Western States Petroleum Association
Credible Solutions • Responsive Service • Since 1907

Catherine H. Reheis-Boyd
Executive Vice President and COO

November 5, 2008

Mr. Floyd Vergara, Manager
Industrial Section
California Air Resources Board
1001 I St., P.O. Box 2815
Sacramento, CA 95812
Via e-mail to fvergara@arb.ca.gov

Re: **Western States Petroleum Association's Comments on CARB Draft Document Concerning a Comparison of GHGs from Natural Gas and Diesel Vehicles**

Dear Mr. Vergara:

WSPA is pleased to provide ARB with comments relative to the draft document referenced above. WSPA is a trade organization representing companies that explore for, produce, refine, distribute and market petroleum, petroleum products and natural gas in California and five other western states. Our companies are directly involved in all three fuels: CNG, LNG and diesel, so we have a significant interest in the ARB document.

To briefly summarize, the document "Comparison of Greenhouse Gas Emissions from Natural Gas and Diesel Vehicles" describes the comparison estimates of the greenhouse gas (GHG) emissions from natural gas (NG) and diesel vehicles based on the estimates of the full fuel cycle data available for NG and diesel fuel.

A generalized diesel pathway was compared to eight different pathways for natural gas, five for compressed natural gas (CNG) and three for liquefied natural gas (LNG). The paper concludes the following:

- In the case of light-duty vehicles, all of the CNG pathways and two of the LNG pathways present GHG emissions improvements, as compared to existing diesel. However, only three of the CNG pathways and two of the LNG pathways represent a GHG emissions improvement over LCFS diesel.
- In the case of heavy-duty vehicles, four of the five CNG pathways and two of the LNG pathways offer GHG emissions improvements over existing diesel fuel. In contrast, only three of the CNG pathways and none of the LNG pathways present an opportunity for GHG emissions improvement on LCFS diesel.

WSPA has provided a number of overarching comments that are contained in this letter. We also have appended more specific questions and comments. We ask that ARB staff carefully review and respond to each one.

General Comments:

- WSPA provided ARB with comments on the individual pathway documents for natural gas and for ULSD fuel earlier this year. By reference to these earlier documents, we would like to include those comments here, since it appears ARB has failed to respond effectively to our earlier comments.

- Why is such a report really necessary and why did ARB write the report? Is ARB going to produce a report comparing bio diesel to CNG and LNG, or electricity and CNG/LNG? WSPA believes it is more important to make sure the individual reports on natural gas and diesel are correct. As a result of this

comparison document, a question does arise as to whether or not the two assessments are done in a fuel neutral manner. In general, it appears to resurface the California bias against diesel fuel, otherwise why wouldn't similar comparison documents be done for all the other fuels/vehicles.

- Based on our review, WSPA's criticism of the CNG-ULSD pathway comparison documents focuses on the lack of transparency surrounding the underlying assumptions. ARB has released multiple related documents within the past year, all of which appear to be harboring differing critical underlying assumptions and factors utilized in the pathway calculations. WSPA requests ARB release a final document clearly stating all current assumptions and factors, and explaining how these assumptions and factors vary from previously released documents and/or versions of CA-modified GREET.

- The value of such an assessment is dependent in large part on how ARB has proposed regulating natural gas and diesel under the LCFS, and whether or not the estimated impacts can actually be measured and effectively enforced so that California actually gets the estimated benefits. For example, will the regulated party for natural gas, whether CNG or LNG, be able to document what the Carbon Intensity (CI) was for the natural gas they used to produce their final product given how natural gas is supplied to the State?

- There has been a lot of controversy around CI values regardless of the fuel type because they depend on so many assumptions (e.g., plant details, delivery distance, and even LDV vs. HDV performance). Use of the scenarios is a good approach to get some sense of the variation in the production and use of the fuels. All of the proposed pathways or scenarios are useful for scientific comparison, but may not be realistic or practical for a specific volume of natural gas supplied to a mobile source. [See our detailed comments under "Sources of Natural Gas"] We question whether it is possible for an obligated party to know what the CI is of the natural gas that they use to produce CNG or LNG. Given this uncertainty, how would ARB enforce such rules?

- If utilities are already mandated to provide natural gas to consumers, both public and private, as they are with electricity, what GHG emissions reductions can actually be attributed to the utilities for providing the fuel - especially if they are also mandated to meet the Renewable Portfolio Standards? Shouldn't it be the vehicle manufacturers that enable the new technology by providing the vehicle, or the party providing the refueling facility, that are credited?

- In addition, any GHG emission benefits from natural gas powered vehicles will be captured under the AB 1493 program or the EPA CAFÉ standard. So, where is the GHG benefit that can be attributed to the utilities? Is ARB again "double counting" the emission reductions for natural gas and the natural gas powered vehicles as they are with electric powered vehicles? How will all this be accounted for in the LCFS and AB 32 program?

WSPA appreciates the opportunity to comment on the document and would be happy to meet with ARB staff to further discuss our comments. For any minor clarifications please contact me or Gina Grey at 480-595-7121.

Sincerely,

c.c. M. Scheible ARB
B. Fletcher ARB
D. Simeroth ARB
J. Courtis ARB
R. Littaua ARB
J. Sparano WSPA
G. Grey WSPA

1415 L Street, Suite 600, Sacramento, California 95814
(916) 498-7752 • FAX (916) 444-5745 • cathy@wspa.org • www.wspa.org

Western States Petroleum Association's (WSPA's) Detailed Comments on the CARB Draft Document on a Comparison of GHG Emissions from Natural Gas and Diesel Vehicles

Inappropriate Comparison:

Why are light-duty natural gas vehicles (NGVs) compared to diesel vehicles in this analysis? It seems that comparison to gasoline vehicles would be more appropriate for the light-duty sector, whereas a comparison to diesel vehicles would be appropriate for the heavy-duty sector.

Clarity of Assumptions:

The document "Comparison of Greenhouse Gas Emissions from Natural Gas and Diesel Vehicles" (referenced here as "CNG comparison document") states that data sets underlying the carbon intensities presented are derived from the California-specific GREET Model (created by Argonne Laboratory), version 1.8b. Detailed assumptions on the CNG pathway are more rigorously presented in the April 21, 2008 ARB-released document "Detailed California-Modified GREET Pathway for Compressed Natural Gas (CNG) from North American Natural Gas, Version 1.0".

Since the CNG comparison document states that the values for carbon intensity and fuel economy for light-duty and heavy-duty vehicles have been updated since the release of this document, further clarification should be provided to the public in order to establish a clear understanding of what specific assumptions are presently being put to use.

Examples of this lack of clarity include:

- April 2008 ARB-released documents for CNG and ULSD (aka CARB diesel) state that assumptions are based on GREET 1.7 ca_98, yet the CNG comparison document claims that underlying data sets are based on GREET 1.8b (CA-GREET). There are substantial differences between critical assumptions used in the two versions that are available to be downloaded from ARB's website, including:
    - Crude recovery efficiency (for ULSD pathway): 93.9% in version 1.7 versus 98% in version 1.8b. While it is evident that carbon intensities reflected in the CNG comparison document reflect a crude recovery efficiency closer to 93.9%, why does the CA-modified GREET 1.8b version still reflect a recovery efficiency of 98%?
    - ULSD refining efficiency: 89.3% in version 1.7 versus 86.7% in version 1.8b. Which should be the assumed efficiency to arrive at the carbon intensity for ULSD refining reflected in the CNG comparison document?
- Natural gas compression efficiency is expressed as 100% in version 1.7 versus 97.3% in version 1.8b. Furthermore, the April 2008 ARB-released document for CNG references a compression efficiency of 98% based on data provided by Clean Energy Fuels.

A brief sensitivity analysis using the referenced versions of GREET was performed, focusing on the questionable input factors described above. Table 1 below documents the differences in carbon intensity results that arise from varying these critical factors. A review of the results indicates that there are differences in assumptions between the three sources reviewed and these assumptions may or may not be the sole sensitivity factor affecting the various carbon intensities (for example, no variation of recovery efficiency for CNG production between GREET versions 1.7 and 1.8b still showed differences between resulting carbon intensities).

Table 1 – CNG – ULSD Comparison Pathway Sensitivity Analysis Results

	Carbon Intensity Result	**Factor Varied**
	Crude/NG Production g CO2e/MJ	*Recovery Efficiency* %
Comparison Document ULSD	6.40	Unknown
ULSD - GREET V 1.7 (CA) Default	6.60	93.9%
ULSD - GREET V 1.8b (CA) Default	2.65	98.0%
Comparison Document NG from CA	3.70	Unknown
CNG - GREET V 1.7 (CA) Default	3.30	97.2%
CNG - GREET V 1.8b (CA) Default	3.43	97.2%
	Refining g CO2e/MJ	*Refining Efficiency* %
Comparison Document ULSD	12.30	Unknown
ULSD - GREET V 1.7 (CA) Default	11.00	86.7%
ULSD - GREET V 1.8b (CA) Default	9.25	89.3%
Comparison Document NG from CA	---	---
CNG - GREET V 1.7 (CA) Default	---	---
CNG - GREET V 1.8b (CA) Default	---	---
	Compression g CO2e/MJ	*Gas Compression Efficiency* %
Comparison Document ULSD	---	---
ULSD - GREET V 1.7 (CA) Default	---	---
ULSD - GREET V 1.8b (CA) Default	---	---
Comparison Document NG from CA	2.90	Unknown
CNG - GREET V 1.7 (CA) Default	2.10	98.0%
CNG - GREET V 1.8b (CA) Default	3.55	97.3%

For transparency purposes, the most current factors and assumptions should be used within the referenced GREET model (CA-GREET 1.8b) such that resulting carbon intensities calculated

within the version of GREET provided on ARB's website match those expressed in the relative document(s). Furthermore, WSPA recommends a simple modification be made to the CA-GREET model such that user input and export can be made on one tab, yet the user can still view the inner workings of the model. The addition of an "input/export" tab that provides a location for the user to control and/or inspect the key assumptions that are being input for each scenario, as well as resulting outputs, would be highly valuable. Input values could be altered and resulting calculations of interest (carbon intensities) could be inspected in one location. The inclusion of this option would greatly increase user confidence in the model.

Uncertainty Analysis:

ARB has not provided an uncertainty analysis of the assumptions listed in the CNG comparison document. As seen above, variation of certain key assumptions have large effects on resulting carbon intensities. WSPA recommends that ARB perform a simple uncertainty analysis (range-based approach) surrounding key assumptions utilized in the compared fuel pathways.

Marginal or average emissions:.

In estimating the emissions from producing and using additional fuels, what is assumed concerning the emissions from their production? Are the assessments for both incremental demand for diesel and natural gas using the same assumption, if not, why not? For CNG, the electricity used to compress the natural gas is based on the marginal electricity that is assumed to meet the utility Renewable Portfolio standard – does the electricity used to produce additional diesel have that same benefit?

Marginal California Electricity:

The April 2008 ARB-released document for CNG states that compression energy is assumed to be provided by marginal California electricity, which is based on natural gas and renewable power. While four of the five CNG pathways presented in the CNG comparison document reflect natural gas produced outside of California, is it fair to assume that all compression will take place within California using only this marginal assumption?

Sources of Natural Gas:

- We question the assumptions made relative to sources of natural gas. It appears that only a small percentage of natural gas used in the state comes from within the State.
- Currently much of the LNG is trucked into the state from Wyoming, the Midwest or some other out-of-state location - this pathway is not represented in any of the cases. Is ARB assuming this will totally stop?
- One case (#8) appears to assume that a LNG terminal is located in the LA/LB port area. There is no LNG delivered to Port of LA/Long Beach by ship and the chance of such deliveries in the future seems remote.
- Pipelines to California typically accept gases from various sources and blend them along the way as they deliver the gas to the customers along the pipeline as well. Will the obligated party know the CI of the natural gas that they actually provide?
- Pathways 2 and 4 are almost the same because after a long transmission from Texas/Gulf to California, the gas quality will be essentially the same, and the processing steps are also almost the same.

Diesel Transport Carbon Intensities:

The CNG comparison document provides a "California average" carbon intensity for diesel transport (2.2 gCO2e/MJ) and LNG truck transport (0.3 gCO2e/MJ). These values match the

estimates for crude transport and ULSD transport and distribution, respectively, described in the April 2008 ARB-released document for ULSD; therefore, how can they reflect the "California average" for diesel? What does the "California average" for diesel encompass?

CARB Diesel versus LCFS Diesel:

The CNG comparison document states that "LCFS" diesel has a ten-percent lower carbon intensity than CARB diesel, but provides no further detail. What are the underlying assumptions that lead to this variance? Where can these assumptions be found?

EMFAC 2007 Fuel Economy Values:

The CNG comparison document indicates that fuel economy values are derived from a spreadsheet model based on the latest version of the EMFAC model, and represent an average across all categories of light-duty and heavy-duty vehicles for a particular fuel. While EMFAC 2007 works with multiple variations of light-duty, medium-duty, and heavy-duty vehicles, and base energy consumption (MJ/mile) is dependent upon vehicle type and scenario year, further information detailing the assumptions made for this comparison should be provided.

In addition, a fuel economy value of 25.25 MJ/mile is being assumed for heavy-duty diesel vehicles (HDDVs). Using an energy density of 134.47 MJ/gal for California diesel fuel (from the draft regulations), this implies an average fuel economy for the in-use HDDV fleet of 5.3 miles per gallon. This appears to be a low estimate. Is this just for Class 8b trucks, or is this for the entire HDDV fleet above 8,500 lbs. gross vehicle weight?

EER Value:

How was the EER value of 0.94 for heavy-duty NGVs developed? This appears too high given that many heavy-duty natural gas engines are spark-ignited and are being compared to diesel cycle engines. It doesn't appear that the efficiency difference between the two cycles is being properly accounted for. It also appears ARB underestimated the fuel efficiency difference between NG and diesel (only 6%). It may be that this is based on only one engine, but needs clarification.

Vehicle Emissions:

Does the assessment use the same assumption on vehicle degradation rates and whether they use the regulatory certification levels or the certification results? Even though the tested results may be lower they are not enforceable so the certification limits should be used.

CH4 emission rate:

- Assuming that CH4 emissions from diesel and natural gas vehicles are equivalent is a poor assumption – diesels have inherently low CH4 emissions while NGVs have inherently high CH4 emissions.

- Assuming that CH4 emissions from heavy-duty and light-duty vehicles on a g/mi basis are equivalent is not supported and is probably incorrect.

- The source of the CH4 emission rate is listed as "Some undocumented source." Please identify the source of the estimate (it appears that the value of 0.146 g/mi was pulled from GREET1.8b).

In the absence of vehicle emissions data, CARB staff could have used their EMFAC model to estimate CH4 emission rates from gasoline and diesel vehicles. Using a statewide model run for calendar year 2006 results in the following CH4 emission rates:

Average light-duty gasoline vehicle = 0.052 g/mi
Average light-duty diesel vehicle = 0.0033 g/mi

Average heavy-duty gasoline vehicle = 0.155 g/mi
Average heavy-duty diesel vehicle = 0.049 g/mi

These estimates compare to the value of 0.146 g/mi used for all vehicles and fuels in CARB's analysis. As noted above, 0.146 g/mi appears to have been extracted from GREET1.8b, and if so, it would apply to light-duty NGVs. Further, GREET1.8b assumes that NGVs have CH4 emissions that are 10 times higher than gasoline vehicles. Estimates presented on the DOE's Alternative Fuels and Advanced Vehicles Data Center website (http://www.afdc.energy.gov/afdc/vehicles/emissions_natural_gas.html?print) show a 400% increase in CH4 emissions for light-duty NGVs versus gasoline vehicles.

It is strongly suggested that input from CARB El Monte staff involved in vehicle testing and emissions data analysis be obtained before going forward with any of the vehicle emissions estimates used in this analysis.

In addition, it is unclear how ARB incorporated methane emissions from CNG/LNG operations. Are fugitive emissions included as well? In one table it appears that CH4 emissions are the same between NG and diesel, so we are requesting clarification on this aspect.

N2O Emission Rate:

The light- and heavy-duty NGV N2O emission rate of 0.012 g/mi assumed by CARB staff is cited as being calculated using data from EMFAC. EMFAC does not explicitly model NGVs, nor does it explicitly model N2O. Was this calculated from gasoline vehicle results, and if so, how? Is there any technical support for the same N2O emission rate being assigned to both light-and heavy-duty NGVs? What was the basis of the motor vehicle N2O emission rates that were used to develop the GHG inventory on CARB's website, which served as the starting point for the diesel vehicle emission rates used for this work?

CO2:

How is the CO2 contained in natural gas treated in CARB's analysis? This is not clear from the documentation.