Transforming Alberta's Grid

Exploring Options for Natural Gas as a Bridge to a Renewable Future.

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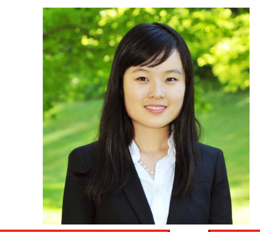
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INTRODUCTION

The Alberta (AB) electrical grid generated 43 $MtCO_2e$ in 2016 [1]. To reduce this, the province has committed to phase out coal and build renewables to account for 30% of public grid generation by 2030 [2]. The technologies chosen to replace coal will impact Alberta's ability to achieve the ~80% reduction in CO_2 by 2050 that Canada committed to in the Paris Climate Agreement.

Compared to a 'Reference' scenario where coal is replaced with natural gas combined cycle (NGCC), this study models three alternatives for coal replacement:

(1) Renewables: Large scale wind/solar with BC storage to ensure reliable supply;

(2) Coal-to-Gas: Early conversion of coal plants to NG fired plants, then extend life for 5 years followed by renewables as above;

(3) Co-gen: Early replacement of coal plants with NG Cogeneration to 2034, then at end of life, replace with renewables as above.

METHODS

All scenarios are modeled to ensure the generation demand is met and:

- Behind-the-Fence (generation to power industrial process) assumed not to change
- Consistent carbon intensity used to calculate GHG emissions in all scenarios [3]
- Additional renewables installed according to Figure 1.

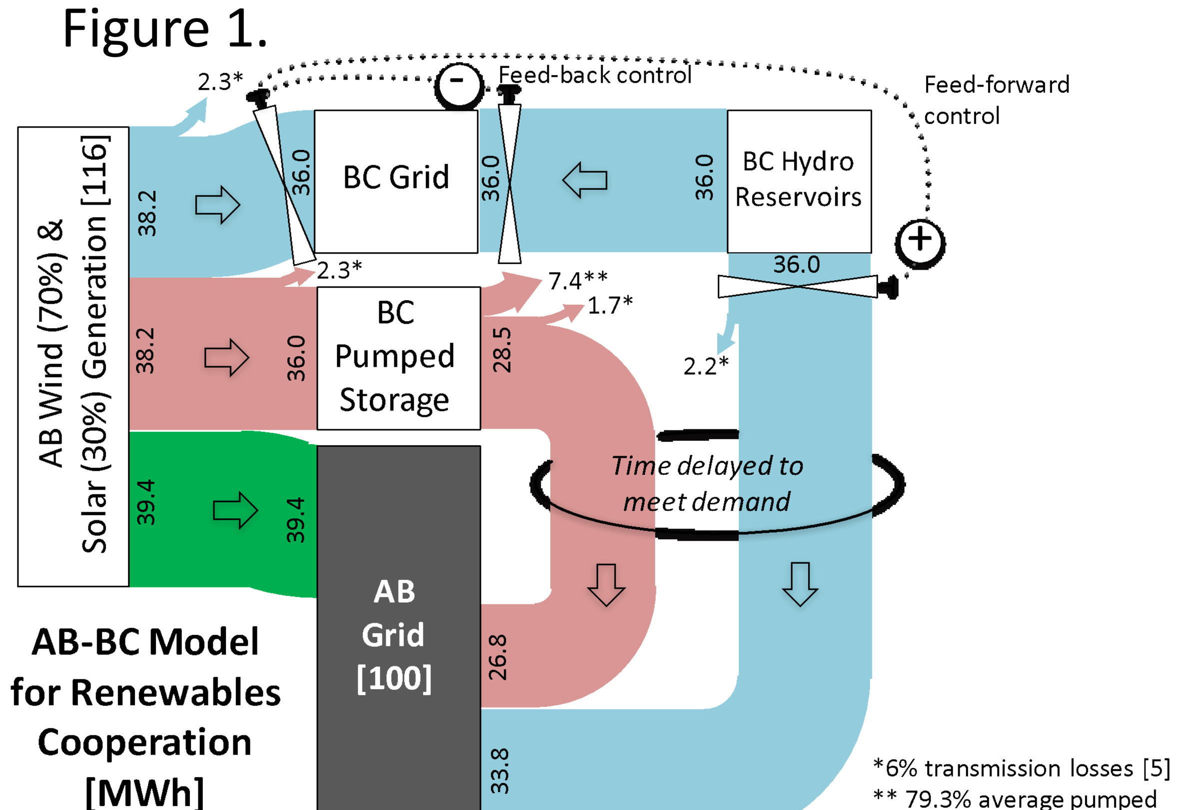
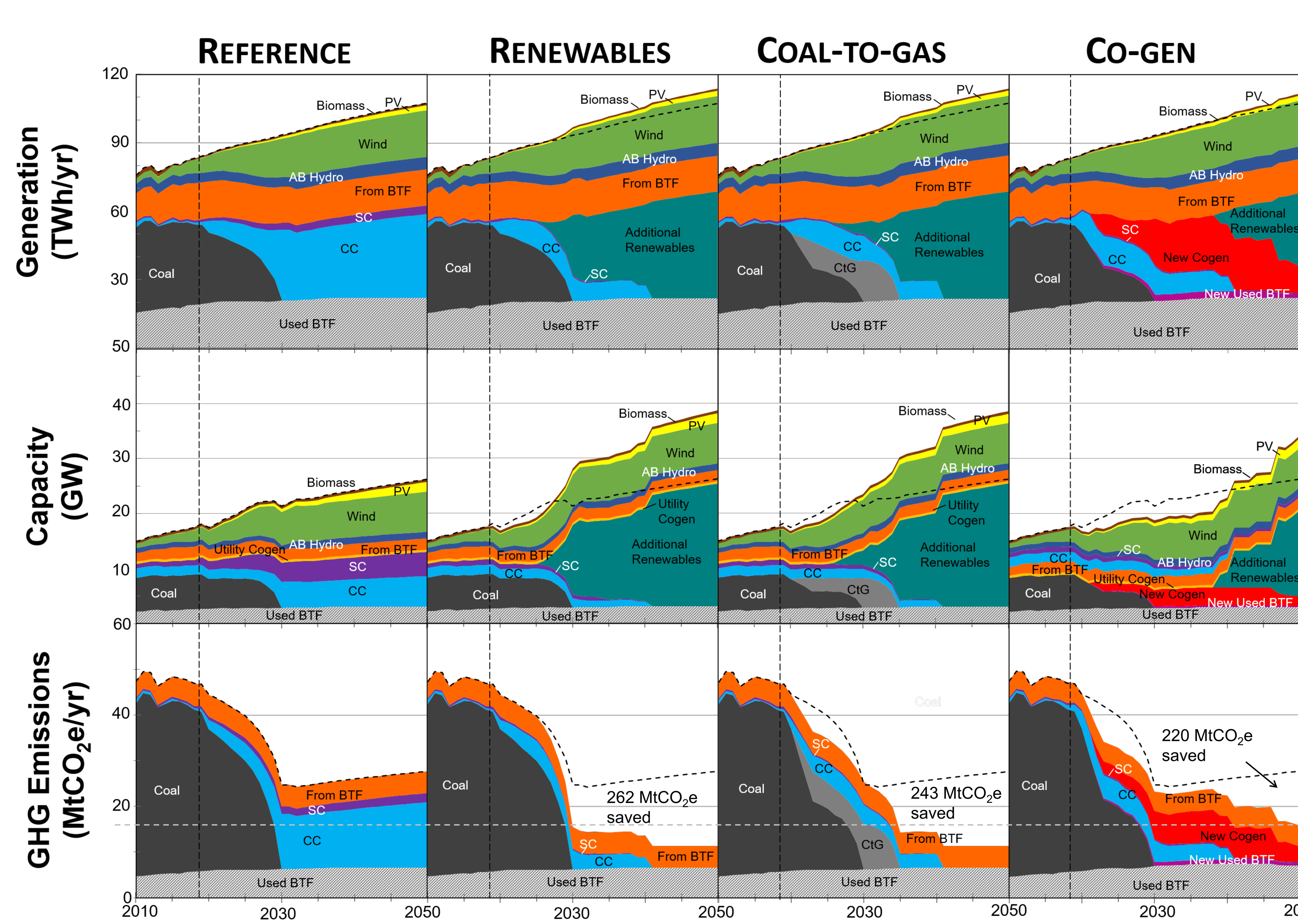


Figure 1: Renewable energy flow diagram

RESULTS



80% reduction in Public Grid GHG emissions compared to 2016 levels

NOTE:

- Total generation is larger in the alternative scenarios to account for transmission and pumped hydro storage losses
- More capacity is needed to account for the intermittent nature of renewables.
- The Renewables and Coal-to-Gas scenarios meet the goal of 80% reduction by 2050.

NOTE: (Reference)

- 50% reduction in GHGs 2050 vs. 2016
- 5584 MW of new Natural Gas Combined Cycle (CC)
- 4401 MW of new Natural Gas Single Cycle (SC)
- Total future public grid GHG emissions: 888 $MtCO_2e$

NOTE: (Renewables)

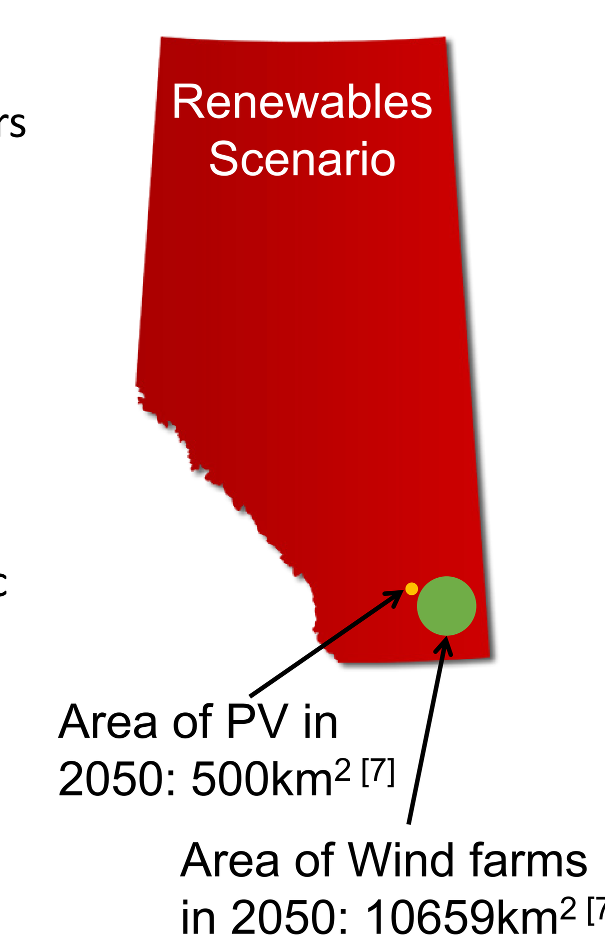
- Start intertie 2026
- 89% reduction in annual GHGs 2050 vs. 2016
- 82% renewables by 2050
- Total future public grid GHG emissions: 626 $MtCO_2e$

NOTE: (Coal-to-Gas)

- Additional 5 years to develop new renewables
- 89% reduction in annual GHGs 2050 vs. 2016
- Coal-to-gas plants phased out by 2034
- Total future public grid GHG emissions: 645 $MtCO_2e$

NOTE: (Co-gen)

- Additional 15 years to develop new renewables
- 79% Reduction in GHGs by 2050 vs. 2016
- No new Cogen plants after 2034
- Total future public grid emissions: 668 $MtCO_2e$



CONCLUSIONS

Alberta's coal retirement and renewables policy should achieve the Paris Agreement's 30% reduction target by 2030 for the electricity sector. However, plans for transforming the AB grid must begin now if we are to meet 80% reduction target for CO_2 emissions by 2050.

AB's vast wind and solar generation potential could be stored in BC's hydro pump storage and supplied to AB on demand, but this will take years to design, negotiate and build.

Replacing coal in the **Renewables** scenario achieved the most carbon reduction, but is not practical as there is not sufficient time to implement.

The **Coal-to-Gas** scenario gives an additional 5 years to transition to renewables, but it will still be a major challenge to implement this magnitude of change within the next 20 years.

The **Co-gen** scenario provides a longer, more gradual transition period and achieves a lower level of CO_2 emissions than the Reference scenario during the transition period.

Natural gas generation will be an important transitional fuel in the transformation of the AB electrical grid towards sustainability. However, policy makers must start now to plan for how the AB electrical grid will be developed to meet the 2050 targets.

Detailed analyses are needed regarding the costs, benefits and tradeoffs of the various alternatives.

Interprovincial discussions are also needed to explore areas for cooperation and mutual benefit. There is also a role for the federal government in these discussions.

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