

# ***CARBON PRICING AND ALBERTA'S ENERGY-ONLY ELECTRICITY MARKET***

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## **Overview**

Alberta operates an energy-only electricity market. This paper highlights the benefits of Alberta's market design for the incorporation of a carbon price which efficiently transmits incentives to market participants. Specific attention is paid to how carbon pricing has contributed to the shift away from coal towards natural gas and wind. The incentives created by carbon pricing have resulted in substantial new investment in wind, solar, and natural gas-fired generation capacity.

Alberta has eschewed the introduction of a capacity market, instead relying on competitive forces and direct carbon pricing to bring about change. In 2022, the carbon price is set at C\$50/tCO<sub>2</sub>e (about USD\$39) and it is legislated to increase to C\$170 in 2030 (about USD\$133). Substantial investment has occurred and is occurring in the market, including in response to carbon pricing. As of February 2022, there is about 16,600 MW of capacity available in the market, including about 2,300 MW of wind, 900 MW of hydro, and 800 MW of solar. In addition, 4,500 MW of generation capacity was under construction, including about 1,900 MW of natural gas, 1,400 MW of wind, and 1,200 MW of solar capacity.

The paper closes with a discussion of how the lessons learned in Alberta can inform evolving market designs in other jurisdictions, including those which have capacity markets.

## **Methods**

We have assembled a detailed dataset that includes generator-specific characteristics (hourly offers and carbon emissions characteristics) and hourly market outcomes (market prices, generator dispatch instructions, and average / marginal carbon emission intensities over the period 2001 to 2021). We use these data to show how average hourly generation in Alberta by fuel type has evolved over time, paying specific attention to the shift away from the use of coal and toward wind, solar, and natural gas.

We provide a detailed discussion of the nature and development of carbon pricing policy in Alberta, from the initial imposition of relatively minor charges in 2007 to a critically important policy change at the beginning of 2018 that had the effect of raising the marginal cost of production from coal-fired generators significantly above that of natural gas-fired generators. These changes are analysed within the context of Canada's federal-provincial division of powers constitutional scheme.

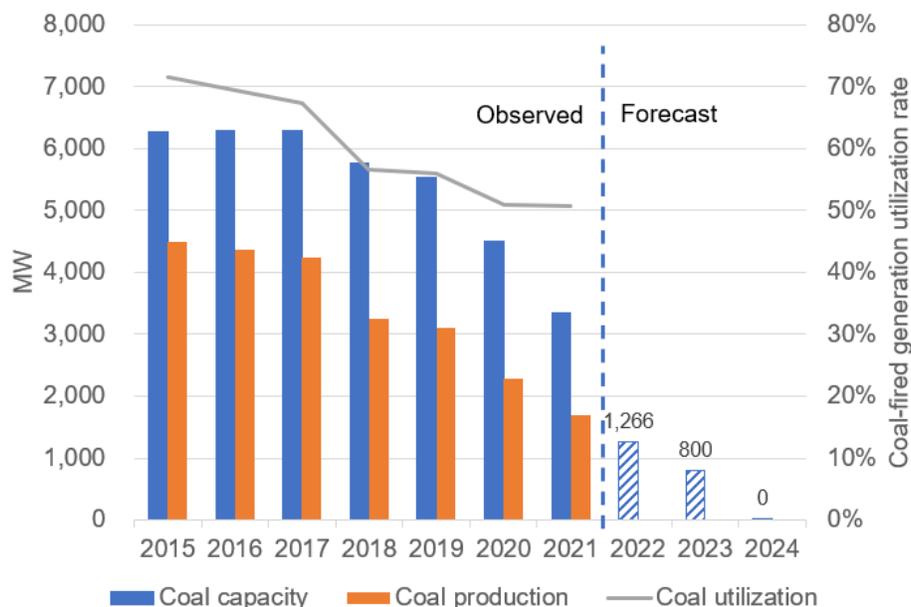
## **Results**

Using generator-specific hourly offer data, we show how cost-reflective offers changed with the evolution of carbon pricing to reflect carbon costs, how these costs were flowed through the hourly market to consumers, and how the 2018 policy change in particular had a dramatic effect in reducing the use of coal in the production of electricity. Further, we document how this change led Alberta's profit-seeking generation firms to retire or convert to natural gas all coal-fired generation by the end of 2023.

Our additional findings are as follows:

- Alberta's competitive energy-only electricity market provides immediate flow-through of carbon pricing to purchasers.
- The merit order and dispatch has changed dramatically, reducing the share of coal-fired generation and increasing the number of hours that it is on margin.
- The price signals have led to rapid improvements in carbon intensity and total carbon emissions.
- High value monetized environmental attributes have created strong incentives for expansion of wind generation.

The changes in coal use are illustrated in the figure below.



## Conclusions

The imposition of carbon pricing in Alberta raised the marginal cost of coal-fired generation above that of natural gas-fired generation. This had the immediate effect of reducing coal use in favour of natural gas and led market participants to retire all Alberta coal-fired generation much sooner than they would have otherwise (seven years before required by regulation). In short, the energy-only market has been highly compatible with carbon pricing, leading to measurable carbon emissions reductions without subsidies.

However, the design of the hourly market will need to change to account for the implications of renewable generators receiving payments for their renewable attributes from outside the electricity market. In particular, negative offer prices in the hourly market will be necessary in the future. Further, we note that there remain a number of important outstanding questions about how environmental attributes are exchanged across jurisdictions.

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