January 5, 2018

Sam Wade, Branch Chief
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Western Propane Gas Association Comments Regarding Propane EER/LCFS Issues

Dear Mr. Wade:

Please accept these comments on behalf of the Western Propane Gas Association (WPGA) and its members who provide propane fuel, products, and services to residents, businesses, and farms across California. I write to convey specific concerns for certain components of the LCFS process as they affect the establishment of propane as an LCFS fuel, and the extent to which traditional propane and renewable propane would generate related carbon reductions and credits.

The following identifies several areas we believe require further analysis to best assess the GHG emissions of propane vehicles in establishing an accurate Economy Efficiency Ratio (EER) under LCFS Article 4.

I. MD/HD VEHICLE EER CORRECTION TO GASOLINE V. DIESEL

Propane vehicles displace gasoline vehicles in several medium/heavy duty markets. Propane vehicles compete in the Class 4-6 vehicle markets, where, contrary to the unsubstantiated and inaccurate assumption by CARB that all vehicles Class 4 and above automatically displace diesel vehicles, LPG displaces gasoline vehicles.

Gasoline engines in Class 4-6 applications are prevalent with private operators, and include airport shuttle buses, package delivery trucks, and school and shuttle buses as but a few examples. Although these same vehicles can be obtained in diesel configurations, the vast preference in the private market is for a gasoline-operated vehicle and not diesel.

Operators choose gasoline engines over diesel because of operational issues associated with diesel within these weight classes. A diesel engine is not preferred when considering specific operational requirements and duty cycles, including frequent starts and stops, running at sustained idle or low speeds, or under other conditions that will negatively impact diesel DPF operation and longevity. As an example, an airport shuttle bus stops every few hundred feet to load and unload passengers, leading to long idle times often under covered areas. If a diesel engine were used in such an application, sustained low-load, lower engine temperature operation could easily result in damage to diesel emissions controls and even to the diesel engine.

Other problems associated with diesel engines applied to these specific operational requirements include:

- greater diesel engine and emissions controls maintenance requirements and costs;
- increased costs for DPF regeneration and disposal of related toxic materials;
- maintenance of stored reductants; and
- greater fuel costs

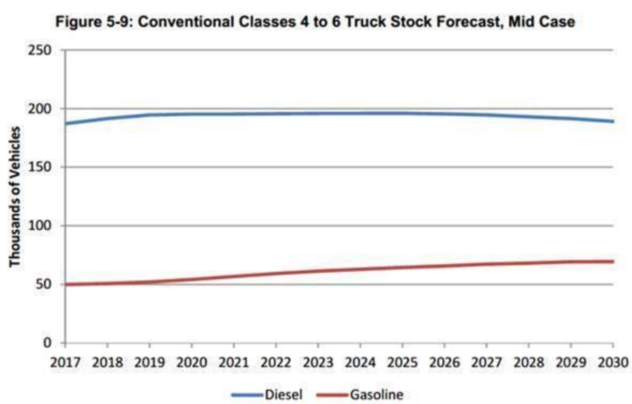
While there are diesel engines designed for relatively low mileage or shorter-term transportation and passenger-service contracts, such engines are limited and expensive. Consequently, the great majority of private owners invest in gasoline engines that are less expensive to purchase, operate, and repair, and otherwise meet use-specific, operational requirements.

As an example of a commercial fleet that purchases and relies on heavy-duty propane vehicles in their CA operations, recognizing that the propane vehicle is derived not from a diesel but from a gasoline vehicle, UPS notes on their website:

> **"The propane vehicle technology functions in very similar fashion to a conventional gasoline package car. The standard, six-liter, GM V8 gasoline package car is convertible to propane fuel. The propane is in a liquid state (LPI) when it is delivered to the fuel injectors via an electric fuel pump. The fuel injects into the intake manifold in the same manner as a gasoline model. Like its gasoline counterpart, the propane vehicle's engine also uses a spark ignition. This makes operation of the propane vehicle virtually identical to a standard gasoline model (emphasis added)."**

Further, based on a December 2017 WPGA membership survey, 100% of the propane class 4-6 vehicles (14,000 – 26,000 lb. GVWR) in propane retailers' customer markets replaced gasoline vehicles. Against the full range of vehicle classes, this represents a significant portion of the industry's heavy-duty vehicle population.

Additional data compiled by the CEC contradicts LCFS Article 4's assumption that all heavy-duty onroad-registered vehicles are, by default, diesel powered. CEC staff has determined that 35% or more of heavy-duty CA vehicles are not diesel-powered, but instead are utilizing Otto-cycle engines. Further, CEC's current mid-case forecast for Class 4 – 6 shown below predicts that gasoline trucks will begin to increase in numbers in 2019 and continue to increase slightly through 2030, while diesel trucks will remain relatively static in number until 2025 when their numbers will begin to drop slightly each year.



Source: California Energy Commission

In addition, the following CEC current forecast for eight fuel types in CA heavy-duty trucks for 2017 through 2030, broken into low-, mid-, and high-case categories, indicates that about 35% of the current fleet will not operate with diesel but with Otto-cycle engines.

Table 5-1: Truck Stock Forecast by Fuel Type and Case

		2017	2020	2025	2030
High case	Diesel	748,041	852,973	886,491	887,741
	Diesel-Electric Hybrid	2,802	10,449	21,169	41,715
	Electric	1,166	6,690	19,851	42,580
	Ethanol		756	2,639	16,085
	Gasoline	233,183	243,272	245,682	231,347
	Gasoline Hybrid		112	694	5,045
	Natural Gas	9,939	13,164	33,307	61,117
	Propane	1,996	3,156	4,785	5,829
Mid case	Diesel	710,322	757,938	827,310	866,487
	Diesel-Electric Hybrid	1,919	6,665	18,244	32,233
	Electric	1,020	4,207	16,562	29,722
	Ethanol		441	2,707	16,582
	Gasoline	229,129	229,248	235,893	237,505
	Gasoline Hybrid		54	597	3,826
	Natural Gas	9,642	11,919	17,938	29,653
	Propane	1,626	2,349	3,616	4,622
Low case	Diesel	712,314	754,492	823,344	877,244
	Diesel-Electric Hybrid	1,999	6,490	16,707	29,683
	Electric	830	819	1,099	5,085
	Ethanol		323	1,775	10,459
	Gasoline	229,485	231,473	241,053	242,483
	Gasoline Hybrid		99	679	4,429
	Natural Gas	9,658	11,562	15,090	18,664
	Propane	1,672	2,451	3,460	4,174

Source: California Energy Commission analysis

In addition to the CEC data, CARB's issuance of Executive Orders for propane heavy-duty vehicles that were originally designed for gasoline should be considered as acknowledgement that gasoline Class 4-6 vehicles are a working component of California's heavy-duty vehicle fleet mix. Furthermore, CARB emissions warranty and useful life values reinforce the notion that LCFS Article 4 must be incorrect in Article 4's unsupported assertion that all CA heavy-duty vehicles are diesel by default.

According to CARB, Otto-cycle engines found in Class 4-6 vehicles operate at between 110,000 and 185,000 miles useful life, whereas heavy-heavy duty (HHD) diesels operate with a useful life of 485,000 miles. Similarly, the lighter-duty trucks and bus classes with Otto-cycle (gasoline) engines operate with a 50,000-mile warranty, whereas the same vehicle class with diesel engine requires a 100,000-mile warranty. Class 4 – 6 vehicles, in comparison to HHD diesels, routinely operate with lower annual miles traveled and on replacement schedules that simply do not justify the increased costs for the heavier-designed and -built diesel vehicles.

Where the marketplace and CARB regulations applying to vehicle useful life and warranty periods have recognized the inherent operational and economic differences between shorter-lived, lighter duty-cycle, spark-ignited vehicles and their more expensive, longer-lived diesel counterparts, without explanation LCFS Article 4 has assumed that all heavy-duty vehicles will be diesel-powered. This is particularly inappropriate in how Economy Efficiency Ratios (EERs) for fuel types are established and then used for qualifying a fuel for LCFS status, since diesel engine thermal efficiency is typically 30% – 35% greater than gasoline (Otto-cycle) engine efficiency. Comparing in the LCFS qualification process a diesel EER to a propane EER, where the propane engine is based on the lighter-duty spark-ignited gasoline engine platform, is clearly inequitable.

CARB, through its engine certification process, together with CEC vehicle fuel use estimates, directly support the recognition that gasoline engines are a mainstay within Class 4-6 applications. Notably, spark-ignited CNG Class 4 – 6 vehicles operate in that non-diesel portion of the heavy-duty onroad fleet, as well. LPG engines, however, are exclusively designed as spark-ignited engines and built on the lighter-duty gasoline engine base versus the heavier, more expensive, longer-lived diesel engine base.

Providing a baseline comparison of propane to gasoline is, therefore, substantiated by CEC data, WPGA members whose clients operate light- and heavy-duty propane vehicles across California, and testimonials provided by major U.S. fleet owners. Rather than forcing all alternatively-fueled, lower-carbon heavy-duty vehicles through the distorting filter of the 100% diesel-vehicle assumption found in LCFS Article 4, a separate category for propane and CNG vehicle EER assignment must be created.

RECOMMENDED ACTION: LCFS Article 4 should incorporate gasoline as an additional fuel that can be displaced by propane and CNG in Class 4-6 weight classes. Adequate precedent exists to justify this separate category; for example, CARB has established three separate EER classes of electric vehicles, on the basis that one class would not adequately capture the variability of electric vehicle types in the actual marketplace.

II. EER VALUE CORRECTION FOR PROPANE V. GASOLINE

EER values have been calculated for propane, compared with either gasoline vehicles using the same engines or via comparable certification data. Table A.1, below, shows the EER results for several leading manufacturers of propane vehicle fueling systems on spark-ignited engines, tested using a heavy-duty engine dynamometer. These include an engine certified for sale in California and three others sold in 49 states. The exhaust emission results are converted to grams of fuel or g/hp-hr data and then Btu/hp-hr, with the EER calculated from the ratio of propane-to-gasoline fuel efficiency. The analysis showing below identifies the fuel properties for Indolene (gasoline) test fuel and propane. The results are similar, however, for a range of fuel compositions since the carbon factor (g CO_2e/MJ) is relatively constant among gasoline types.

The EER data are also verifiable from vehicle and engine certification test results from propane and gasoline vehicle and engine manufacturers. CARB has access to these data and can examine a range of comparable gasoline vehicles and engines in comparison to propane. Laboratory test data in support of the emissions test results provided here are available to CARB upon request.

Table A.1. Calculation of EER for Heavy-Duty Engine Dynamometer Testing

HDV/MDV g/bhp-hr certification results

	Manufacturer A		Mfr B		Mfr C		Mfr D	
Fuel	Gasoline Test Fuel	Propane	Gasoline Test Fuel	Propane	Gasoline Test Fuel	Propane	Gasoline Test Fuel	Propane
Exhaust Emissions (g/bph-hr)								
Carbon (wt%)	86.3%	82.0%	86.3%	82.0%	86.3%	82.0%	86.3%	82.0%
Density (g/gal)	2,819	1,923	2,819	1,923	2,819	1,923	2,819	1,923
LHV (Btu/gal)	116,090	84,950	116,090	84,950	116,090	84,950	116,090	84,950
LHV (Btu/lb)	18,680	20,038	18,680	20,038	18,680	20,038	18,680	20,038
Carbon Factor (g CO_2/gal)	8,920	5,782	8,920	5,782	8,920	5,782	8,920	5,782
Carbon Factor (g CO_2e/MJ)	72.8	64.5	72.8	64.5	72.8	64.5	72.8	64.5
Exhaust Emissions (g/bhp-hr)	HFMXE06.8BWZ	HRIIE06.8BWZ	GM 6.0L		GM 6.0L		Ford 6.8L 3 Valve	
CO_2	712	621	615	535	627	529	672.8	594.43
HC	0.05	0.105	0.01	0.01	0.15	0.06	0.0911	0.0633
CO	3.7	2.33	0.1	0.1	14.4	3.05	5.4973	1.662
CH_4	0.042	0.048	0.01	0.01	0.1	0.02	0.0446	0.0271
CO_2c	718.1	625.1	615.2	535.2	650.4	534.0	681.8	597.3
Brake Specific Fuel Consumption (g/bh-hr)								
bsfc	227.1	207.9	194.6	178.0	205.7	177.6	215.7	198.7
Btu/hp-hr	9,354	9,185	8,014	7,864	8,472	7,846	8,882	8,776
EER	**1**	**1.018**	**1**	**1.019**	**1**	**1.080**	**1**	**1.012**

Note that bsfc is inverse of efficiency

Similar results are achieved with chassis dynamometer tests. Table A.2 shows the results from another propane developer. These vehicles are all certified for sale by the EPA. If certified for sale in California, the EER comparisons would be similar. An average propane EER of 1.011 was derived from the evaluation of the third party FTP75 test results from over ten paired gasoline and propane vehicle combinations. Each vehicle was tested through the three phases of an FTP75. In all tests the same vehicle, and the same testing facility, was used for each fuel. The emission test data that support the EER calculations are shown in Table A.3

Table A.2. LPG EER Calculations Based on Chassis Dynamometer Testing

MY	Make Model	Engine	EER - EEE	EER - LPG
2015	Toyota Sienna	3.5L PFI	1	1.009
2014	RAM Promaster	3.6L PFI	1	1.054
2016	Dodge Charger	5.7L PFI	1	1.01
2015	Ford Transit	3.7L PFI	1	1.015
2013	Chevrolet Tahoe	5.3L PFI	1	0.986
2016	Ford Transit	3.7L PFI	1	1.033
2012	VPG MV1	4.6L PFI	1	1.003
2012	Ford F250/350	6.2L PFI	1	0.998
2016	Ford F250/350	6.2L PFI	1	1.003
2017	Ford F250/350	6.2L PFI	1	1.004
		Mean Propane EER		**1.0115**

Table A.3 Exhaust Emission Results for Propane and Gasoline

		CO	CO2	NMHC	CH4
2015 Toyota Sienna 3.5L PFI	EEE	0.026335658	453.1734341	0.000454613	0.001045779
	LPG	0.009266362	397.7524705	0	0.001623844
2014 RAM Promaster 3.6L PFI	EEE	0.558689184	692.2612151	0.016081827	0.006760545
	LPG	0.556200912	581.6101645	0.000747901	0.002885038
2016 Dodge Charger 5.7L PFI	EEE	0.312870171	583.1167343	0.003631422	0.004034312
	LPG	0.224409032	511.7102088	0.000273929	0.001605547
2015 Ford Transit 3.7L PFI	EEE	0.704578939	609.5604317	0.01977848	0.006335246
	LPG	0.443990318	532.2456076	0.013548361	0.010444162
2013 Chevrolet Tahoe 5.3L PFI	EEE	0.384725406	589.7798119	0.001802808	0.006588211
	LPG	0.408243024	529.9371332	0	0.012780439
2016 Ford Transit 3.7L PFI	EEE	0.799265226	714.9910592	0.002774663	0.004769032
	LPG	0.30131545	613.5590173	0.006462198	0.005610628
2012 VPG MV1 4.6L PFI	EEE	0.52014952	610.1295343	0.004961089	0.002044358
	LPG	0.569206334	538.5746324	0.002564218	0.003638664
2012 Ford F250 6.2L PFI	EEE	0.90342495	932.9874098	0.008881555	0.003785157
	LPG	0.21538	828.93106	0.00735	0.00561
2016 Ford F250 6.2L PFI	EEE	0.278941324	902.2022373	0.00496721	0.00246632
	LPG	0.21725	796.71562	0	0.00427
2017 Ford F250 6.2L PFI	EEE	0.368220087	986.6248868	0.001665318	0.002143988
	LPG	0.26514	870.5878	0.00036	0.00638

Under the current LCFS process gasoline receives an effective EER of 1.0; logically, propane vehicles should also receive an EER not lower than 1.0 when displacing gasoline vehicles. Without it operators of gasoline engines will have an incentive to continue to operate on gasoline with its carbon intensity greater than either fossil propane or renewable propane, contradicting the essential intent of the LCFS. Alternatively, if spark-ignited propane engines are assigned an EER of, say, 0.9 the EER for gasoline must then also be reduced to 0.9.

RECOMMENDED ACTION: The EER value of propane versus gasoline should be assigned a value greater than 1.01.

III. ERRORS & OMMISSIONS WITH EER LPG V. DIESEL COMPARISON

Methodology Flaws with LPG – Diesel EER Determination -- Because propane engines primarily displace gasoline engines in on-road heavy-duty vehicles, accurate, "apples to apples" comparisons of LPG vehicles to diesel vehicles to establish the LPG – diesel EER are extremely difficult to find. CARB's preliminary analysis of information to support establishing a propane - diesel EER reflects several areas of concern, noted below.

Data developed out of the Altoona LPG vehicles cited in the LPG Comparison document reflect older propane vehicle technology going back to year 2010 vehicles[1]. The age of the vehicles assures results in the efficiency comparison process less favorable to propane. Current propane vehicle technology incorporates engine knock sensors, improved ignition timing to take advantage of propane's high-octane level, and a high degree of electronics integration with the vehicle's ECM. Stringent NOx standards for >2010 onroad diesels have also resulted in correlative reductions in diesel fuel efficiency. Note that CARB used this exact line of thinking, combined with engine certification data, to assess the EER of CNG vehicles in 2009[2]. In this analysis (see "Heavy Duty Engines Using CNG" on page 7) CARB compared newer LPG engines to diesel engines, recognizing that trends in NOx control justified an EER of 0.9 for CNG.

The use of Altoona test data for the EER determination has additional challenges. The testing is not as accurate as controlled chassis dynamometer testing. Key issues with the information contained within the LPG Comparison document include:

- Fuel consumption for on-road driving is difficult to measure.
    - The Altoona report indicates the use of flow meters to determine fuel consumption. This approach is extremely inaccurate compared with weighing test-vehicle fuel tanks. The reports also reference mobile fuel tanks but it is unclear how much validation of the accuracy of the fuel economy measurements was performed. Laboratory testing based on constant-volume exhaust sampling of CO_2 is much more accurate. Clearly the objective of the Altoona test facility was to assure the safety and reliability of buses. The facility was originally funded for this purpose, and estimating vehicle emissions or energy efficiency was never a priority.

- The Altoona test report contains errors in heating values that are essential for the determination of energy efficiency. The report cites the heating value of pure propane, whereas the vehicles were tested

[1] 2010 Roush Propane vehicles, for example, have since been superseded by at least two generational sets of technical improvements to emissions and fuel economy.

[2] CARB (2009). STAFF REPORT: INITIAL STATEMENT OF REASONS, PROPOSED REGULATION TO IMPLEMENT THE LOW CARBON FUEL STANDARD VOLUME II, APPENDICES, Page C-11. Date of Release: March 5, 2009

on a commercial propane-butane mixture. The heating value of diesel is cited as 126,700 Btu/gal, which appears to be at least 1% too low.

- Engine/ transmission combinations may differ, substantially affecting economy findings.
    - The testing includes steady state driving where CARB's document notes differences in propane efficiency. Differences in steady state driving can be due to the selection of the transmission. Different shift points can have a substantial effect on fuel economy for constant speed tests even though the differences would even out over real-world driving.

The use of Altoona testing is notably inconsistent with CARB's prior methodology on EER determination, discussed below and as contained in its March 2009 "Proposed Regulation to Implement the Low Carbon Fuel Standard"; Vol. II., pg C-12, C-13:

> **"Heavy Duty Engines Using CNG"**
>
> There is widespread use of CNG in heavy duty vehicles. Most of this use is in transit buses. Therefore, there is a substantial amount of data on the fuel economy of CNG relative to diesel in transit buses. Most of this data show a significant fuel economy penalty for CNG relative to diesel, ranging from about 10 percent to about 25 percent, depending on driving cycle. However, many of the CNG engines used in transit buses are older model years. Improvements to CNG engine efficiency have been achieved in more recent model year engines.
>
> Cummins Westport LLC has recently developed a spark ignited, stoichiometric-cooled exhaust gas recirculation heavy duty CNG engine, referred to as ISL G, which meets the ARB's 2010 NOx and PM standards. The ISL G engine has less of a fuel penalty relative to diesel, than most of the CNG engines that are currently being used in transit buses. According to the data used to certify the ISL G engine to the ARB's 2010 NOx and PM standards, the fuel penalty for the ISL G engine is about 10 percent. This translates to an EER of 0.9. The staff believes that this engine and emissions control technology will likely play an increasingly greater role in the use of CNG in heavy duty engines beginning in 2010 as engine manufacturers comply with the 2010 standards. For this reason, the staff has decided to use the fuel economy of the ISL G engine as the basis for heavy-duty CNG engines.
>
> The Staff will continue to review the test data from other CNG engine technologies as these technologies are used to meet the 2010 standards, and will make any needed revisions to the EER for the heavy duty CNG engines."

When comparing the LPG EER to diesel, CARB's approach must be consistent with the process used to establish the CNG-to-diesel EER. On-road EER-related data from carefully-designed, latest-generation propane v. diesel vehicle studies is extremely limited, and older data gained from Altoona tests cited by CARB (LPG Comparison document) is burdened with "apples-to-oranges" inconsistencies that render unacceptably poor confidence levels.

Furthermore, the Altoona studies contain significant errors in the energy density of commercial propane (Altoona tests mistakenly assumed use of pure propane) and diesel such that their efficiency comparisons may be invalid. The tests use flow meters for fuel use determination, which is far less accurate than CO_2 measurements used in certification testing. CARB should examine the Altoona certification test data carefully.

Pending the availability of acceptable test emissions and fuel use comparative data taken from the most recent CARB-certified propane vehicles to establish the LPG – diesel EER, and because LPG – gasoline EER data point to a >1.0 EER, it is logical that the LPG – diesel EER be set at not less than the 0.9 EER given to CNG – diesel[3] vehicles.

Finally, CARB should examine onroad vehicles in the 26,000 lb. – 33,000 lb. GVWR weight range that are primarily gasoline-designed and fueled, and then assign a reasonable EER. CARB must also recognize the fuel efficiency improvements of newer LPG vehicles and not base its EER determination on older technology and dubious test results.

RECOMMENDED ACTION: The LPG EER compared to diesel should be no lower than 0.9, and CARB must provide equal treatment of both LPG and CNG in the EER determination process.

IV. PROPANE SUPPORTS LCFS OBJECTIVES

Propane's Carbon Benefits Are Superior to Gasoline or Diesel -- Propane is a hand-in-glove displacement strategy for gasoline, and because propane has a comparatively lower carbon intensity its potential to displace gasoline helps fulfill the mission of the LCFS in reducing CA transportation's carbon emissions.

As noted above, CARB has already certified propane-powered engines that displace gasoline in both heavy- and light-duty applications. These certified propane vehicle engines are spark-ignited, built on the lighter, less industrial gasoline engine base, and operate in lighter-duty commercial truck and bus weight classes—as opposed to engines designed on compression-ignition (diesel) engine bases operating up to and through heavy-heavy duty (HHD) Class 8 applications.

Higher-carbon, traditional petroleum fuel EERs used in the LCFS to qualify a renewable fuel for carbon credits may be ultimately counterproductive, since a renewable fuel's ability to generate credits is made functionally moot if the renewable-fuel test vehicle has an EER less than that established for its gasoline counterpart. Incorrectly setting an EER of less than 1.0 for gasoline-vehicle displacement effectively taxes propane, and contrary to the LCFS' essential objective of reducing transportation-related carbon emissions, vehicle operators will then be forced to remain with gasoline vehicle use, particularly when operating in rural areas and under duty cycles and budgets that do not yet permit reliance on electric, hydrogen, or fuel cell vehicles. Worse yet is what occurs when forcing spark-ignited, gasoline-replacing propane vehicles to compete for an EER against the more thermally-efficient diesel engine.

LCFS Article 4's Inherent Bias -- Assuming for argument's sake that the diesel EER is the only EER that propane can be compared to in the Class 4-6 weight class, and that CARB's LPG Comparison document acceptably identifies the propane-diesel EER despite its highlighted flaws, propane would be penalized as an LCFS deficit generator--despite its lower carbon intensity. In such a case, the LCFS' carbon-reducing goals would be circumvented.

The central regulatory goal of the LCFS is to decrease carbon intensity in transportation-energy consumption. Producers, marketers, and users of energy are all impacted by the LCFS. Specifically, through its reward-and-penalties process of classifying fuels as either credit generators or deficit generators, CARB has shaped the energy landscape for fuel producers and marketers. Indeed, the propane industry which once sought exclusion from the LCFS is now asking for inclusion because of the role its lower-carbon intensity fuel can play in encouraging the production, sale and use of lower-carbon fuels over gasoline and diesel.

[3] ARB (2009). STAFF REPORT: INITIAL STATEMENT OF REASONS, PROPOSED REGULATION TO IMPLEMENT THE LOW CARBON FUEL STANDARD VOLUME II, APPENDICES, Page C-11. Date of Release: March 5, 2009.

However, propane will have no such role if the LCFS' Article 4 acts to force a propane EER that must be set below the more thermally efficient diesel's EER, since such a lower-than-diesel EER could only result in carbon deficit (and not credit) generation for the refiner or retailer. Refiners capable of producing renewable LPG (RLG) would then have no LCFS-based economic rationale for the extra costs to produce RLPG and take it to market-- thereby preventing RLPG development and market access to an otherwise viable, very-low carbon intensity alternative vehicle fuel for CA.[4]

In short, forcing an alternative fuel used in an Otto-cycle engine to compare to the more efficient diesel cycle engine sets the propane engine at an EER disadvantage—which, in turn, can be expected to effectively preclude renewable propane production since refiners would accrue carbon deficits and not credits. This "for want of a horse"[5] LCFS Article 4 conundrum not only serves to eliminate development of an alternative, low-emission renewable fuel that would have far lower carbon intensity values (compared to gasoline or diesel), it penalizes propane vehicle technology and fuel marketers while contradictorily ensuring retention of diesel vehicles and diesel fuel use by California drivers.

V. CONCLUSION

In conclusion, the Western Propane Gas Association asks that CARB recognize that:

- Over one-third of California's heavy-duty vehicle fleet use gasoline-based engines and will continue to do so, inclusive of propane vehicles with engines exclusively derived from gasoline (and not diesel) platforms;

- Propane engines operating in Class 4 – 6 vehicles exclusively displace gasoline engines

- For purposes of establishing an EER for propane in the LCFS process, propane heavy duty vehicles will be compared to the gasoline EER; or, at the very least have parity with natural gas at 0.9

- LCFS Article 4 appears to inappropriately require that traditional, non-renewable propane be used to establish an EER which, when compared to traditional gasoline and diesel EERs, will determine whether the fuel qualifies LCFS credit generation. This process ignores disparities between fuels and engines used to generate EERs;

- Altoona data used in the "Propane Bus Energy Efficiency Compared to Conventional Diesel Vehicles" appears to be greatly flawed and must not be relied upon to identify propane regulation in the LCFS.

- Renewable propane would provide substantial carbon emission reduction benefits, yet is precluded as an LCFS option if the EER established for traditional (non-renewable) propane is not equivalent to or better than traditional gasoline and diesel EERs. If it is not, LCFS Article 4 will then essentially preclude development of renewable low-carbon propane for use in California, in obvious contradiction to LCFS objectives.

[4] Renewable LPG is estimated to have a carbon intensity in the low 30's, a ~60% reduction from that of fossil LPG. Fossil LPG's carbon intensity is, notably, several points below that of gasoline.

[5] "For the want of a nail the shoe was lost, For the want of a shoe the horse was lost, for the want of a horse the rider was lost, For the want of a rider the battle was lost, For the want of a battle the kingdom was lost,
And all for the want of a horseshoe-nail." Quote attributed to Ben Franklin.

We look forward to continuing to work with CARB staff in the coming weeks and appreciate the dialog thus far. We remain hopeful that traditional and renewable propane's carbon benefits are recognized and treated fairly in the LCFS process, and then realized with their expanding use in CA fleets.

Sincerely,

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