Ontario

MINISTRY OF

ENERGY

Supply/Demand Outlook

FOUNDATIONAL BRIEFING

April 2017

Overview

- Ontario begins its electricity system planning process by forecasting electricity demand.

- Supply must be planned to meet demand to ensure there is sufficient electricity to meet peak demand conditions when consumer needs are the highest.

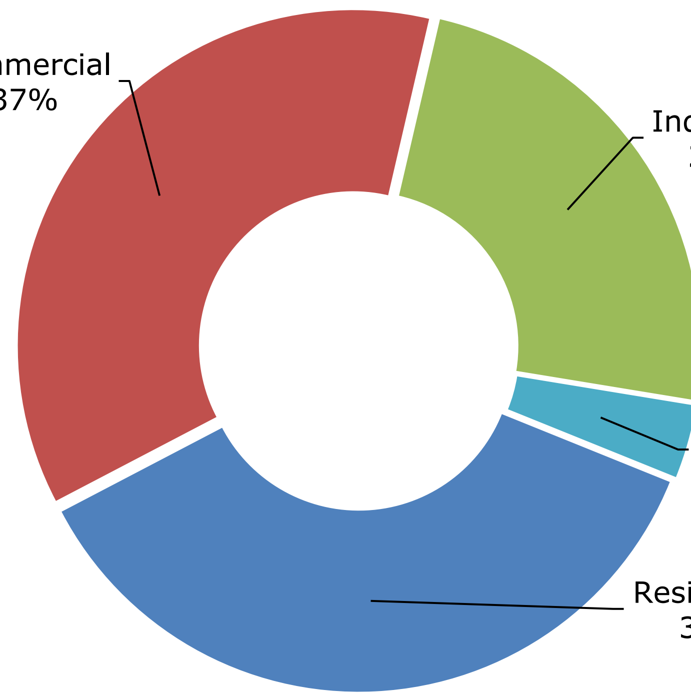
- Forecasting is an iterative process and the system must be planned to meet a range of demand scenarios (particularly in a long-term forecast where there is much greater uncertainty).
    - Demand is affected by numerous factors that are difficult to forecast, primarily commodity prices and general economic conditions.
    - Supply changes over time as contracts expire and new generation come on online.

Demand Forecasting

Current Electricity Demand by Sector

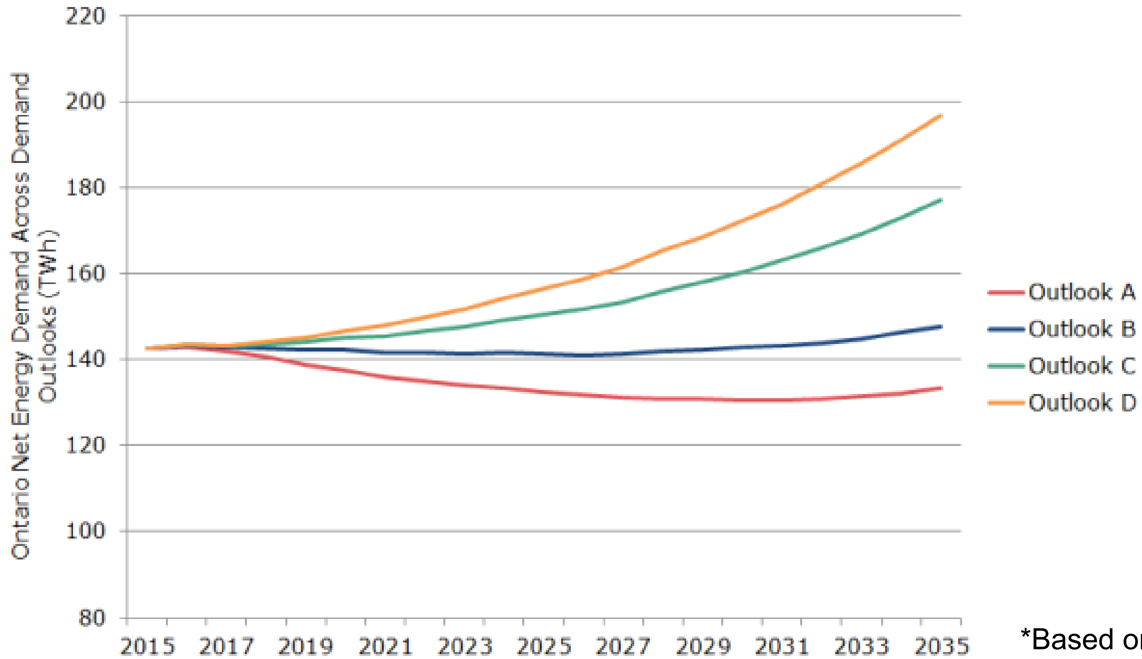
- Since 2010, industrial demand has declined by about 30%.
- In the same timeframe, residential energy demand has decreased by about 1%, while commercial has declined by about 12%.
- The range of future electricity demand is influenced by a variety of factors including growth in household numbers, conservation, commercial and industrial sector activity, uptake of electric vehicles and the electrification of energy systems.
- Implementation of the province's climate change policies ~~that are consistent with the Climate Change Action Plan (CCAP)~~ will have an impact on the demand for electricity including through greater electrification of the economy.

Proportion of Electricity Consumption (201~~6~~7 Projected)



Note: Based on ~~LTEP 2013~~the Ontario Planning Outlook (OPO) Outlook B. Transportation currently makes up ~~less than~~ 0.0~~2~~6% of demand in Ontario. 'Other' includes agriculture, remote communities, generator demand, the Industrial Electricity Incentive (IEI) program, and street lighting. Numbers may not add due to rounding.

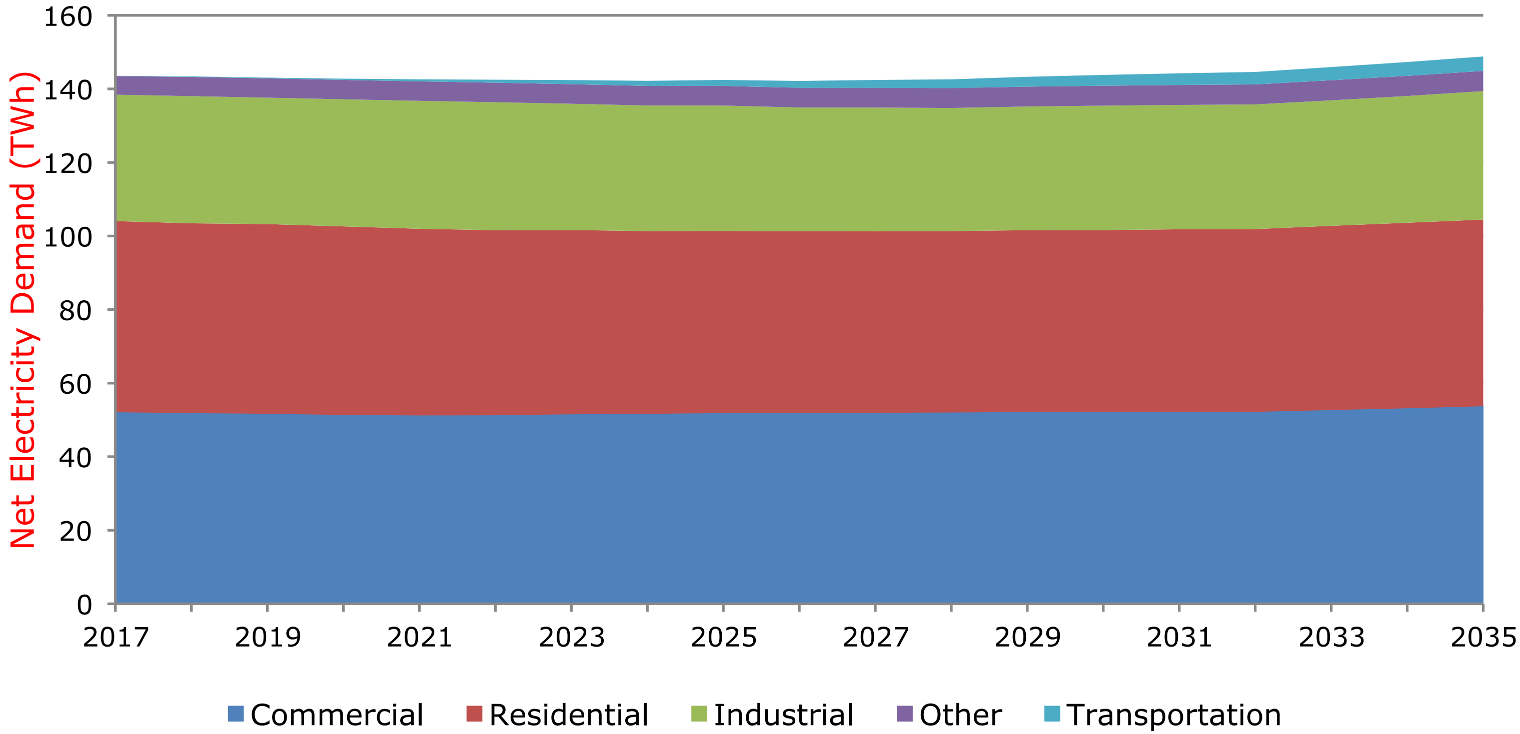
Net Demand Forecast



*Based on 2016 OPO

- This chart shows the four energy demand outlooks from the Ontario Planning Outlook.
- The four demand outlooks span a net electricity demand between 133 TWh and 197 TWh by 2035.
- Outlook A (“low demand outlook”) shows the implications of lower electricity demand.
- Outlook B (“flat demand outlook”) demonstrates a level of long-term demand that roughly matches the level of demand that exists today.
- Outlooks C and D (“higher demand outlooks”) include higher levels of demand driven by different levels of electrification associated with policy choices on climate change.
- **Note**: Outlook B is used throughout this document for forecast data.

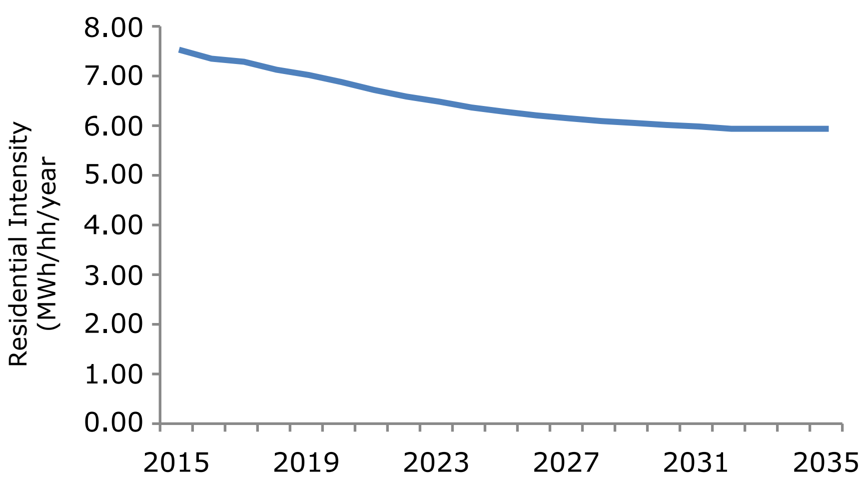
~~Gross~~Net Demand Forecast by Sector

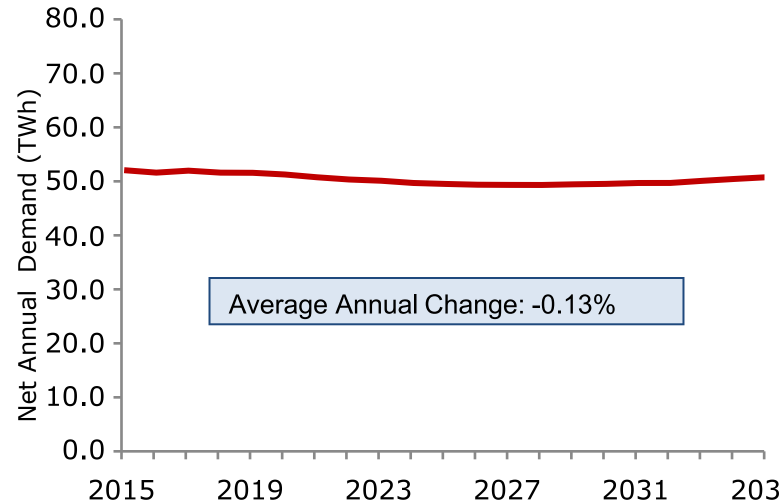


- Ontario's net demand forecast is determined by electricity consumption from the residential, commercial, industrial, agriculture and transportation sectors.
- This graph shows forecasted ~~gross~~ net demand, which represents ~~the~~ expected grid demand plus output from embedded resources on the distribution system. ~~expected energy use for electricity before the impacts of after conservation initiatives~~.

Note: 'Other' includes agriculture, remote communities, Generator Demand, IEI and Street Lighting.

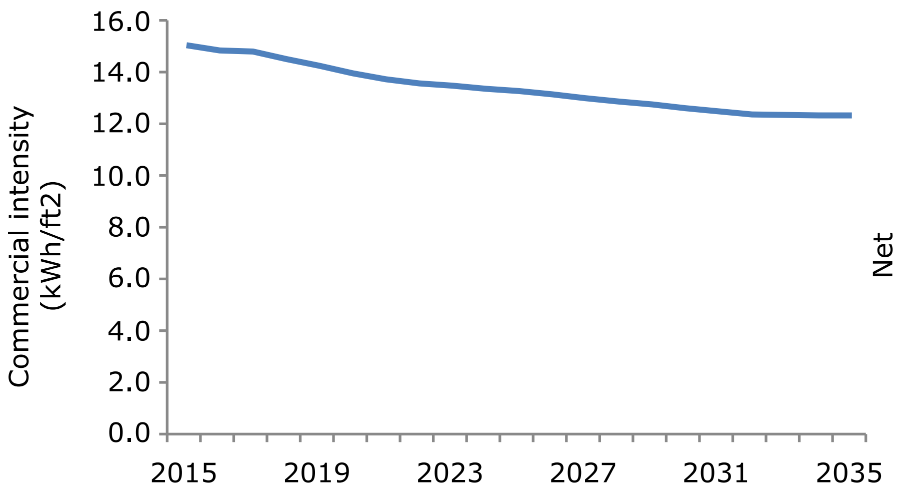
Residential Demand Outlook – Increased Efficiency Offsets Population Growth

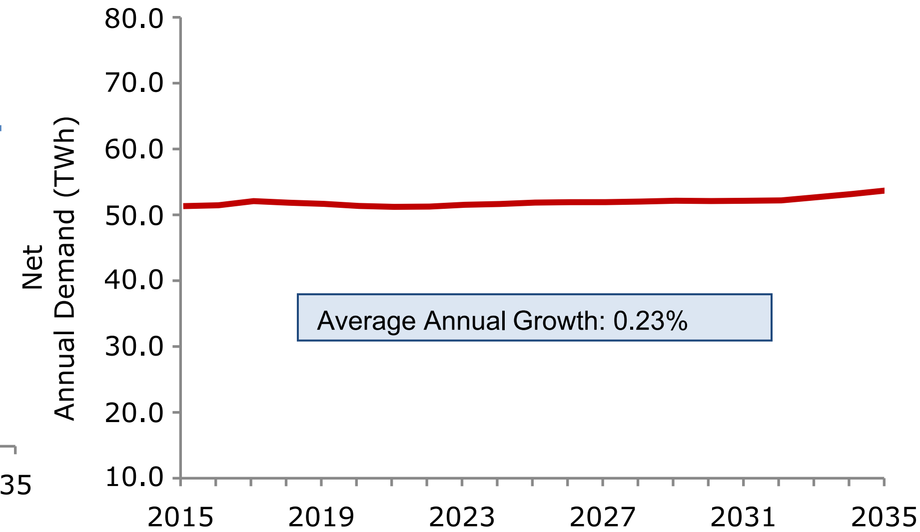




- The residential sector is expected to increase by approximately 23% between 2015 and 2035. ~~an additional 1.5 million households over the next 20 years.~~
- Despite population growth, households are becoming more efficient. As a result, residential electricity demand is expected to remain relatively flat ~~grow slowly~~ over the long-term.
- Factors that increase residential energy demand include increases in size and saturation of TVs and electronics, increase in small end uses (e.g., miscellaneous devices, appliances and electronics), and increase in electricity's share of space and water heating.
- Factors that decrease residential energy demand include significant efficiency improvements in lighting, major appliances already at high saturation levels that are being built to efficiency levels required by standard regulations and the rising share of multi-residential dwellings. Households in multi-residential buildings tend to consume less energy than single family homes.

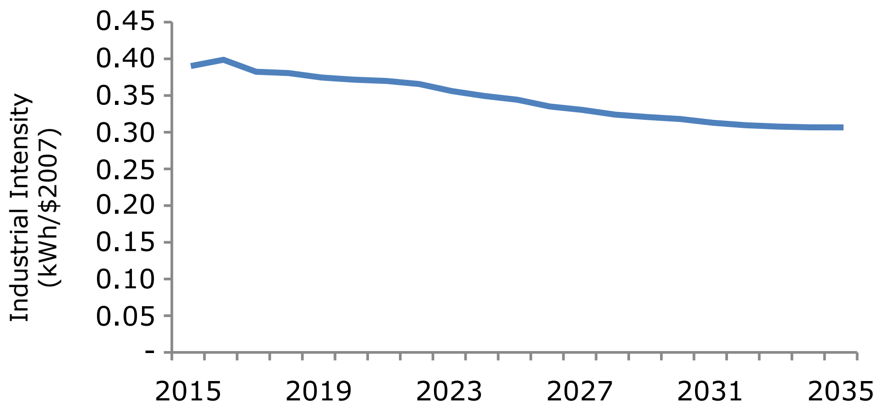
Commercial Demand Outlook – Efficiency Offsets Growth~~Increased Electrical Equipment Usage~~

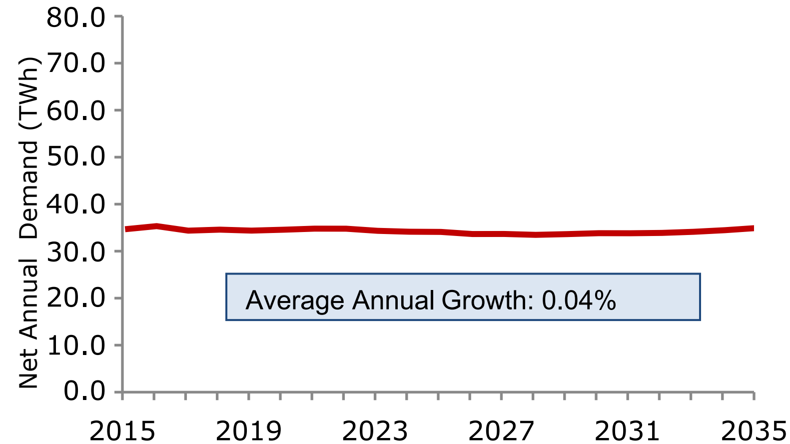




- Lighting, cooling, HVAC fans/pumps and computer equipment together account for approximately 75% of commercial sector consumption. ~~Growth in these areas, along with increased consumption from data centres, are the major contributors to electricity demand growth.~~
- Ontario's commercial floor space ~~is also growing and~~ is forecast to increase by 26% ~~42%~~ between 201~~3~~5 and 203~~2~~5, but growth trends for floor space are slowing, especially for sectors such as retail where the growth of online shopping is competing with physical retail space.
- Improved efficiency provides a partial offset to growth.
- ~~As a result,~~ Commercial electricity demand is expected to grow slowly over the long-term.

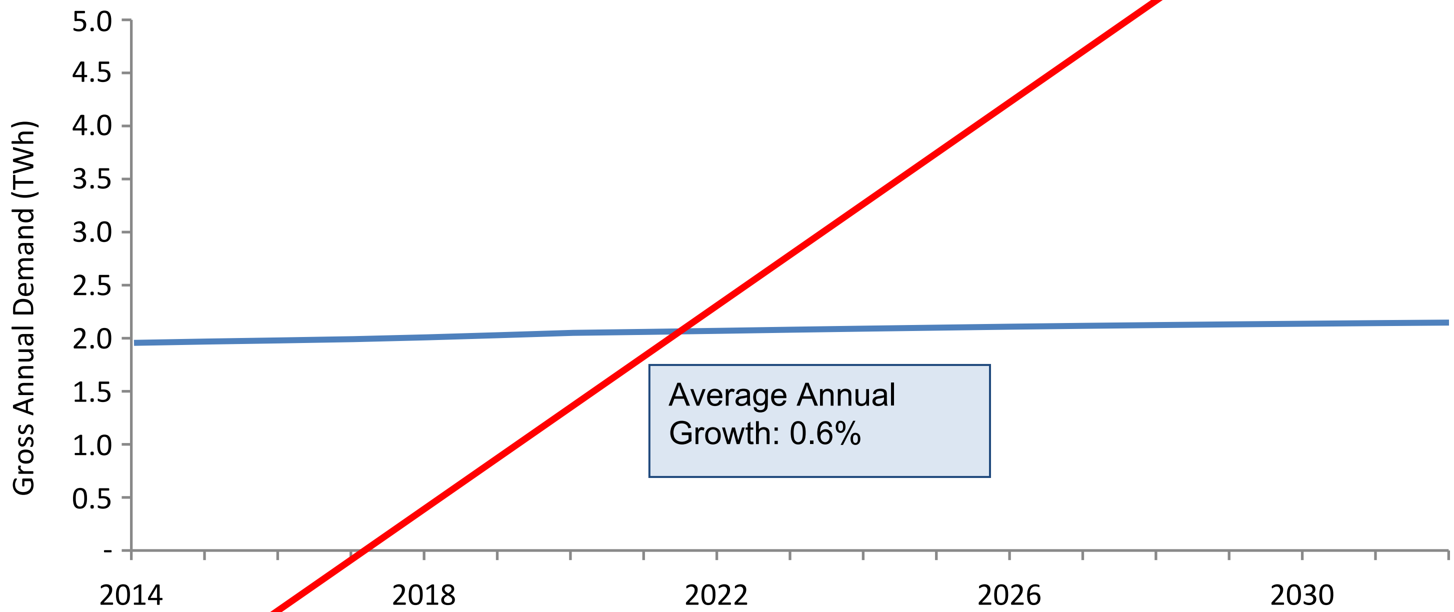
Industrial Demand Outlook – Flat Demand Driven by Reduced Intensity and Slower Growth ~~Driven by Mining and Chemical Sectors~~





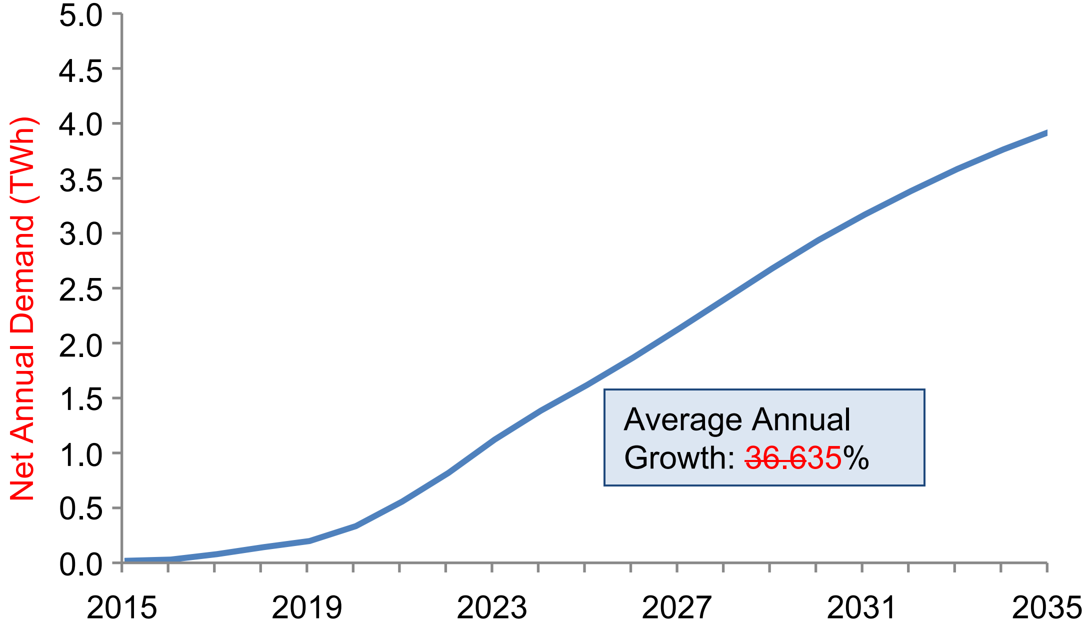
- Ontario's industrial GDP is expected to grow by 2% between 2015 and 2035. Reduced electricity intensity contributes to a flat sector demand outlook. The industrial sector accounted for 16% of peak demand in 2015, and is expected to account for 16% in 2035.
- Ontario's economy has experienced structural change over the last few years. Our economic output is becoming less reliant on electricity intensive industries such as steel, and pulp and paper.
- Pulp and paper, mining (including smelting), primary metals, auto manufacturing and chemical manufacturing are the five largest industrial sector electricity consumers in Ontario.
- In 2005, these five sectors accounted for 62% of Ontario's industrial electricity consumption. In 2013, these same energy intensive industries accounted for 58% of total consumption.
- While mining and chemical manufacturing are expected to ~~drive industrial~~ grow~~th~~ through to 203~~2~~5, the remaining sectors (i.e. pulp and paper, auto manufacturing and primary metals) ~~are~~ have not ~~expected to~~ returned to their pre-recession demands.
- Ontario's industrial sector has shown energy efficiency gains in recent years which are expected to increase over the outlook.

Agricultural Demand Growth Driven Mainly by Increased Lighting Load from Greenhouses



- Agricultural electricity demand is expected to increase by ~10% from 2014 to 2032 and is driven largely by increased lighting.
- Increased lighting load associated with greenhouse growth in southwestern Ontario and Niagara.

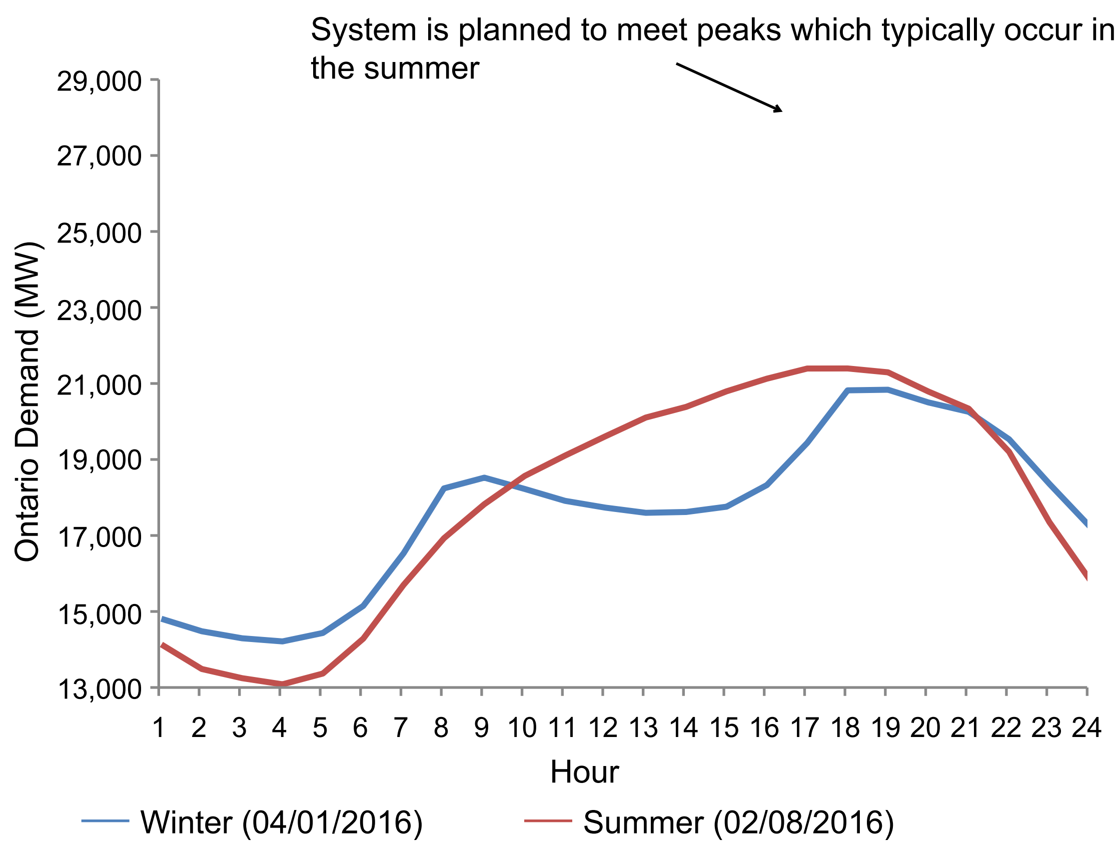
Transportation Electricity Demand is Expected to Increase Significantly from Further Electrification



- By 203~~2~~35 Ontario is expected to reach 3.4 TWh ~~add 3.6 TWh~~ of~~ gross~~ demand from the penetration of battery electric vehicles and plug-in hybrid electric vehicles and the electrification of some mass transit.

Summer and Winter Demand Curves

- Peak demand occurs at a different time of day in the winter and summer months.
- Summer demand increases throughout the day, peaking in late afternoon as cooling load (air conditioner use) rises.
- In the winter there are two peak periods: in the morning when lights, equipment and heating systems are typically turned on, and again in the evening when home energy use increases with the use of appliances.
- Total system load is dominated by residential & commercial demand, so the system load shape is similar to residential/commercial demand.
- Baseload (minimum) demand is typically 13,000 to 18,000 MW.



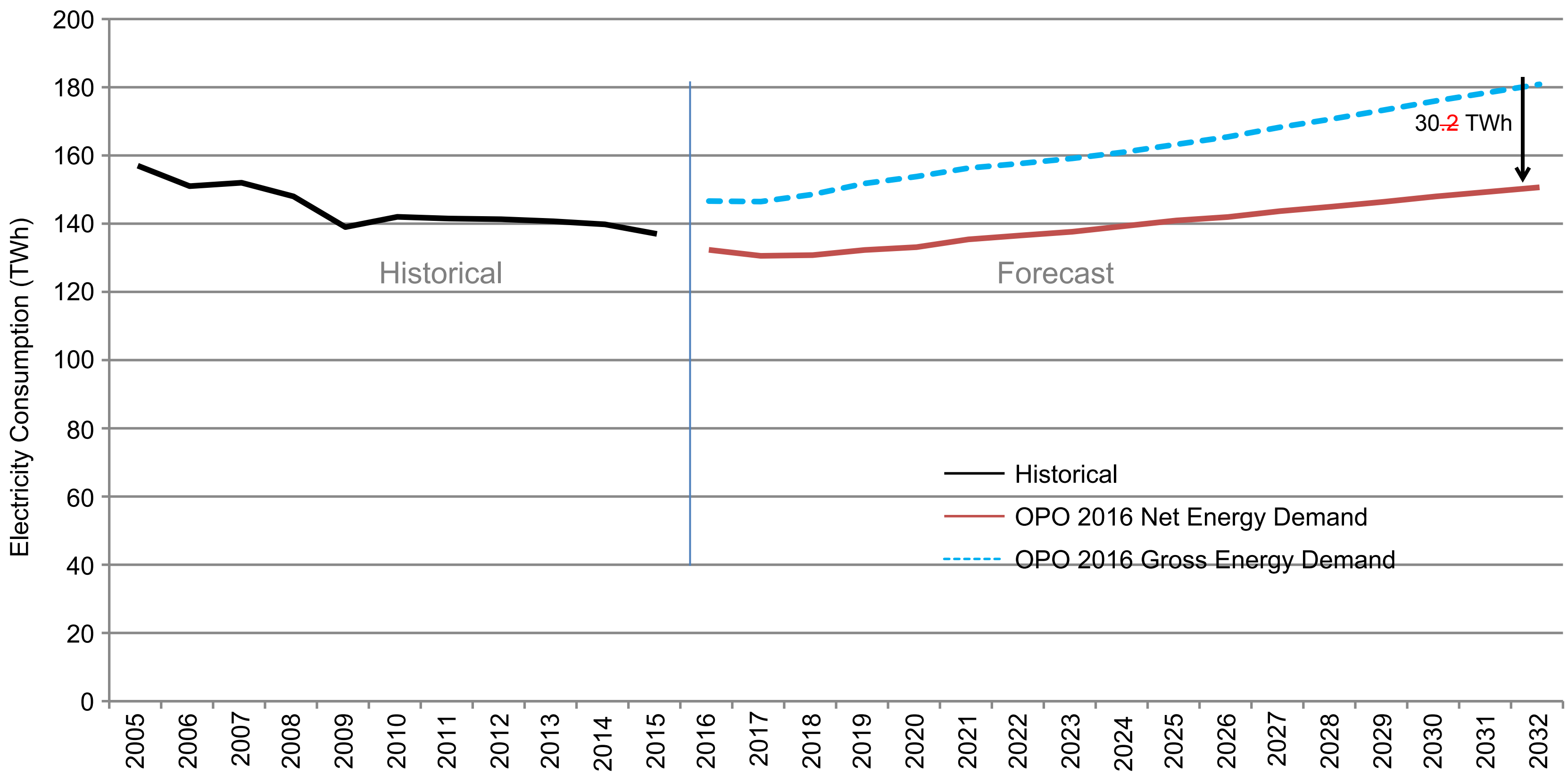
Note: Based on demand observed during a winter and a summer day.

General Drivers of Electricity Demand

- Demand is principally influenced by:
  - Price of electricity (e.g., time-of-use prices)
  - Government energy policy (e.g., Industrial Conservation Initiative program)
  - Prices of equipment/technology
  - Changes in economic growth
  - Technology/innovation
  - Weather

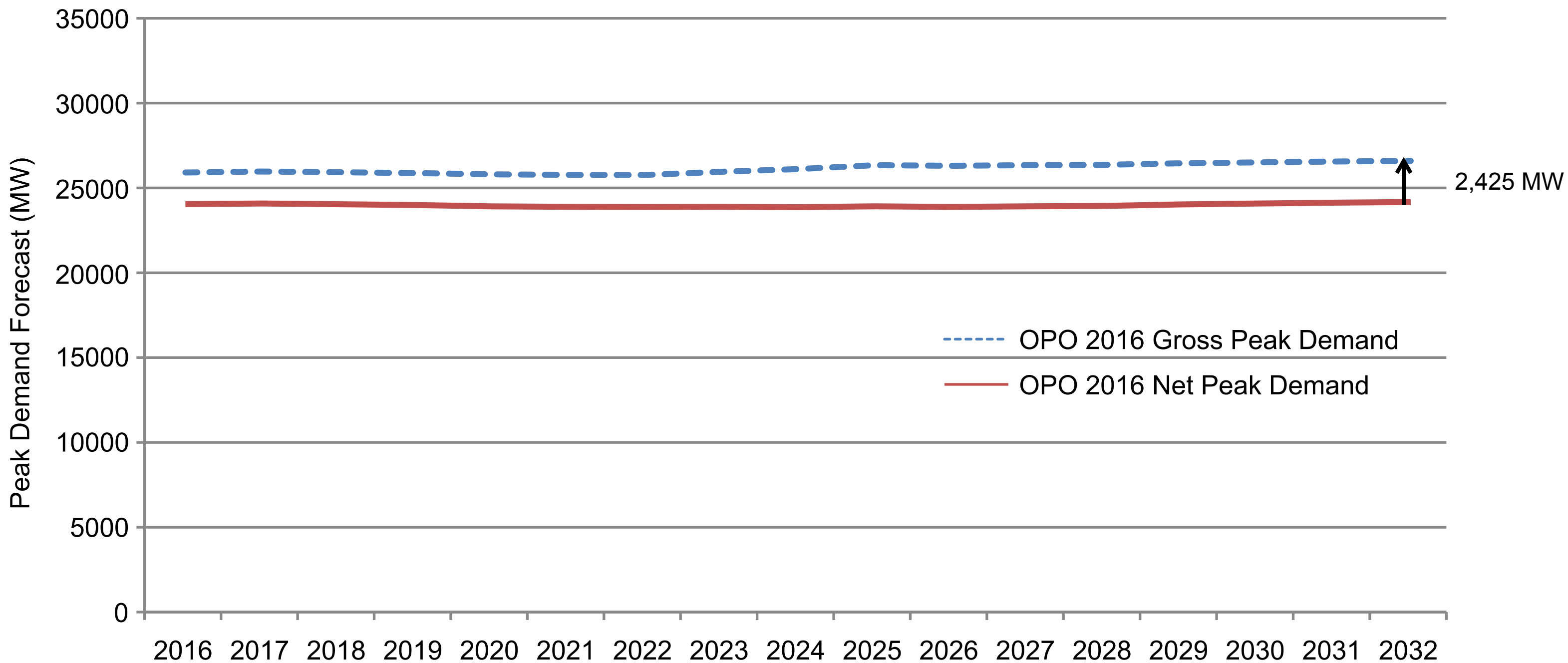
Gross and Net Electricity Demand Forecast (TWh)

- System planners reduce the gross demand forecast by incorporating expected savings from electricity conservation initiatives, including programs and updates to building codes and product standards, ~~conservation and C&S savings~~ to arrive at net demand.
- The 2013 LTEP set a long-term conservation target of 30 TWh ~~conservation target~~ in 2032.
- The OPO's forecast of 30~~.2~~ TWh reduction in 2032 is the result of a projected decrease in demand. Subtracting 30~~.2~~ TWh from the gross demand in 2032 results in the net electricity demand.



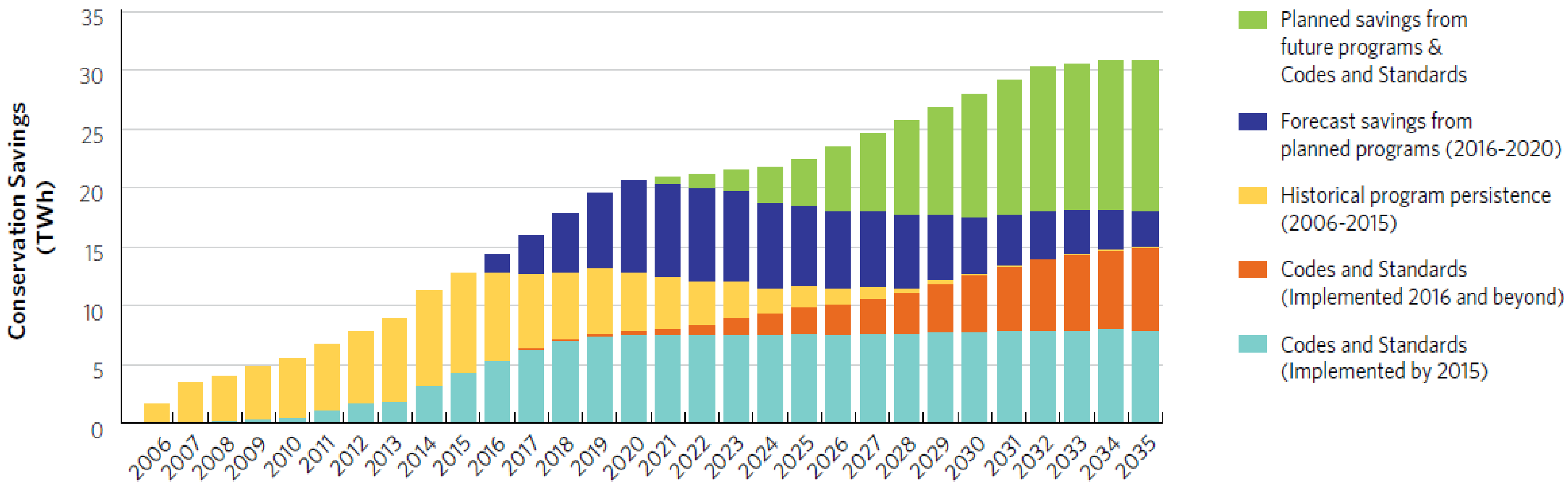
Gross and Net Peak Demand Forecasts (MW)

- A similar method is used to determine gross peak demand.
- After 2,425 MW of conservation is added to the net peak demand in 2032, the result is the gross ~~net~~ peak demand.



Conservation Savings

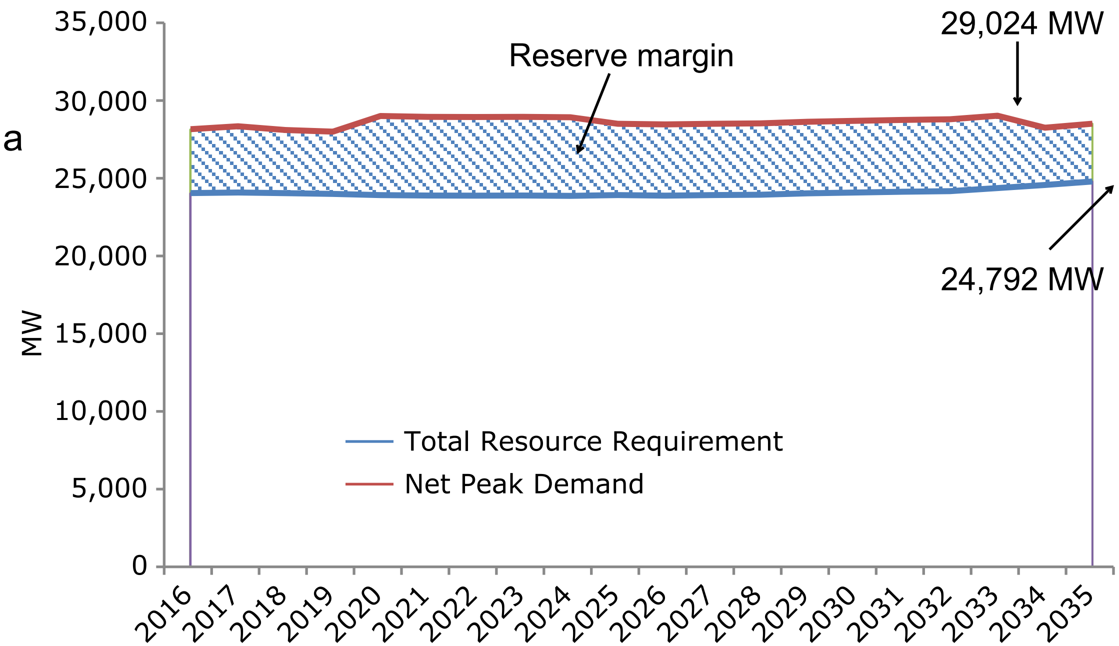
- Government policy initiatives to encourage conservation have contributed to the flattening of demand.
- Forecasted demand set out by the IESO in the Ontario Planning Outlook incorporates the achievement of the conservation target established in the 2013 LTEP of 30 TWh by 2032, and the near-term target set in the Conservation First Framework and Industrial Accelerator Program of 8.7 TWh by 2020.
- The long-term target is achieved through a combination of conservation programs and building codes and equipment standards, shown in the chart below.



Planning and Balancing Supply/Demand

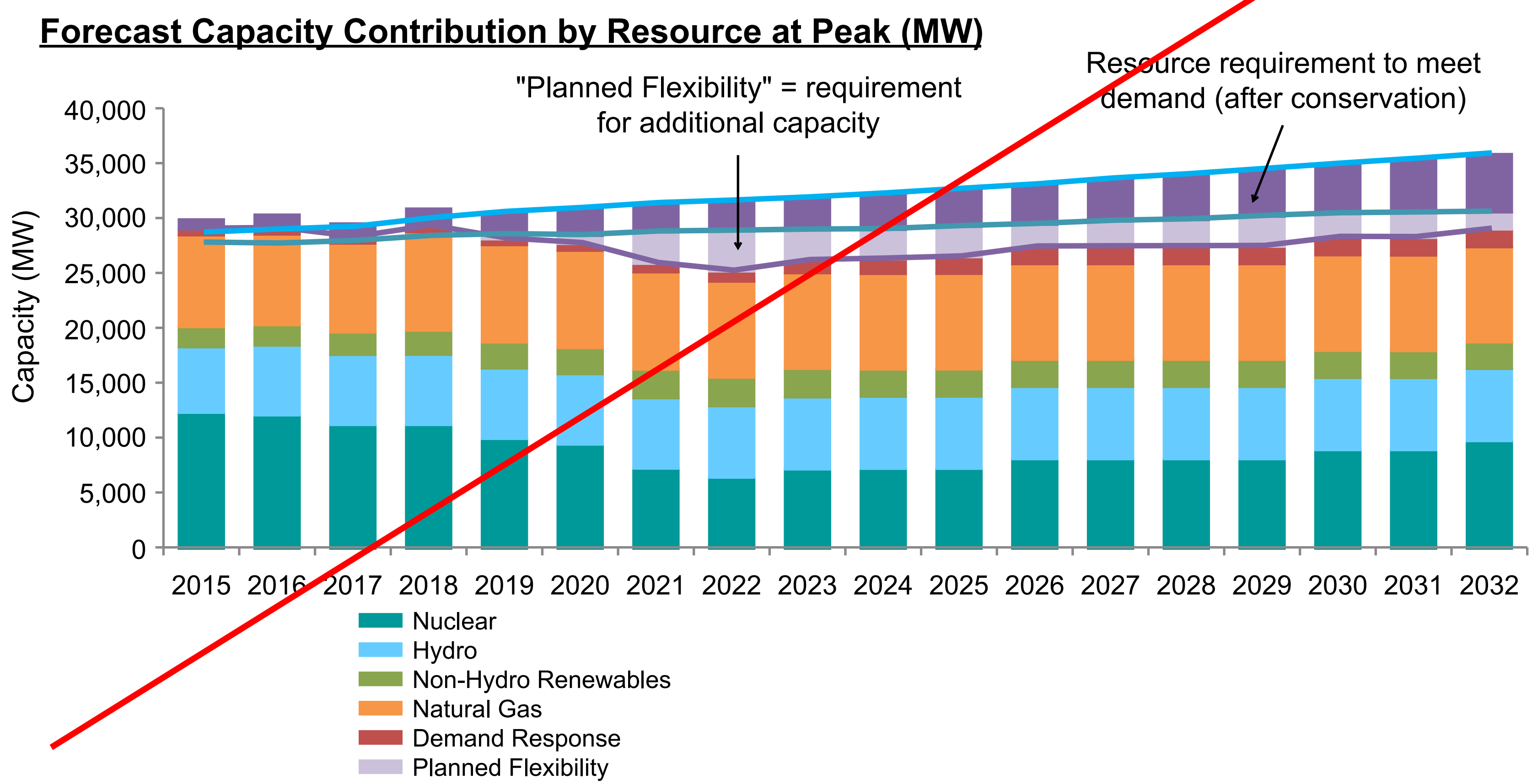
Total Forecasted Resource Requirement

- The electricity supply mix that will most efficiently and reliably meet peak demand must include a reserve margin.
- Ontario is required to maintain a reserve margin in order to comply with *Northeast Power Coordinating Council (NPCC)* resource adequacy criteria.
- Supply availability varies year by year as the system evolves, contracts expire, and new generation comes online.
- Reserve margin requirements can fluctuate based on system operational characteristics and other factors, but are expected to remain near 20% of peak demand.



Note: Based on OPO forecasts of summer net peak demand and planning reserve.

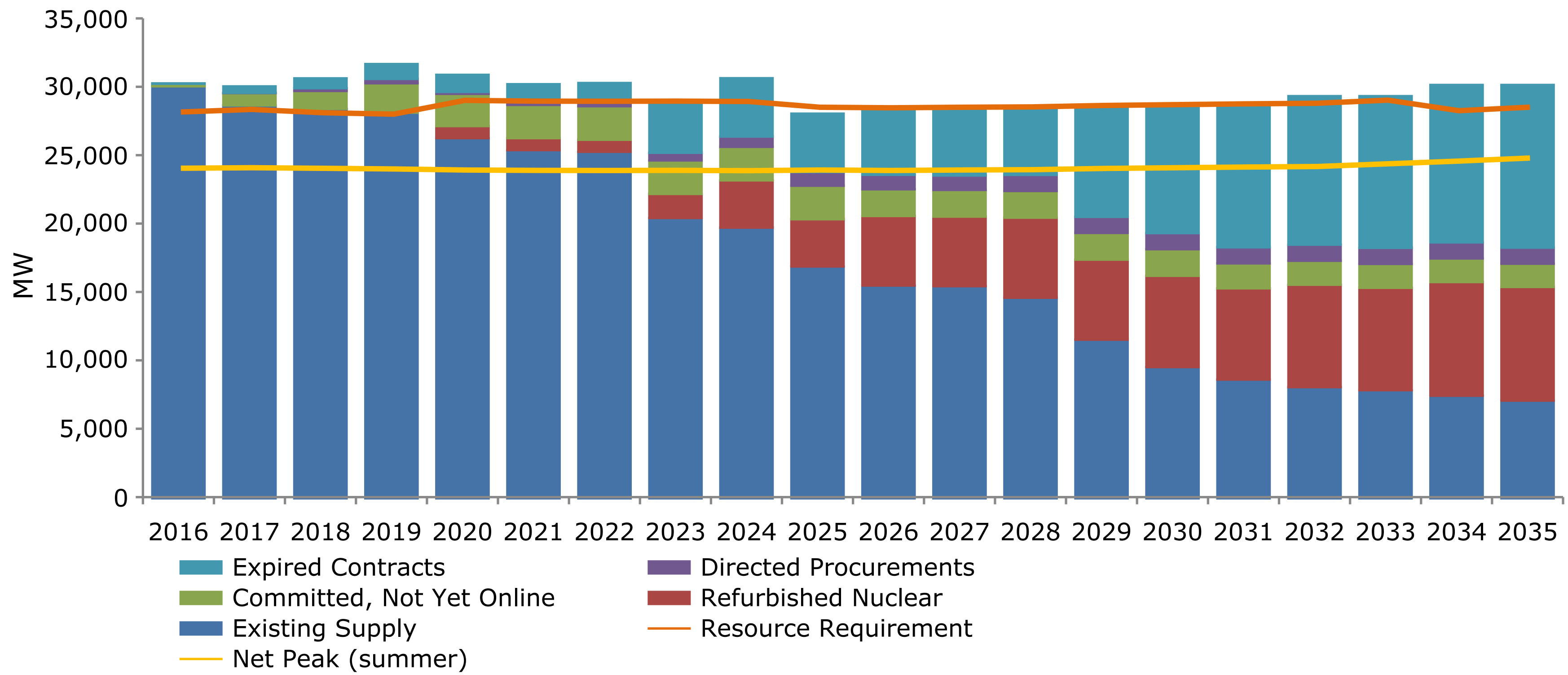
A Substantial Amount of Supply Resources Already Exist or have been Committed to Under the 2013 LTEP



Note: The above graph builds up to Figure 18: Ontario's Planned Supply Mix in the 2013 Long-Term Energy Plan

Forecasted Available Supply relative to Peak Demand

While the system has no energy or capacity needs in the short-term, there is expected to be a capacity shortfall beginning around 2023, primarily related to the nuclear refurbishment at Bruce and Darlington, and the retirement of Pickering. Several options exist to meet this capacity requirement, including IESO proposed capacity market, conservation initiatives, and growth in embedded wind and solar.

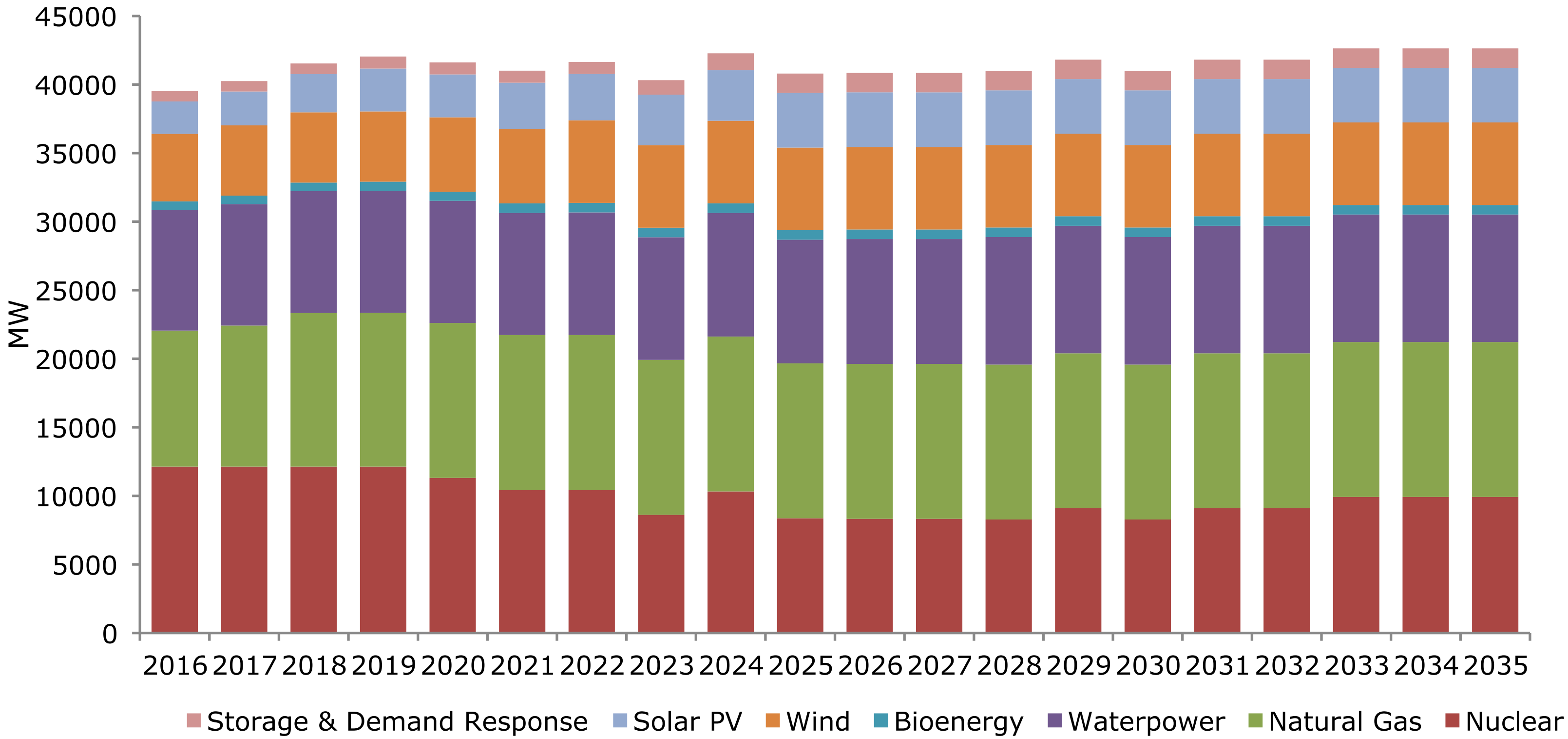


Note: Based on the OPO forecast for summer net peak demand and total available capacity.

Forecasted Supply by Fuel Type

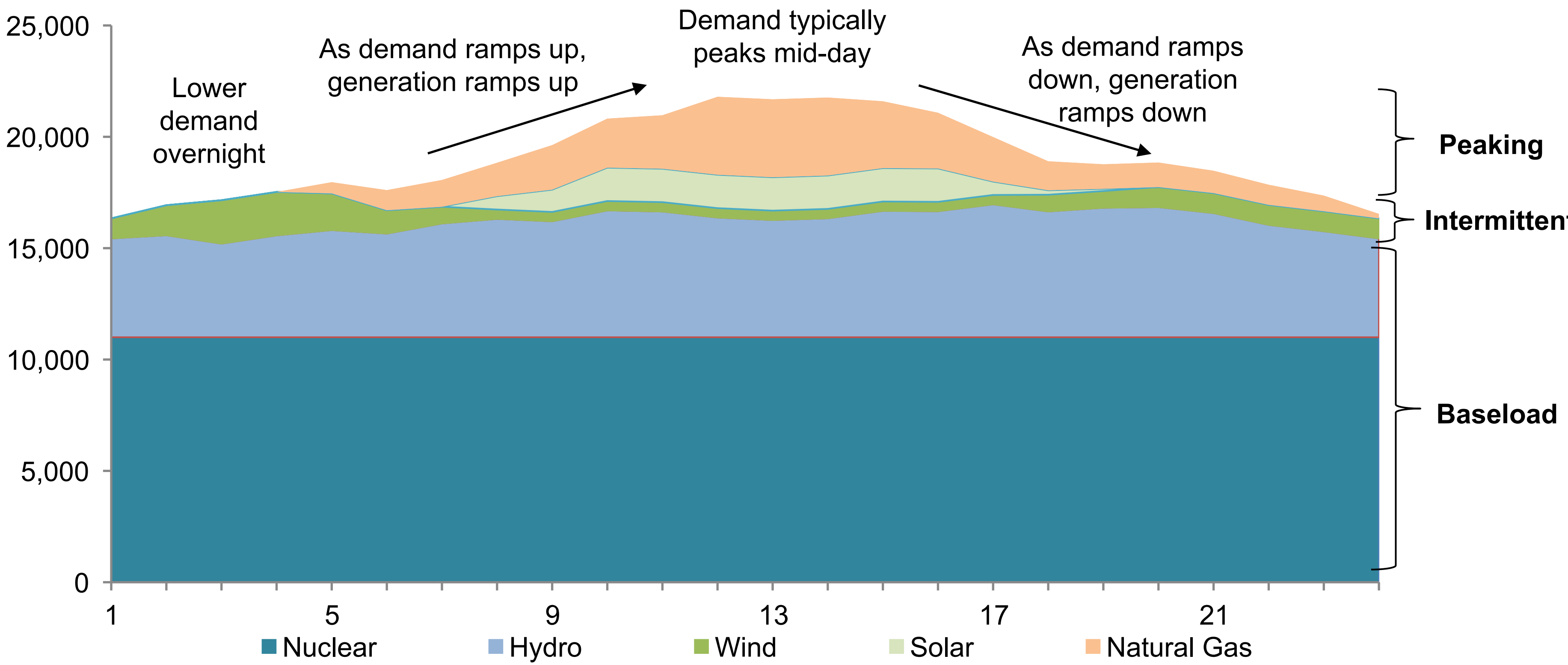
Ontario's supply mix depends on a diversity of resources.

Currently, over 7,200 MW of non-hydro renewable generation (i.e., wind, solar and bioenergy) is connected to both the transmission and distribution networks in Ontario. In 2016, non-hydro renewables produced approximately 10 terawatt hours (TWh) of energy.



Supply is Planned and Called Upon to Meet Ontario's Needs

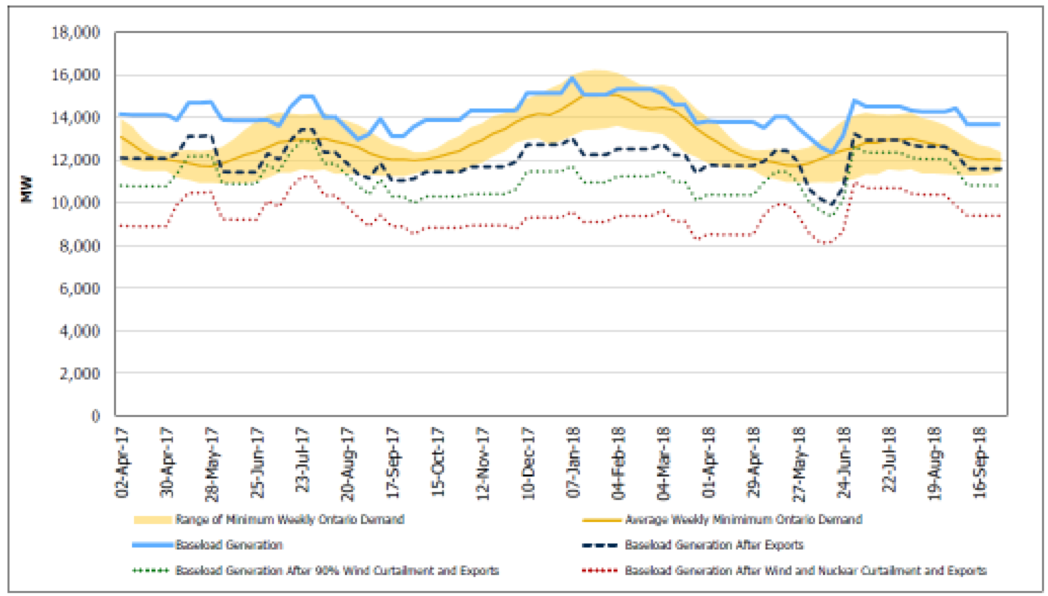
Generation over the Course of an Illustrative Summer Day (MW)



Surplus Baseload Generation Occurs During Periods of Low Demand

- Surplus Baseload Generation (SBG) occurs when electricity generation from baseload facilities exceeds demand.
- Increasing the volume of exported electricity is generally the most cost-effective way to deal with SBG.
- Curtailment (temporarily shutting down) of wind and solar generation is considered as the next mitigation option after exports.
- Other mechanisms such as spilling water at hydroelectric plants and nuclear manoeuvers are considered when further mitigation is required.
- Nuclear shut-downs are the most costly option and is applied when further mitigation is required.
- SBG is expected to decrease during nuclear refurbishment.

Comparison of SBG with Minimum Demand
in megawatts (MW)

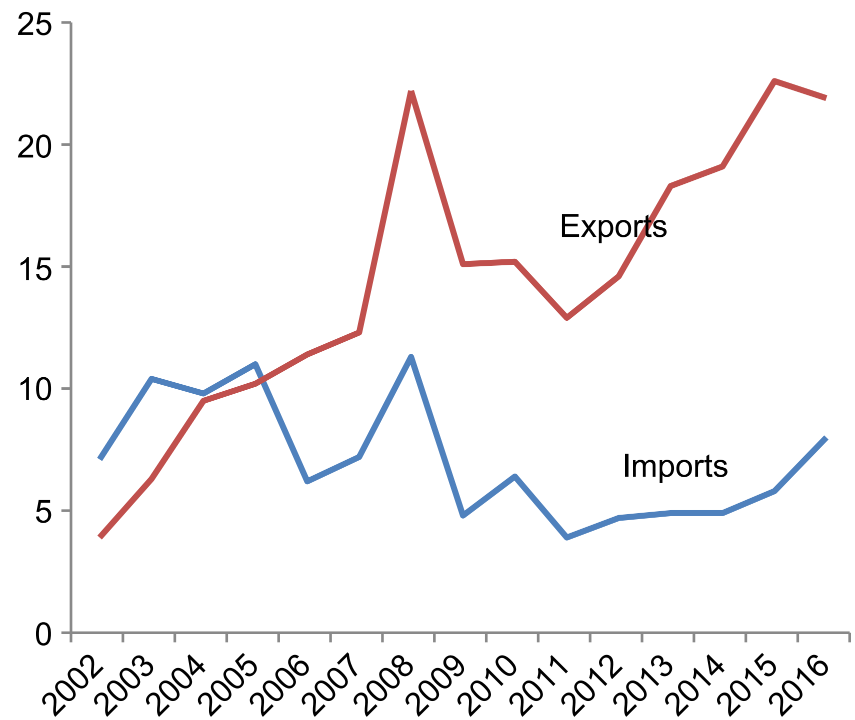


Source: IESO, 18 Month Outlook

Electricity Trading

- Ontario's electricity system is interconnected with neighbouring provinces and states and is capable of importing or exporting up to 6,500 MW - mainly from/to Quebec, Michigan, and New York.
- Electricity trade increases reliability and cost-effectiveness and as part of the operation of the electricity market.
- Imports compete with domestic generation in Ontario's electricity market – allowing the least expensive resources to be scheduled to supply the electricity system.
- Ontario has been a net exporter since 2006. In 201~~5~~6, Ontario had net exports of ~~16.8~~13.9 TWh.

Annual Electricity Trade (TWh)



Overview of Supply Resources

Supply Resource Characteristics

- System planners must consider the characteristics of different supply resources as they plan which resources to procure to meet peak demand. The following slides provide an overview of the characteristics of different supply resources.

Key Concepts

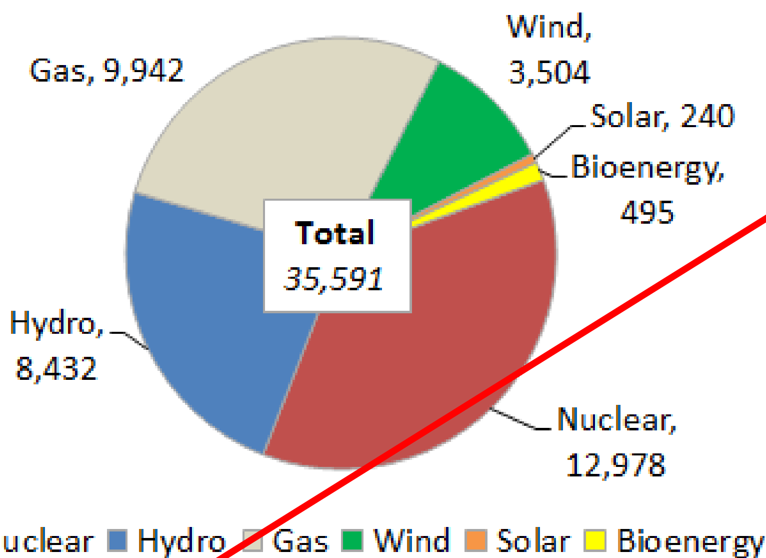
- **Capacity** – Refers to the rate at which electricity is generated. Capacity is typically reported in megawatts (MW). “Contracted Capacity” indicates existing contracts for generators that have not yet come online.
- **Capacity Factor** – Is a measure of how often an electricity generator runs on average over the course of a given period.
- **Peak** – Periods during which electricity demand is the highest. A “peaking plant” is a power plant that has the ability to change its operations in order to meet periods of peak demand.
- **Baseload** – The minimum capacity required to meet periods of lowest demand. Baseload generators are typically designed to run at a constant rate.
- **Intermittent** – Supply sources that can vary significantly due to weather, such as wind and solar.

Note: Data on the following slides is current as of most recent data.

~~Electricity Capacity and Generation~~

Installed Capacity, Ontario (MW)

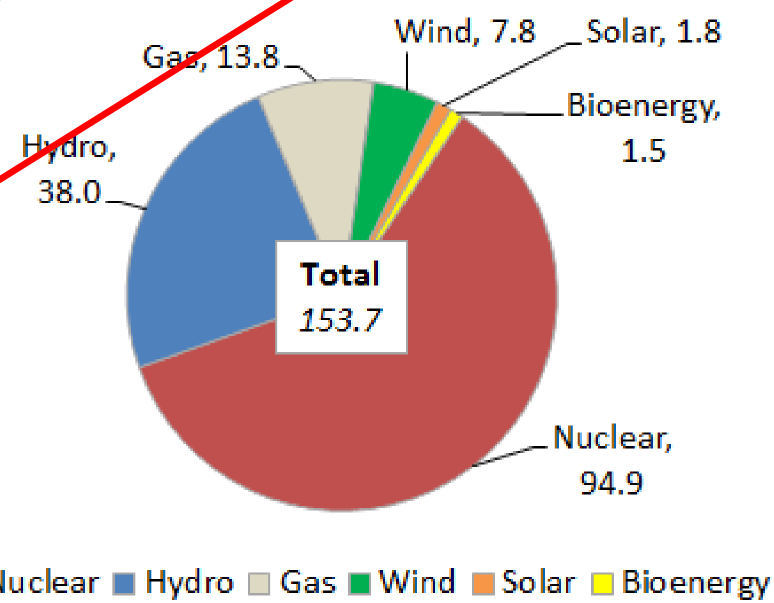
At end of 2015



Source: Ontario Energy Report

Generation, Ontario (TWh)

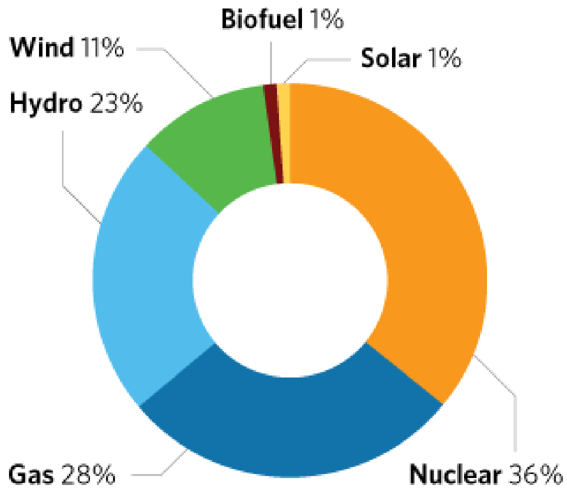
2015



Source: Ontario Energy Report

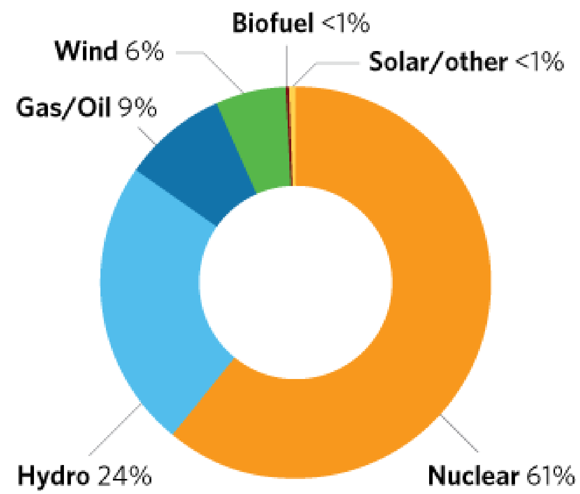
Electricity Capacity and Output

2016 Generation Capacity by Fuel Type:



Nuclear	12,978 MW or 36%
Gas/Oil	9,943 MW or 28%
Hydro	8,451 MW or 23%
Wind	3,983 MW or 11%
Biofuel	495 MW or 1%
Solar	280 MW or 1%

2016 Generator Output by Fuel Type:



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%

Note: Sourced from the IESO. These figures do not include distribution-connected facilities, except those that participate in the IESO-administered market. Distribution-connected generation includes: Solar – 1,947 MW, Wind – 561.8 MW, Hydro – 238.2 MW

Nuclear Power

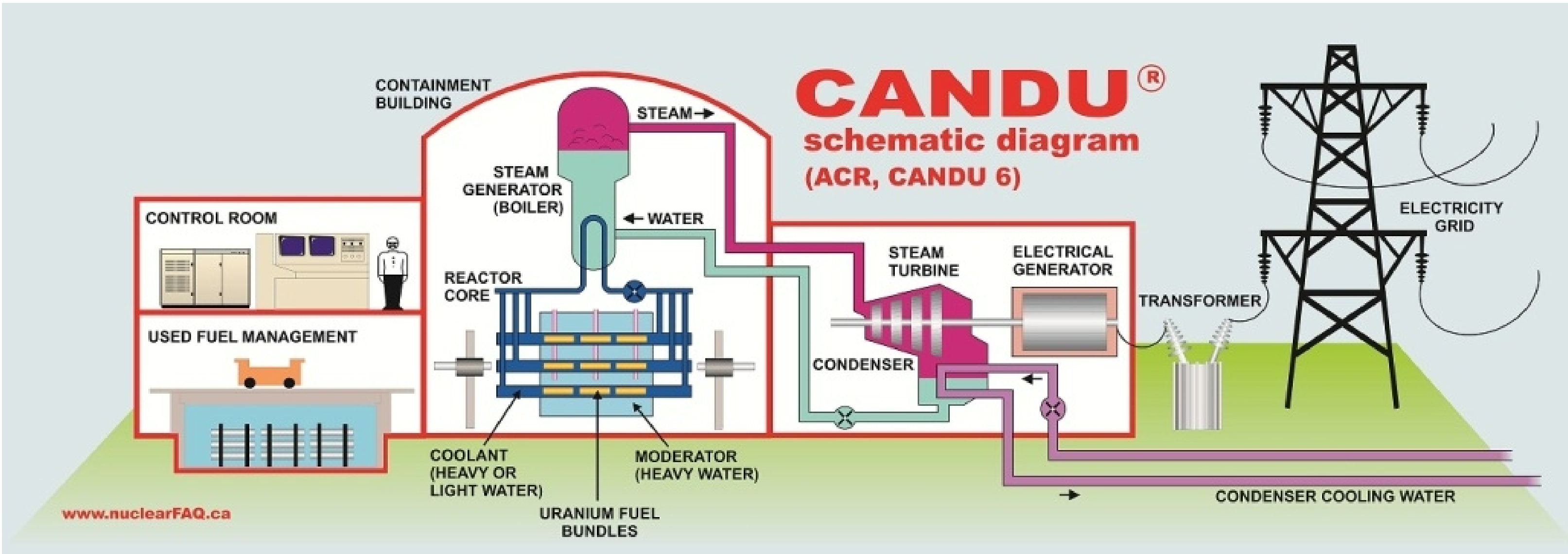
How it works: Neutrons are used to split Uranium nuclei, creating energy and additional neutrons that continue the chain reaction. The heat generated creates steam, turning a turbine that powers an electric generator. See the next slide for a schematic of a CANDU nuclear reactor.	
Installed capacity	12,9~~47~~78 MW (18 reactor units at 3 sites)
Contracted capacity	Current refurbishment plans would retain 10,000 MW of nuclear capacity over the long term. See subsequent slide for details.
Average Capacity Factor	~~80 - 85~~ 70-95%
Summer Capacity Contribution	97 -100 %
Role in Supply Mix	Baseload
Environmental Considerations	No GHG or other emissions during operation, some GHG emissions associated with materials/construction. Radioactive nuclear waste is generated through the operation of nuclear plants and must be safely disposed of.
Current Cost of Electricity	5 to 8 cents/kWh

Pickering

2013 LTEP Commitment:

- Ontario plans to refurbish four Darlington units between 2016 and 2025 and six Bruce units between 2016 and 2031.
- The Pickering Generating Station is expected to be in service until 2020.
- Current refurbishment plans would retain just under 10GW of nuclear capacity over the long term.

Nuclear Technology – The CANDU Reactor

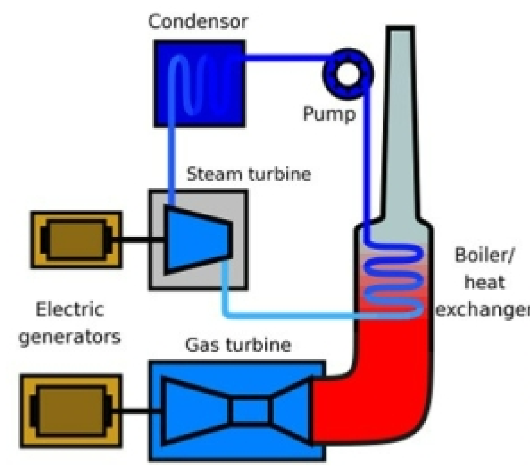


- CANDU stands for “Canada Deuterium Uranium”. It is a pressurized heavy-water power reactor design.
- Heat generated from the nuclear reaction boils water that turns to high pressure steam in the steam generators that then flows through a steam turbine and turns an electrical generator to make electricity.

Natural Gas

How it works: **Simple Cycle Gas Turbine (SCGT)** - Compressed air is combined with natural gas and ignited. The high temperature gas drives a turbine which drives a generator. Lower efficiency than other technologies, but better ramping rates. **Combined Cycle Gas Turbine (CCGT)** - Exhaust gas from a SCGT is used to create steam that drives a steam turbine connected to a generator. The combined efficiency is quite high, in the range of 55%. Higher efficiency than a SCGT but not as good at providing peaking generation. **Cogeneration or Combined Heat & Power (CHP)** – Waste heat from a gas plant is delivered to nearby users, primarily for industrial processes and district heating. To gain highest efficiency, must be operated based on the needs of the steam host and as a baseload resource.	
Installed Capacity	~~10,544~~ 10,202 MW (Primarily CCGT and CHP, includes dual fuel)
Contracted Capacity (Not Online)	~1,200~~7~~ MW
Capacity Factor	10 - ~~60~~ 65%
Summer Capacity Contribution	66 - 100 %
Primary Role in Supply Mix	Peak and intermediate
Environmental Considerations	Moderate greenhouse gas emissions.
Current Cost of Electricity	8 to 29 cents/kWh

CCGT Schematic

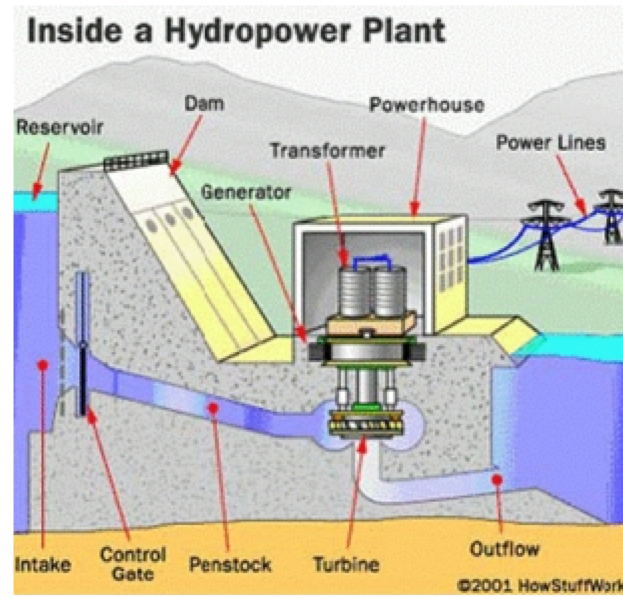


2013 LTEP Commitment:

- No new natural gas projects expected over the near term.

Hydroelectric

How it works: Hydroelectric projects use falling or flowing water to rotate the blades of a turbine. This turns a shaft that moves magnets in the generator thereby creating electricity.	
Installed Capacity	~8,800~~8,768~~ MW
Contracted Capacity (Not Online)	~200~~190~~ MW
Capacity Factor	50%
Summer Capacity Contribution	63%
Primary Role in Supply Mix	Peak (with reservoir storage), Baseload (no reservoir storage)
Environmental Considerations	No GHG or other emissions during operation, some GHG emissions associated with materials/construction. Lower impact on river ecosystems from run-of-river hydroelectric projects, which have minimal storage capabilities and use only the natural flows in the river as they are available.
Current Cost of Electricity	4 cents/kWh (OPG regulated price) to 17.6 cents/kWh (LRP I weighted average price)



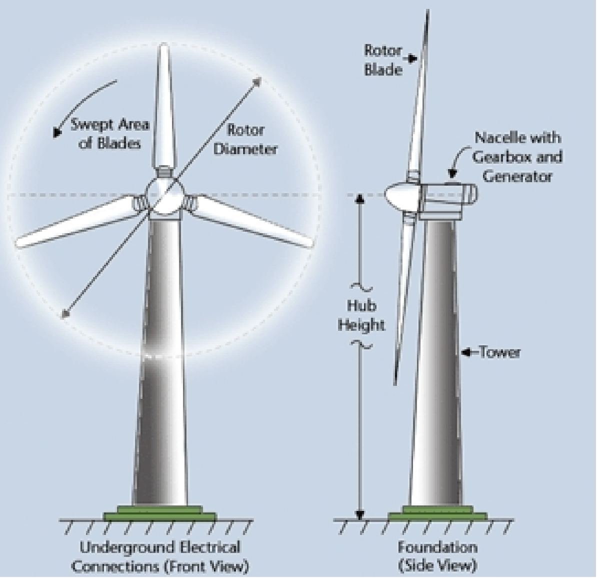
2013 LTEP Commitment:

- Increase the province's 2010 target of 9,000 MW by 2018 to 9,300 MW by 2025.

Wind

How it works: Wind turbines capture the kinetic (moving) energy in the wind and convert it to electricity. The blades capture energy from the wind and rotate, which turns a shaft that moves magnets in the generator thereby creating electricity. Wind turbines need a minimum wind speed of ~2-4 metres/second to start working, where maximum power is reached at ~10-15 m/s. At greater wind speeds (~20-25 m/s) the turbine is shut down to prevent damage.

Installed Capacity	~4,500~~4,374~~ MW
Contracted Capacity (Not Online)	~1,600~~1,890~~ MW
Capacity Factor	30 %
Summer Capacity Contribution	10 %
Primary Role in Supply Mix	Intermittent
Environmental Considerations	No GHG or other emissions during operation, some GHG emissions associated with materials/construction. Impacts on birds/bats which can be mitigated through operational protocols.
Current Cost of Electricity	8.6 cents/kWh (LRP I weighted average price)

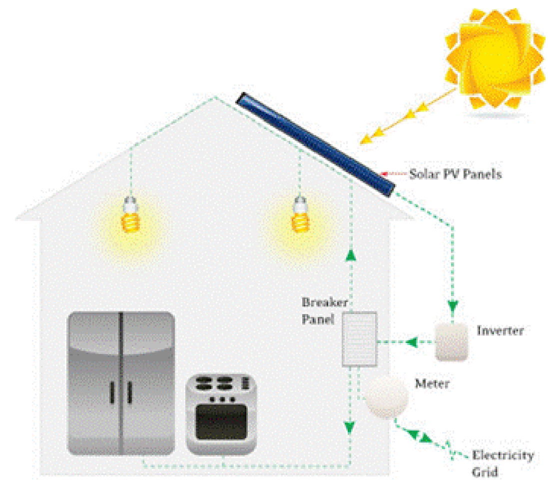


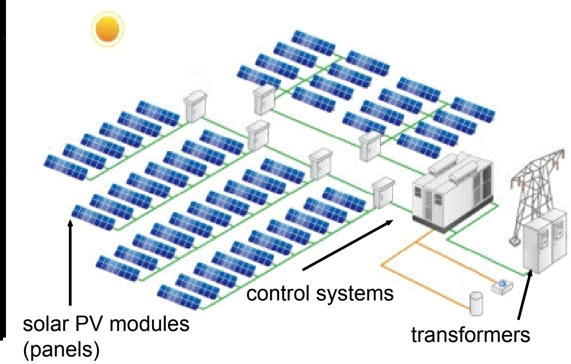
2013 LTEP Commitment:

- The government will extend the 2010 target of 10,700 MW for non-hydro renewable energy from 2018 to 2021. Wind capacity is forecasted to be 6,430 MW by 2021.

Solar Photovoltaic (PV)
(Roof-Top and Ground Mounted)

How it works: Solar photovoltaic (PV) technology converts the sun's rays into electricity. Solar PV cells use semiconductor materials to generate electricity. Visible and infrared light "bumps" electrons in the semiconductor out of their normal pathway to create a flow of electricity. The most commonly used semiconductor is silicon.	
Installed Capacity	~2,200~~2,119~~ MW
Contracted Capacity (Not Online)	~425~~633~~ MW
Capacity Factor	15 % (higher values are for ground mount installations with tracking technology)
Summer Capacity Contribution	20 %
Primary Role in Supply Mix	Intermittent
Environmental Considerations	No GHG or other emissions during operation, some GHG emissions associated with materials/construction. Manufacturing of solar cells may involve toxic materials.
Current Cost of Electricity	~~9 cents/kWh (2030)~~ 15.7cents/kWh (LRP I weighted average price). Some existing microFIT solar contracts up to 80 cents/kWh.



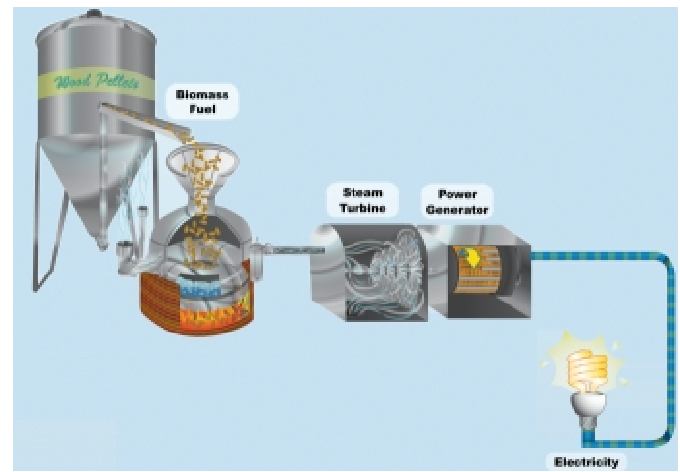


2013 LTEP Commitment:

- The government will extend the 2010 target of 10,700 MW for non-hydro renewable energy from 2018 to 2021. Solar capacity is forecasted to be 3,510 MW by 2021.

Bio-energy (Biomass)

How it works: Combustion of biomass is used to create steam which is used to drive a turbine, creating electricity. Biomass feedstock may first be pelletized for ease of transportation.	
Installed Capacity	~500~~574~~ MW (bioenergy total)
Contracted Capacity (Not Online)	~6~~24~~ MW (bioenergy total)
Capacity Factor	80 % (bioenergy average)
Summer Capacity Contribution	90 % (bioenergy average)
Primary Role in Supply Mix	Peak and baseload
Environmental Considerations	GHG and other emissions during operation, some GHG emissions associated with materials/construction. Considered net zero GHG emissions since carbon dioxide was absorbed through the growth of the biomass.
Current Cost of Electricity	~~16.4 cents/kWh (bioenergy average)~~ 17.2 cents/kWh (FIT 2017 prices for projects 500kW and below)

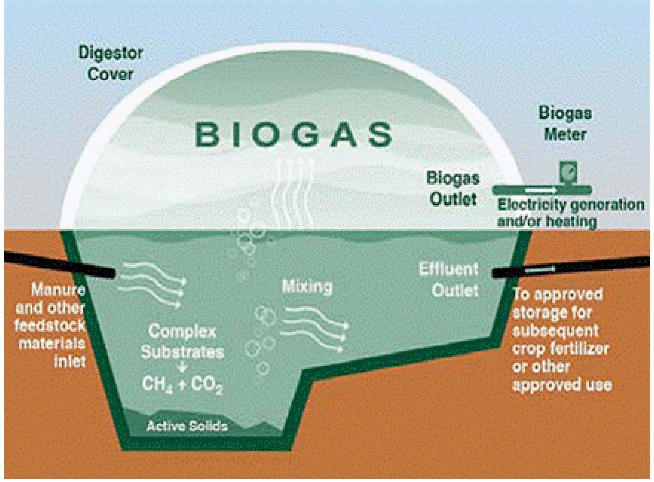


2013 LTEP Commitment:

- The government will extend the 2010 target of 10,700 MW for non-hydro renewable energy from 2018 to 2021. Bioenergy (includes biomass, biogas, and landfill gas) capacity is forecasted to be 685 MW by 2021.

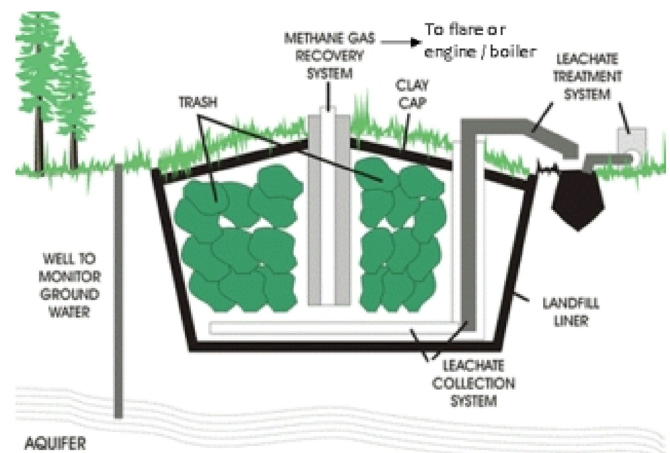
Bio-energy (Biogas)

How it works: Biogas is produced by the anaerobic (i.e., in the absence of oxygen) digestion of manure, food waste or other organics by micro-organisms. The biogas (bio-methane) that comes off can be burned in a generator to produce electricity.	
Installed Capacity	~500~~574~~ MW (bioenergy total)
Contracted Capacity (Not Online)	~6~~24~~ MW (bioenergy total)
Capacity Factor	80 % (bioenergy average)
Summer Capacity Contribution	90 % (bioenergy average)
Primary Role in Supply Mix	Peak ~~and baseload~~
Environmental Considerations	GHG and other emissions during operation, some GHG emissions associated with materials/construction. Considered net zero GHG emission since carbon dioxide was absorbed through the growth of the biological material.
Current Cost of Electricity	~~16.4 cents/kWh (bioenergy average)~~ 16 to 26 cents/kWh (FIT 2017 prices for projects 500kW and below)



Bio-energy (Landfill Gas)

How it works: Landfill gas is a type of gas that is captured through a set of pipes and venting systems at landfill sites. The gas is mostly composed of methane, which is also the major component of natural gas. The gas is then burned in an engine or boiler to drive a generator to generate electricity.	
Installed Capacity	~500~~574~~ MW (bioenergy total)
Contracted Capacity (Not Online)	~6~~24~~ MW (bioenergy total)
Capacity Factor	80 % (bioenergy average)
Summer Capacity Contribution	90 % (bioenergy average)
Primary Role in Supply Mix	Peak and baseload
Environmental Considerations	GHG and other emissions during operation, some GHG emissions associated with materials/construction. Considered net zero GHG emission since carbon dioxide was absorbed through the growth of the biological material.
Current Cost of Electricity	~~16.4 cents/kWh (bioenergy average)~~ 16.8 cents/kWh (FIT 2017 prices for projects 500kW and below)



Summary

- Ontario is currently in a healthy supply position but needs to consider additional capacity commitments for the mid-2020s and beyond to meet higher demand outlooks driven by increased electrification in support of climate change actions.
- System planners must weigh the characteristics of different supply options in order to pick an appropriate supply mix, including:
  - Cost – cost-effectiveness of options, the role of different resources in Ontario's electricity system, fuel pricing – particularly natural gas.
  - System requirements – including peak demand levels and North American standards regarding margins
  - Environmental considerations - clean and emissions-free resources, and the electricity sector's carbon emissions going forward based on achievements to date.
  - Geographic location of resources (water, gas supply, etc.)

Appendix

Comparing Electricity Demand Projections

- Electricity demand forecasts have inherent uncertainty, particularly beyond the five years. As such it is an ongoing, iterative process.

- Variances in past demand forecasts are mainly due to:
  - Greater than expected response to higher electricity prices leading to greater efficiency uptake;
  - Cost decrease of new efficient technologies, leading to increased uptake by the market;
  - Introduction of government policies and programs;
  - Weaker than forecasted economic conditions;
  - Softening of commodity prices, leading to decreased industrial output;
  - Introduction of ‘new’ technologies/uses of electricity (e.g., electrification of transportation); and
  - Improvements in forecasting methodology.

Non-Utility Generators

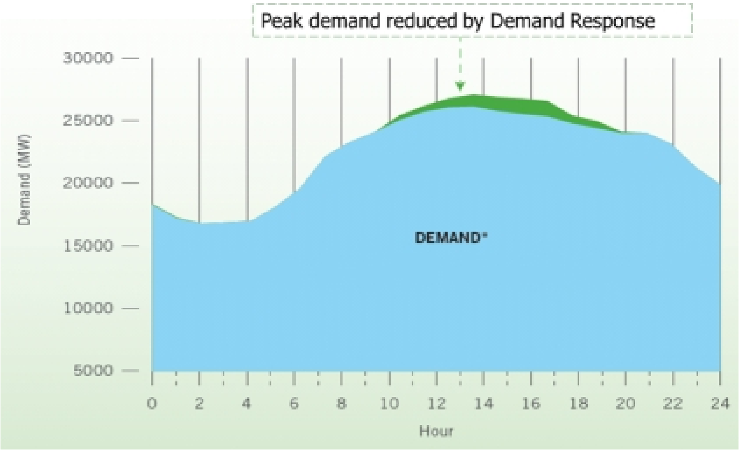
- Non-utility Generators (NUGs) are independent power producers which were originally contracted by the former Ontario Hydro in the late 1980s and early 1990s.
- In total, these contracts have a combined capacity of ~1,500 MW, reflecting about four percent of Ontario's installed capacity.
- Due to their contract structure, NUGs typically operate in accordance with their businesses requirements rather than in a way consistent with changing system needs throughout the day. This generally results in the plants running as baseload (i.e., always on), which can exacerbate surplus conditions.
- NUGs could be considered as part of the planned flexibility options in meeting with the capacity gap that is expected to emerge after 2020. It is expected that IESO will use a capacity auction t o procure any required resources, and NUGs would be able to compete in this market.

IESO NUG Recontracting Report

- On December 19, 2014, the Minister directed the former OPA (now IESO) to assess the framework for NUG contracting in Ontario in the context of changing supply conditions and our commitment to bending the cost curve.
- On September 1, 2015 IESO submitted its report, *NUG Framework Assessment*, to the Minister. IESO's report contained the following recommendations:
  - Continue the current pause in the recontracting of NUGs;
  - Actively monitor evolving sector conditions and impacts on system need; and
  - Continue the development of the capacity auction and capacity export markets with consideration given to facilitating broad participation, including that of NUG representatives.
- On December 14, 2015, the Minister directed IESO to end the process of negotiations for new contracts for NUGs.
- IESO will continue to engage stakeholders, including NUG representatives as relevant, in the development of an Ontario capacity auction, and rules and protocols for Ontario-based capacity exports.
- In addition, NUGs will continue to be considered as options to maintain regional reliability.

Demand Response

How it works: Demand Response (DR) resources procured through the IESO's DR Auction receive payments to shift their electricity consumption at times of system need. DR resources can reduce the need to build additional peaking generation units.	
Current capacity	~563 MW*
Contracted capacity	-
Capacity Factor (Fraction of current capacity that responds to trigger signal)	85%-100%
Summer Capacity Contribution	~85%
Primary Role in Supply Mix	Peak
Environmental Considerations	DR reduces the need to build new generation facilities which may burn fossil fuels and release greenhouse gases and other emissions.
Cost of Demand Response	~$300/MW-day in 2016 (payments are based on capacity and not on energy provided)



2013 LTEP Commitment:

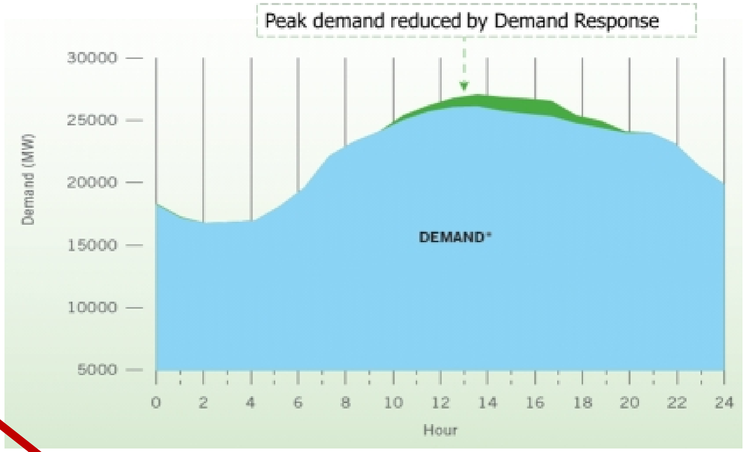
- Ontario is aiming to using DR to meet 10% of peak demand by 2025, equivalent to approximately 2,400 MW under forecast conditions. The DR Auction is expected to account for ~1,366 MW of total DR in 2025**.

*includes DR resources procured through the DR Auction and those related to the former Capacity Based Demand Response Program (expected to expire in 2018)

**Other Demand Response initiatives include Time of Use (TOU) rates, Industrial Conservation Initiatives (ICI) and dispatchable load.

Capacity Based Demand Response

How it works: The Capacity Based Demand Response (CBDR) program provides payments to businesses and industry to shift their electricity consumption at times away from peak periods. CBDR can reduce the need to build additional peaking generation units.	
Current capacity	~500 MW
Contracted capacity	-
Capacity Factor (Fraction of current capacity that responds to trigger signal)	85%-100%
Summer Capacity Contribution	~85%
Primary Role in Supply Mix	Peak
Environmental Considerations	CBDR reduces the need to build new generation facilities which may burn fossil fuels and release greenhouse gases and other emissions.
Cost of Demand Response	$117/kW in 2014



2013 LTEP Commitment:

- Ontario is aiming to use DR to meet 10% of peak demand by 2025, equivalent to approximately 2,400 MW under forecast conditions. CBDR is expected to account for ~1,500 MW of total DR*.

*Other Demand Response initiatives include Time of Use (TOU) rates, Industrial Conservation Initiatives (ICI) and dispatchable load