CANADIAN ENERGY RESEARCH INSTITUTE

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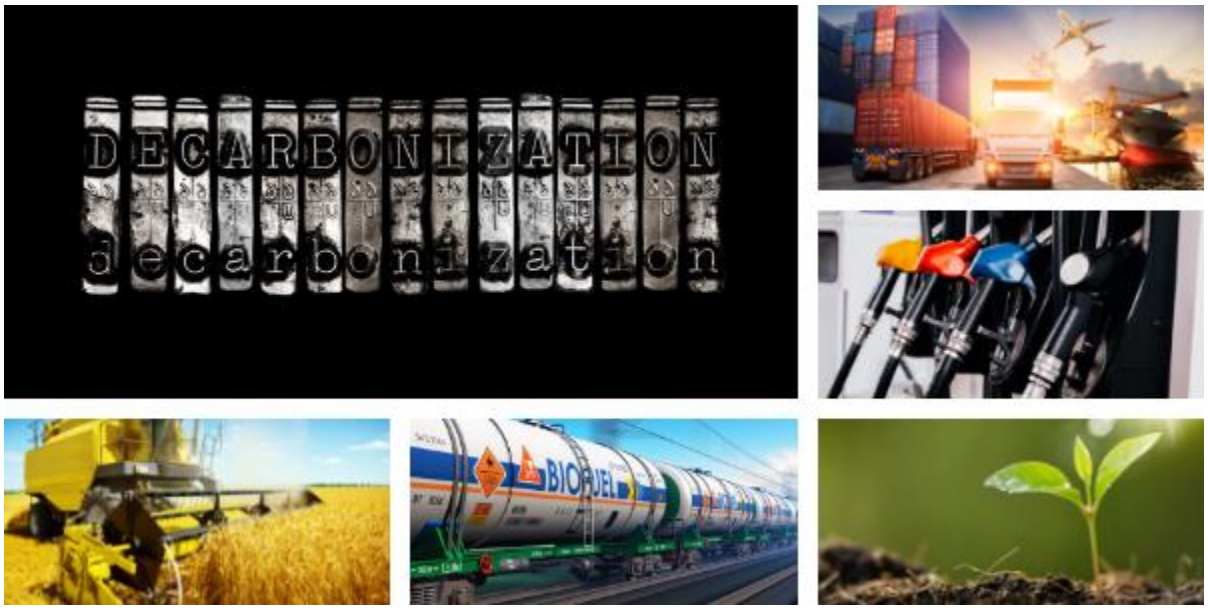
ECONOMIC AND EMISSIONS IMPACTS OF FUEL DECARBONIZATION



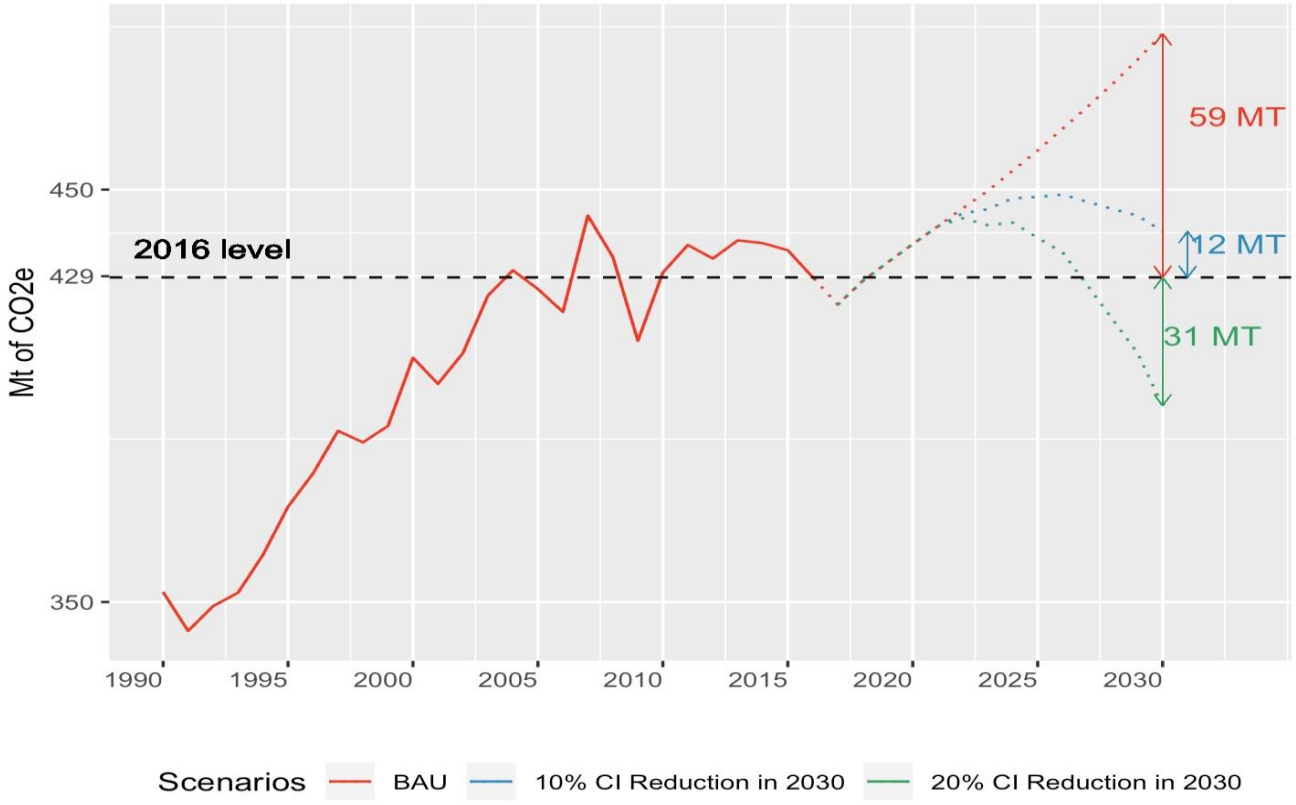
Executive Summary

Fuel decarbonization, also referred to as a low-carbon fuel standard, is a policy or regulation to reduce carbon-intensity (CI) usually in transportation fuels as compared to conventional petroleum fuels, such as gasoline and diesel. The most common low-carbon fuels are alternative fuels – which in the transportation sector include biofuels, propane, hydrogen, and electric vehicle charging and cleaner fossil fuels, such as natural gas. Traditionally, the main objective of fuel decarbonization is to decrease carbon dioxide emissions associated with vehicles powered by various types of internal combustion engines while considering the entire life cycle ("well to wheels") carbon footprint of transportation.

This project evaluates the potential greenhouse gas (GHG) emissions reduction of fuel decarbonization scenarios and their overall economic cost. The analysis takes into consideration the proposed Clean Fuel Standard of the federal government and explores two scenarios to reduce the carbon intensity of gaseous, liquid, and solid fuels against the Business as Usual (BAU) scenario. The study assesses how these three fuel types affect the industrial (including agriculture), transportation and building sectors.

Figure E.1 shows total emission reductions as compared to the 2016 emission level under alternative carbon intensity reduction scenarios. 2016 was chosen as it reflects the most recent year of detailed emissions data available. As shown in the Figure, scenarios that reduce carbon intensity by 10% will result in annual avoided emissions in the year 2030 of 47 million tonnes (MT) below Business as Usual but still 12 MT above the 2016 emission level. Under a 20% carbon intensity reduction scenario, emissions decrease by 31 MT below 2016 level. The largest emission reductions can be realized in the industrial and transportation sectors.

Figure E.1: Total Emissions – Canada (MT of CO2e)



Source: Historical data comes from Table 1 in Residential Sector, Table 1 in Commercial Sector, Table 3 in Industrial Sector, Table 2 in Agriculture sector, and Table 4 in Transportation Sector from the Comprehensive Energy Use Database from NRCan (2018a). The forecast is from CERI.

In 2030, the total cost impacts to the Canadian economy are estimated to be about $7.6 billion annually in a scenario with a 10% carbon intensity reduction and approximately $15 billion for a 20% carbon intensity as compared to the BAU with no carbon-intensity reduction. This is shown in Table E.1. The largest impact will be felt in industry, followed by transportation, buildings and agriculture (Figure E.2).

Carbon pricing stimulates market forces for finding the lowest-cost options to reduce emissions. Standards on fuels' carbon intensity are less flexible than carbon pricing and hence could be less cost-effective. The findings of this report show that the costs of fuel decarbonization would be between $163 (in the case of 10% CI reduction) and $170 (in the case of 20% CI reduction)[1] per tonne of GHG emissions, while federal carbon pricing reaches emission reductions by $50 per tonne. Although fuel standards are less cost-effective than carbon pricing, these standards are complimentary to carbon pricing to reduce emissions, since carbon pricing does not cover all sources of emissions, such as, for example, fugitive methane emissions.

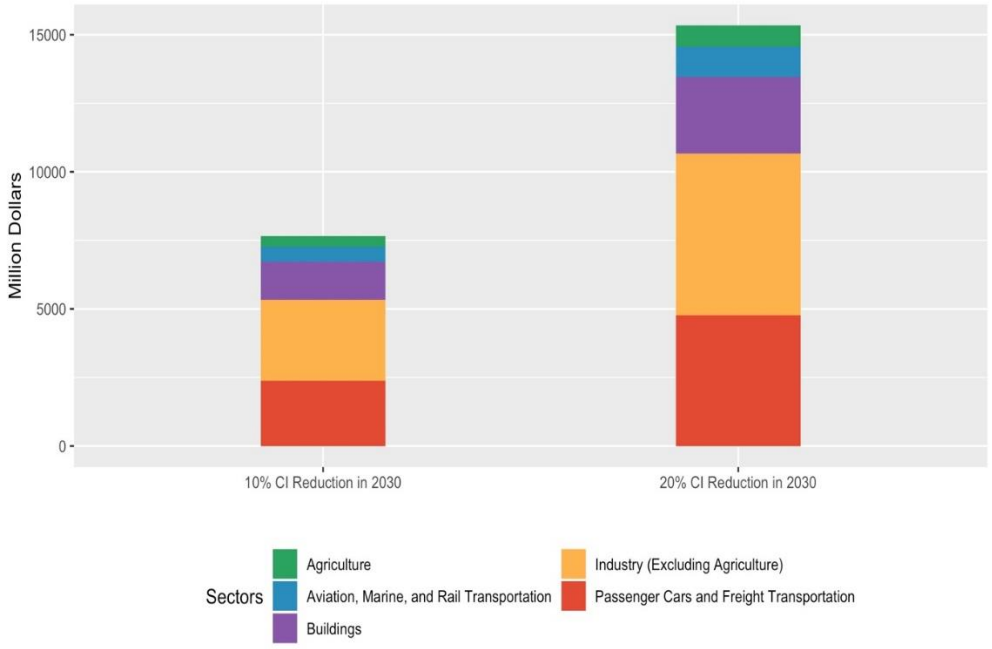
[1] The cost per tonne of GHG emissions is calculated by dividing the total cost of fuel decarbonization in each scenario by total emission reductions.

Table E.1: CFS Total Cost Impacts, $200 Credit Price

Carbon Intensity Reduction / Sector	Household (buildings)	Industry (including agriculture)	Passenger Cars and Light Trucks	Freight Trucks	Rail, Aviation, Marine	Total, Annually 2030 and After
	Additional Fuel Costs per Sector					
10% CI reduction	$42 per household or 2% increase in fuel cost	6% increase in fuel cost	$31 per vehicle or 1.4% increase in fuel cost	$150 per vehicle	-	-
20% CI reduction	$84 per household or 4% increase in fuel cost	13% increase in fuel cost	$62 per vehicle or 2.8% increase in fuel cost	$300 per vehicle	-	-
	Total Annual Cost Increase per Sector (million $CAD)					
10% CI reduction	$1,395	$3,322	$1,149	$1,237	$553	$7,656
20% CI reduction	$2,791	$6,645	$2,299	$2,475	$1,109	$15,319

Source: CERI

Figure E.2: Fuel Decarbonization Total Cost Impacts



Source: CERI

Retail prices for diesel and gasoline by 2030 with a maximum $200 credit price are expected to be between 5-6 cents per litre with 10% CI reduction target, and 10-11 cents with 20% CI reduction.

A $200 credit price will bring additional costs ranging from $0.94 per GJ (10% CI reduction) to $1.88 per GJ (20% CI reduction) in 2030 for gaseous fuels, which include natural gas, landfill and waste gases, still gas,[2] and coke oven gas. The largest impact is to be expected in the industry and building sectors. Natural gas is a large source of energy for buildings (46% of total consumption in 2016) and industry (40% of total consumption in 2016) with substantial existing supply infrastructure and limited opportunities to switch fuel without additional investments.

The impact on solids is expected to be the most significant as the starting intensities are higher relative to other fuels and the reduction is steeper in absolute terms. A $200 credit price will bring additional costs ranging from $1.76 per GJ (10% CI reduction) to $3.51 per GJ (20% CI reduction) in 2030. The fuels included here are coal, petroleum coke, and biomass. Solids play a significant role in steel manufacturing (47% of total solids consumption in the economy), electricity generation (41%), and cement manufacturing (4%).[3]

[2] Any form or mixture of gases produced in refineries by distillation, cracking, reforming, and other processes.
[3] Only domestic consumption is used. Exports are not included.