The Future of Alberta's Electricity System

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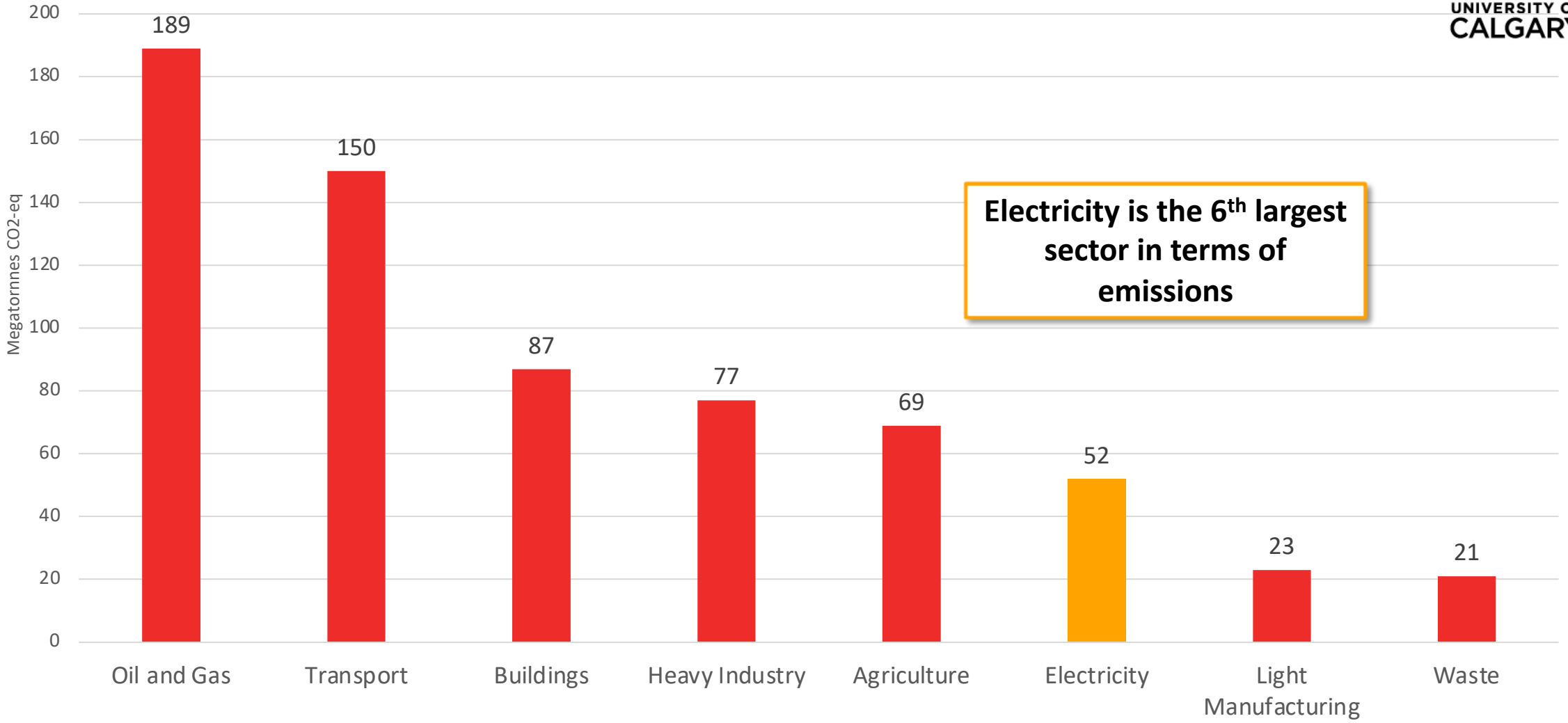
About me…

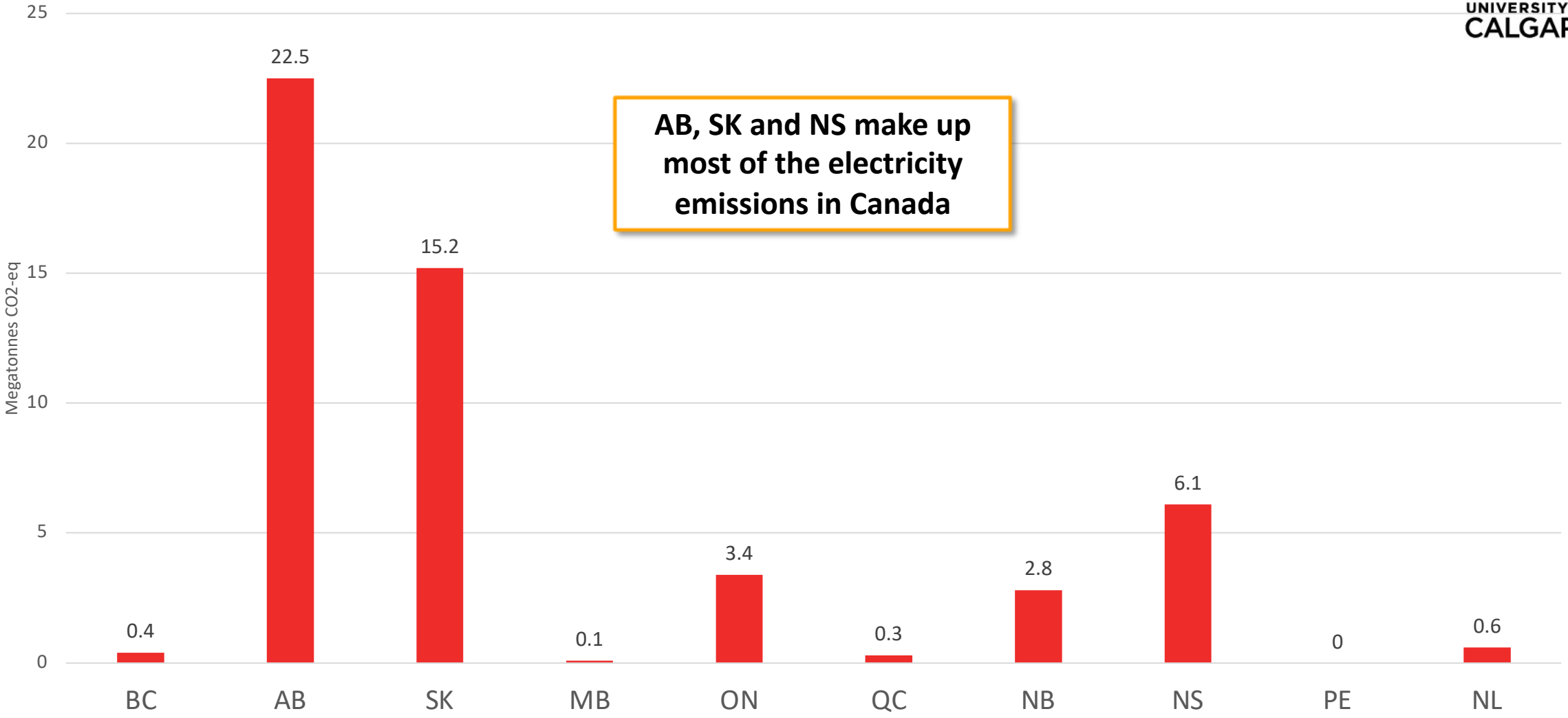
- I’m an Associate Professor in Economics and Public Policy
- Before academia I was an electricity trader for 15 years
- I do a fair amount of policy advisory work
- I never received media training…

GHG emissions in Canada (2021)



Data Source: Canada NIR

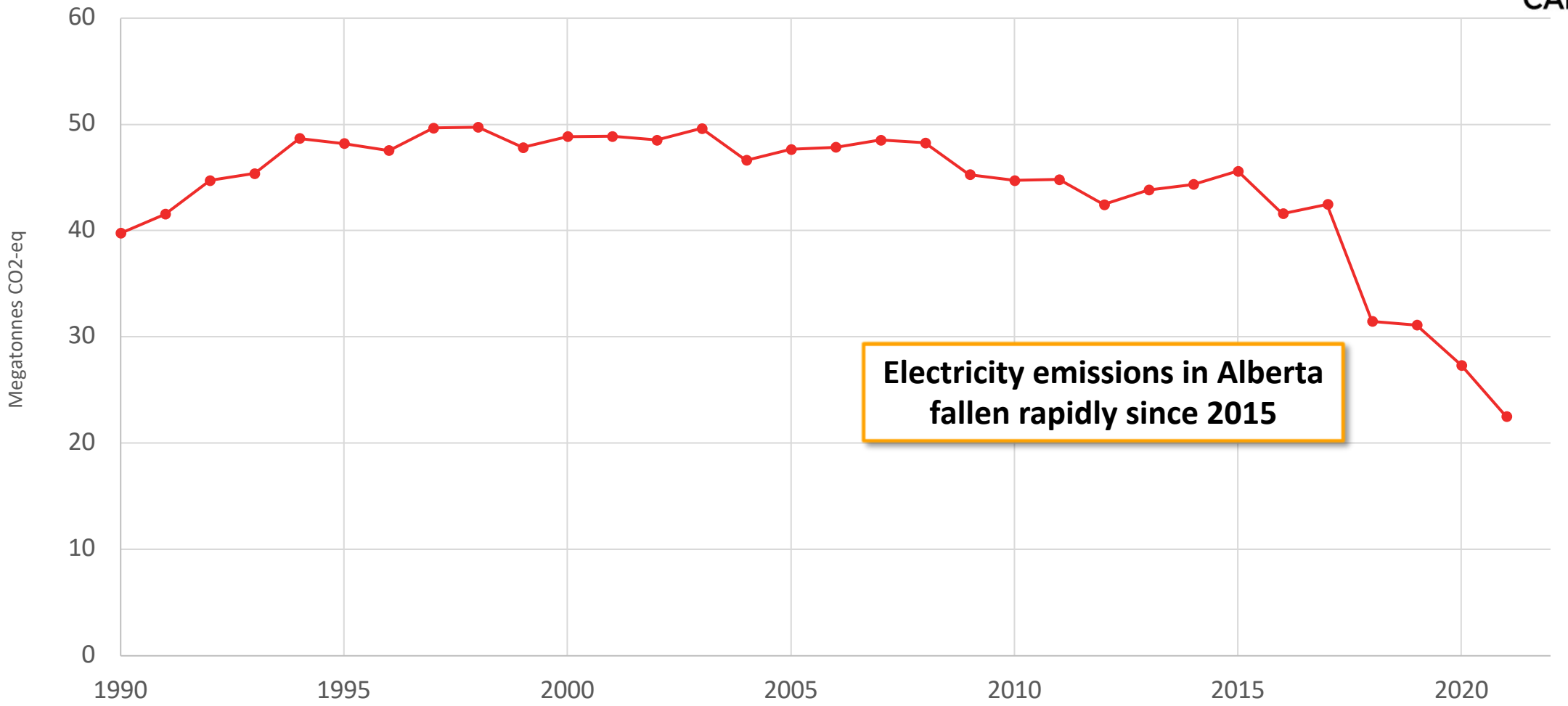
Electricity Emissions (2021)



AB, SK and NS make up most of the electricity emissions in Canada

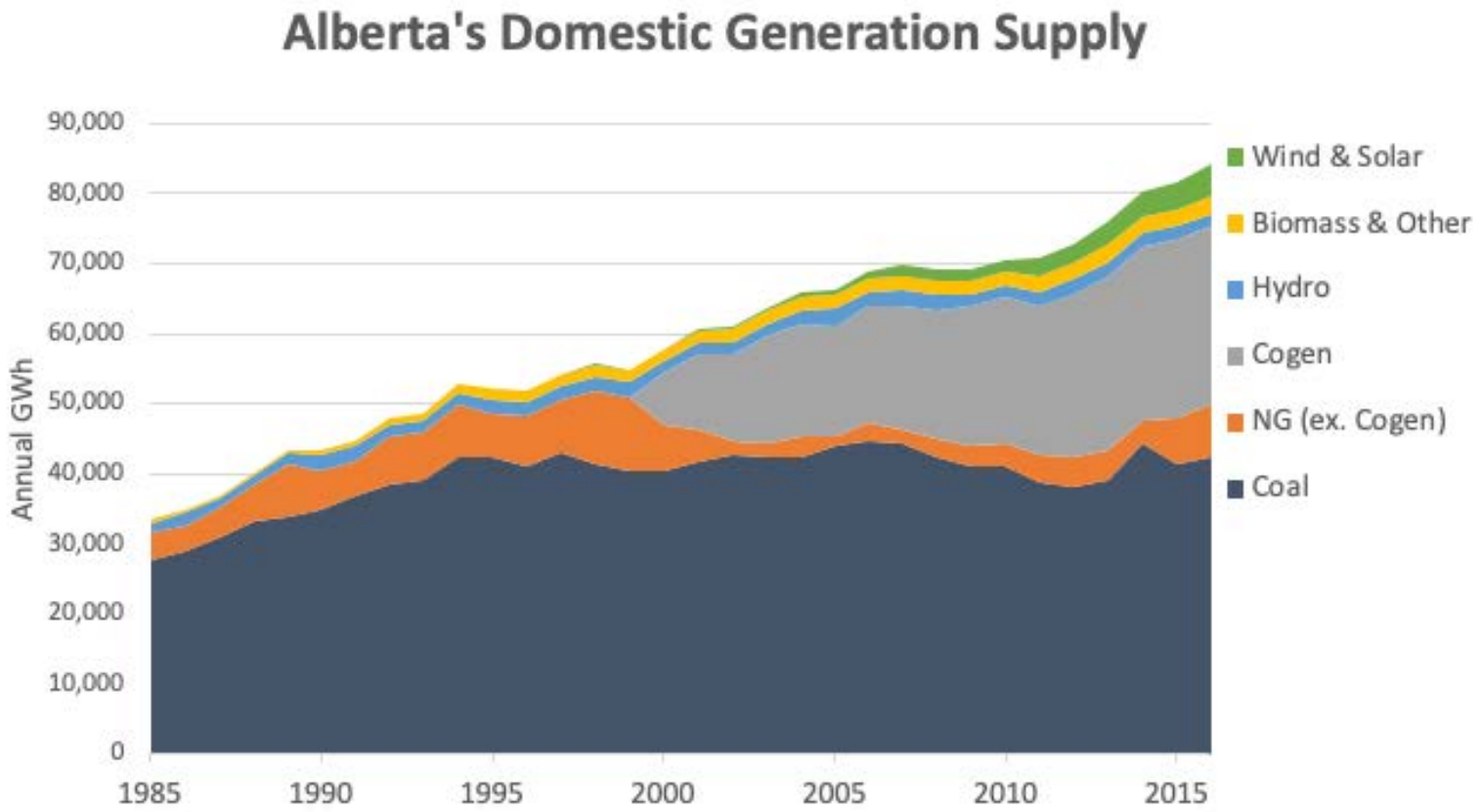
Data Source: Canada NIR

Alberta Electricity Emissions

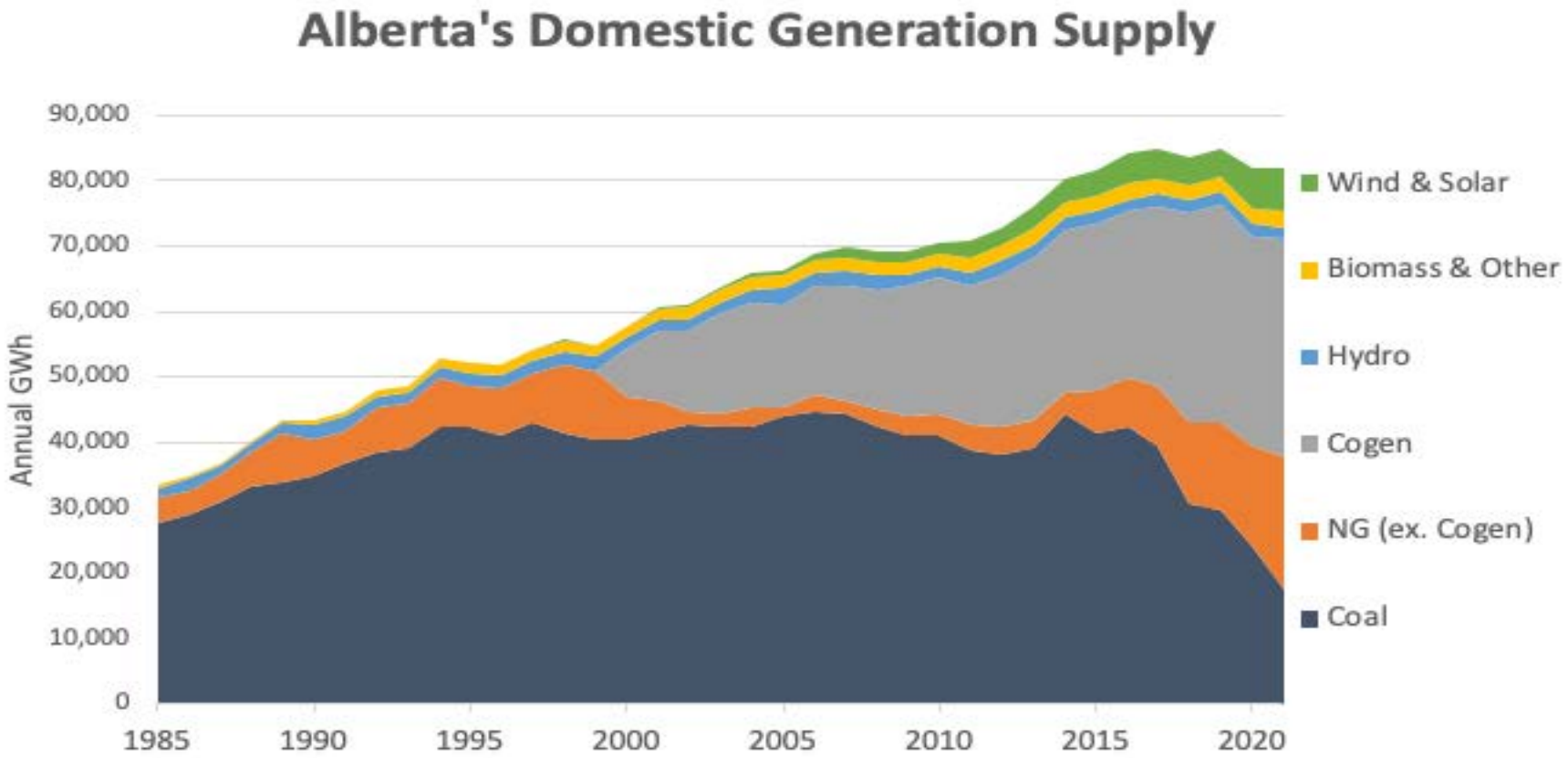


Source: Canada NIR

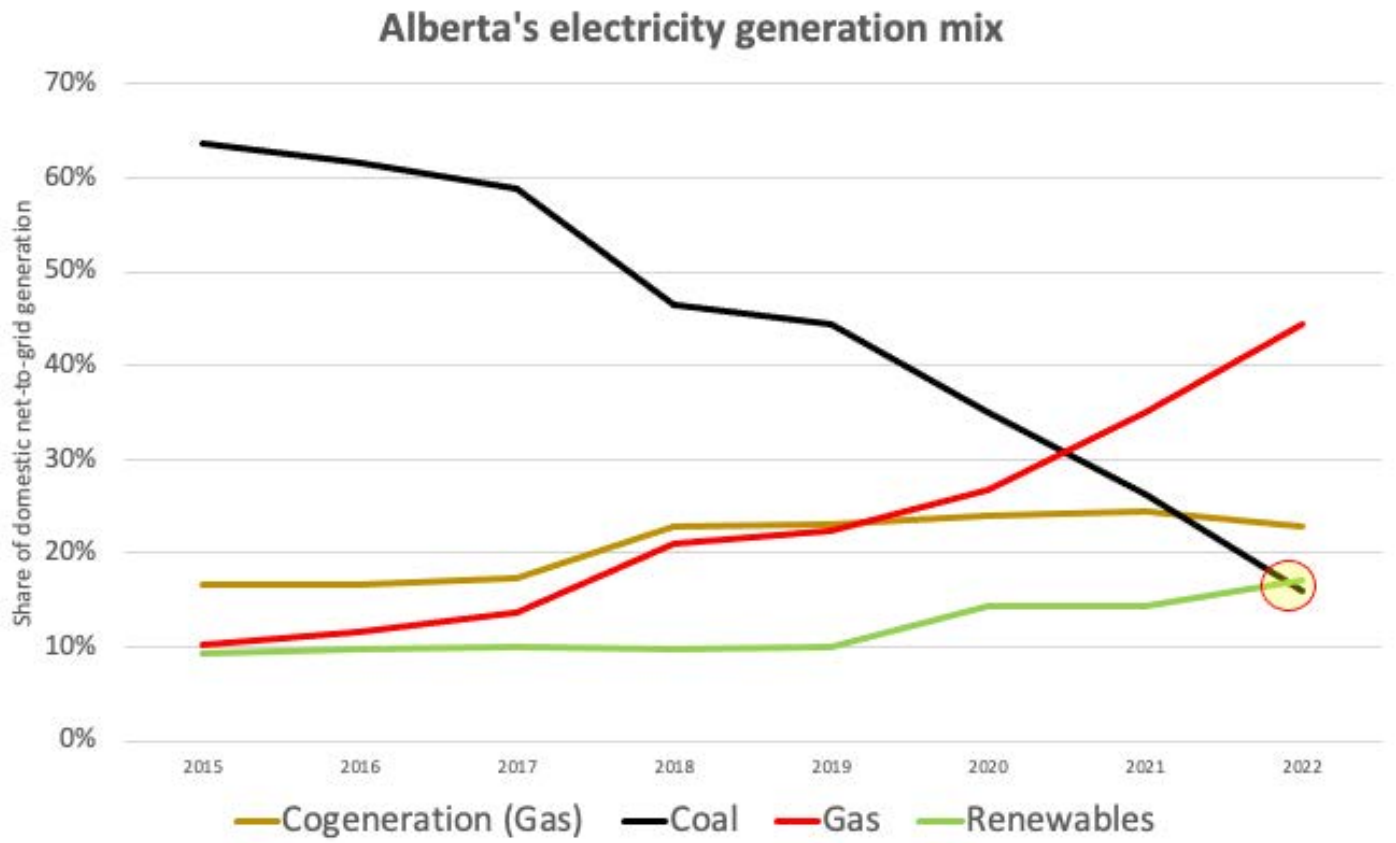
Coal dominated the supply mix… through 2016



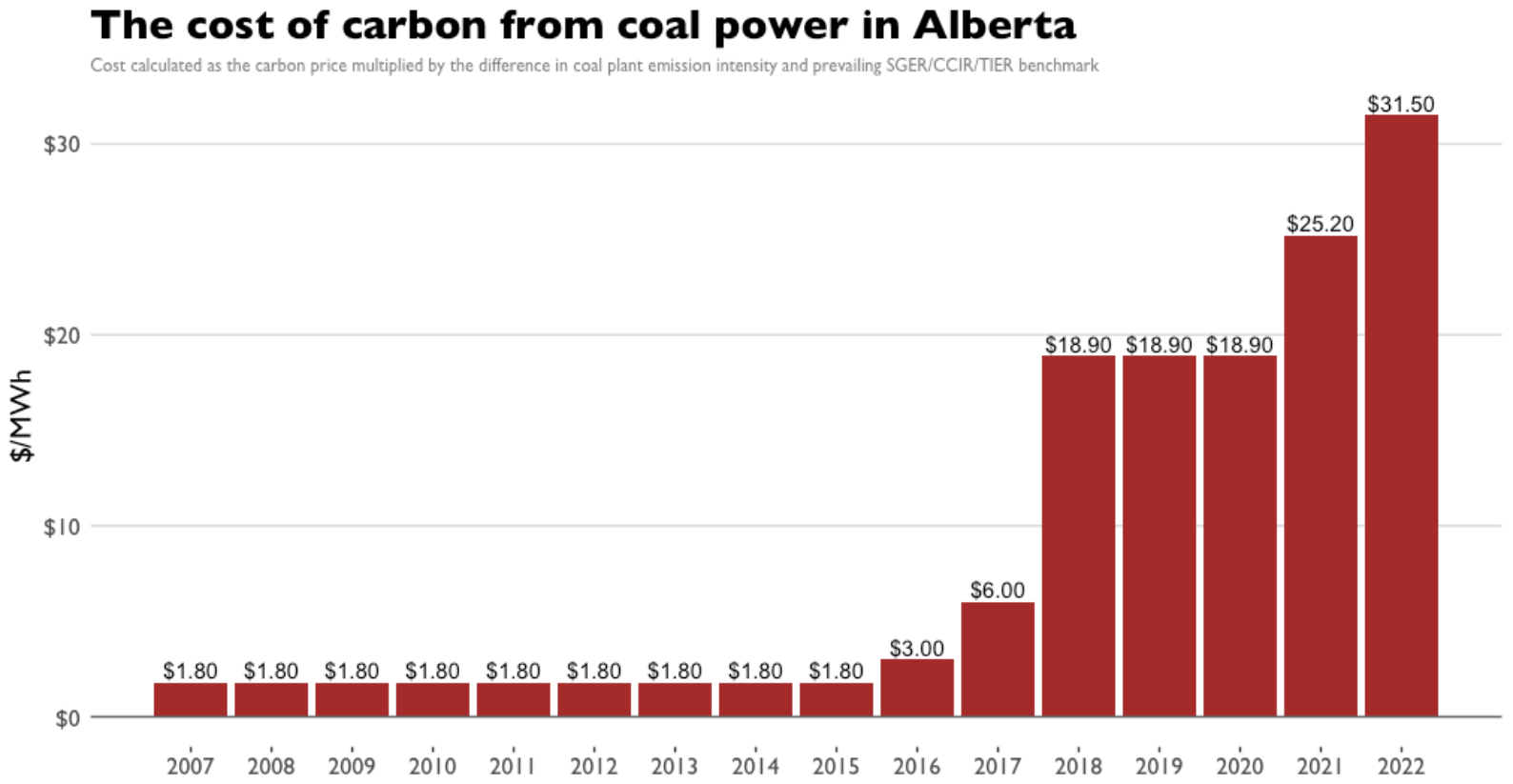
… but coal plummets post-2016 (will be gone by 2024)



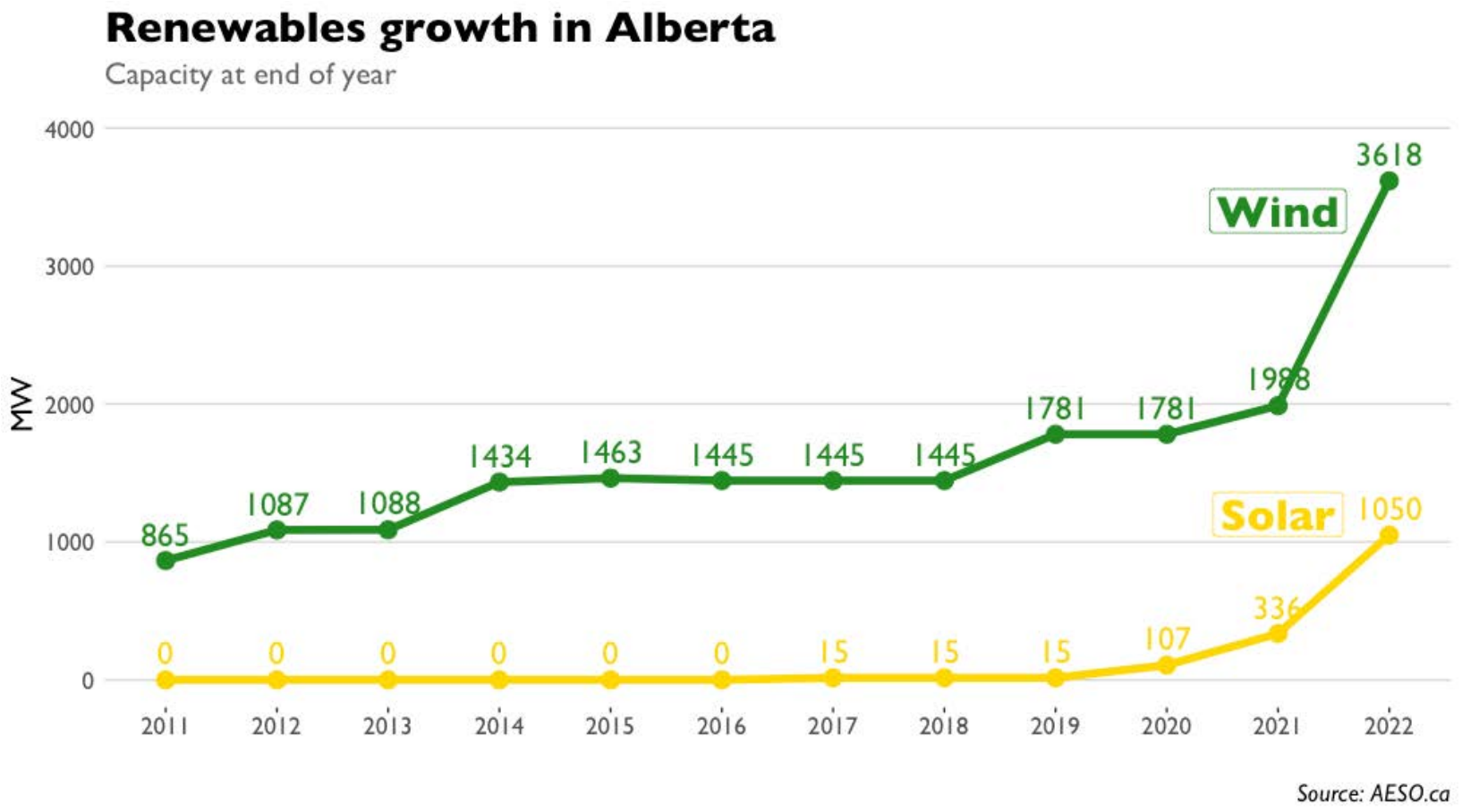
Wind, water, solar surpassed coal in 2022
… but natural gas has seen the biggest rise.



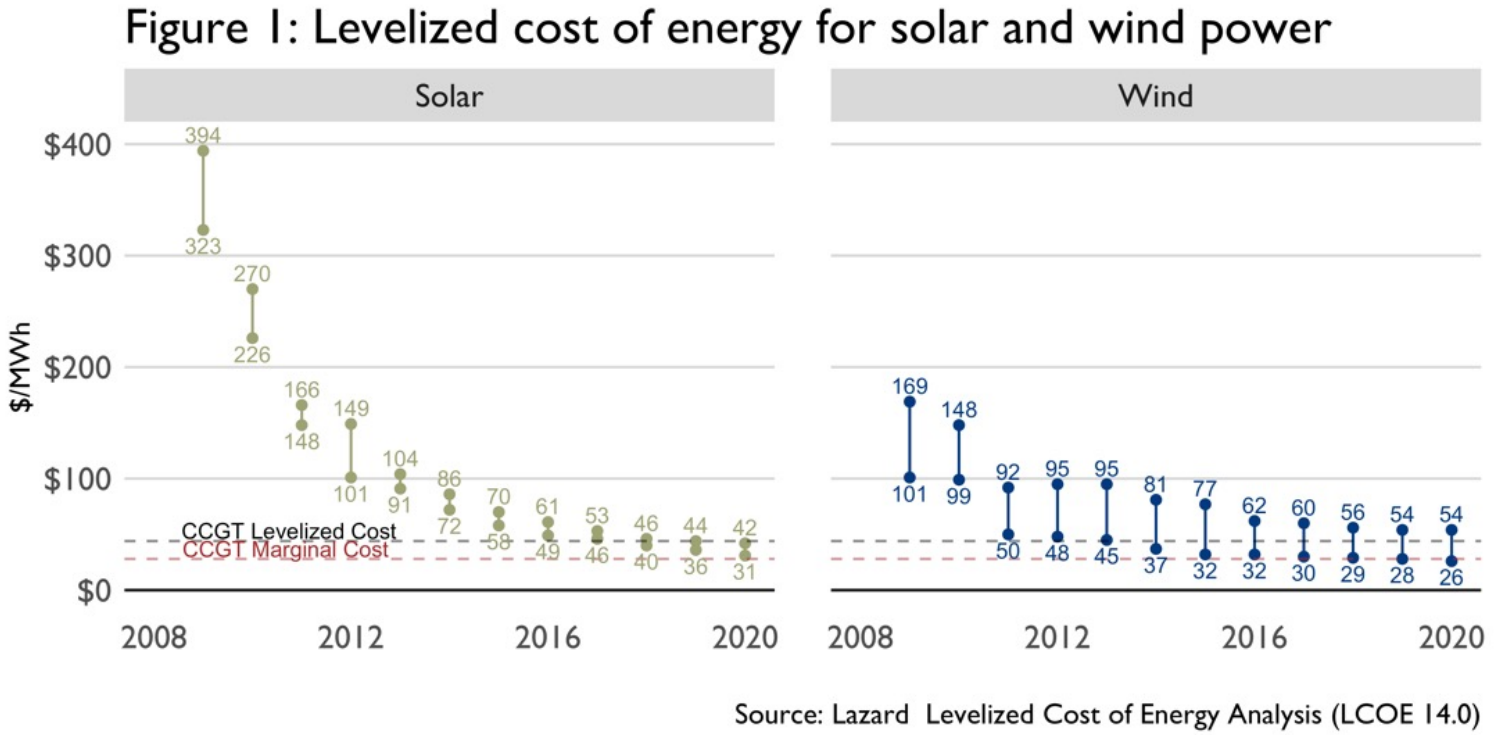
Carbon pricing works in the power sector!



Renewables are growing

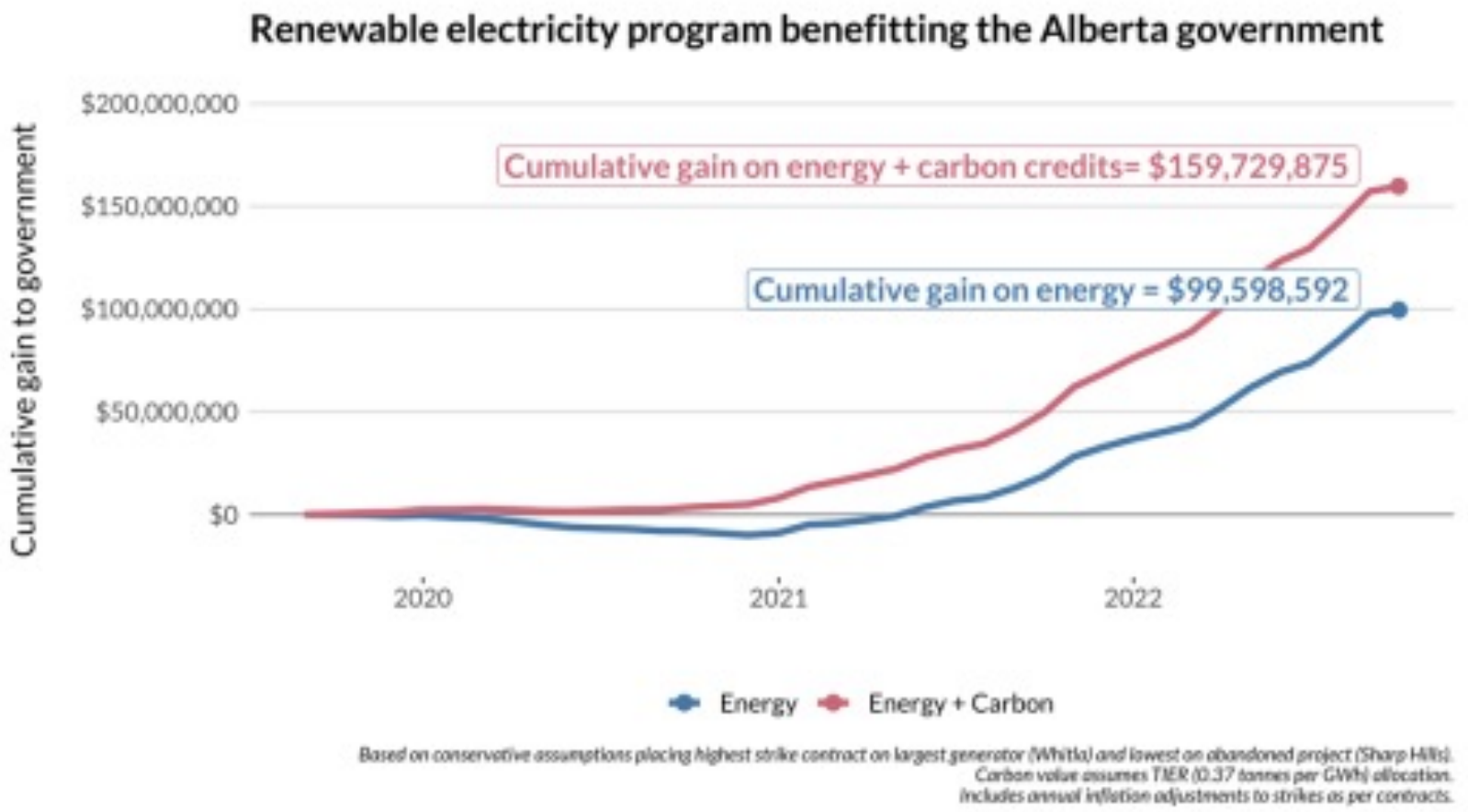


Wind and solar costs have fallen 70 - 90% in 10 years



Source: https://www.policyschool.ca/wp-content/uploads/2020/11/Energy-Trends-Renewables-Nov.pdf

Renewables are making money (without subsidies)



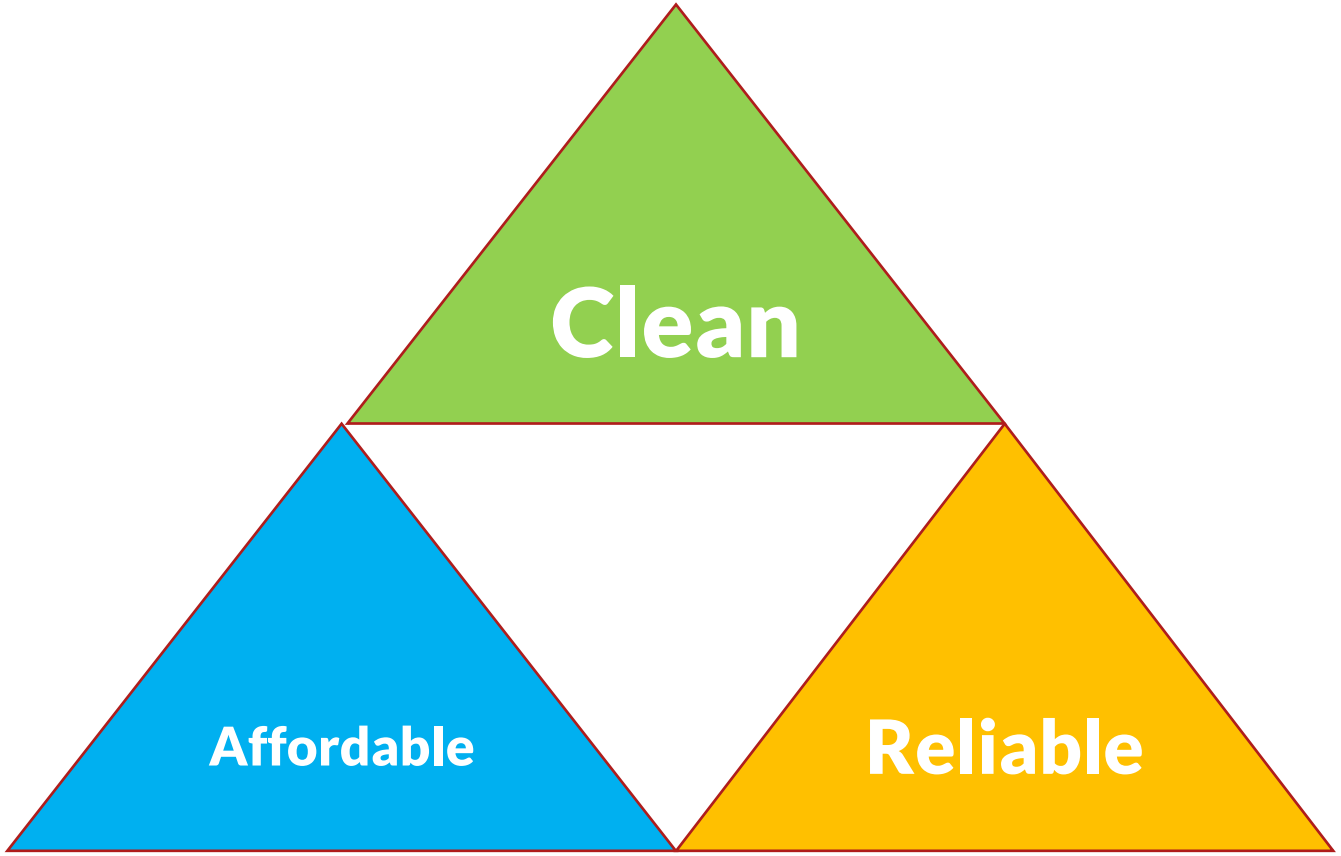
Source: https://www.policyschool.ca/wp-content/uploads/2022/10/wind-windfall-final.pdf

For today's discussion

- What are the options to "firm up" power in a high share variable renewable grid?
- How will Canada's proposed Clean Electricity Regulations affect Alberta?

Clean is just one desired attribute

Need clean *and* affordable *and* reliable



Alberta’s abundant and cheap renewables give us **clean** and **affordable** but what are our options for **reliable**?

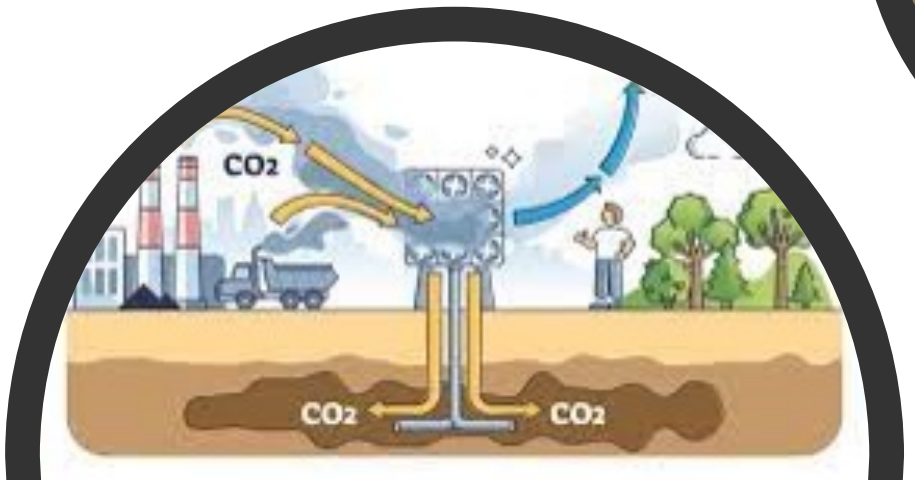
The Path Forward…

1. Flexible supply
2. Storage
3. Transmission
4. Flexible Demand

For expanded discussion, see: https://climatechoices.ca/wp-content/uploads/2021/09/CICC-Technical-pathways-to-aligning-Canadian-electricity-systems-with-net-zero-goals-by-Blake-Shaffer-FINAL-1.pdf

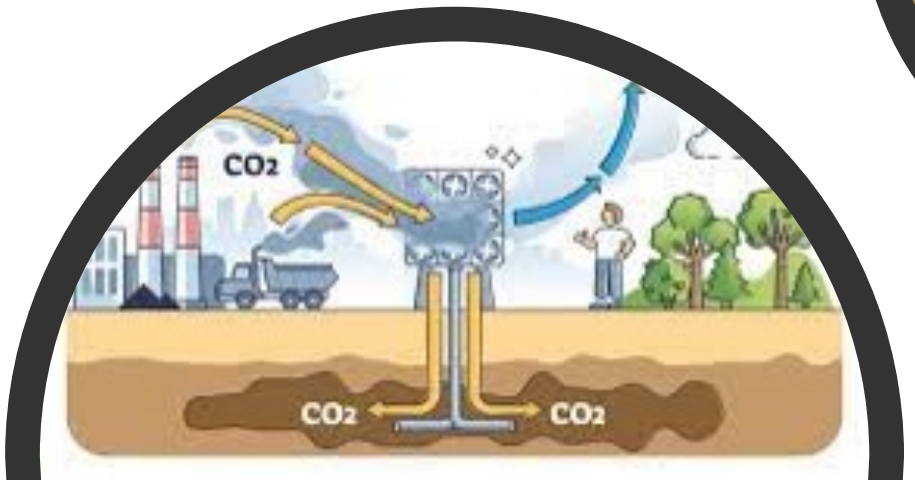
1. Clean Firm (and flexible) Supply

- Renewables are cheap, but intermittent
- Supply-side “firm” solutions include:
  - Reservoir hydro
  - Nuclear
  - Hydrogen turbines
  - Natural gas with CCS
  - Geothermal



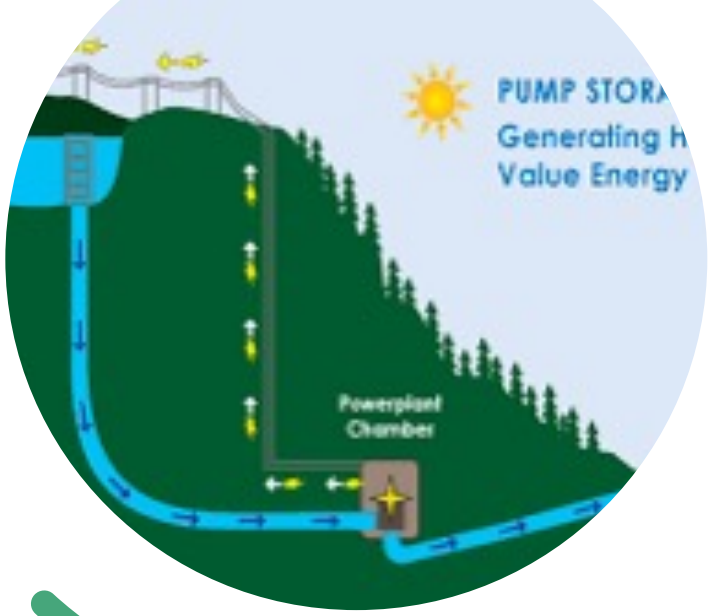
1. Clean Firm (and flexible) Supply

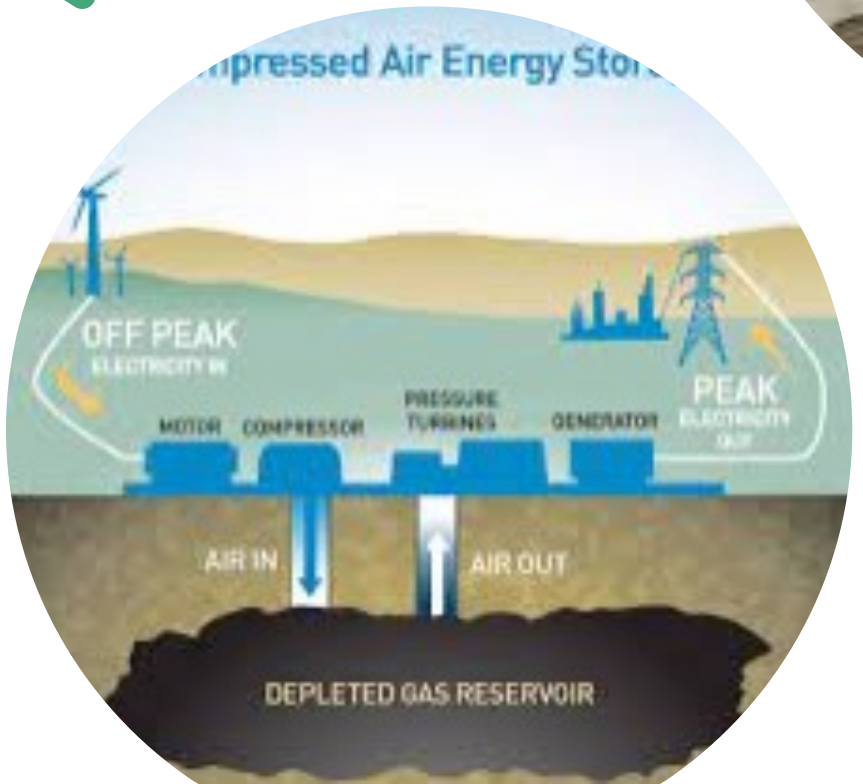
- Renewables are cheap, but intermittent
- Supply-side “firm” solutions include:
  - Reservoir hydro *(available?)*
  - Nuclear *(lead time? flexibility?)*
  - Hydrogen turbines *(cost?)*
  - Natural gas with CCS *(tech ready?)*
  - Geothermal *(scale?)*



2. Storage

- Storage directly solves some of the intermittency challenge
- But the real issue is **seasonal** and **long duration** storage
- Options include:
  - **Batteries**
  - **Pumped hydro**
  - **Compressed air energy storage**
  - **Hydrogen** can also act as a storage medium





3. Transmission

- Leverage the **complementarity** of different supply mixes (e.g. BC's hydro and AB's wind and solar)
- **Diversify** weather dependent portfolios
- Challenges:
  - Differences in **market structure**
  - **Permitting** linear infrastructure
  - **Politics???**

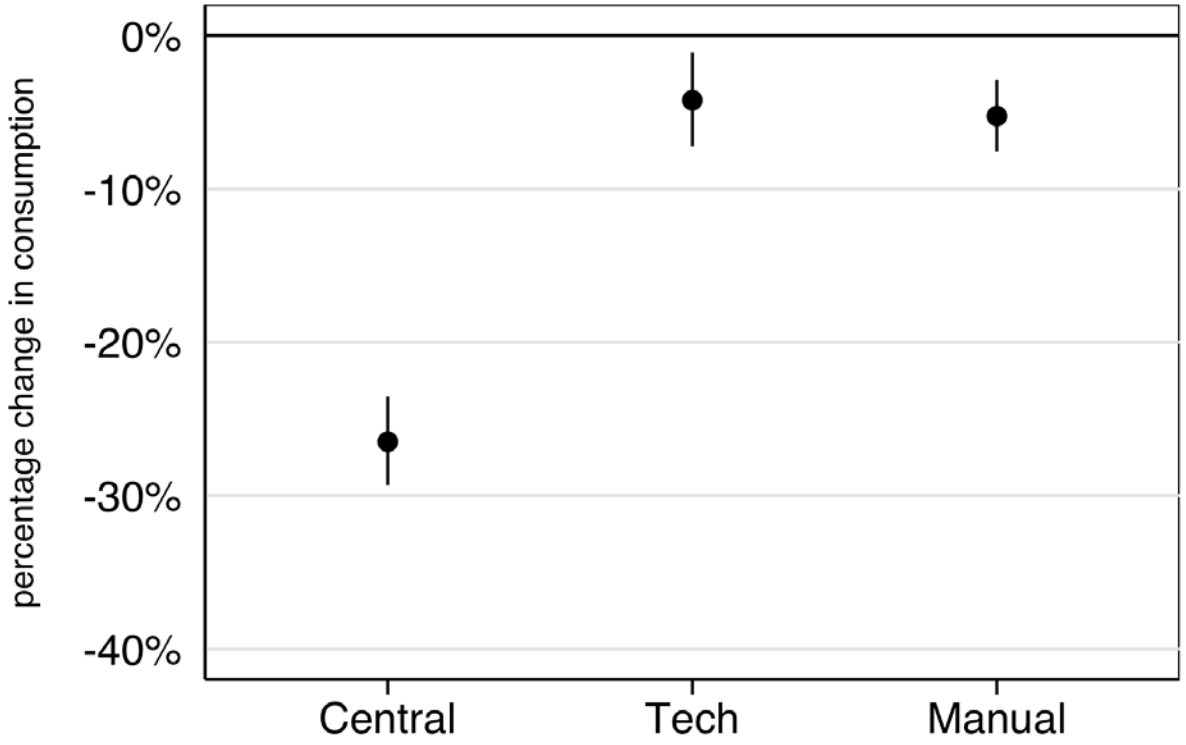
4. Flexible demand

"If the old world was forecasting demand and dispatching supply, the new world involves forecasting supply and dispatching demand"

- More **need** for flexibility (more intermittency)
- **Bigger** flexible loads (e.g. electric vehicles)
- Cheap control **technology**

Will people respond? Heck yes!

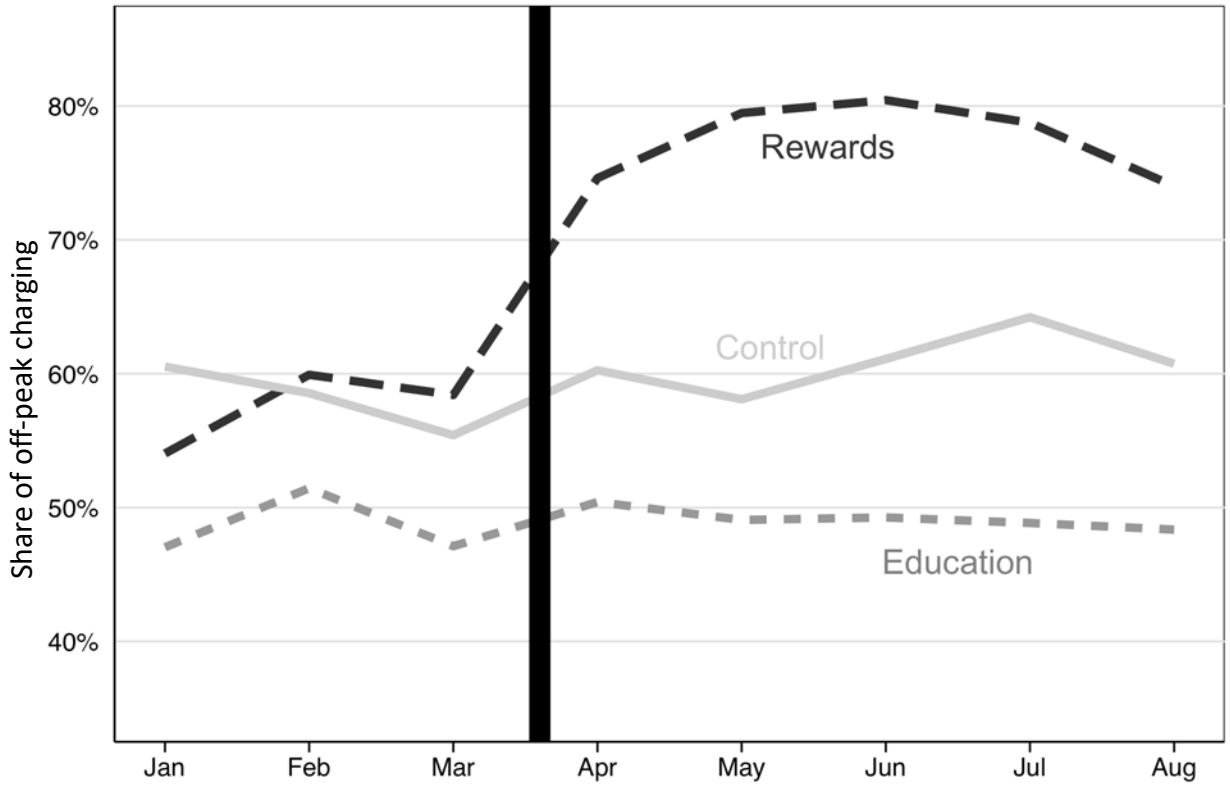
- Preliminary results from a demand response pilot testing:
  - Incentives
  - Technology
  - Automation
- Big response when people are:
  - Paid!
  - Response is automated *(make it easy)*
- **Over 25% peak load reduction**



Source: Work in progress by Bailey et al (2023)

Electric vehicles are a huge opportunity

- Preliminary results from an EV charging pilot in Calgary
- **Financial rewards** (3.5c/kWh) very effective in shifting EV charging to off-peak ☺
- No effect from education "nudges" ☹



Source: Bailey et al (2023). https://www.nber.org/papers/w31630

Clean Electricity Regulations

What are the *Clean Electricity Regulations?*

- Proposed federal regulations to accelerate the pace of decarbonization of Canada's electricity systems
- After 2035, power plants must emit less than 30g/kWh
  - For context, a modern combined cycle gas plant emits 370g/kWh
- Exceptions:
  - 20-year end-of-prescribed life (i.e. new plants can run to 2044)
  - Peakers (450 hours)
  - Cogeneration (behind-the-fence)
  - Emergencies

Can Alberta meet the clean electricity regs?

- Certainly not if we ban the most ubiquitous form of clean electricity!
- Forecasting blackouts 12 years from now assumes we are powerless to prepare and adapt
- But… in reality, the pace and inflexibility will be hard to meet as written
- The CER will likely change to incorporate more flexibility
  - Need flexibility to allow for a range of potential outcomes
  - Need time for tech development and cost declines
  - Need time for major infrastructure development (especially transmission)

In summary…

- Yes, Alberta faces many **challenges** in decarbonizing its electricity
  - There's a LOT to do!
  - Currently 83% of generation comes from fossil plants.
- **Renewables** are now economic… we will build a lot more
- The bigger challenge becomes **firm resources**
- **Flexible demand** is often an afterthought in the discussion but should have more emphasis:
  - The *need* is there (more variable supply side)
  - The *magnitude* is there (EVs and other large flexible loads)
  - The *technology* is there (makes it cheaper to respond to events and automatically control loads)

Contact info

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