Ensure **electrification is efficient** and served by clean energy when/where it happens

Existing IESO program infrastructure can effectively incorporate fuel-switching, renewables and financing to deliver CCAP goals

Existing province-wide business infrastructure, delivery system and partnerships

- All LDCs delivering res. and business programs under IESO oversight
- IESO delivery of IAP to 58 of the largest single-site energy users
- All programs marked under Save on Energy brand
- Application, QA/QC, payment and reporting established
- Partnerships with major retailers, associations, NGOs (see Appendix A)

Results verification demonstrates value for money

- Evaluation, measurement and verification (EM&V) program ensures reductions are measured, real (bill data, equipment metering); recognized by US DOE for rigour; adopted by OEB for gas programs
- Addresses challenges US green banks have had showing value for \$
- Currently measure gas/water savings (will measure GHGs Fall 2016)

Expediency to market with customer-focused programs

- Strong existing relationships with customers/delivery partners will deliver near-term (3-6 months) results with rapid inclusion of new program elements (fuel-switching, renewables)
- Existing project concepts can be connected with financing to drive deeper GHG reductions and results

Cost-effective/ Funding

- Integration of CCAP funding/goals and \$3B 2015-2020 commitment to Conservation will leverage existing delivery infrastructure for more cost-effective delivery (less \$ for admin./more \$ for GHG reductions)
- Fuel-switching can readily be added to existing programs to offer customers complete package of low carbon energy solutions

Integration of CCAP and existing IESO energy efficiency infrastructure = immediate/near-term deliverables

Existing Save on Energy Service/Product	Potential Announce-able Date (programs enhanced w/ fuel-switching /net-metering)	CCAP Deliverable Addressed through Update of Existing Conservation Program				
		Retrofits - Private Residential & Multi-Tenant Buildings	Retrofits for existing Single Family Homes	Near net-zero carbon emission homes	Clean tech for industries, small and medium enterprise	Low Income Households – targeted initiatives
Province-wide Residential Whole Home Program	3 months	✓	✓	✓		
Province-wide Retrofit program for Multi-tenant buildings	6 months	✓				
Energy managers embedded in businesses	6 months	✓			✓	
Province-wide sector-based energy managers (Hospital, Retail, etc.)	3 months	✓			✓	✓
Industrial Energy Efficiency Program	2 months				✓	
Province-wide low income home retrofit program	6 months	✓	✓			✓
Province-wide New Construction program (Res & Business)	6 months			✓	✓	

Integration of CCAP and existing IESO energy efficiency infrastructure action plan for immediate/near-term deliverables

Existing Save on Energy Service/Product	Current Funding Commitment (to 2020)	Description (status)	Enhancement to deliver GHG reductions
Province-wide Residential Whole Home Program	\$21M	All fuel audit-based home retrofit program (partnership with gas utilities/GIF)	GHG reductions targeted, additional ultra low carbon technologies for space/ water heating, access to climate change tools (e.g. education, GHG calculator)
Province-wide Retrofit program for Multi-tenant buildings	\$650M	Retrofit program provides incentives (up to 50% of cost) for energy efficiency measures (with adder for social-housing)	Add fuel-switching and low carbon measures, access to climate change tools
Energy managers embedded in businesses	\$50M	Fully funded full-time resource dedicated to achieving energy savings target in business	Add GHG target/incentive to energy manager contracts
Province-wide sector-based energy managers (Hospitals, Retail, etc.)	\$22M	Fully funded full-time resource dedicated to driving energy efficiency/results in sector	Add GHG target/incentive to energy manager contracts
Industrial Energy Efficiency Program (Industrial Accelerator)	\$500M	Funding for energy managers, studies, retrofits, audits	Add GHG targets, make financing available, promote adoption of low-carbon technologies
Province-wide low income household retrofit program	\$43M	Free whole home assessment and upgrades (up to \$10K/home)	Extend program to all fuel types, additional ultra low carbon technologies for space and water heating
Province-wide New Construction Programs (Res & Business)	\$82M	Funding for designers and builders to construct and implement energy-efficient homes/buildings.	Extend program to all fuel types, encourage low carbon technologies, EV ready homes/buildings, renewables

System Operator

Potential Delivery Options

Option 1 – IESO (with expanded mandate)/ and partnership with new Green Bank entity

- Existing IESO energy efficiency programs are augmented with additional ultra-low carbon measures with funding from the Green Bank
- Financing made available to existing/potential program participants for deeper retrofits, fuel-switching and renewable generation
- Program delivery model continues to leverage existing resources (IESO and partners)
- IESO responsible for program design/delivery; Green Bank responsible for providing Cap and Trade funding and investment strategy

Option 2 – Green Bank / IESO Conservation responsibilities and resources merge

- The IESO Conservation resources evolve into a new entity, which is the “Green Bank” reporting to both MoE and MoECC
- Same programs and delivery model as described under Option 1
- This option may be more feasible under a one-to-three year timeline given time needed to establish a larger stand alone entity. HR, IT Finance and Communications services do not currently exist within the IESO Conservation group. HR matters such as compensation structure, pension, etc. would take time to establish for the new entity and take attention away from program design and delivery
- Single entity responsible for program design/delivery and administration of Cap and Trade funding/investment strategy

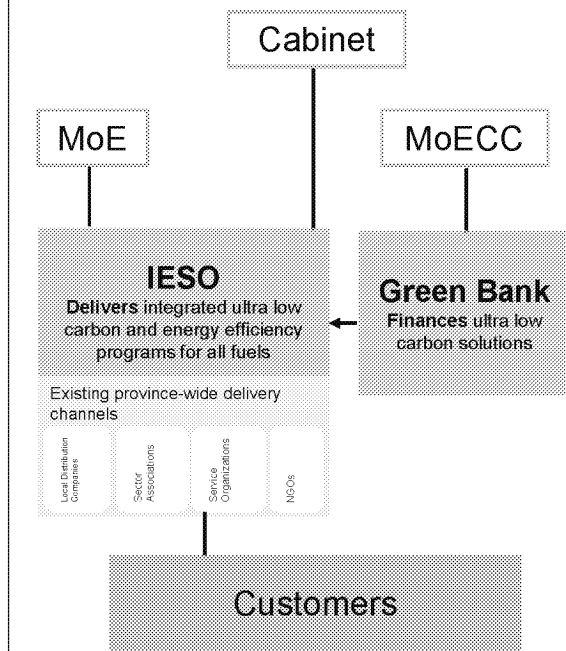
CCAP Implementation - Organizational Considerations

Criteria	IESO (with expanded mandate)/ Green Bank Partnership	Green Bank and Conservation responsibilities/resources merge
Start-up time/ establishment of program delivery infrastructure	+3 months (for ultra-low carbon measures and energy efficiency integrated in existing programs)	+ 1 year (time to create Green Bank – establish governance/Board, staff, business infrastructure set-up, program design, delivery infrastructure set-up)
New authorizing legislation required	Existing (may require changes)	TBD – depending on how Green Bank is created
Governance	Existing: independent board with possible advisory committee	New independent board for Green Bank
New FTEs	Low - Shared corporate support functions with IESO; existing program delivery expertise	High – Full organizational requirements for creation of new organization
Start-up costs	Low	High
Budget approval	Green Bank budget process TBD; IESO budget approved via business plan (rates) or service agreement with Green Bank (Cap & Trade funds)	Green Bank budget process TBD; IESO budget approved via business plan or service agreement with Green Bank

CCAP Implementation - Organizational Considerations

Criteria	IESO (with expanded mandate) / Green Bank Partnership	Green Bank and Conservation responsibilities/resources merge
Funding Sources	Cap & Trade; Rates	Cap & Trade; Rates
Policy/Program Duplication	No – if Green Bank focuses on financing/investment strategy and IESO delivers programs	No
Independent Audit	Yes	Yes
Public Reporting	IESO would report within current and/or separate annual report to Green Bank / MoECC	Green Bank reporting requirements would need to be determined
Existing Customer Engagement	High – leverage established IESO relationships	High – leverage established IESO relationships
Expertise Availability (cost to acquire/timing)	Low cost; quickly leverage/ expand existing IESO expertise	High cost to acquire quickly for Green Bank; Low cost for existing IESO expertise
Stakeholder Engagement	High – established relationships and engagement process by IESO	Would need to be established as part of creation of new organization

Option 1. IESO (with expanded mandate)/Green Bank partnership



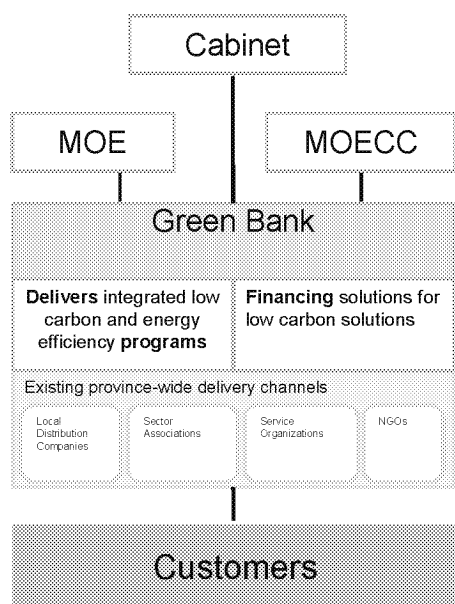
Relationship to Government:

- Cabinet has directive authority for IESO and could use this authority to integrate ultra-low carbon measures (fuel-switching, renewables), financing and existing energy efficiency programs into existing programs
- IESO would receive funding for integration of ultra-low carbon measures into existing energy efficiency programs from Green Bank (e.g. via a service agreement). Energy efficiency would continue to be funded through Global Adjustment and rates
- IESO reporting relationships with both Green Bank (Cap and Trade) and MoE (energy efficiency) and dedicated staff to ensure IESO achieves deliverables for both organizations
- Would require time/resources for Green Bank creation as new entity and funding agreement between IESO and Green Bank
- IESO would be Green Bank's delivery partner for building sector; Green Bank may have other partners for waste, agriculture, etc.

Governance and Organizational Efficiency

- Could create a separate entity within existing corporate structure (e.g. Smart Metering Entity within IESO)
- Avoids overlap/optimizes cost-efficiencies and customer convenience if IESO focuses on program delivery and Green Bank focuses on funding and investment strategy

Option 2. Green Bank / IESO Conservation responsibilities and resources merge



Relationship with Government

- Cabinet has directive authority for Green Bank (IESO) and could use this authority to integrate ultra-low carbon measures (fuel-switching, renewables), financing and existing energy efficiency programs into existing programs
- Green Bank (IESO) would have reporting relationship to MoECC and MoE
- Would require enhancements to current governance tools (ex: MOU) and possibly legislative amendment to IESO objects under Electricity Act (e.g. for fuel-switching to non-electricity resources)

Governance and Organizational Efficiency

- Would need to create governance structure for new organization as well as organizational supports including IT, HR, Legal, Finance