

Analysis of Biofuel Analysis of Biofuel Sources for Canada's Future

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ABSTRACT

This project aims to provide a detailed assessment of the future of biofuels in Canada. Since the federal Renewable Fuels Regulations enacted in 2010, biofuel mixing has played an increasing role in the transportation sector as part of a wider strategy of reducing greenhouse gases. Due to the novelty of some biofuel production methods as well as improvements in vehicle engines for consuming biofuel mixtures, predicting the future of the industry can be challenging. In order to understand what the future of biofuel will look like, four possible scenarios were identified and subject to economic analysis, lifecycle greenhouse gas assessment as well as discussed in a broader societal context.

BACKGROUND

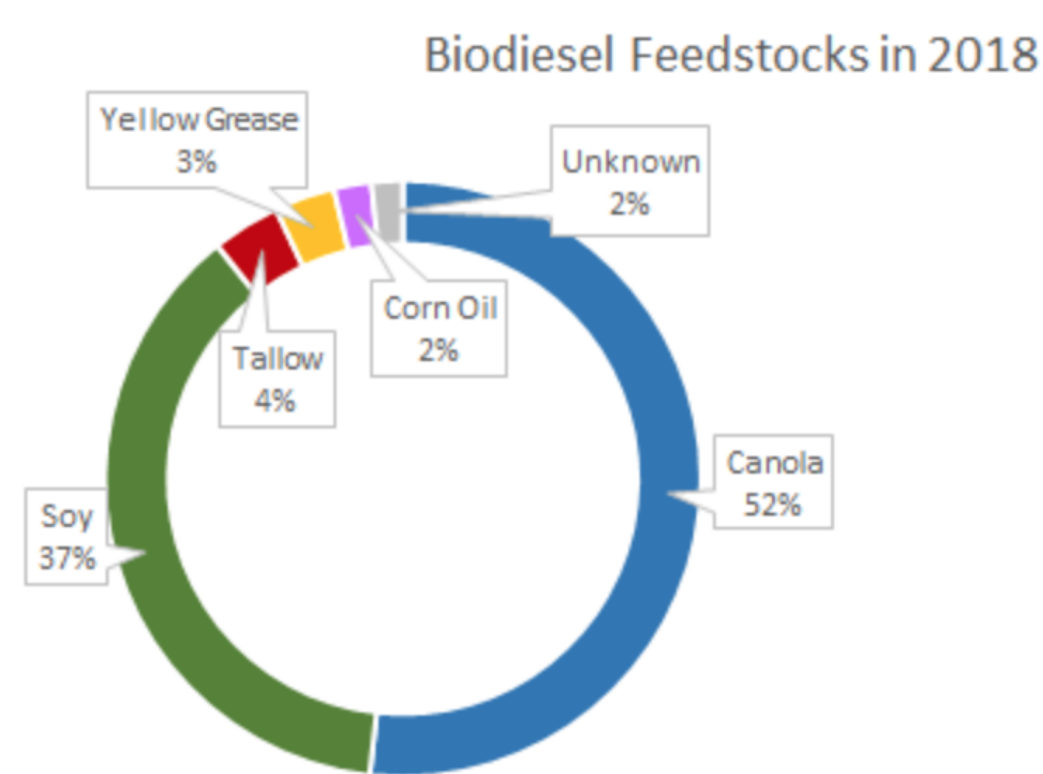
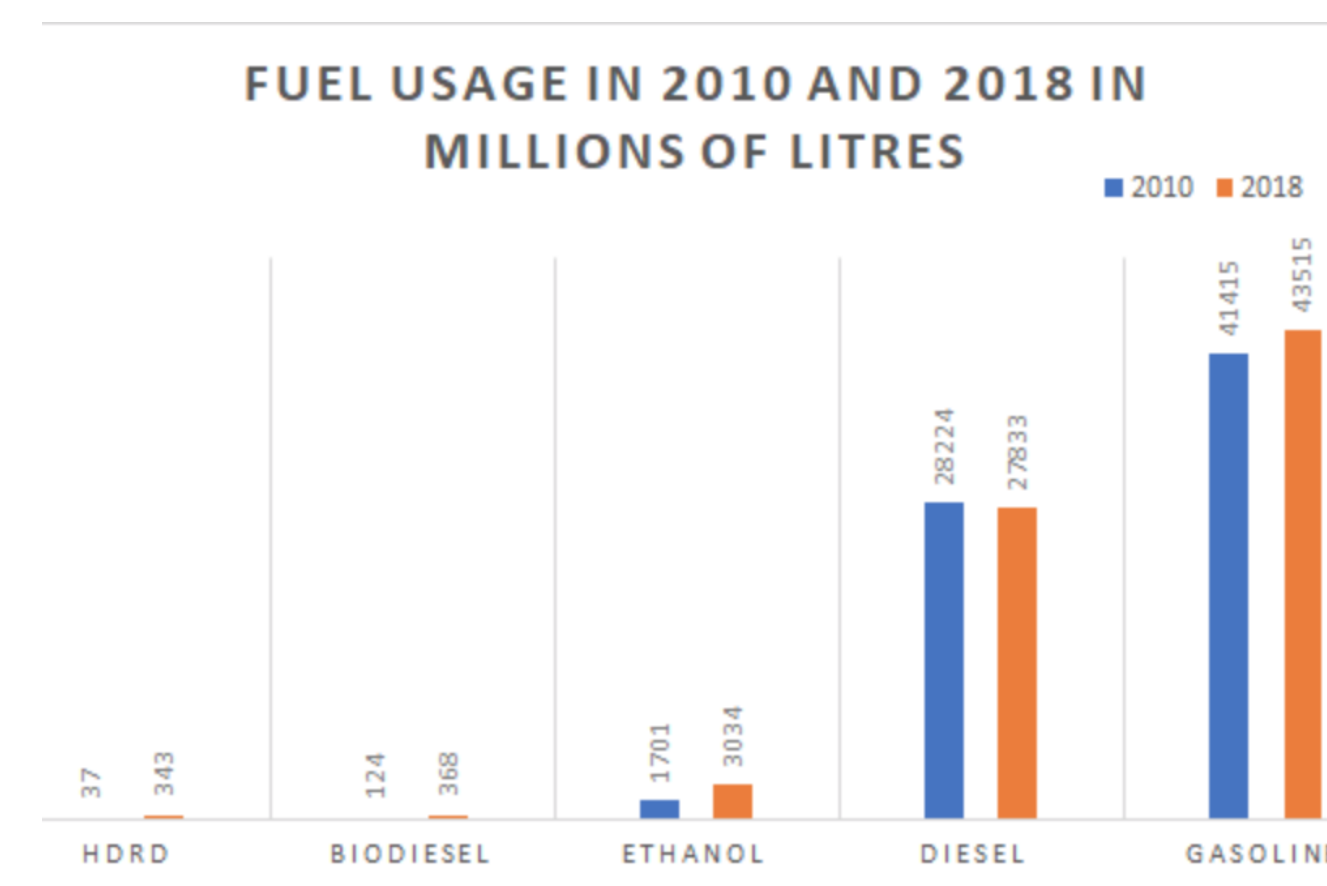
Biofuel is simply the use of biomass for energy generation. The most common type of biofuel is generated through a fermentation process of sugars to create ethanol. Since the feedstocks for biofuel are generally derived from edible crops such as corn and sugarcane, the production of biofuels has always been considered in relation to the effect on food prices and land usage. The damages and dangers posed by rapid anthropogenic climate change is encouraging shifts from petroleum based fuels to less carbon intensive alternatives. The new innovations have presented alternatives to traditional methods of biofuel generation. Biofuel has been produced using non-edible energy sources that offset concerns about rising food prices from implementation. Each technology has associated advantages but also importantly disadvantages. Biofuels as a renewable option must also compete with the production and distribution of fully electric and hydrogen based vehicles.

PROJECT GOALS/OBJECTIVES

- ▶ To compare and contrast different biofuel alternatives by their benefits.
- ▶ Investigate the applicability of these alternatives in Canadian society.
- ▶ Pursue possibilities of more sustainable and less environmentally harmful forms of fuel.
- ▶ The purpose of this project is to use the skills and knowledge acquired to analyse the situation from an engineering systems perspective. The objectives are to present the advantages and disadvantages of biofuel sources, to develop predictions of the fuel profile for Canada on the twenty to thirty year scale, to analyse the resulting economic effects for the gasoline and diesel consumer, to estimate the amount of greenhouse gas abatement for multiple implementation strategies and discuss the wider societal implications.

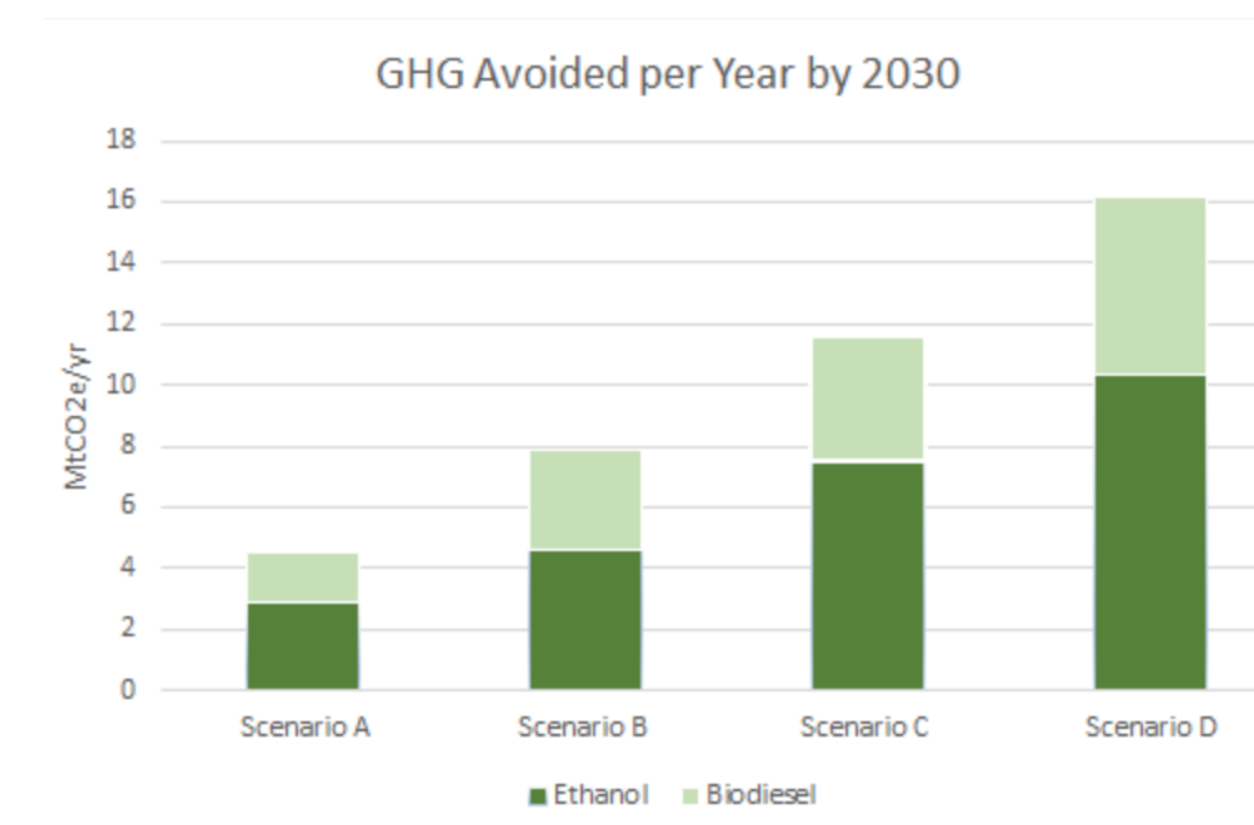


CURRENT STATE AND REGULATION



- ▶ Current Provincial and Federal Regulation of Fuel Mixing: This regulation mandates that 5% by volume of the gasoline pool must be composed of renewable fuel and 2% of the diesel pool. This regulation accounts solely for the average across the country such that regions which are over the compliance targets can compensate for regions which fail to meet the standard.
- ▶ Proposed Low Carbon Fuel Standard (LCFS): The LCFS is a proposed comprehensive regulation mandating a reduction in the carbon intensity of fuels used in Canada. Higher mixing of renewable fuel will be one method for manufacturers to meet compliance.

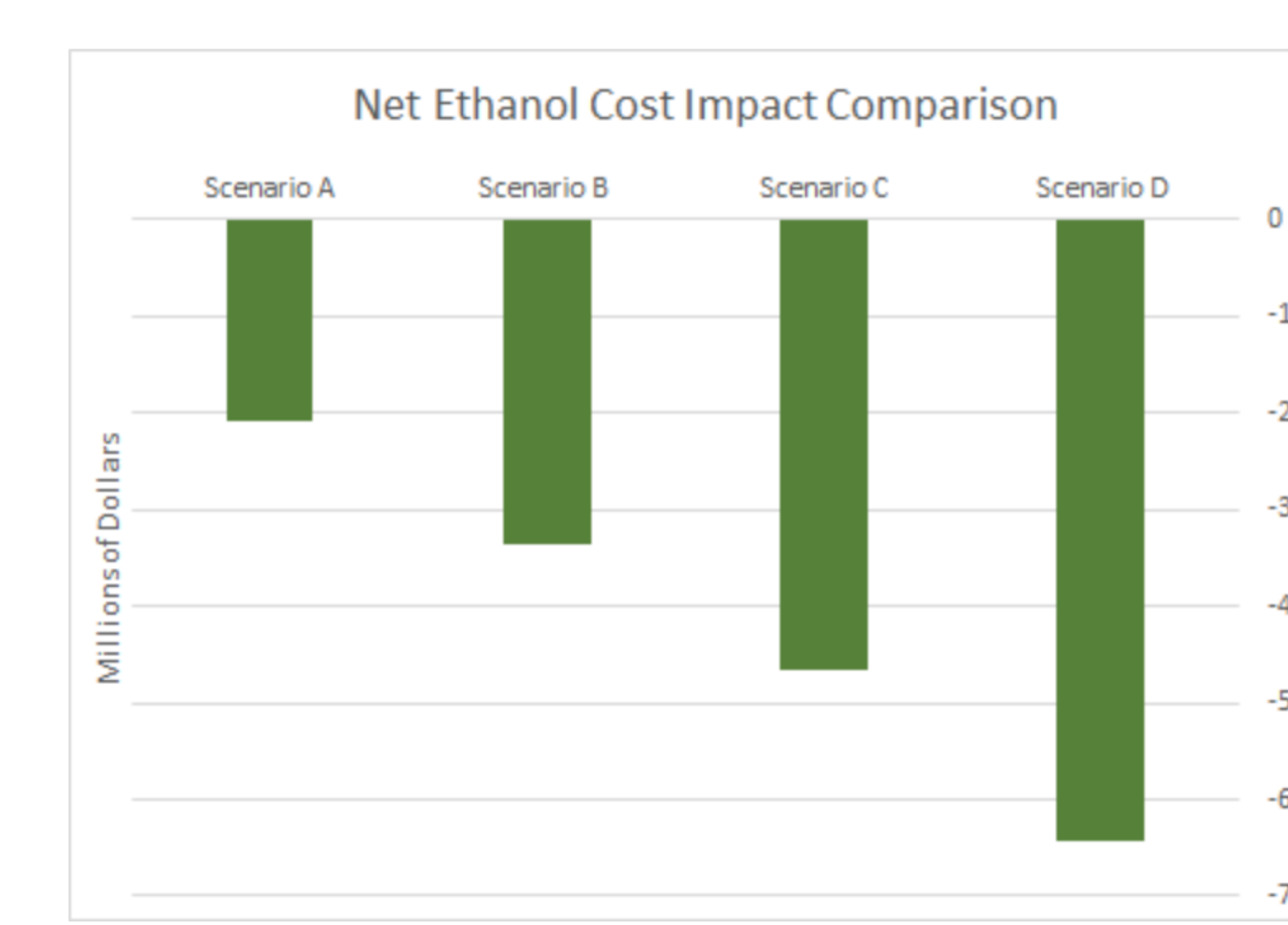
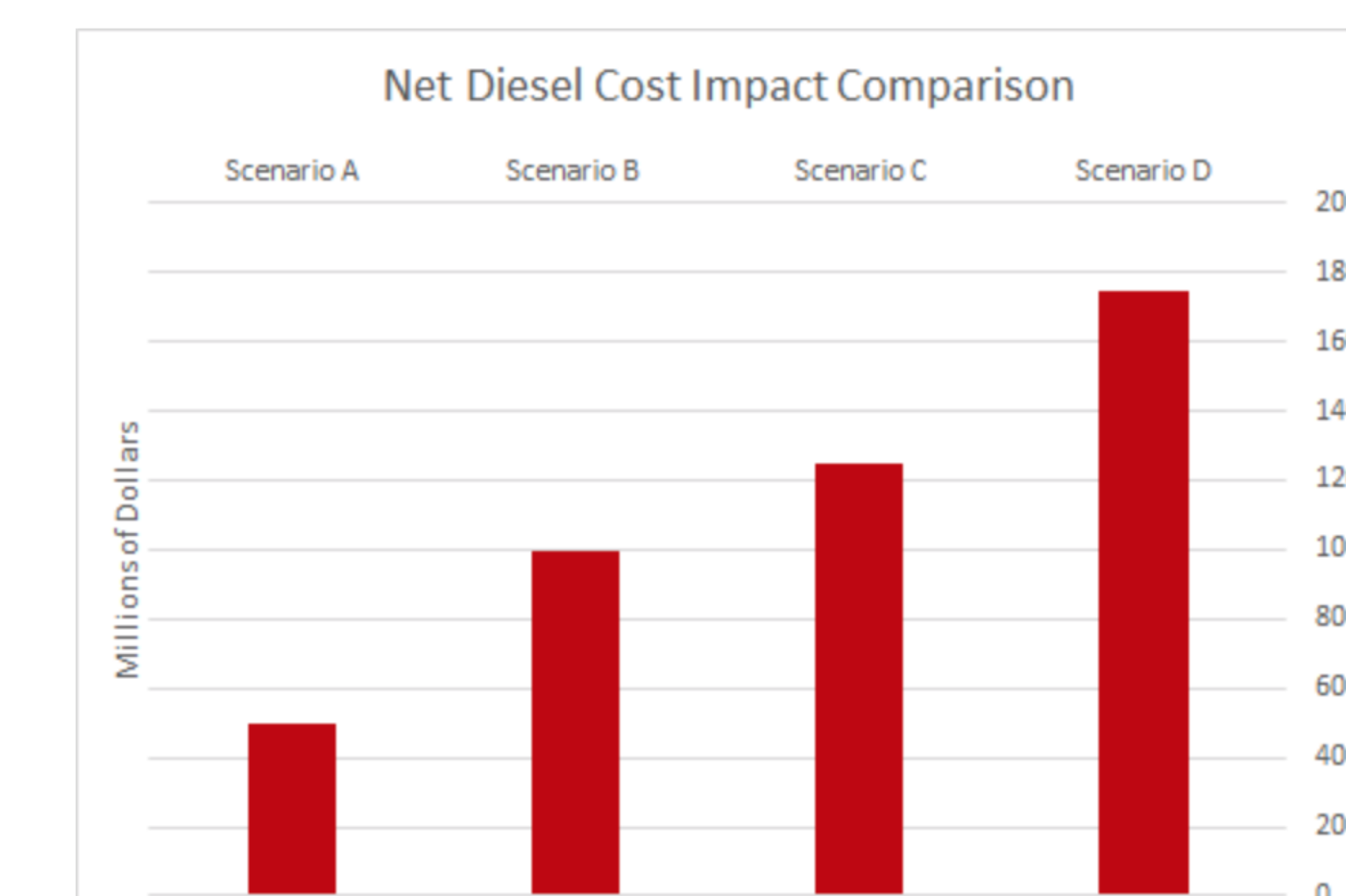
DATA / OBSERVATIONS



Scenario	GHG Avoided
A	4.48 MtCO ₂ e/year
B	7.86 MtCO ₂ e/year
C	11.6 MtCO ₂ e/year
D	16.2 MtCO ₂ e/year



According to the above table, we compared the GHG data of four different scenarios for finding a best mixing formula to implement. And we also compared the net cost impact for diesel and ethanol by four different scenarios.



IMPACTS

- ▶ Environmental Impacts: In order to determine the most environmentally friendly mix, we compared and discussed four scenario. (Scenario A - Baseline 5% gasoline pool, 2% diesel pool, Scenario B - 8% gasoline pool, 4% diesel pool, Scenario C - 11% gasoline pool, 5% diesel pool, and Scenario D - 15% gasoline pool, 7% diesel pool). We compare the advantages among different scenario through contrasting energy density, carbon intensity and GHG abatement in each scenario.
- ▶ Economic Impacts: The use of renewable fuel may alter the price for consumers due to three reasons. The first being that the price per volume between the biofuel and the petrol fuel may be different. The energy density of the renewable fuel is less than the petroleum based fuel that is being replaced. Second, the energy efficiency was considered to be equal. This means that a larger volume of ethanol will need to be consumed to travel an equivalent distance. The increase in volume will also have taxation effects on the consumer price. The final reason derives from the difference in fuel properties between biofuel and petroleum fuels.
- ▶ Societal Impacts: May cause competitive land and agricultural impact, biodiversity loss, degradation of forest resources, and threat to food security.

RESULT

Despite significant progress, Canada did not meet its clean fuel production capacity goals and fell behind the United States in the production/use of biofuels over the past 10-15 years. Renewable fuels, and other non-fossil low carbon liquid fuels, have proven to be very responsive to market-based and performance-based regulatory and policy signals. The proposed regulatory approach for the Clean Fuel Standard lacks a clear clean fuel demand signal. Provided changes are made to align the regulatory design with the goal to increase the production and use of non-fossil clean fuels in Canada, and fiscal policies and programs are established to attract private sector capital investment in Canadian assets, significant growth in the sector is predicted over the next decade.

REFERENCES

- ▶ Clean Fuels Investment in Canada, Advance biofuels Canada, November 2019.
- ▶ Biofuels in Canada 2020: Tracking biofuel consumption, feedstocks, avoided greenhouse gas emissions and fuel cost impacts, Michael Wolinetz, October, 2020.