

Issue Paper  
August, 2008

Issue: Low Carbon Fuel Standards (LCFS)

Increasingly, individual states are beginning to adopt strategies for reducing greenhouse gas (GHG) emissions. As they look to develop a comprehensive climate strategy that addresses all emissions sources, the transportation sector has proved to be one of the most difficult. Transportation fuels are particularly challenging because limited substitutes currently exist. To that extent, the Low-Carbon Fuel Standard (LCFS) has rapidly emerged as a policy option states are considering for achieving GHG reductions in the transportation fuel supply. Proponents also believe an LCFS could stimulate improvement and innovation in transportation fuels. Others disagree with the view that an LCFS is a good mechanism for stimulating innovation. This backgrounder discusses the features, positive and negative of a Low Carbon Fuel Standard.

Background:

- An LCFS for transportation fuels is a policy to encourage the utilization of low carbon fuels (measured on a full life-cycle basis) to reduce GHG emissions from the transportation sector. An LCFS limits carbon emissions per unit of output, theoretically allowing fuel producers to achieve a given carbon emissions rate by flexibly altering their production of fuels.<sup>1</sup> In the near term, based on current technology, increased blending of biofuels is the likely way that fuel providers will attempt to comply with an LCFS.
- Senators John McCain and Barack Obama have both called for a national Low Carbon Fuel Standard.<sup>2</sup>
- Other countries, states, and regions also have proposed Low Carbon Fuel Standards; California is currently designing an LCFS for automotive fuels.<sup>3</sup>

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<sup>1</sup> There is much ambiguity in the design of an LCFS, including: what output is covered (e.g., light duty v. heavy duty vehicle fuel), how output is measured (energy v. miles), and how emissions rates are measured (e.g., upstream, downstream). These policy design issues are currently being debated for the California LCFS.

<sup>2</sup> Similarly, US Senators Dianne Feinstein (D-CA), Susan Collins and Olympia Snowe (both R-ME) have introduced a measure (S.1073) designed to reduce carbon emissions, which requires an increase in the percentage of alternative fuels.

<sup>3</sup> A current count includes: British Columbia, Washington, Oregon, Arizona, New Mexico, Minnesota, Illinois, the United Kingdom and the European Union.

- GHG emissions reductions from transportation must, generally, come in one of three ways: (1) reduce fuel consumption through more efficient vehicles or through reduction in vehicle miles traveled (e.g., mass transit, carpooling, etc.); (2) reduce the carbon content of transportation fuels through the blending of lower- carbon fuels into conventional fuels; (3) switch from conventional fuels to alternatives with lower lifecycle emissions.
- The federal Corporate Average Fuel Economy (CAFÉ) standards, as amended by EISA, require increasing fuel economy for new passenger cars and light trucks.<sup>4</sup>
- The political appeal of Low Carbon Fuel Standards has several components. First, the absence of federal regulation of GHG emissions has limited states' options. In particular, the options for addressing carbon emissions from the transportation sector, which accounts for 28 percent of U.S. emissions (U.S. EPA 2006), are severely limited.<sup>5</sup>
- Second, a carbon tax or increase in the gas tax has proven politically infeasible. An LCFS is not a tax.
- Third, cap and trade policies, which are more politically palatable, may be undermined by demand shocks. For example, the RECLAIM emissions market was almost destroyed by the California electricity crisis since it was argued that the rigid emissions limits contributed to electricity blackouts.<sup>6</sup> An LCFS, by regulating emissions rates rather than emissions, allows for higher emissions in years with higher demand.
- Despite this political appeal, critics of an LCFS argue that the standards have a cost in terms of efficiency and effectiveness. In particular, an LCFS can achieve the first best outcome only if the low-carbon fuel has no emissions. Moreover, contrary to the stated purpose, an LCFS can actually *raise* carbon emissions.

## How does an LCFS Work?

- California is considering having their Low Carbon Fuel Standard apply to providers of liquid and non-liquid fuels used for transportation purposes produced or imported into California.

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<sup>4</sup> Congressional Research Service , Report RL33413, *Automobile and Light Truck Fuel Economy: The CAFÉ Standards*, by Brent D. Yocobucci and Robert Bamberger.<sup>4</sup>

<sup>5</sup>The Clean Air Act of 1970 stipulates that only the Environmental Protection Agency (EPA) is allowed to regulate fuel economy. California AB 1493, which caps greenhouse gas emissions from vehicles, is currently being challenged in the courts.

- These include “conventional fuels” such as RFG (“gasoline”) and ULSD (“diesel”), compressed or liquefied natural gas (“natural gas”), liquefied propane gas (“propane”), electricity, compressed or liquefied hydrogen (“hydrogen”), ethanol blends greater than 10 percent by volume ethanol including E85, denatured neat ethanol (“ethanol”), neat biodiesel/biomass-based diesel (“biodiesel/biomass-based diesel”), and blends containing up to 20 percent by volume biodiesel/biomass based diesel including B5 and B20.”
- The United Kingdom is implementing a renewable fuel program that includes GHG emission tracking beginning in this year.
  - The UK Renewable Transport Fuel Obligation Programme (RTFO) requires fossil transport fuel suppliers, as of April 2008, to ensure that biofuels constitute 2.5% of total road transport fuels in 2008-09, 3.75% in 2009-10, and 5% in 2010-11 and beyond (Department for Transport 2006).
  - British Prime Minister Gordon Brown has called on European Union countries to reevaluate biofuel mandates in light of increasing food prices.

#### Policy Implications:

The introduction of new fuels will affect the physical and human environment in many ways. The reality is that all forms of energy have downsides. If developed on a large scale, biofuels are likely to have substantial economic, social, and environmental impacts, which may vary substantially among feedstock and production processes. However, they involve a wide range of factors and pose a number of different policy challenges.

As California finishes designing and implementing an LCFS, it is important to understand the effect this policy may have and how the implementation of it in Minnesota would have different impacts.

#### Impacts on Minnesota Transportation Fuel Supply and Prices

- Adoption of a California-style LCFS would discourage the use of Canadian crude oil, which would hurt Minnesota’s economy and potentially increase gas prices.
  - California is considering having an LCFS take into account the full life cycle emissions of transportation fuels, which includes emissions from crude oil production.
  - Currently, more energy is used in recovering oil sands crude than is used in recovering light, sweet crude oil. Therefore, recovery of oil sands crude generates more greenhouse gas emissions than

- conventional drilling, resulting in higher life cycle emissions for transportation fuels made from oil sands crude.
  - Oil sands projects have reduced their carbon dioxide emissions intensity by up to 45 per cent since 1990 and are working towards further reductions.
  - In 2007, Alberta became the first in North America to legislate greenhouse gas reductions on large industrial facilities such as those found in the oil sands.
  - In the first year, companies made 2.6 million tons of actual reductions, the equivalent to taking 550,000 cars off the road.
- Canadian crude is the predominant source of crude oil for Minnesota and the Midwest and an important part of the region's economic growth. It is Minnesota and the Midwest's solution to energy security and independence from crude oil from unstable, foreign countries.
  - According to the Minnesota Department of Commerce, Canada supplies approximately 80 percent of the crude oil used in Minnesota.
- Disrupting or discouraging crude oil supplies from the Canadian oil sands could have negative regional economic impacts and negatively impact global GHG emissions.
  - An LCFS would likely interfere with existing trade patterns that seek to minimize costs and force higher costs by diverting crude oil from their natural markets.
  - Discouraging Canadian crude oil supplies will force higher reliance on imports from places like the Middle East and have perverse impacts on global GHG emissions by forcing inefficient transportation of crude oil since the U.S. Midwest is the natural and most efficient transportation destination for Canadian crude oil.
  - Inefficient transportation will increase associated crude oil transportation GHG emissions by unnecessarily forcing crude oil supplies to alternative locations. (i.e. – Canadian crude oil to China/Middle East crude to U.S. Midwest).

### Impacts to Land Use and Food Prices

- As mentioned above, increased biofuel blending is the likely means fuel providers will employ to comply with an LCFS in the short term. The sustainability issues associated with biofuels, in addition to degraded air and water quality, might include increased soil erosion, loss of biodiversity, use of genetically modified organisms, loss of wilderness and natural habitats, increased concentration of land holdings and land appropriation, and increases in food prices.

- Many of these issues are also associated with other fuels, such as electricity or hydrogen, depending on energy resources and conversion technologies. These are very important issues today and will persist as important issues into the foreseeable future.
- The impact of nitrous oxide emissions from the application of nitrogen fertilizer needs to be examined because it is a potential source of greenhouse gas emissions.
- Conversion from food crops to biofuel crops can raise food prices.
- Increased biofuel production can lead to a consolidation of land holdings which could affect small land owners with little political power.
- Biodiversity loss, soil erosion, and runoff of nutrients and pesticide.
- The California LCFS is recommending that a reporting requirement for sustainability impacts be imposed on fuel providers.
  - This reporting includes the impacts of biofuels production in California, as well as impacts throughout the US and globally.
  - The global scale of the assessment is recommended since the global market for biofuels is affected by increased biofuel consumption in California, regardless of where the biofuel is produced. This would be true in Minnesota as well.
  - The assessment should include direct and indirect impacts, taking into account the indirect impacts agriculture-based industry can have.
  - If negative impacts of the LCFS are identified in the assessment, California will have to take action to mitigate these impacts through means such as best management practices, incentives, regulation, and sustainability metrics.
  - This “reporting requirement” will impact the price of gasoline.

#### Conclusions and Recommendations:

While California is required to implement an LCFS by Executive Order, the state is still looking at how to structure an LCFS. A final standard has not been adopted. California is struggling with a number of issues including impacts on sources of crude oil, as well as whether land use impacts from increased biofuels would actually increase overall GHG emissions relative to gasoline and diesel fuel.

Other issues that need to be looked at include impact of an LCFS on the food supply, water supply, impact on other emissions like nitrogen oxides and volatile organic compounds, technical feasibility, timeframe for implementation and cost to consumers.

Even if an LCFS is ultimately finalized and adopted in California, that standard may not be an effective policy for Minnesota or other states based on differences in sources of crude oil, biofuel feedstocks, other fuel regulations, and the role of transportation in overall GHG emissions. Minnesota policymakers need to be careful not to blindly adopt a standard developed for California in light of the differences between the two states fuel markets. A careful analysis of issues unique to Minnesota will be required when evaluating the effectiveness of a Low Carbon Fuel Standard.

## Appendices

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Scientists Across the Nation Counsel California to Regulate Low Carbon Fuel Standard... add letter from scientists about better land and biofuel impact research.

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CRS Report for Congress, Climate Change: Costs and Benefits of S.2191, May 15, 2008 by Larry Parker and Brent Yacobucci, Specialists in Energy and Environmental Policy, Resource, Science and Industry Division

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Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel **EPA420-F-05-001 February 2005**

*The U.S. Environmental Protection Agency (EPA) developed this series of four fact sheets to facilitate consistency of assumptions and practices in the calculation of emissions of greenhouse gases from transportation and mobile sources. They are intended as a reference for anyone estimating emissions benefits of mobile sources air pollution control programs.*

## Carbon Content in Motor Vehicle Fuels

One of the primary determinants of carbon dioxide (CO<sub>2</sub>) emission from mobile sources is the amount of carbon in the fuel. Carbon content varies, but typically we use average carbon content values to estimate CO<sub>2</sub> emissions.

The Code of Federal Regulations (40 CFR 600.113) provides values for carbon content per gallon of gasoline and diesel fuel which EPA uses in calculating the fuel economy of vehicles:

Gasoline carbon content per gallon: 2,421 grams

Diesel carbon content per gallon: 2,778 grams

Note that for the ["Inventory of U.S. Greenhouse Gas Emissions and Sinks,"](#) EPA estimates CO<sub>2</sub> emissions from fuel from the heat content of the fuel and carbon content coefficients in terms of carbon content per quadrillion BTU (QBTU), using data from the Energy Information Administration (EIA). EIA's numbers are derived from carbon content by mass, and equate to roughly the same carbon content per gallon of fuel as the values provided in 40 CFR 600.113. EPA uses heat content data from Energy Information Administration's (EIA) ["Annual Energy Outlook 2003"](#) EXIT Disclaimer and carbon content from EIA's ["Emissions of Greenhouse Gases in the United States, 2000."](#) EXIT Disclaimer

Note also that these estimates are based only on an average carbon content of conventional gasoline and diesel fuel, and do not specifically address the impact of fuel additives such as ethanol or methyl tertiary butyl ether (MTBE) that may depend on the feedstock.

## Calculating CO<sub>2</sub> emissions

The [Intergovernmental Panel on Climate Change](#) (IPCC) EXIT Disclaimer guidelines for calculating emissions inventories require that an oxidation factor be applied to the carbon content to account for a small portion of the fuel that is not oxidized into CO<sub>2</sub>. For all oil and oil products, the oxidation factor used is 0.99 (99 percent of the carbon in the fuel is eventually oxidized, while 1 percent remains un-oxidized.)[\[1.\]](#)

Finally, to calculate the CO<sub>2</sub> emissions from a gallon of fuel, the carbon emissions are multiplied by the ratio of the molecular weight of CO<sub>2</sub> (m.w. 44) to the molecular weight of carbon (m.w.12): 44/12.

CO<sub>2</sub> emissions from a gallon of gasoline = 2,421 grams x 0.99 x (44/12) = 8,788 grams = 8.8 kg/gallon = 19.4 pounds/gallon

CO<sub>2</sub> emissions from a gallon of diesel = 2,778 grams x 0.99 x (44/12) = 10,084 grams = 10.1 kg/gallon = 22.2 pounds/gallon

*Note: These calculations and the supporting data have associated variation and uncertainty. EPA may use other values in certain circumstances, and in some cases it may be appropriate to use a range of values.*

### **For More Information**

You can access documents on greenhouse gas emissions on the Office of Transportation and Air Quality Web site at:

[www.epa.gov/otaq/greenhousegases.htm](http://www.epa.gov/otaq/greenhousegases.htm)

For additional information on calculating emissions of greenhouse gases, please contact Ed Coe at:

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[1.] *Based on emissions data, EPA's Office of Transportation and Air Quality (OTAQ) is currently examining whether this fraction is higher (closer to 100 percent) for gasoline.*