Replacing Alberta's Transportation Fuel with Home Grown Biofuel

Can Alberta Crop Residuals Supplement Fuel Demand and Reduce GHG Emissions?

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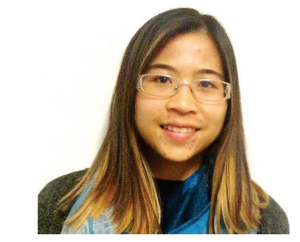
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INTRODUCTION

Freight transportation in Alberta consumed 286 PJ in 2014 contributing over 25 Mt of GHG to the atmosphere – nearly 10% of the provinces GHG emissions.

This project looks at a Thermochemical Gasification process which uses Fischer-Tropsch synthesis to convert lignocellolosics to diesel and other hydro-carbons and its potential to reduce GHG emissions [1].

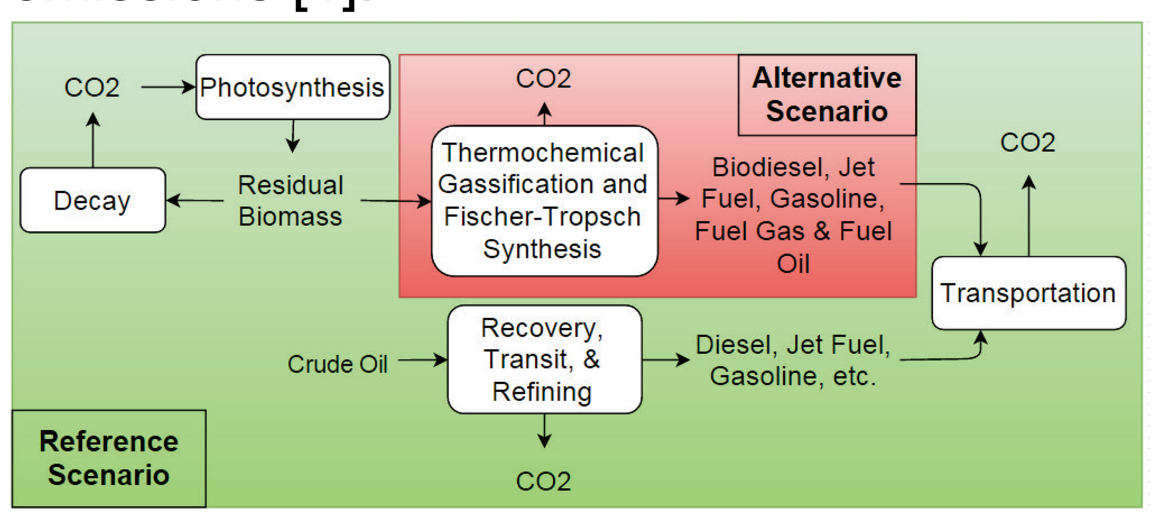

Fig. 1 CO_2 Flow Chart for Reference and Alternative Scenarios

METHODS

Our reference scenario and Alberta crop projection data were provided by Dr. Layzell from the CanESS model (CESAR).

The alternative scenario process was taken from the Thesis of Maria Pinilla (Fig. 2) [1], which is assumed to be accurate.

Assumptions

- Alternative process has 67% efficiency
- Current freight systems can transport 1.15 Mt of biomass / facility / year
- Stable biomass prices at $115/tonne [2]
- First facility in 2025, new facility every 3 years, each with 15 PJ annual capacity

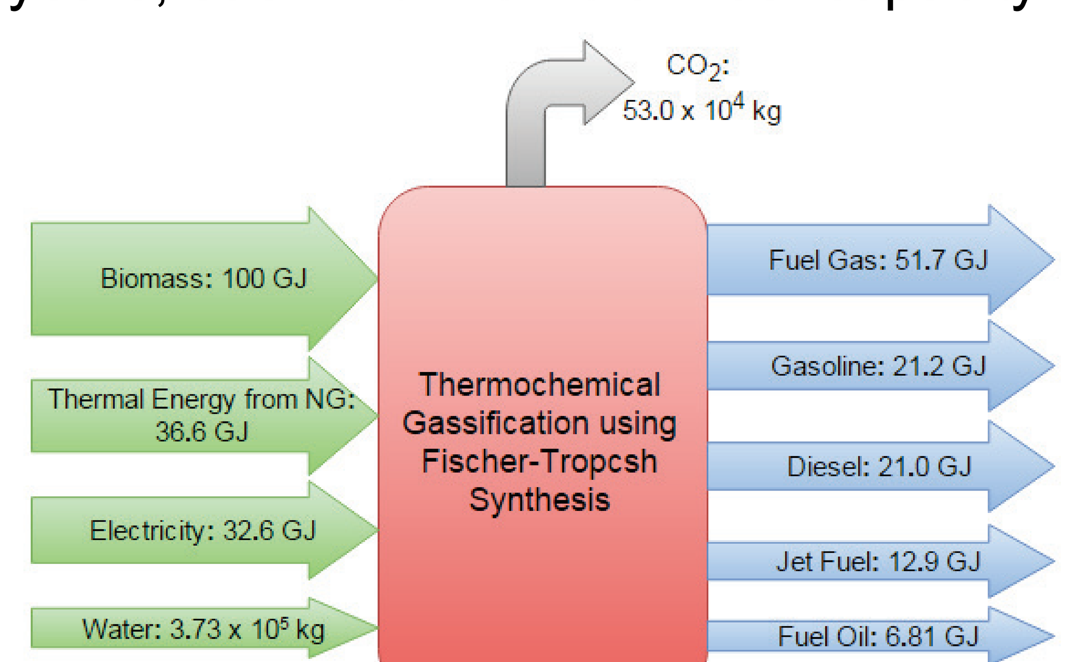

Fig. 2 Alternative Scenario Process Flow Chart [1]

RESULTS & DISCUSSION

REFERENCE | **ALTERNATIVE** | **NOTES:**

Residual Biomass

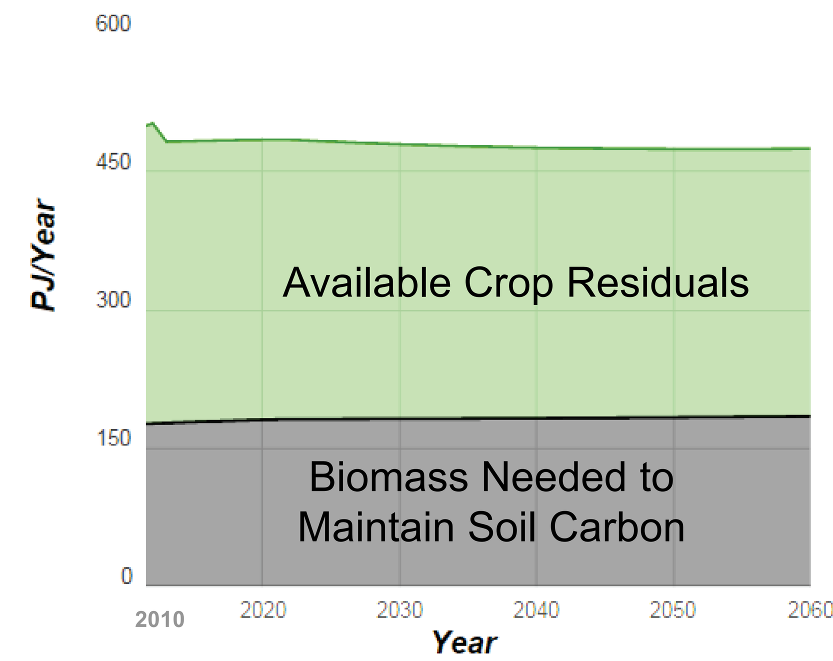

Fig. 3a Ref Residual Biomass

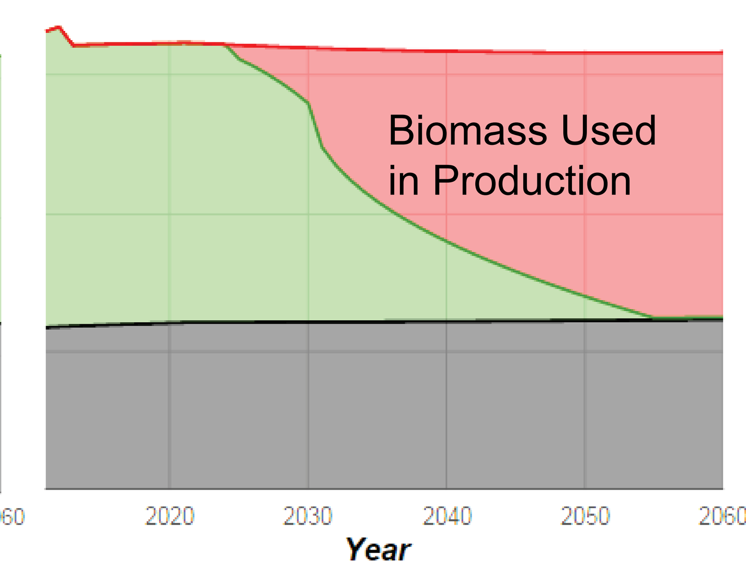

Fig. 3b Alt Residual Biomass

Peak residual biomass use by 2054, roughly 290 PJ per year.

By maintaining soil carbon, GHG mitigation is maximized.

Transportation Fuel Demand

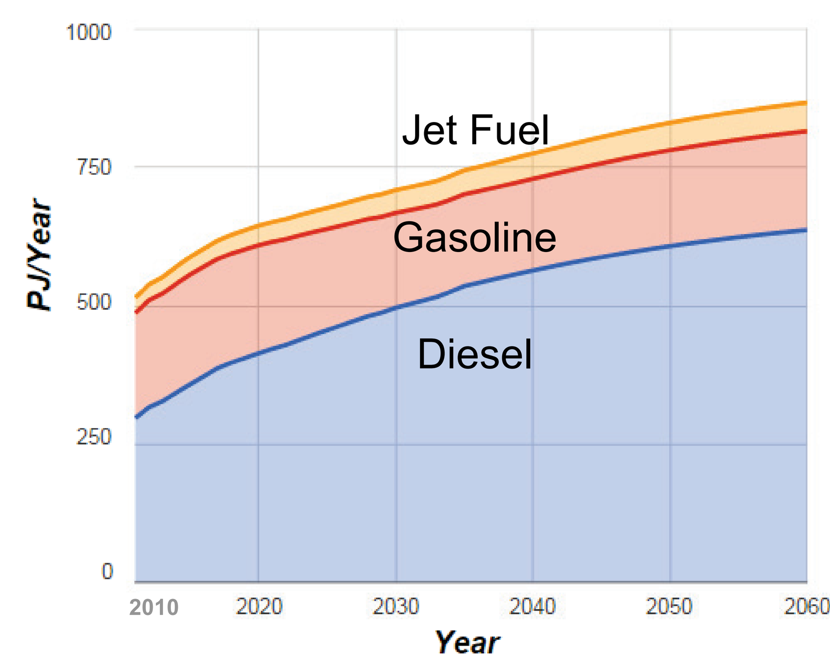

Fig. 4a Ref Fuel Production

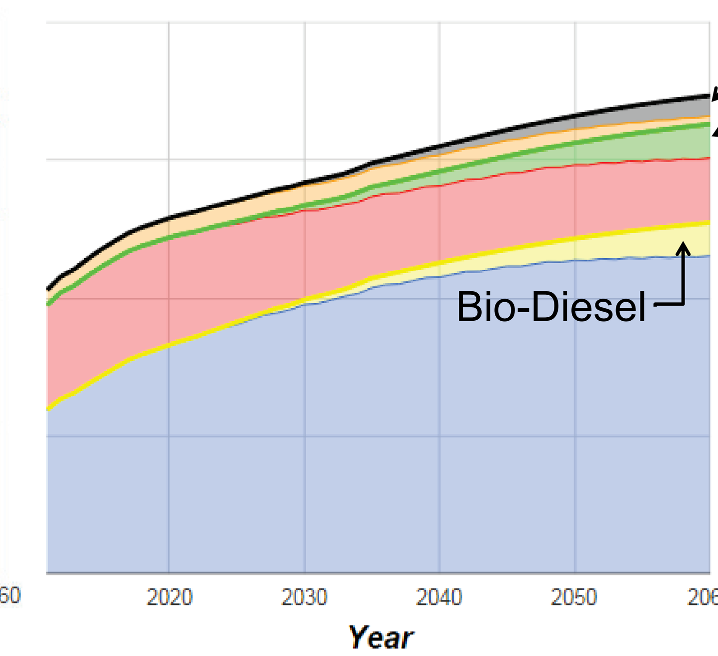

Fig. 4b Alt Fuel Production

Maximum Market Contribution:

- Jet Fuel: 71.9%
- Gasoline: 34.2%
- Diesel: 9.5%

Total Market Contribution: 18.3%

Lifecycle GHG Emissions

Takes into account the transportation, refining process and final engine combustion of fuels [3].

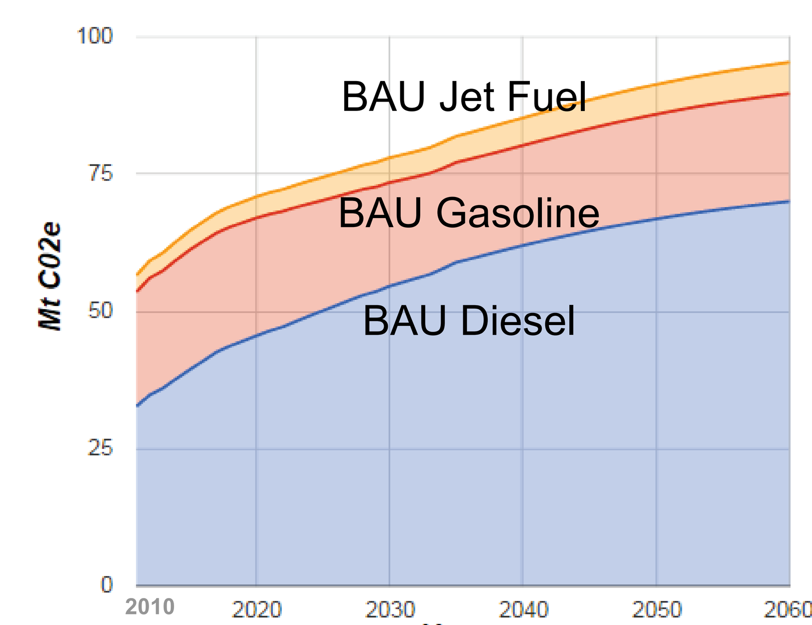

Fig. 5a Reference GHG

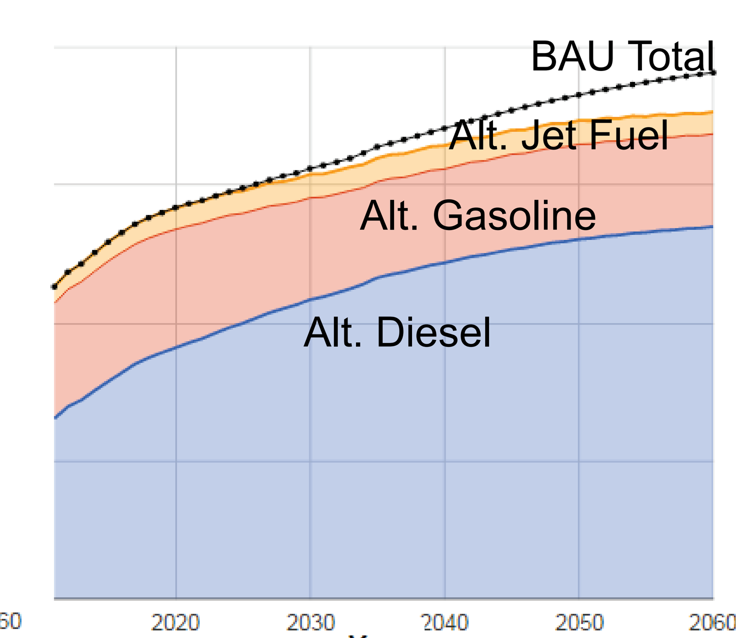

Fig. 5b Alternative GHG

7.16Mt CO_2e Reduction in 2060

Cumulative reduction since deployment: 127.5 Mt CO_2e

Comparative Carbon Prices

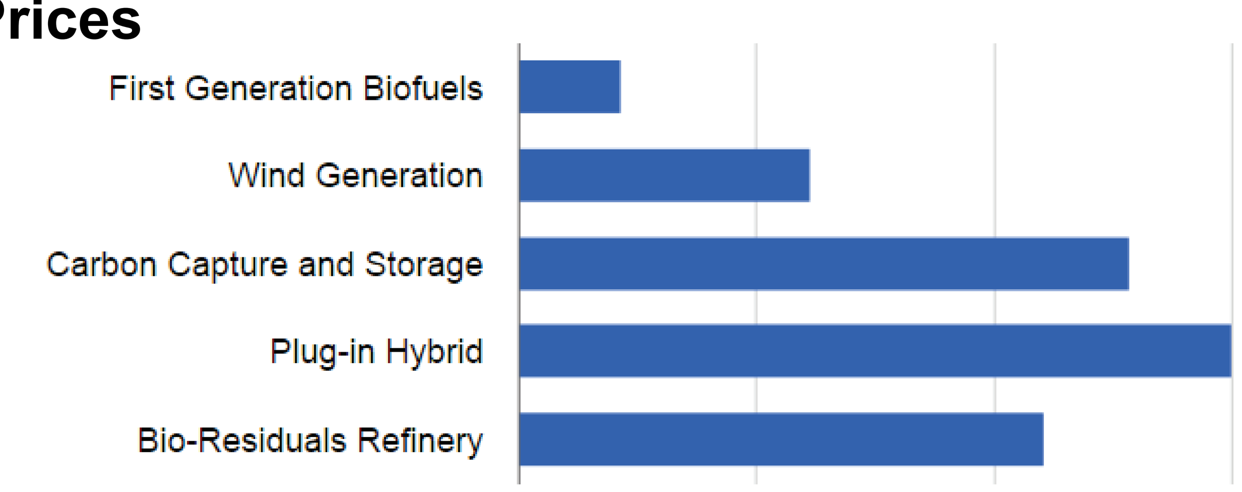

Fig. 6 Comparative Carbon Prices (CAD) [4]

Advantages

- Synthetic gas generation products such as this are very high quality
- Uses readily available resources
- Does not take resources away from food production

Disadvantages

- Feedstock has low energy density
- May lead to higher fertilizer use
- Heavy burden on transportation system

CONCLUSIONS

Fischer-Tropsch biofuel production has significant potential to reduce freight transportation emissions but at a high cost ($110/t$CO_2$e). This value corresponds to a 550% increase of current carbon price [5]. Our study examined the best-case scenario of bio-fuel production, therefore further research is recommended to achieve realistic application.

Given the high cost associated with this technology and the practical problems with transportation logistics, pursuing other climate change strategies is recommended at this time.

Some recommendations in order to potentially implement this technology in the future include:

- Policy on soil carbon
- Policy to improve rail infrastructure
- Policy to invest in Fischer-Tropsch technology

ACKNOWLEDGMENTS

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REFERENCES

[1] Pinilla, M. (2011) *Comparative Life Cycle Assessments of Lignocellulosic and Algae Biomass.* University of South Florida.

[2] Alberta Agriculture (2011) *Census of Agriculture for Alberta.*

[3] Steenhof P., Woodsma C., Sparling E. (2006). *Greenhouse gas emissions and the surface transport of freight in Canada.* Transportation Research Part D 11.

[4] McKinsey&Company (2009) *Pathways to Low-Carbon Economy: Vs. 2 of the Global Greenhouse Gas Abatement Curve Cost.*

[5] Government of Alberta (2015) *Climate Leadership Plan: Carbon Pricing.*

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