ATA
Driving Trucking's Success

American Trucking Associations
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April 22, 2009

Clerk of the Board
California Air Resources Board
1001 I Street
Sacramento, California 95814

Via: http://www.arb.ca.gov/lispub/comm/bclist.php

Re: Proposed Regulation to Implement the Low Carbon Fuel Standard

Dear Chairman Nichols and Members of the Board:

The American Trucking Associations, Inc.[1] ("ATA") submits these comments in response to the California Air Resources Board ("CARB") *Proposed Regulation to Implement the Low Carbon Fuel Standard* (hereinafter the "LCFS").[2] As the national representative of the trucking industry, ATA is vitally interested in matters affecting truck fleets, including the supply, price and specifications of diesel fuel. ATA's membership is directly affected by the diesel fuel specifications enacted by various states and has a substantial interest in CARB's LCFS.

ATA is committed to reducing the trucking industry's carbon footprint. ATA has enacted a sustainability plan, which could reduce annual carbon emissions by more than 90 tons, or roughly 20% of the trucking industry's total domestic carbon emissions.[3]

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[1] ATA is a united federation of motor carriers, state trucking associations, and national trucking conferences created to promote and protect the interests of the trucking industry. Directly and through its affiliated organizations, ATA encompasses over 37,000 companies and every type and class of motor carrier operation.

[2] The comments set forth herein are based upon the CARB staff Report entitled *Proposed Regulation to Implement the Low Carbon Fuel Standard*, (March 5, 2009). *See* http://www.arb.ca.gov/regact/2009/lcfs09/lcfsisor1.pdf

[3] A copy of ATA's sustainability recommendations may be viewed through the following link: http://www.trucksdeliver.org/recommendations/index.html

Notwithstanding our demonstrated commitment to the reducing the trucking industry's carbon emissions, we are reluctant to support the CARB LCFS, as proposed. For the reasons set forth herein, ATA recommends that CARB delay the implementation of the Proposed LCFS and thoughtfully consider the relationship to the federal Renewable Fuel Standard ("RFS") and the likelihood that the California LCFS could increase carbon emissions in the short term. We also recommend that CARB revisit the economic analysis to appropriately characterize the economic impact of the proposed LCFS on the trucking industry. ATA also is concerned with the potential impact that high percentage blends of biodiesel will have upon the trucking industry. Finally, ATA highlights serious concerns over the use of natural gas for the over-the-road segment of the trucking industry. We address each of these issues below.

A. Relationship to the Federal RFS

The LCFS proposes to reduce emissions of greenhouse gases ("GHG") by lowering the carbon content of transportation fuels used in California. With respect to ultra-low sulfur diesel fuel, the LCFS proposes to achieve a 10 percent reduction in diesel carbon intensity by 2020. The primary mechanism envisioned to achieve that goal is through the blending of biodiesel and renewable diesel.

Unlike other criteria pollutants (*i.e.*, particulate matter, NOx) that are of concern to the trucking industry, the impact of GHG on the environment is not dependent upon their point of emission. While the impact of particulate matter is limited to a finite area surrounding the location from which the pollutant is emitted, the emission of GHGs will have an equivalent impact upon climate change whether it is emitted in California, Kansas or Kazakhstan. For this reason, GHG regulation needs to be addressed at the national level (and arguably at the international level).

Reducing the carbon intensity of the fuel consumed in California may not be the best way to maximize global carbon reductions. Indeed, as discussed below, we believe that the LCFS will actually increase total U.S. carbon emissions. While this may sound counter intuitive, the interplay between the federal Renewable Fuel Standard[4] ("RFS") and the proposed LCFS suggests that the short term impact of the LCFS will simply increase the amount of renewable fuel that is transported into California for consumption. If the ultimate focus of the LCFS is to reduce total carbon emissions, then additional transportation of biofuels over long distances should be minimized.

The federal RFS requires obligated parties to blend 500 million gallons of biodiesel this year. That quantity grows to a billion gallons in 2012. By not specifying

[4] In 2005, Congress enacted a renewable fuels standard. In 2007, Congress increased the amount of renewable fuel that is required to be used in the United States to 36 billion gallons by 2022.

where the renewable fuel must be consumed, the RFS allows for the renewable mandate to be met in the most economically efficient manner (*i.e.*, close to where the renewable fuel is produced). State renewable fuel mandates distort these economic efficiencies, as fuel must be transported from the location where the feedstock is plentiful or the biofuel is refined to a location where it is mandated for consumption.[5] In this regard, state renewable fuel mandates actually increase the carbon profile of the fuel by forcing the fuel to be transported to specific points of consumption rather than being consumed close to where it is produced. The proposed LCFS causes this unintended consequence and will actually increase the carbon emissions and reduce the GHG benefits of the federal program, as biodiesel and other biofuels are forced to be transported from the Midwest to California to comply with the LCFS.

> Production capacity of biorefineries in California in 2020 is not expected to supply the total volume of biofuels necessary for California transportation use. To acquire the necessary volume of biofuels, they will be imported from the Midwest.[6]

In this regard, the California LCFS does not compliment the federal RFS and instead actually erodes some of its benefit.[7]

B. Economic Analysis of LCFS

The economic analysis underlying the LCFS staff report incorrectly concludes that the proposed regulatory action would not affect small businesses because (1) most regulated parties are expected to be large businesses, and (2) small businesses (generally fueling station owners and operators) would presumably invest in equipment that dispenses LCFS-compliant fuel and the expenses would be recouped through fuel sales.[8] While LCFS places compliance obligations on upstream entities (*i.e.*, producers and importers of transportation fuels) the increased costs of the fuels required under the LCFS will be borne by consumers. The fact that CARB does not consider the entities that actually have to purchase the fuel to be affected by this proposal is troubling.

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[5] While the LCFS is less proscriptive than some existing state biofuel mandates, because biofuel substitution is the likely compliance path for the foreseeable future, the LCFS will operate in a similar manner to a state renewable fuel mandate.

[6] LCFS at VII-16.

[7] Since biodiesel does not move by pipeline, it will be transported into California by railroad and truck. As such, biodiesel produced in Indiana will have a higher carbon pathway than biodiesel produced in Oregon.

[8] *See* LCFS at VIII-1.

As the largest consumer of diesel fuel, the cost of complying with the LCFS is a significant concern to ATA members. The trucking industry is dominated by small businesses, many of whom are unable to pass on the full cost of fuel price increases.[9]

The economic analysis described in the staff report indicates a potential savings to consumers of $11 billion and as much as 8 cents per gallon.[10] While we do not opine on potential savings to gasoline consumers, diesel consumers will most certainly see an increase in their fuel price. In fact, if the fuels used under the LCFS were actually less expensive than the petroleum fuels they are replacing, then there would be no need to enact the LCFS, as the free market would ensure that the less expensive fuel was consumed. Unfortunately, this is not the case.

CARB staff concluded that "the LCFS will not significantly impact either the price or supply of transportation fuels in California."[11] With respect to the price of diesel fuel, this conclusion is in error. Biodiesel derived from soy oil is significantly more expensive than petroleum derived fuel. The example provided below demonstrates the difference between the wholesale cost of biodiesel and the wholesale price of ULSD.

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[9] More than 95% of the trucking industry is comprised of small businesses that operate fewer than 20 trucks. *See* Federal Motor Carrier Safety Administration Carrier Database (June 2008).

[10] *See* LCFS at VIII-1.

[11] LCFS at ES-30.

The Economics of Biodiesel[12]

Feedstock Costs:	$ 2.70
Soy Oil (7.6 lbs./gal.) @ 32.55 cents +.03 cents for transport:	
Production Costs:	
Methanol (12%-20% by volume)	$ .10 - .20
Catalyst	$ .10 - .12
Electricity	$ .01
Natural Gas (boiler - heat)	$ .08 - .10
Labor and Overhead	$ .05 - .10
Maintenance	$ .03 - .05
Insurance & Tax	$ .03 - .05
Depreciation	$ .05 - .10
Total Production Costs	**$ 3.15 - $3.43**
Federal Tax Credit (expires 2009)	$ -1.00/ gallon
Wholesale biodiesel (w/o transport)	$ 2.15 - $2.43 / gallon

On April 22, 2009, the wholesale price of ULSD was $1.41 per gallon.[13] Even with the $1.00 per gallon federal blending credit applicable to biodiesel, the renewable fuel was still significantly more expensive than the average price of ULSD. Moreover, although the staff report assumes the biodiesel tax credit will continue indefinitely, there is no guarantee that Congress will extend the biodiesel blending credit, which will expire at the end of 2009 unless renewed. Indeed, there have been several attempts to make the biodiesel blending credit permanent, but each of these attempts have failed. If Congress does not act to extend this tax credit, then the cost of biodiesel could be almost double the cost of ULSD. Even a low percentage blend, such as B5, could cost consumers an extra 10 cents per gallon.

The price comparison of biodiesel to ULSD shown above is not an anomaly as the price of soybean oil has varied directly with the price of crude oil. Even during the record high diesel prices during the summer of 2008, biodiesel remained more expensive than ULSD.

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[12] Sources: Iowa State University Center for Agricultural and Rural Development, *Iowa Ag Review* vol. 14, No. 1 (Winter 2008), http://www.card.iastate.edu/iowa_ag_review/winter_08/article3.aspx; *The Wall Street Journal*, p. C14 (April 22, 2009); and American Trucking Associations.

[13] *The Wall Street Journal*, p. C14 (April 22, 2009).

In addition to the increased cost of biodiesel relative to ULSD, biodiesel also results in additional costs that are borne by its users, especially at blend levels exceeding 5%. The LCFS assumes that biodiesel has the same energy content as conventional diesel fuel.[14] Actually, biodiesel has about a 10% lower energy content compared to ULSD. This lower energy content translates to lower fuel economy. In other words, the 838 million gallons of biodiesel anticipated to be used under the LCFS in 2020 would have the same energy content as 755 million gallons of ULSD. The need to use an extra 84 million gallons of biodiesel is a significant cost that should not be ignored. The LCFS improperly ignores this diminution in energy content and therefore understates the costs to consumers.

C. Impact of High Percentage Biodiesel Blends

The LCFS compliance schedule likely will require increasing percentages of biodiesel blends beginning in 2011. While renewable diesel that meets the ASTM D-975 standard is expected to perform comparably to today's ULSD fuel, first generation biodiesel (*i.e.*, biodiesel that complies with ASTM 6751 and is used for blending into ULSD) will present operational challenges for the trucking industry as the blend rate increases. The LCFS envisions the use of B20 and contains no limits on biodiesel concentrations.[15]

In December 2006, ATA submitted comments on CARB's draft biodiesel policy. Those comments discussed the trucking industry's concerns with biodiesel use, including the cost of biodiesel, the need to ensure biodiesel quality, the impact of biodiesel use on nitrogen oxide emissions, and the operational challenges for on-road use of biodiesel in blends exceeding five percent. These comments are still relevant in the context of the LCFS. Although we do not repeat the concerns raised in our biodiesel comments, we do incorporate them by reference and have attached them as Exhibit A.

We also note that California is in the process of promulgating a biodiesel standard to authorize the sale of biodiesel blends within the state.[16] We believe that it is inappropriate to finalize the LCFS for diesel fuel until an acceptable standard for its primary substitute has been finalized. Moreover, less than 25% of the GHG reduction benefits under the LCFS will come from the reduction of diesel fuel carbon intensity. For this reason, ARB should consider delaying the implementation of the LCFS for diesel fuels.

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[14] *See* LCFS at VIII-30.

[15] *See e.g.*, LCFS at VII-17.

[16] *See* LCFS at II-11.

D. Concerns With Natural Gas Alternative

We believe that it is unlikely that natural gas will be a viable alternative for most trucking operations. While natural gas may be an attractive alternative for some short haul operations, the extremely high premium for natural gas engines and the enormous cost of developing a natural gas refueling infrastructure make it an unlikely choice for most trucking fleets.[17]

We are also concerned that the lifecycle analysis of the natural gas pathway does not fully account for GHG emissions. The primary constituent of natural gas is methane. Methane is 25-times more potent than CO2 as a greenhouse gas. As liquefied natural gas in fuel tanks warms, methane is released to the environment through a pressure relief valve.[18] The venting of methane could result in a net increase in greenhouse gas emissions compared to diesel fuel. The LCFS is unclear as to whether the release of natural gas from on-board tanks has been accurately quantified.[19]

Exhibit B provides additional information on the costs and other concerns surrounding the use of natural gas as an alternative to diesel fuel.

E. Miscellaneous Issues

a. Carbon Accounting

CARB proposes to use a lifecycle analysis to consider both the direct and indirect impacts caused by the use of alternative fuels. ATA agrees that the incorporation of both direct and indirect carbon emissions is important to ensure that the substitution of alternative fuels actually reduces carbon emissions. If the goal of the program is to reduce GHGs, then it is important to consider all potential emissions of GHGs. Calls to ignore the indirect GHG emissions that result from land use changes jeopardize the goal of the program.

ATA recommends that the LCFS be postponed until scientific data on indirect emissions becomes available. CARB staff has indicated that the biodiesel lifecycle carbon analysis is very preliminary.

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[17] Due to the economics of natural gas, we believe that two of the three compliance scenarios for diesel fuel are unrealistic. *See* LCFS at VI-14 – VI-15.

[18] This issue is of particular concern in warm environments such as Southern California.

[19] *See* LCFS at IV-4; table IV-2.

> In particular, staff is concerned that our estimate of land use allocation for co-products may significantly underestimate the land use impacts of soy-based biodiesel, thereby overestimating its GHG benefits.[20]

In light of the fact that soy-based biodiesel will be the primary diesel fuel substitute used to comply with the LCFS, ATA believes that CARB should delay implementing the LCFS for diesel fuel until the impact of soy-based biodiesel is quantified. It is not appropriate to rush this aspect of the LCFS into effect, especially when CARB staff has specifically acknowledged that the preliminary estimate overstates GHG benefits.

If the LCFS program does move forward in the absence of this data, then we believe that the program must account for these emissions. While we recognize that the science on the magnitude of indirect emissions is not fully developed, the failure to use an estimate of these emissions is not warranted and could result in the program causing an increase in GHG emissions. As more data becomes available to help quantify indirect emissions, the GHG pathway assumptions should be revised.

Sound science dictates that both direct and indirect effects be included in the carbon intensity calculations. The debate over the quantification of the magnitude of indirect effects will continue; however, the failure to conclude this debate does not warrant the conclusion that indirect effects should be completely ignored.

b. NOx Emissions

The LCFS discussion on biodiesel NOx emissions is particularly troubling. Rather than accounting for the fact that the use of biodiesel will increase NOx emissions, the report ignores the prevailing body of scientific evidence on the subject because it undermines the plan for biodiesel substitution.

> NOx is of particular interest because biodiesel has been reported to increase NOx emissions. ARB staff has assumed that there will be no increase in the emissions of NOx. This is because staff is currently conducting an extensive test program for biodiesel and renewable diesel and will follow that effort with a rulemaking to establish specifications to ensure there is no increase in NOx.[21]

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[20] LCFS at ES-15. *See also* LCFS at IV-33 – IV-34.

[21] LCFS at VII-19.

We are unsure of how CARB will ensure that biodiesel use does not increase NOx emissions; however, we note that the use of fuel additives to address this issue will further increase the cost of biodiesel and will require significant testing to ensure that it will not adversely impact engine durability or the long term efficacy of emissions control equipment.

c. Federal Regulatory Efforts to Reduce Carbon from Transportation Fuels.

On February 26, 2009, U.S. EPA sent a draft of its proposed Renewable Fuels Standard Program to the White House Office of Management and Budget for review prior to publication. CARB should analyze this federal rule before finalizing its LCFS. EPA has also announced its intention to create a federal low carbon fuel standard. Again, California should work with EPA on a federal approach to this issue to ensure the most efficient reduction of GHGs and to prevent low carbon fuel from simply being transported to California from other parts of the country.

On March 31, 2009, Congressmen Henry Waxman (D-CA) and Edward Markey (D-MA) introduced the American Clean Energy and Security Act of 2009 to propose a national climate change solution. Section 121 of the Discussion Draft establishes a Low-Carbon Fuel Standard to cut the lifecycle emissions intensity of transportation fuels by at least 5% in 2023 and 10% in 2030 from a yet-to-be-determined baseline year. The Draft requires the U.S. EPA Administrator to promulgate regulations within 3 years to: (1) determine the lifecycle GHG emissions of all transportation fuels; (2) determine a fuel GHG baseline; and (3) ensure that transportation fuel providers reduce lifecycle GHG emissions per unit of energy for transportation fuels sold or introduced into commerce in any of the 50 States or the District of Columbia. While the ultimate goal of both the California LCFS and the Discussion Draft is consistent (i.e., achieve GHG reductions through less carbon-intensive fuels), individual efforts to address this common problem will undermine the efficiency of a national approach and create regulatory uncertainty for fuel providers. Climate change is a national problem that is best resolved through a national solution. California should therefore delay the implementation of the LCFS and allow the federal government to take the lead in this area.

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The focus of any LCFS initiative should be the total reduction of carbon. Unfortunately, the focus of the proposed LCFS is reducing the carbon intensity of fuels sold in California without regard to the impact on the Nation's total carbon emissions. The LCFS will simply ensure that low carbon fuel will be transported into California for consumption rather than be used in the area where it is produced. This unnecessary

transportation of biofuels increases the amount of fuel the nation will consume and unnecessarily increases the Nation's carbon footprint. To ensure the maximum reduction of GHG emissions, California should embrace a national approach. The federal RFS and the EPA's efforts to develop a national low carbon fuel standard may provide a more appropriate framework for reducing GHGs. CARB should delay implementation of the proposed LCFS to ensure that its carbon reduction initiative dovetails with the rest of the nation.

We also believe that the costs of the LCFS to the trucking industry and other diesel consumers generally have been overlooked. These costs are significant and will have a detrimental impact upon the trucking industry.

If you have any questions concerning the issues raised in this letter, please contact the undersigned at (703) 838-1910.

Respectfully submitted,

Richard Moskowitz
Vice President & Regulatory Affairs Counsel

Enclosures:

Exhibit A – ATA's Comments on Biodiesel Use
Exhibit B – Natural Gas Alternative for Trucking

AMERICAN TRUCKING ASSOCIATIONS

EXHIBIT A

December 5, 2006

Robert Okamoto
Industrial Section
Air Resources Board
P.O. Box 2815
Sacramento, California 95814

Via e-mail: bokamoto@arb.ca.gov

Re: Comments on the California ARB Draft Advisory on Biodiesel Use

To Whom It May Concern:

The American Trucking Associations, Inc.[1] ("ATA") submits these comments in response to the California Air Resources Board ("ARB") draft advisory on biodiesel use, as revised on November 14, 2006 (hereinafter the "revised draft biodiesel policy").[2] As the national representative of the trucking industry, ATA is vitally interested in matters affecting truck fleets, including the supply, price and specifications of diesel fuel. ATA's membership is directly affected by the diesel fuel specifications enacted by various states and has a substantial interest in the ARB's biodiesel policy.

In June 2006, ATA submitted comments on ARB's original draft biodiesel policy.[3] These comments discussed the trucking industry's concerns with biodiesel use, including the cost of biodiesel, the need to ensure biodiesel quality, the impact of biodiesel use on nitrogen oxide emissions, and the operational challenges for on-road use of biodiesel in blends exceeding five percent. These comments are still relevant in the context of the revised draft biodiesel policy. Although we do not repeat the concerns raised in our June 2006 comments, we do incorporate them by reference hereto. We offer specific comments on the revised draft biodiesel policy; however, we believe that the

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[1] ATA is a united federation of motor carriers, state trucking associations, and national trucking conferences created to promote and protect the interests of the trucking industry. Directly and through its affiliated organizations, ATA encompasses over 37,000 companies and every type and class of motor carrier operation.

[2] The comments set forth herein are based upon a 4-page document posted on the ARB website, and accessible through the following link: http://www.arb.ca.gov/fuels/diesel/altdiesel/altdiesel.htm

[3] ATA's original comments responded to a 7-slide presentation posted on the CARB website. *See* http://www.arb.ca.gov/fuels/diesel/altdiesel/052406arb_prsntn.pdf

issues raised in these comments and in our earlier comments would be better addressed through a formal rulemaking process.

The revised draft biodiesel policy specifies that the "biodiesel portion of the blend complies with the American Society for Testing and Materials (ASTM) specification D6751. . . ."[4] We support this reference to an accepted biodiesel quality specification. We are concerned, however, that a substantial amount of biodiesel in the marketplace does not meet this quality specification and believe that the ARB policy should contain a much stronger statement concerning biodiesel quality and ensure that California will have a role in policing and enforcing biodiesel quality.

Although biodiesel is relatively easy to make, high quality biodiesel is difficult to consistently produce. Last winter, the trucking industry experienced problems in Minnesota caused by poor quality biodiesel. More recently, the National Biodiesel Board conducted a survey of 40 biodiesel producers and found that one-third of the samples taken did not meet the ASTM quality specifications. If ARB is seeking to promote the increased use of biodiesel, then ARB bears some responsibility for ensuring that biodiesel entering the marketplace meets minimum quality standards. A statement that biodiesel meets ASTM specifications, in and of itself, is a step in the right direction, but does not go far enough to ensure that end-users will be protected from poor quality biodiesel.

The revised draft biodiesel policy also states that biodiesel blends should not exceed 20 percent biodiesel by volume. As our original comments point out, biodiesel blends that exceed five percent biodiesel by volume create operational challenges for the over-the-road trucking industry. We will not repeat the discussion of these challenges, but will reiterate that the ARB should distinguish off-road biodiesel use from on-road biodiesel use and enact a cap of five percent biodiesel for on-road diesel blends. Many of the challenges presented by biodiesel use in an on-road application are more easily overcome in off-road applications.

The revised draft biodiesel policy also acknowledges the potential for biodiesel in blends of more than five percent to have an adverse impact on engine warranties. We believe that until each of the individual engine manufacturers specifically embrace biodiesel blends that exceed five percent for existing on-road heavy duty diesel engines, ARB should refrain from promoting higher percentage blends for use in these engines. It is unreasonable to encourage the sale of high percentage biodiesel blends and place the onus on the end-user to determine whether its use will jeopardize potential warranty claims. This warranty issue becomes even more complex in the context of diesel engine retrofit technologies.

On the issue of air emissions, the revised draft biodiesel policy states that "ARB is beginning to develop the technical information to support setting specifications to ensure that the emissions benefits of California diesel fuel are retained." While it is clear that biodiesel will reduce particulate matter emissions and reduce green house gasses, its

[4] Revised Draft Biodiesel Policy at 3.

impact on ozone formation is less clear. The trucking industry has spent billions of dollars on engine technologies that reduce nitrogen oxide emissions and has borne additional costs in the mandated use of California's boutique diesel fuel. It seems irrational to promote the use of 20 percent biodiesel blends, prior to quantifying the positive and negative impacts this will have on ambient air quality.

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ARB's adoption of a biodiesel policy is an opportunity to expand the use of biodiesel within California, while ensuring that the trucking industry does not suffer the harmful effects that often accompany fuel changes. To accomplish this, ARB's biodiesel policy must ensure that only high quality biodiesel finds its way into the marketplace and ensure that on-road biodiesel blends are limited to no more than **five percent** biodiesel.

The blending of biodiesel into CARB-diesel is a critical issue for end-users and the issue would benefit from a more formal rulemaking process. If you have any questions concerning these comments, please contact the undersigned at 703-838-1910.

Respectfully submitted,

Richard Moskowitz
Assistant General Counsel and Regulatory Counsel
American Trucking Associations

EXHIBIT B

Natural Gas is Not a Viable Alternative for Long-Haul Trucking

Natural gas is not a viable alternative for most long-haul trucking operations; however, the alternative fuel could be an acceptable fuel solution for certain short-haul applications within an industry as diverse as trucking.

Economic Issues: The conversion to natural gas is prohibitively expensive.

- *Engine Costs* – Class 8 trucks powered by natural gas engines sell at a large premium ($40,000 - $90,000) compared to those powered by heavy duty diesel engines.
- *Fuel Economy Penalty* – Natural gas has lower energy content than diesel fuel. Compressed natural gas (CNG) does not have enough volumetric energy content to fit within the limited fuel storage constraints of a long haul Class 8 heavy duty tractor. While liquefied natural gas (LNG) has greater energy content than CNG, its use translates into a significant fuel economy penalty compared to No. 2 diesel - a diesel gallon equivalent of LNG results in a 39% fuel economy penalty.
- *Weight* – LNG fuel tanks are cryogenic vessels constructed from double walled stainless steel with a vacuum and multi layers of insulation between. A 119 gallon tank weighs approximately 500 lbs., while a 72 gallon tank weighs approximately 270 lbs. This increased weight directly translates to a reduction in the amount of freight that can be hauled and further reduces the truck's fuel efficiency.

Infrastructure Concerns:

- *Refueling Stations do not Exist* – New infrastructure is required for refueling as truck stops and gas stations do not have the ability to dispense LNG and may not have the real estate needed to install LNG refueling systems.
- *Cost of Refueling Infrastructure* – Building an LNG refueling station capable of refueling one truck costs over $500,000. Refueling multiple trucks simultaneously is significantly more expensive.
- *Lack of Competition among Refueling Stations* – Building out a natural gas refueling infrastructure along key freight corridors will take time and may result in a monopoly pricing situation, as there is unlikely to be significant pricing competition among fuel vendors due to the high barriers of entry. A competitive fuel model would require the presence of multiple entities selling LNG in the same geographic area
- *Refueling Standardization Issues* – LNG trucks must be refueled at specialized stations that are configured for the specific truck. Running out of gas on the side of the road is a significant challenge as LNG mobile refueling is not an option and the truck would have to be towed to a compatible refueling station.
- *Driver Safety* – Since LNG is dispensed at -260 degrees Fahrenheit, employee training and the provision of personal protective equipment may be necessary.

Operational Challenges:

- *Maximum Torque Output* – There are anecdotal reports of insufficient torque for some applications – LNG engines may not be appropriate for certain heavy haul operations over steep terrain.
- *Operating Range* – An LNG truck equipped with two 119 gallon tanks has a reduced operating range (775 miles).
- *Maintenance Issues* – Natural gas engines operate differently than diesel engines and in-house mechanics will require approximately 60 hours of specialized training. Natural gas engines may require fuel injectors to be replaced more frequently than diesel engines. For spark-ignition natural gas engines, replacement of spark plugs, ignition modules and various sensors add additional maintenance costs. In-house maintenance facilities may require expensive upgrades to address potential methane exposure (*i.e.*, electrical modifications, sensors, ventilation).
- *LNG On-Board Tanks* – LNG tanks are double-walled construction with a vacuum between the two walls (like a giant thermos bottle) to help reduce the rate at which the LNG temperature will increase. The loss of the vacuum is a common problem that is expensive to remedy.

Environmental Implications:

- *Criteria Pollutants* – PM and NOx emissions from LNG-fueled trucks are similar to post 2007 diesel trucks.
- *Greenhouse Gas Emissions* –Some studies have found a reduction in greenhouse gas emissions while others have not. Methane is 25-times more potent than CO2 as a greenhouse gas. As LNG in fuel tanks warms, methane is released to the environment through a pressure relief valve. The venting of methane could result in a net increase in greenhouse gas emissions compared to diesel fuel.

The proposed transition to natural gas presents several significant challenges from economics to operability and poses significant refueling infrastructure hurdles. In the absence of a competitive natural gas refueling infrastructure, this alternative fuel is problematic for long haul trucking operations.