Fuel from Biomass Residues

The Potential of DME in Alberta's Freight Transport Sector

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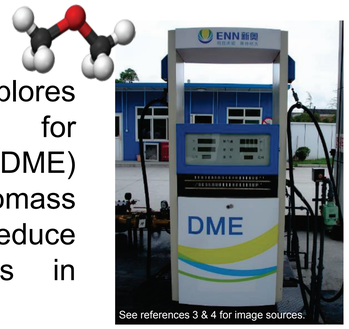
INTRODUCTION

Freight transportation currently accounts for 14% of Alberta's GHG emissions [1], and with continued use of diesel fuel, it has been projected to rise to 300 Mt CO_2/year by 2060 [2].



This project explores the potential for Dimethyl Ether (DME) made from biomass residues to reduce freight emissions in Alberta.

METHODS

Size of biomass resources

- Projected using CanESS data [5]
- Up to 90% of MSW, 80% of forestry residues and 50% of agriculture can be reasonably collected & converted to DME

Biomass to DME Conversion Technology

- 48.6% feedstock conversion [6]. Refer to Sankey Diagram below for energy flows.
- Heat and power requirements for processing are provided by waste streams

Size of Competing Diesel Market

- Projected using CanESS data [5] for heavy truck freight transportation only
- Diesel engines can burn up to 25% DME by volume without need to retrofit

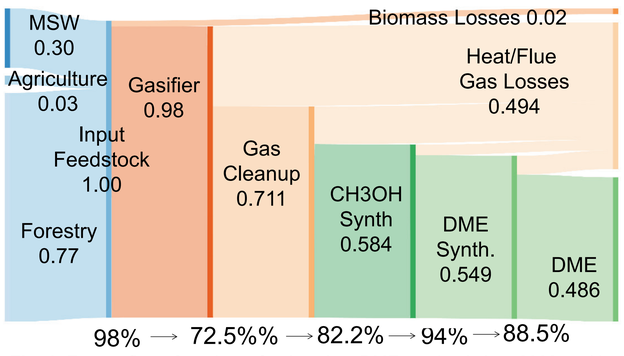


Fig. 1. Energy flows from input feedstock to DME synthesis in a 2000 ton/day DME production facility. Percentages show stage-wise energy efficiencies.

RESULTS

Fig. 2: Feedstock Diversion

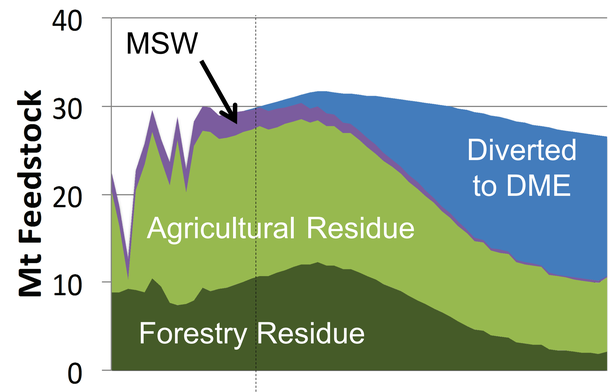


Fig. 3: Projected Fuel Mix

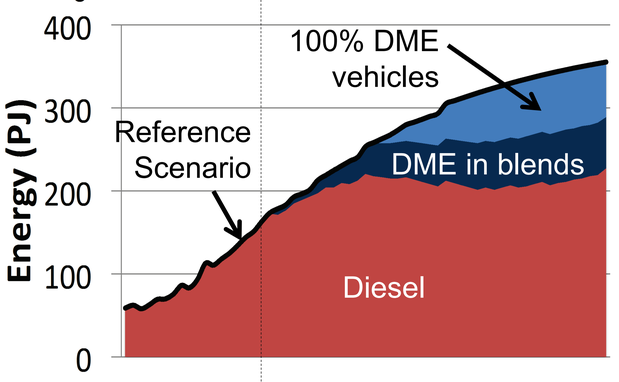
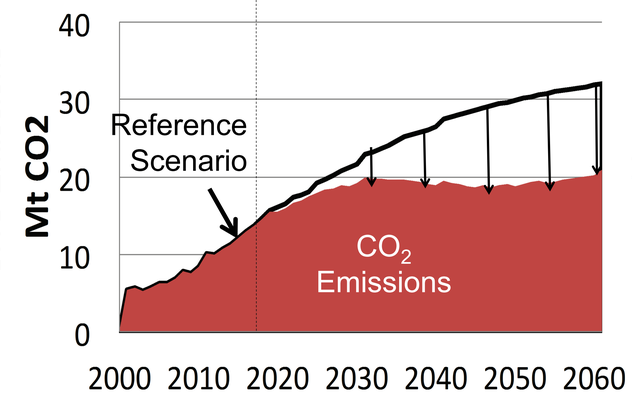


Fig. 4: Life Cycle GHG Emissions



Key Notes:

Figure 2:

- Up to 16 Mt/year of feedstock is diverted for DME production by 2060
- This will require 24 DME plants at 600 to 2000 tons/day to process

Figure 3:

- By 2031, Diesel-DME blend can reach 25% by volume. At this point, we assume commercial availability of 100% DME vehicles.
- 128 PJ of Alberta's annual diesel demand can be reduced due to DME use by 2060

Figure 4:

- 11 Mt CO_2 annual reduction by 2060
- DME production will decrease CO_2 emissions by 37%

Figure 5:

- DME is cheaper to produce when carbon tax reaches \$15/ton CO_2 neglecting initial capital investment.

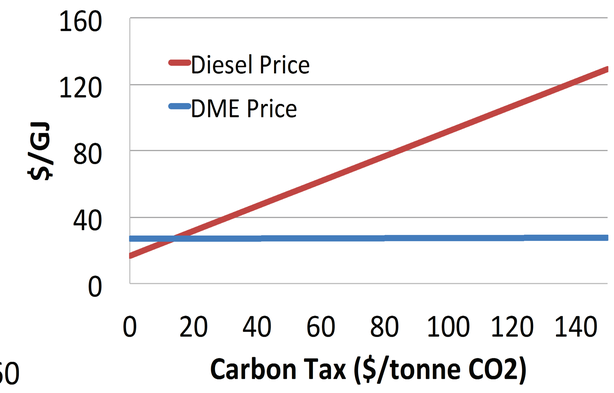


Fig. 5: Cost of Diesel vs. DME

DISCUSSION

- Potential for 15% carbon emissions reduction by 2031 without engine retrofits.
- Through continued expansion of the industry, and with feedstock availability as the limiting factor, annual reductions of 37% can be achieved by the year 2060.
- Viability of the model is contingent on Alberta maintaining it's carbon sinks
- Growth in Alberta's trucking industry, as projected by CanESS data, is optimistic. This is reflected in our results.
- Model requires rapid deployment of infrastructure and assumes funding is readily available. Our recommendation is to mandate a gradual increase in the percentage of DME to be blended into Alberta's diesel supply (up to 25%) and incentivize continued development of engines that can run on 100% DME.
- Taking into account the initial cost of investment, the plant is expected to become profitable at a carbon tax of \$45/tonne CO_2.

CONCLUSIONS

Alberta needs to reduce its carbon emissions by about 150 MT/year according to the Government of Alberta. [7] This technology has the potential to reduce roughly 11 Mt/ year with DME supply limited by projected availability of municipal solid waste and biological residues in Alberta. With adequate funding, this technology could be employed to reduce a portion of Alberta's CO_2 emissions.

ACKNOWLEDGEMENTS

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[3] Photo from International DME Association website: https://www.aboutdme.org/index.asp?sid=97

[4] Photo from Research Triangle Energy Consortium website, cont'd

[4] cont'd: "Particulate Matters": https://rtec-rtp.org/2013/12/29/particulate-matters

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