Electric Vehicles and the Energy Systems of Alberta

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INTRODUCTION

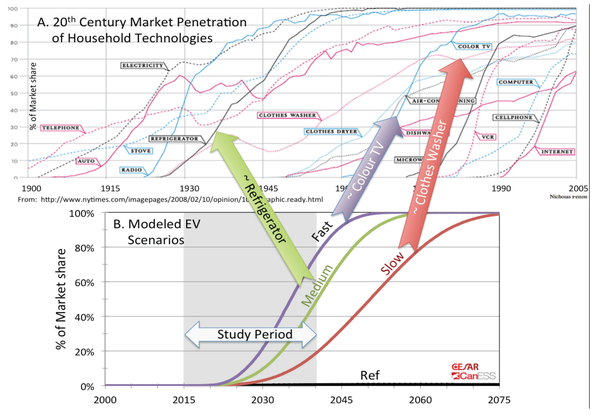
In 2015, 88 billion person-kilometers were travelled in Alberta, 2/3rd by light duty vehicles (LDVs) resulting in 13 million tonnes (Mt) of CO_2e/yr in life cycle greenhouse gas (GHG) emissions.

Many companies are working to transform personal LDV transport with plug-in electric vehicles (EVs). *With the high carbon grid in Alberta, will EVs contribute to climate change solutions?*

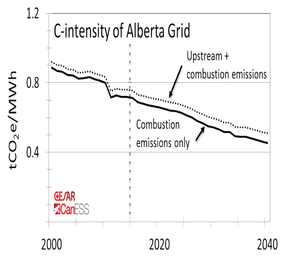
Also, what impact might EV deployment have on demand for oil in Alberta, across NA and globally?

METHODS

Using the Business-as-usual (BAU) low oil sands growth (LOSG) model [1] as the reference scenario, three other scenarios were built using the CanESS model [2] assuming different rates of EV market penetration as shown here [3,4]:

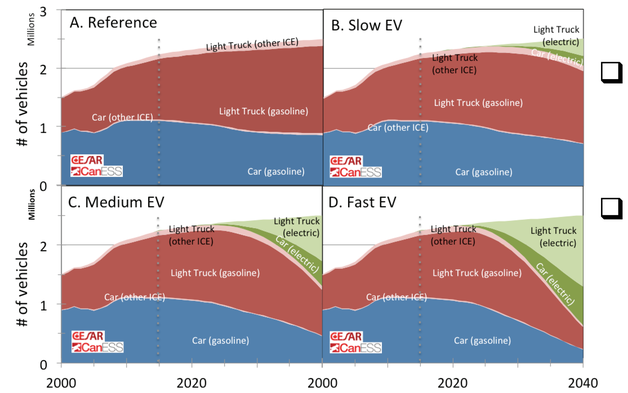


Grid carbon intensity was calculated assuming 50 yr coal plant retirement replaced with Natural gas combined cycle [6,7].

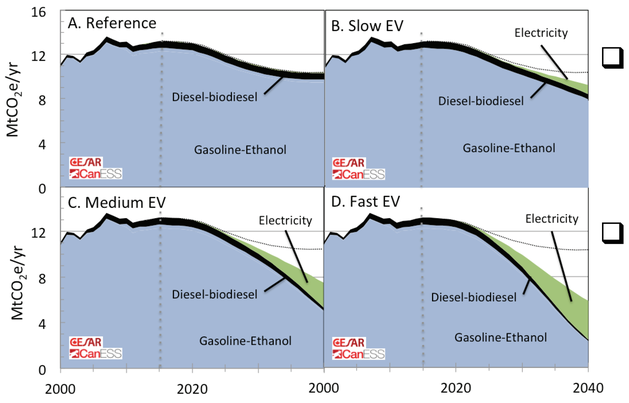


RESULTS and DISCUSSION

Four Scenarios for Personal LDV Numbers in Alberta

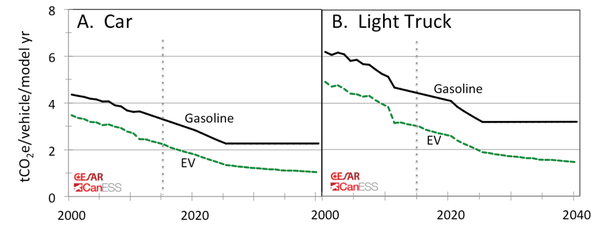


Life Cycle (well to wheel) GHG Emissions associated with Personal LDV use.

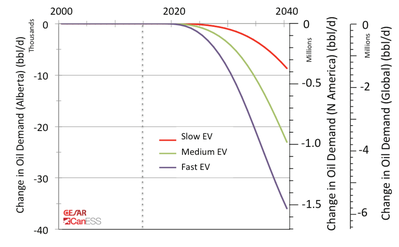


Projected Annual GHG Emissions

- ✓ new vehicle each year
- ✓ 15,000km/yr travelled
- ✓ 60% city/40% highway



Impact on Oil Demand



NOTE:

- ❑ Vehicles numbers increase slower than population growth
- ❑ By 2040, 18%, 48% and 74% of vehicles on road are EVs in Slow, Medium and Fast scenarios, respectively.
- ❑ Despite more vehicles, emissions decline with improved efficiency standards (CAFE)
- ❑ Emissions from electricity generation reversed ~40% of GHG savings from reduced gasoline use.
- ❑ New vehicle comparison projects EV emissions lower than conventional by ~1 t CO_2e/yr
- ❑ By 2040, global oil demand could be up to 6 M bbl/d lower than BAU scenario

CONCLUSIONS

Even in Alberta, with its high carbon electrical grid, there should be a net GHG benefit of EVs over vehicles with internal combustion engines (ICEs). By 2040, the models project savings of up to 4.5 Mt CO_2e/yr.

However, these calculations do not consider the emissions associated with vehicle manufacture, which tends to be higher for EVs than ICEs [8].

Nevertheless, other trends could improve EV performance as a GHG solution, including:

- ❑ The Alberta government's recent commitment to speed coal plant replacement and increase the role for renewables.
- ❑ The development of self-driving and car sharing technologies which would reduce the proportion of manufacturing emissions in vehicle life cycle costs;
- ❑ Improved battery technologies.

In a provincial economy dependent upon oil recovery and export, a North American or global transformation to EVs would likely have a negative impact on the price received for each barrel and therefore on the strength of the provincial economy.

This could be offset if Alberta were to simultaneously develop industries that will benefit from the EV transformation.

REFERENCES

[1] Poster on BAU scenarios for Alberta

[2] whatIf? Technologies Inc., 2014. Canadian Energy Systems Simulator (CanESS) - version 6, reference scenario. www.caness.ca

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[7] Howarth, R et al, 2011. Supplementary material to Methane and the greenhouse-gas footprint of natural gas from shale formations. Climate change 2011, vol 106, p 679-690.

[8] Hawkin, T. et al, 2013. Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles. Journal of Industrial Ecology, Vol 17, num. 1, p 53-64

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