

# Canadian Climate Policy and Its Implications for Electricity Grids

*By G. Cornelis van Kooten*

Along with many Western developed countries, Canada has pledged to reduce its greenhouse gas emissions by 40–45 percent by 2030 from 2005 emissions levels, and to achieve Net Zero emissions by 2050. This is a huge challenge that, when considered on a global scale, will do little to stop climate change because emissions by developing countries are rising faster than emissions are being reduced in developed countries. Even so, the potential for achieving emissions reduction targets is extremely challenging as there are questions as to how and whether targets can be met and at what cost. Because electricity can be produced from any source of energy, including wind, solar, geothermal, tidal, and any combustible material, climate change policies have focused especially on nations' electricity grids.

Canada's electricity grid consists of 10 separate provincial grids that are weakly connected by transmission interties to adjacent grids and, in some cases, to electricity systems in the United States. At times, these interties are helpful in addressing small imbalances between electricity supply and demand so as to prevent brownouts or even blackouts, and are a source of export revenue for provinces that have abundant hydroelectricity, such as British Columbia, Manitoba, and Quebec. Due to generally low intertie capacities between provinces, electricity trade is generally a very small proportion of total generation. Essentially, provincial grids are stand-alone, generating electricity to meet domestic demand (known as load) from the lowest cost local resources.

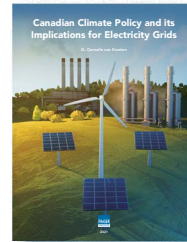
Because climate change policies have focused on electricity (namely, wind and solar energy, and electric vehicles), this study employs information from the Alberta electricity system to provide an estimate of the possible costs of reducing national CO<sub>2</sub> emissions related to power generation. The

Alberta system serves as an excellent case study for examining the potential for eliminating fossil-fuel generation because of its large coal fleet, favourable solar irradiance, exceptional wind regimes, and potential for using BC's reservoirs for storage. Using a model of the Alberta electricity system, we find that it is infeasible to rely solely on renewable sources of energy for 100 percent of power generation—the costs are prohibitive. Under perfect conditions, however, CO<sub>2</sub> emissions from the Alberta grid can be reduced by 26 to 40 percent by eliminating coal and replacing it with wind, solar, and gas, but by more than 75 percent if nuclear power is permitted. The associated costs are estimated to be some \$1.4 billion per year to reduce emissions by at most 40 percent, or \$1.9 billion annually to reduce emissions by 75 percent or more using nuclear power (an option not considered feasible at this time). Based on cost estimates from Alberta, and Ontario's experience with subsidies to renewable energy, the costs of relying on changes to electricity generation (essentially eliminating coal and replacing it with renewable

energy sources and gas) to reduce national CO<sub>2</sub> emissions by about 7.4 percent range from some \$16.8 to \$33.7 billion annually. This constitutes some 1 to 2 percent of Canada's GDP.

The national estimates provided here are conservative, however. They are based on removing coal-fired power from power grids throughout Canada. We could not account for scenarios where the scale of intermittency turned out worse than indicated in our dataset—available wind and solar energy might be lower than indicated by the available data. To take this into account, a reserve market is required, but the costs of operating such a capacity market were not included in the estimates provided in this study. Also ignored are the costs associated with the value of land in other alternative uses, the need for added transmission lines, environmental

and human health costs, and the life-cycle costs of using intermittent renewable sources of energy, including costs related to the disposal of hazardous wastes from solar panels and wind turbines.



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