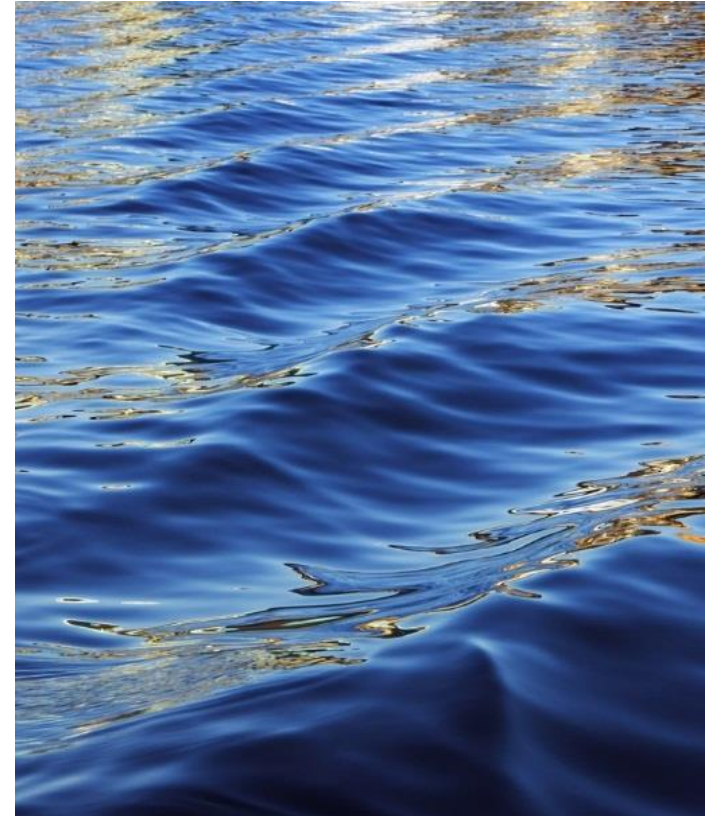




By David Katz
August 19th 2022
& Sept 16th 2022

Electricity Innovation in Canada to IREC CGE Group





The electric power industry in Canada

Agenda – Questions welcome any time.

Quick overview on the Canadian Electric Power Industry

The electric power industry in Canada

An overview on the electric power industry in Canada including the differences and similarities to the US.

- Some of the innovative issues studied at Ontario Hydro and the breakup of this largest Canadian utility.
- - Problems with the Canadian nuclear industry (build, cost overruns, and now refurbishment).
- - The challenges of the DER industry as provincial governments own and control most of the utility and non utility fossil generation contracted assets.

The electric power industry in Canada

- The Canadian carbon tax. Quebec and California in Trading Program
- - How the Canadian federal government is promoting the reduction of green-house gasses and the decarbonization of the grid that needs renewable and deep retrofits for efficiency to meet the new loads.
- - Canadian inventions in solar panels, inverters, storage and transactive energy.
- - The interconnections of the Canadian and US grids physically, with joint responsibility for reliability and disaster repairs.
- Explore potential organizational relationships for IREC with Canadian energy trade associations.

The Electric Power Industry in Canada

- The structure of the electricity sector has been evolving over the past decade. In most provinces, there has been a shift from vertically-integrated electric utilities (often provincial Crown corporations) to various degrees of market liberalization and/or unbundling of generation, transmission and distribution services.



Bringing energy decisions closer to the customer.

The Electric Power Industry in Canada

- The CER's Canada's Energy Future 2021 report projects that non-hydro renewable electricity capacity in Canada will grow by 83% to 33.3 GW by 2040 in its Current Policies Scenario, and by 239% to 61.8 GW in its Evolving Policies Scenario.



The electric power industry in Canada

- In 2019, Canada produced 632.2 terawatt-hours (TWh) of electricity. More than half of the electricity in Canada (60%) is generated from hydro sources. The remainder is produced from a variety of sources, including natural gas, nuclear, wind, coal, biomass, solar, and petroleum. In 2020, Canada had the fourth largest installed capacity of hydropower in the world.



The electric power industry in Canada

Regulation of the electricity sector is primarily at the provincial level.

Set policies related to pricing as well as the types of power generation used.

Jurisdiction of intra-provincial transmission, and distribution.

Federal government has authority over some aspects of the nuclear generation sector, electricity exports, and designated international and inter-provincial transmission lines .



Voters Killed A Project To Get New England Off Fossil Fuels. A Court May Have Just Saved It.



The electric power industry in Canada

Energy Conservation and Demand Response incentive programs used to defer investment in new capacity with utility receiving higher rates of return for this lost revenue.





Strategic Plan 2021-2025

Our new strategic goals reflect our role to think, advocate, communicate and educate on behalf of our members.

View

Our Vision and Mission >

Our Team >

Our Values >

Current Affairs >

Strategic Plan 2021-2025 >

Electricity Canada Vision and Mission

We need to create the technology of tomorrow to decarbonize our planet.

We need to hire the diverse and inclusive workforce to gain better perspectives to drive our industry forward.

We need to rethink our current regulatory regimes so that we build for the future we want instead of the future we have.

We need to collaborate.

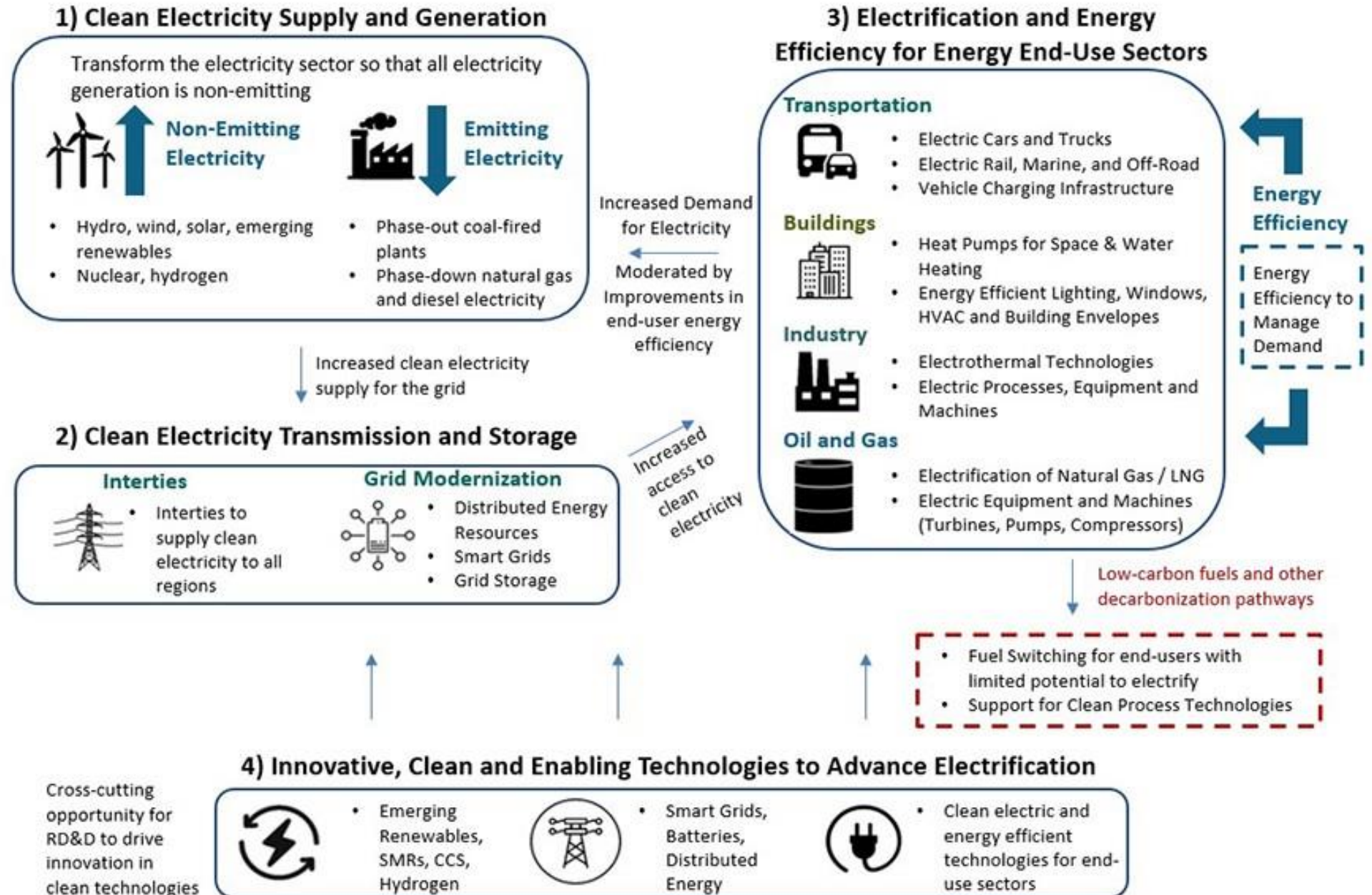
To bring about all this, our venerable association in its 131st year that has shed its old skin and rebranded as Electricity Canada. The new brand signals that we want to be leaders, bringing about – as our new tagline says – Our Energy Future.

Quebec and other provinces heading toward electricity shortage: report

- *Most provinces in central and eastern Canada will be incapable of meeting electricity needs by 2030, says the Institut de l'énergie Trottier.*
- The white paper says that at the current rate, most provinces will be incapable of meeting the electricity needs created by the increase in the number of electric vehicles and the decarbonization of building heating by 2030. "The situation worsens if we consider carbon neutrality objectives of the federal government and some provinces for 2050," the institute says.
- The researchers called on public utilities to immediately review their investment plans for the coming years.

Electrification and Energy Efficiency Overview

Proposed Frame for the Clean Electricity Regulations



CEATI established from the initial shared Canadian utility research projects.

- Our History

- Our roots date back to 1891 as part of the Canadian Electricity Association. In the 1970's an exclusive Research & Development program was developed for Canadian utilities.
- By the mid-1990s, as the electric industry landscape started to shift and a new era of deregulation and open markets emerged, we expanded our operations beyond Canada. By the end of the decade, our new and innovative program had nearly quadrupled in size and represented over 50 utilities from Canada, the United States, Europe, Asia, and Australia.

CEATI established from the initial shared Canadian utility research projects.

- Our History

- In 2001 the program was renamed CEA Technologies and began to operate independently of the Canadian Electricity Association. With visionary leadership appointed, they were able to meet industry needs by developing new Interest Groups and Task Forces, while continuing to flourish on the national and international stage.
- On January 1, 2008, they officially became known as CEATI International (Centre for Energy Advancement through Technological Innovation).
- In February of 2021, Pamlico Capital – a US-based private equity firm - made a growth investment in CEATI and began working with the leadership team to expand the business and enhance the value we deliver to our members.

Report for

CEA TECHNOLOGIES Inc. (CEATI)
1155 Metcalfe Street, Suite 1120
Montreal, Quebec, Canada H3B 2V6
Website: www.ceatech.ca

CUSTOMER ENERGY SOLUTIONS INTEREST GROUP (CESIG)
CEATI REPORT No. T031700-7010

DAYLIGHT HARVESTING PILOT TESTS USING A VARIETY OF SKYLIGHTING SYSTEMS AND DIMMABLE ELECTRONIC BALLAST TECHNOLOGY

Prepared by
Sustainable Environmental Solutions
Toronto, Ontario, Canada
Principal Investigator
David Katz
Sponsored by
BC Hydro
Manitoba Hydro
Natural Resources Canada
National Rural Electric Cooperative Association

The Comparison of electric power rates in North America.

Lowest rates in North America

Residential customers – Monthly bills for a consumption of 1,000 kWh/month (in CA\$) as of April 2021.

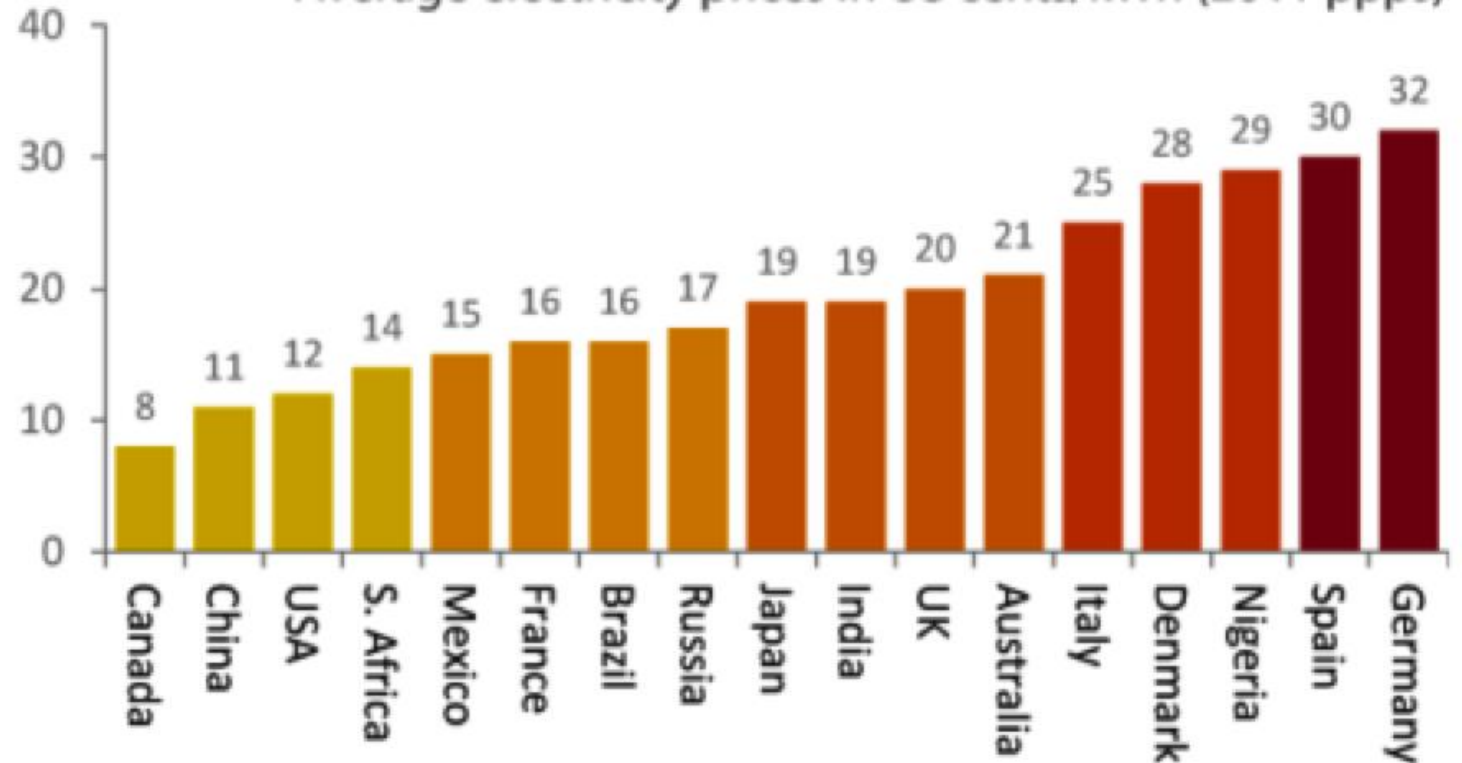
In Québec, Hydro Quebec residential rates are nearly half of those in Toronto, and close to four and a half times lower than those in New York.



The Comparison of electric power rates in other countries.

The United States also maintains a relatively inexpensive price on energy, due to the abundance and low cost of natural gas and the use of a combination of different sources of energy: from renewable, alternative options, to coal, natural gas and other fossil fuels.

Electricity prices relative to purchasing power
Average electricity prices in US cents/kWh (2011 ppps)



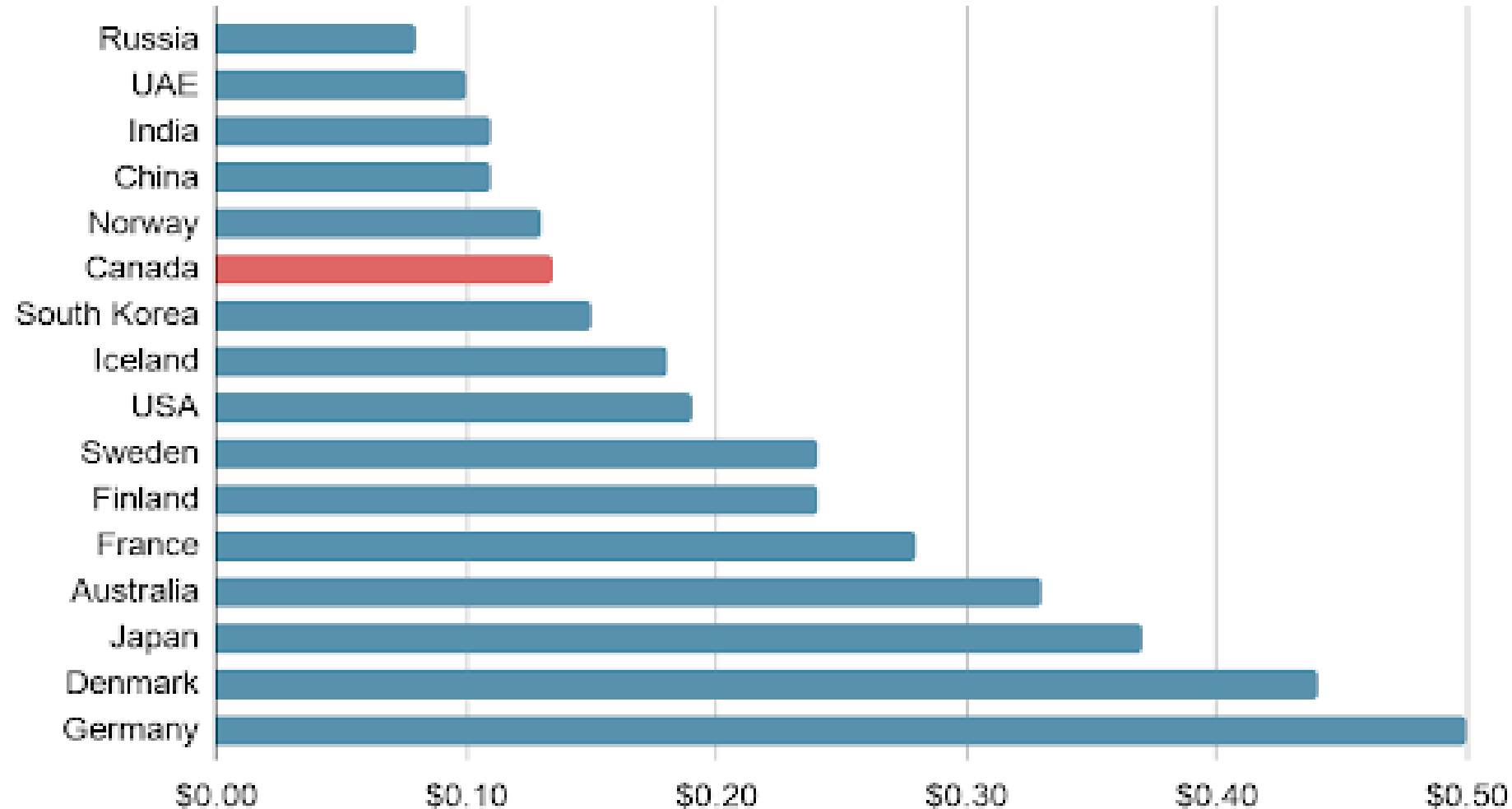
Data: average prices from 2011 converted to USD using purchasing power parities

Sources: IEA, EIA, UN

shrinkthatfootprint.com

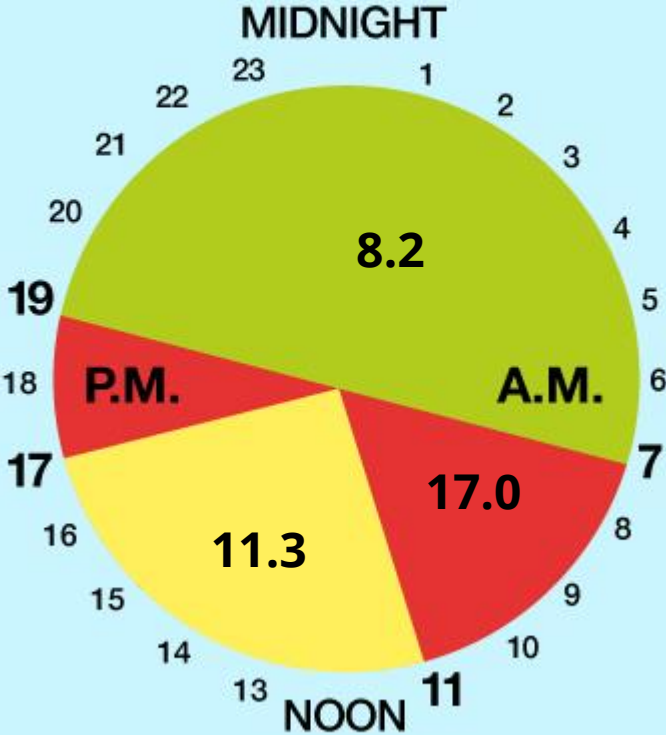
The Comparison of electric power rates in other countries.

Electricity Rate (\$CAD / kWh)

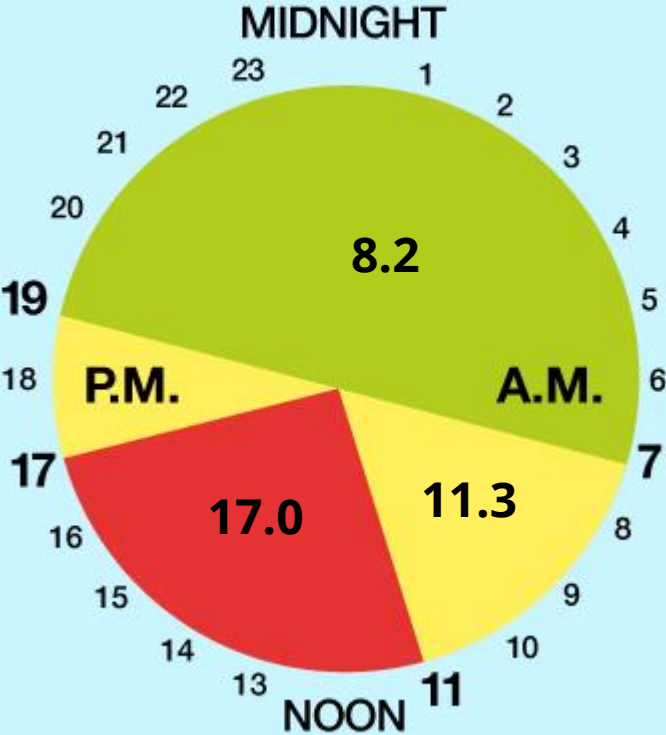


Ontario Smart Meter Time of Use c/kwh

WINTER

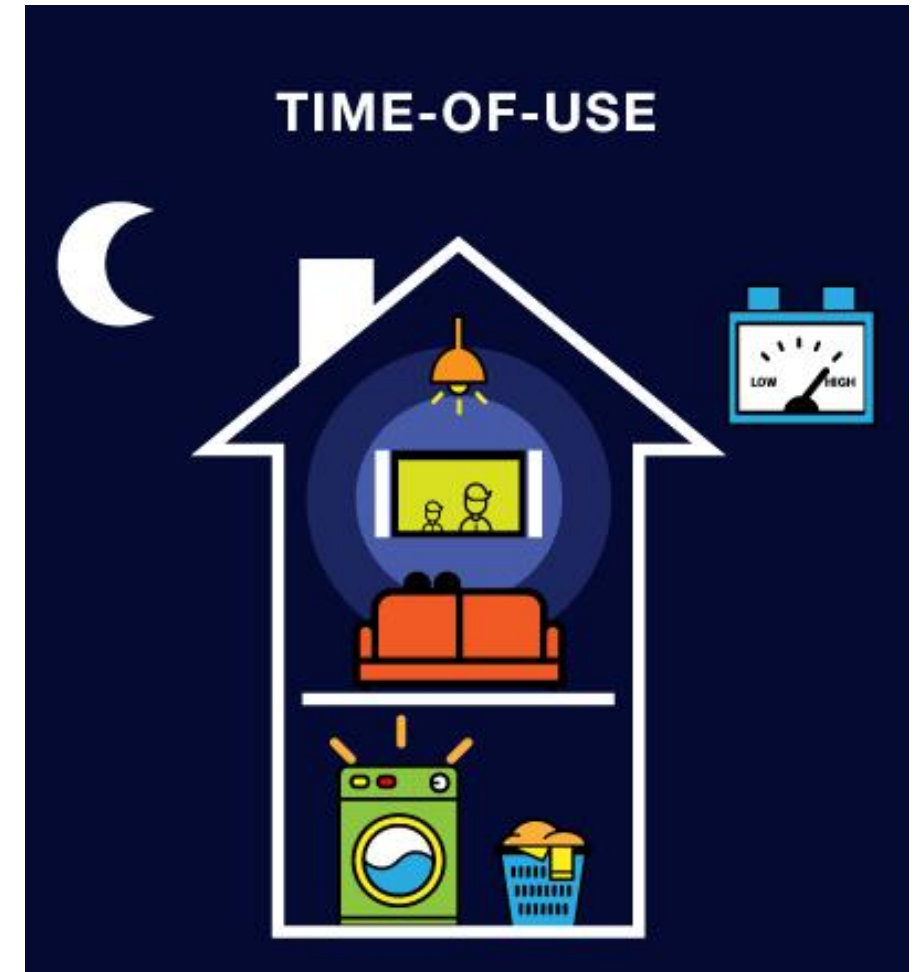


SUMMER



How to know if TOU pricing is right for you

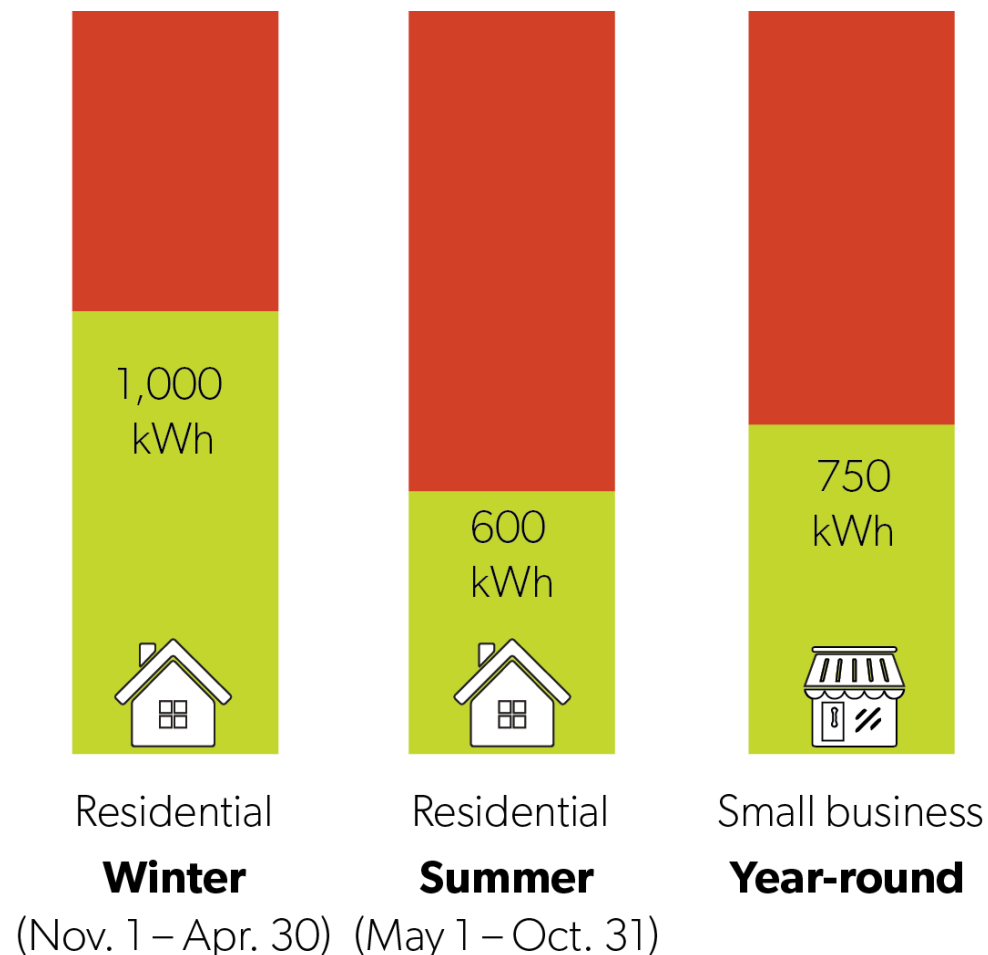
- If you use most of your electricity during off-peak hours (evenings and weekends), and have higher electricity demands, time-of-use may be your preferred pricing plan.
- Time-of-use pricing may be right for you if, for example:
 - you work outside the home during the day and do your dishes and laundry in the evening
 - you have a large family or many people in your household, with higher electricity usage
 - you have an electric vehicle (EV) that you charge overnight
 - you work shift work, and use most of your electricity in the evenings
 -



Tiered Rates Can be chosen and switched back to TOU at any time.

- With Tiered prices, you can use a certain amount of electricity each month at a lower price. Once that limit (called a threshold) is exceeded, a higher price applies. The threshold changes with the season to reflect changing usage patterns – for example, there are fewer hours of daylight in the winter and some customers use electric heating.

- Currently tier 1 Green is **9.8 c/kwh** and Tier 2 Red is **11.5 c/kwh**



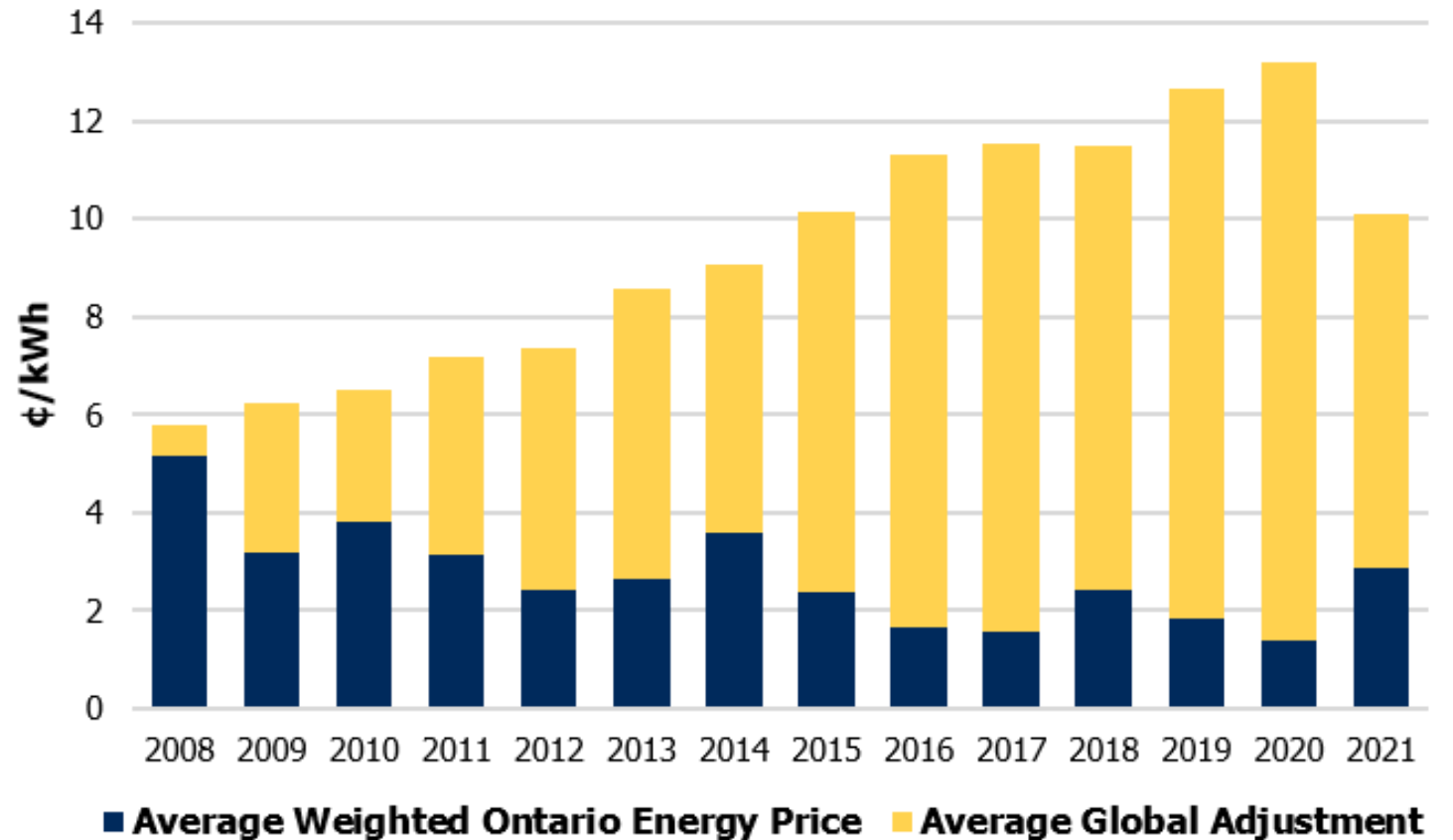
Ontario Global Adjustment and its impacts

- The Global Adjustment
- Most electricity generating companies get a guaranteed price for the electricity that they produce. The Global Adjustment is the difference between that guaranteed price and the money the generators earn in the wholesale marketplace. The Global Adjustment also covers the costs of some conservation programs.
- All electricity consumers have to pay a share of the Global Adjustment. The Time-of-Use and Tiered prices charged by your electricity utility already include an estimate of the Global Adjustment. If you sign up for a contract with an energy retailer, you have to pay your share of the Global Adjustment on top of the contract price. The Global Adjustment will also appear as a separate line on your bill.

Ontario Global Adjustment and its impacts

How are rates set.

HOEP (Hourly Ontario Energy Price) is only one component of the total commodity cost for electricity in Ontario. The graph shows the breakdown of the total commodity costs on a typical electricity bill. In addition to the energy portion there are the T&D costs and admin charges.



SAMPLE MONTHLY BILL STATEMENT - RESIDENTIAL

Account Number: 000 000 000 0000
Meter Number: 00000000

Your Electricity Charges

Electricity

Off-Peak @ 8.2 ¢/kWh	\$36.74
Mid-Peak @ 11.3 ¢/kWh	\$14.24
On-Peak @ 17 ¢/kWh	\$21.42

Delivery

\$43.61

Regulatory Charges

\$3.08

Total Electricity Charges

\$119.08

HST

\$15.48

Ontario Electricity
Rebate

(-\$20.24)

Total Amount

\$114.32

Energy Retailers licenced by Ontario Energy Board

- Only about 1 in 10 purchase their electricity and /or gas from an energy retailer in Ontario. Many direct retailers have left the province.
- Even if the electricity portion is fixed by the contract, the global adjustment is also added as everyone has to pay their share.
- Many customers believe the sales pitch and don't compare prices and read and understand what you are agreeing to. The OEB website has important information to help those considering a contract understand energy contracts and their rights including the warning below.
- Savings are not guaranteed.
- An energy contract may not save you money. Do your homework. Take the time to review and compare the contract offer and the prices charged by your utility. Make sure you understand what you will pay under the contract.

OEB Staff Examination of Alternative Price Designs for the Recovery of Global Adjustment Costs from Class B Consumers in Ontario

All of the pricing prototypes introduced in this paper have been designed to be revenue adequate in that they fully recover market and GA costs over the cost recovery period. Prototypes assessed are:

Status Quo pricing (SQ) – a simplified version of the class B pricing in place in 2018, used as a baseline against which all other pricing profiles are compared for the purposes of estimating demand response impact.

Flat pricing (Flat) – the least dynamic prototype, charging consumers the same price in all hours so as to recover all market and GA costs over the cost recovery period.

Expanded time-of-use pricing (TOU) – a natural extension of the existing status quo RPP time-of-use pricing structure but applied to all class B consumers.

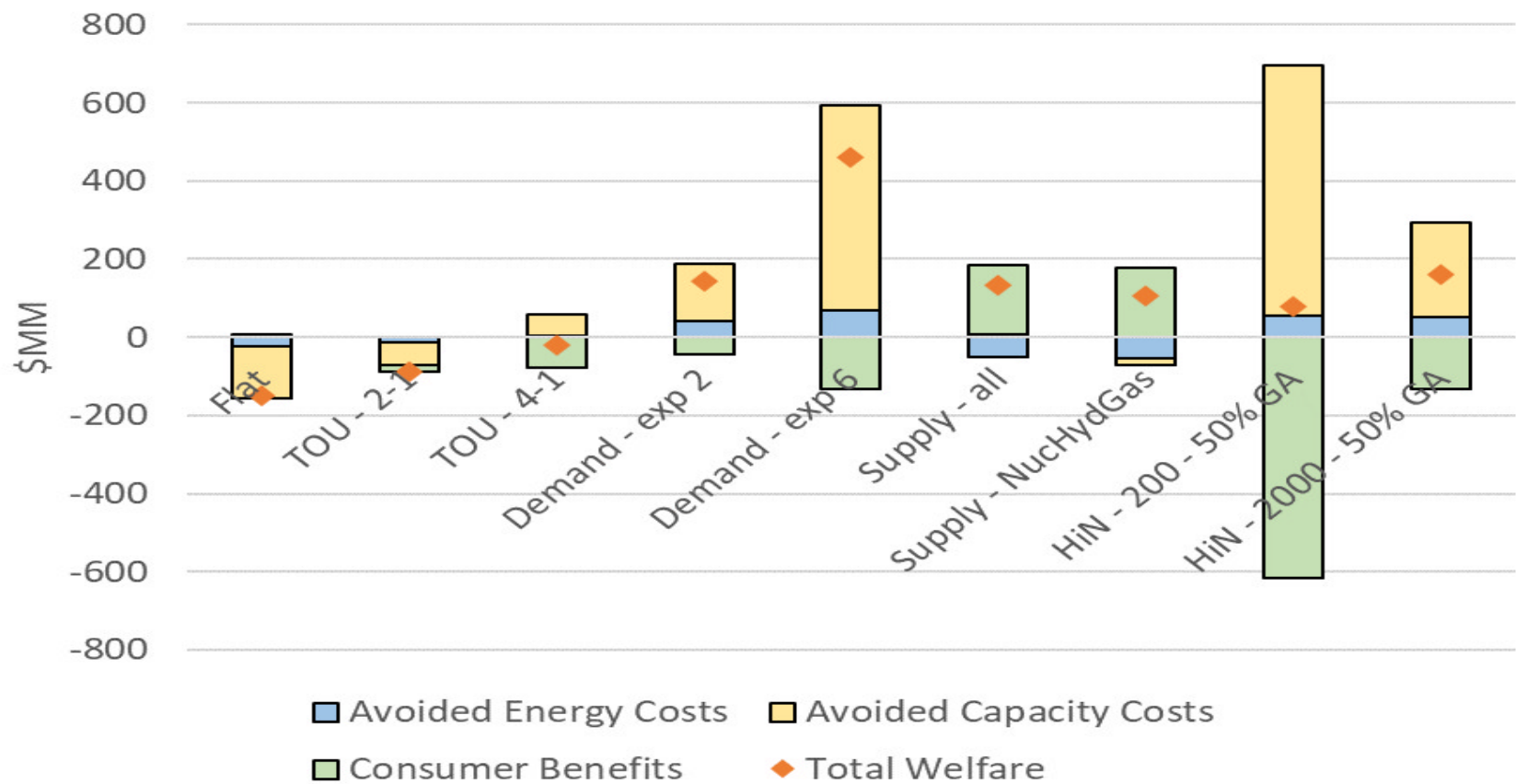
Demand-shaped pricing (Demand) – market costs (i.e. those costs that are paid to generators through the real-time energy market which defines the Hourly Ontario Electricity Price (HOEP)) are recovered through HOEP; GA costs are recovered in a fashion that is directly correlated with total Ontario demand in each hour.

Supply-shaped pricing (Supply) – market costs are recovered through HOEP; GA costs of different generators are recovered in the hours in which those generators produce electricity.

High NN pricing (HiN) – market costs are recovered through HOEP; some fraction (here 50%) of GA costs are recovered based on the consumption of class B consumers during the highest demand hours within each cost recovery period.

Figure 1: Avoided cost, consumer benefit and net benefit in forecast year 2030.

*In Figure 1, the results of this economic evaluation for all variants are shown for the forecast year 2030. The range of outcomes for the demand-shaped pricing examples indicate that the **demand-shaped prototype is the most economically efficient in 2030** relative to the other prototypes studied. In other words, the demand-shaped prototype exhibits the highest overall combination of avoided cost and consumer benefit among all prototypes studied.*



OEB Manage the Local Distribution companies with a ScoreCard.

		Customer Focus					
		Services provided in a manner that responds to customer preferences.					
		Service Quality ²			Customer Satisfaction		
		New Residential / Small Business Services Connected on Time	Scheduled Appointments Met On Time	Telephone Calls Answered On Time	Billing Accuracy	First Contact Resolution ³	Customer Satisfaction Survey Results ³
	Target:	90%	90%	65%	98%	No Target	No Target
48	Renfrew Hydro Inc.	100.00%	100.00%	97.76%	99.35%	99.97%	86%
49	Rideau St. Lawrence Distribution Inc.	100.00%	100.00%	76.20%	99.28%	99.91%	B
50	Sioux Lookout Hydro Inc.	100.00%	100.00%	91.96%	99.69%	A-	83.51
51	Synergy North Corporation	100.00%	100.00%	89.99%	99.93%	A+	A
52	Tillsonburg Hydro Inc.	99.51%	98.21%	N/A	97.60%	97.7%	Satisfied
53	Toronto Hydro-Electric System Limited	99.86%	99.92%	76.87%	99.00%	91%	95%
54	Wasaga Distribution Inc.	100.00%	100.00%	99.91%	99.98%	99.9	81
55	Waterloo North Hydro Inc.	100.00%	98.45%	94.71%	99.95%	99.95%	96%
56	Welland Hydro-Electric System Corp.	99.68%	97.88%	83.07%	99.91%	99.89%	96%
57	Wellington North Power Inc.	100.00%	99.56%	90.26%	99.52%	99.70	80%
58	Westario Power Inc.	96.24%	99.52%	88.45%	99.78%	98.83%	94.00%

OEB Manage the Local Distribution companies with a ScoreCard.

Operational Effectiveness									
Continuous improvement in productivity and cost performance is achieved; distributors deliver on system reliability and quality objectives.									
Safety				System Reliability		Asset Management	Cost Control		
Level of Public Awareness	Level of Compliance with Ontario Regulation 22/04 ⁴	Serious Electrical Incident Index		Avg. Number of Times that Power to a Customer is Interrupted	Avg. Number of Hours that Power to a Customer is Interrupted	Distribution System Plan Implementation Progress ³	Efficiency Assessment	Total Cost per Customer	Total Cost per Km of Line
		Number of General Public Incidents	Rate per 10, 100, 1000 km of line						
No Target	Compliant (C)	Distributor Specific	Distributor Specific	Distributor Specific	Distributor Specific	No Target	No Target	No Target	No Target
85.30%	C	0	0	0.16	0.38	62.5%	3	\$ 621	\$ 33,455
83.30%	C	0	0	0.10	0.28	116%	2	\$ 594	\$ 31,275
79.00%	C	0	0	0.39	0.78	114%	1	\$ 818	\$ 3,335
84.00%	C	0	0	1.96	1.28	97.41	3	\$ 651	\$ 29,384
83.70%	C	0	0	0.37	0.53	In-progress	3	\$ 686	\$ 39,137
68.00%	C	22	0.758	1.46	0.97	36%	5	\$ 1,189	\$ 32,110
84.10%	C	0	0	0.63	1.23	Completed	1	\$ 427	\$ 21,189
86.00%	C	0	0	0.72	0.61	20.45%	3	\$ 826	\$ 29,276
83.00%	C	0	0	1.35	1.52	Completed	1	\$ 494	\$ 24,455
84.70%	C	0	0	0.17	0.23	22%	3	\$ 831	\$ 15,101
84.00%	C	0	0	0.73	1.79	Completed	3	\$ 610	\$ 25,340

TH

OEB Manage the Local Distribution companies with a ScoreCard.

Public Policy Responsiveness		Financial Performance			
Deliverables on obligations mandated by Ministerial directives to the Board.		Financial viability is maintained; and savings from operational effectiveness are sustainable.			
Connection of Renewable Generation ²		Financial Ratios			
Renewable Generation CIA Completed on Time ⁵	New Micro-embedded Generation Facilities Connected on Time	Liquidity: Current Ratio (Current Assets / Current Liabilities)	Leverage: Total Debt (short-term & long-term) to Equity Ratio	Regulatory ROE	
				Deemed (included in rates)	Achieved
No Target	90%	No Target	No Target	No Target	No Target
N/A	N/A	1.19	0.69	8.78%	5.28%
N/A	N/A	0.63	0.61	8.78%	2.79%
N/A	N/A	0.68	0.57	9.00%	9.26%
N/A	100%	1.72	0.74	8.85%	7.82%
N/A	100%	1.49	0.41	8.98%	1.43%
100%	92%	0.95	1.13	8.52%	7.08%
N/A	N/A	1.11	0.39	9.19%	10.70%
N/A	100%	0.97	1.11	8.34%	7.74%
N/A	N/A	1.58	0.91	8.78%	10.72%
N/A	100%	0.77	1.24	8.34%	11.18%
N/A	100%	1.05	0.66	9.00%	7.01%

TH

DER investment

- - The Canadian Renewable Energy Industry
- The Canadian Renewable Energy Association was established on July 1, 2020 when the Canadian Wind Energy Association and the Canadian Solar Industries Association united to create one voice for wind energy, solar energy and energy storage solutions. Previously there were competing events and technology specific interests but without the utility or governments promoting renewables these associations could not survive financially.
- **The Mission**
- To advocate on behalf of the wind energy, solar energy and energy storage industries to benefit Canada's economy and energy future.
- To increase stakeholder understanding that renewable electricity and energy storage are clean, low-cost, reliable, flexible and scalable solutions for Canada's energy needs.

DER investment

- - The DER industry
- Level of activity and installations
- With Conservative provincial governments that own the utilities there is little incentives to promote DER Some provincial governments with fossil fuel generation are willing to procure DER as some of the large projects are less costly than to continue to run old fossil fuel generators.
- Now with federal governments win in Supreme Court on imposing the carbon tax and new clean energy generation legislation, the level of debate increases including the adoption of climate change policies by many municipalities and their request that the gas fired generators they receive electricity from be retired early.

DER investment

- - The DER industry
- Is there a Canadian "duck curve"?
- The weather and solar patterns are much less significant in Canada and while Ontario had a significant PV feed in tariff the electricity was needed as they were at peak times and displace marginal fossil fuel.
- The wind projects were also given a significant incentive with 20-year contracts providing the security for the investor and operators as long as the wind blows.



DER investment and then government Interference

- Ontario has signed generous contracts with wind producers for about 5,800 megawatts of electricity, only about 1,500 of which is currently connected to the grid.
- In September 2013 Ontario Energy Minister stated the system operator can now order wind producers not to generate power, and will pay them not to produce electricity when it's not needed.
- Ontario will start paying wind power generators not to produce electricity, but the government says the move will actually save ratepayers big bucks.
- Ontario has had a surplus of power since 2006, but until now, the province paid for all the electricity generated from industrial wind mills, even when it wasn't needed.

DER investment and then government Interference


- Energy Minister says the system operator can now order wind producers not to generate power and will pay them — just as it pays Bruce nuclear — not to produce electricity when it's not needed.
- He says they are paid at a reduced rate that will save the province \$200 million a year just on the wind turbines.
- The Progressive Conservatives say paying wind power producers with 20-year contracts not to generate electricity shows the Liberals' green energy act "is a failed social experiment."
- Critics point out wind power is unreliable and can't be counted on in peak demand periods like gas-fired generation or nuclear plants.
- Meanwhile, Chiarelli says Ontario is making a net profit of up to \$6 billion a year on importing and exporting electricity, a big turnaround from 2003 when the province paid \$500 million to import power because it didn't have enough to meet demand.

DER investment Uptake with new focus on decarbonization

- Green building requirements on new construction are encouraged by some municipalities with offer of faster building permit approval. - Public financial incentives for:
- Roof-top solar – Individuals make the decision based on provincial or federal incentive programs and net metering rules. New Canadian Greener Home program may provide low interest loans for renewables and heat pumps.
- Community solar- Some provinces allow for 3rd part ownership that facilitates community solar projects.
- Impact on adoption of DER as incentives have changed – The inflation in energy prices now from the war in Ukraine and tensions with China has all levels of government considering their energy supply and demand options.
- Just as the pandemic increased the awareness for improved indoor air quality and brought forward many of the IAQ technologies, the climate change disasters and the IPCC reports showing we are at a tipping point has brought the renewed interest in DER.

Ontario commissions 5-gigawatt of newly-built electricity generation capacity

- To meet demand driven largely in part by the retirement of nuclear energy facilities and the transition towards electric vehicles, Ontario commissions 5 GW of newly-built electricity generation capacity.
- Solar and storage will significantly impact the province's green power generation fleet expansion.
- Among 55 companies approved to provide new generation capacity soon, numerous renewable energy and energy storage developers are included on the list to secure 1 GW of new generation plants in Ontario by 2025.
- This is big news for solar and storage developers, who have been developing innovative solutions to Canada's anticipated need for greater electricity generation.
- According to the provincial government-appointed Independent Electricity System Operator, IESO, the increasing adoption of electric vehicles and the planned retirement of nuclear reactors justifies the need for Ontario to commission 5 GW of new electricity generation capacity.
- There is also a separate call for proposals intended to commission 2.5 GW additional facilities in the province by 2027.



Enbridge Gas investing \$4Billion in renewable energy projects. Full page Ad and new website.

- Tomorrow. It's more than just a day, it's an idea. It doesn't exist, yet we prepare for it. It hasn't happened, yet it brings us hope.
- Tomorrow is what we make it. And we're making it happen today.
- By constantly renewing our commitment to renewables. By modernizing our systems with newer technologies and lower-carbon solutions. By providing the energy life demands without straining the resources we have. While listening to the communities we serve and working with our partners to make a difference. Today is for adding substance to sustainability. And dotting every "i" in innovation.
- We know there's no single path to net zero. And we're committed to putting in the work and energy to get there.
- Because when we step up and meet the challenges of today,
- Tomorrow is on.

thetarepaper#refer@daaccess.com

There are 4 billion reasons to look forward to tomorrow.

Tomorrow is on.™
The energy transition is underway. And as a bridge to a cleaner energy future, Enbridge is investing another \$4 billion in renewables and lower-carbon solutions through 2025. It's part of our ongoing commitment to meet today's energy needs, while being ready for what's ahead.

tomorrowison.com



- DER technology innovations
- - Integration with storage – Many utility procurements of storage options of all types.
- - Any Canadian inventions in solar panels, inverters, storage?
- Promotion of DER
- - Canadian trade associations
- - Coordination with US trade associations
- - Potential organizational relationships for IREC in Canada

Canada developed RetScreen now used globally in many languages.

The *RETScreen® Clean Energy Management Software* platform enables low-carbon planning, implementation, monitoring and reporting.

RETScreen Expert, an advanced premium version of the software, is available in Viewer mode completely free-of-charge.

[Click here to download RETScreen Expert](#)

Our software is also available in Professional mode on an annual subscription basis. [Click here for more information.](#)

About us



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Data
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[RETScreen
Capacity
Building](#)

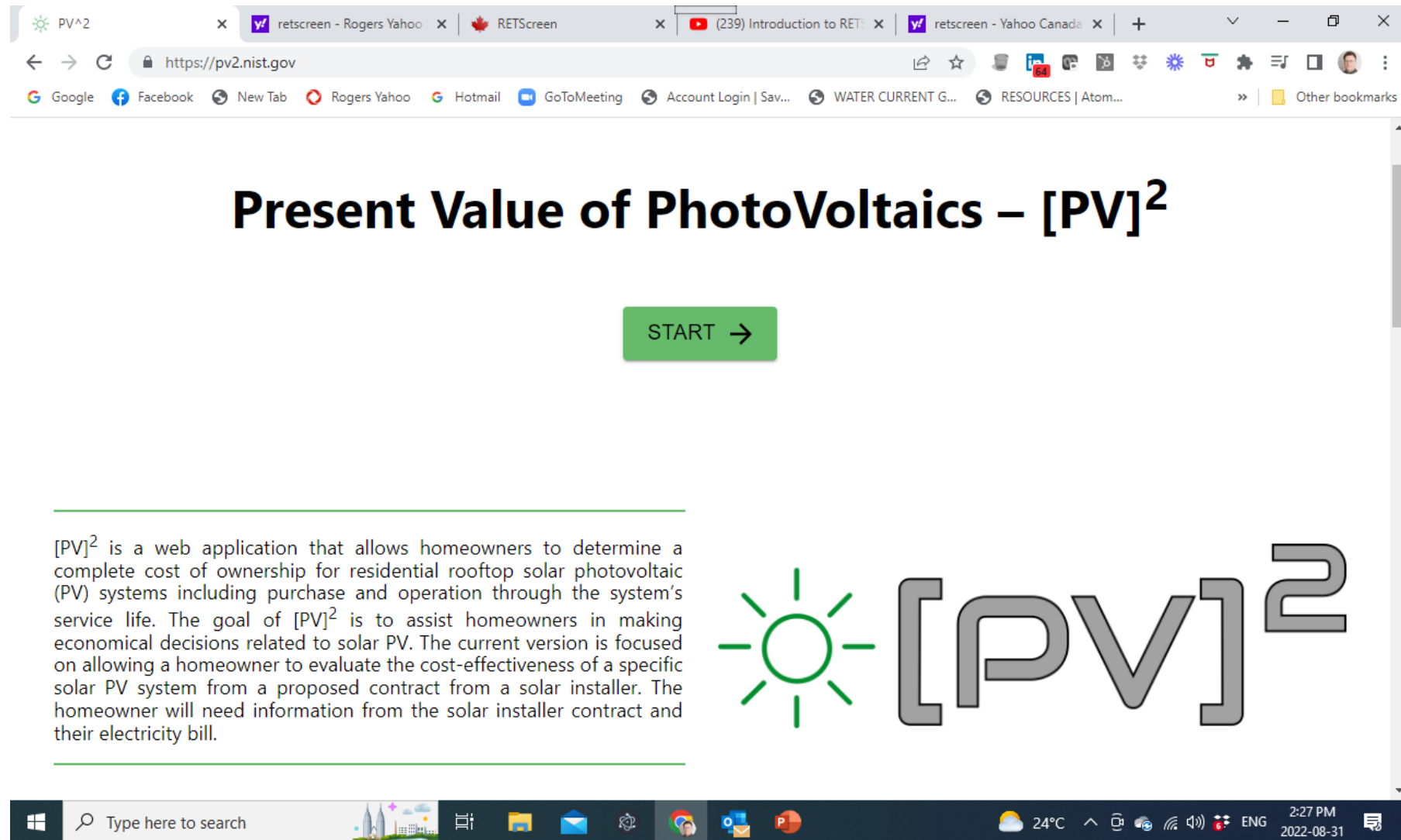
Video at: <https://youtu.be/wa3oPZQRGzw>



RetScreen Update Version 9 for Deep Retrofits

- Deep retrofit archetypes will be released with Version 9 of the RETScreen Software in October 2022. Our RETScreen Innovation Lab team is busy working on the final validation and testing stages for a whole new suite of archetypes for our Virtual Energy Analyzer.
- These new archetypes incorporate artificial intelligence to help our users very rapidly prepare pre-feasibility studies, in a matter of a few seconds, for potential deep carbon reduction projects, targeting to eliminate at least 80% to 90% GHG emissions at each facility assessed.
- This suite of archetypes will grow over time to include a large number of commercial, institutional, military and residential buildings, as well as agricultural and industrial facilities. Stay tuned!

US has developed similar program just for PV




The screenshot shows a web browser window with the URL <https://pv2.nist.gov>. The browser's address bar and tabs are visible at the top. The main heading of the page is "Present Value of PhotoVoltaics – [PV]²". Below the heading is a green button labeled "START →". To the left of the logo is a paragraph of text describing the application. To the right is a large logo consisting of a green sun icon and the text "[PV]²". The Windows taskbar is visible at the bottom of the screen.

Present Value of PhotoVoltaics – [PV]²

START →

[PV]² is a web application that allows homeowners to determine a complete cost of ownership for residential rooftop solar photovoltaic (PV) systems including purchase and operation through the system's service life. The goal of [PV]² is to assist homeowners in making economical decisions related to solar PV. The current version is focused on allowing a homeowner to evaluate the cost-effectiveness of a specific solar PV system from a proposed contract from a solar installer. The homeowner will need information from the solar installer contract and their electricity bill.

 **[PV]²**

DER technology –Energy Storage Canada.

- Founded in 2016, Energy Storage Canada (ESC) is a not-for-profit organization and the only national trade association in Canada dedicated solely to the growth and market development of the country's energy storage sector as a means of accelerating the realization of Canada's ongoing energy transition and Net Zero goals through advocacy, education, collaboration, and research.
- ESC's technology-agnostic approach allows for a diverse membership of 85 members (and growing!) representing the end-to-end value chain of the country's energy storage industry including technology and component providers, project developers, energy storage service providers, power generators, electric utilities, engineering, and construction firms, as well as professional services companies and NGOs.

Energy Storage Still has Regulatory Challenges.

- Energy storage can enhance the reliability and lower the costs of operating and maintaining Ontario's electricity distribution network, but current rules and regulations make that tricky.
- Batteries are being seen as a useful tool to help add flexibility to electricity networks and at transmission and distribution (T&D) grid level are often described as “non-wires alternatives” (“NWAs”) to expensive investment in new infrastructure.
- However, according to Energy Storage Canada, local distribution companies (LDCs) in Ontario are finding “several legislative and regulatory barriers” to deploying energy storage as NWAs and from recovering the costs of investing in them.

Canadian Energy Storage Company getting traction

Video at: <https://youtu.be/yhspgSbsxmE>

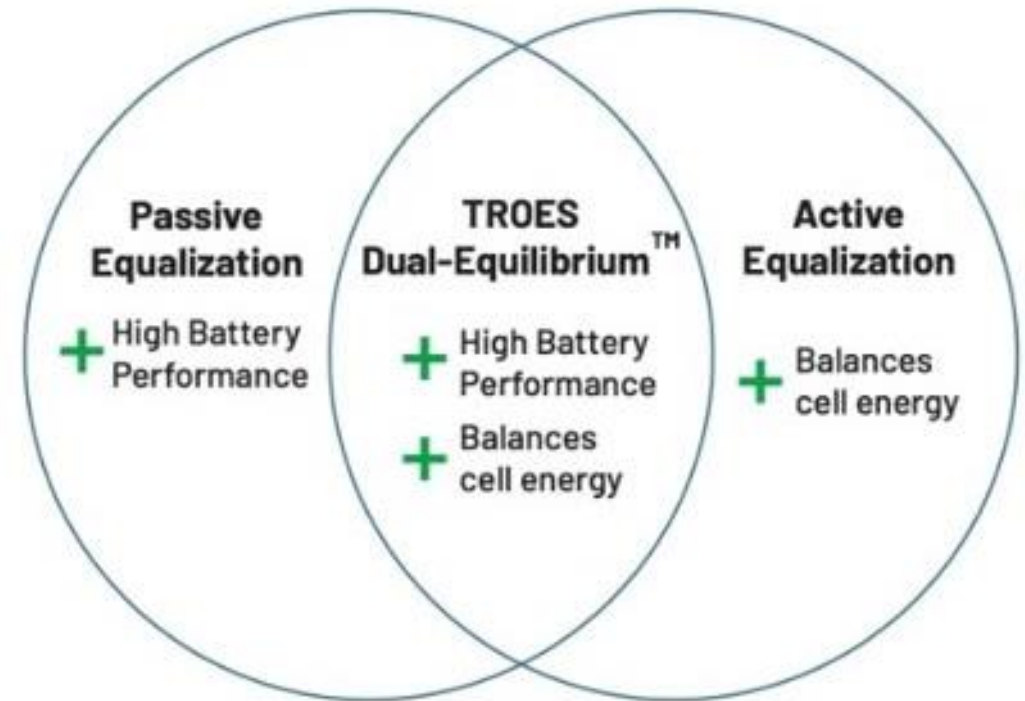


Canadian Energy Storage Company getting traction

Proprietary Dual-Equilibrium™ Technology

With the usage of lithium battery packs, it is difficult to maintain performance consistency for all individual cells. Especially in large-scale grid applications, the battery cycle life will be seriously affected over time.

TROES solves this issue by combining the advantages of both passive and active equalization and avoids the shortcomings of both.





HydroStor Initial innovation

Place balloons in lake and pump up at night and release during the peak hours.

HydroStor latest innovation

Video at : <https://youtu.be/cOWjwwKSR78>



Transactive Energy with Block Chain By Hero energy

Video at: <https://youtu.be/XHQd-nqL8HM>



V2G Project By Hero Energy

Video at: <https://youtu.be/QsV45ZaiTdU>



Plug'n Drive promotes EVs and now is on the move!



Given the success of our mobile operations and with our lease expiring, Plug'n Drive has an opportunity to re-evaluate where our next home should be and consider a more community-oriented model.

As part of this new approach, Plug'n Drive has entered into an exciting new partnership with Toronto Hydro to provide test drives across Toronto over the next nine weeks at three Toronto Hydro locations:

At the same time, our MEET will continue in Oshawa, followed by Wellington County, Bruce County and Mississauga. Meet West will be travelling to Banff, Canmore, and Edmonton, Alberta.





Canada's Public Charging Infrastructure Needs

UPDATED PROJECTIONS

Canada announces new EV charging report

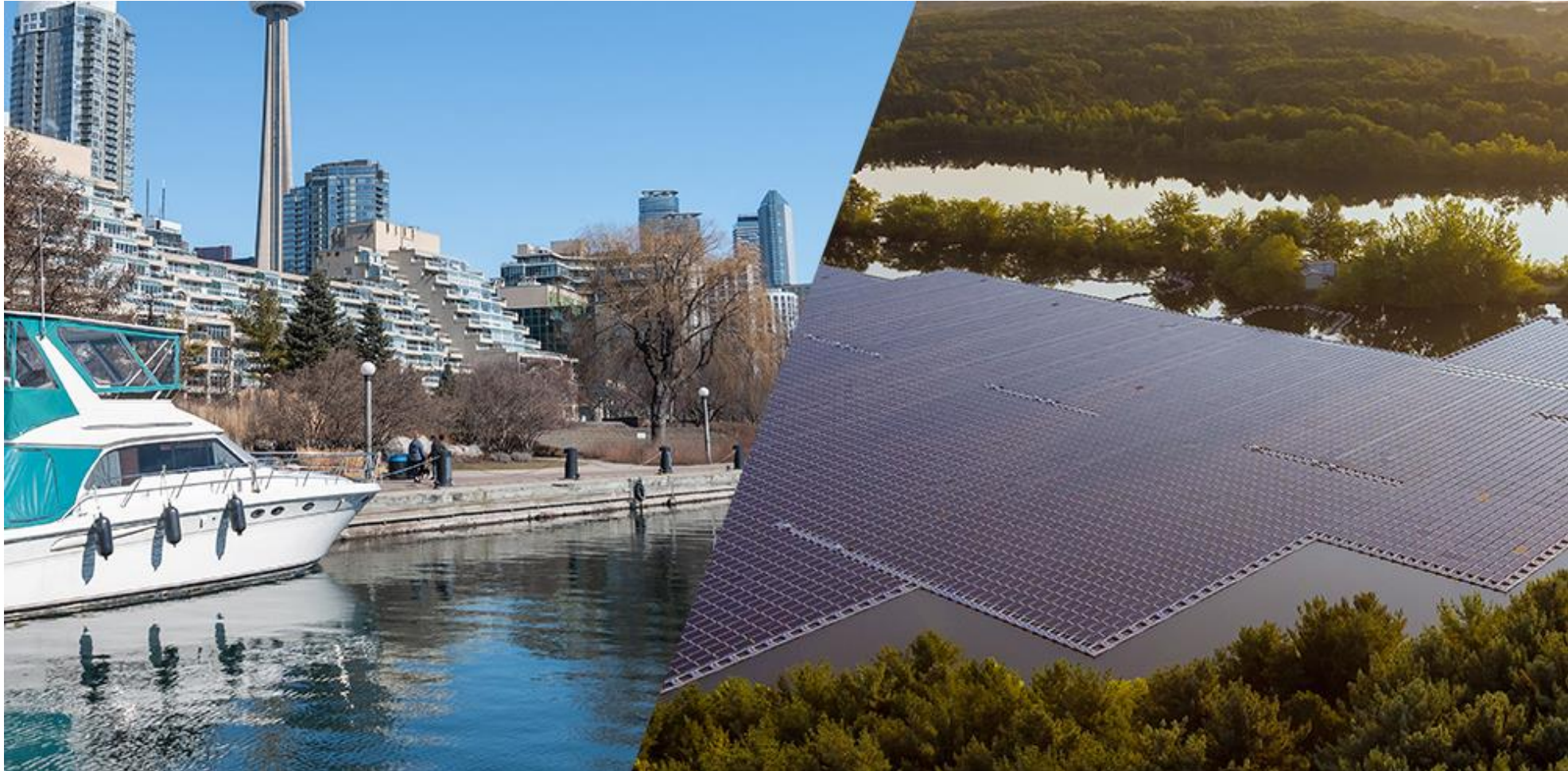
- **News release** August 26, 2022 Ottawa, Ontario - Natural Resources Canada
- From coast to coast to coast, Canadians are actively contributing toward Canada's fight against climate change in many ways. Given that transportation accounts for 25 percent of emissions, this contribution includes making the switch to pollution-free electrified transportation. Across the country, the Government of Canada is [supporting Canadians](#) by making it easier for families and businesses to purchase, charge and use electric vehicles (EVs) while driving toward a net-zero future.
- Today, the Honourable Jonathan Wilkinson, Minister of Natural Resources, released the report, entitled [Canada's public charging needs – Updated projections](#) (the "Report"), conducted by [Dunsky Energy + Climate Advisors](#). The updated analysis concluded that, by 2030, Canada will need to have around **200,000** publicly accessible chargers, with a ratio of one charger for every **24** electric vehicles and with the chargers varying in charge-time. While the model assumed a 15 percent market share of new vehicle sales by 2025, the 60 percent by 2030 and 100 percent by 2035 targets are in line with federal mandate.

Estimated Charging Infrastructure Scenarios

Table ES- 2: Estimated total charging infrastructure needs and EV-to-charger ratios for Canada.

		2025	2030	2035	2040	2045	2050
Scenario 1: High access to home charging	Public DCFC	4,300	13,800	32,000	50,200	62,700	69,000
	Public L2	48,000	181,000	410,000	593,000	673,000	658,000
	Total Public Ports	52,000	195,000	442,000	643,000	736,000	727,000
	Total MURB Ports	515,000	1,302,000	2,189,000	3,191,000	4,326,000	5,610,000
Scenario 2: Low access to home charging	Total DCFC	4,300	14,100	33,700	55,100	72,500	84,900
	Total L2	49,000	186,000	436,000	659,000	791,000	830,000
	Total Ports	53,000	201,000	469,000	714,000	864,000	914,000
	Total MURB Ports	46,000	152,000	499,000	886,000	1,318,000	1,799,000

Ontario Tech researcher floating a clean energy solution for vessels in Toronto Harbour



Fire departments in Toronto, Greater Montreal embrace electric trucks for safety and performance



Our Mission

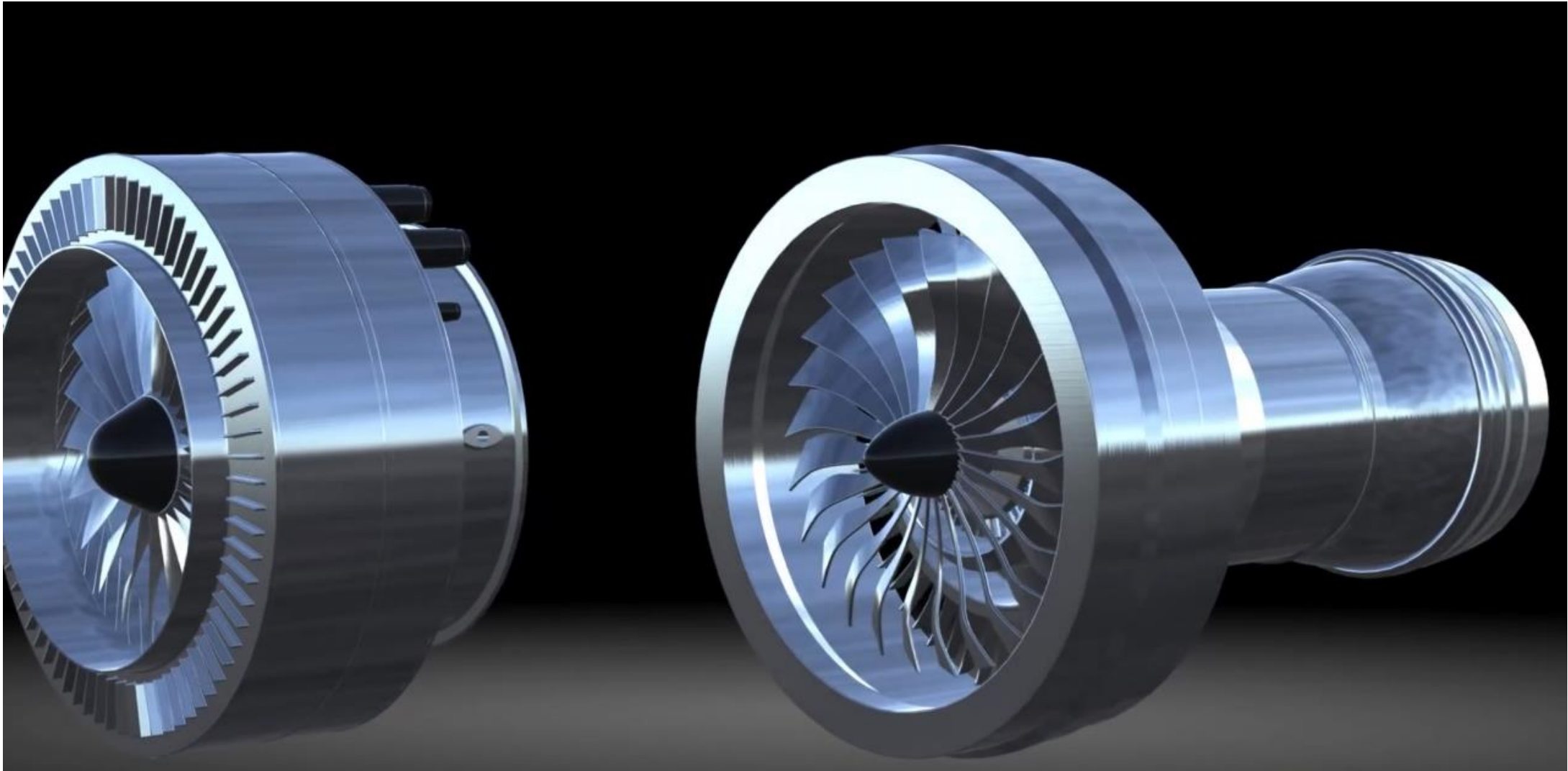
To electrify transportation by creating cost-effective and scalable propulsion solutions.



Founded in 2017, Duxion Motors Inc. is an advanced motor design and manufacturing company developing high power density electric propulsion systems for aviation and marine industries.

Our engineers have developed powerful scalable electric drives that accelerate the transition to emission free electric transportation. Our patented eJet motor enables jet owners and OEMs to hybridize or fully electrify their existing fleets more quickly and economically.

Hybrid to Electrifying Jet engines



Major Carbon Reduction Plan –Transform TO

Pocket Change

East end ‘Pocket’ neighbourhood goes all in on fossil fuel reduction

FRANCINE KOPUN

CITY HALL BUREAU

Architect Paul Dowsett remembers the day five years ago when a neighbour dropped by with a great big idea.

city’s ambitious TransformTO plan to reduce greenhouse gas emissions to net zero by 2040.

As the number of climate change disasters climbs — heat domes and derechos; knee-deep hail in Mexico — what seemed like a wild idea five

dian Institute for Climate Choices. Langille’s great big idea is now the Pocket Change Project, and an important component of TransformTO.

While there are individuals across the city, including Coun. Mike Lay-

[FULL
INDEX](#)
A2

Canada solar-powered self-contained mini-off-grid home



Canada solar-powered self-contained mini-off-grid home



Micro Grid Community

- This project will develop a new microgrid community in west Pickering (Altona Towns) giving new homeowners more choice and control over their electricity production and consumption.
- The project is the first pre-planned smart energy community in Ontario. As the electricity system becomes increasingly decentralized, local utilities and developers have important roles to play. This project enables the developer and the local utility (Elexicon Energy) to participate in the development of the smart energy community from its inception and to develop processes and procedures as a blueprint for future smart energy communities in Ontario.
- The microgrid includes a group of 27 townhouses supported by 250 kW / 500 kWh battery energy storage system, 25kW rooftop solar photovoltaics, one electric vehicle charger and an integrated distribution energy service platform to control and coordinate the components of the microgrid.

Micro Grid Community



Canadian Waste to Energy Company

- SHARC Energy's (SHRC-CN) technology — in the form of a SHARC or PIRANHA system — recycles thermal energy from wastewater which can then be used in heating, cooling and hot water production for commercial, residential and industrial buildings. The SHARC is intended for district energy, large commercial or industrial use while PIRANHA is ideal for apartments, hotels or commercial use.



Green button and Canadian connection



AGENDA



Jeremy J. Roberts, GBA

- GBA Chair, Syed Mir
- GBA Executive Director, Jeremy J. Roberts

Green Button Solutions Showcase

- UtilityAPI
- Utilismart
- Logical Buildings
- SEW
- Big Data Energy Services
- Rodan Energy
- SilverBlaze
- London Hydro

Green button and Canadian connection



GBA Board of Directors



Syed Mir (Sponsor rep)
Chair of GBA
London Hydro



Daniel Roesler (Sponsor rep)
Vice-Chair of GBA
UtilityAPI



Travis Arnce (Sponsor rep)
Treasurer & Secretary of GBA
ENGIE



Jonathan Booe (voting *ex officio* rep)
North American Energy Standards Board



Tracy Lynch (Sponsor rep)
Enbridge Gas (Union Gas)



Bob Champagne (Sponsor rep)
Smart Energy Water (SEW)



Jeff Hendler (elected: 2021)
Logical Buildings



Bill Pfister (elected: 2022-2023)
Edison Electric Institute



James Lewis (elected: 2021-2022)
Big Data Energy Services




David Wollman (*ex officio* rep)
U.S. NIST (Dept. of Commerce)



Christopher G. Irwin (*ex officio* rep)
U.S. Department of Energy

Join Us as a Sponsor!

Green button and Canadian connection


Green Button Solutions Showcase

at DISTRICT TECH 2022

Press Esc to exit full screen

Watch later
Share


Green Button Evolution

GREEN BUTTON LEGISLATIONS & DEVELOPMENT

10 States with GB mandate

&


Now Ontario as the First Province in Canada



Legend:

- Limited 'official' data-access discussions to-date
- Data-Access discussions including Green Button in progress. ***
- Green Button mandated or called-out specifically in legislation, rules, or dockets.

GREEN BUTTON ADOPTION



6:50 / 1:54:52
Syed Mir, Chair of GBA; London Hydro

CC
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*** Ontario regulation: <https://www.ontario.ca/laws/regulation/r21633>

Rodan Energy - Canadian Aggregator operating in deregulated markets.



Green Button Solutions Showcase at DISTRIBUTECH 2022

WHY RODAN ENERGY?

Watch laterShare

Vince Thomas, Rodan Energy Solns

Our **ENERGENT™ **RENEWABLE + ENERGY STORAGE** solution delivers industry leading technology to effectively manage and optimize distributed energy resources, battery storage and microgrids.**

We are active across North American and with services in all deregulated markets including IESO, PJM, NYISO, MISO and AESO.



MORE VIDEOS









1:26:07 / 1:54:52 • Vince Thomas, Rodan Energy Services

Quest Canada –Community Energy Association

- QUEST Canada is a national non-profit that supports communities in Canada on their pathway to net-zero. Since 2007, we've been facilitating connections, empowering community champions and influencing decision-makers to implement efficient and integrated energy systems that best meet community needs and maximize local opportunities. We develop [tools and resources](#), convene stakeholders and rights holders and advise decision-makers — all with the goal of encouraging and enabling communities to contribute to Canada's net-zero goals.

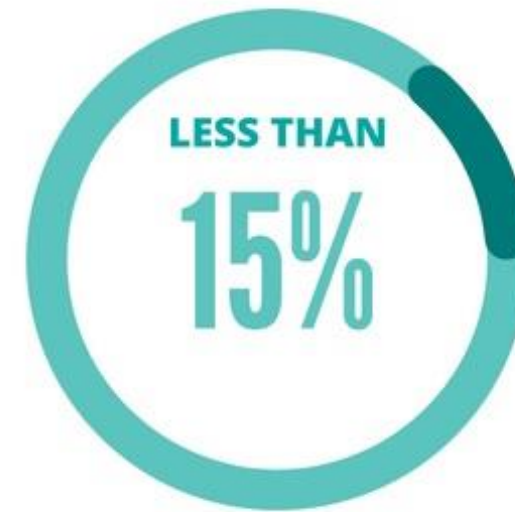
Quest Canada –Community Energy Association

There are more than 4,000 communities in Canada at the forefront of the energy transition. They are diverse with regards to culture, geography, economies, energy mix as well as resources. We need to give communities the support and resources they need to implement local solutions that contribute to Canada's net-zero target.

Communities on the pathway to net-zero reap several benefits. **Community energy planning** lowers greenhouse gas emissions and pollutants, creates energy and health expenditure, and also offers greater resilience to the impacts of climate change. On average, less than 15% of energy spending stays in the local economy, but community energy planning can change that.



of Canada's energy use and GHG emissions are the responsibility of communities



of energy spending stays within in the local economy

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OSEA and IREC Collaboration.

- **How OSEA Does It and possible sharing with IREC:**
- **Educate:** OSEA provides content rich webinars and workshops featuring emerging themes in the rapidly evolving sustainable energy industry
- **Support:** OSEA hosts its annual showcase, Green Energy Doors Open, that publicly recognizes promising SMEs working with emerging clean technologies in Ontario
- **Advocate:** OSEA engages with government and clean energy stakeholders to improve access to the grid, accelerate deployment of distributed energy resources, and improve energy efficiency

OSEA and IREC Collaboration.

- The Ontario Sustainable Energy Association (OSEA) is dedicated to advancing a sustainable energy economy with thriving small-medium sized enterprises (SMEs) and green jobs.
- OSEA is a non-partisan, member-based, non-profit with a long history of advocating for clean energy on behalf of Ontario's sustainable energy sector.
- OSEA works to remove barriers to growth for sustainable energy SMEs as a Designated Intervenor with the Ontario Energy Board.
- OSEA supports climate mitigation by promoting energy efficiency with the building stock and grid in Ontario.
- We welcome exploring the possible benefits of a collaboration with IREC.

The following slides cover my historical perspective on major electric utility issues from both the advanced innovation but also the financial and economic impacts.

Break Up of Ontario Hydro and subsequent provincial interference and financial impacts.

- February 1997 Mike Harris's Conservative government announced its intention to privatize Ontario Hydro.
- In 1998 the company wrote \$6.6 billion off its books, a move that resulted in a \$6 billion loss, the largest in Canadian history, rendering the crown corporation technically bankrupt.

At \$1B, cancelling gas plants was actually one of Ontario Liberals' cheaper electricity decisions

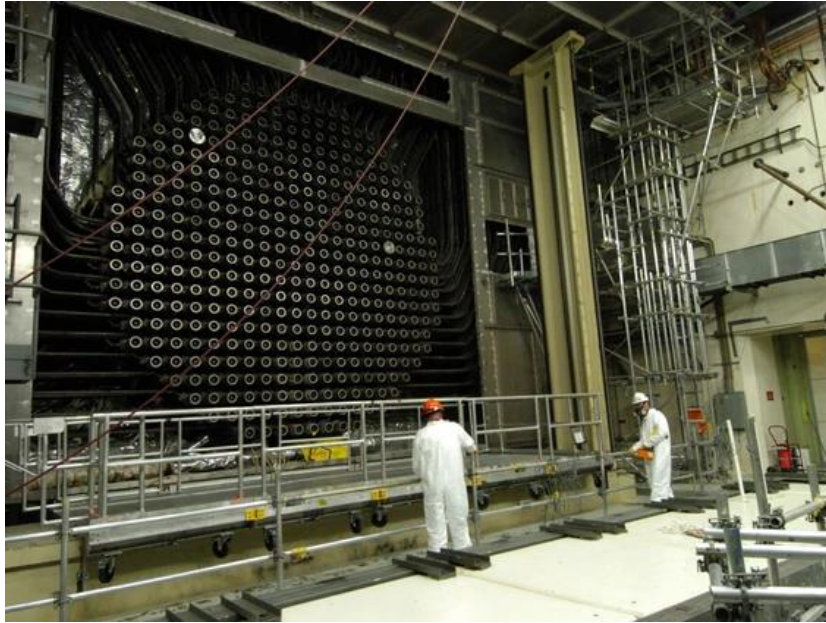


The remains of the 800-megawatt gas-fired power plant in Mississauga, which had its construction canceled by the Liberal Ontario government prior to the 2011 provincial election

Ontario Electricity Rates as a Political Football

- In 2015, a year after Kathlyn Wynne won her first election, auditor general Bonnie Lysyk issued a scathing report that suggested Ontarians had paid **\$37 billion** more for power than they should have between 2006 and 2014, partly because the province run by the Liberals had allowed exorbitant prices for wind, solar and other alternative energy sources.
- The bad news continued on Wynne's watch as rising hydro rates put political pressure on the Liberals, so they introduced a plan to reduce electricity prices **by 25 per cent**, borrowing money that will have to be paid back by consumers starting in 2028.

OPG's multi-billion-dollar gas-plant buying spree partly prompted by shifting nuclear landscape: CEO



Now with the closing of the 2000MW Pickering Nuclear plant the OPG is buying back the gas plants that were previously moved to acceptable locations at great public expense. Many of these plants had finished the long term contracts and the IESO needs them to meet the reserve margin interconnection reliability requirements and also operate them in favour of their capacity market they are about to open.



A crane has begun dismantling one of the four turbines built in Prince Edward County

Each provincial government plays to their base with significant decisions on the electricity system and the rates that result from them .

The Progressive Conservative government has spent \$231 million so far to cancel some 750 renewable energy projects, most of which went to the axed White Pines wind farm project in Milford, Ont. That total may eventually rise — in December, Premier Doug Ford's government ordered the partially built Nation Rise wind farm to be cancelled and taken down, with the company behind it losing \$230 million in sunk costs. (The company, EDP Renewables, has launched a court challenge of the decision.)

Clean air alliance Opposition.

Ontario energy strategy will harm environment

ANGELA BISCHOFF ANGELA BISCHOFF IS DIRECTOR OF THE ONTARIO CLEAN AIR ALLIANCE

When it comes to keeping our homes comfortable and well lit, Ontario is quickly moving into the dark ages.

The province's gassy energy strategy is the exact opposite of what our climate needs and will undermine the health and safety of our communities.



Wind turbines near Martello Tower in Kingston. It seems like Ontario is fine with falling behind and letting others reap the benefits of a green-energy transition, Angela Bischoff writes.

First, the province is planning a huge increase in the use of gas-fired electricity — more than 600 per cent by 2040. Second, it is th



Some of the innovative issues I dealt with at Ontario Hydro over 29 years ago

- 1) Negotiating with GPU for power export after 3 Mile Island accident.
- 2) Evaluating the construction of a DC cable under Lake Erie to PJM that is still being considered now after many years and much lower costs than in 1990s.
- 3) Applying early expert systems like Decision Tree for risk analysis and Analytical Hierarchy Program for multi criteria attributes to the first 25 Year Demand/Supply Strategy Study, an Integrated Resource Plan

Some of the electric power issues I dealt with at Ontario Hydro

- 4) Establishing the first Ontario non utility generation rates and the 25 year contracts that are now over and subject to great debate as many want to close all the gas plants.
- 5) Worked on the first Cap and Trade program with US on NOx and SO2 that dealt with both the air and the water impacts.
- 6) Evaluated the financial and environmental impacts of massive hydro power purchases from Quebec and Manitoba. Contributed to the energy provisions in the first NAFTA agreement.

Some of the electric power issues I dealt with at Ontario Hydro

8) Major financial study on global nuclear costs and benefits as the government had to decide on the completion or deferral of the Darlington Nuclear station that had massive interest costs ballooning to final contrition costs over \$14 Billion.

4 - 878 MW units were planned but as cost mounted the government requested a major financial study on completing only 2 units and incur massive cancellation charges or completing all 4 units at much higher costs.

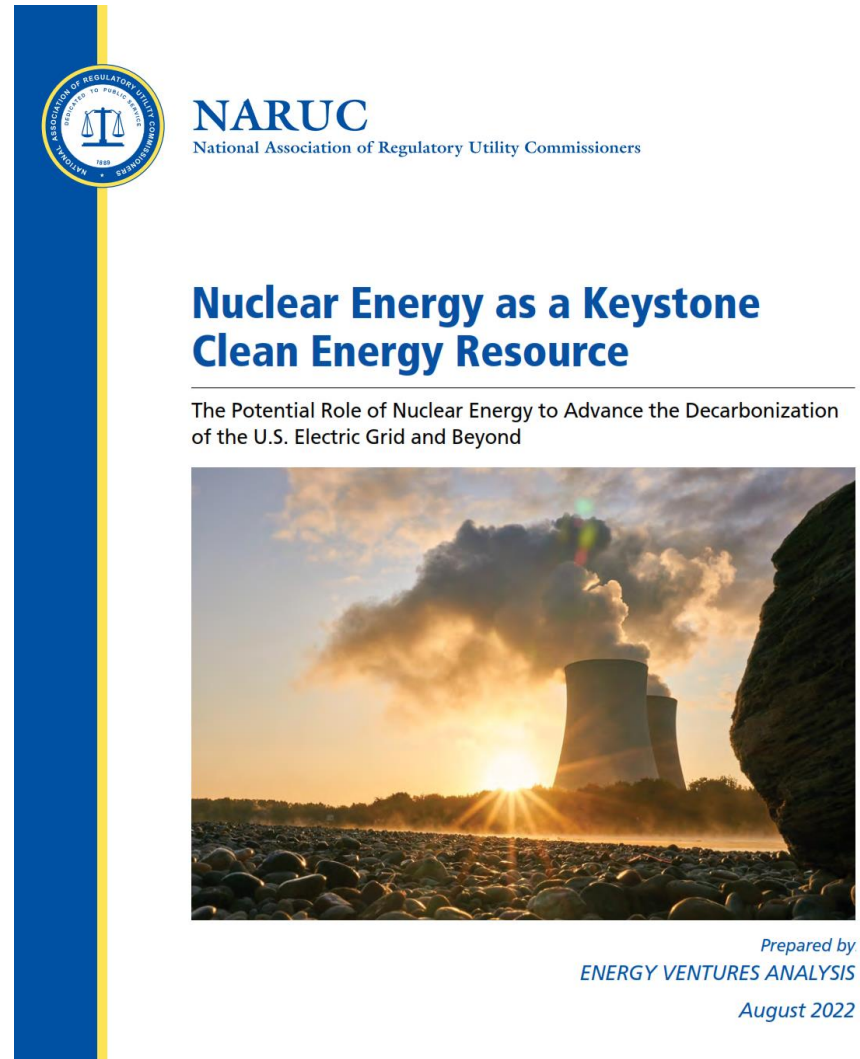
Nuclear Plant Extensions

- A smart investment
- According to an independent report by the Conference Board of Canada, the Darlington Refurbishment Project and the subsequent 30 more years of station operation, are expected to generate a total of \$89.9 billion in economic benefits for Ontario, create 14,200 jobs per year, and boost personal income by an average of \$1.6 billion on an annual basis.
- With 96% of project costs spent in the province and a heavy reliance on Ontario-based contractors, for every \$1 spent on the project, Ontario's GDP will increase by an average of \$1.40.
- In addition to playing a significant role in strengthening Ontario's economy, an independent report prepared by Intrinsik Environmental Sciences, noted that the continued operation of Darlington Nuclear to 2055 will take the equivalent of two million cars off Ontario's roads per year by avoiding significant greenhouse gas emissions. This is an important step in Ontario and Canada's fight against climate change.

Nuclear Plant Extensions

- In December 2015, Bruce Power reached an agreement with the Independent Electricity System Operator (IESO) to advance a long-term investment program which would refurbish its nuclear fleet and secure the site's operation until 2064.
- The Life-Extension Program started on January 1, 2016 and involves the gradual replacement of older systems in the company's eight reactor units during regularly scheduled maintenance outages.
- As part of the Life-Extension Program, Bruce Power is carrying out its intensive Major Component Replacement (MCR) Project. The MCR Project began in January 2020 and focuses on the replacement of key reactor components in Units 3-8, including steam generators, pressure tubes, calandria tubes and feeder tubes.
- The program will secure an estimated 22,000 jobs directly and indirectly from operations, and an additional 5,000 jobs annually throughout the investment program, injecting billions into Ontario's economy..

Nuclear Energy in US now included in Clean Energy Agenda



Nuclear Energy in US now included in Clean Energy Agenda

I. Executive Summary

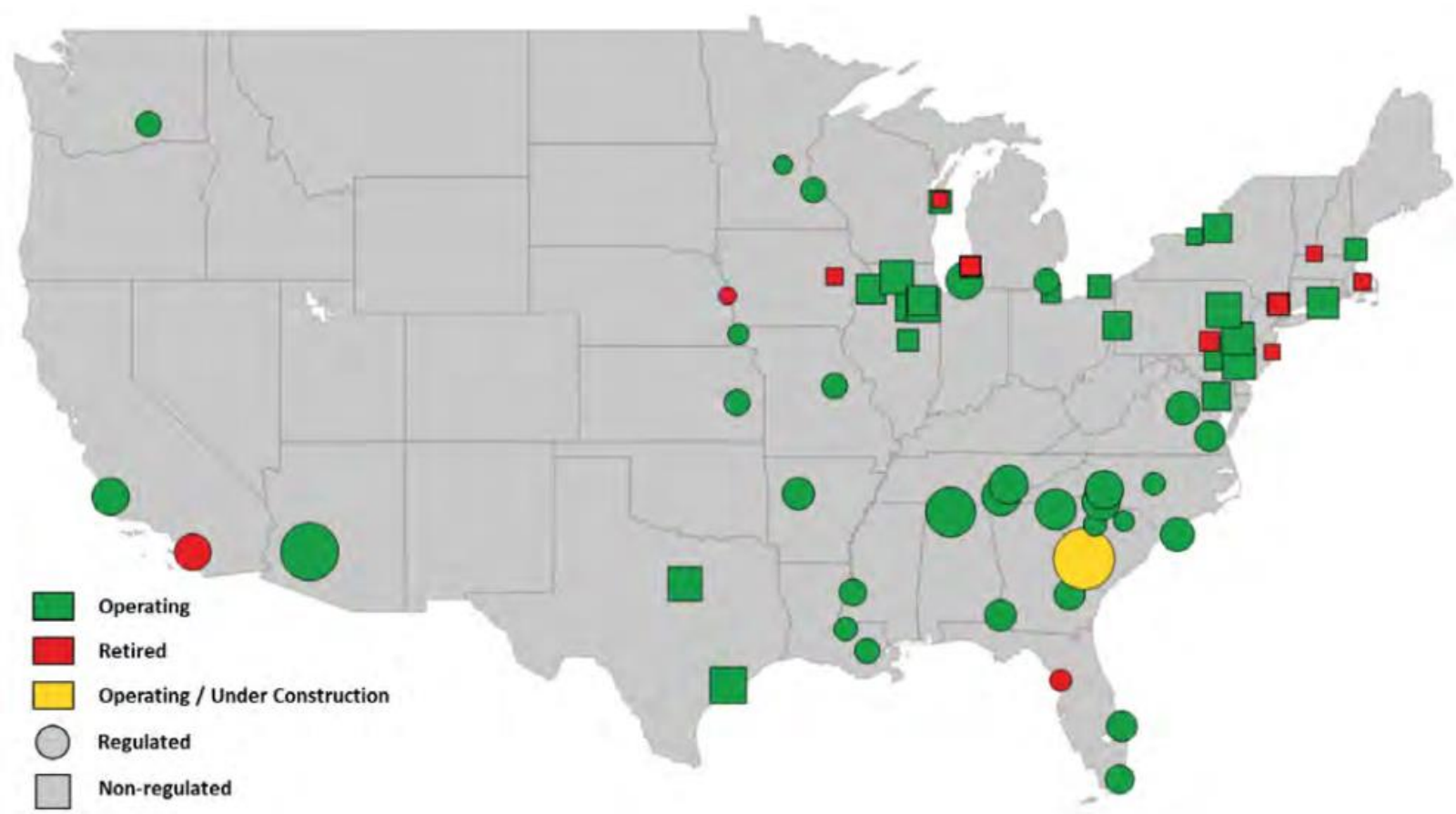
Since the first commercial nuclear reactors started operating in December 1957, nuclear energy has been a keystone clean energy source in the U.S. electricity sector. In 2021, nuclear energy accounted for approximately 20 percent of total U.S. electric generation and almost 50 percent of its carbon-free electricity. As of June 2022, 92 nuclear power reactors totaling roughly 97,400 MW operate in 28 states.

Over the decades of operation, nuclear energy has proven to be one of the lowest-cost and most reliable energy resources integrated into the U.S. electric grid. According to the North American Electric Reliability Corporation (NERC), nuclear reactors have the lowest forced outage rates among major fuel and technology types, making them one of the most reliable sources of electricity in the country.

Additionally, due to their low cost of fuel, nuclear power plants are also one of the cheapest non-renewable generating resources currently operating in the U.S., providing steady around-the-clock (baseload) electricity to countless customers across the country.

Nuclear Energy in US now included in Clean Energy Agenda

Exhibit 2: Map of Nuclear Power Plants Currently Operating, Retired, or Under Construction



Nuclear Energy in US now included in Clean Energy Agenda

Some of the drawbacks of nuclear energy that have limited its deployment in recent decades are high capital costs, construction delays, the significant amount of water needed to cool traditional nuclear reactor designs (boiling water/pressurized water reactors), perceived risk by the public of a possible accident and release of radioactive material, and limited operating flexibility due to current NRC operating license requirements.

However, many of the advanced nuclear reactor designs currently in development aim to address some or all of these challenges. Many small modular reactors (SMRs) under development are designed to be plug-and-play and scalable to fit the needs of the owner, significantly reducing the capital costs and construction lead times for these projects. Additionally, locating new nuclear power plants at brownfield sites, e.g., sites of recently retired power plants, can also significantly reduce the capital costs and lead times associated with new projects, as assets like transmission lines and cooling systems may be reused.

Many advanced nuclear reactor designs also include passive safety mechanisms that significantly reduce the potential risk of a nuclear accident and make these reactors safe to deploy closer to population and industry centers. Virtually all new reactor designs include enhanced operating flexibility procedures, allowing nuclear power plants to work in tandem and perfectly complement intermittent resources such as wind and solar.

Some of the electric power issues I dealt with at Ontario Hydro

8) Worked on the first sustainable development issues for a utility after Maurice Strong became OH Chairman after COP 1. Maurice Strong, hired to restructure the company, put an end to construction and cut 7000 employees.

I left Ontario Hydro in 1992 with many others on major downsizing program with voluntary separation incentive to find a new career. They decided to not be the builders of the new assets and allow for privatization and have less well-paid union and management staff.



SUSTAINABLE RESOURCES
management

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Canadian Electricity Innovation
contact: David Katz
dkatz@sustainable.on.ca
416-493-9232

