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. It does this by:

- Planning
- Enabling conservation
- Ensuring supply
- Operating the grid
- Engaging stakeholders and communities
## Ontario at a Glance

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Capacity</td>
<td>35,221 MW (December 2015)</td>
</tr>
<tr>
<td>Record Summer Peak</td>
<td>27,005 MW (August 1, 2006)</td>
</tr>
<tr>
<td>Record Winter Peak</td>
<td>24,979 MW (December 20, 2004)</td>
</tr>
<tr>
<td>Total Annual Energy Consumed</td>
<td>137 TWh (2015)</td>
</tr>
<tr>
<td>Energy Savings Through Conservation (2011-2014)</td>
<td>6,553 gigawatt-hours (GWh)</td>
</tr>
<tr>
<td>Customers</td>
<td>4.9 million</td>
</tr>
<tr>
<td>Ontario Import Capability</td>
<td>4,800 MW</td>
</tr>
<tr>
<td>Transmission Lines</td>
<td>30,000 km</td>
</tr>
<tr>
<td>Interconnections</td>
<td>New York, Quebec, Manitoba, Michigan, Minnesota</td>
</tr>
</tbody>
</table>

The IESO is the reliability coordinator for Ontario and works closely with other jurisdictions to ensure energy adequacy across North America.
The Changing Electricity Landscape
An Evolving Supply Mix

2003  Ontario government commits to coal closures
2006  First wind farms commissioned
2007  Lakeview Coal Generating Station closes
2009  Ontario announces Feed-In-Tariff program
2010  Ontario Long Term Energy Plan — 10,700 MW of renewable energy
2009  Demand decreased 6.1% compared to the previous year
2011  3.6 million Ontarians on TOU rates
2014  Remaining coal facilities close
Ontario’s Electricity Supply - Capacity

2005

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

Installed Capacity: 31 GW

2015

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

Installed Capacity: 39 GW

2025

- Solar/Wind/Bioenergy: 26%
- Natural Gas: 26%
- Water: 23%
- Nuclear: 20%
- Coal: 5%
- Demand Response: 20%

Installed Capacity: 41 GW

Reflects transmission grid connected and embedded generation, at year end.
Ontario’s Electricity Supply - Energy

Reflects transmission grid connected and embedded generation, at year end.
Wind/Solar Outlook

Total Wind and Solar Outlook

Note: Values include assumptions based on current information
Evolving Resources: Clean & Distributed

• The **price** of renewable energy **continues to decrease**
• New capacity added to the system is **increasingly distributed**, generating electricity closer to loads
• There has been significant uptake of rooftop solar
• **Solar retail grid parity**: cost of residential roof-top solar is approaching the cost of buying electricity from the utility in many jurisdictions
• Distributed generation now has **material impacts** on how Ontario’s power system is managed
Evolving Grid: Digital & Smart

- $2 trillion is expected to be invested globally over the next decade to modernize grid infrastructure
- The future grid will manage centralized generation in concert with hundreds of thousands of distributed energy resources
- Internet of Things (IoT): Sensors, automation and data analytics will be added, improving visibility, control and efficiency
Evolving Regulations: New Utility Models

• **Regulation is changing** to accommodate the more complex grid

• In 2015, the Ontario Energy Board (OEB) set in place new rules to “decouple” rates that local distribution companies (LDCs) charge
  – Decoupling: separating the charge for LDC’s fixed costs ($/kW) from the volume (kWh) of electricity sold ($/kWh)

• Several jurisdictions are considering fundamental changes, including California, New York, Hawaii, Germany, Australia

• New York State’s **Reforming the Energy Vision (REV)** initiative, envisions utilities playing a similar role as the system operator, but at local level
  – **Integrate and optimize** distributed energy resources
  – Create a **market** for consumers, 3rd parties and utilities
  – Better recognize **value** of distributed energy resources
Leading a Culture of Conservation

Energy conservation is a key resource in helping customers save energy and helping the province reduce its demand for electricity.

- Since 2006, Ontario has saved 9.9 billion kilowatt-hours of electricity through programs and changes to codes and standards
- 2011-2014 saveONenergy programs exceeded the provincial energy-saving target
- In 2015, the IESO launched the six-year Conservation First Framework
  - 7 terawatt-hours (TWh) of energy savings from conservation programs delivered by LDCs and
  - 1.7 TWh through conservation projects with transmission-connected customers
Conservation Success in Ontario

Customers invested over $2 billion into Conservation Programs and saved over $4 billion in avoided costs.
Evolving Customers: the Prosumer

- 21\textsuperscript{st} century customers expect more from utilities, including clean, reliable, affordable electricity and services tailored to individual needs

- Customers are increasingly shifting from passive consumers to proactive, producing consumers or “prosumers”
  - Monitoring/managing consumption
  - Multi-platform, real-time connection to utility
  - Connecting solar, batteries, electric vehicles in homes
Evolving Market: Toward Transactive Energy?

- One emerging concept for a distributed smart grid: “transactive energy”
- Automated response, based on price, cost, other factors
- Level of response is voluntary and set by the asset owner
- Challenge: how to create a system that properly values price, reliability, and individual preferences
Demand Response (DR)

Provides an opportunity for customers to participate, reduce consumption and help mitigate costs

• Enables consumers to reduce their electricity consumption in response to prices and system needs
  ➢ already has had impact on energy demand and helped reduced peaks
  ➢ provides a valuable and cost-effective resource to the system

• What is the IESO doing with DR?
  ➢ Demand Response Pilot Projects
  ➢ Demand Response Auction
IESO Energy Storage Initiatives

• IESO’s ‘Alternate Technologies for Regulation’ (ATR) procurement (2012)
  – 2 MW flywheel – operated by NRStor
  – 4 MW battery – operated by Renewable Energy Systems Canada (RES)

• IESO’s Storage Phase 1 procurement (2014)
  – 12 projects totalling ~34MW providing voltage control or frequency regulation services
  – technologies: batteries, flywheel, thermal energy, power-to-gas

• IESO’s Storage Phase 2 procurement (2015)
  – 9 projects totalling ~16 MW providing capacity
  – technologies: batteries, compressed air
What is the Role of Electricity Markets?

Markets enable the efficient allocation of resources in different time frames

**Competition**
Incentives based on competition drive efficient market participant behaviour and result in cost-effective outcomes

**Price Signals**
Clear and transparent price signals drive the coordination of decisions made by market participants

**Outcomes**
Markets are most effective when sending price signals that maximize the economic welfare of both consumers and suppliers
Times Have Changed Since 2002....

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
# Market Development – Future Needs

## Customers and Technology Driving Change
- Solar and storage becoming more cost competitive
- Increasing role for demand-side participation
- How we supply and consume energy may change dramatically

## Increasing Role for Distributed Resources
- Transition from small number of centrally organised suppliers to large number of disaggregated suppliers
- Many supply options with varying benefits, costs and operational characteristics

## Rising Electricity Costs
- Significant and ongoing cost increases for residential and industrial consumers
- Pressing need to bend the cost curve and provide consumers with choices

---

**Meeting Future Needs Is A Key Objective**
- Integrate resources and deliver reliable supply cost-effectively
- Provide a level playing field to organize the behaviour of a wide group of players
- Provide opportunities and flexibility to help manage future uncertainty
Energy and Capacity

ENERGY
Evolving the wholesale energy market

- Address known issues and inefficiencies
- Opportunity to improve efficiency and flexibility
- Prepare energy market for future challenges

CAPACITY
Growing capacity as a market-based product

- Competitive and open to all resources
- Stable and enduring market-based solutions
- Growing DR and enabling capacity trade are the first steps
### Proposed Sequencing: Energy

<table>
<thead>
<tr>
<th>ENERGY</th>
<th>Single Schedule Pricing</th>
<th>Day-Ahead Market</th>
<th>Real-time Unit Commitment and Interties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Address core design issue by replacing two schedule system with congestion pricing</td>
<td>Replace the existing Enhanced Day Ahead Commitment process with a financially binding Day Ahead Market (DAM)</td>
<td>Augment real-time generation cost guarantee with 3 part offers and multi-hour optimization process</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>More frequent intertie scheduling</td>
</tr>
</tbody>
</table>
Proposed Sequencing: Capacity

C\textsc{apacity}  

**Demand Response Auction**  
Evolve DR auction to increase participation and value  

**Capacity Trade**  
Facilitate capacity exports in the near term and imports over the longer term  

**Capacity Auction**  
Evolve DR auction into an incremental capacity auction to meet resource adequacy as needs emerge
Profile of Ontario’s Utilities by Service Area

ONTARIO’S ELECTRICITY DISTRIBUTION SYSTEM
LOCAL DISTRIBUTION COMPANY SERVICE AREAS
## Profile of Ontario Utilities by Customer Base

### Provincial Customer Overview

<table>
<thead>
<tr>
<th>Category</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Customers</td>
<td>4,988,859</td>
</tr>
<tr>
<td>Residential Customers</td>
<td>4,502,650</td>
</tr>
<tr>
<td>General Services &lt;50kW Customers</td>
<td>430,842</td>
</tr>
<tr>
<td>General Service (50-4999kW) Customers</td>
<td>54,688</td>
</tr>
<tr>
<td>Large User (&gt;5000kW) Customers</td>
<td>117</td>
</tr>
</tbody>
</table>

*Source: OEB 2014 Yearbook of Electricity Distributors*
## The SME – Historical Context

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2004</td>
<td>The Smart Metering Initiative is introduced</td>
</tr>
<tr>
<td>July 2004</td>
<td>The OEB received a directive from the MoE to provide an implementation plan for Ontario’s smart meter targets</td>
</tr>
<tr>
<td>January 2005</td>
<td>The OEB submitted its implementation plan on smart meters</td>
</tr>
<tr>
<td>July 2006</td>
<td>The Government appoints the IESO as SMSIP coordinator</td>
</tr>
<tr>
<td>July 2007</td>
<td>Regulation 393/07: The IESO is designated as the SME</td>
</tr>
<tr>
<td>March 2008</td>
<td>Newmarket Hydro becomes the first electricity distributor to begin enrolling smart meters with the MDM/R</td>
</tr>
<tr>
<td>May 2009</td>
<td>The Government announces the TOU rate roll out targets</td>
</tr>
<tr>
<td>December 2010</td>
<td>4.6 million smart meters installed, 2 million meters enrolled and approximately 1.6 million customers on TOU rates</td>
</tr>
<tr>
<td>December 2012</td>
<td>4.7 million smart meters installed, 4.5 million meters enrolled, and approximately 4.5 million customers on TOU rates</td>
</tr>
<tr>
<td>April 2013</td>
<td>The OEB approves the Smart Metering Charge</td>
</tr>
</tbody>
</table>
The SME – Role

• Procurement
• Design / technical specifications
• Standards development
• Progress reporting
• Roll out to LDCs including integration with LDC’s Advanced Metering Infrastructure (AMI) and Customer Information Systems (CISs)
• 1st Level Support for LDCs
• Training LDCs
• Review, assess and approve Request For Changes from LDCs
The SME – Service Delivery Model
Ontario’s Smart Metering System

- **LDC Responsibility**: Smart Meters Track Hourly Energy Use
  - LDC Reads Data Sent To Neighbourhood Collectors
  - Control Computers receive data from Collectors and Transmit it to Smart Meter Data Repository.

- **SME (IESO) Responsibility**: IESO Smart Meter Data Repository Prepares Time-of-Use Billing Quantity Data

- **LDC Responsibility**: Time-of-Use Billing Quantity Data Sent Back to LDCs
  - LDC Provides Customers with Energy Use Information through Invoices and Online Access
The MDM/R – Data Flow

Meter Data Management System

CIS / AMI System
- Master Data
- Meter Data
- Billing Request
- Reports

Meter Reads Retrieval Web Services
- Web Service Request
- Web Service Response

Master Data
- SYNC
- DC & VEE

Billing
- Billing Request
- Billing Response

Reports
- Reports

Distributors
- Meter Data
- Billing Statement
- Web Presentment

Consumers
- Meter Data
- Billing Statement
- Web Presentment

Ad-hoc Queries / Bulk Retrievals

IESO - Meter Data Management and Repository
The MDM/R – Processing Overview

SDP ID and USDP ID Assignment -> Synchronization -> Meter Read Data Collection & Validation -> Validation, Estimation and Editing -> Storage in DB

IESO Use

Setting up service delivery points

Meter Read Data Collection to Storage and Use/Access Processes

3rd Party Access
## The MDM/R in Numbers

<table>
<thead>
<tr>
<th>Service Delivery Points</th>
<th>Residential: 3.8m, Small General Service: .4m</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI Supported</td>
<td>Sensus, Elster, Trilliant, Tantalus, SmartSynch (5, 15, 30, 60 minute intervals; most are 60 minute)</td>
</tr>
<tr>
<td>Services</td>
<td>26 Validation, Estimation and Editing Services, 28 Framing Structures</td>
</tr>
<tr>
<td>Interval Reads</td>
<td>~ 100m – 120m per day (processing 20 to 28 million per hour)</td>
</tr>
<tr>
<td>Billing Requests</td>
<td>200K to 300K per day</td>
</tr>
<tr>
<td>Data Retrieval Requests</td>
<td>15K to 60K per hour</td>
</tr>
<tr>
<td>Reports Delivered</td>
<td>2,300 per day</td>
</tr>
<tr>
<td>Data Size</td>
<td>200+ billion rows of data</td>
</tr>
</tbody>
</table>
The MDM/R Data Mart
In order to support data analytics under a recent OEB order the SME is to do the following:
“… collect the following information associated with each meter (modified where necessary to sufficiently render it non-personal information); (a) the postal code; (b) the distributor rate class; (c) the commodity rate class; (d) occupant change data.”
Energy Leaders Summit

- International conference and trade show
- Presented by the IESO and the Ontario Ministry of Energy
- Summit theme is “Rethink Energy”
- May 24 - May 27, 2017
- Sheraton Centre Hotel, Toronto, Ontario
- More information and registration details at www.energyleaderssummit.ca.
- Presented in partnership with MaRS Advanced Energy Centre
IESO Resources – *Keep in Touch*

Phone: 905.403.6900  
Toll-free: 1.888.448.7777  
E-mail: customer.relations@ieso.ca

iese.ca  
-twitter.com/IESO_Tweets  
-linkedin.com/company/ieso  
-facebook.com/OntarioIESO

saveonenergy.ca  
-twitter.com/saveonenergyONT  
-facebook.com/saveonenergyFORHOME