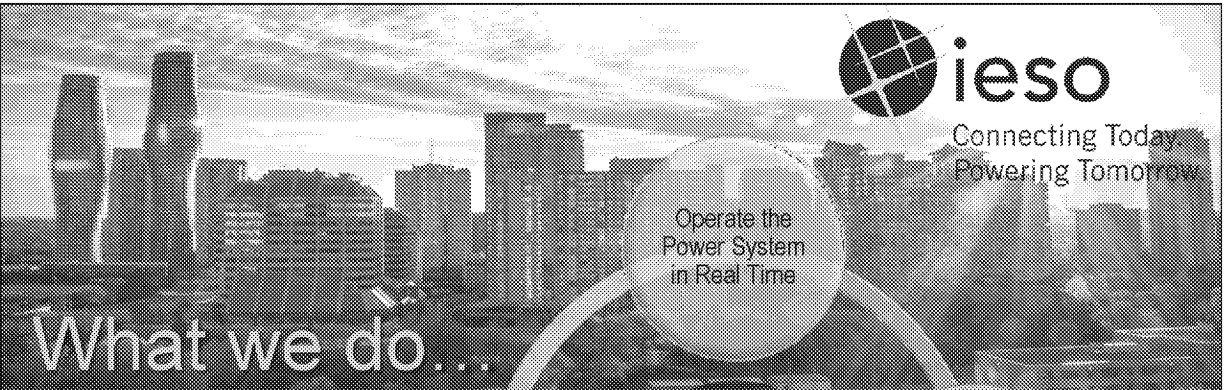


An Introduction to the IESO

August 28, 2017





ieso
Connecting Today.
Powering Tomorrow.

What we do...

The IESO works at the heart of Ontario's power system ensuring there is enough power to keep the lights on, today and into the future...

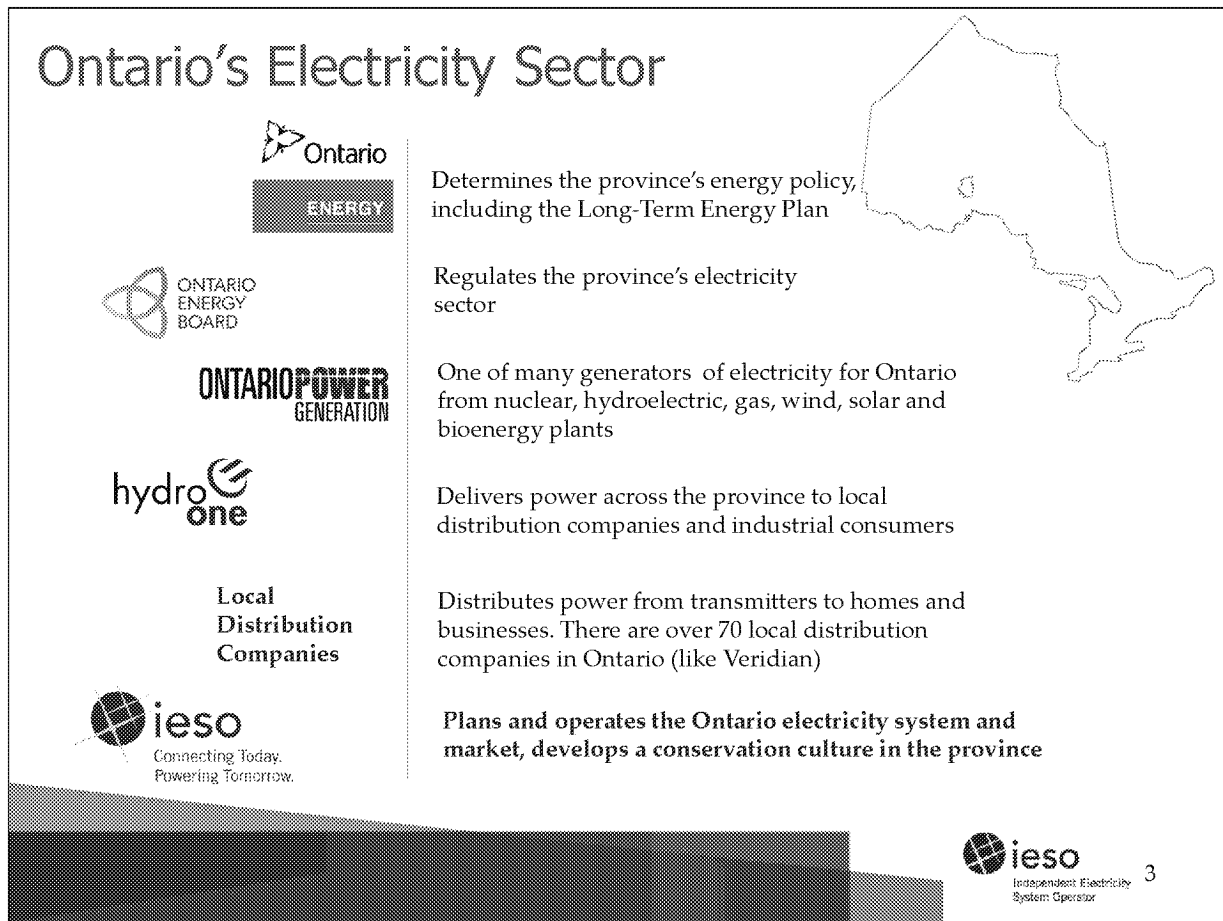


- Operate the Power System in Real Time
- Plan for Ontario's Future Energy Needs
- Oversee Ontario's Electricity Market
- Enable Conservation

ieso
Independent Electricity
System Operator

2

Ontario's Electricity Sector



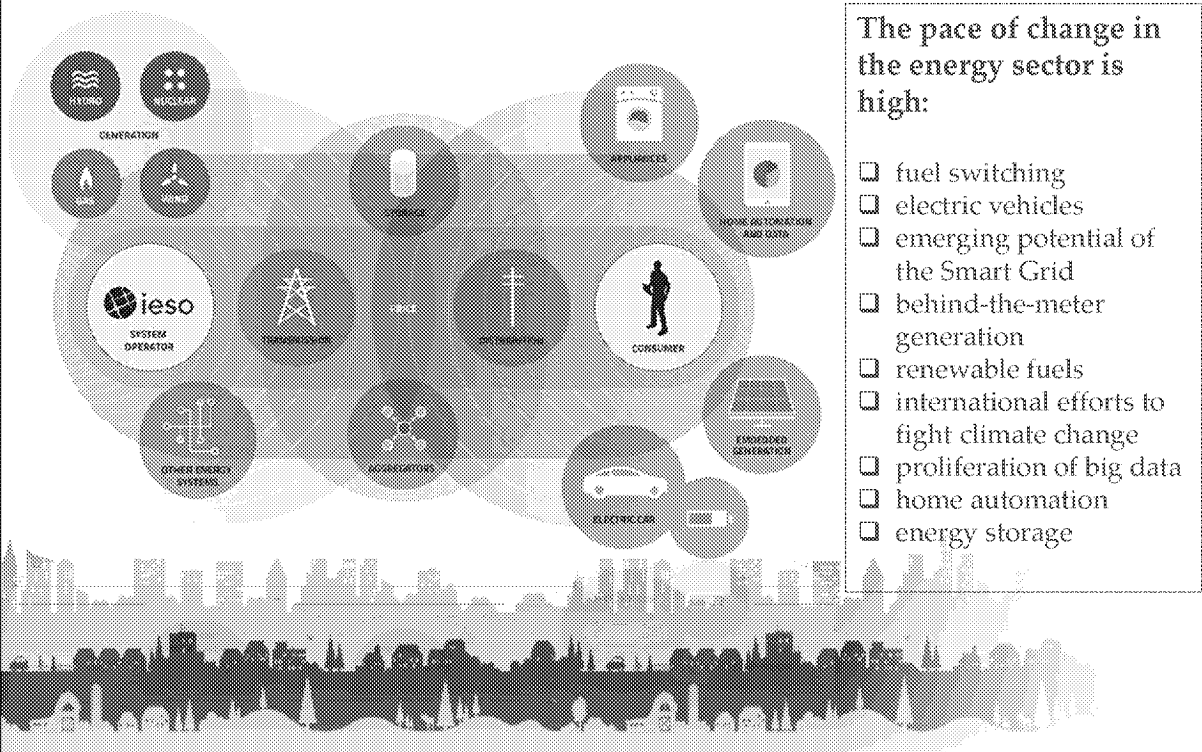
The challenge of managing the electricity system begins with balancing just enough supply of electricity with the need for it on a minute-by-minute basis. There are many moving parts to the electricity system, all of which need to be carefully coordinated for the system to work.

The Government of Ontario, through the Ministry of Energy, sets the overall policy for the energy sector.

A number of different companies and agencies play a part in ensuring that Ontario's homes and businesses have a reliable supply of electricity when they need it.

They include: (refer to slide)

What's happening in the electricity sector...

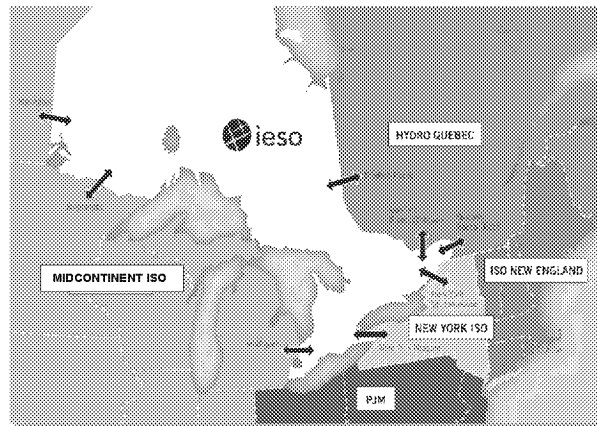


Operating the Grid



Ontario at a Glance

Installed Capacity	36,070 MW (December 2016)
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 (2015)	1.3 terawatt-hours (TWh)
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.

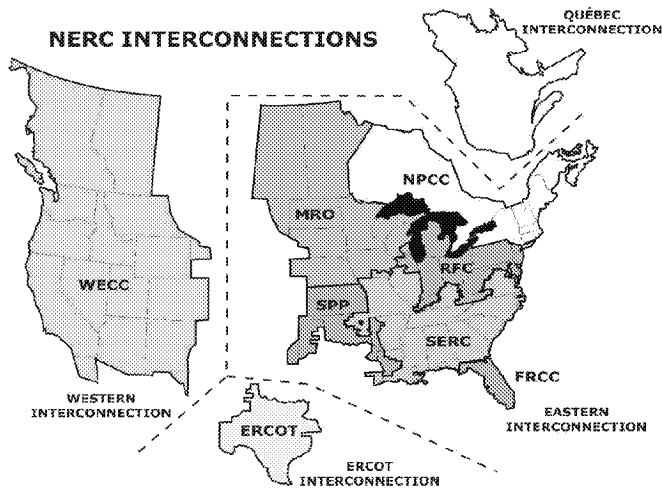
We have a number of neighbouring jurisdictions with whom the IESO works closely with.

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.

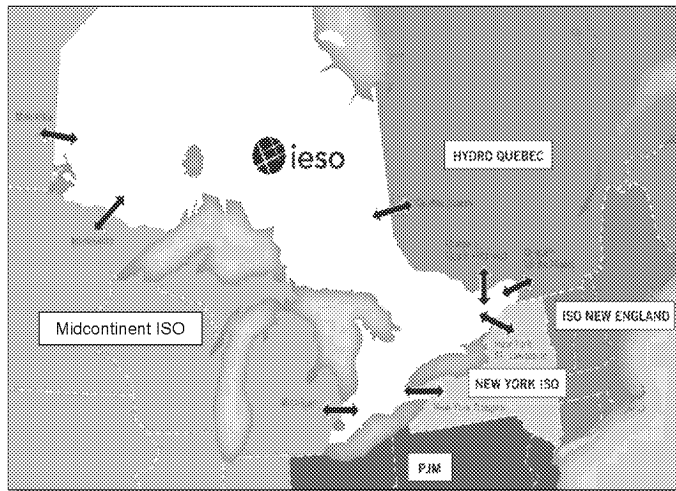
Ontario's Reliability Co-ordinator



- IESO is responsible for monitoring and enforcing reliability standards in Ontario
- IESO represents Ontario's interests as member of North American Electric Reliability Corporation (NERC) and Northeast Power Coordinating Council (NPCC)
- IESO is active in the interconnected community in emergency preparedness related activities

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.

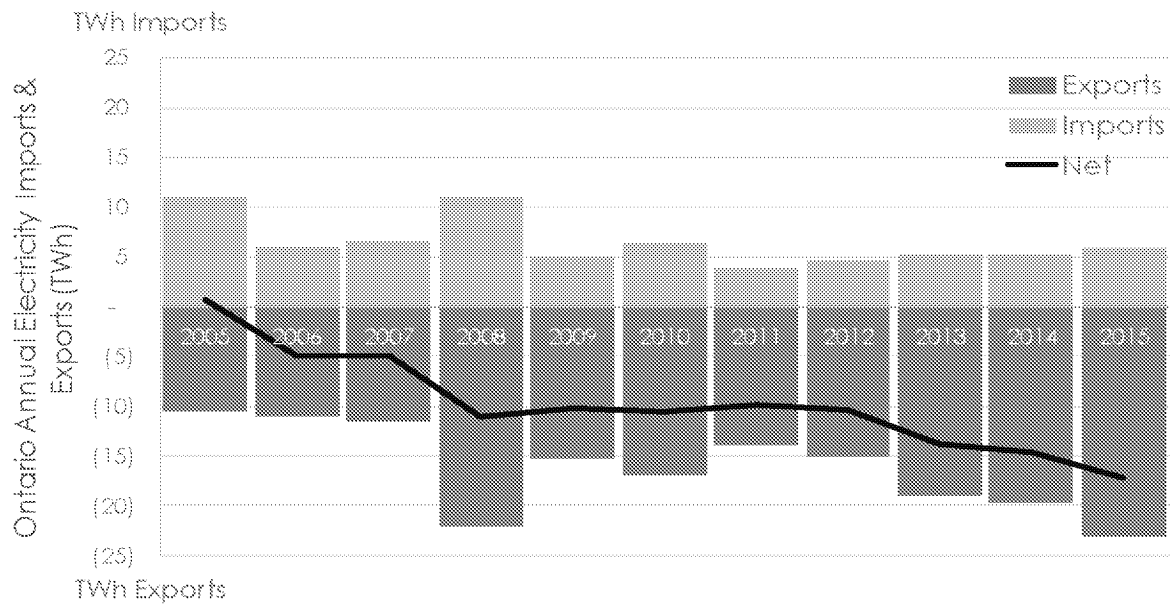
From an economic perspective:

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

Transmission Rights Auction

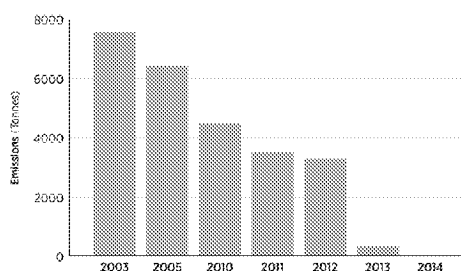
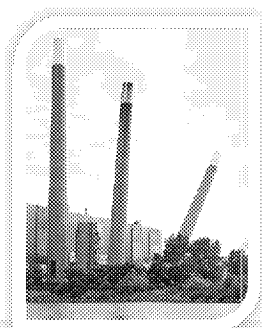
Most uplifts apply to exports (except RRA, DRC and OPA fee)

Import and Export Trends



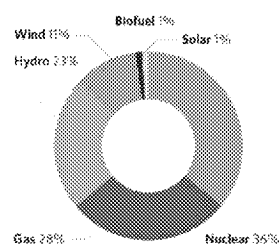
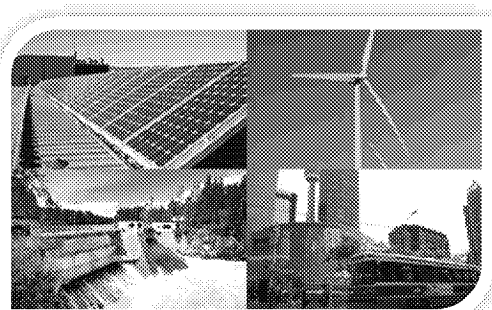
Over the last 15 years...

**Coal retired
from Ontario's
supply mix**

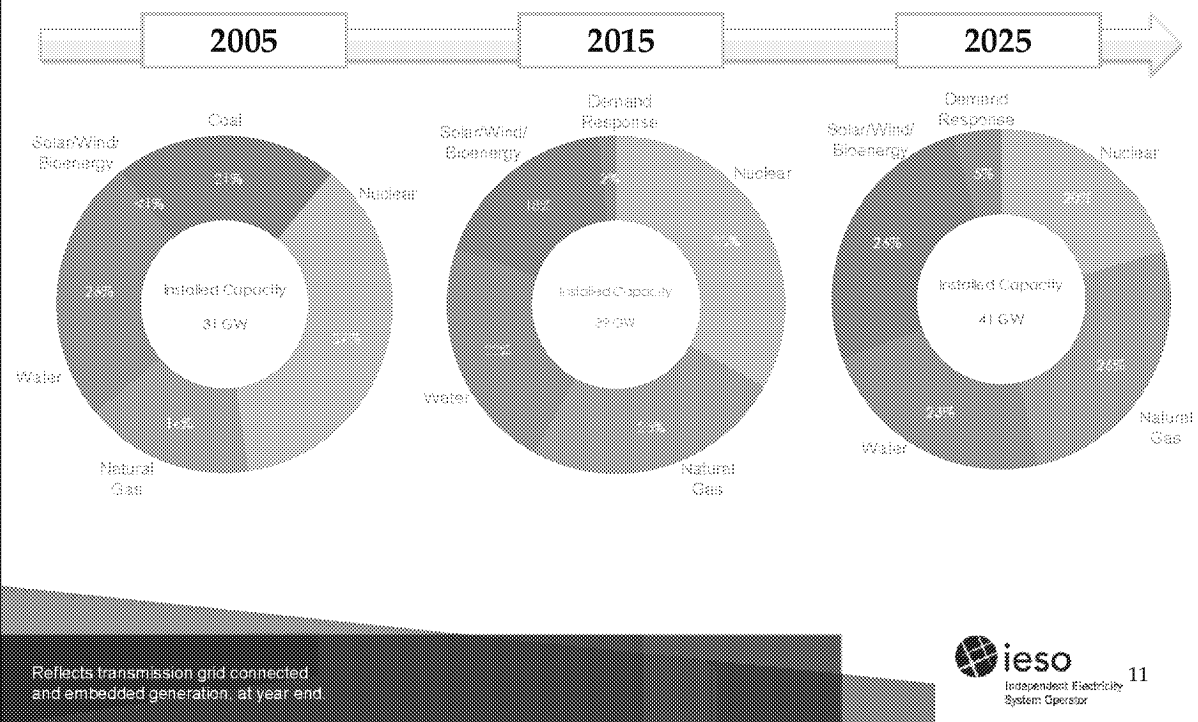


2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

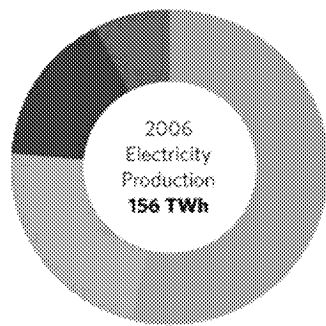
Coal replaced by 14
GW of renewable,
natural gas-fired,
nuclear and
demand response
resources



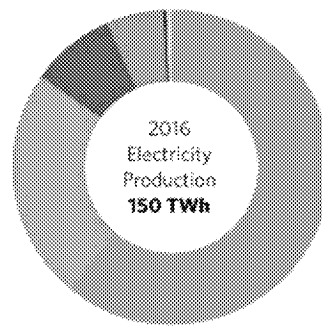
Ontario's Electricity Supply - Capacity



Electricity Production 2006/ 2016



Nuclear	84.4 TWh or 54%
Hydro	34.8 TWh or 22%
Coal	25 TWh or 16%
Other (gas, oil, alternative sources)	11.8 TWh or 8%



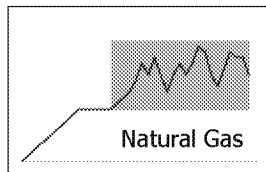
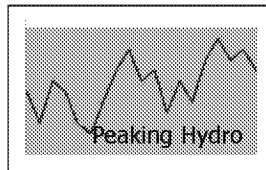
Nuclear	91.7 TWh or 61%
Hydro	35.7 TWh or 24%
Gas/Oil	12.7 TWh or 9%
Wind	9.3 TWh or 6%
Biofuel	0.49 TWh or <1%
Solar/Other	0.46 TWh or <1%



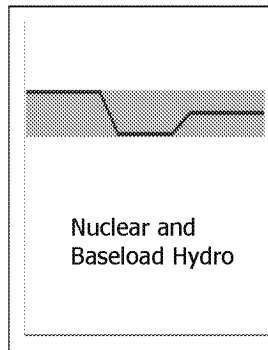
Ontario's Generation Fleet: Operating Characteristics

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

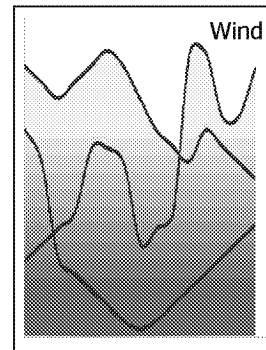
Dispatchable



Baseload



Variable



Flexibility is needed to:

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

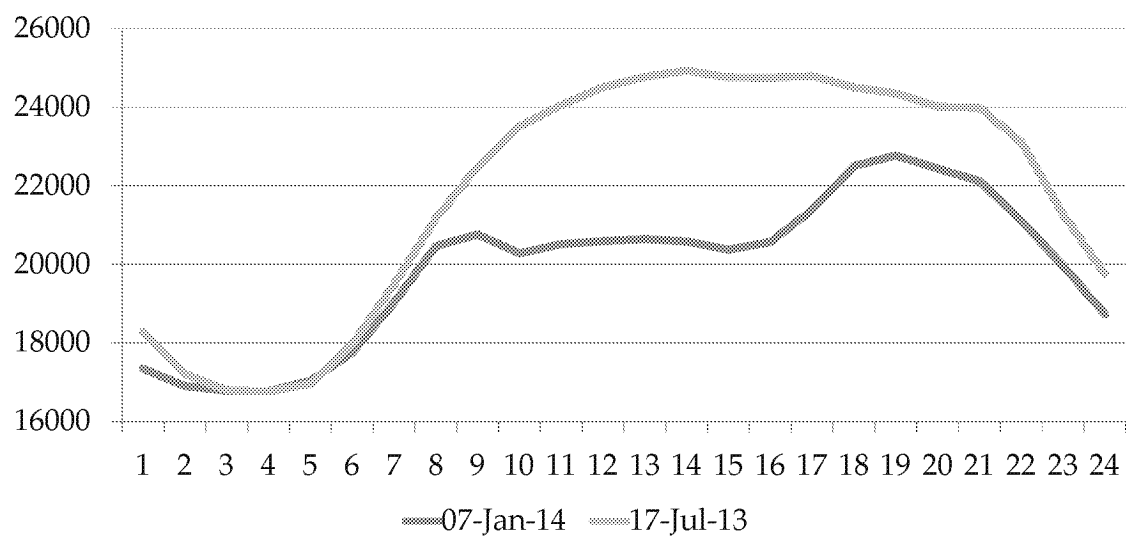
Ideally every resource is highly flexible with unlimited fuel but the reality in Ontario (and every other jurisdiction) is a mix of resources having different operating characteristics

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

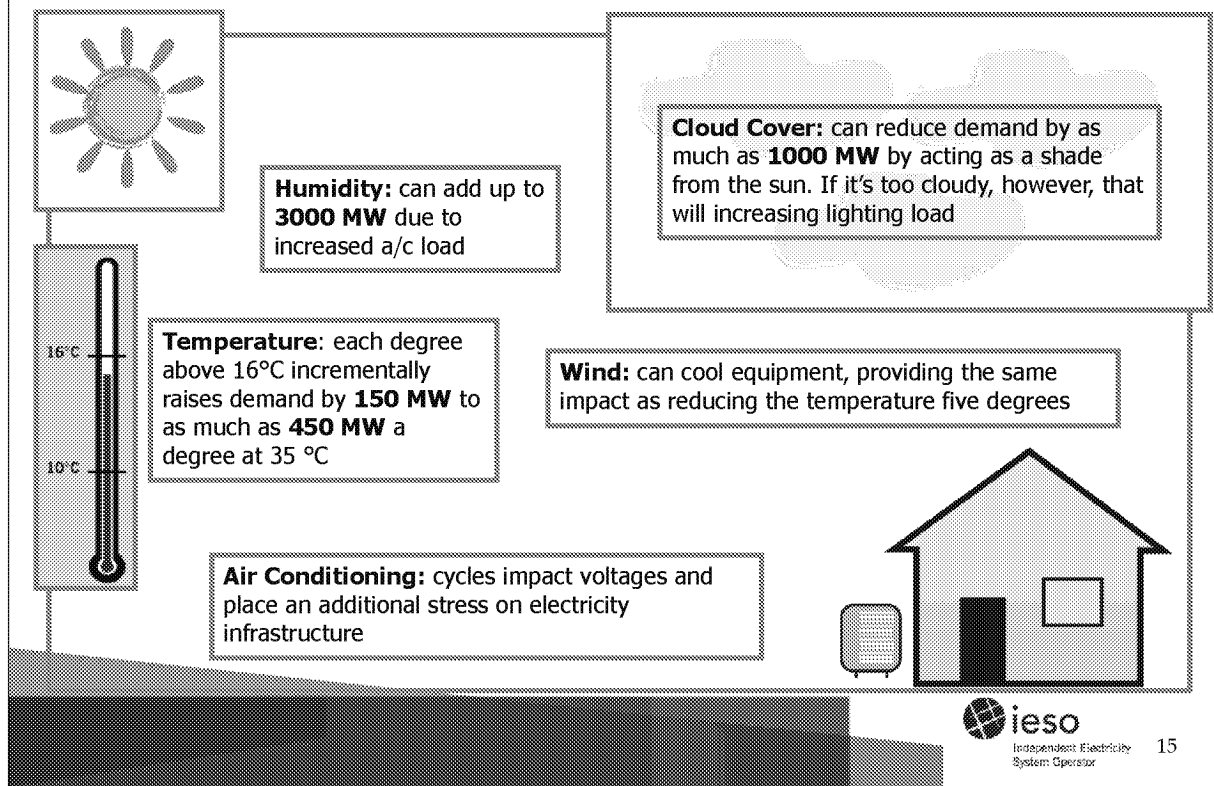
So looking at Baseload.....Variable....Dispatchable....

How do we overcome this inherent inflexibility? (next slide...)

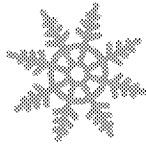
Summer vs. Winter Demand



Summer Impacts

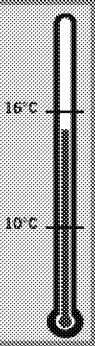


Winter Impacts



Ice: can cause significant transmission issues and make restoration and repairs troublesome. Under extreme conditions it can cause infrastructure issues (e.g. 2013 ice storm)

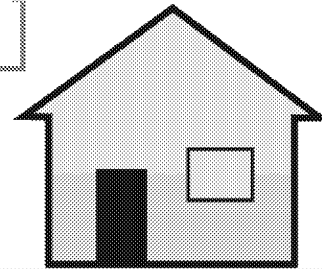
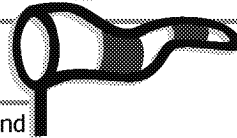
Cloud Cover/Snowfall: contributes to increased lighting load by as much as 750 MW



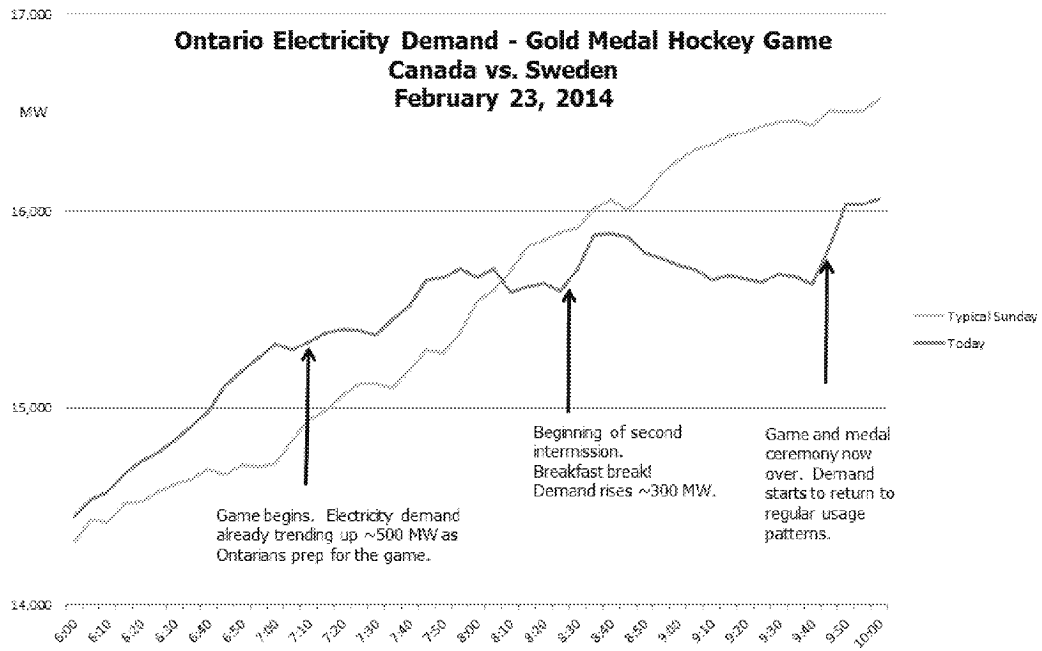
Temperature: each degree below 10°C incrementally raises demand by **50 MW** to as much as **250 MW** a degree at -20°C (furnace load)

Wind: strong winds (30 km/h and up) on cold days (-10°C) can increase demand by 800 MW

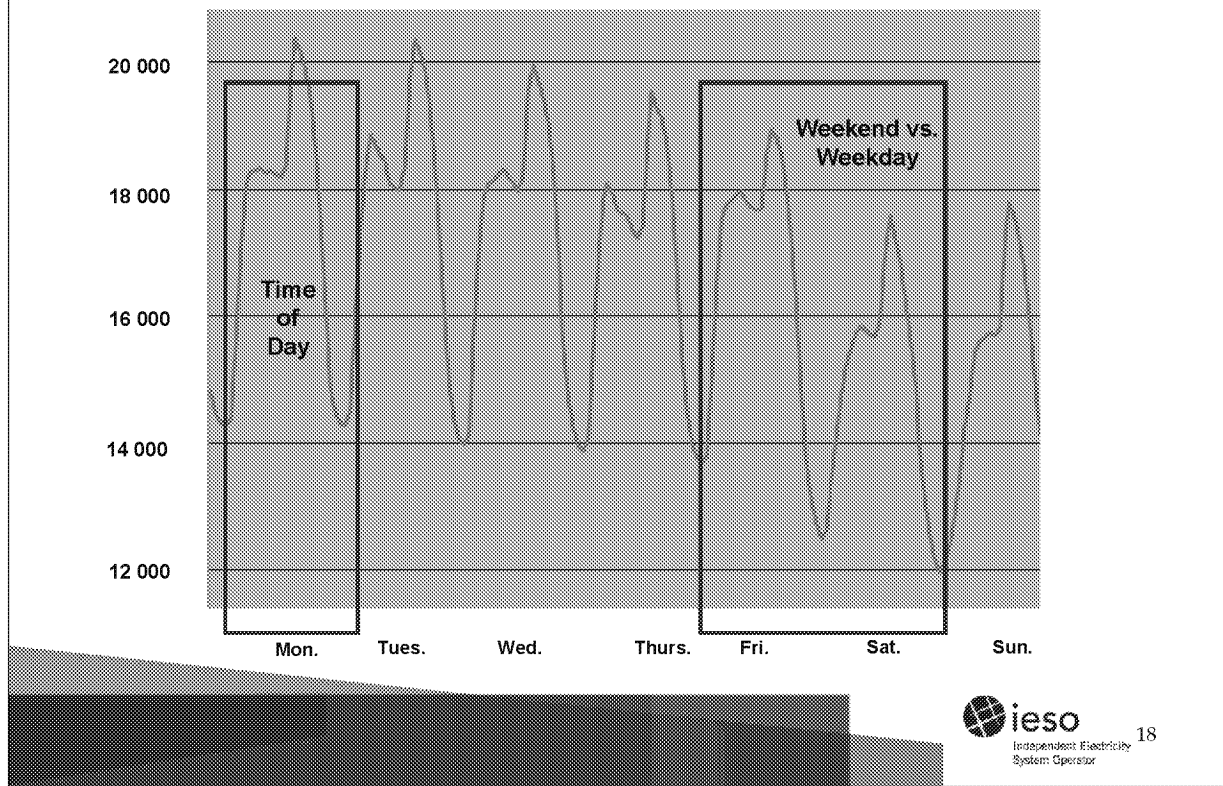
Lighting influences demand peaks in winter with late sunrise and early sunset



Demand for Electricity: The Impact of Consumer Behaviour

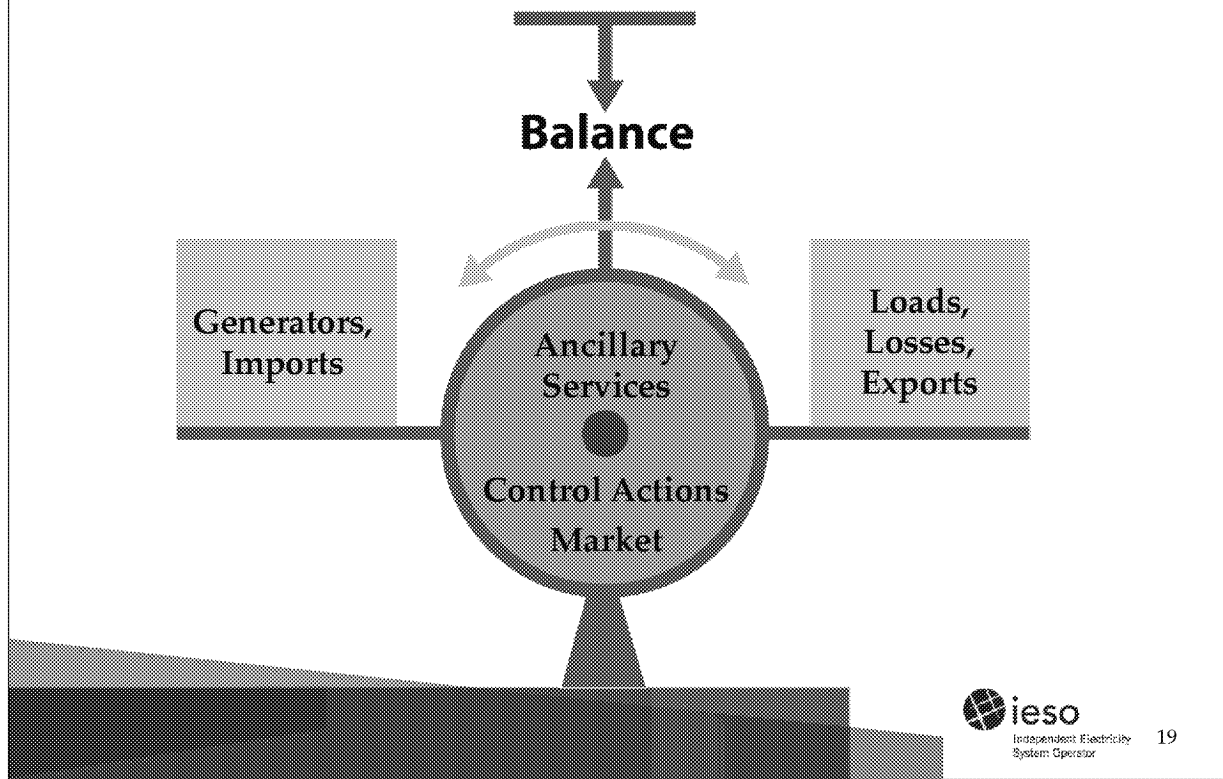


Day-to-Day Demand Varies Considerably



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

Balancing Supply and Demand



Bringing it all together – we operate the complexities of the system to achieve a balance that ensures we achieve reliability objectives to ensure electricity remains a backbone to the Ontario economy and daily life of consumers

Planning for Ontario's Future Electricity Needs



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

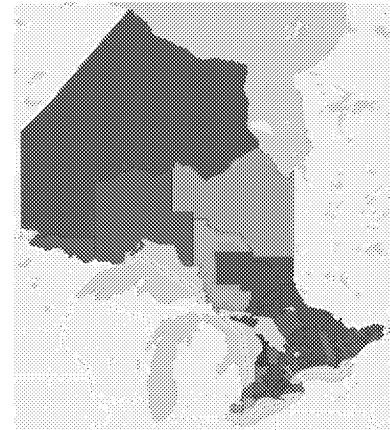
CHPSOP

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



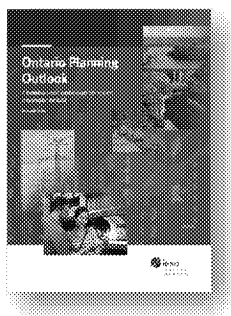
Independent Electricity
System Operator

21

Preparing for change in an evolving sector

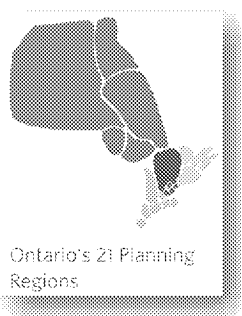
The IESO has a **unique vantage point** on the power system – ensuring reliability for the next five minutes all the way to the next 20 years

Provincial Bulk Planning



Identifies the provincial mix of electricity resources and determines what's needed to deliver electricity to customers throughout the province

Regional Planning Process



A process for identifying and meeting regional electricity needs, with the goal of maintaining reliable electricity supply to the region

Province's Long-Term Energy Plan



Identifies a policy planning framework that considers cost-effectiveness, reliability, clean energy, community engagement and conservation before building new generation and transmission

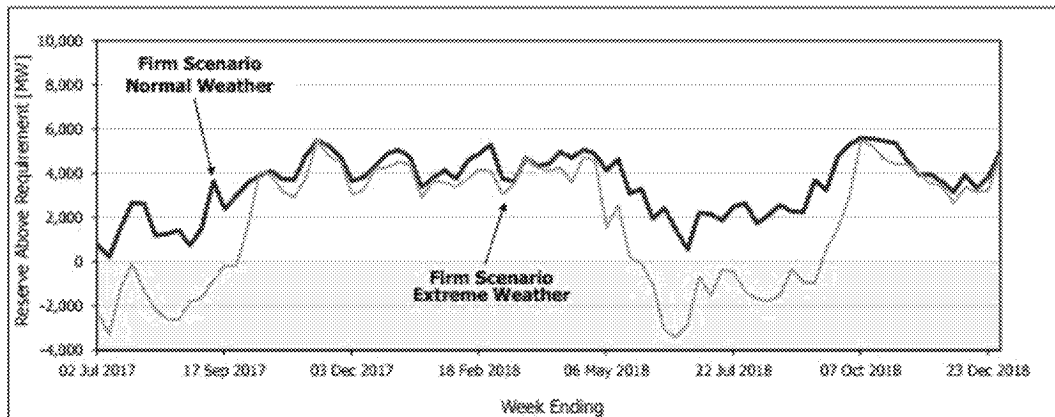
18 Month Outlook

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

Summer 2017:

July 2017 to
December 2018

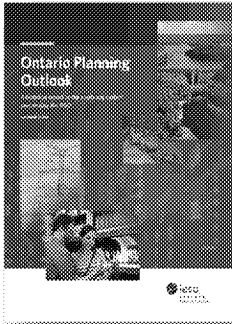
- The outlook for the reliability of Ontario's electricity system remains positive with adequate domestic generation and transmission to supply Ontario's demand under normal weather conditions.



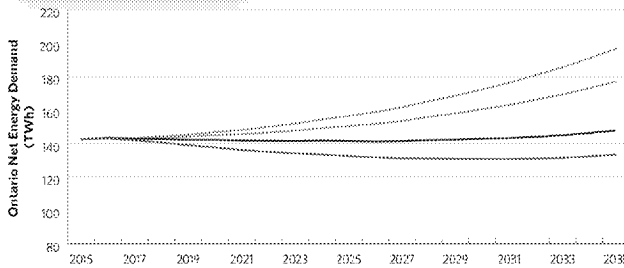
Preparing for change in an evolving sector – *system planning*

Ontario Planning Outlook (OPO)

Report presents the IESO's planning outlook for the 2016 through 2035 period and includes a range of demand outlooks

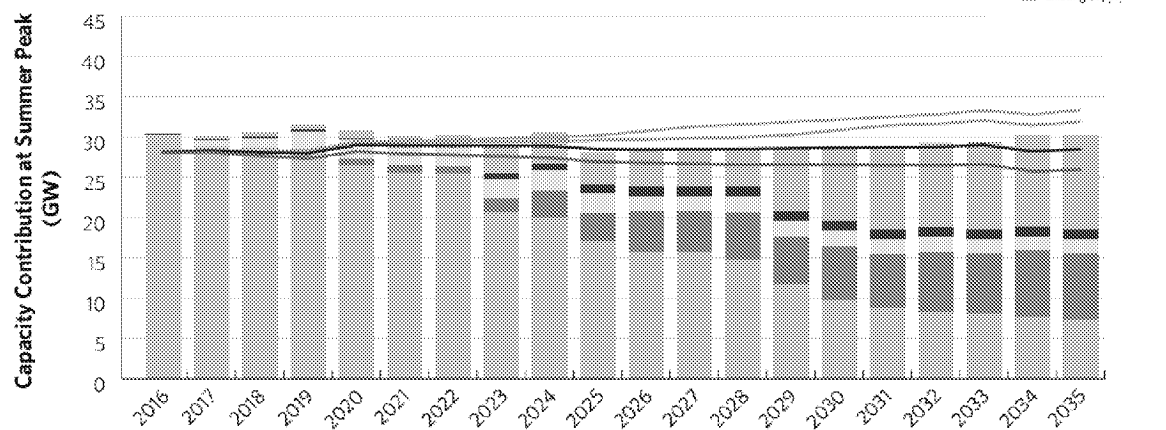


Looks at the needs of the electricity system associated with capacity, reliability, market and system operations, transmission and distribution



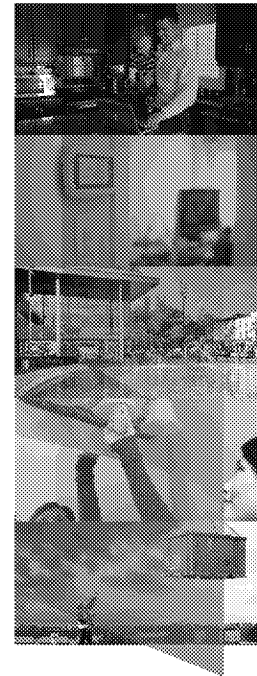
- Ontario well-positioned to meet provincial needs until the mid-2020s
- Implementation of the province's climate change policies will have an impact on the demand for electricity
- In higher demand outlooks, additional investments in new resources would be required to meet the increase in demand
- Opportunities for increased conservation will also vary with increases and decreases in demand

Available Supply at the Time of Peak Demand Relative to Total Resource Requirements



Putting Conservation First

- Conservation provides a clean and cost-effective alternative to building new generation
- Conservation lowers peak demand, deferring and avoiding the need to build new infrastructure
- Conservation is expected to offset almost all demand growth until 2032
- The goal of the *Conservation First Framework* is 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

It also lowers peak demand, allowing the IESO to defer or avoid the need to build new infrastructure

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

For example, peaksaver PLUS® helps residential consumers reduce energy during peak demands by allowing their utility to remotely cycle down their air conditioners and water heaters.

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'



Save on Energy has programs, rebates and resources to help you:

- ✓ SAVE MONEY
- ✓ SAVE ENERGY
- ✓ STAY COMFORTABLE



For Homes

HEATING & COOLING INCENTIVE +

Peaksaver Plus®

COUPONS +

Buying a New Home +

Home Assistance Program +

For Business

Small Business Lighting

Retrofit Program +

Peaksaver Plus®

AUDIT FUNDING +

EXISTING BUILDING COMMISSIONING +

Energy Managers +

HIGH PERFORMANCE NEW CONSTRUCTION +

PROCESS AND SYSTEMS +

DEMAND RESPONSE

TRAINING & SUPPORT +

NEW HOME CONSTRUCTION +

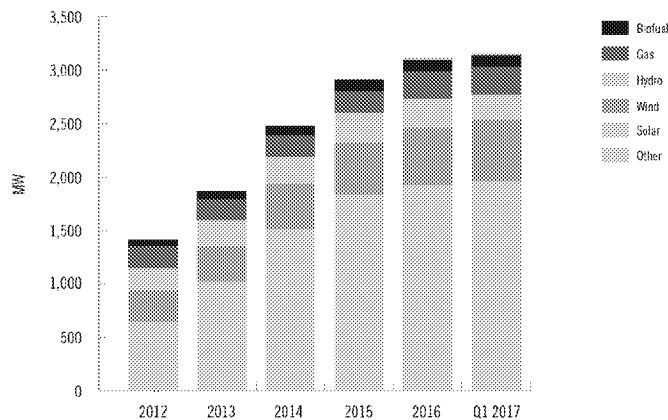
Social and Assisted Housing



Peaksaver transitioning to Residential DR

Growth of Embedded Generation and DER

- More than 2,000 MW of solar has been added over a 6 year period
- Expecting 3,000 MW of embedded wind and solar by the early 2020's with more than 1,000 MW being solar installations less than 5MW
- Output from embedded generators directly offsets the need for the same quantity of grid supplied electricity



By the end of Q1 2017, there was 3,161.9 MW of contracted generation in commercial operation within local distribution systems.

Enhancing reliability: IESO collaborating with LDC and municipalities

The IESO is looking at ways to enhance reliability and efficiency through the coordination of IESO and LDC-controlled resources

IESO's Grid-LDC Interoperability Standing Committee

- Members discuss and identify current operations opportunities from local distribution companies (LDCs) that have potential to interact with the IESO
- Explore areas where further collaboration and data sharing opportunities may exist

Smart Grid Forum

- Includes member organizations from Ontario's utility sector, industry associations, public agencies and universities
- Forum aims to guide the development of the smart grid in Ontario.
- Prepares a series of reports on the grid's evolution 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



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Preparing for change in an evolving sector – regional planning engagement

Local Advisory Committees (LAC)

- A LAC has up to 18 members, representing municipalities, Indigenous communities, consumers and citizens, the business community, and environmental and conservation groups
- LACs represent community interests within the study area, and provide insight into their values and perspectives, such as:
 - Input on the needs and options identified in the plan, including information on local priorities and ideas on the design of community engagement strategies
 - An avenue to have a broader energy dialogue being the bridge between planning cycles

Current LACs

Greenstone-
Marathon

GTA East

Parry Sound/
Muskoka

Barrie/ Innisfil

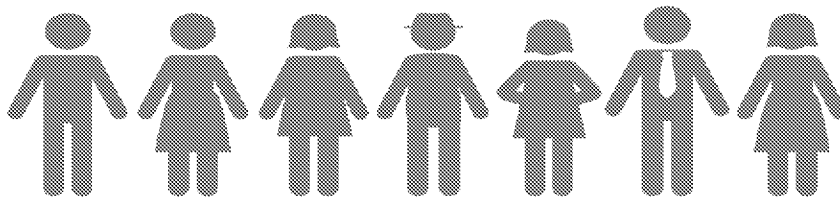
Thunder Bay

Toronto

West of Thunder
Bay

York Region

Ottawa



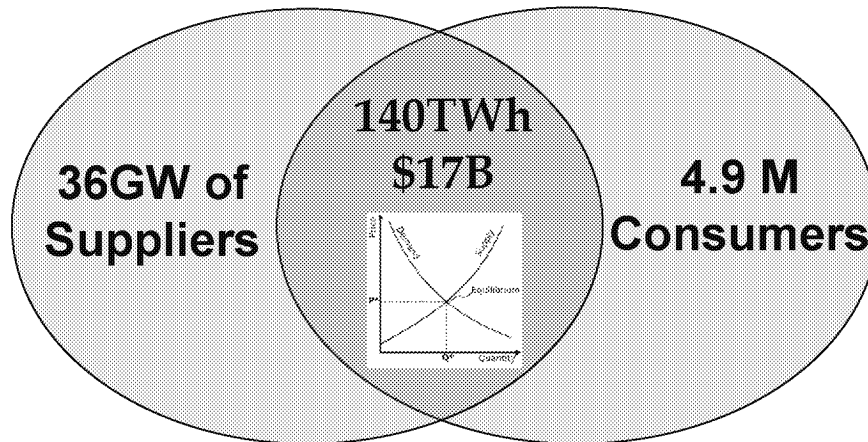
Electricity Market



The Wholesale Electricity Market

- Primary role of the spot market - the **efficient dispatch** of resources to meet system demand
- 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



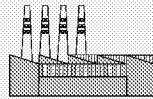
- The wholesale market connects Consumers and Suppliers in real time and allows for competition amongst resources
- Advances in technology are enabling even greater competition through resources such as **energy storage** and **demand response**

Market Participants

Boundary of IESO-controlled grid

90

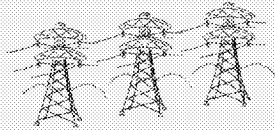
Direct Connect
Customers



Large facilities
(over 5,000 kW)

5

Transmitters



74

Generator
Market Participants



70+ Local Distribution Companies Serving

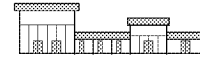
~4,400,000

Residential Customers



~430,000

General Service
Customers (< 50 kW)



~57,000

Large General
Service Customers
(> 50 kW to 4,999 kW)



60

Energy traders
(import/export market)



Note: diagram does not include participants in all IESO programs or initiatives



Independent Electricity
System Operator

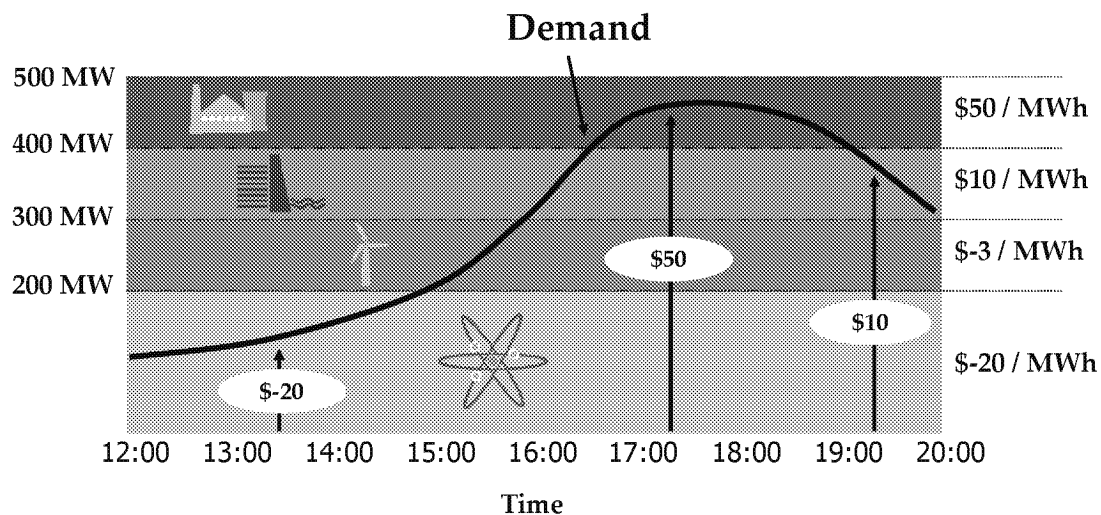
35

Our electricity market spans the IESO-controlled grid, which includes all transmission lines above 50,000 volts. This includes about 90 large-scale industrial facilities that connect directly to the high-voltage transmission grid. It also includes a number of large generating stations, including nuclear, hydroelectric, natural gas, biomass, solar, wind and others.

Although Hydro One is by far the largest transmitter in the province, there are several other, smaller transmission networks serving local needs. The deal hasn't gone through yet, but earlier this year, Hydro One announced it had entered into a purchase agreement to acquire Great Lakes Power Transmission LP from Brookfield Infrastructure. And then there are the province's distribution companies that buy power from our spot market to serve over 5 million residential and small business customers across the province. Ongoing mergers and acquisitions mean the number is a little fluid, but there are currently approximately 70 local utilities in Ontario.

Increasingly, we are finding that this market boundary is starting to erode. As we will see later in this presentation, a growing number of retail customers are generating and storing their own power. They are also making more sophisticated use of electricity and electricity prices.

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.

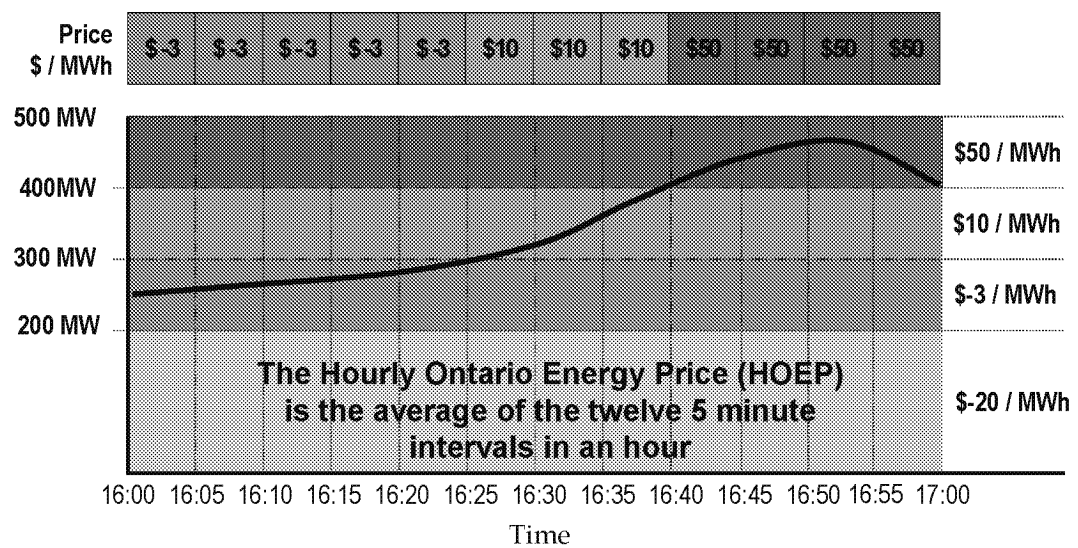
Prices are set every 5-minutes, however, non-dispatchable loads are charged an hourly price. This price is called HOEP and is the arithmetic average of the prices over the hour.

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)



Hourly Ontario Energy Price = \$20.42

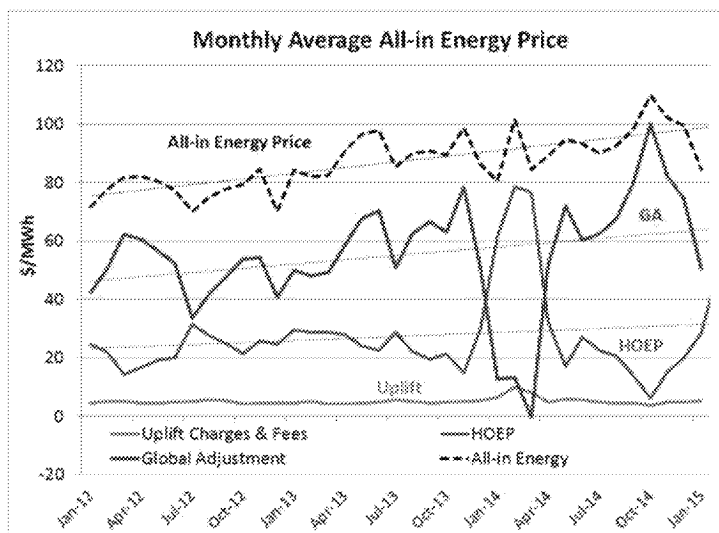
The Market Works Efficiently When...

- Price signals are transparent to all resources and technologies
 - the more resources (*generation, imports, consumers, exports*) and technologies that respond to the market price, the more efficient the operation of the system
 - clear price signals inform decisions to consume/generate
- Consumers are active participants and compete on level playing field with generators
 - consumers are able to response to price signals and system needs (time-of-use pricing, demand response initiatives, etc.)
- There is flexibility to respond to short-term and long-term change
- Limited from external impacts/intervention



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

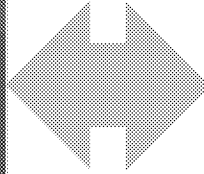
Congestion Management Settlement Credits (CMSC) – payment to generators and large consumers when they are instructed to take specific actions to avoid possible overloads of the transmission system, or to maintain the balance of supply and demand

Operating Reserve Prices

Market Price and Global Adjustment

Market Price

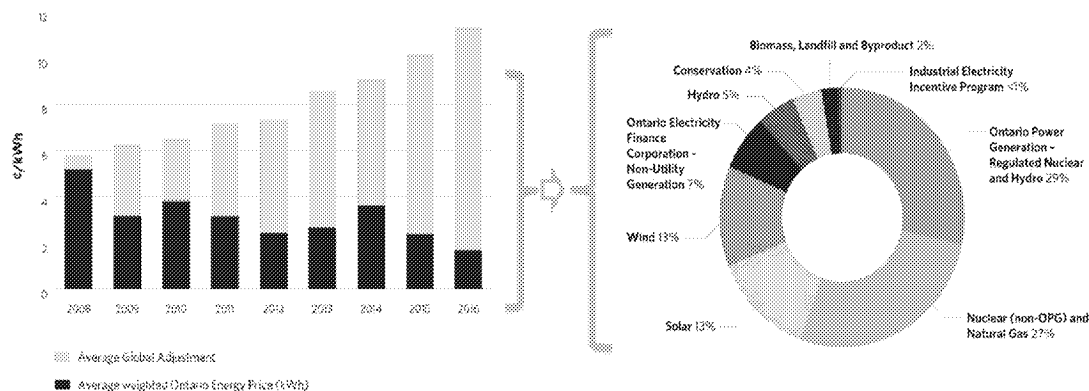
- Signals current supply and demand situation
- Covers operational costs of electricity production – such as fuel
- Impacted by consumption, weather, time of day, season, and sometimes contracts
- Set every 5 minutes



Global Adjustment (GA)

- 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

Electricity Pricing Trends and Global Adjustment Contributors



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 or ICI 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.

Ontario Government's Fair Hydro Plan

- As of July 1, 2017, your electricity bill will be reduced by 25% on average if you're a residential consumer.
- In addition:
 - electricity rates will not increase beyond the rate of inflation for four years
 - your bill will be even lower, as much as 40 to 50%, if you live in an eligible rural or remote community or have a low income
 - This 25% reduction includes the 8% rebate that took effect on January 1, 2017.
- The plan spreads out the cost of Ontario's electricity investments over a longer period of time.

Time-of-Use Pricing

Current Time-of-Use Rates

effective July 1, 2017

6.5¢ per kWh off-peak

9.5¢ per kWh mid-peak

13.2¢ per kWh on-peak

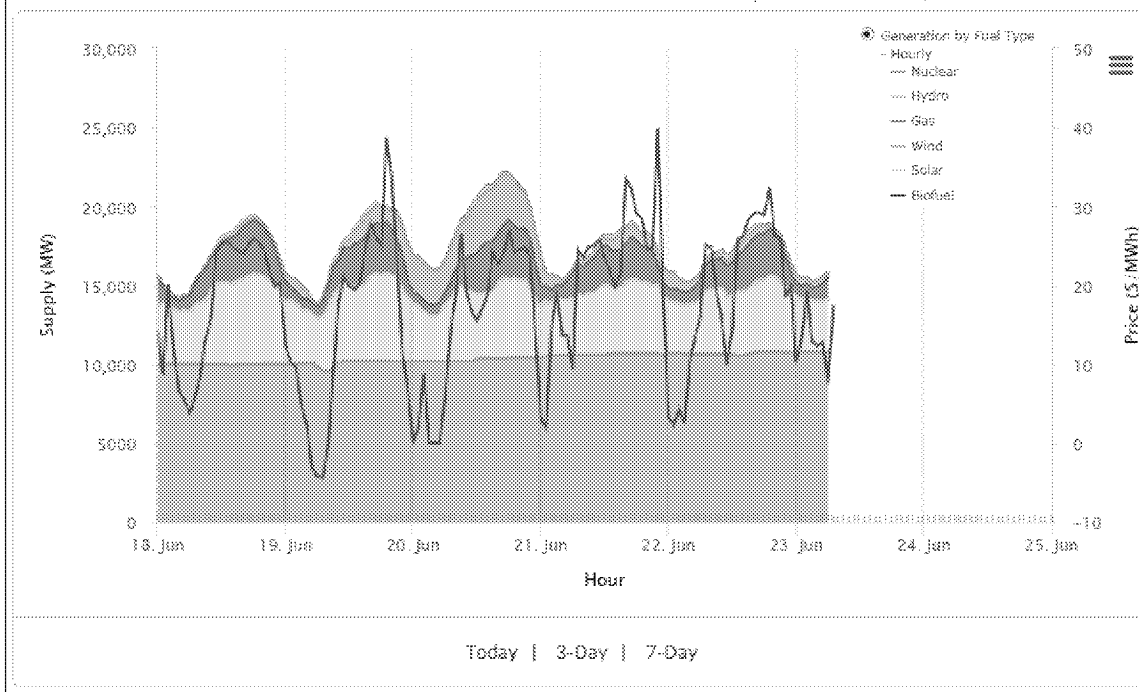
- The Ontario Energy Board (OEB) sets time-of-use rates.
- Time-of-use rates paid by residential and small business customers include the global adjustment charge.
- These regulated rates are based on projections of consumption – how much power consumers will use – combined with the estimated cost of power over that time period.
- If the previous projection was either too high or low, that will also be accounted for in the new rates.
- For more information, see [OEB website](#).

Supply, Demand and Price in Real Time

Download: [XML](#)

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

17,421 MW



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

- Although our current design has served Ontario well, the demands of a modern grid are evolving rapidly
- 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.)

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

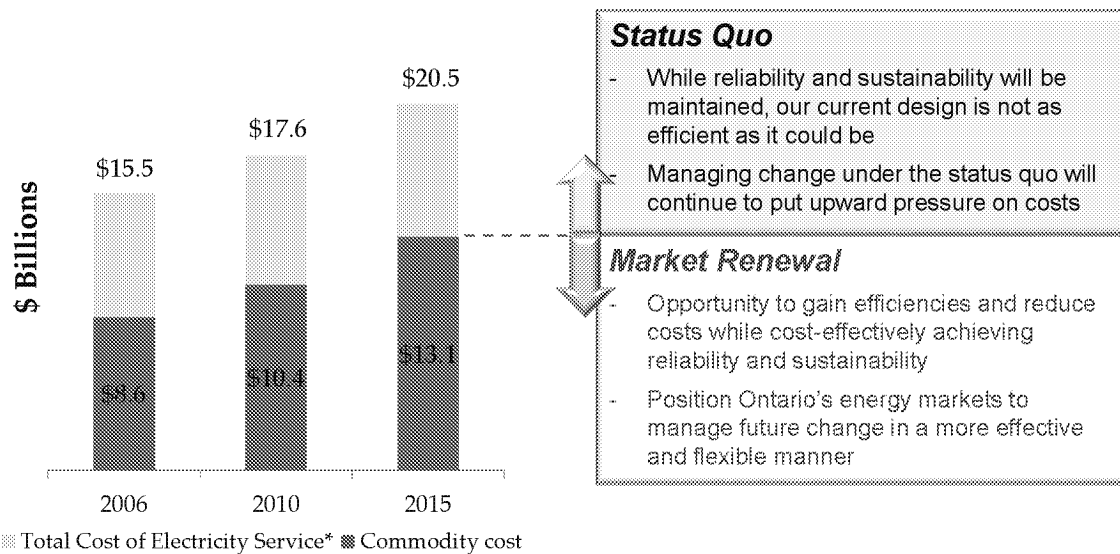
The time is right since we are in a period of stability and surplus and can learn from the lessons of other jurisdictions

Market Renewal

- An ambitious set of initiatives, informed by our stakeholders and taking place over the next few years, which will amount to a fundamental redesign of Ontario's electricity markets and prepare us for future change
- Purpose is to address known market inefficiencies and to lay the foundation for a more dynamic market in the future
 - Changes to more efficiently schedule resources
 - Use capacity auctions to allow all resources to compete to meet future incremental capacity needs
 - Changes to meet emerging operability needs, such as more frequent scheduling of energy imports and exports

Driver: Managing Electricity Costs

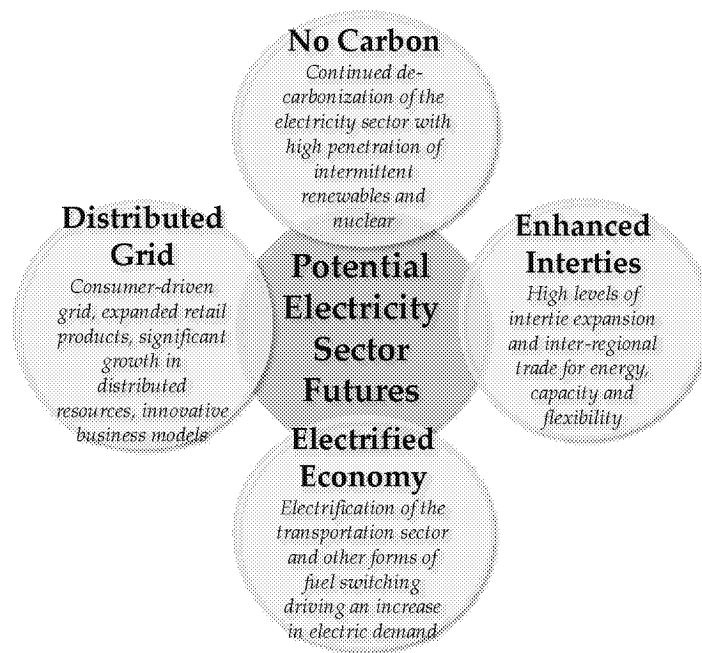
Efficiency benefits from a more efficient market design can help to reduce the future commodity cost of electricity, which is the bulk of the consumers' bill



**Includes transmission, distribution, conservation, etc.*

Driver: Managing Future Change

- Across the sector change and increased complexity are certain
 - E.g., more players, greater consumer choice, new technologies, etc.
- Market Renewal will help us prepare for a more dynamic, decentralized future

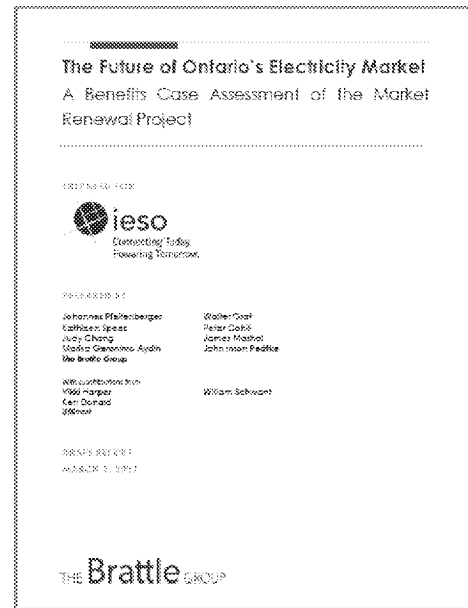


Driver: Benefitting from Best Practices

- Market Renewal will draw on lessons learned and best practices in Ontario and elsewhere
- In Ontario:
 - Over the last decade, stakeholders, the IESO, and the Market Surveillance Panel (MSP) have identified important opportunities to enhance our current design to gain greater efficiencies
- Other jurisdictions:
 - Two decades of experience have established best practices and have resulted in ongoing market evolution efforts in other markets (e.g., California, Texas, New York, etc.)
 - Ontario has a tremendous opportunity to learn from and build upon this experience

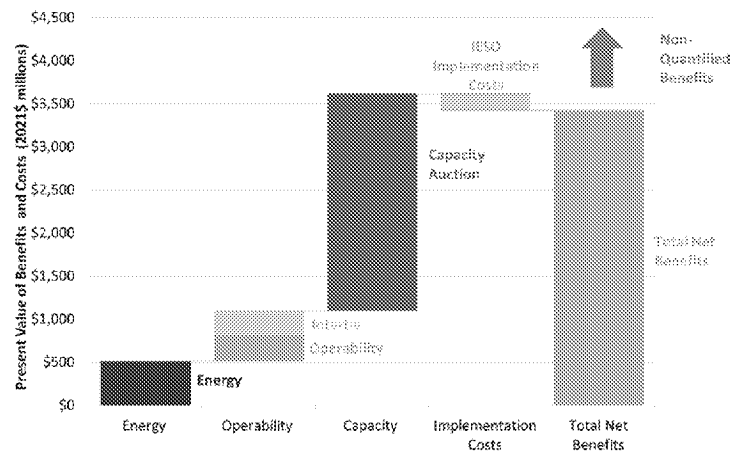
Making the Case for Market Renewal

- IESO commissioned a third party assessment to establish the potential benefits and costs
- Study took 8 months and was extensively stakeholdered internally and externally
- Final report has been posted to the IESO website



Benefits Case - Key Findings

- Benefits ranging from \$2,200 million to \$5,200 million (10 yr. NPV, 2021-2030)
- The benefits are likely to grow significantly over time
- Creates a framework for new and emerging technologies
- Opportunity to leverage best practice from other jurisdictions

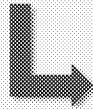


Where Do the Savings Come From?

- The potential savings fall into two broad categories

Approximately half the savings come from utilising existing assets where possible rather than building new ones

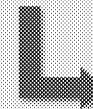
1



An incremental capacity market is a well tested way to avoid new build by attracting lower cost options from existing assets like uprates, imports and the demand side

The remainder comes from finding new ways to manage resources on the grid much more efficiently

2



Revised market design expected to significantly reduce the number of natural gas starts (avoided fuel costs and emissions) and enable better use of the interties

Stakeholder Engagement Framework

- Due to the scope of Market Renewal, an enhanced engagement framework has been put in place
- Our focus is on ensuring that stakeholders have multiple opportunities and levels at which to participate
- We are designing a market **with** not **for** our stakeholders



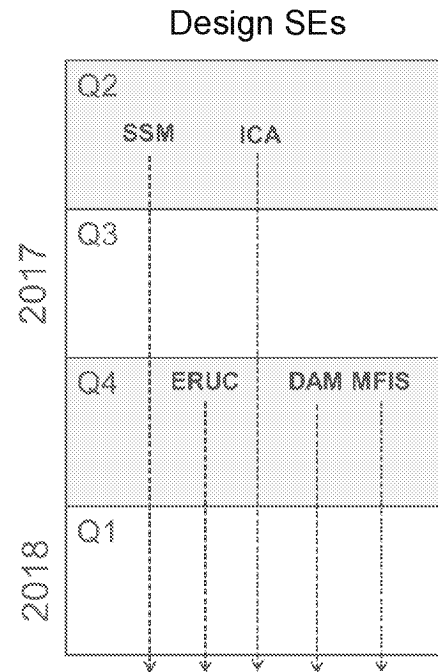
Core Elements of Market Renewal

Market Renewal consists of three distinct work streams that offer a holistic solution to challenges with Ontario's existing market design

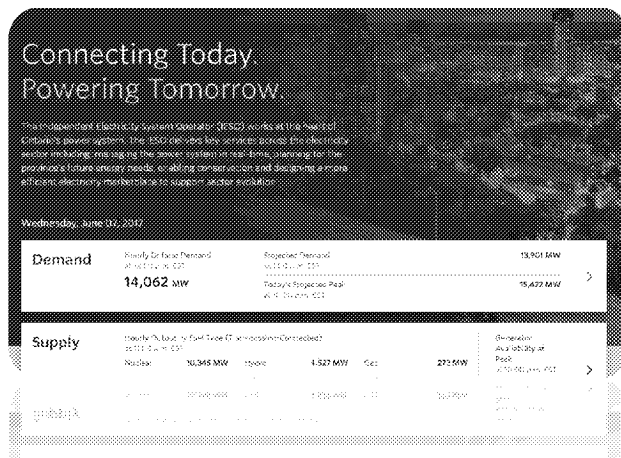
Work Stream	Primary Objective	Initiatives
Energy	Reduce cost and gain efficiency scheduling energy to meet provincial demand	• Single Schedule System • Day-Ahead Market • Enhanced Real-Time Unit Commitment
Capacity	Reduce cost of procuring resources to meet long-term demand	• Capacity Trade • Incremental Capacity Auction
Operability	Increase flexibility to reliably and cost-effectively integrate renewable resources	• More Frequent Intertie Scheduling • Investigate other opportunities

Next Steps for Market Renewal

- Stakeholder engagements will be launched for each of:
 - Single Schedule Market (SSM)
 - Incremental Capacity Auction (ICA)
 - Day-ahead Market (DAM)
 - Enhanced Real-time Unit Commitment (ERUC)
 - More Frequent Intertie Scheduling (MFIS)
- Over the next year and a half, the IESO and stakeholders will work together to develop high-level designs for each initiative
- We will continue to work closely with stakeholders to address design challenges and strategic issues



IESO Resources – Keep in Touch



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