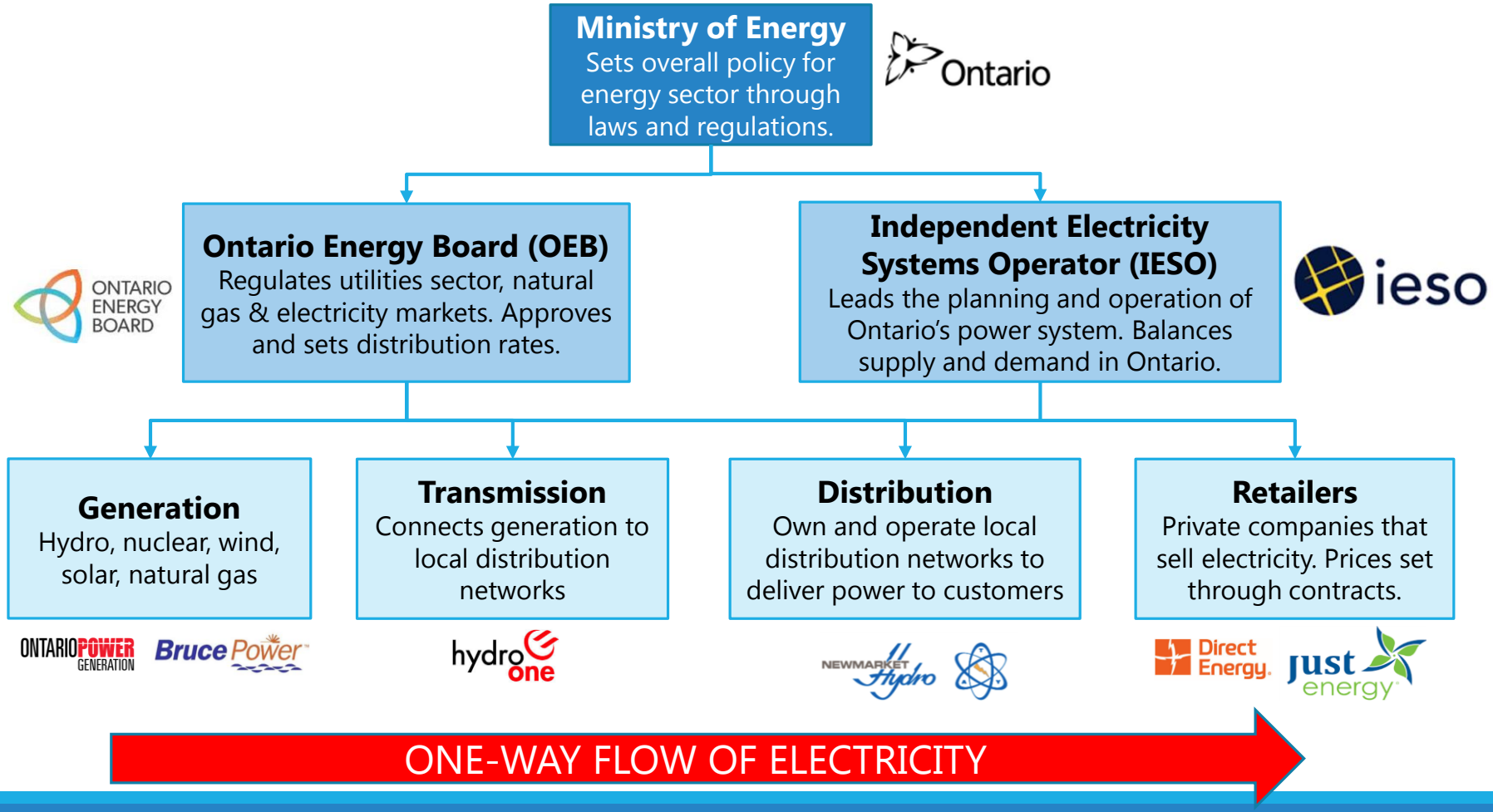
NAVIGATING ONTARIO'S EVOLVING ENERGY LANDSCAPE: A UTILITY'S EXPERIENCE

Newmarket-Tay Power Distribution Ltd.

Newmarket-Tay Power Distribution Ltd.

Electricity Industry in Ontario

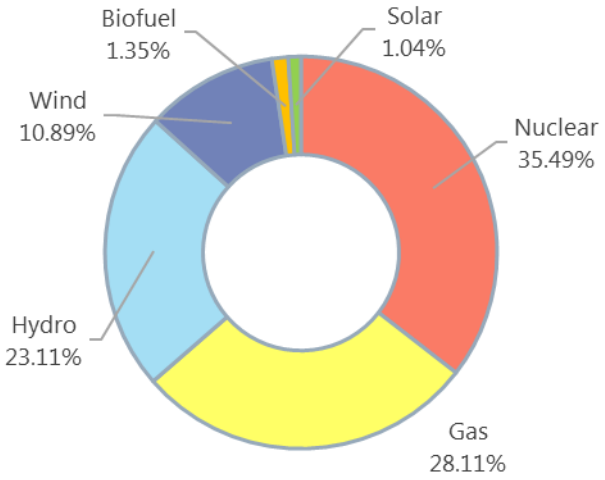
Structure


Ministry of Energy
Sets overall policy for energy sector through laws and regulations.
Ontario
Ontario Energy Board (OEB)
Regulates utilities sector, natural gas & electricity markets. Approves and sets distribution rates.
ONTARIO ENERGY BOARD
Independent Electricity Systems Operator (IESO)
Leads the planning and operation of Ontario's power system. Balances supply and demand in Ontario.
ieso
Generation
Hydro, nuclear, wind, solar, natural gas
ONTARIO POWER GENERATION
Bruce Power
Transmission
Connects generation to local distribution networks
hydro one
Distribution
Own and operate local distribution networks to deliver power to customers
NEWMARKET Hydro
Retailers
Private companies that sell electricity. Prices set through contracts.
Direct Energy.
just energy
ONE-WAY FLOW OF ELECTRICITY

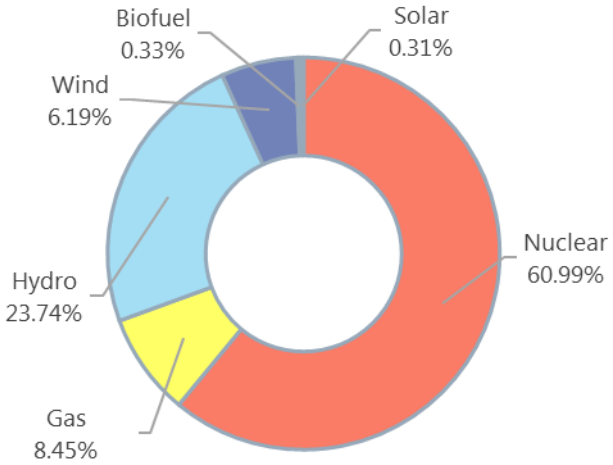
Ontario's Electricity Supply – Domestic Generation

- Ontario Power Generation (OPG) produces more than half of Ontario's electricity (nuclear and hydro power plants)
- Other private-sector electricity generators produce power from nuclear, natural gas, bio-energy, solar and wind sources.
- Ontario's installed generation capacity totals 36,563 MW

Installed Capacity (2016)



Generation Output (2016)



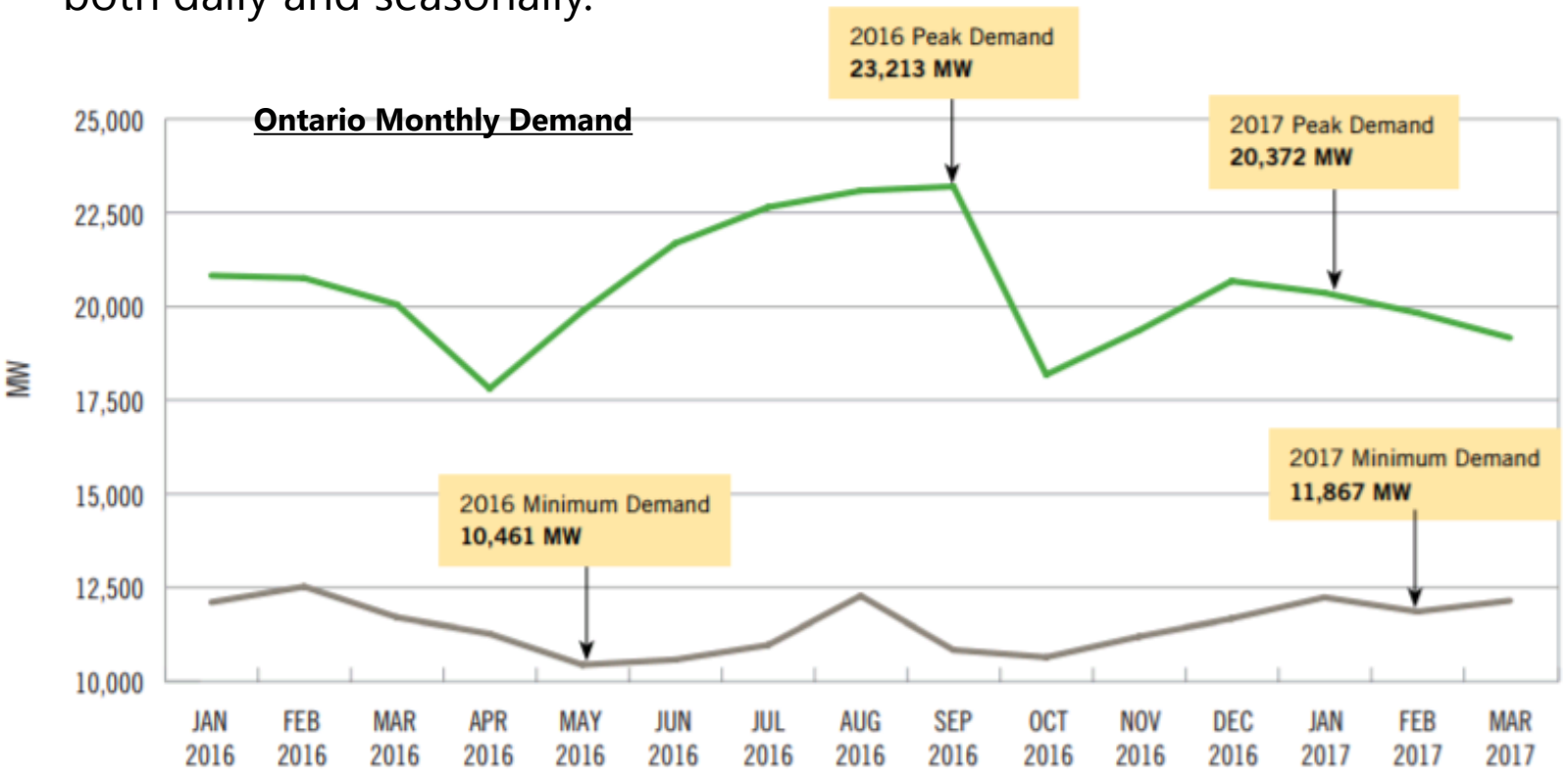
	Total Unit Cost of Generation (Cents/kWh)
Nuclear	6.9
Hydro	5.8
Gas	20.5
Wind	17.3
Solar	48.0
Bio	13.1

Source: OEB

Source: IESO

Ontario's Electricity Supply – Challenges

- There are significant variations in Ontario's demand throughout the year, both daily and seasonally.

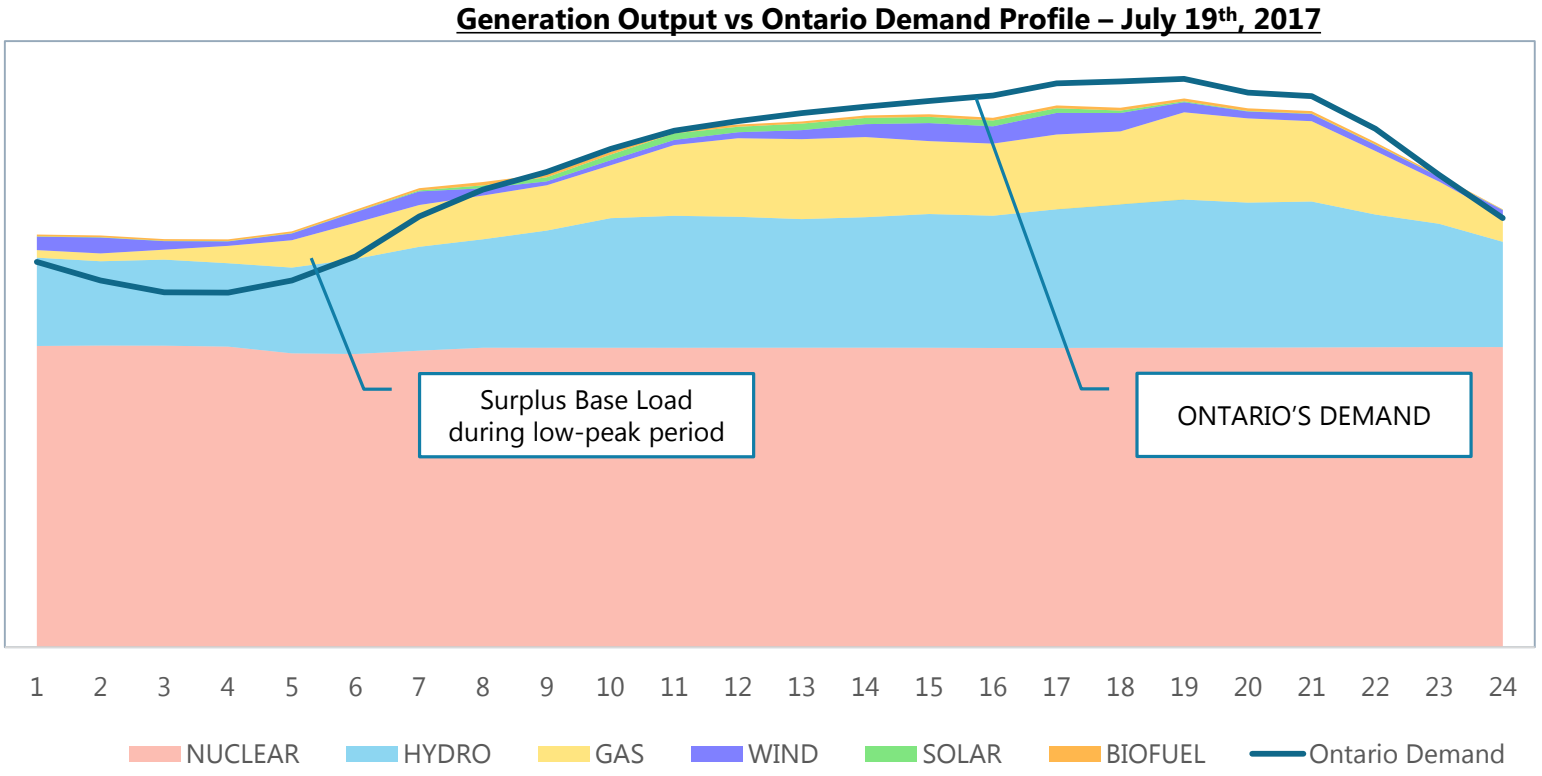


Source: IESO

How do we build a system that is always available "on-tap" to provide a consistent source of energy?

Generation Baseload

- Ontario's system is structured with: baseload generation, peaking generation and variable generation.



Surplus Base Load Generation (SBG): when baseload generation exceeds demand.

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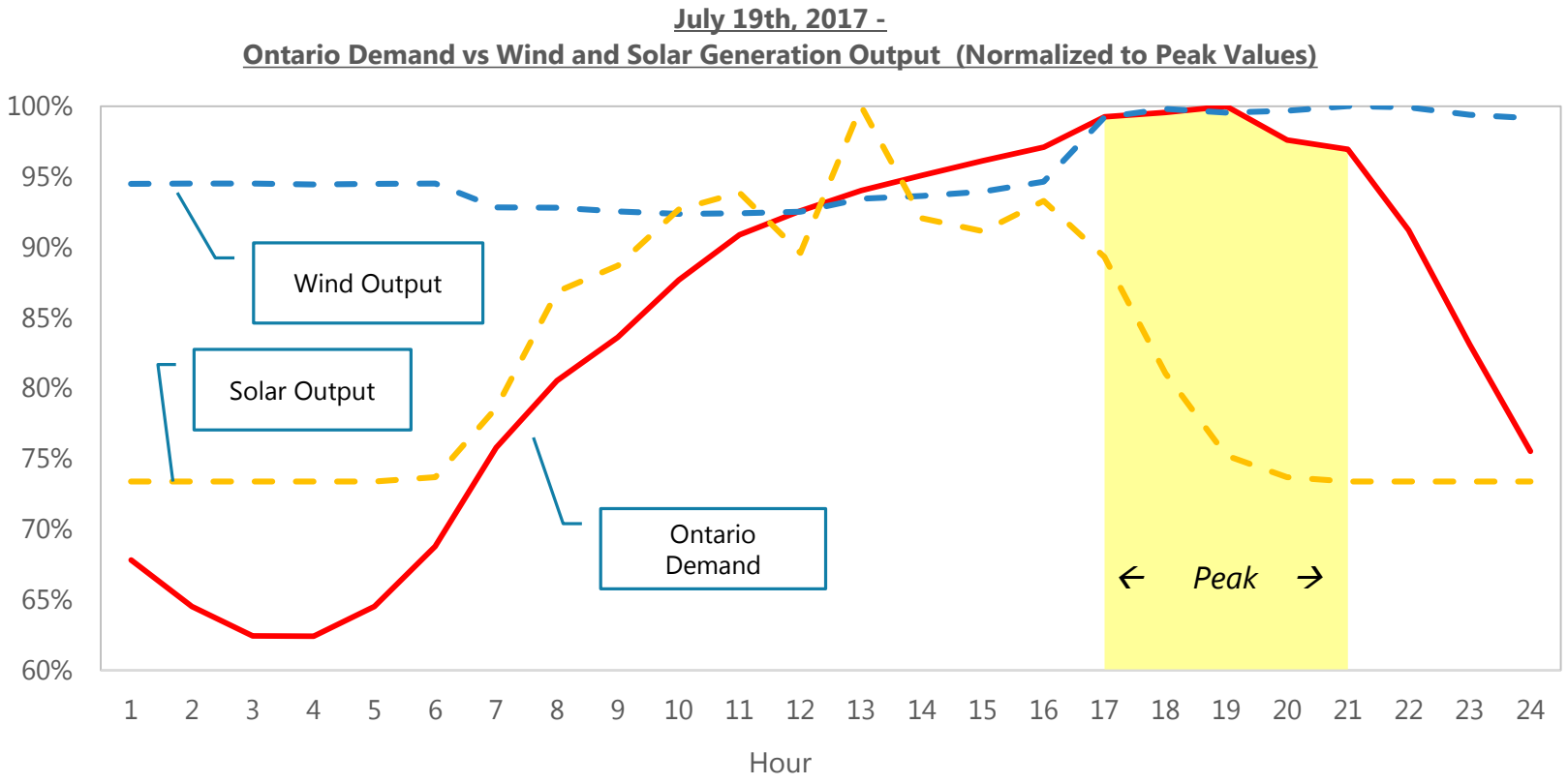
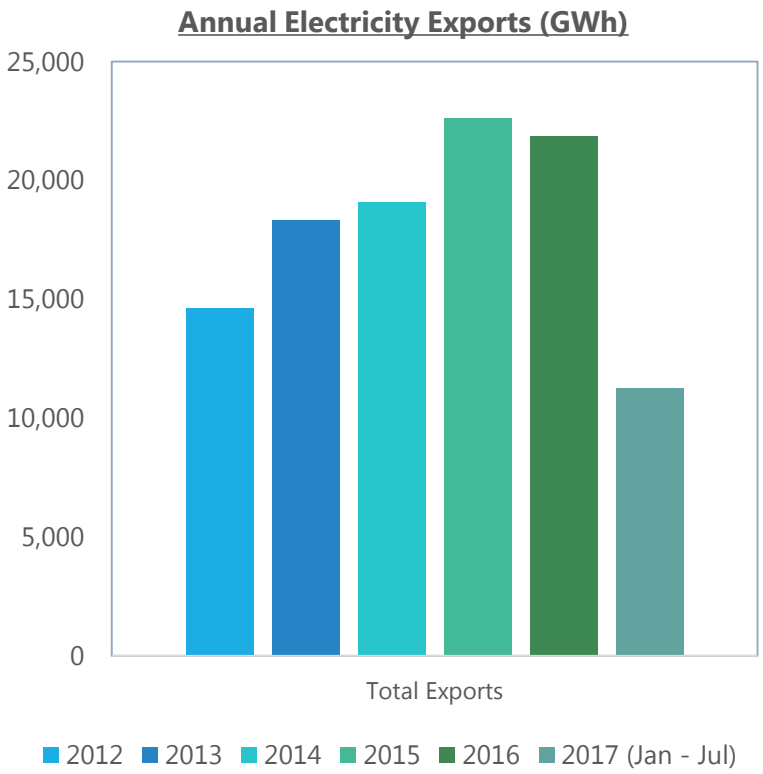
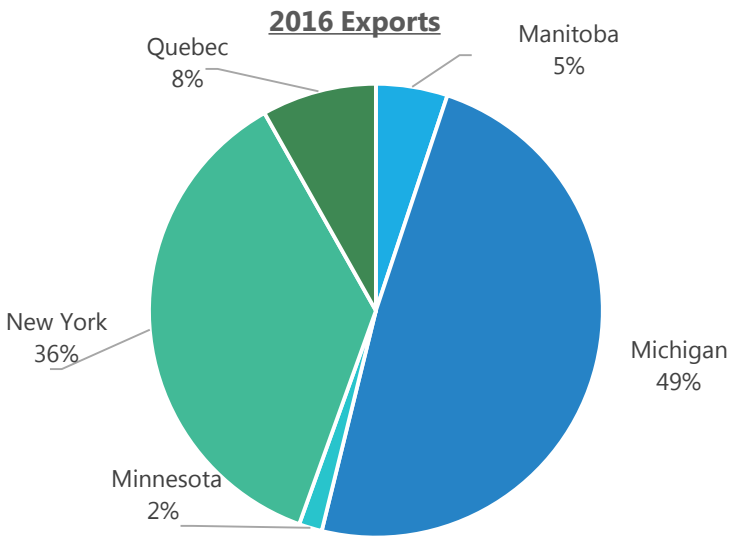
Surplus Baseload Generation (SBG) – Wind / Solar



There is a time delay in the availability of wind and solar and Ontario's Peak Period.

What happens to the SBG?

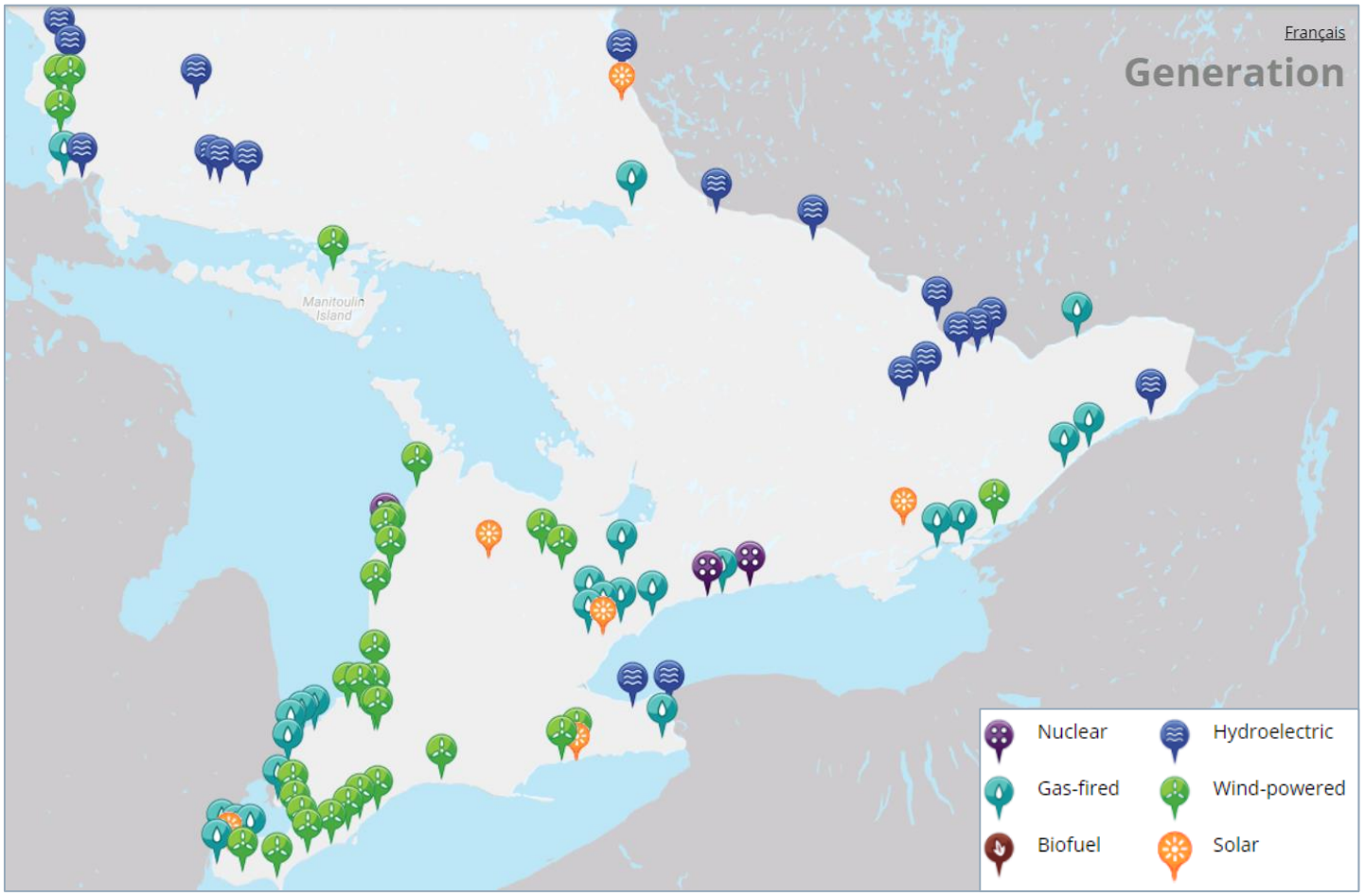




To think about: *How can we can keep SBG in Ontario instead of relying on exports or curtailment?*

Source: IESO

Ontario's Electricity Supply – Domestic Generation



Source: IESO

Transmission

- Hydro One Networks is the province's primary transmission systems operator, operating approximately 97% of Ontario's high voltage transmission grid.

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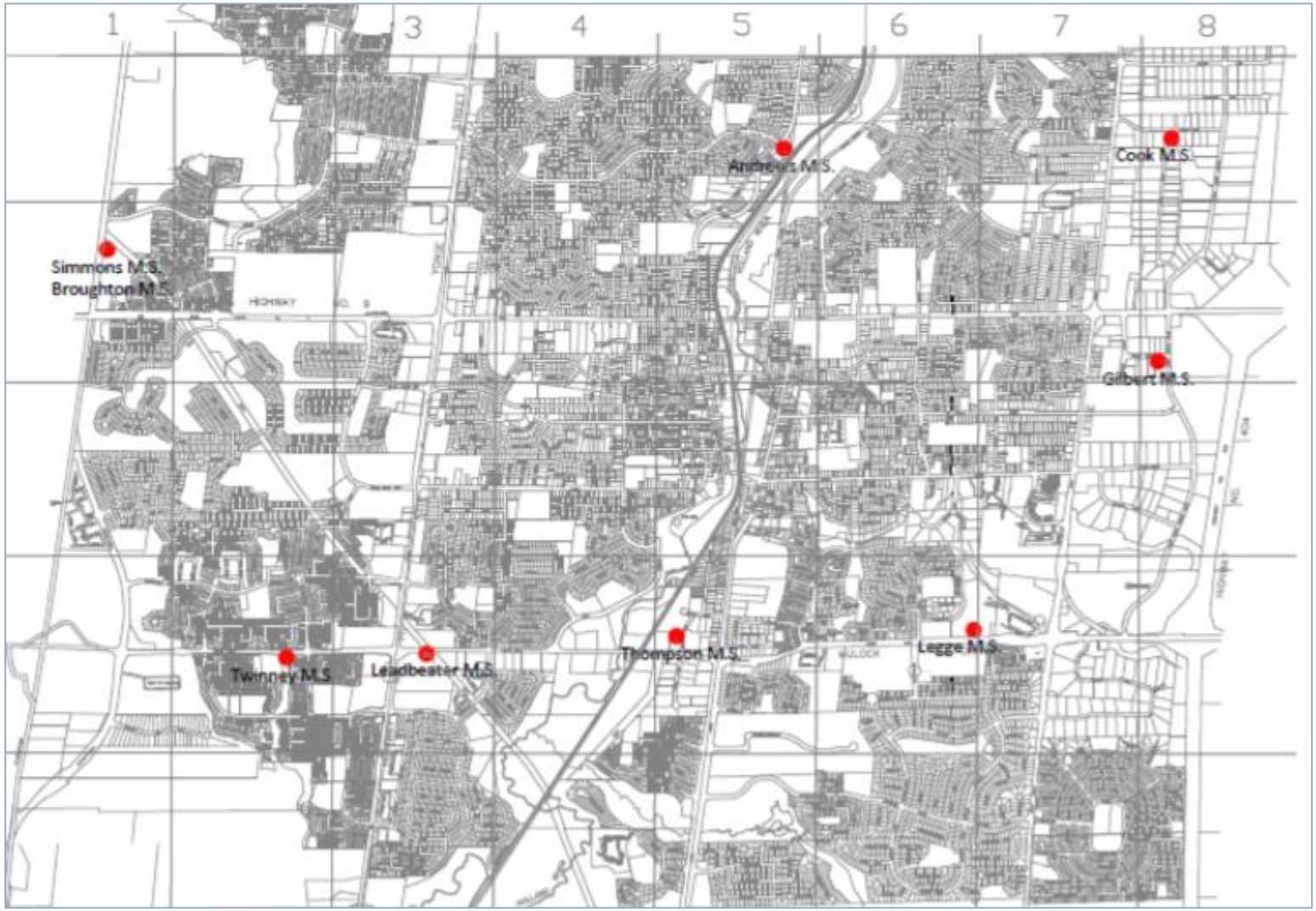
Distribution

- Local distribution companies (LDCs) own and operate distribution networks that take electricity from transmission system / other local sources of generation and deliver it to consumers.

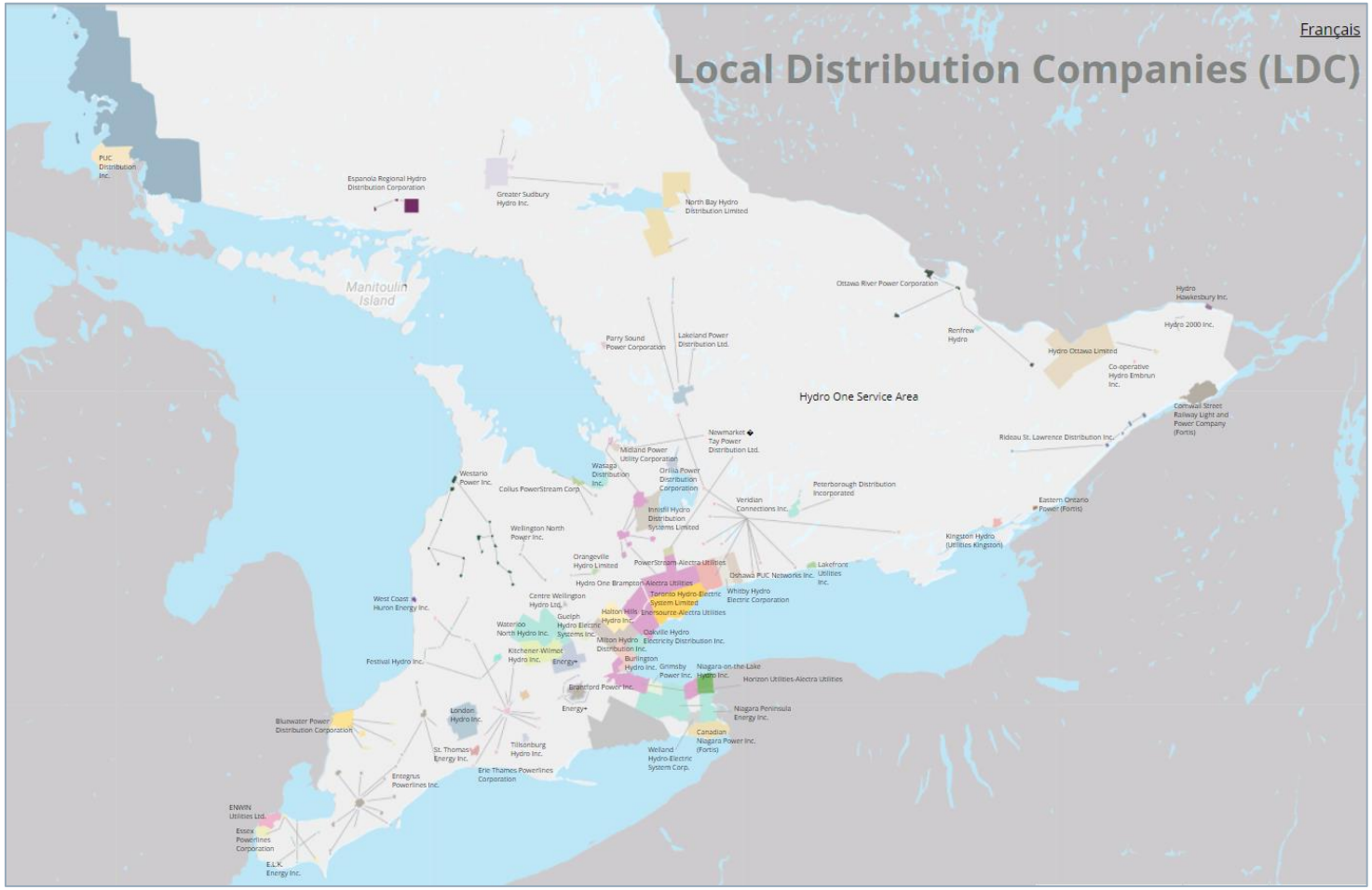
- Transformer stations (TS) step down the high-voltage electricity for distribution.
  - Newmarket service area receives deliveries of bulk power through 8 x 44kV feeders.
  - Tay service area receives power from Hydro One Networks as a Low Voltage customer.

- Distribution sub-stations further step-down electricity for local distribution.
  - There are 9 distribution substations in Newmarket service territory and 3 distribution substations in Tay territory.

Distribution stations in Newmarket take power at 44kV and transform it down to 13.8kV:



A Snapshot of LDCs Across Ontario



Source: IESO

Newmarket-Tay Power Distribution Ltd.

Newmarket-Tay Power Distribution Ltd.

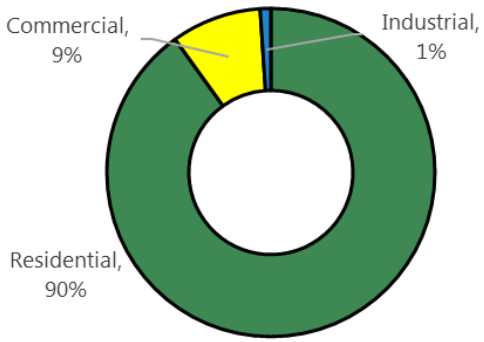
WHO WE ARE

Newmarket-Tay Power Distribution Ltd.

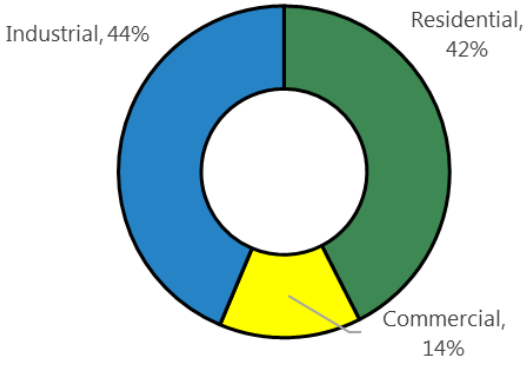
Newmarket-Tay Power Distribution Ltd. (NTPDL)

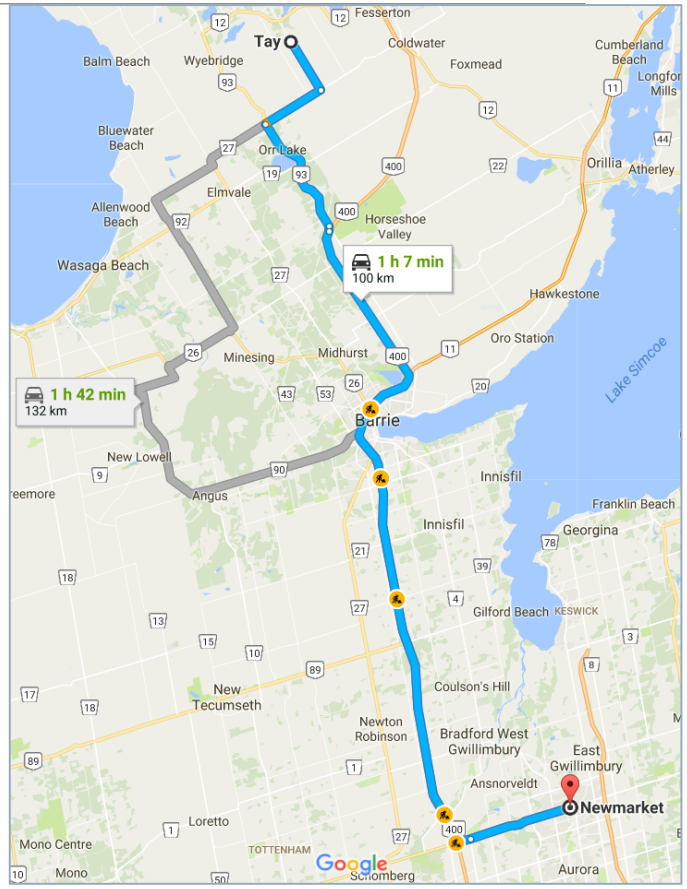
Service Area	74 km^2
Total Length of Distribution Wires	855 km
No. of Customer (2016)	35,460
Energy Delivered (2016)	634 GWh
Average Demand (2016)	76.13 kW

NTPDL Customer Class Distribution



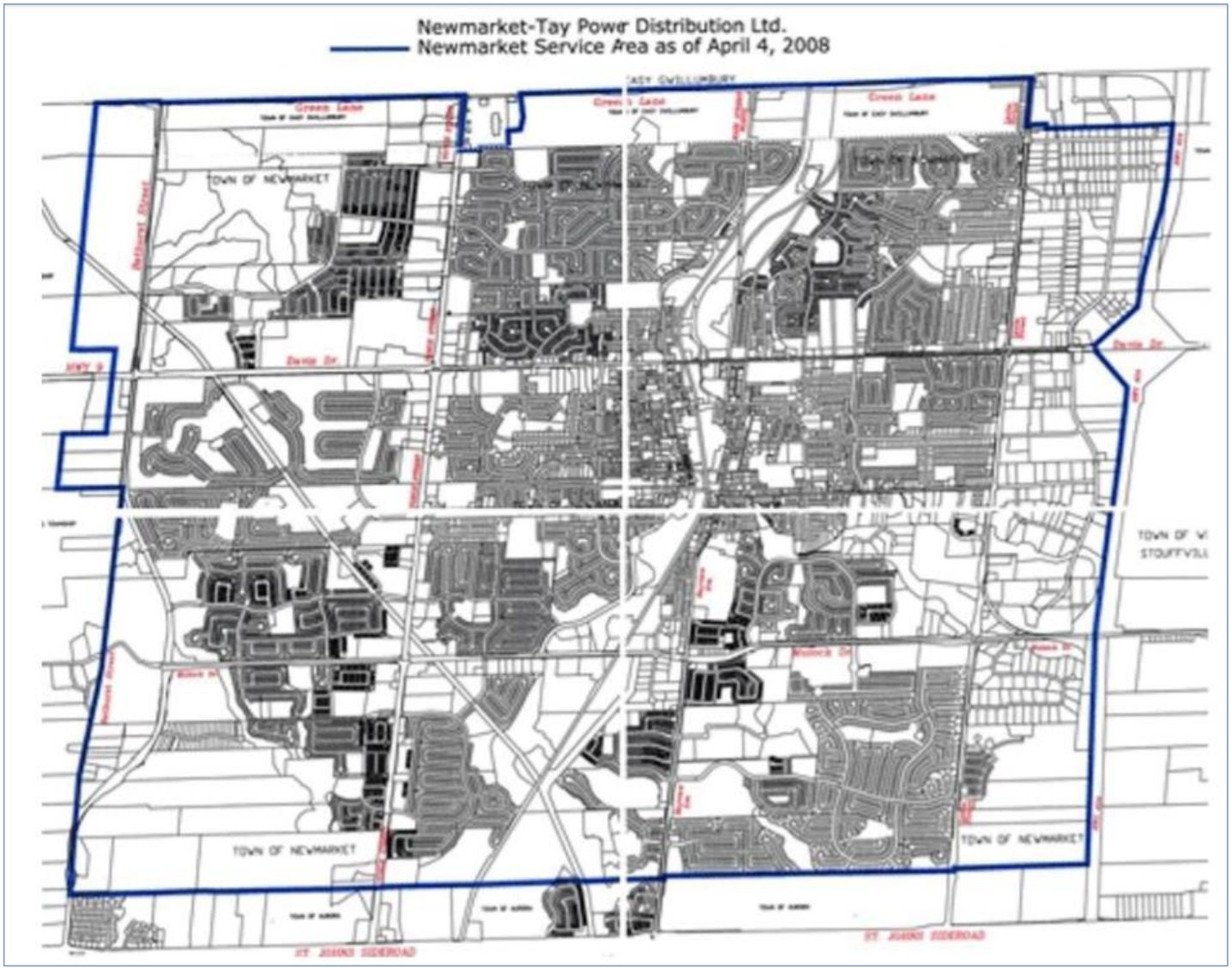
NTPDL Energy Consumption by Customer Class*

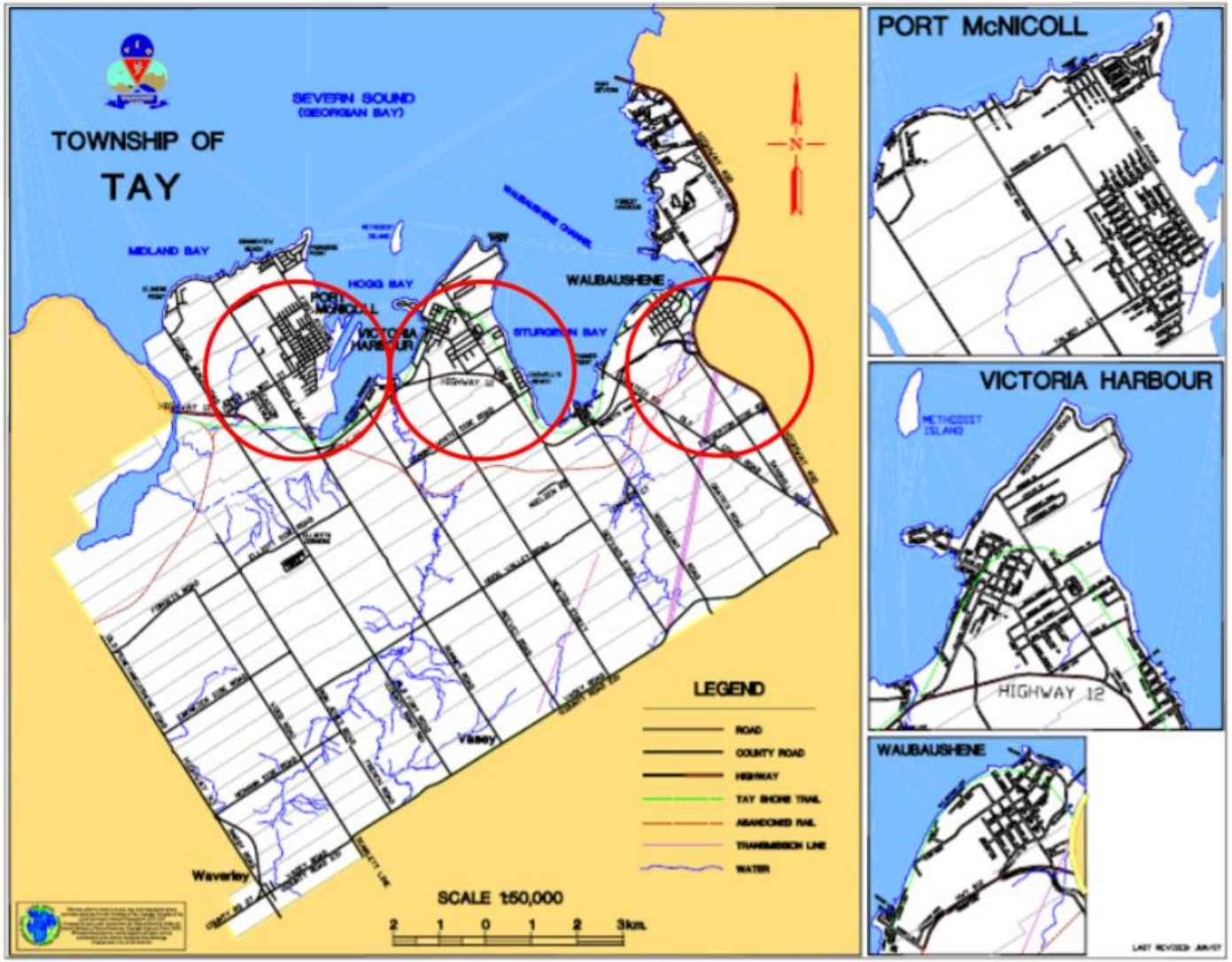




Source: Google Maps

*2016 data


Newmarket-Tay Power Distribution Ltd.
Newmarket Service Area as of April 4, 2008
TOWN OF NEWMARKET
TOWN OF NEWMARKET
TOWN OF NEWMARKET
Davis Dr
Davis Dr
Green Lake
Green Lake
Green Lake
Bathurst Street
Bayview Avenue
Woodbine Ave
ST JOHNS SIDEROAD
ST JOHNS SIDEROAD


TOWNSHIP OF
TAY
SEVERN SOUND
(GEORGIAN BAY)
MIDLAND BAY
HOGG BAY
PORT McNICOLL
VICTORIA HARBOUR
STURGEON BAY
WAUBAUSHENE
Victoria Passage
Waverley
Vasey
LEGEND
ROAD
COUNTY ROAD
HIGHWAY
TAY SHORE TRAIL
ABANDONED RAIL
TRANSMISSION LINE
WATER
SCALE 1:50,000
2 1 0 1 2 3km.
PORT McNICOLL
VICTORIA HARBOUR
METHODIST ISLAND
HIGHWAY 12
WAUBAUSHENE

Newmarket-Tay Power Distribution Ltd.

NTPDL - A Leader in Innovation

NTPDL IS COMMITTED TO SUPPORTING THE PROVINCE'S EFFORTS TO ATTAIN A RELIABLE AND BALANCED GRID

Newmarket-Tay Power Distribution Ltd.

We See System Challenges as Opportunities to Innovate

1. **Energy Conservation**
   - Deliver conservation programs to foster a conservation culture and contribute to overall reduction in provincial energy consumption.

2. **Demand Response**
   - Promote / Pilot programs that encourage peak shifting to lessen stress on the grid during peak periods.

3. **Small Scale Pilots**
   - Integrate new technologies on a small-scale to evaluate grid-interoperability and advise on large-scale, provincial deployment.

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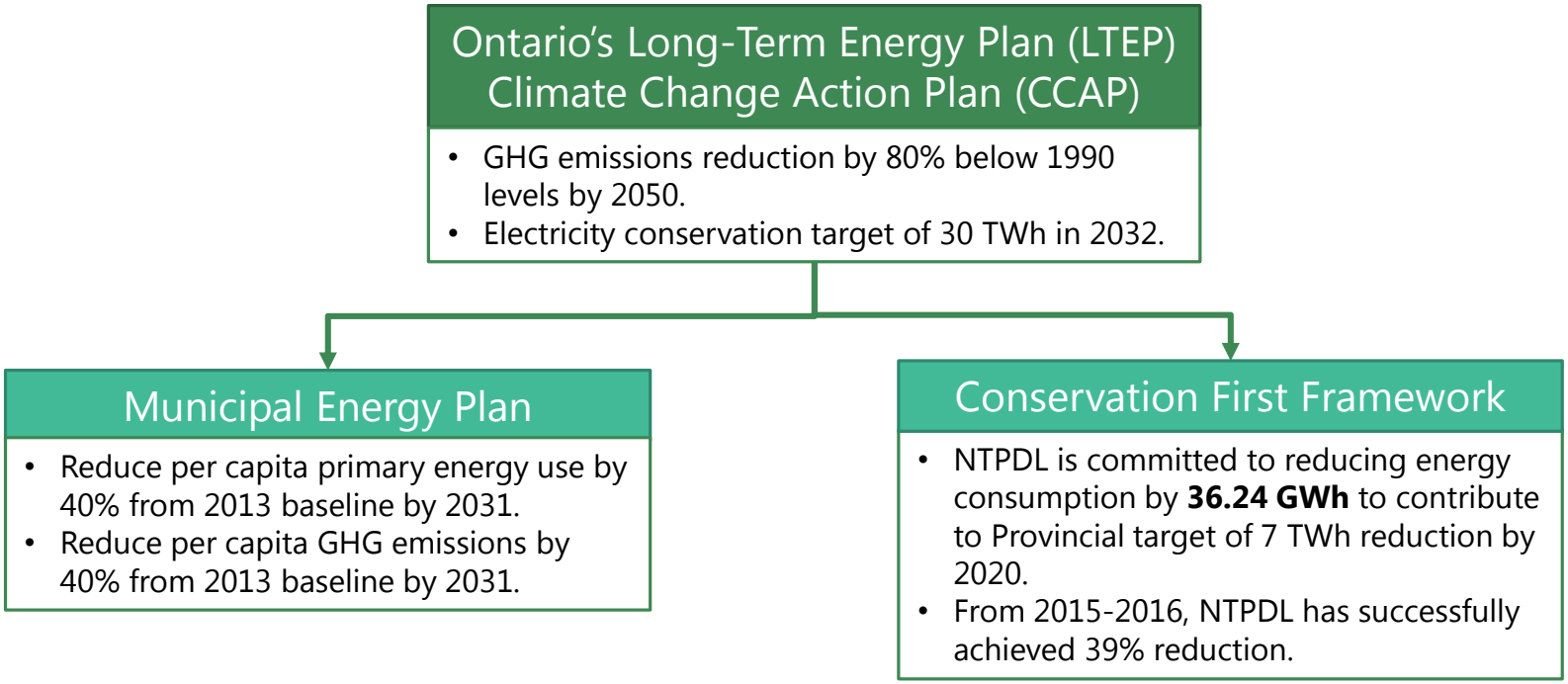
Energy Conservation

- NTPDL works hand-in-hand with the municipality to foster a culture of conservation in the community and support provincial and federal GHG reduction efforts.



Demand Response: Industrial Conservation Initiative

- Under ICI, large consumers are charged Global Adjustment (GA) based on their contribution to Ontario's top 5 demand hours over a 12-month period (Peak Demand Factor, PDF). Customers participating in ICI are referred to as Class A.

- **Eligibility:** Average Peak Demand > 1 MW or Average Peak Demand > 500 kW for manufacturing and industrial sectors only.

- Rather than paying Class B rates, Class A customers pay: **HOEP + GA** where GA is calculated as:

PDF x Ontario's Global Adjustment Charge

**Class B customers pay RPP (e.g. TOU rates, $/kWh consumed)*

What's Global Adjustment?

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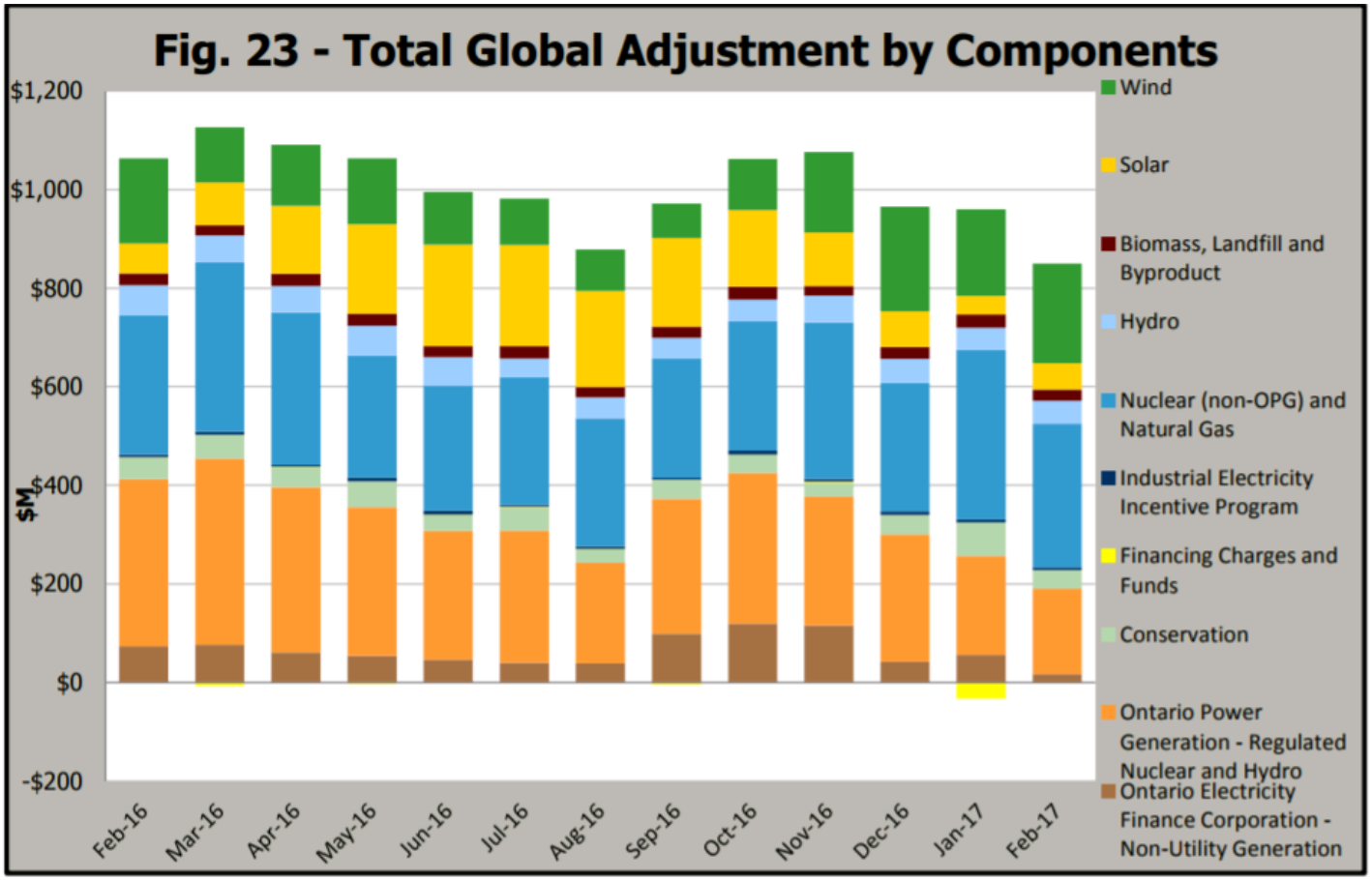

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2017 (M$)	927.7	850.1	770	965.7	1144.5	1208.8	1096.1					
2016 (M$)	1070.6	1063.7	1120.1	1090.7	1060.8	995.3	981.8	878.6	967.7	1062.3	1076.1	965.5

Source: IESO

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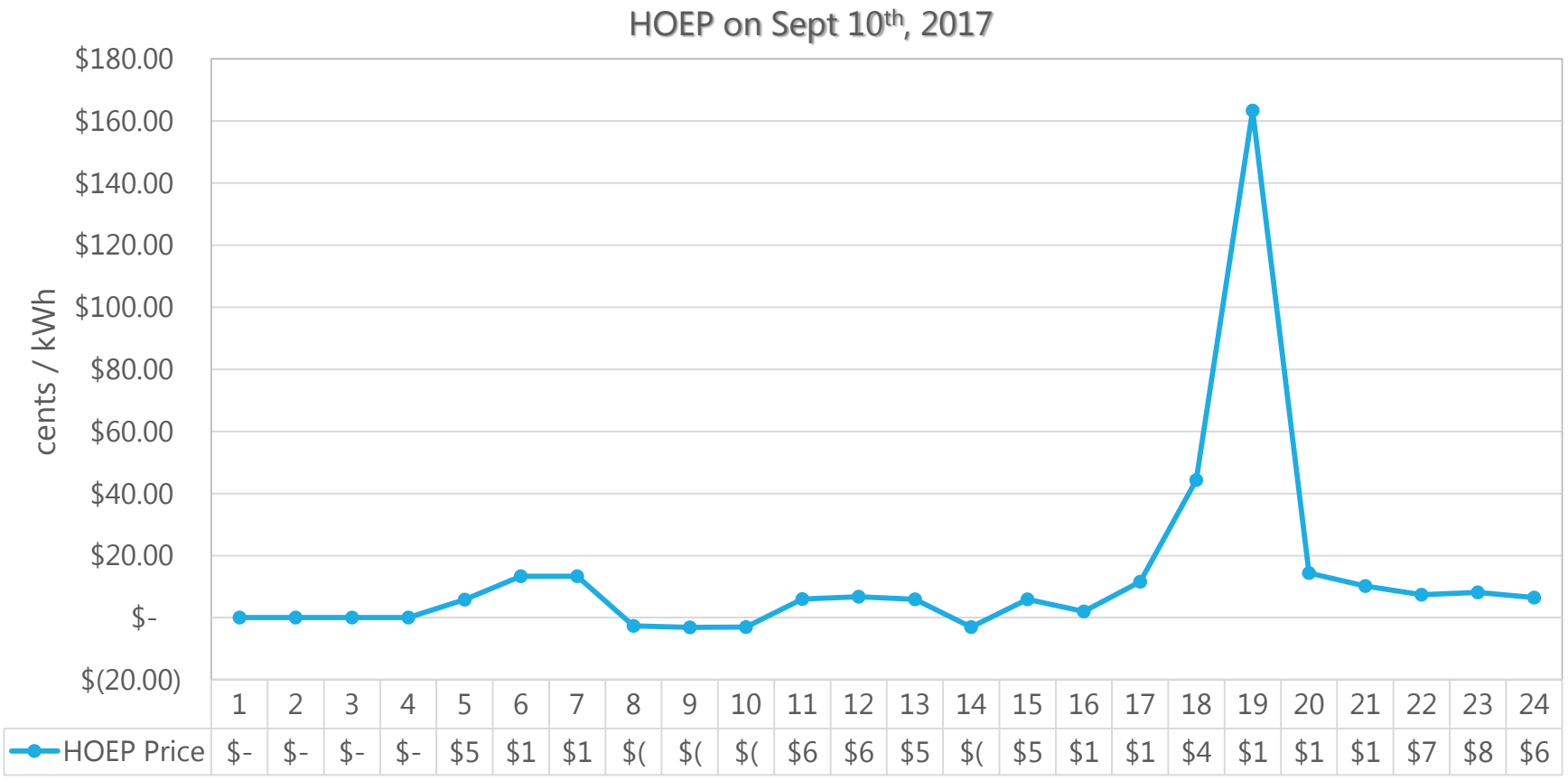
What's HOEP (Hourly Ontario Energy Price)?

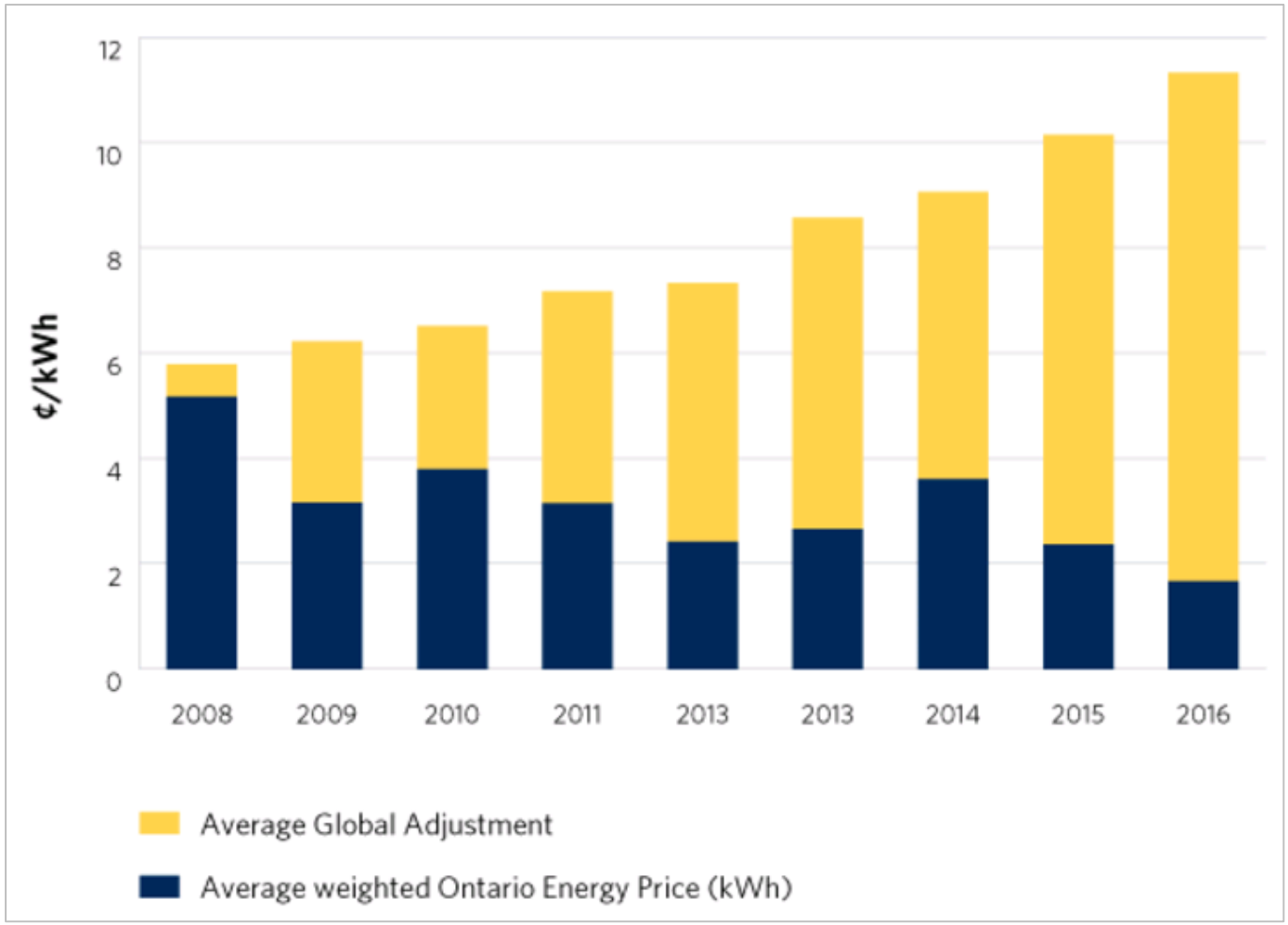


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
HOEP Price	$-	$-	$-	$-	$5	$1	$1	$(	$(	$(	$6	$6	$5	$(	$5	$1	$1	$4	$1	$1	$1	$7	$8	$6

***HOEP**: the commodity price for electricity in Ontario charged to large consumers and LDCs.*

Source: IESO

"Zero-Sum" – As HOEP goes Down, GA Goes Up



Source: IESO

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Demand Response: Industrial Conservation Initiative

- **Peak Demand Factor**: a customer's contribution to Ontario's top 5 peaks during the previous year.

Rank	Date	Hour Ending	AQEW (MW)	Customer's Contribution to Top Peaks (MW)
1	September-07-16	17	22,527	3.22
2	August-10-16	18	22,637	3.14
3	August-11-16	17	22,318	3.08
4	July-13-16	18	22,189	3.33
5	August-12-16	17	21,904	3.47
			111,575	16.25

PDF = 16.25 / 111,575 = 0.000145603

- By reducing their PDF by reducing consumption during Ontario Peak days, Class A customers can significantly reduce their Global Adjustment charge.

Demand Response: Time-of-Use (TOU) Pilot

- **Objective:** Will customers move energy-consuming activities to Off-Peak hours to take advantage of lower electricity TOU rates?

- **Parameters:** 250 residential customers were charged electricity at the below parameters during the pilot period of 2007 – 2009.

Time	Summer Period (May 1 – Oct 31)	Winter Period (Nov 1 – April 30)
Off-Peak	10pm – 7am* weekdays and all day on weekends and holidays	10pm – 7am* weekdays and all day on weekends and holidays
Mid-Peak	7am – 11am and 5pm – 10pm* weekdays	11am – 5pm and 8pm – 10pm* weekdays
On-Peak	11am – 5pm weekdays	7am – 11am and 5pm – 8pm* weekdays

Cents per kWh	Nov '06 - April '07	May '07 - Oct '07	Nov '07 - April '08	May '08 - Oct '08	Nov '08 - April '09	May '09 - Nov '09
On-peak	9.7	9.2	8.7	9.3	8.8	9.1
Mid-peak	7.1	7.2	7	7.3	7.2	7.6
Off-peak	3.4	3.2	3	2.7	4	4.2

- **Results:** Control group reduced their on-peak consumption by an average 2.8%, equivalent to taking 1,000 homes off the grid.

	Parameter Estimates
On-Peak	-2.80%
Mid-Peak	1.39%
Off-Peak	0.16%
Weekends	2.21%

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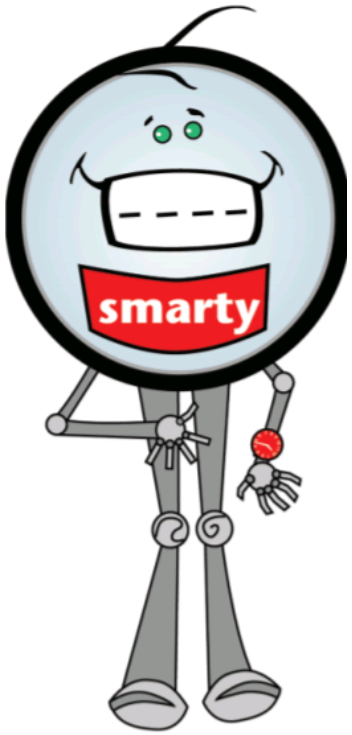
Demand Response: Time-of-Use Pilot

- NTPDL was at the forefront of Ontario's Smart Metering Initiative – led the Provincial rollout of smart meters by deploying 27,000 smart meters in 8 months across its entire customer base.

- Best practices executed for successful deployment:
  - Ran pilot to test customer receptiveness and technology.
  - Full roll-out of smart meters was completed in phases.
  - A character, "Smarty ", was created to help educate and market smart meter implementation in the community.
  - Hosted public meetings throughout the community to introduce smart meters and TOU.
  - Distributed brochures on smart meters, bill inserts on conservation tools and programs and advertising in local media.



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Small Scale Pilots: Battery Storage Pilot

- Ontario's Long-Term Energy Plan (LTEP, 2013) committed the province to procuring 50 MW of energy storage (ES) to learn how energy storage works in real-world applications.
- The IESO, tasked with fulfilling the 50 MW target, awarded contracts in 2 Phases to projects that will integrate ES technologies into the Ontario grid.

Phase	Proponent	Technology	MW
I	Canadian Solar Solutions Inc	Battery	4
I	Convergent Energy and Power LLC	Battery, Flywheel	12
I	Dimplex North America LTD	Thermal	0.74
I	Hecate Energy	Battery	14.8
I	Hydrogenics Corp.	Hydrogen	2
II	Ameresco Canada Inc.	Battery - Solid	4
II	SunEdison Canada Originiation LP	Battery - Flow	4
II	NextEra Canada Dev. & Acquisitions Inc	Battery - Solid	4
II	NRStor Inc	Compressed Air	1.75
II	Baseload Power Corp	Battery - Flow	2

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Small Scale Pilots: Battery Storage Pilot

- **Objective:** Determine if grid-connected battery storage can support "peak shaving" as well as provide on-going grid reliability and stability as more renewable energy come online.

- **Parameters:** Ameresco will design, build, own, operate and maintain 2 x 2 MW, 4-hour "Battery Solid", Tesla Powerpacks. Battery systems will be connected to Newmarket Hydro's 44 kV feeders. The IESO will manage discharge and dispatch of batteries.

- **Status:** in planning stage – Target in service, May 2018. Ameresco has up to 30 months to come into service and a contract term of 10 years.

- NTPDL will use the best practices accredited to success of smart meter roll-out to ensure community education and acceptance.

Small Scale Pilots: Battery Storage Pilot

Source: Tesla Powerpack installation in California.

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Small Scale Pilots: Transit Electrification

- NTPDL is first in Ontario to participate in an electric bus pilot project as part of CUTRIC* “Pan-Ontario Electric Bus Demonstration and Integration Trial”.
- This Trial will add 6 electric buses to 2 transit routes on the York Region Transit (YRT) as well as an overhead on-route bus charging station.

CUTRIC CRITUC
FASTER • SMARTER • GREENER RAPIDE • INTELLIGENT • VERT

YORK REGION TRANSIT \ VIVA

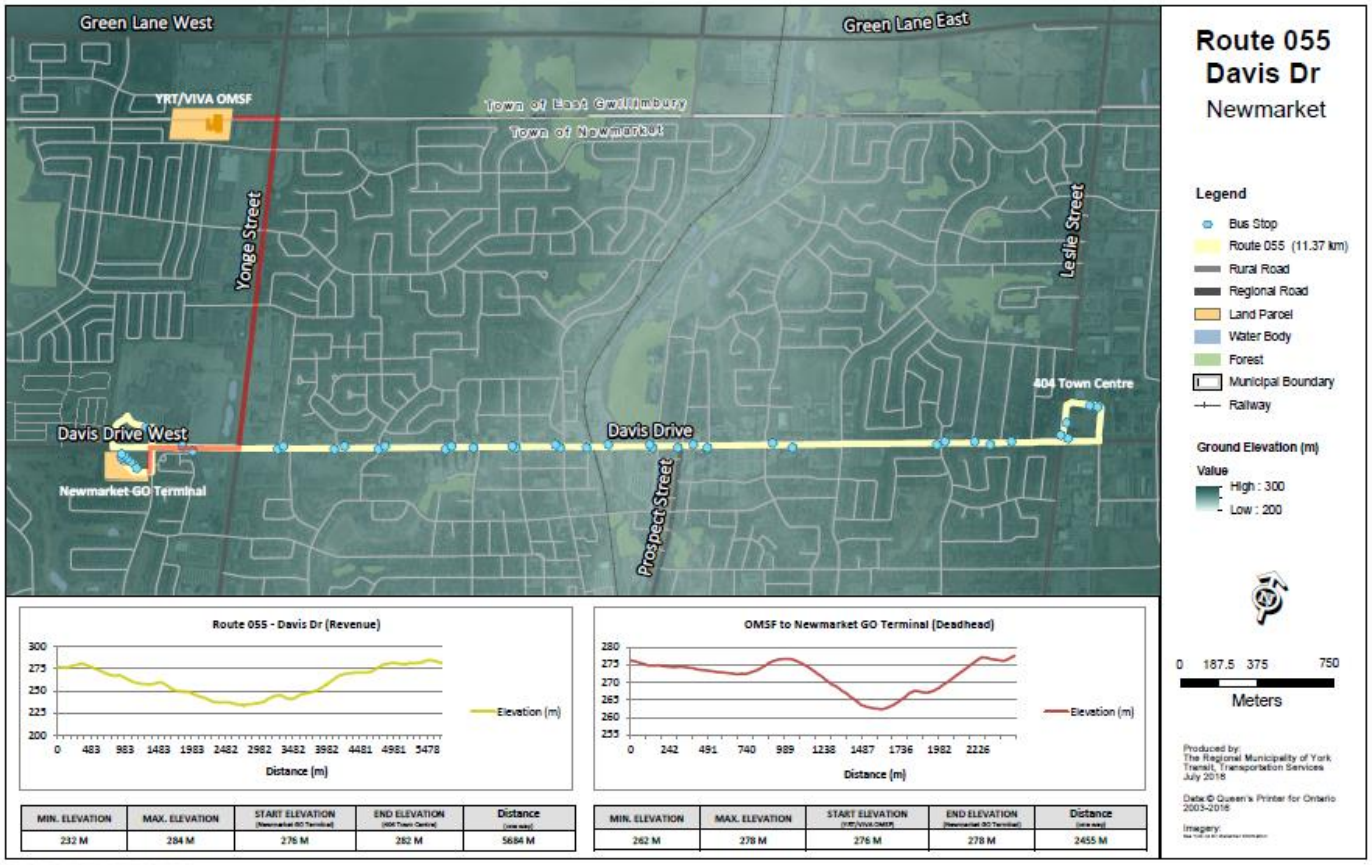
*Canadian Urban Transit Research & Innovation Consortium

Newmarket-Tay Power Distribution Ltd.

Fundamentals

- Two different Canadian-manufactured bus types will be used, to be owned by YRT:
  - 4 by New Flyer (200kWh – long range)
  - 2 by NOVA Bus (76kWh – short range)
- The overhead bus charger, to be owned and maintained by NTPDL, provides on-route opportunity charging for the buses. (up to ~5 min charge time). Result is range extension.

Davis Drive Route 55

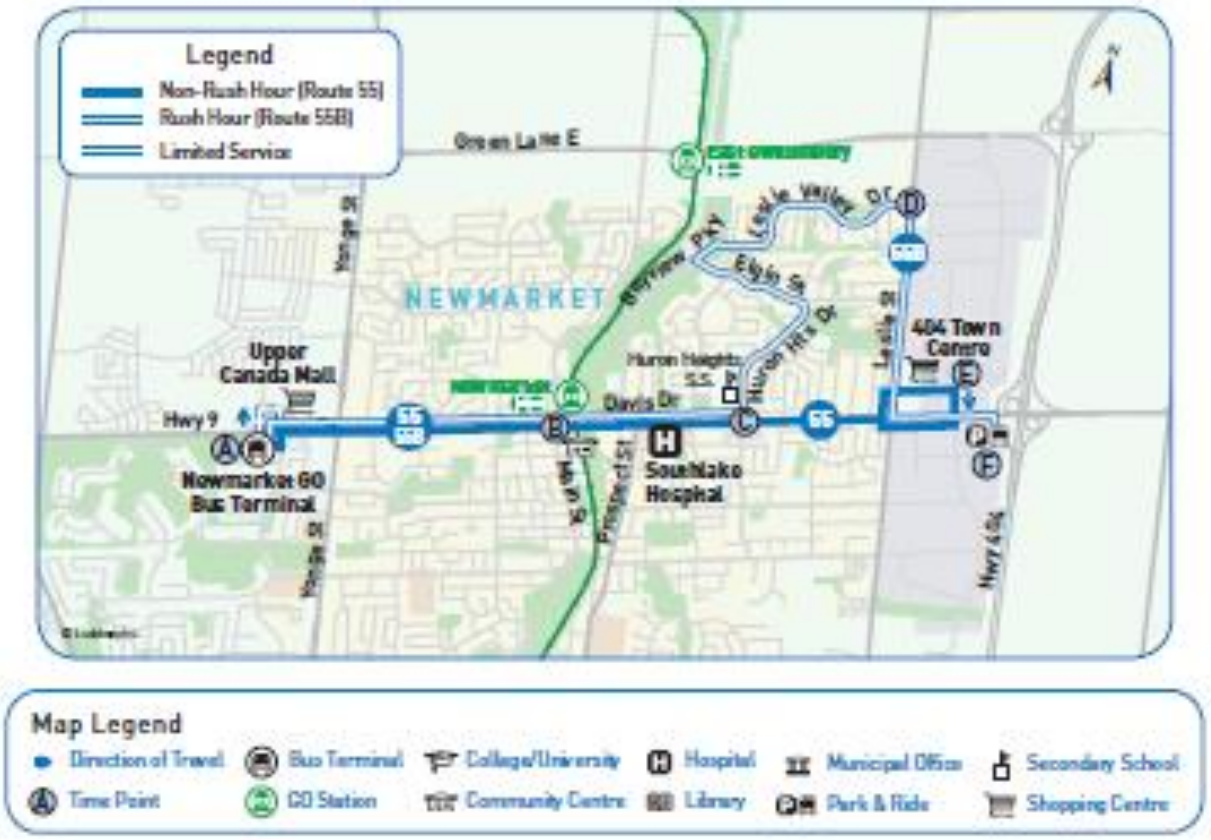


MIN. ELEVATION	MAX. ELEVATION	START ELEVATION	END ELEVATION	Distance
232 M	284 M	276 M	282 M	5684 M

MIN. ELEVATION	MAX. ELEVATION	START ELEVATION	END ELEVATION	Distance
262 M	278 M	276 M	278 M	2455 M

Newmarket-Tay Power Distribution Ltd.

Davis Drive Route 55



Bristol Route 44

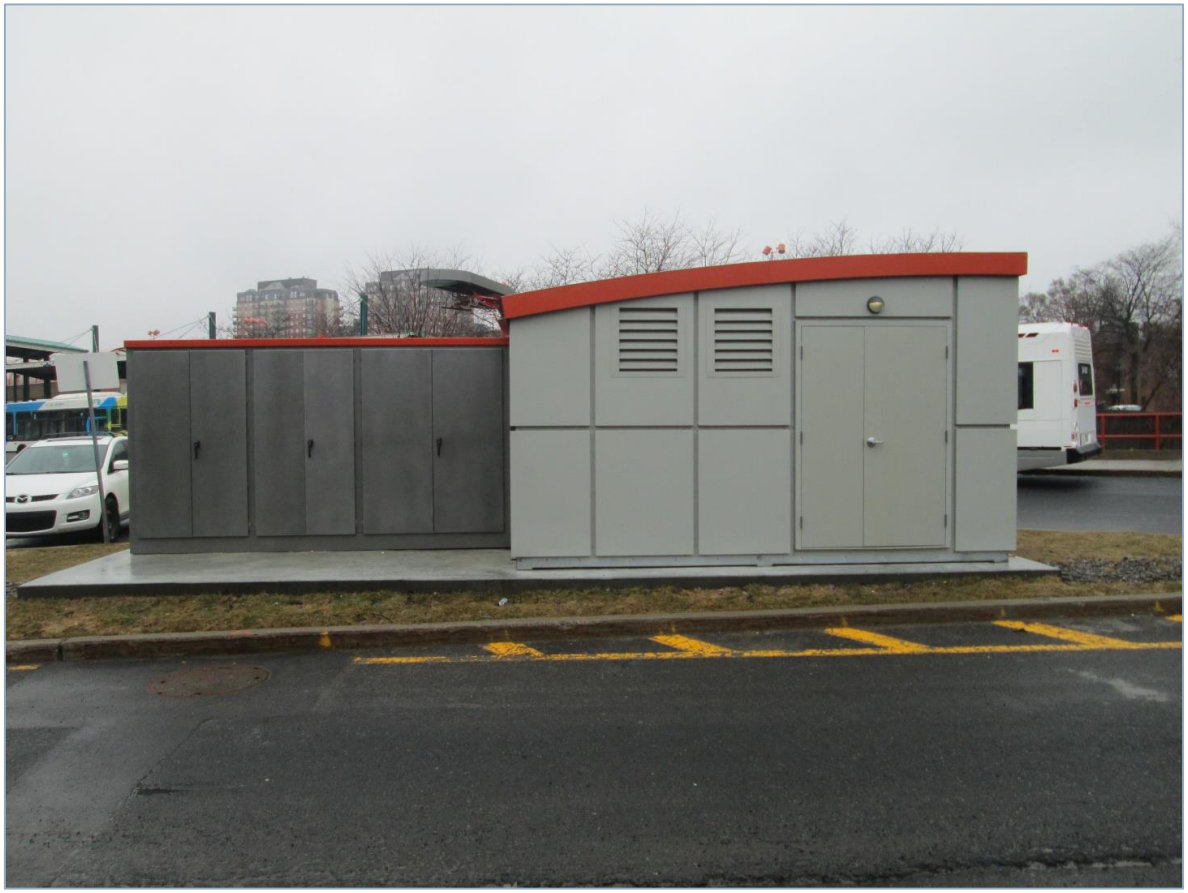
Newmarket-Tay Power Distribution Ltd.

EV Overhead Charger Specifications

Input Voltage	600/347V (+/- 5%) AC (60Hz) 3 phase, 4 wire
Output Voltage	Within 450 – 750V DC range
Power Rating	450kW DC maximum output power

- Limit on total harmonic distortion is not to exceed 5%
- Overhead inverted pantograph based on OppCharge Automatic Conductive Charging Interface
- DC connection standard based on IEC 61851-23
- WiFi communication charger/vehicle via IEEE 802.11a (5 GHz)/ compliant with ISO 15118

EV Bus Charger substation



EV Bus Charger Mast / Bus Charging

EV Charger location

Newmarket Bus Terminal – Davis & Eagle – Electrical Infrastructure

Trial Outcomes

NTPDL believes this trial will serve not only as a technology testbed but also as a nexus for economic growth provincially and nationally, and it will create environmental and social benefits for Ontarians and Canadians in the following ways:

1. Provide a basis for development of EV transit infrastructure in Ontario and provide the market for promoting investment in vehicles and charging infrastructure production facility.
2. Demonstrate the ability to reduce GHG emissions through electrification of bus transit routes thereby supporting Provincial and Federal GHG reduction targets.
3. Support the goals of Ontario's Long Term Energy Plan and the Town of Newmarket's Municipal Community Energy Plan.

Route 55 is expected to reduce GHG emissions by 60,000 – 120,000 kg of CO_2 per year. YRT target is to be GHG free by 2051.

Newmarket-Tay Power Distribution Ltd.

Obstacles

- Regulatory limitations on charger ownership
- Charger location
- Charger familiarity
- Demand Charges
- Cost
- Limited local support at present for charger (parts, maintenance, etc.)
- Maintaining on-time performance

Risks

- Long term reliability of the station infrastructure.
- Post-trial cost of ongoing maintenance and support for the charging station infrastructure.
- Changes in the route/changer location affecting cost and servicing ability.
- Commitment of the local transit agency to continue EV bus utilization on the Trial specific route once the Trial is completed.
- Existing charging station compatibility with finalized plug-and-play overhead charging systems and future busses to be procured by the local transit agency.
- Ability to access charging station/EV vehicle data required for performance analysis throughout the trial period.

Risks

- Lack of certainty as to whether the bus, the charging station, and the utility can communicate with one another seamlessly to support demand management mechanisms or load-shifting wherever and whenever appropriate - currently, charging station providers have not demonstrated data confirming that their communications tools have been optimized for the Canadian or Ontario utility context.
- Current and future regulatory decisions affecting charging station ownership and operation, electricity rates for charging EVs, and ability of LDCs to make a rate of return on the charging stations investment.
- The charging station is a specific infrastructure installation to service EV transit busses. At this time, it cannot be used for other EV or electrical grid purposes. The above risk could potentially affect the long-term utilization and usefulness of the facility to NTPDL.

Thank You!

Q&A

Newmarket-Tay Power Distribution Ltd.