



Changing Perspectives in Ontario's Electricity Industry

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VP – Innovation & Growth



Program Overview



1. Electricity 101
2. Ontario's Electric Grid
3. Deregulation
4. Industry Challenges
5. New Opportunities
6. Future Reflections

Electricity 101

- 1752 – Benjamin Franklin



Electricity 101

- Edison
~ 1878

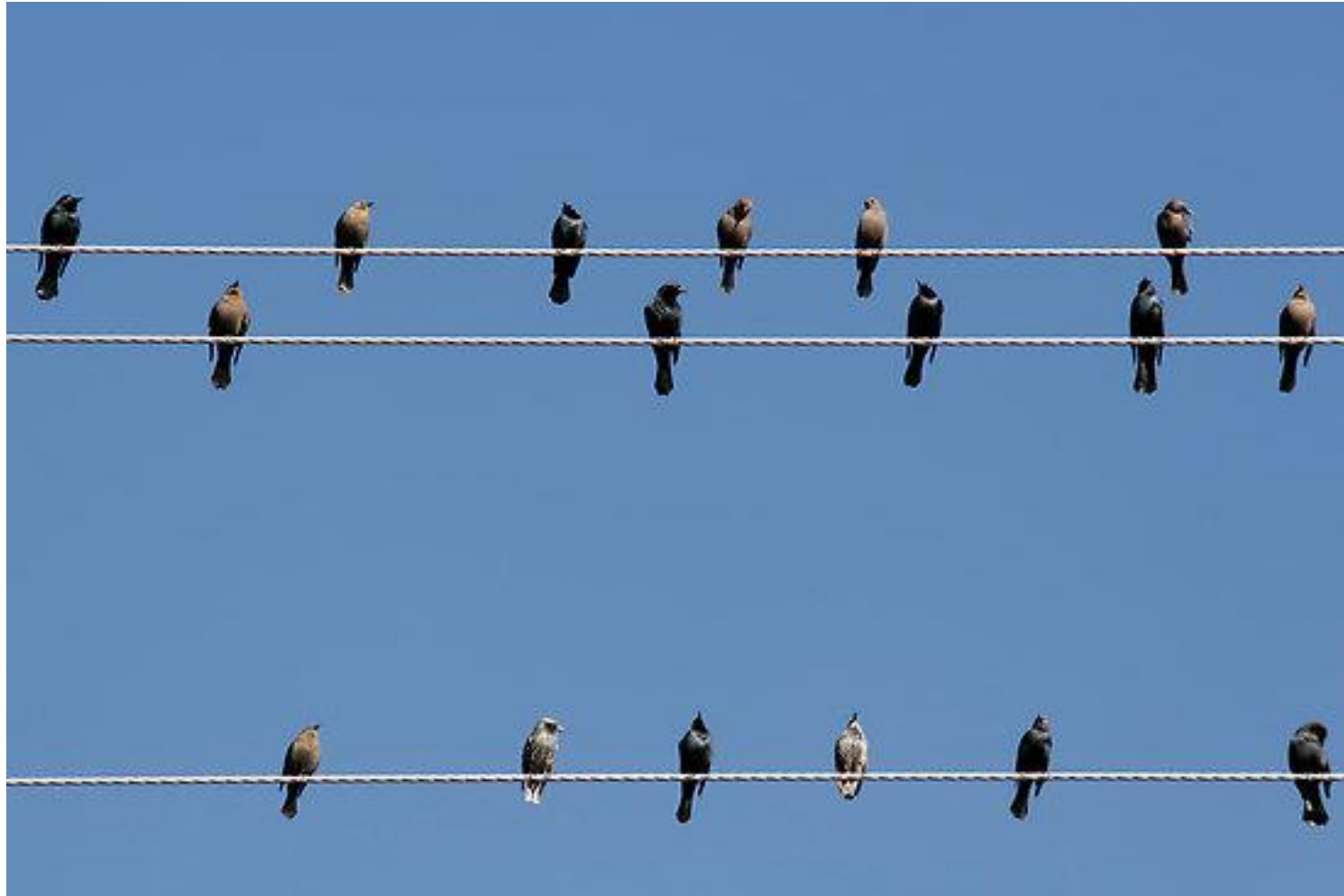


Electricity 101

- 1900 – Nikola Tesla



Electricity 101



A GENERATOR

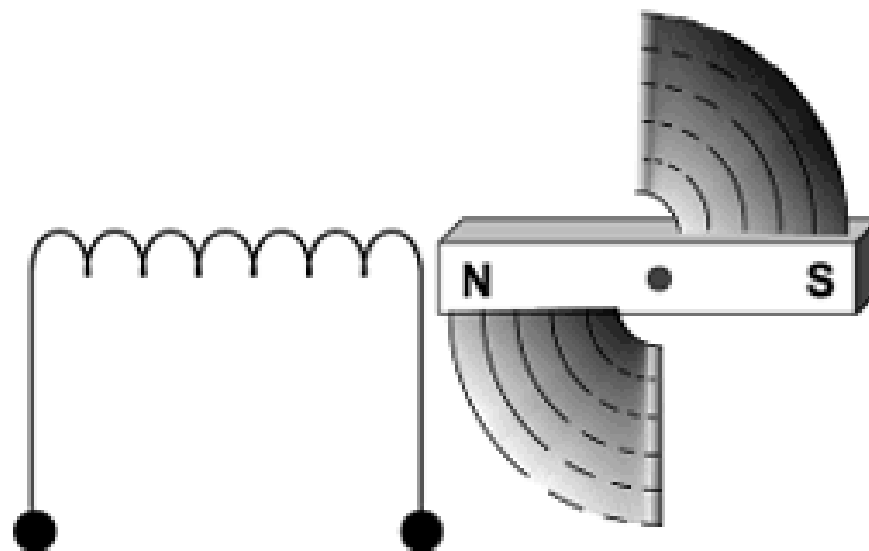
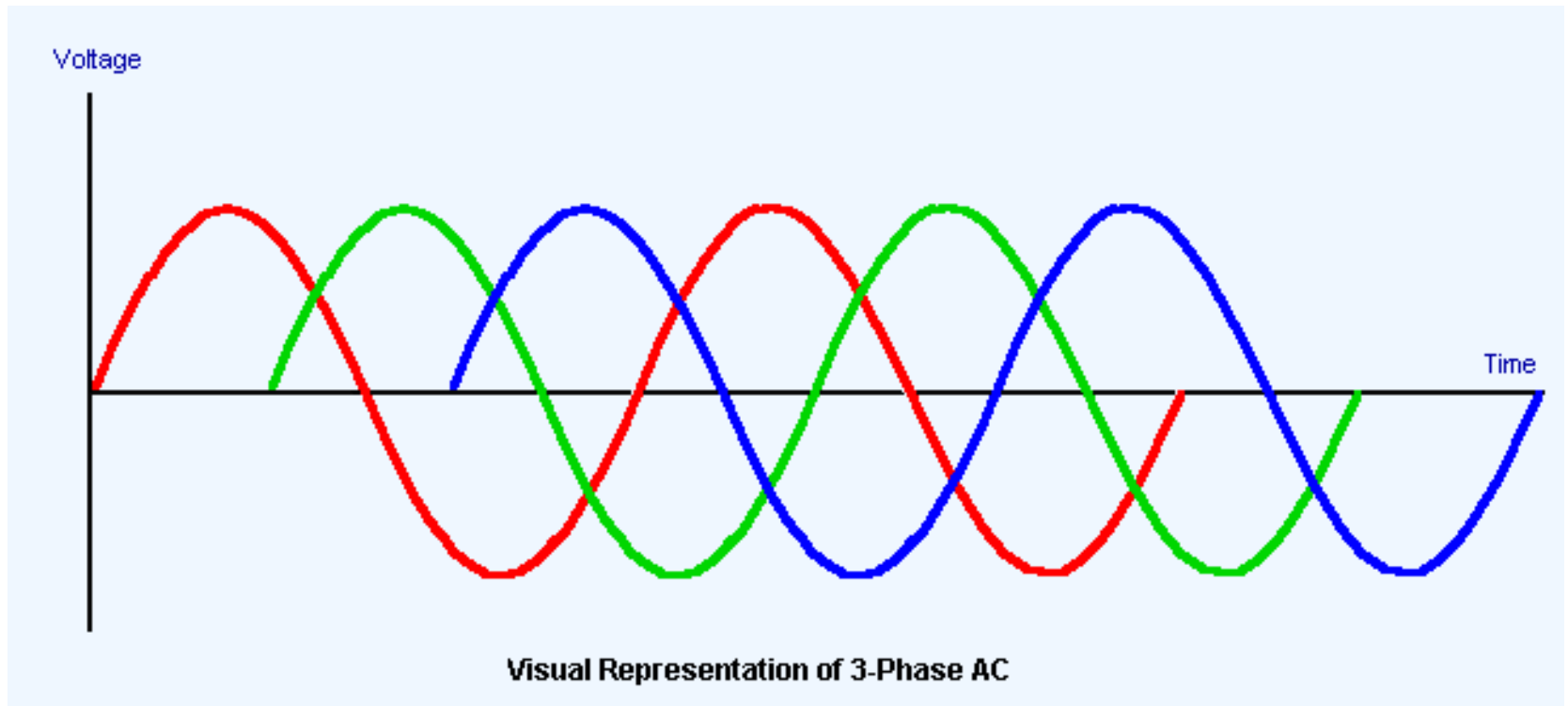
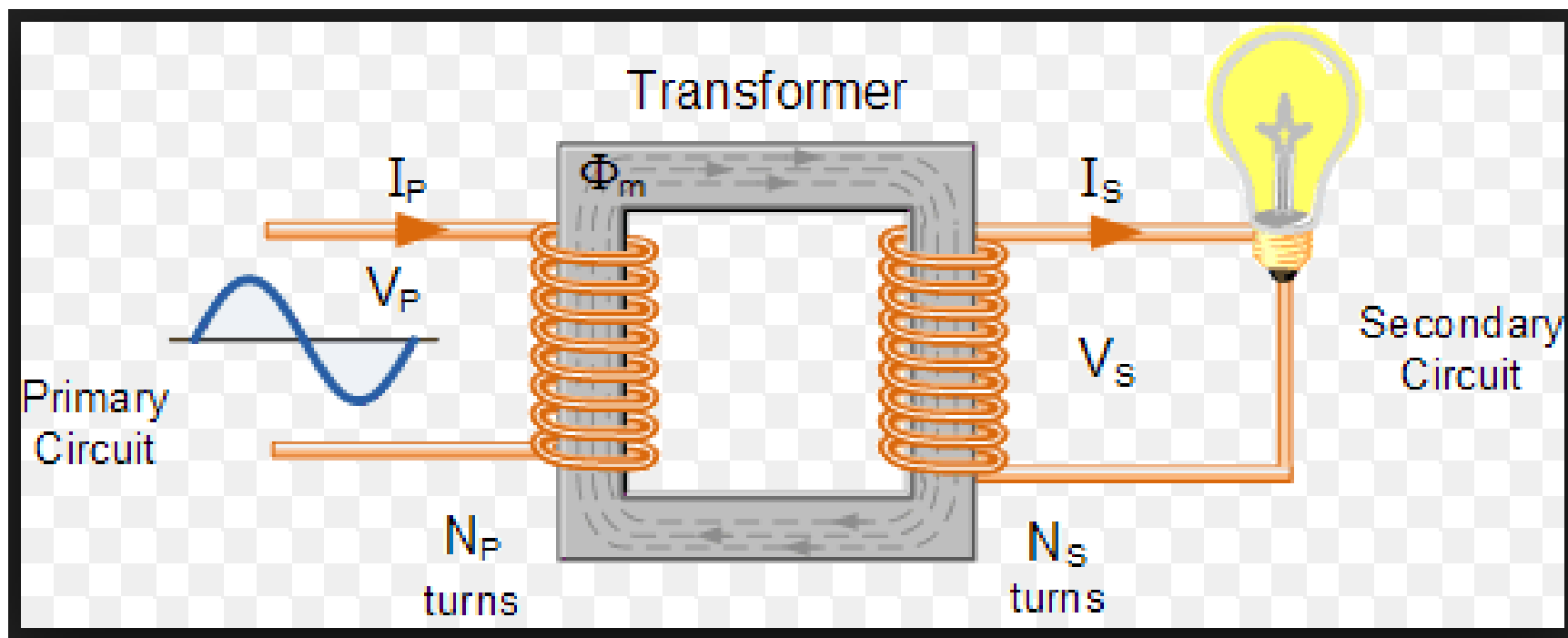


Figure 1: To generate electrical power, a coil is mounted close to a magnet that is spinning on a shaft. As the poles of the magnet sweep past the coil, voltages of alternating polarity are induced in the coil.

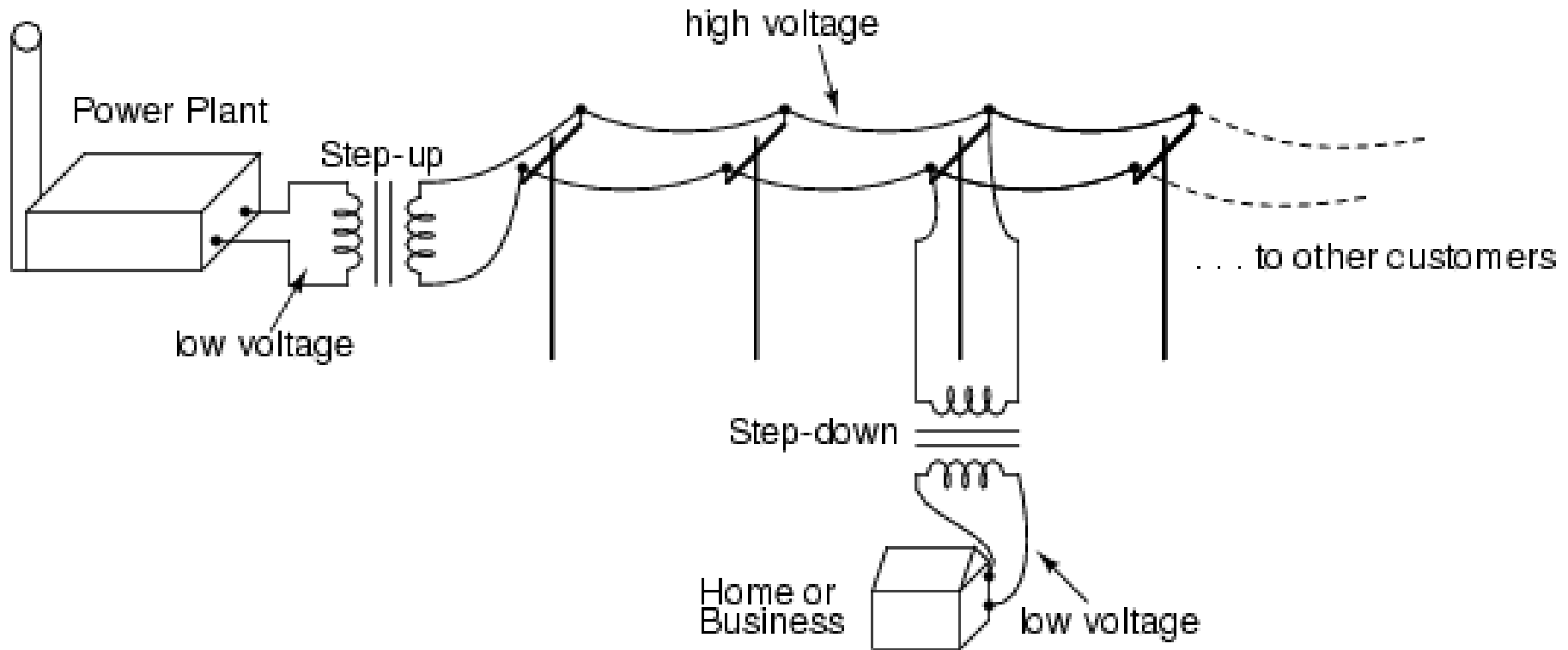
Electricity 101



Electricity 101



Electricity 101



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Ontario's Electric Grid



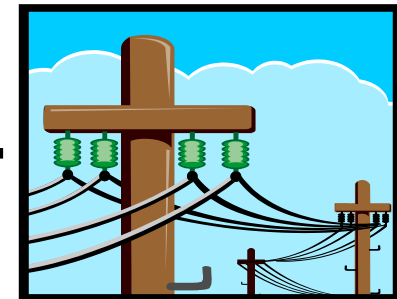
**Generators - OPG /
Bruce Power, Others**



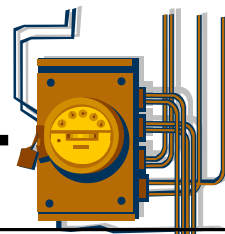
**Transmitters - Hydro One /
Great Lakes Power**



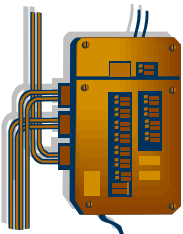
Transformer Stations



**Distribution
System**



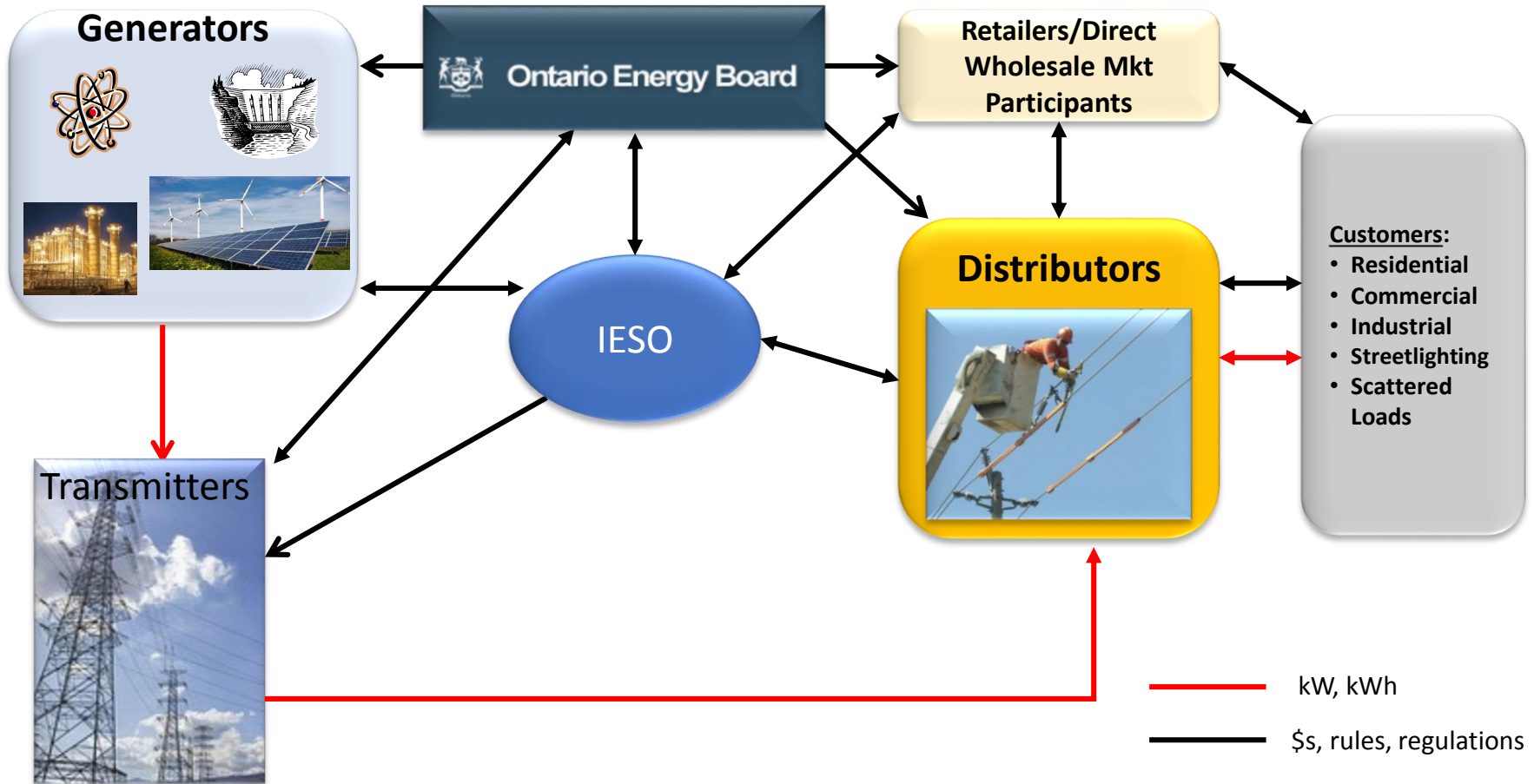
**Customer Demarcation
Point - Meter and our
Customer's Meterbase**



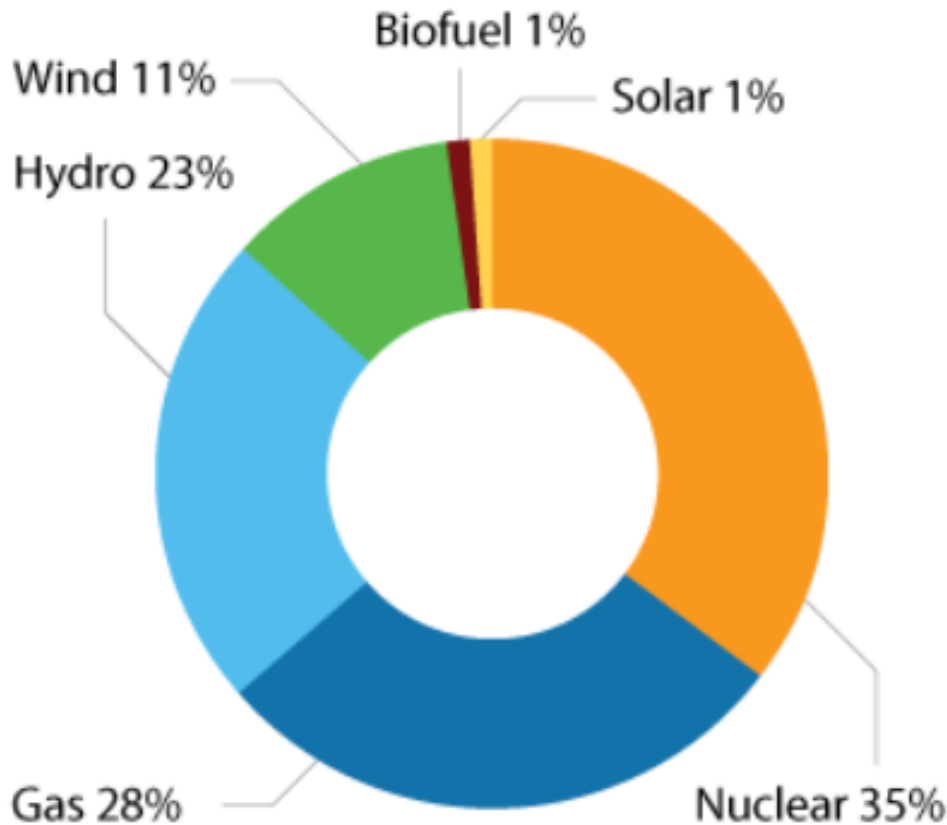
**Utilization by the
Customer**



Ontario's Electric Grid

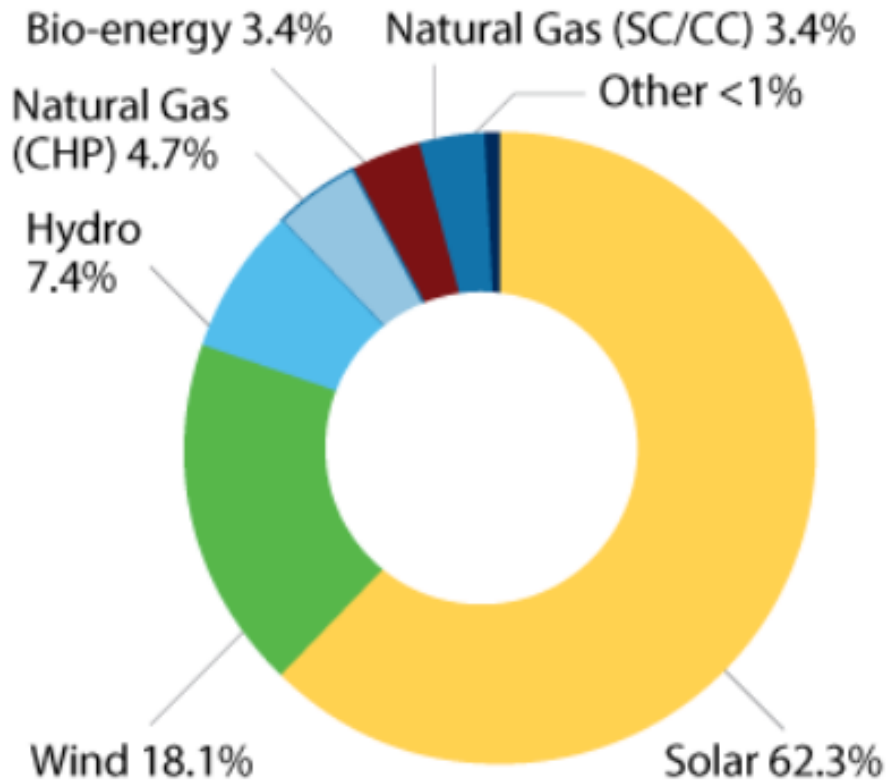


Ontario's Electric Grid



Nuclear	13,009 MW or 35%
Gas/Oil	10,277 MW or 28%
Hydro	8,480 MW or 23%
Wind	4,213 MW or 11%
Biofuel	495 MW or 1%
Solar	380 MW or 1%

Ontario's Electric Grid



Solar	1,997.0 MW or 62.3%
Wind	579.8 MW or 18.1%
Hydro	239.2 MW or 7.4%
N. Gas (CHP)	150.2 MW or 4.7%
Bio-energy	108.7 MW or 3.4%
N. Gas (SC/CC)	108.4 MW or 3.4%
Other	24.2 MW or <1%

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1995 - MacDonald Report

- Wholesale competition
 - Generators should compete to supply electricity
 - Dismantling of Ontario Hydro's generating assets - Monopoly
- Retail competition
- Creation of independent electricity system operator to coordinate dispatch of electricity in the province (IESO)
- Restructured distribution
 - Industry consolidation
 - Result: 300 utilities reduced to 90 (approx.)

1997 - Energy Competition Act – Bill 35

- Divided Ontario Hydro into:
 - Ontario Power Generation – generation assets
 - Hydro One – transmission system
 - Ontario Electricity Financial Corporation – debt and stranded debt
 - Assigned existing debt to successors
- Required all municipalities to transfer assets of electric utilities to new Ontario Business Corporation Act companies
 - Board structure
 - For-profit or non-profit structures
 - 1998 - Local Distribution Companies (LDCs) transformed into commercial entities
- Ontario Energy Board regulator for, all including distribution utilities
 - Set rates for IESO, Hydro One, others...
 - Established how Local Distribution Companies (LDCs) would recover energy costs – full pass through, no hedging

2002 - Competitive Market

- May 1, 2002 – Market opened
- Perfect storm
 - Hottest summer in 50 years resulted in record demand for electricity
 - Lack of rain = reduced hydro power
 - Coal and nuclear plants – unplanned shutdowns
 - High demand and limited supply
 - Residential consumers exposed to widely fluctuating and skyrocketing spot prices
 - Hedging of electricity prices by LDCs too risky
- November 2002 – Bill 210 - electricity rates for consumers capped – wholesale market for generators and large buyers
 - Cost to debt of capping electric rates to consumers, over \$1 billion
 - Energy prices were higher than the cap
 - Little to no consultation with industry
 - Contributed to downfall of Eves' Government

2004 – Electricity Restructuring Act

- Creation of Ontario Power Authority (OPA) to forecast and ensure an adequate, long-term supply of electricity through standard offer contracts
 - OPA had the adequacy obligation
- Creation of Conservation Bureau to increase energy conservation
 - Subsequently became part of the OPA
- Minister of Energy to set province-wide targets for conservation, renewable energy and supply mix
- Ontario Energy Board responsible for market surveillance

2009 – Green Energy and Economy Act

- Energy conservation
- Renewable energy
 - Feed-in-Tariff programs (FIT, microFIT)
 - Encourage investment in renewable generation
 - Coal-fired generation that will be eliminated by 2014
 - Canada's single biggest climate change initiative
 - LDCs required to connect renewable energy
 - LDCs responsible for infrastructure upgrades
 - Utilities (and municipalities) permitted to build, own and operate renewable energy projects (not previously allowed under the regulated banner)
- Smart grid development
 - Many elements of this already in place



2013, 2017 Long Term Energy Plan

- Current Plan –

1. Affordable and Accessible Energy
2. Flexible Energy System
3. Innovating to Meet Growth
4. Improving Value and Performance
5. Commitment to Conservation and Efficiency
6. Responding to Climate Change
7. Supporting First Nation/Metis Capacity and Leadership
8. Supporting Regional Solutions and Infrastructure



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Industry Challenges

1. Cost Pressures
 - Global Adjustment
 - Efficiency
2. System Capacity & Reliability
 - Load growth
 - Weather events
 - Aging infrastructure
3. Technology
 - Grid defection
 - Distributed generation
 - Electric vehicle charging

Industry Challenges

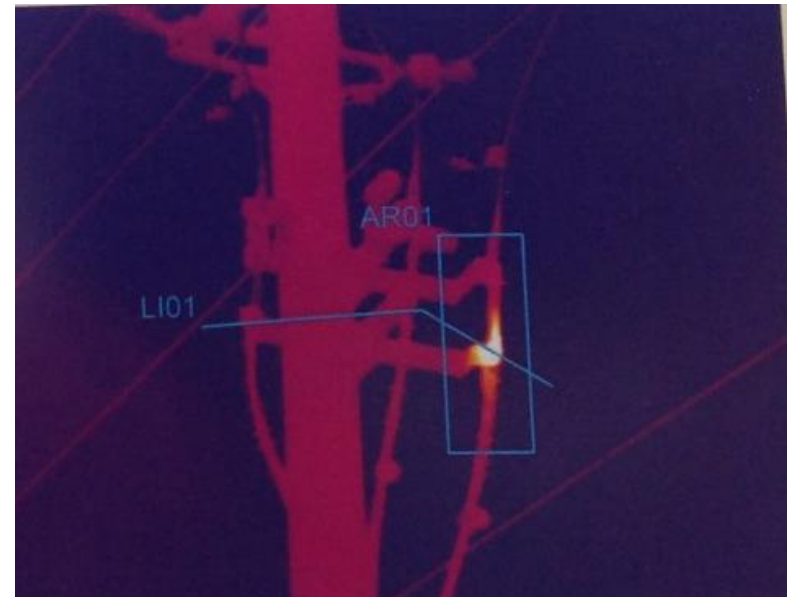
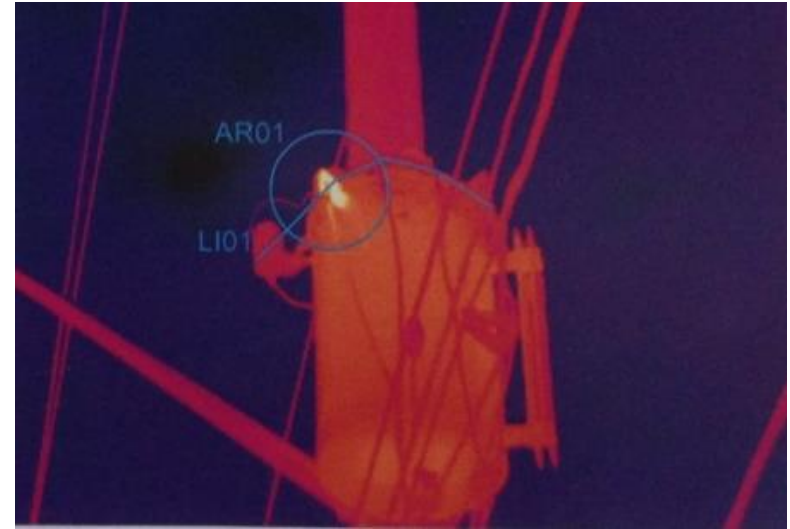
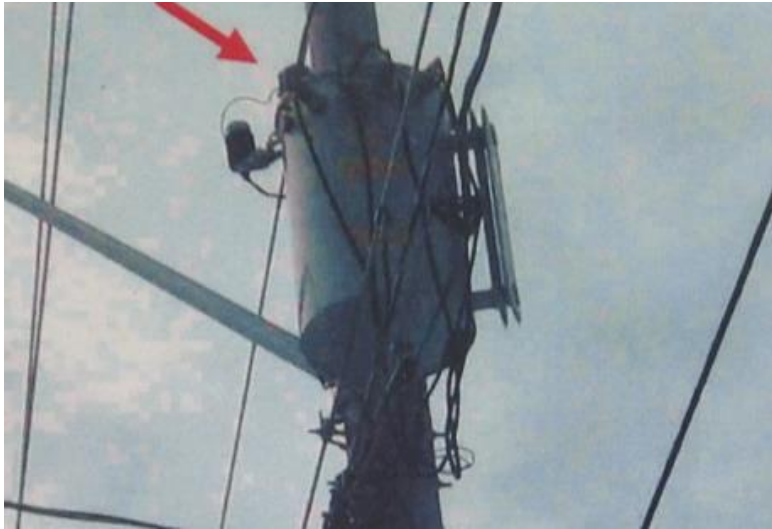
Weather extremes are the new normal -

- 2017- Most destructive Atlantic hurricane season
- 2016 – Windsor area floods, Fort McMurray fires, Ontario’s earliest recorded tornado
- Summer 2015 – Burlington area floods
- 2014 – Various floods
- December, 2013 – Ice storm,
- April 12, 2013 Local ice event
- October 29, 2012 – Hurricane Sandy
- August 21, 2011 – Goderich Tornado
- December 12, 2008 – New York Ice Storm
- August 30, 2005 – Hurricane Katrina
- August 14, 2003 – North Eastern Blackout
- January 9, 1998 – Ice Storm ’98
- May 31, 1985 – Barrie Tornadoes
- April 3, 1974 – Windsor Tornado
- October 5, 1954 – Hurricane Hazel

Industry Challenges



Industry Challenges



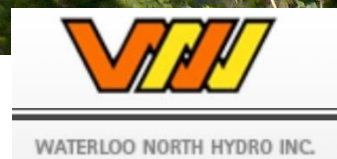
Industry Challenges





Hurricane Sandy

STORM RESPONSE
Long Island Power Authority

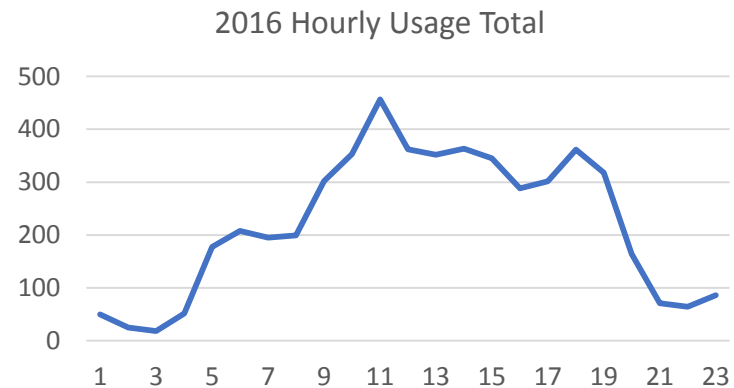
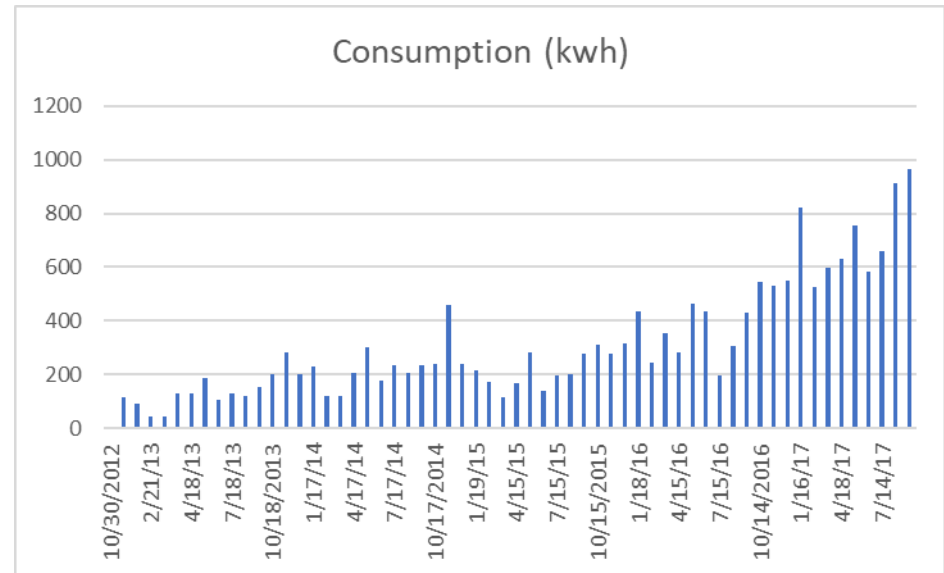




Industry Challenges



Industry Challenges



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New Opportunities

1. FIT Program status
2. Net Metering
3. Conservation
4. Energy Storage
5. Distributed Generation
6. Microgrids
7. Cap & Trade

New Opportunities

FIT Programs:

- FIT 5 – Ended September, 2017
- MicroFIT program - accepting new applications until December 28, 2017 - or sooner if procurement target met.
- Replacement programs coming

2. Net Metering

- Allows customers to offset bill over 12 months
- New regulations 2017 –
 - Size limitations removed
 - Energy storage component allowed
- Virtual Net Metering coming soon:
 - Community renewable enabler
 - Savings in scale, flexibility
 - Allows for multiple loads to be ‘virtually’ connected

CDM Still Going Strong –

- Latest program: 2015 – 2020
- Utility targets increasing for customers' kWh savings
- Confusion between this and new “Green Ontario Fund” programs
- Positive customer feedback

New Opportunities



5. Distributed Generation

- Behind the meter
 - Islanding capable
 - Load Shifting (Global Adjustment)

- Utility scale
 - Islanding capable
 - Load Shifting (HOEP)

New Opportunities

Microgrid research



-  Mini-grid Control System
-  PV system
-  Wind Turbine
-  Flywheel
-  Battery Storage System
-  Load Banks
-  Diesel Gensets
-  Grid Simulator
-  PV Solar Simulator
-  Wind Simulator
-  Forecasting

7. Cap & Trade Program

- Implemented January, 2017
- Emission reporting
- GHG reduction credits
- Green Ontario Fund
- Grid Impacts

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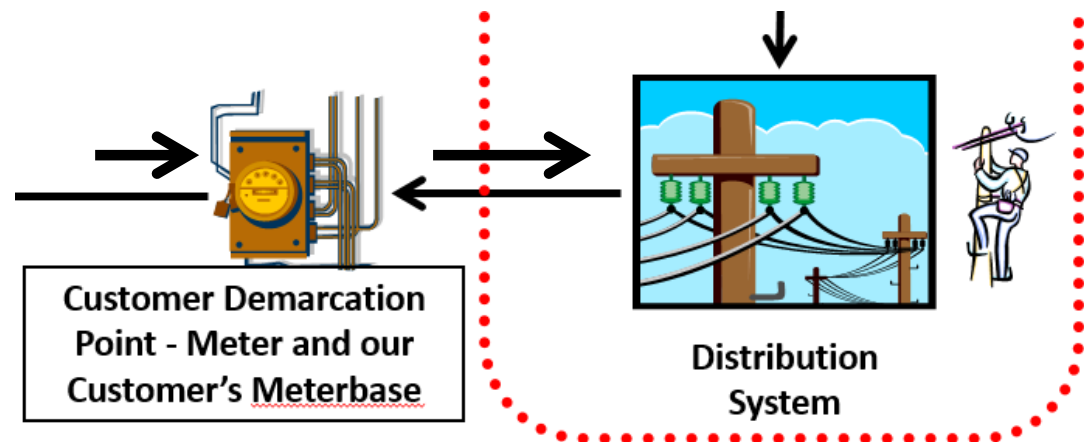
Future Reflections

1. Utility 3.0
2. Increased Energy Storage
3. Transactive Energy
4. Continued GHG Reduction
5. Hydrogen

Future Reflections

1. Utility 3.0

- Services oriented
- Customer relationships key
- Community energy oriented
- Transactive energy enabler
- Integrated offerings



Future Reflections



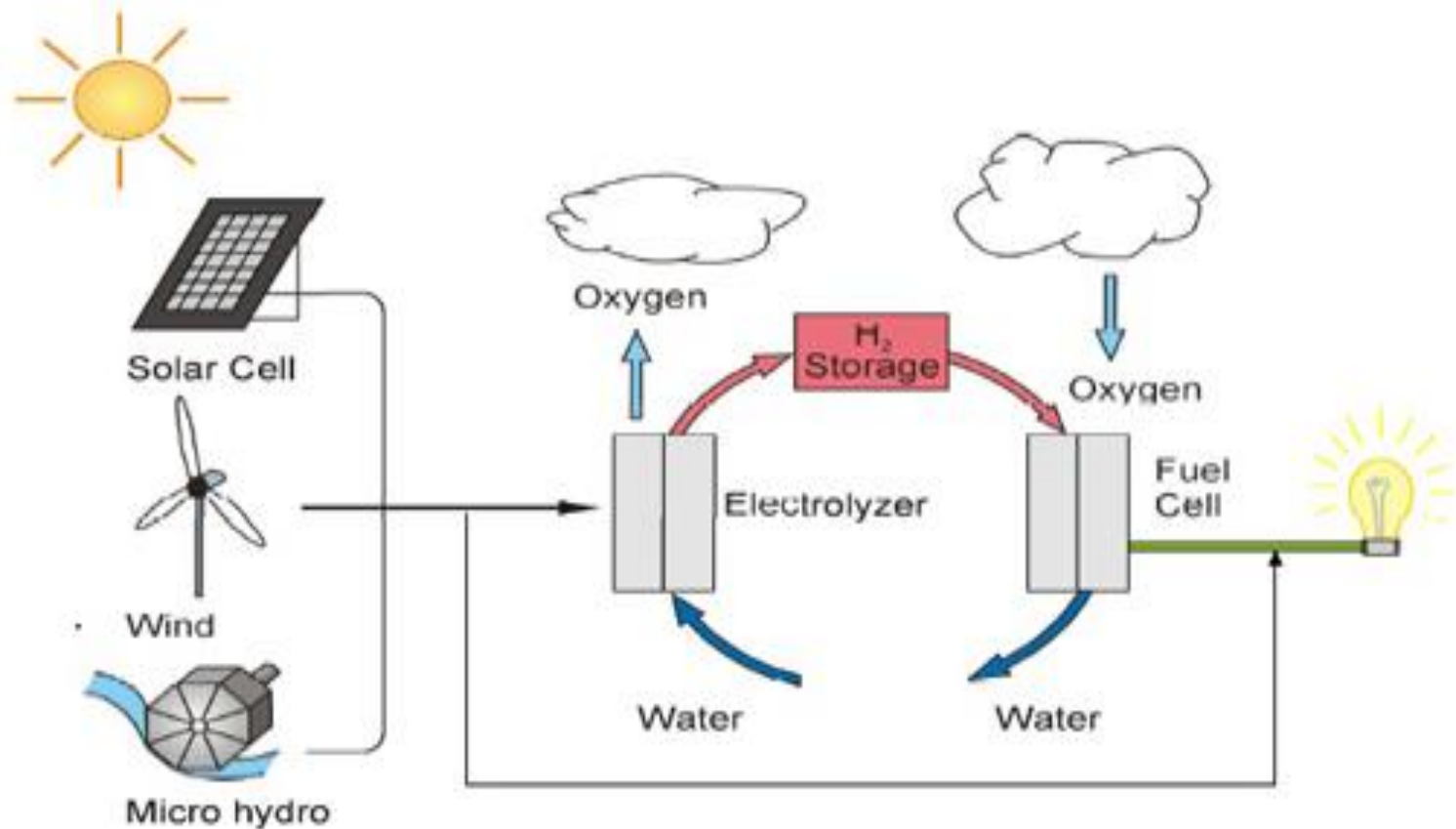
Future Reflections

3. Transactive Energy
 - Brooklyn Microgrid



Future Reflections

5. Hydrogen



Future Reflections



Future Reflections





Thank you !

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