ELECTRIFICATION AND CANADA'S ENERGY FUTURE

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Overview

Canada's energy system is entering a period of significant change. The government is committed to a 30 per cent GHG reduction from 2005 levels by 2030. To meet this commitment both federal and provincial governments have put forth policies and proposals to reduce GHG emissions. Futures trends will be driven by these policies along with other factors such as changing energy markets and technological innovation. In particular, electricity is expected to play a key role in the transition to a cleaner economy. The National Energy Board (NEB) has incorporated some of these developments into its latest long-term outlook, Canada's Energy Future 2017 (EF 17). This outlook includes two cases: a Reference Case based on a current economic outlook, a moderate view of energy prices, and climate and energy policies announced at the time of analysis and; a Technology Case which considers the impact of greater adoption of a selection of emerging technologies such as heat pumps, faster uptake of electric vehicles (EVs), and cost decline for non-hydro renewables.

Methods

The NEB has been producing long-term energy supply and demand projections regularly since 1967. The latest outlook, EF 17, projects energy supply and demand for Canada to the year 2040. These outlooks are created using the NEB's Energy Futures Modelling System, which contains various supply and demand modules that interact to produce the outlook at a provincial and territorial level. The supply modules include oil sands, non-oil sands crude oil, natural gas, and natural gas liquids production models that are developed within the NEB. ENERGY 2020, an integrated energy model creates the demand and electricity projections. Demand projections are made across four general sectors, each of which has several sub-sectors: residential, commercial, industrial (including oil and natural gas production), transportation and an exogenous macroeconomic outlook prepared by an external consultant. This short summary is based on EF17's two cases, Reference and Technology. Results are presented below with focus on electricity supply and demand.

Results

Electricity Supply

Canada has considerable non-hydro renewable resource potential including wind, biomass and solar. The type of energy used to generate electricity varies substantially between regions because of resource accessibility and historical infrastructure development. Over the past few years favourable policies and declining costs have spurred the deployment of renewables. In 2015 non-hydro renewables accounted for 10% of total installed capacity, this more than doubles by 2040 in the Reference Case. In the Technology Case, which assumes aggressive cost decline for solar and wind, installed capacity for solar and wind reach 25 GW and 31 GW respectively by 2040. The shift towards wind, and solar causes Canada's already low-emitting electricity sector to become even greener. By 2040, non-hydro renewables make up 30% of the supply mix.

Electricity Demand

In the Reference Case, electricity demand in the end-use sectors rise from 1 800 PJ in 2015 to 2 300 PJ in 2040. This growth is largely driven by end-use electrification in the residential, commercial and transportation sectors. In the Reference case EVs make up 16% of all cars sold in 2040 compared to 47% in the Technology Case. By 2040, this sector's electricity demand rises to 34 PJ in the Reference case and 74 PJ in the Technology Case. Although electricity demand increases across all provinces, the rate of increase varies considerably between provinces. EV adoption rate is higher in regions with incentives and low cost electricity. In particular, sales grow quickest in Quebec because of the province's EV mandate. In contrast, greater adoption of EVs reduce demand for fossil fuels. By 2040, EVs account for 34% of all passenger vehicles; total transportation energy demand in the Technology Case is 5% lower than the Reference Case.

In Canada, different technologies are used to heat homes and business. The predominant type of heating system in a region usually depends on relative cost of heating fuel and available infrastructure. For example, low electricity prices in Quebec encourage electric baseboard heating. In Atlantic Canada, oil furnaces and electric heat are more common, in part due to limited natural gas distribution infrastructure. Electrification of space and water heating in the residential and commercial sectors increase national electricity demand but not in all provinces. In regions like Quebec, with a high share of baseboard heating systems, high penetration of heat pumps decreases electricity demand. In contrast, the switch increases electricity demand in other provinces, such as Ontario, Alberta and British Columbia. These provinces currently use natural gas as the primary home heating fuel. Thus, electrification leads to an increase of electricity demand for these provinces while reducing natural gas demand.

Conclusions

The results from this analysis show electricity will have key role in future energy transition. In both demand and supply there are interesting regional differences. The modelling showed there is potential for electrification in the residential and commercial sectors although this should be viewed in conjunction with improved efficiency. Transportation sector electrification increases the sector's electricity demand but its share remains less than 1% of total end-use demand. Canada's grid is already low emission and decreases further with power sector decarbonizaiton. This shift in generation mix will require flexible energy systems that can accommodate growth in renewables. The findings of this study show end-use electrification and power sector decarbonization contribute to limiting fossil fuel growth.