ELECTRIC VEHICLE COSTS AND ADOPTION TRENDS

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Overview

The purpose of this paper is to explore future trends in electric vehicle (EV) costs and adoption. An important feature of the Technology Case in *Canada's Energy Future 2018* (EF2018) was the increasing rate of adoption of EVs, which climbs to over 60% of new vehicles sold by 2040. This is in part driven by the assumption that the cost of electric vehicles will continue to fall over the coming years to the point where they are cost competitive with internal combustion engine vehicles. These falling costs largely depend on the advancement of battery technology which has thus far made purchasing an EV a more expensive option. While costs have significantly fallen and technology has improved over time there are still some hurdles that may slow adoption. These include the reliance on minerals such as cobalt in battery production which is subject to geopolitical risk and large price fluctuations. Through a rigorous analysis of these risks we have created a number of cost breakdowns for various technologies that will be needed to achieve the projections outlined in EF2018.

Methods

The EF2018 projections are developed using the NEB's Energy Futures Modelling System. This includes a variety of modules covering various sections of the energy system based on a common set of assumptions. Modules include: Demand and electricity (using the ENERGY2020 energy systems model), crude oil and natural gas production (using NEB developed models), and macroeconomics (provided by Stokes Economics). Assumptions on electric vehicle costs were derived from NREL (2018).

For analysis on the availability and prices of key input materials such as cobalt and lithium, information on metal reserves, prices, and production was sourced taken from the United States Geological Survey's *Mineral Commodity Summaries 2018*. Many of the future demand assumptions we made were based on those in the Technology Case from EF2018. Other assumptions such as the cost of labour and vehicle efficiencies where derived from projecting current trends forward. As policies supporting the adoption of EVs are common in many jurisdictions it is important to include these and assess their impacts. This includes, but is not limited to, carbon pricing and EV subsidy programs. A target price for batteries used in EVs that is frequently cited is $100/kWh which is the rough point where EVs would achieve cost parity with ICE vehicles. This number has been used as a target for our model.

Results

Both the Reference Case and Technology Case from EF2018 show a rising share of electricity in the transportation sector. In the Reference Case, EVs rise to approximately 15% of new passenger sales in the long term, and add approximately 12.5 TW.h of electricity demand in Canada. In the Technology Case EVs rise to approximately 60% of new passenger sales and add approximately 45 TW.h of electricity demand by 2040. Given their relatively lower energy use per km travelled as compared to ICE vehicles, the increased EV penetration reduces long term gasoline demand by an even larger amount.

Our analysis on input prices and efficiency assumptions sheds light on some of the uncertainty regarding these cost and adoption projections. They will also help illustrate the impact that technological breakthroughs, such as solid state batteries, could have on adoption and potential for significantly faster growth rates in EVs, as observed in EF2018 Technology Case. Our study illustrates how this could be met under a variety of global conditions taking into account material prices and changes in product design.

Conclusions

As with any technology on the cusp of a potential breakthrough, there is much uncertainty in the rate at which EVs will be adopted. This paper does not seek to create another outlook, but instead focuses on the factors needed to make these vehicles cost competitive with traditional ICE models, specifically on the price of batteries. By taking into account the supply risks of input materials and technological improvements we have created an estimate of what will be needed to meet the frequently cited price target of $100/kWh and the forecasts made in the report EF2018.

References

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