# Patchworking Canada's Energy Transition

## Accelerating through Evidence-based Decision Making

*Backgrounder CCRE Energy Leaders Roundtable, October, 2023*

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**Disclaimer**

*The views expressed here are those of the author and do not necessarily reflect the opinions of the CCRE or its members.*

STRATEGIC POLICY ECONOMICS

# Patchworking Canada's Energy Transition

## Outline on opportunities to accelerate climate decision making

- The world has changed since the CCRE's national energy vision
- Set against a global context, Canada's energy and climate policies are inconsistent and conflicting
  - Policy tactics in the absence of a strategy to address how Canada's challenges differ across the country is destined to fail
- These differences are leading to controversy and a fracturing of national politics
  - The tactics around the demise of Oil and Gas and advent of CCUS and Hydrogen may be misplaced
  - The difficult path to clean electricity is understated
- Policy makers have not grasped the growth challenge in front of the Clean Electricity Regulation (CER)
  - Clean electricity pathways have regional disparities that don't align with the CER
  - Transmission (Tx) and Hydro are not a panacea and cannot solve the CER's 2035 ambition
  - Renewables as a standalone solution are a myth
- Canada has more economically beneficial options and should not rely solely on renewables
- ITCs should support Canada's economic battle for a share of the new global net zero economy
- Conclusion
  - Use evidence to accelerate awareness and urgently drive a winning national energy transition strategy

# Since the CCRE's National Energy Vision the world has changed

## In Penticton 2019, the CCRE NEV initiative led to national dialog and several works

CCRE tabled the potential of a principled and evidence-based national energy vision to get Canada to Net Zero

- Pathways consist of an Energy Trifecta enabling Canada to "Hit Above Its Weight to Reduce Global Emissions"

**CCRE National Energy Vision Commentaries**

*Why Canada needs a national energy strategy*
B.Tobin, A.Engen, Nov 2019

*A Principled Approach*
K.Taylor, Apr 2021, Foreword by G.Wright

*Canada's Low Carbon Energy Infrastructure Opportunity in a Global Net Zero Future*
M.Brouillette, Dec 2021

*Case Study: Implications for Ontario & Quebec*
M.Brouillette, Jun 2022

Latter two were informed by:

- *The Realm of the Possible for Canada: Hitting Above Its Weight to Reduce Global Emissions,* Strategic Policy Economics, Dec 2020
- *Electrification Pathways for Ontario,* Strategic Policy Economics, Jul 2021

Recent tectonic global geopolitical shifts

- Russian invasion of Ukraine and energy security
- U.S. – China tensions around trade, trade balance, strategic supply chain security, and manufacturing
- Dimming view on effectiveness of carbon taxes
- U.S. IRA, the economics of energy and supply chain security in the energy transition
- Rising recognition of nuclear as a clean energy option
- Global flooding, heatwaves, wildfires and the hottest September ever

# Canada's Energy and Climate policies in a global context

## The portfolio is a mix of inconsistent and conflicting policy objectives

**Global Trends for Trifecta of Decarbonizing Energy Solutions**

**Decarbonized Fossil Fuels**
- IEA forecast potential *global decline* of Oil & Gas to achieve climate goals
  - Countered by the EIA in assessing current policies

**Promise of Hydrogen**
- IEA's 1500 bcme hydrogen forecast displaces 75% of NG
- U.S. $7B hub, IRA tax credits
- European demand & Atlantic Canada developments

**Electrification**
- Rise of wind & solar renewables
  - IEA forecasts over 70% of supply mix
  - CER 2023 for Canada models 60% of new generation production
- Resurgence of nuclear acceptance, 200 GW in the U.S.

Note: IEA reference is the 2022 World Energy Outlook

| Sector<br>Measure Type | Oil and Gas Sector<br>Supportive | <br>Offsetting | End User Transition | Electricity Sector Transition |
|---|---|---|---|---|
| **Canadian Policy Instruments** (sample) | Trans Mountain | OBPS<br>GHG Caps<br>Methane reduction | Carbon Pricing Fuel Charge<br>Clean Fuel Standard | Powering Canada Forward<br>Atlantic Loop, SMR Action Plan<br>Clean Electricity Regulation<br>(Get off of Nat Gas) |
| | | | Zero Emission Vehicles, Heat Pump subsidies<br>National Hydrogen Strategy | |
| **Federal Budget Tax Credits** (sample) | CCUS<br>(Up to 50%)<br>Blue production | | Hydrogen<br>(up to 40%) | Green production<br>Clean Technology and Manufacturing<br>(e.g. 30% for wind, solar, and small modular reactors)<br>Clean Electricity<br>(e.g. 15% for nuclear, hydro, transmission) |

# Canada's challenges differ across the country

## Canada's energy reality requires a patchwork of competitive transition strategies

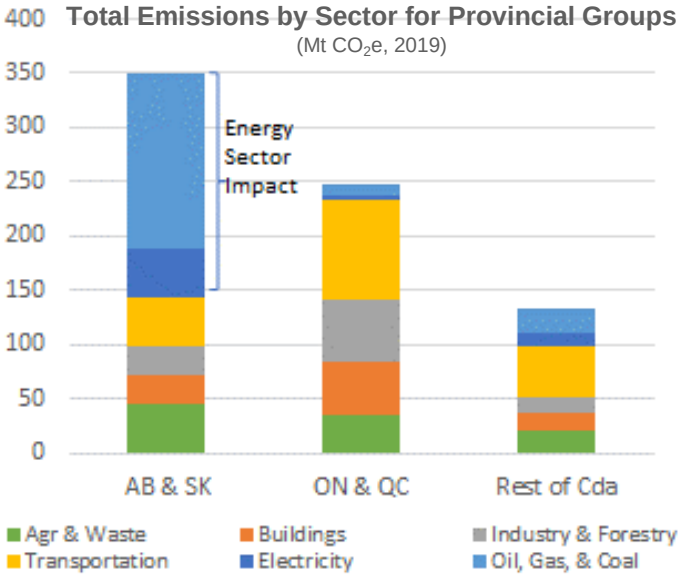
Alberta and Saskatchewan emissions dominated by Oil and Gas

- Canada is a leading global supplier of energy yielding high emissions
  - O&G production is a global not Canadian energy transition issue
  - Canada can hit above its weight on global emission reduction
- Federal programs and tax credit investments in CCUS may enable substantial progress on the O&G, Hydrogen and Electricity trifecta
  - A foundation for blue hydrogen hubs
  - Renewables may pair well for electricity production
  - Small modular reactors may offer CHP solutions

Ontario and Quebec are Canada's true emissions challenge

- Must address Transportation, Industry and Buildings
- Renewables don't always pair well
- Without CCUS incentives, green hydrogen may be the route,
- Both provinces will get more emission intensive in next 10 years

Rest of Canada are microcosms of the solutions found for the above



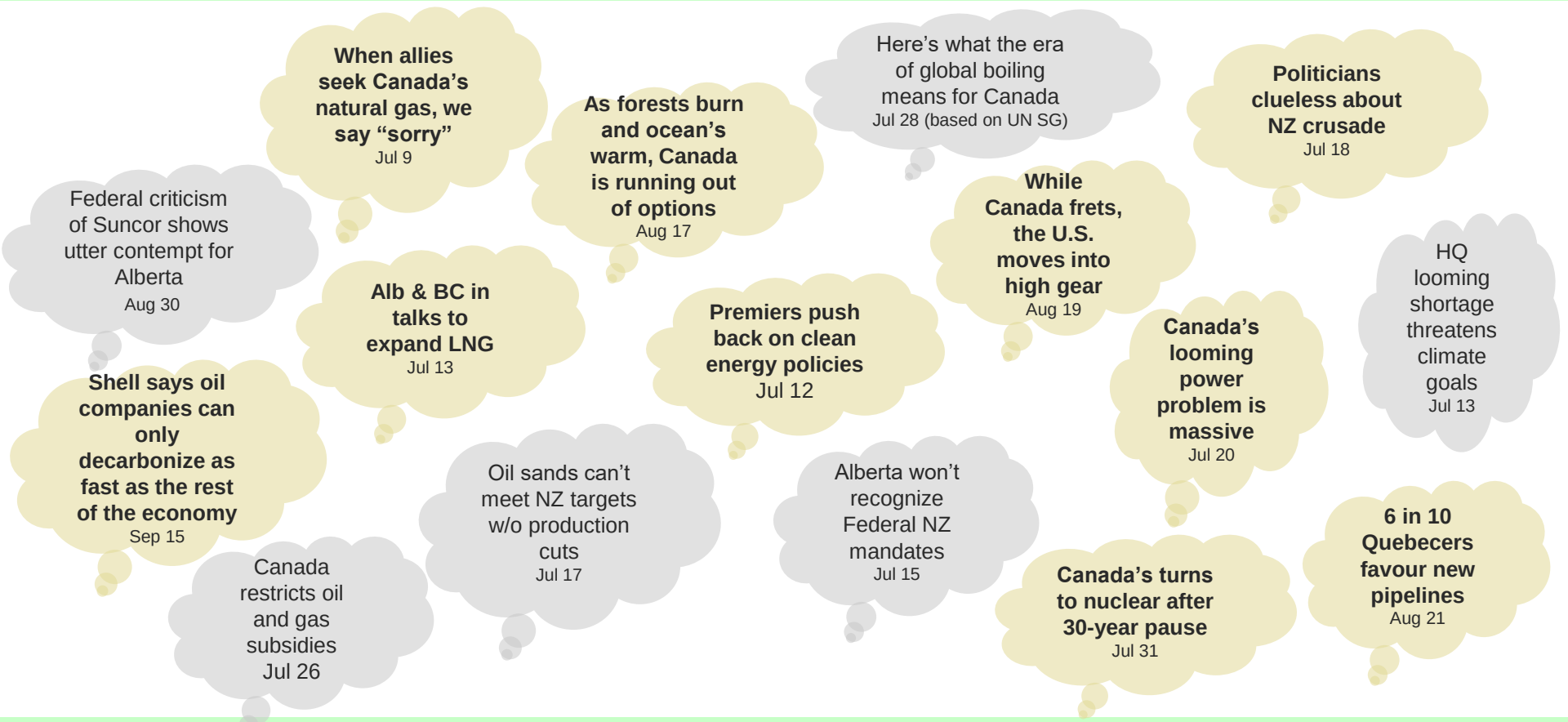

Source: CCRE Commentary, 2022

A poor understanding is underpinning policy maker tactics for the energy transition

- "*Tactics without strategy is the noise before defeat*" → Sun Tzu, "The Art of War"

# Controversy over pathways to NZ have fractured national politics

## Conflicts over policies and objectives are playing out in the public domain



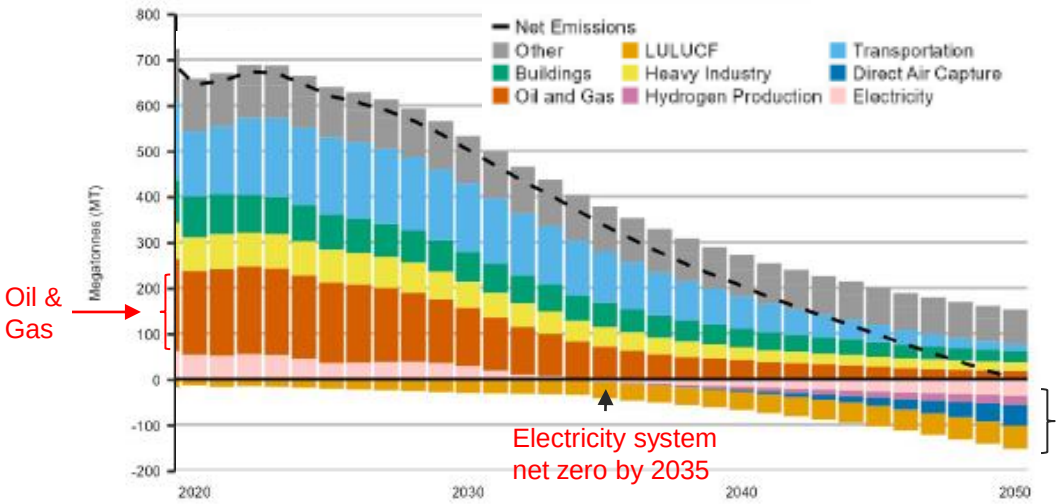
# CER 2023 NZ foretells a substantial decline in oil & gas emissions

## Echoing the IEA's global Net Zero forecast for oil use in transportation

Electrification of transport, buildings and industry to yield most results

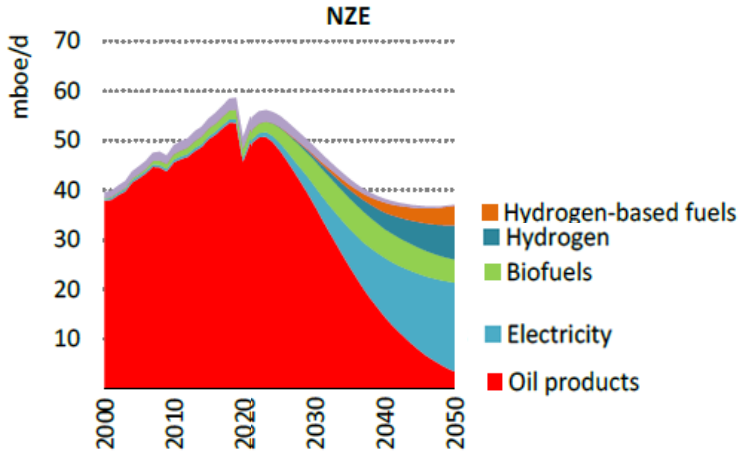
- CCUS and biomass offer negative emissions contributions
  - → but CCUS only incented in the west

Figure R.4: From Canada Energy Regulator (CER) 2023 Energy Futures report
GHG emissions by economic sector, Global Net-zero Scenario




Other incudes agriculture, waste management, light manufacturing, construction, and forest resources

**Figure 1.13** ▷ Energy use in transport by scenario, 2000-2050




Source: IEA 2022 WEO

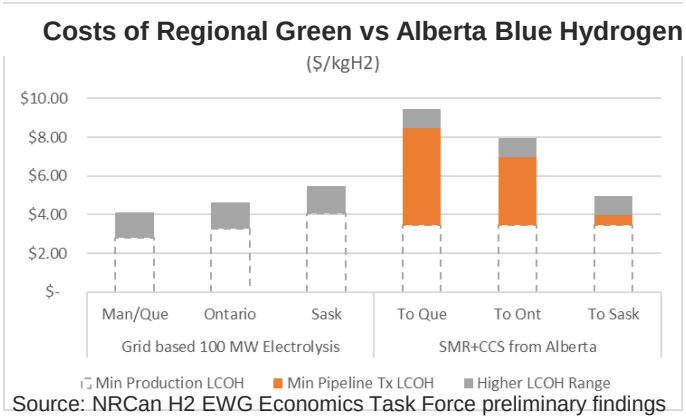
**Net negative contributions enable Canada's NZ objectives**

- Electricity system aided by bioenergy generation with CCUS
- Hydrogen production portion from biomass using CCUS
- Direct Air Capture (DAC) for difficult-to-decarbonize sectors
- Land use and forestry (LULUCF) emissions benefits triple to -50 MT from -17 in 2021

# CCUS and Hydrogen strategies → Blue vs Green

Canada started but is being overtaken by U.S. action, potentially putting opportunity at risk

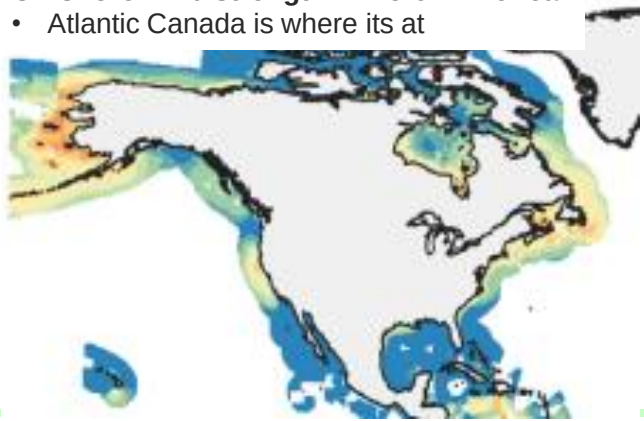

Source: U.S. Hub Announcement, Strapolec Analysis




Source: NRCan H2 EWG Economics Task Force preliminary findings

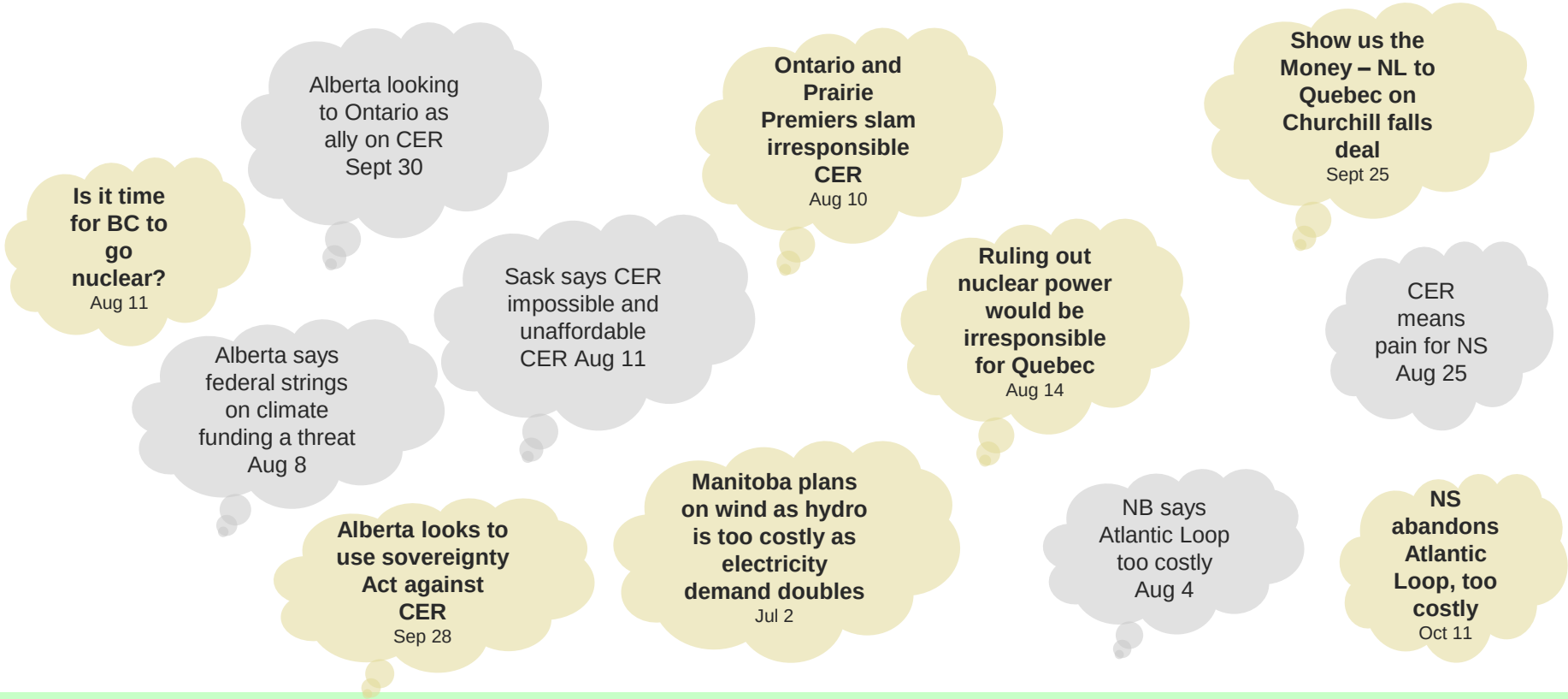
**Off shore wind strength in North America**

- Atlantic Canada is where its at



Source: IEA WEO 2022

# The Clean Electricity Regulation has raised more controversy

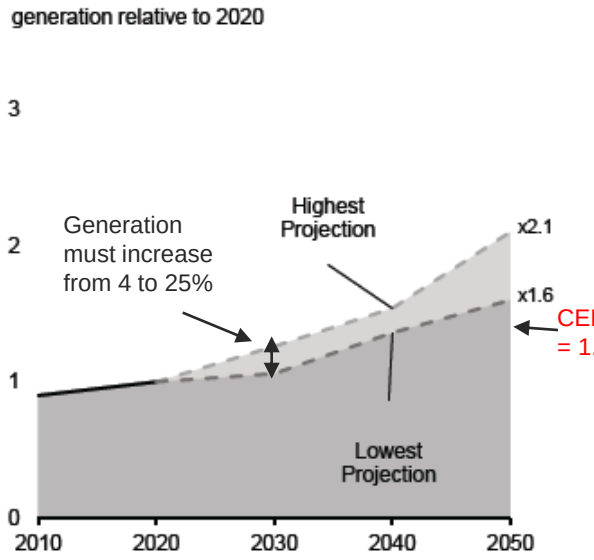


# Federal statements on electricity growth understate the challenge

Policy appears to have been developed against naïve electricity growth outlooks

Chart 3.3

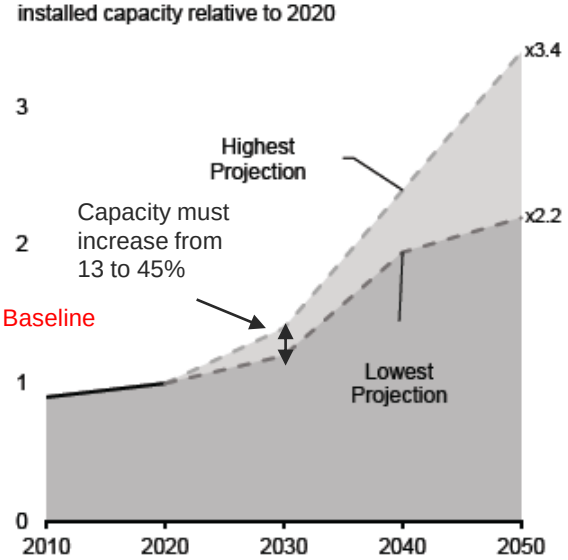
**Projected Electricity Generation Requirements in Canada, 2019-2050**




Source: Canadian Climate Institute (2022), Bigger, Cleaner, Smarter: Pathways for Aligning Canadian Electricity Systems with Net Zero

Chart 3.4

**Projected Electricity Capacity Requirements in Canada, 2019-2050**




Source: Canadian Climate Institute (2022), Bigger, Cleaner, Smarter: Pathways for Aligning Canadian Electricity Systems with Net Zero

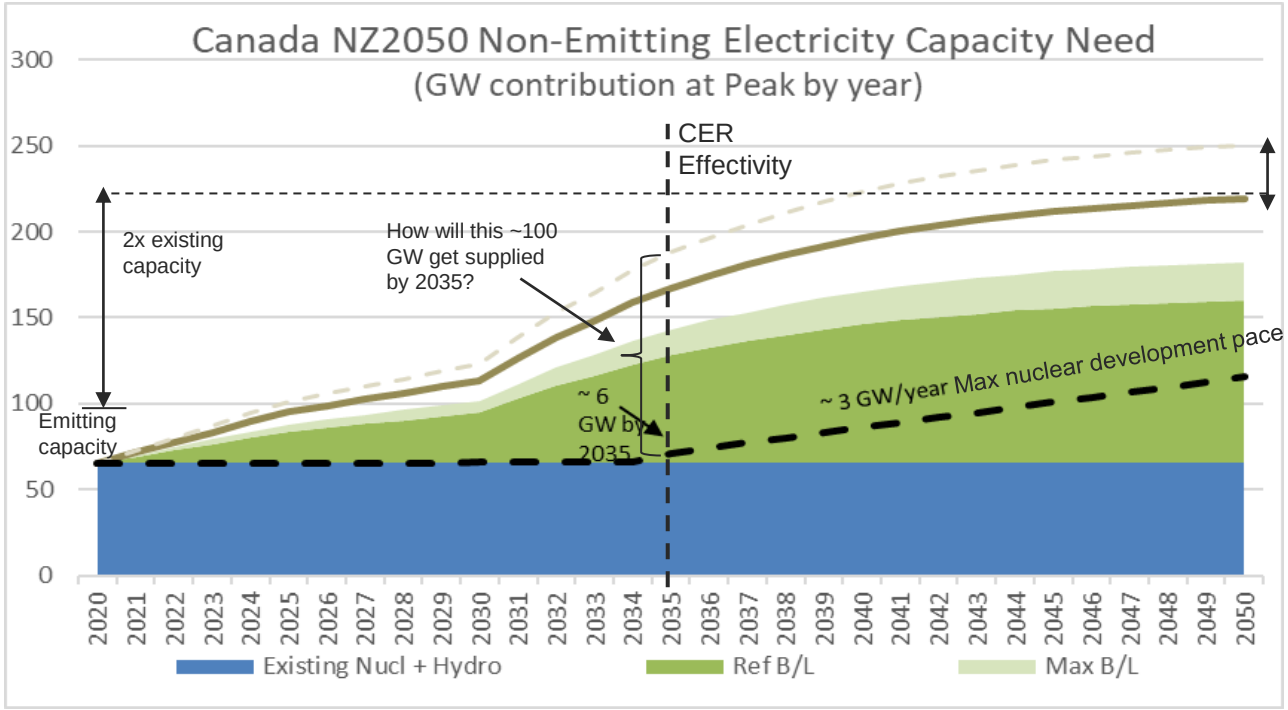
Narratives to policy makers are biased to the lower end of the range despite advocacy for high capacities of renewables

Source: 2023 Federal Budget

# CER suggests policy makers haven't grasped the growth challenge

## Its not just the capacity required to replace emitting supplies, but also to meet new demand

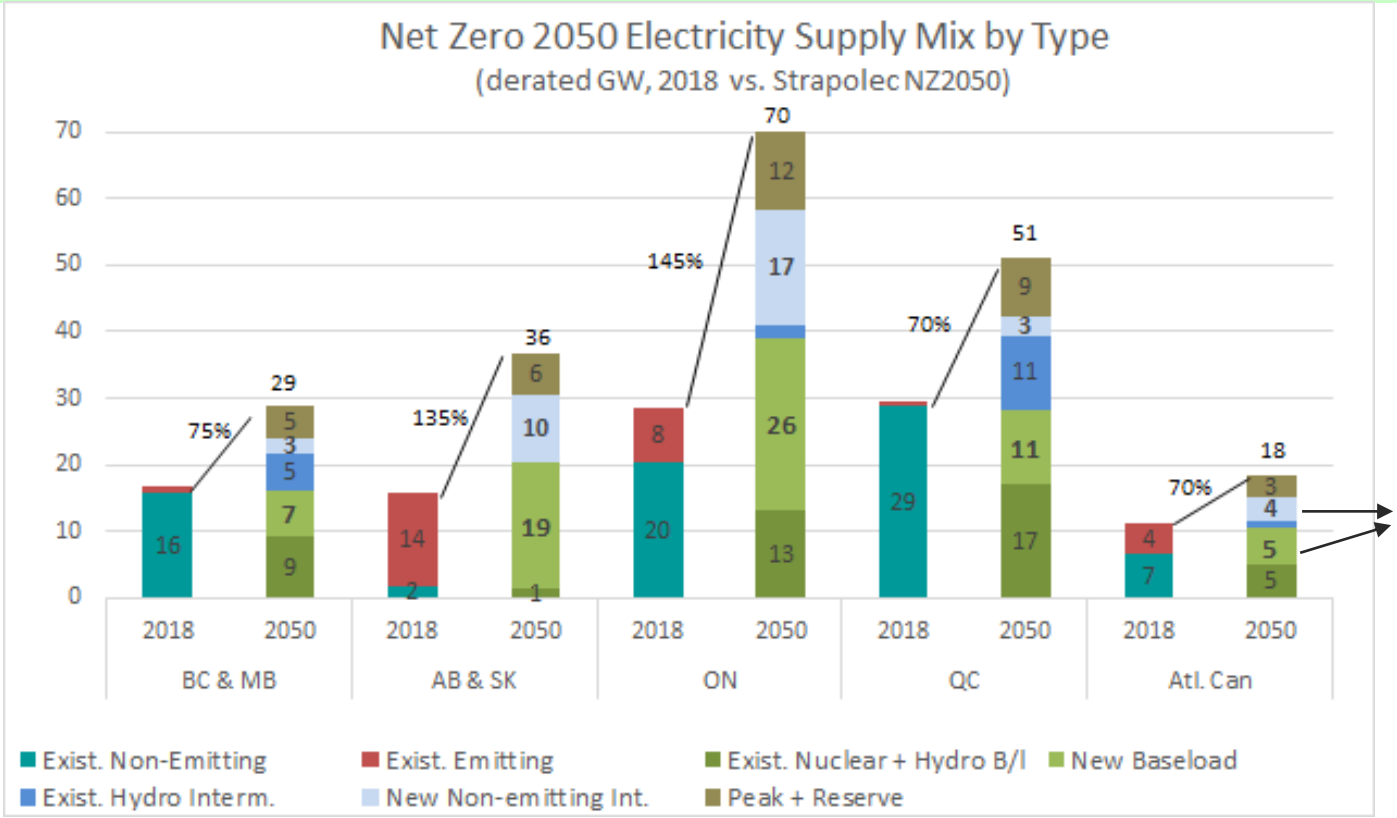
- Accelerating EV and heat pump adoption will drive the curve
- Generation options more limited than many expect
- Must accept that new gas fired generation will be needed in the short term with potential continued use in the long run




***The scale of the challenge and timelines involved require urgent development decisions now***

# New supply capacity is needed across Canada→ A flaw in policy

Ont. & Alb./Sask. have the greatest need for new supply from growth and replacement



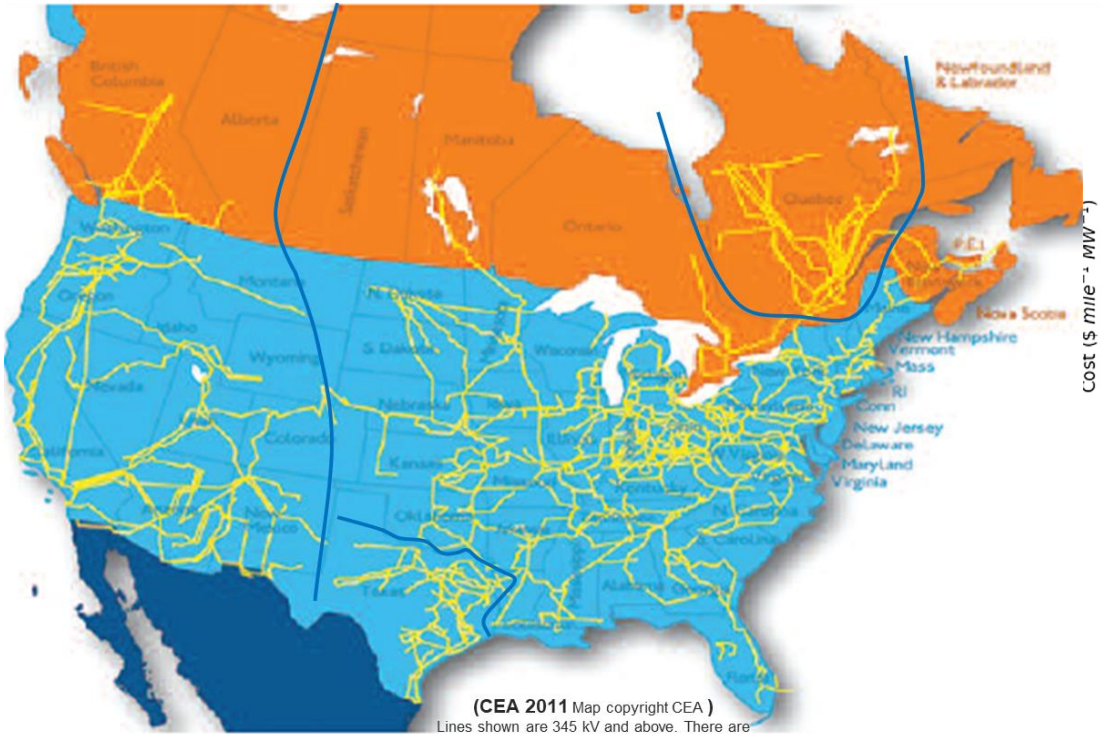

Example: Atlantic Canada needs 9 GW of new baseload and intermediate supply

Baseload defined as demand that is present 98% of the time 24x7, 365 days/years. Peak + reserve is demand that is present less that 2% of the time. Intermediate is everything else.
Source: CCRE Commentary, June 2022; Strapolec Analysis; Strapolec, Electrification Pathways for Ontario, 2021, Strapolec analysis

# Tx and Hydro are not a panacea and cannot solve the 2035 ambition

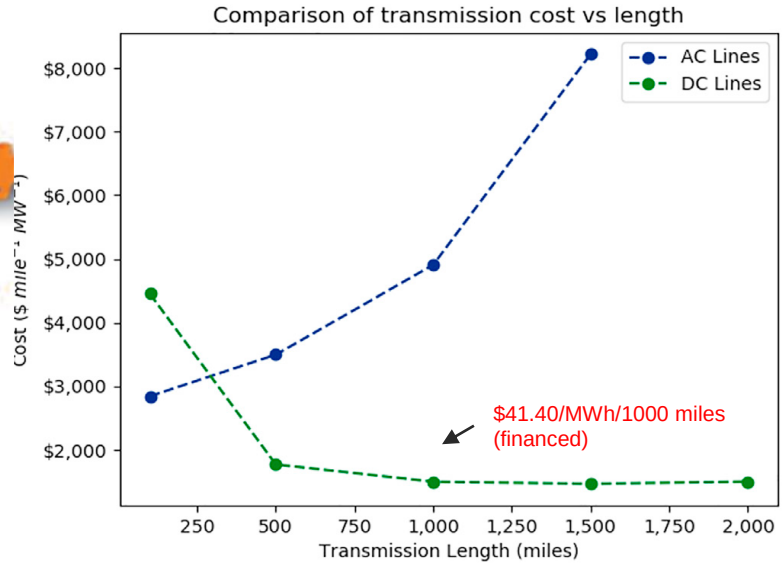
Population and Hydro supply shaped Canada's grid; interties are about nearby cities

## North American Transmission Infrastructure




**(CEA 2011** Map copyright CEA **)**
Lines shown are 345 kV and above. There are numerous interconnections between Canada and the U.S. under 345 kV that do not appear on this map.

## Cost of Transmission is Very High




Source: DeSantis et al., iScience 24, 103495, December 17, 2021

***Cost are best optimized by locating generation as close to demand centers as possible***

Sources: Strapolec, Renewables in Ontario / Quebec Transmission System Interties, 2016; Strapolec analysis

# Wind is widely seen as providing much of Canada's new generation

## But intermittent renewables as an economic standalone solution is a myth

It is well understood that renewables need a reliable backup supply option → The question seems to be how much

- The CER 2023 Energy Futures models 105 GW of new renewables with less than 10 GW of storage
- The CCI argues that solar can complement wind

Figure R.17: From CER 2023 Energy Futures

**Change in electricity capacity from 2021 to 2050, by fuel, Global Net-zero Scenario**

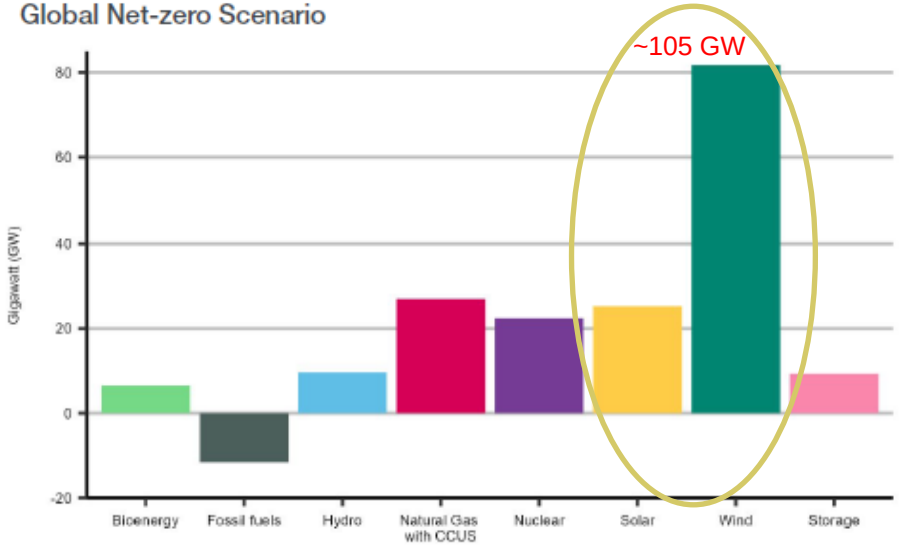
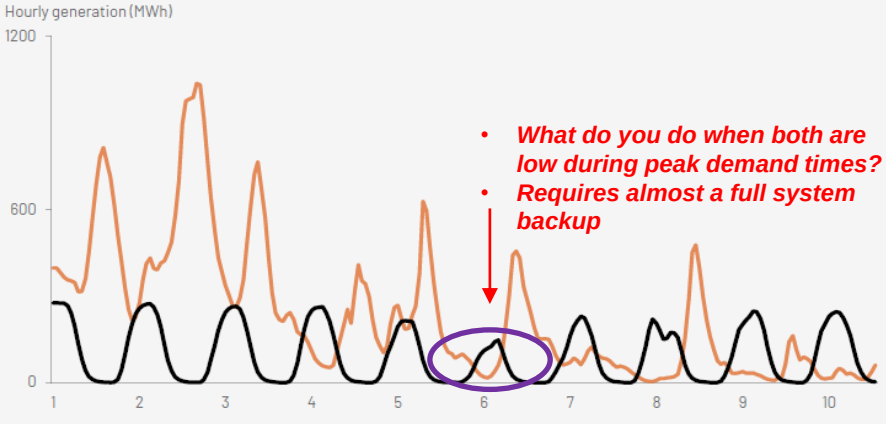



Figure 12. From CCI Bigger Cleaner Smarter

**Wind and solar generation can complement each other**

Diversifying both the type and location of solar and wind installations can smooth overall variability




*Source: AESO (2021). Note: This figure shows wind and solar generation in Alberta in 2021 over a 10-day period in July, showing the complementarity of these sources: solar generation is highest mid-day while wind generation is highest at night.*

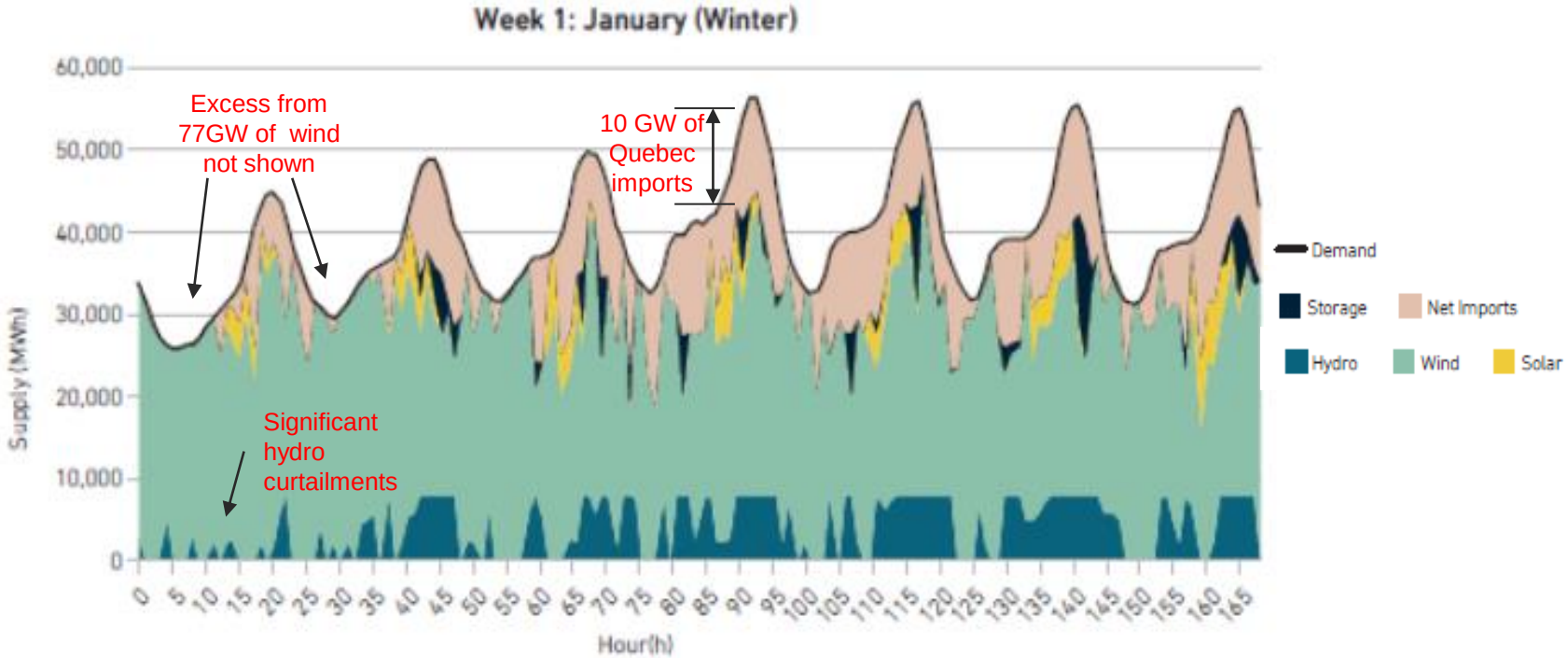
Source: Canadian Climate Institute, Bigger, Cleaner, Smarter - Pathways For Aligning Canadian Electricity Systems With Net Zero, May 2022; Strapolec Analysis

# David Suzuki Foundation (DSF)[1] depicts Ontario Wind-based supply

## DSF is a major proponent of a renewables only solution, arguing it is technically feasible

Bodies of academic research have demonstrated the tendency of models to overestimate renewable's contribution & underestimate the costs[2]

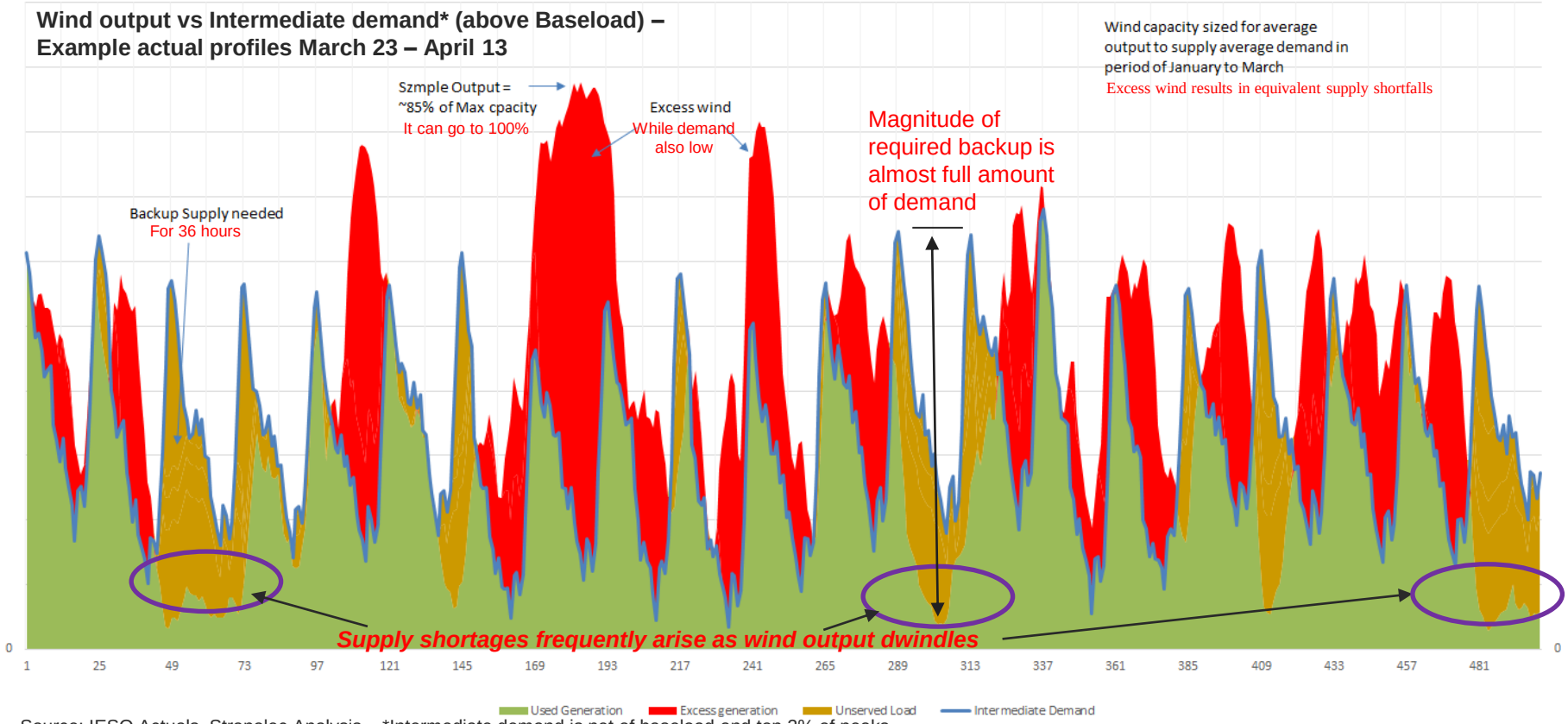
- Primarily due to fidelity of modelling




Source: 1. DSF, 2021; Strapolec Analysis. 2. PWU Submission to ECCC on approach for CER modelling, June 2022.

# Wind Output vs Intermediate Demand - Ontario

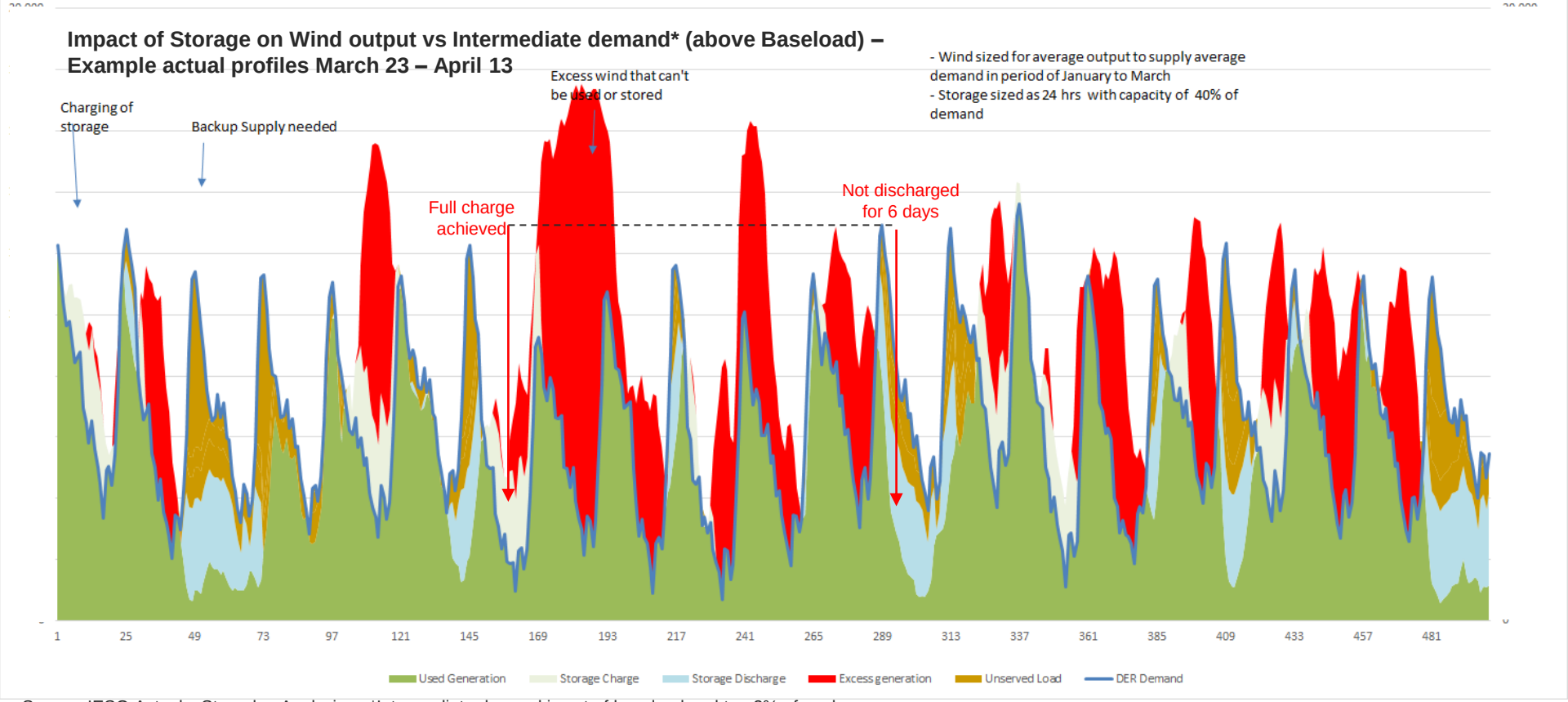
## Wind intermittency & misalignment with Intermediate demand requires significant backup




Source: IESO Actuals, Strapolec Analysis. *Intermediate demand is net of baseload and top 2% of peaks

# Wind Output vs Intermediate Demand – Ontario – With Storage

Even 24-hour storage still needs significant backup generation, and comes at a high cost



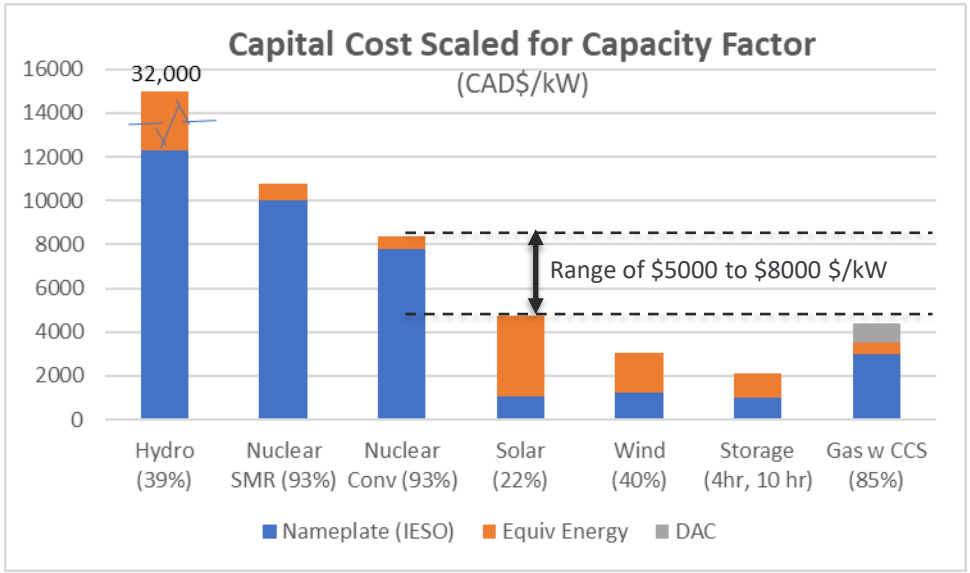

Source: IESO Actuals, Strapolec Analysis . *Intermediate demand is net of baseload and top 2% of peaks

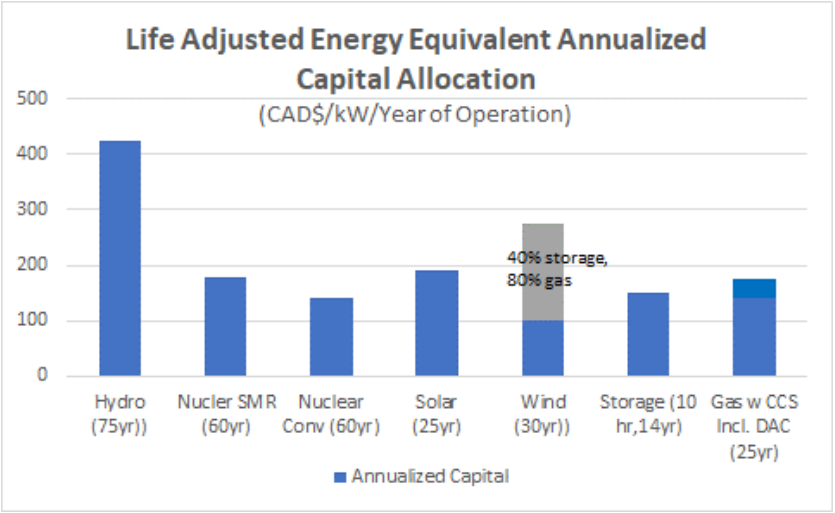
# Non-emitting electricity asset capital costs are largely similar

## Despite the hyperbole out of the renewables sector

Capital costs are comparable when considering energy /emissions equivalency and asset life

- Nuclear arguably has lowest effective capital cost




Source: IESO Decarbonization study cost assumptions, 2022; Canada Energy Regulator assumptions for CCGT, 2021; Strategic Policy Economics assumptions, 2021, based on Navius for Direct Air Capture (DAC). DAC needed to address the 90% CCUS efficiency. Hydro costs vary depending on the opportunity and site conditions.

# To meet the demand, renewables-based solutions are costly

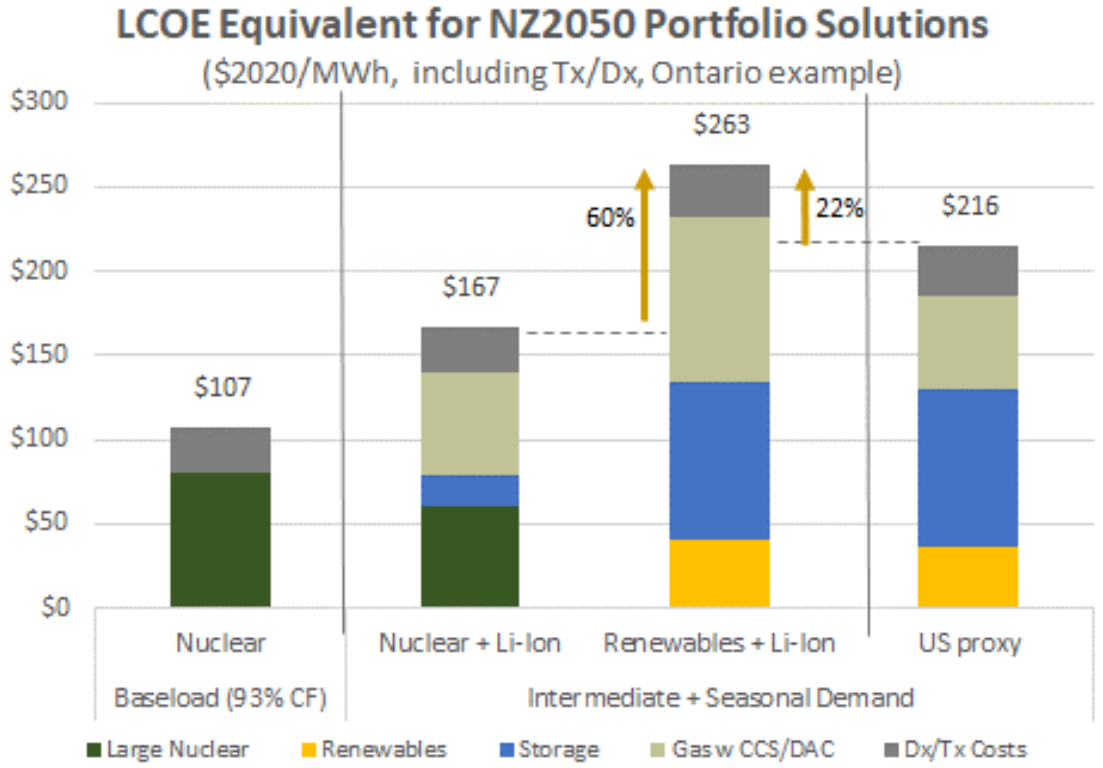
## And could create systemic disadvantages in Canada on the cost of electricity

The cost of electricity will drive the pace of decarbonization

- Renewables could increase the cost of electricity by 60% over other alternatives

Worse, the U.S. has a systemic cost advantage in the renewables space due to their higher yield wind and solar resources

- This will impact Canada's long term cost competitiveness for manufacturing




Derived from Strategic Policy Economics, Electrification Pathways for Ontario, 2021, using NREL ATB 2021 financing assumptions and reflecting IESO 2022 cost assumptions (also from NREL ATB)
CCS/DAC includes all costs for carbon capture and storage (CCS) including supplemental Direct Air Capture (DAC) to get to zero emissions.
CC equipped CCGT costs from CER
CCS & renewables economics are better in Alberta & Saskatchewan, wind economics are better in Quebec due to hydro reservoirs. Initial SMRs may have higher LCOEs.

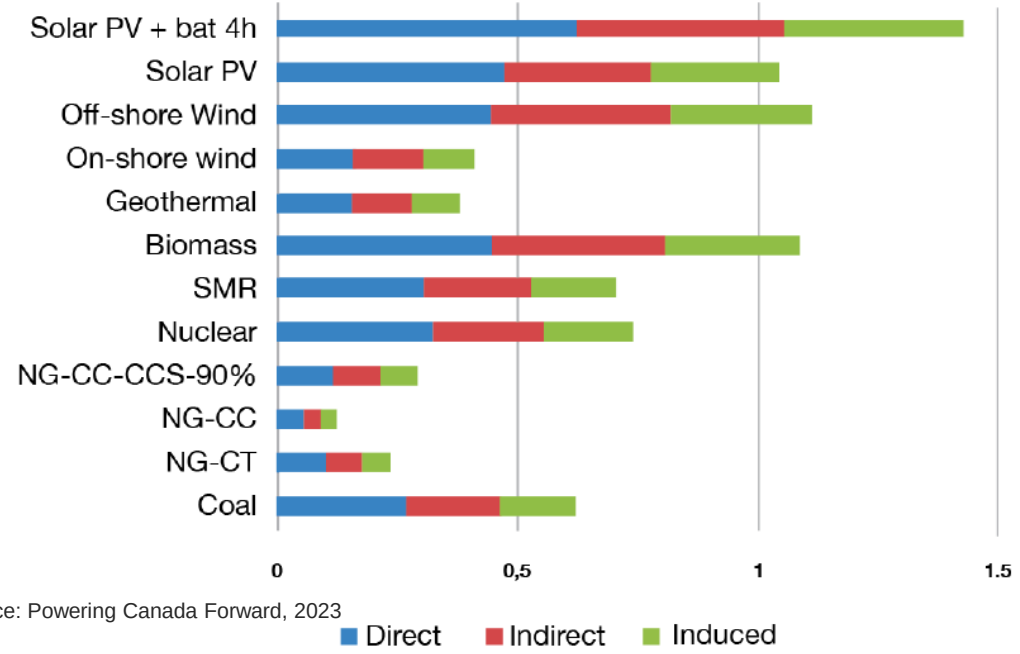
# Powering Canada Forward values economic benefits of transition

## But the metrics used are misleading decision makers

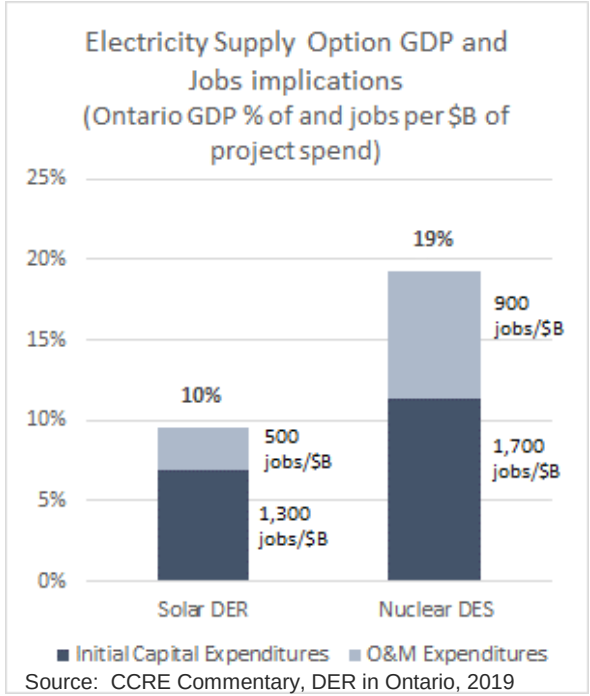
Argues employment numbers will grow with investments in renewable energy which are more labour intensive than conventional energy sectors → *The data does not show that!!*

- Solar + Battery is at the top of this list, not because they are the best, but because they are the most costly

**Figure 2. Jobs per GWh for various generating technologies in Canada**




Source: Powering Canada Forward, 2023



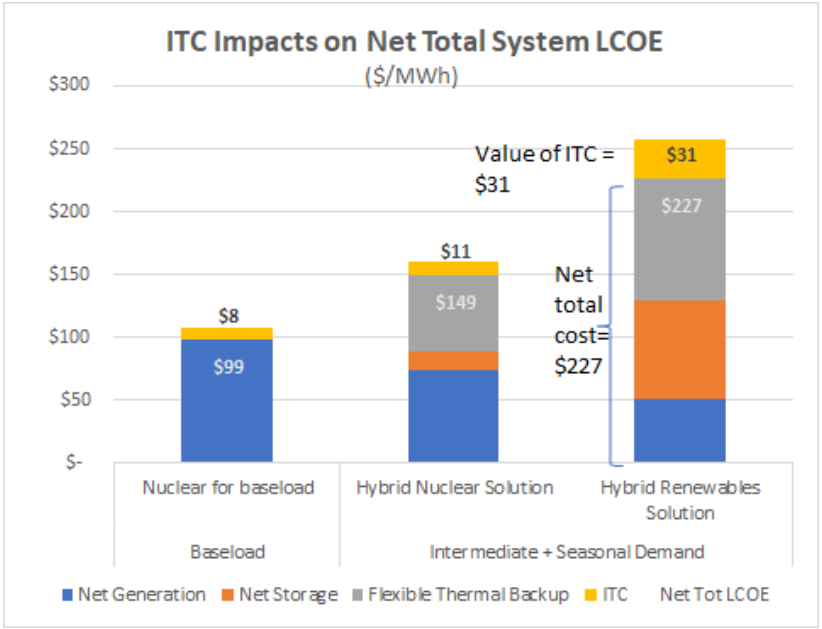

Source: CCRE Commentary, DER in Ontario, 2019

# ITCs and the economic battle started by the U.S. IRA

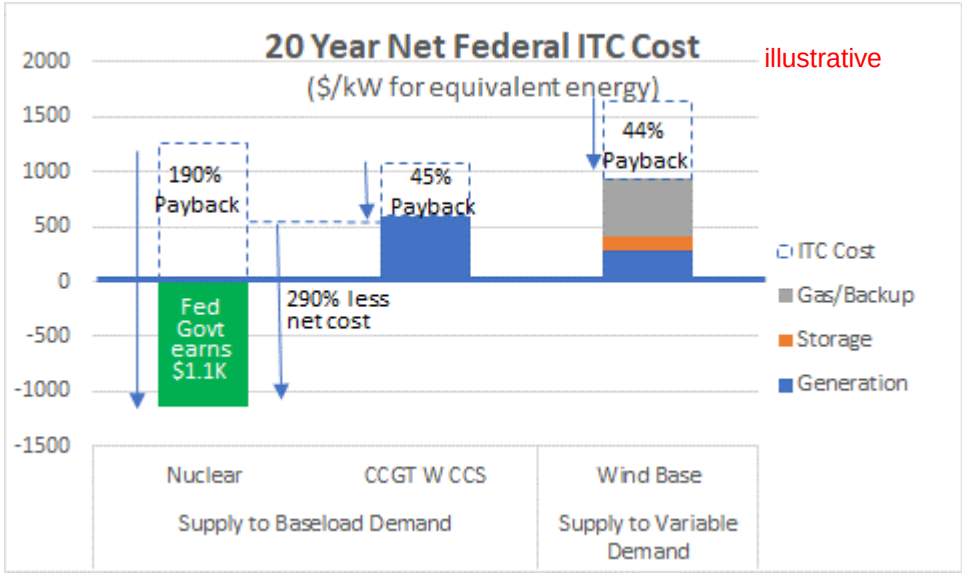
## Adopting a strategic industrial policy around *Domestic Content* should inform tax policy

The Federal ITC response to the IRA does not optimize the benefits to Canadians

**Ratepayers are not being delivered the low-cost options**




**The federal government is not optimizing its ROI from taxes created by the economic development**




Source: PWU submission to Finance Canada on ITCs, Strapolec analysis

# Conclusion: A National Energy Vision remains relevant to placing Canada in a positive economic position globally

Canada needs a stronger evidence-based approach to help accelerate:

- Awareness of the significance and nuances of the challenge
- Urgent definition of a winning national energy transition strategy
- Decision making on the infrastructure choices needed to support Canada's energy transition towards Net Zero.

Canada can hit above its weight on global emissions reduction and should pursue the related economic benefits

- Canada must be cognizant of the climate policy trends among its key trading partners, such as the U.S.

Many current Federal policies are limiting Canada's ability to lead

- The slow pace of decision making is undercutting Canada's opportunities
- Modeling of the energy transition costs and economics is misinforming decision makers
  - e.g. for hydrogen & the electricity system

The pace of decarbonization will be about the cost of electricity, as is the affordability of the transition

- The real available options are limited, the potential for both interprovincial conflict and collaboration remains as a result
- Some options are clearly less costly than others, and federal policies should be aligned to best enable those