



## Low-Carbon Fuel Standards: Driving in the Wrong Direction

By  
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- Many Canadian provinces are considering a low-carbon fuel standard (LCFS). An LCFS would require transportation fuel providers to distribute a mix of fuel that, on average, emitted a declining amount of greenhouse gas emissions per unit of energy produced, measured on a lifecycle basis.
- An LCFS has numerous problems: administrative complexity, scientific uncertainty – owing to the difficulty of measuring all emissions from fuel consumption and production, and the possibility that there will be little net reduction in total emissions.
- An economy-wide cap-and-trade system would be more economically efficient and more certain to reduce greenhouse gas emissions.

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Transportation is a major contributor to Canada's greenhouse gas (GHG) emissions, accounting for 26 percent of the total.<sup>1</sup> A number of technologically feasible low-carbon fuels exist that could reduce these emissions. The leading candidates are electricity, hydrogen, and biofuels, although there is uncertainty about the future market shares of these fuels and about what other technologies will emerge.

One policy tool that has been suggested for increasing the market share of low-carbon fuels, without regulating what specific types of fuels should meet reduction targets, is a low-carbon fuel standard (LCFS).<sup>2</sup> Under an LCFS, fuel suppliers – refiners, importers, and blenders of passenger vehicle fuels – would be required to ensure that the mix of fuel they sell has a maximum GHG emissions content, measured in CO<sub>2</sub>-equivalent grams per gigajoule (GJ), that is based on all emissions from resource extraction, refining, transportation to market, and, ultimately, consumption. The maximum allowable emissions content would be reduced over time to encourage producers continually to reduce the GHG intensity of fuels they sell. Suppliers that reduced the average carbon content of the fuels they sell below the standard would receive credits that they could sell to other suppliers.

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- 1 Transportation's contribution ranges from a high of 41 percent in Quebec to a low of 15 percent in Alberta (Canada 2008). In 2007, gasoline and diesel powered 87.3 percent and 12.3 percent, respectively, of kilometres travelled by fuelled vehicles (Cansim Table 405-0066).
- 2 In British Columbia, such a plan is referred to as a low-carbon fuel regulation.

An LCFS is, however, a complex means of reducing GHGs, given the uncertainties about lifecycle emissions associated with fuel production and consumption and the lack of good information with which to resolve these uncertainties. Further, such a regulation, which would apply only to a single sector of the economy and would simply regulate emissions intensity, as opposed to total emissions, might not be effective in curbing total emissions of GHGs.

## How an LCFS Would Work

One goal of an LCFS would be to reduce the GHG emissions intensity of passenger vehicle fuels by at least 10 percent by 2020. One pioneer in this regard is California, which, in January 2007, established an LCFS for transportation fuels sold in that state (California 2007b). Since that time, Ontario has signed a memorandum of understanding with California to implement a similar LCFS program (California 2007a), while 11 other US states, as well as the European Union and British Columbia, have adopted LCFS policies.<sup>3</sup>

One way of comparing the GHG intensity of different fuels is to look at the GHGs each type of fuel emits per kilometre of travel. If one uses as a baseline the total lifecycle emissions of gasoline produced from conventional oil (the top horizontal line in Figure 1) and fuel providers had to meet a 10 percent lower average emissions content (the lower dashed line), they would need to reduce their reliance on gasoline and sell more of their energy product in the form of, for example, biodiesel or electricity from low-GHG-emitting power plants.

Thus, an LCFS would create a larger, mandated demand for fuels with GHG content below a given level of GHG intensity while increasing the relative cost of fuels with GHG content above the benchmark, including gasoline and some types of ethanol. Fuel suppliers would have to charge higher prices for the higher-carbon fuels, while suppliers of low-carbon fuels would be able to charge a lower price than they otherwise would have – thus creating a larger market for their products – to meet the overall GHG emissions intensity standard.

One concern with such a policy, however, is that producers and consumers of alternative low-carbon fuels such as biofuels, electricity, natural gas, and propane tend to be more sensitive to price changes than are producers and consumers of gasoline (Holland, Knittel, and Hughes 2009). If the LCFS did not cover all petroleum products and geographic markets, incentives for other consumers to switch to more GHG-intensive fuels could offset fully the reduced emissions in the transportation sector. For example, if more drivers used natural gas instead of gasoline, it would drive up the price of natural gas in the entire economy, encouraging consumers of natural gas in regions or sectors not covered by the LCFS to search for substitutes, including coal and gasoline, which could lead to higher overall emissions elsewhere (Holland, Knittel, and Hughes 2009). Likewise, a regulation that did not cover all provinces could lead producers to sell their most GHG-intensive fuel products in non-complying jurisdictions.

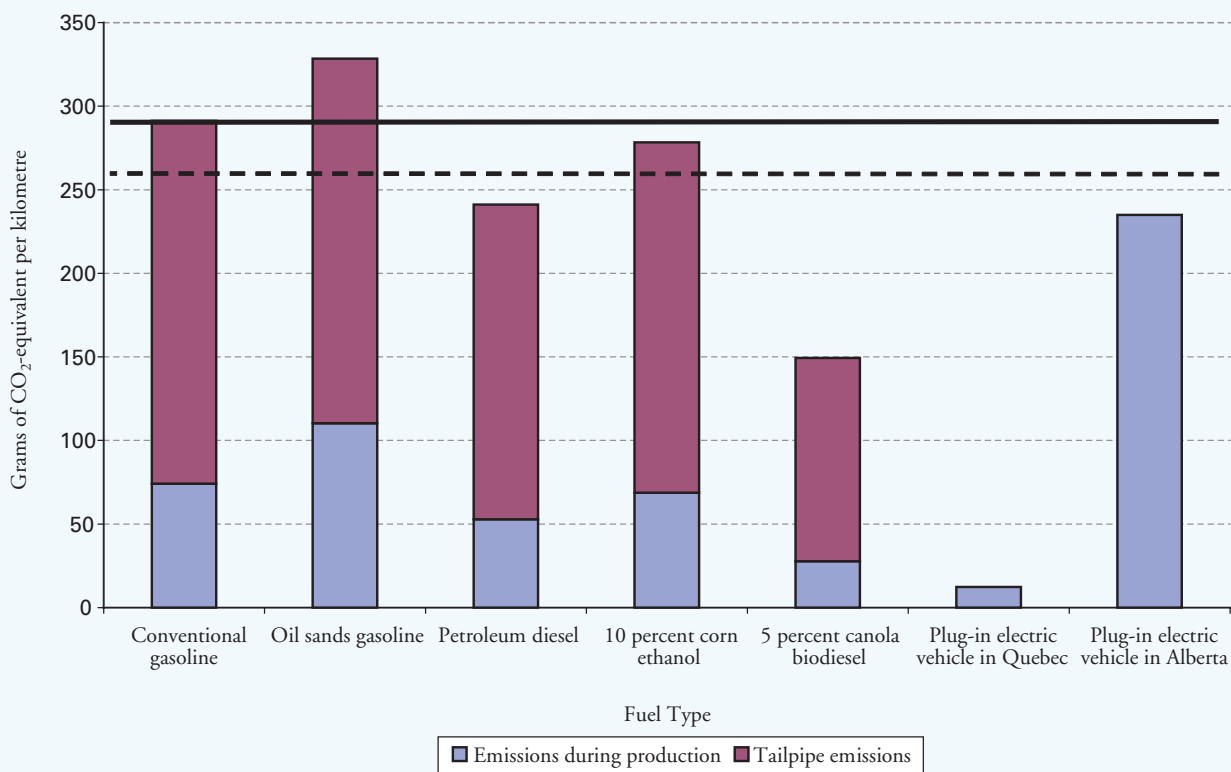
## Implementation Problems

Several problems are inherent in the implementation of an LCFS. One is how to determine conclusively the total amount of emissions created during the production of a fuel – this cannot be done simply by burning the fuel in a test facility, for example. As another example, in determining the relative carbon intensity of ethanol and gasoline, scientifically defensible differences in modelling assumptions of the effect of land use change and the emission reductions credited to co-products<sup>4</sup> can yield sizable differences in emissions estimates for each stage of the full fuel cycle (Pimentel and Patzek 2005, 2007; Plevin and Mueller 2008; Farrel et al. 2006). Moreover, estimates of baseline carbon emissions of

3 See “Eleven states plan Low Carbon Fuel Standard,” Canadian Driver, January 6, 2009; available at website: <http://www.canadiandriver.com/2009/01/06/eleven-states-plan-low-carbon-fuel-standard.htm>. An LCFS has also been a component of eight US federal climate policy bills, but none was passed (Yacobucci 2008).

4 Co-products are items produced during the ethanol production process that have a market value and that displace competing products that require energy (and produce emissions).

Figure 1: Estimated Lifecycle Greenhouse Gas Emissions per kilometre by Type of Fuel, 2008



Note: Emissions from biofuels during production includes CO<sub>2</sub> sequestration.

Source: Author's calculations from GHGenius, version 3.14b, tables 57a-c.

fuel must also take into account regulations – such as renewable fuel and electricity standards – that already exist but that are not yet binding and whether simply complying with them would be sufficient to meet the new standard.

Another problem arises with respect to hybrid-electric or plug-in hybrid vehicles. Because the emissions intensity of electricity consumed at a given location depends on the type of power plant and can vary dramatically by time of day,<sup>5</sup> regulators would have to determine the specific times at which people recharge their vehicles at millions of possible charge points. In this sense, plug-in hybrids, if they are the future of transportation, would present a daunting challenge for LCFS regulators.

A further issue is that, since diesel-powered vehicles are more efficient than gasoline vehicles, lower CO<sub>2</sub>-equivalent emissions result when consumers switch from gasoline to diesel (United States 2005),<sup>6</sup> but only if the switch is measured from “well-to-wheel” rather than “well-to-tank,” since it is the vehicle, not the fuel, that reduces emissions intensity (General Motors Corporation et al. 2001). Hence, translating these savings into LCFS credits and determining whether to allocate these credits to vehicle manufacturers or other parties would be administratively challenging.

5 For example, power consumed in Ontario might be produced from clean hydro in Quebec at night but from coal in the United States during the daytime.

6 British Columbia's low-carbon fuel regulation will be calculated based on the pooled amount of energy from all fuel types that a fuel provider sells, which should encourage consumers to switch to diesel. California has set separate standards for emissions reductions for diesel and gasoline of 71 grams and 92 grams of CO<sub>2</sub>-equivalent, respectively; moreover, sellers must meet the emissions reduction goals for these fuels separately, meaning that gasoline sellers cannot receive credits from selling diesel in place of gasoline (Ontario 2008).

Finally, when an LCFS is integrated with a cap-and-trade system, firms in the rest of the economy can find ways to offset or find cheaper emissions reductions, but the transportation firms cannot seek reductions outside the transportation sector. So an LCFS would increase compliance costs if lower-cost carbon reductions are available outside the transportation sector. Yet, one tonne of CO<sub>2</sub>-equivalent GHG emissions causes the same environmental damage regardless of its source. This logic implies that the price of one tonne of CO<sub>2</sub>-equivalent GHG emissions should be the same for all fuels. This could be achieved by setting an overall cap on all GHG emissions. Once in place, suppliers would then pass on the cost of meeting this overall GHG emissions cap to consumers and trade credits for exceeding targets, thus ensuring that total emissions were reduced.

## Conclusion

Imposing a single-sector, carbon-intensity-based regulation such as an LCFS is less likely to reduce total GHG emissions than would a comprehensive cap-and-trade system. Furthermore, an LCFS would face implementation challenges – with respect to emissions calculations and technology-specific difficulties, for example – that a cap-and-trade system would avoid. Policymakers thus should focus on broader carbon-pricing tools.

## References

- California. 2007a. Office of the Governor. "Governor Schwarzenegger joins Ontario premier McGuinty in signing pact to fight greenhouse gases." Press Release. Sacramento, May 30. Available at website: <http://gov.ca.gov/press-release/6476>.
- . 2007b. Office of the Governor. "Gov. Schwarzenegger signs executive order establishing world's first low carbon standard for transportation fuel." Press Release. Sacramento, January 18. Available at website: <http://gov.ca.gov/index.php?/press-release/5174>.
- Canada. 2008. "National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990-2006." The Canadian Government's Submission to the United Nations Framework Convention on Climate Change. Ottawa: Her Majesty the Queen in Right of Canada, represented by the Minister of the Environment. May.
- Farrell, Alexander E., Richard J. Plevin, Brian T. Turner, Andrew D. Jones, Michael O'Hare, and Daniel M. Kammen. 2006. "Ethanol Can Contribute to Energy and Environmental Goals." *Science* 311 (5760): 506-08.
- General Motors Corporation, Argonne National Laboratory, British Petroleum, Exxon/Mobil, and Shell. 2001. "Well-to-Wheel Energy Use and Greenhouse Gas Emissions of Advanced Fuel/Vehicle Systems – North American Analysis." Detroit: General Motors Corporation. Available at website: [http://www.fischer-tropsch.org/DOE/DOE\\_reports/10556/ANL-ES-RP-10556,%2008-23-01.pdf](http://www.fischer-tropsch.org/DOE/DOE_reports/10556/ANL-ES-RP-10556,%2008-23-01.pdf).
- Holland, Stephen P., Christopher R. Knittel, and Jonathan E. Hughes 2009. "Greenhouse Gas Reductions under Low Carbon Fuel Standards?" *American Economic Journal: Economic Policy* 1 (1): 106-46.
- Ontario. 2008. Ministry of Energy. "Low Carbon Fuel Standards." Discussion Paper. Toronto. May.
- Pimentel, David, and Ted Patzek. 2005. "Ethanol Production Using Corn, Switchgrass and Wood: Biodiesel Production Using Soybean and Sunflower." *Natural Resources Research* 14 (1): 65-76.
- . 2007. "Ethanol Production: Energy and Economic Issues Related to U.S. and Brazilian Sugarcane." *Natural Resources Research* 16 (3): 235-42.
- Plevin, Richard J., and Steffen Mueller. 2008. "The effect of CO<sub>2</sub> regulations on the cost of corn ethanol production." *Environmental Research Letters* 3 (024003): 1-9.
- United States. 2005. Environmental Protection Agency. Office of Transportation and Air Quality. "Emission Facts." EPA420-F-05-001. Washington, DC. Available at website: <http://www.epa.gov/otaq/climate/420f05001.pdf>.
- Yacobucci, Brent D. 2008. "A Low Carbon Fuel Standard: State and Federal Legislation and Regulations." Washington, DC: Congressional Research Service.

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