Climate Change, Electricity the Future of Ontario's Energy Systems

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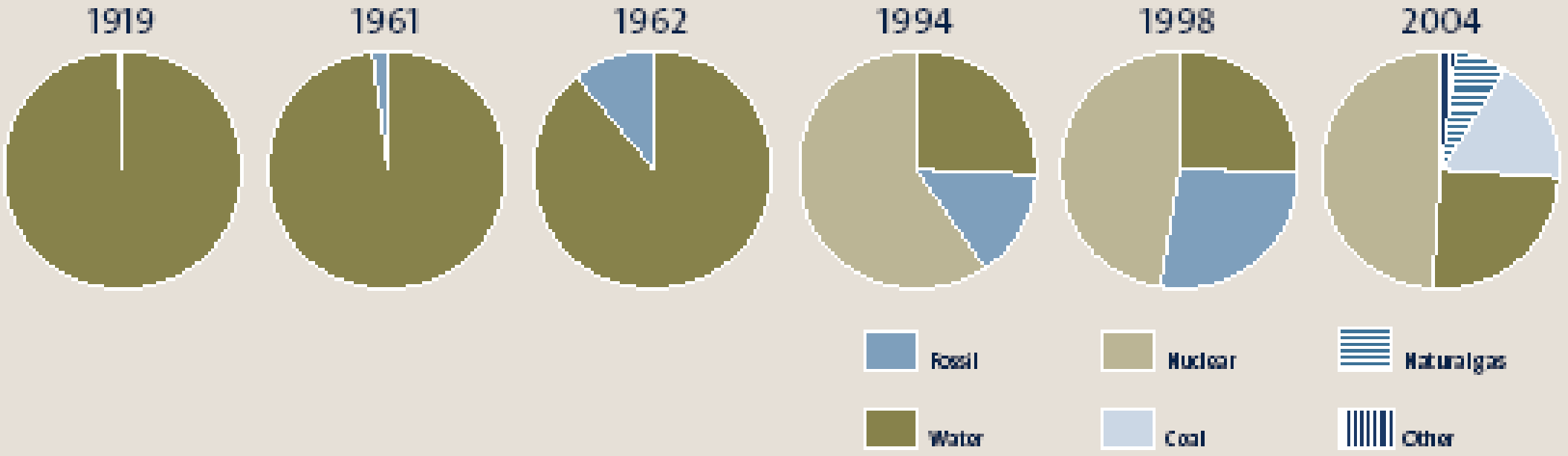
York University
February 2025

Case Study – Ontario Electricity

- Distributed vs. centralized pathways
- Convergence around climate change, decarbonization, electrification and sustainability
- Future roles of nuclear, natural gas, renewables, storage, DERs, demand side and interprovincial relationships

Ontario Electricity Supply 1919-2004

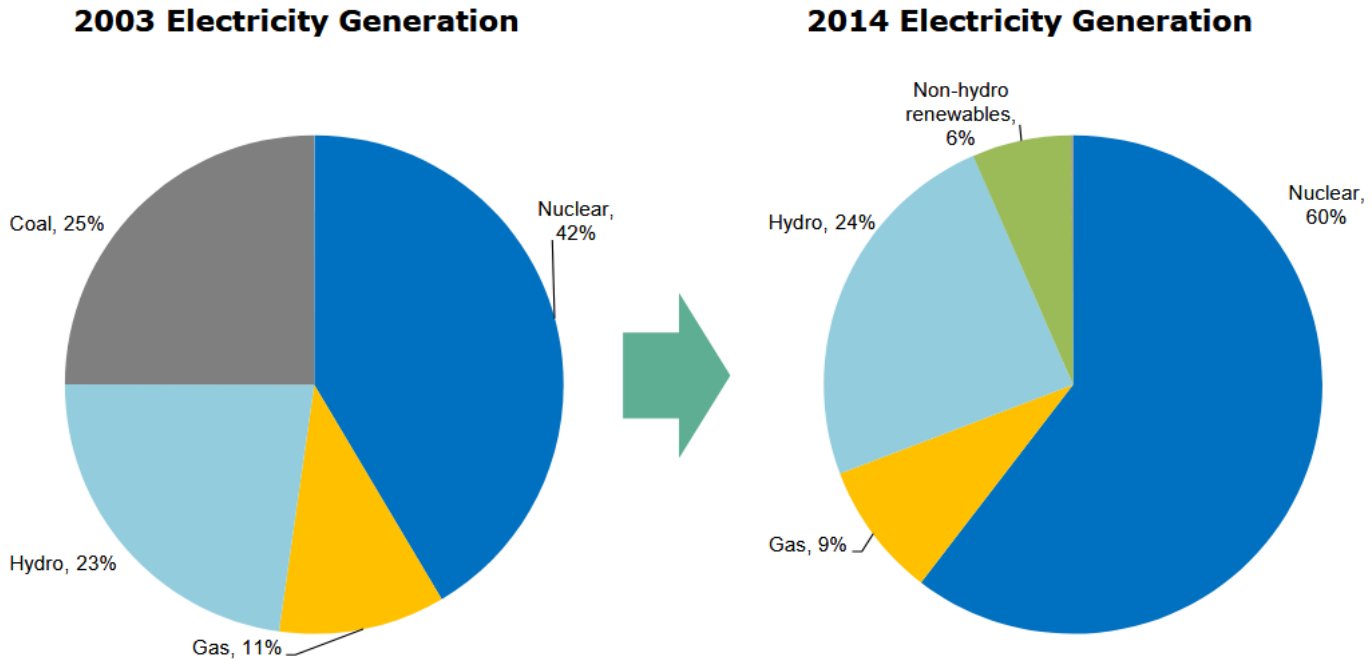
Figure 2: Ontario's Electricity Supply Mix



Ontario Electricity System 2003-2015

Ontario's Current Electricity Supply Mix

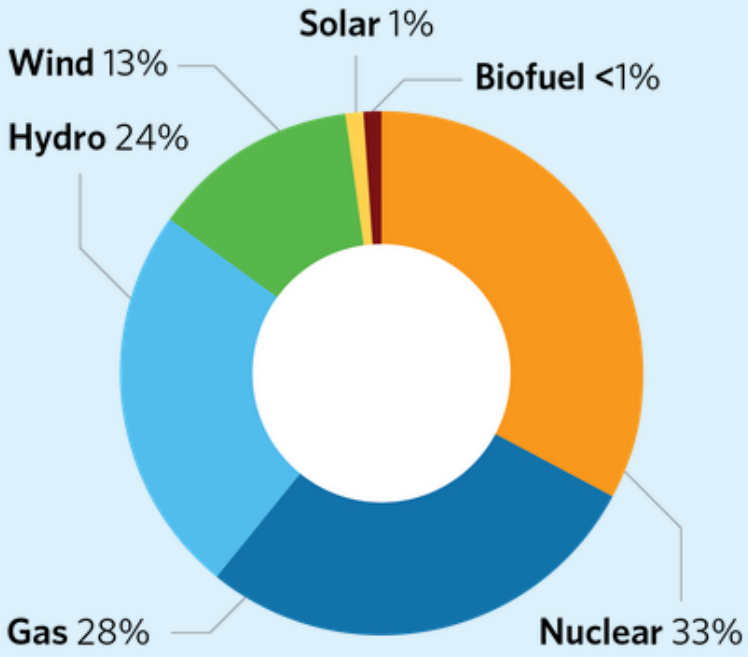
- Today, Ontario has a diverse supply mix without coal:



Ontario Electricity System 2024

Transmission-Connected Capacity

This is the capacity of resources that are connected directly to the high-voltage provincial grid, which is controlled by the IESO. Typically, these are industrial-scale power plants and wind and solar farms that can produce large amounts of electricity. Transmission-connected resources are the backbone of Ontario's electricity system and they supply most of the province's energy needs.



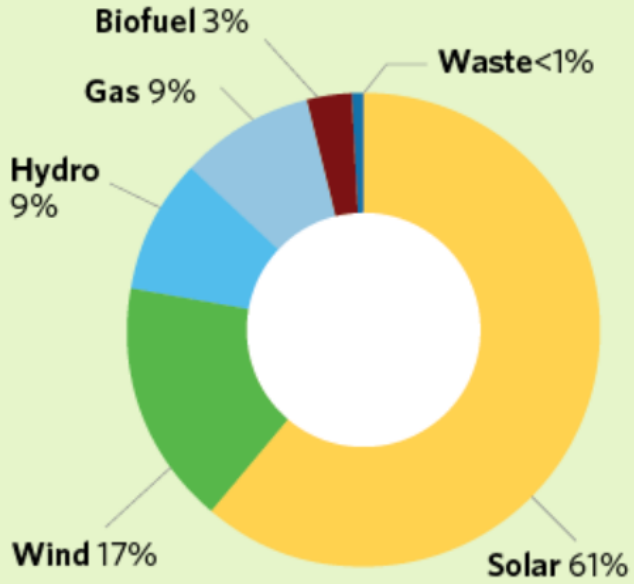
Nuclear	12,184 MW or 33%
Gas/Oil	10,450 MW or 28%
Hydro	8,862 MW or 24%
Wind	4,943 MW or 13%
Solar	478 MW or 1%
Biofuel	287 MW or <1%

Transmission-Connected Capacity as of December 19, 2024 (Source: Reliability Outlook)

Distributed Resources (2022)

Distribution-Connected Capacity

This is the capacity of resources that are connected to a low-voltage community grid, which is controlled by your local hydro company. Typically, these are small-scale generators, demand response resources or energy storage that are owned and maintained by individuals, local facilities or other businesses. These resources serve some, or all, of the energy needs of their owners, reducing demand on the provincial grid.



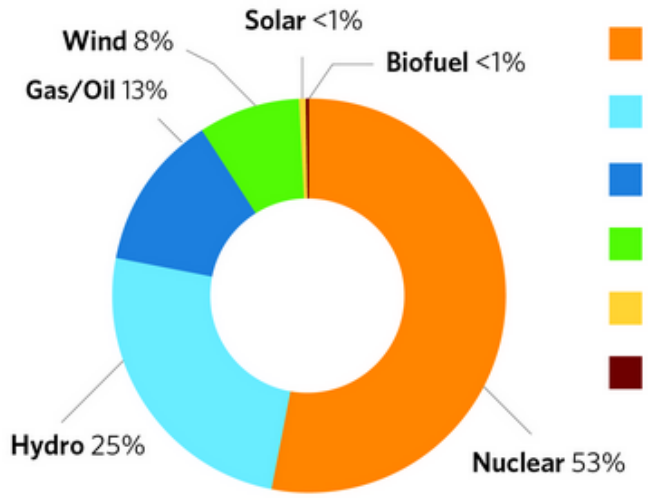
Solar	2,171 MW or 61%
Wind	591 MW or 17%
Hydro	333 MW or 9%
Gas	320 MW or 9%
Biofuel	110 MW or 3%
Waste	24 MW or <1%

Distribution-Connected Capacity as of July 2022 (Source: Progress Report on Contracted Electricity Supply)

Electricity Generation 2023

Energy Output

While capacity represents the maximum amount of electricity that the system can supply at any given time, the actual amount of energy produced varies. For example, while natural gas represented about 19 per cent of Ontario's total transmission-connected capacity in 2023, it only accounted for about 13 per cent of actual generation. Most of the electricity produced in Ontario is generated at nuclear and hydro plants, which produce low levels of greenhouse gas emissions.



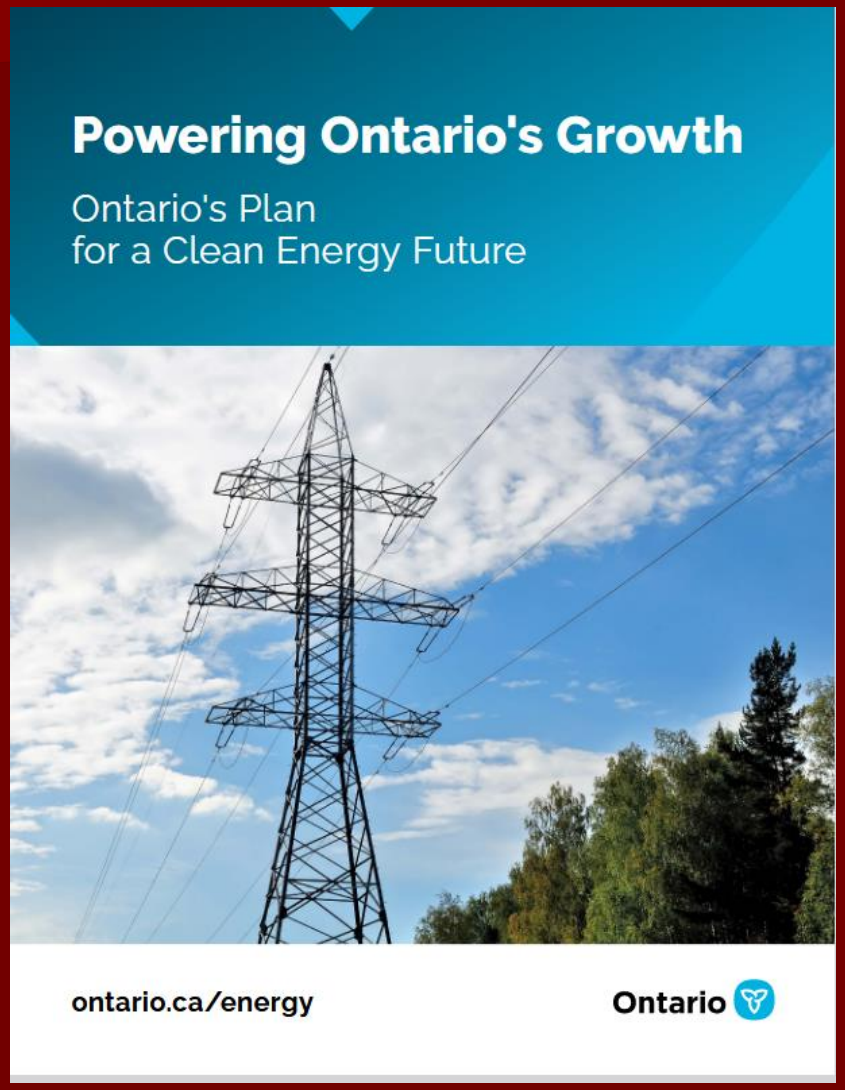
	2023 Energy Output	2022 Energy Output
Nuclear	79.3 TWh or 53.2%	78.8 TWh or 53.7%
Hydro	37.4 TWh or 25.1%	38.0 TWh or 25.9%
Gas/Oil	19.1 TWh or 12.8%	15.2 TWh or 10.4%
Wind	12.2 TWh or 8.2%	13.8 TWh or 9.4%
Solar	0.7 TWh or <1%	0.75 TWh or <1%
Biofuel	0.4 TWh or <1%	0.3 TWh or <1%

Total Electricity Output by Source in 2023 (Source: Year End Data)

The Ford Era

- Cancels 758 Renewable Energy Projects
  - (Cost >$231 Million)
- Repeals *Green Energy Act*
- Terminates of Energy Conservation Strategy (March 2019)
- Termination of Climate Change Action Plan
- Elimination of requirement for LTEPs
- Refuses Quebec offers

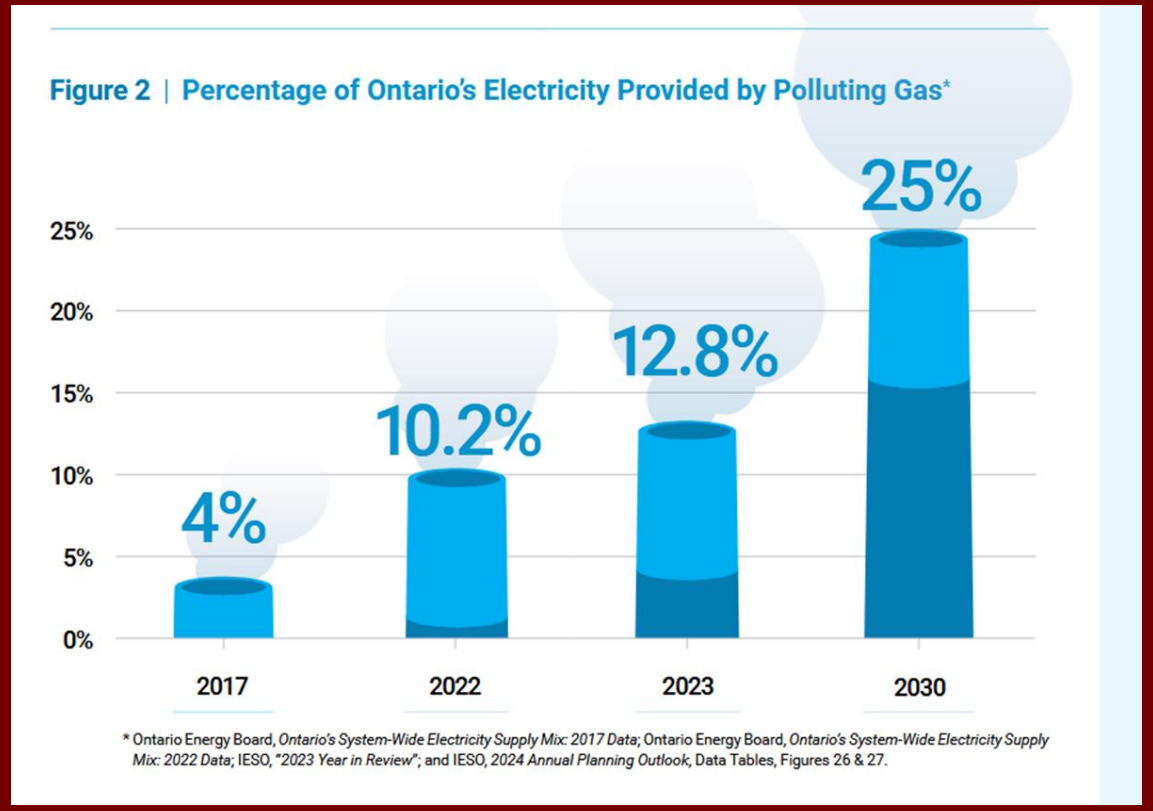
The New Pathway (July 2023)

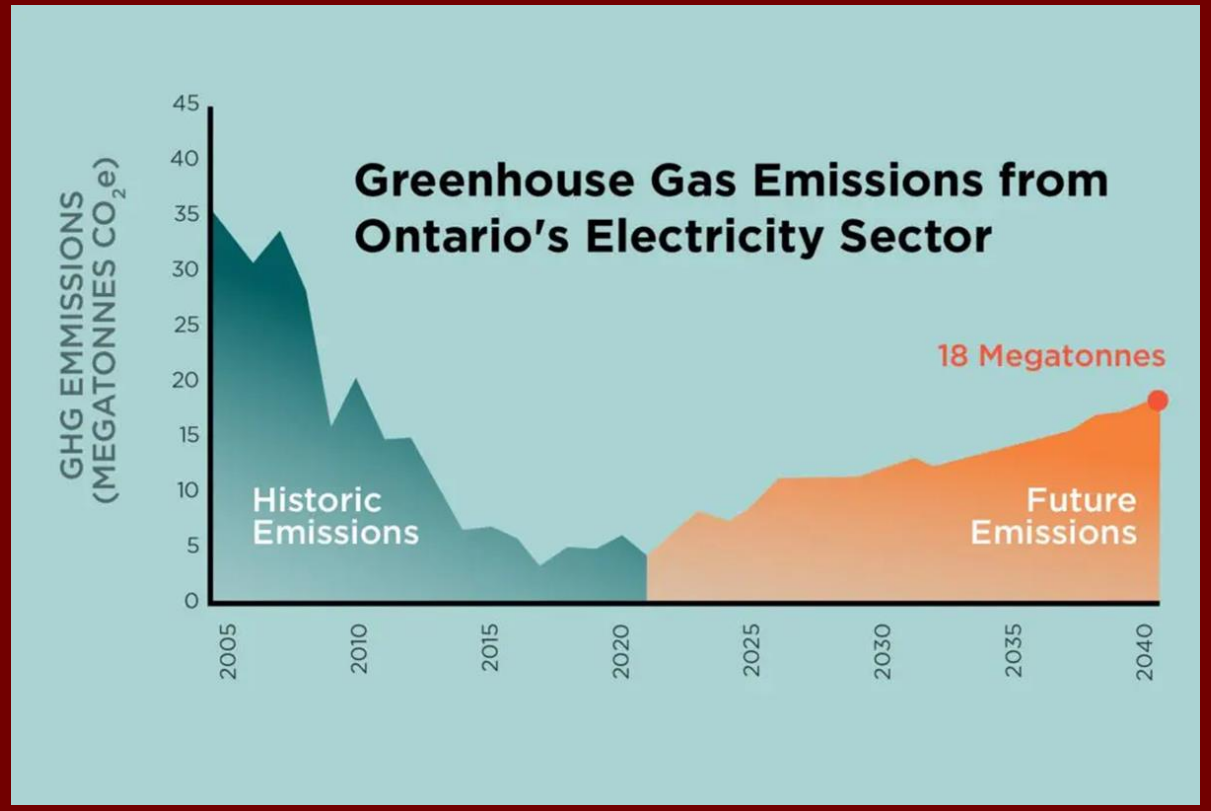


A Nuclear Focus

- Darlington
  - Ongoing Refurbishment ($13B)
  - 4 x 300MW new units ($25B+)
- Bruce
  - Ongoing Refurbishment (~$20B)
  - 4800MW New Capacity (~$100B?)
- Pickering
  - Pickering B Refurbishment (~$15B+?)
- Wesleyville
  - 10,000MW new capacity (~$200B+)
- Grand total: ~$400B

...with some gas on the side...



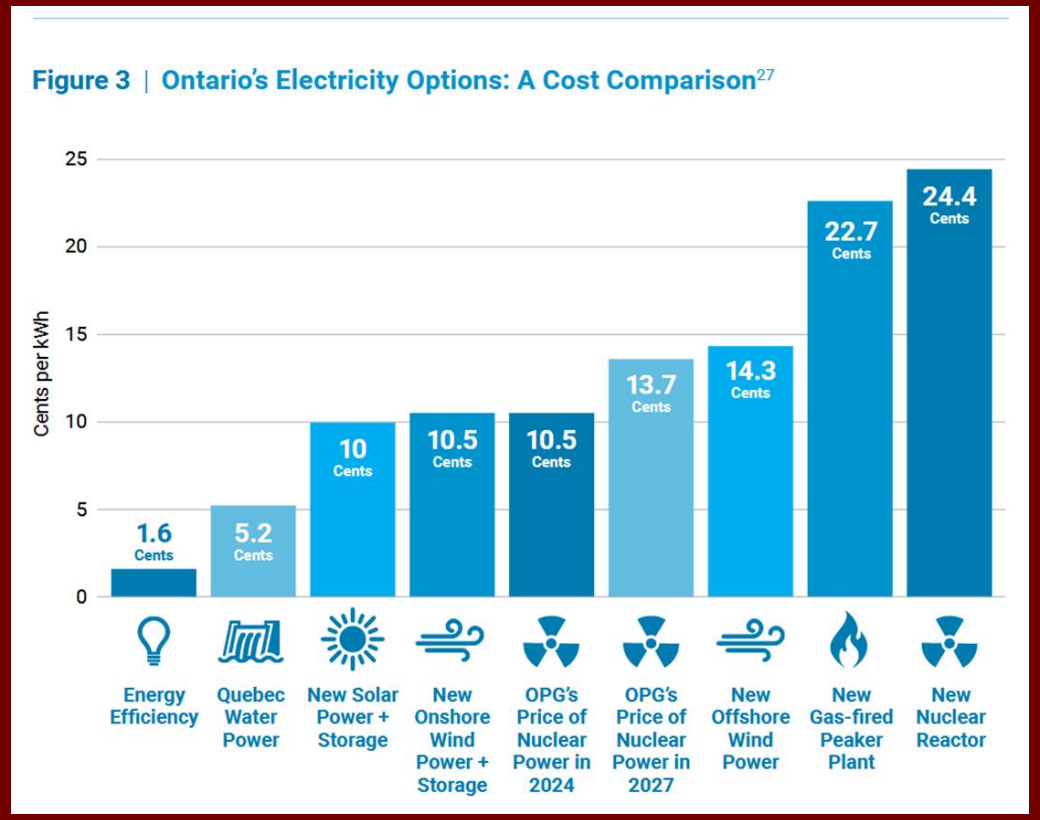


…and not much else

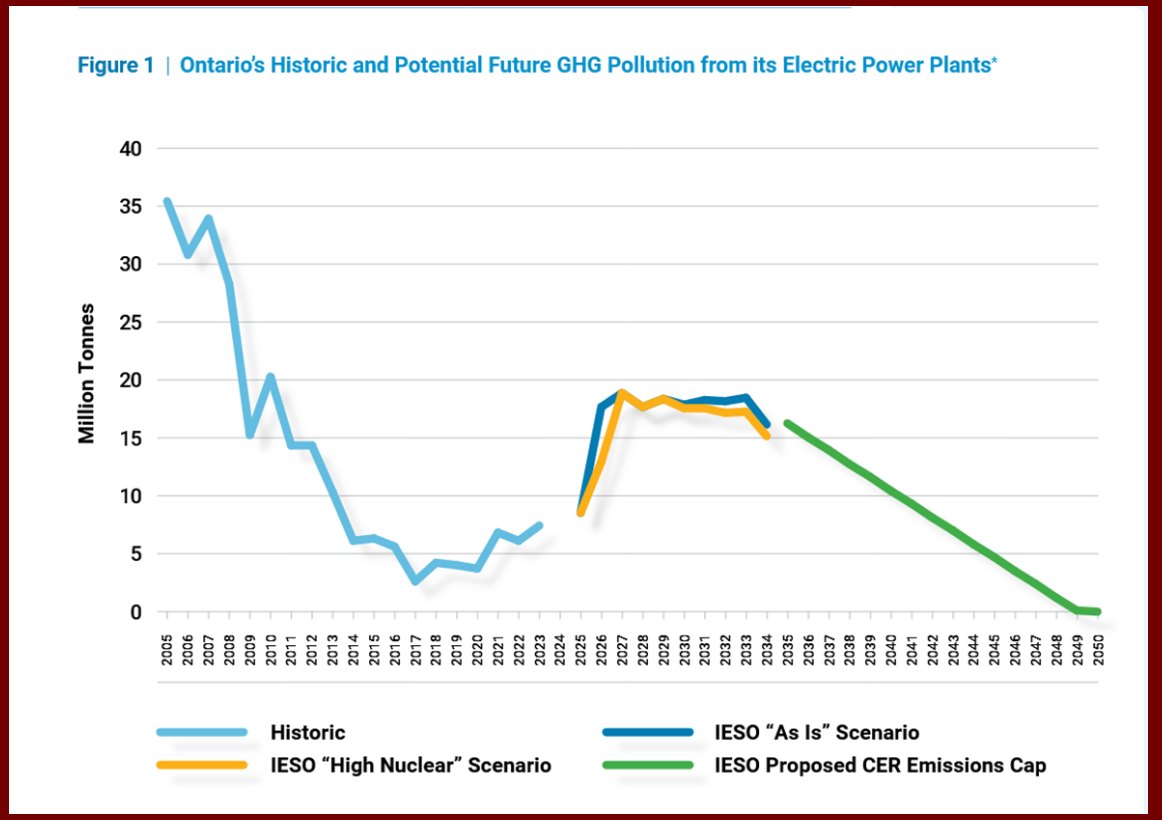
- On/Off on renewables
- Some movement on grid storage
- Feeble re-start on CDM
- ‘Sandboxes’ only on DERs
- Minor movement re: Quebec

The results:

Embedding Rising Costs



And Rising Emissions



Ontario Clean Air Alliance

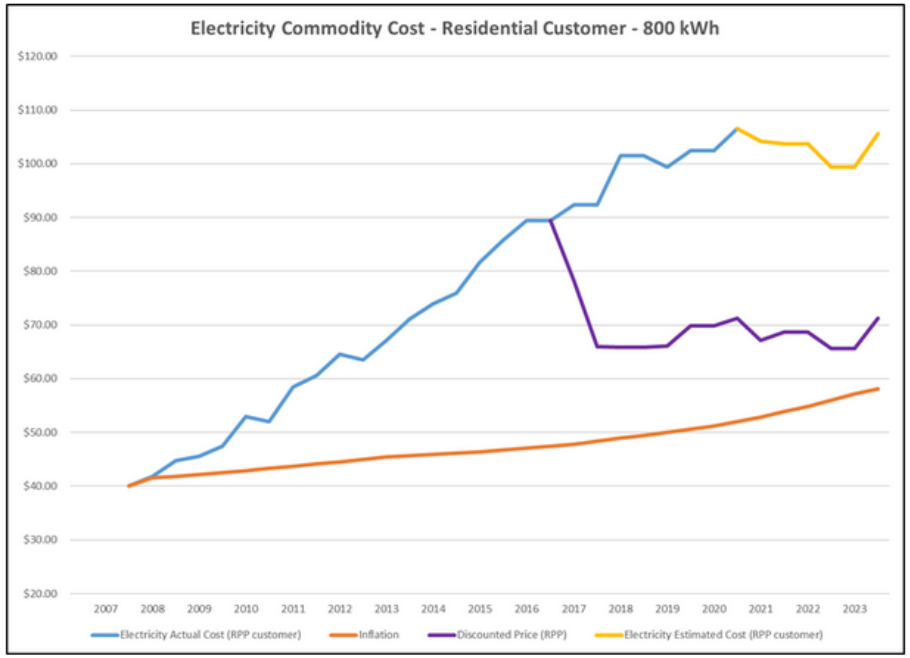
Current Status

- Total nuclear program now $400+ billion.
- Annual subsidization of electricity rates from general revenues: $7.3 Billion/yr

Cost of Power Update

October 25, 2023

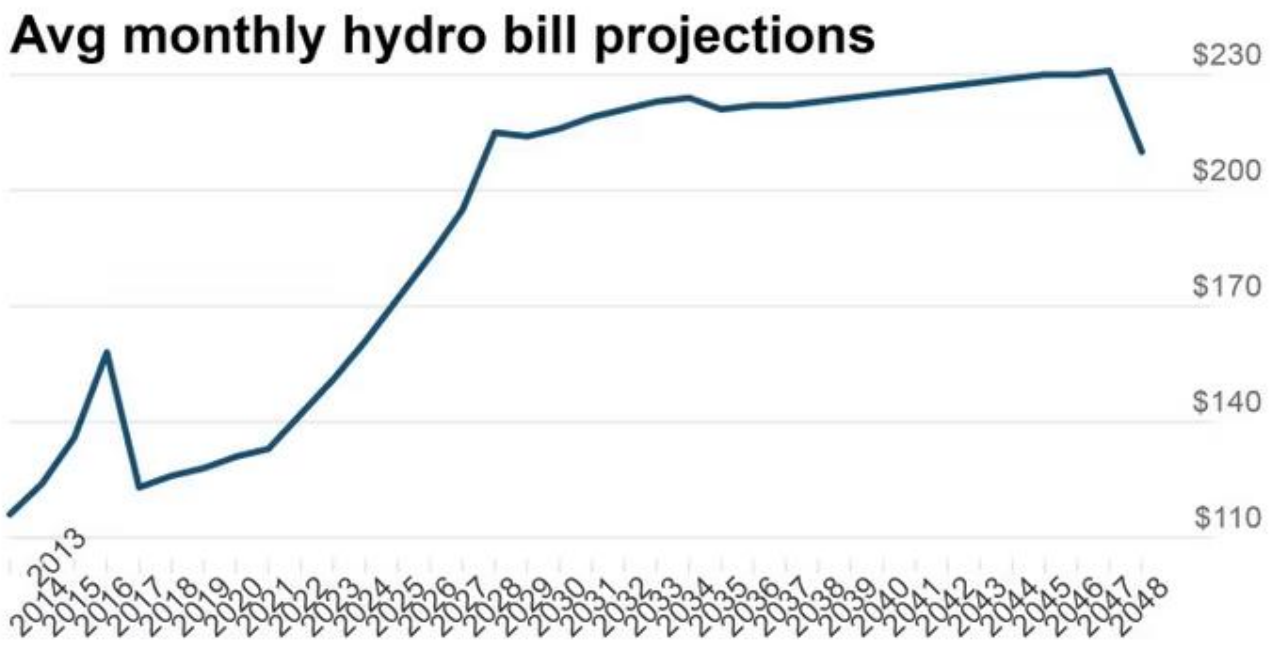
The Ministry of Energy of the Government of Ontario (MOE) and the Ontario Energy Board (OEB) both recently issued press releases related to the cost of power. There are some interesting take-aways from these announcements.



Niagara on the Lake Hydro

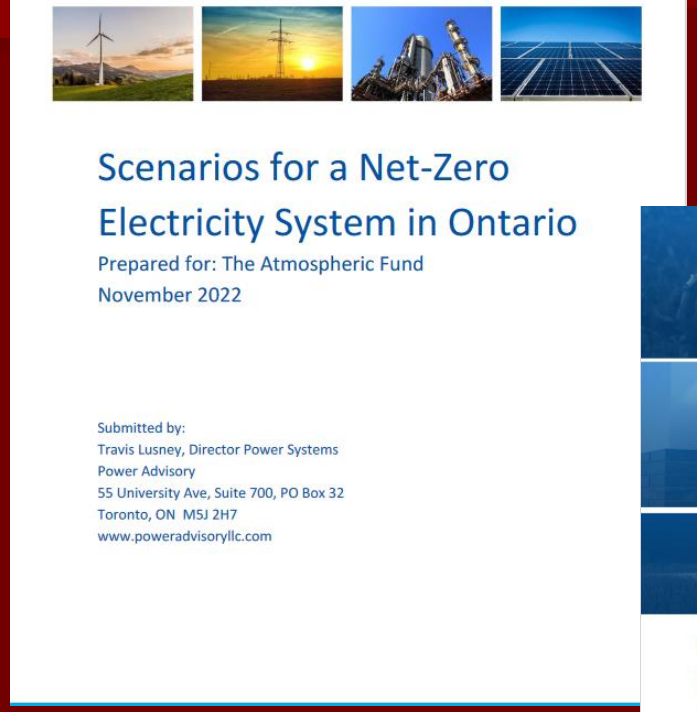
Pre-New Build Cost Projections

Mike Crawley · CBC News · Posted: May 11, 2017 2:31 PM EDT | Last Updated: May 11, 2017



The document shows the average household monthly electricity bill in Ontario rising from $123 in 2017, to $195 in 2027, then $222 in 2037 and $231 in 2047.

The pathways not taken…



Scenarios for a Net-Zero Electricity System in Ontario

Prepared for: The Atmospheric Fund

November 2022

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Ontario's Distributed Energy Resources (DER) Potential Study

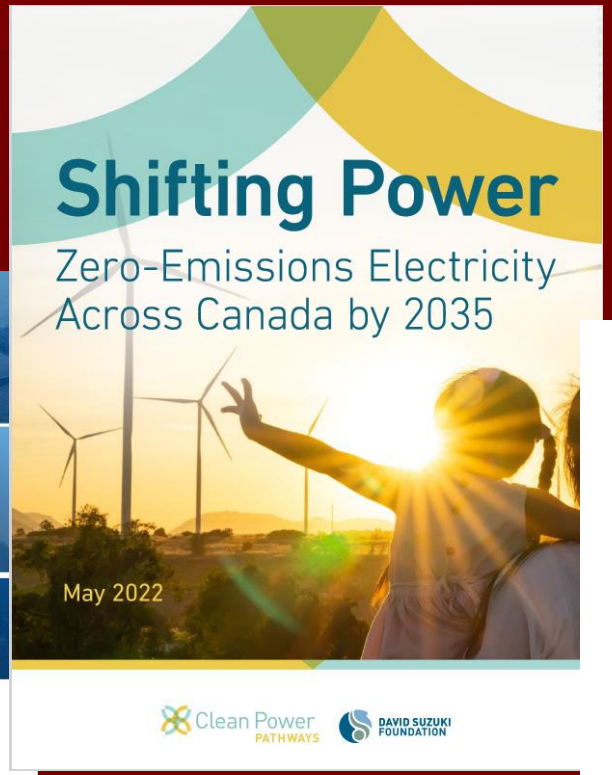
Volume I: Results & Recommendations

September 28, 2022

Prepared for:

ieso
Connecting Today.
Powering Tomorrow.

dunsky
Energy + Climate



Clean Power PATHWAYS

DAVID SUZUKI FOUNDATION

NAVIGANT

2019 Integrated Ontario Electricity and Natural Gas Achievable Potential Study

Prepared for

ieso
Connecting Today.
Powering Tomorrow.

ONTARIO ENERGY BOARD

Submitted: 2019-09-13
Updated: 2019-12-10

Prepared by:

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Who wins?

The power of incumbency in a policy and planning vacuum

ONTARIO POWER GENERATION

Bruce Power™

Innovation at work

The Federal Role
(Clean Electricity Regulations December 2024)

- Restrictions on GHG emissions from fossil fuel (e.g. natural gas-fired) generation) post-2035.
- Existing facilities up to 2025 ‘grandfathered’ for 25 years.
- New facilities can be built 2025-2027 (the Ontario loophole)
- Net zero target now beyond 2050

Deepening Challenges

- Unproven/unknown new reactor technologies
- Unknown nuclear costs
  - Continuing record of delay and cost overruns (Flamanville, Hinkley, Olkiluoto, Vogtle)
- Financing??
- Waste Fuel Management???
- Provincial demand/decarbonization path uncertain
  - No policy framework on decarbonization – focus on gas grid expansion
  - Loads increasingly dynamic
- Rapid technological development of alternatives
  - Renewables
  - Storage
  - 'Smart' grids
  - DERs and Microgrids

Sustainability Pathways

- Powering Ontario
  - High-cost, high-risk, high impact options dominate (nuclear and gas)
  - All other options marginalized
    - CDM
    - DERs
    - Renewables
    - Interties

- Sustainability pathway
  - (lowest cost/risk first; highest risk/cost last)
    - Optimize CDM
    - DER development
    - Renewables and Storage
    - Strengthen interties with Quebec
    - Avoid gas expansion
    - Committed refurbishments likely unavoidable at this point
    - New nuclear as last resort

Where Now?

Political Party Leaders

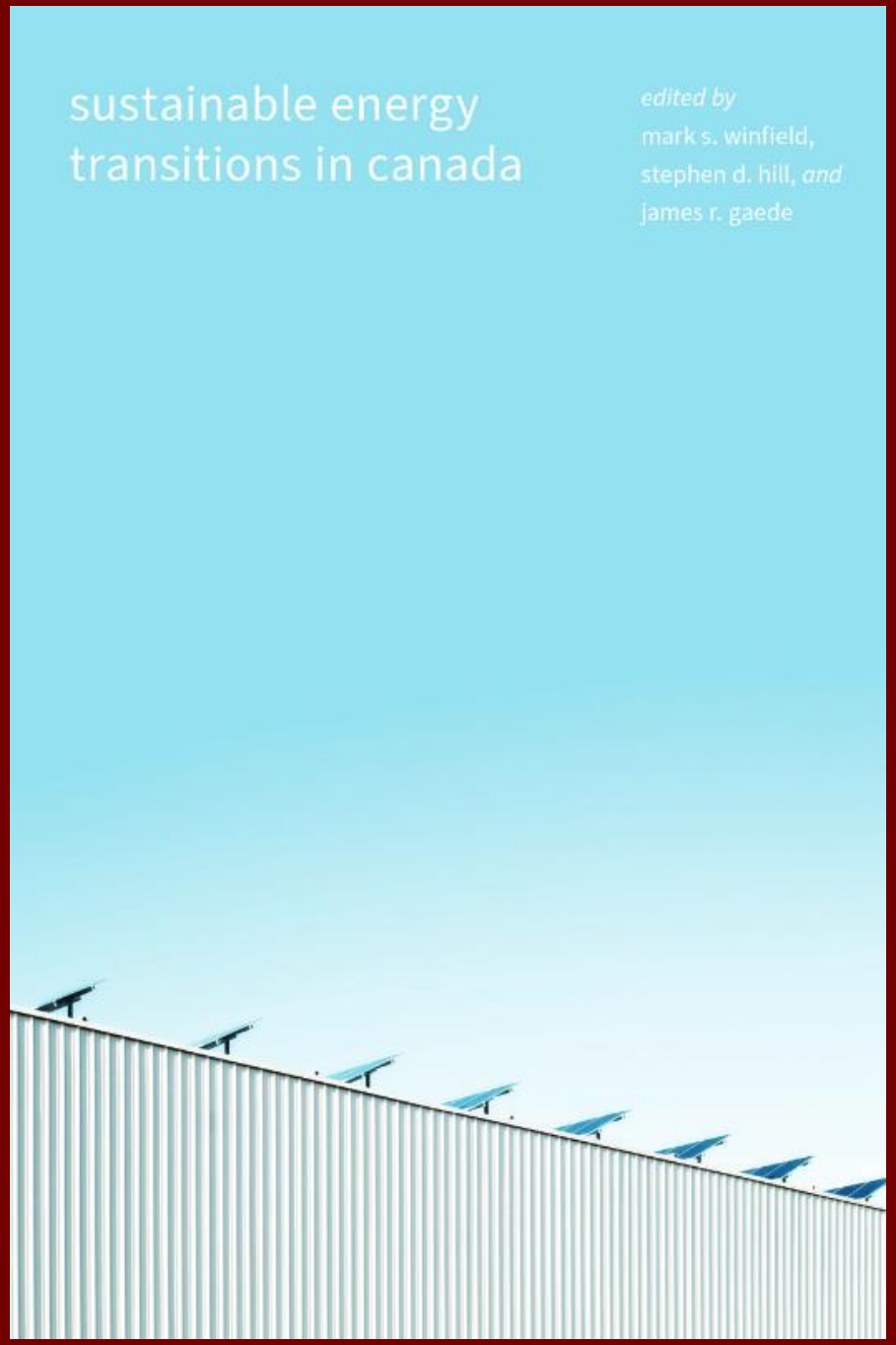
with Representation in the Legislative Assembly of Ontario

The Honourable Doug Ford
Premier of Ontario,
Leader of the Ontario
Progressive Conservative Party

Marit Stiles
Leader of His Majesty's
Loyal Opposition in Ontario,
Leader of the Ontario
New Democratic Party

Bonnie Crombie
Leader of the
Ontario Liberal Party

Mike Schreiner
Leader of the Ontario
Green Party



Winfield, Hill and Gaede (2023)