Volvo Group North America

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To: Renee Littaua
California Air Resources Board
1001 "I" Street
Sacramento, CA, 95812

From: Dawn Fenton
Director, Government Relations & Public Affairs

Subject: **Volvo Group Comments on CARB Draft Technology and Fuel Assessment: Overview**

Introduction

Volvo Group appreciates the opportunity to comment on the technology assessment "Draft Heavy-Duty Technology and Fuels Assessment Overview, April 2015," by the California Air Resources Board. We greatly appreciate the methodical approach to assess the technical readiness, feasibility, suitability and impacts of various technologies as a matter of responsible policy development and rulemaking process. Volvo recognizes that this is an extremely challenging and complex task, and we stand ready to assist. We reference the sections and page numbers of the document in our comments.

Volvo Group is one of the world's leading manufacturers of trucks, buses, construction equipment and marine and industrial engines. The Group also provides complete solutions for financing and service. Volvo Group, which employs about 100,000 people worldwide, has production facilities in 19 countries and sells its products in more than 190 markets. In the United States the Volvo Group employs 12,000 people and has six manufacturing plants in five states.

Executive Summary (p. i)

The staff report lays out a broad overview to the challenges of NOx, GHG and PM reduction to help the state meet 2030/2031/2050 federal and state goals. It cites improvements in efficiency and the use of renewable fuels as one key path,

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but then says a “transition to zero and near-zero emission technologies will be required in all mobile sources.” A company focusing on increased efficiency and renewable fuels would not necessarily preclude moving toward zero and near-zero emissions technology, but the engineering resources needed to pursue all of these paths in tandem will stress most major original equipment manufacturers in the heavy-duty vehicle segment. Volvo’s approach to the market is based on providing the most effective solution for each application and duty cycle to maximize customer efficiency rather than pursuing a specific technology solution.

As noted in the Executive Summary, the heavy-duty sector is coming off a decade of dramatic improvements in its traditional engine technology. While the advances have been significant, there also has been a learning curve about the integration of these new technologies. In fact, those technologies are still striving to attain full acceptance in the market. CARB’s concern about durability and warranty issues are testament to the fact that this “learning curve” is ongoing. To suggest another round of even more dramatic changes will likely cause additional delays in the introduction of new technologies (please remember the massive pre-buy of heavy-duty trucks before the introduction of MY2007 engines) due to concern about the real-world impact of those technologies.

Volvo Group believes that it is important to continue the path towards the development of zero-emission technologies and is actively working on them. However, we caution that artificial deadlines for the introduction of such technologies can result in products coming to market that will not achieve the expected results. We think a period of robust in-use testing and data gathering will be necessary to validate the real-world achievements of any new technology.

In addition, we applaud your call for an “integrated approach” to developing and deploying advanced technologies. As staff has acknowledged, zero and near-zero emissions vehicle technologies can have a direct impact on localized criteria pollutants, but a full lifecycle accounting of greenhouse gas impact is needed. That approach should lead to more consideration of whole vehicle and whole systems considerations. It also would strongly suggest that CARB look beyond engine regulations as the sole method of measuring progress on environmental issues. Integration should refer not only to the intersection between the fueling infrastructure and the vehicle, but also to the integration of emission reductions

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gained from improvements throughout the entire vehicle and not just through the engine.

Overview of Diesel Engines (p. 4)

The discussion here addresses new engines but also touches on in-use rules that CARB is still in the process of implementing. Given the immediate impacts seen by some of the regulations implemented in the port areas, and the speculative nature of some of the new technologies still in their demonstration phase, we wonder if more assessment of the long-term impact of current regulations shouldn't be part of this assessment.

The comment that the emissions reductions from new technology have been "slow to materialize due to slow vehicle turnover in fleets operating in California" is worthy of further discussion. How would new, more stringent emissions regulations positively change this dynamic? In fact, it would seem that a push for technologies that may not have been proven in real-world applications, or able to compete in the marketplace without extensive subsidization, would result in even slower emissions reductions.

Key Preliminary Observations (p. 6)

While these observations are labeled as preliminary, it should be noted that some of them are quite speculative and based on very early demonstration projects that have not delivered results that would lead to such conclusions. Volvo Group comes to this conclusion based on the projects in which it is involved.

For example, the assumption that "series hybrid heavy-duty applications could help commercialize zero emissions technologies, provide zero emission miles or activity in many applications, and serve as a pathway to help zero emissions technologies mature in the heavy-duty sector" is highly speculative because of the diverse nature of heavy-duty vehicles and the wide variety of applications demanded by customers. Our opinion is based on projects we are involved in directly in this area.

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In addition, the nature of heavy-duty vehicles requires that a vehicle not only be functionally effective in its given application, but be able to provide a return on investment for the buyer employing the vehicle. Maintenance and repair costs, downtime and residual value all contribute to total cost of ownership calculations which drive acceptance of technologies in the market. As with most of the new technologies discussed in this draft paper, the jury is still out on whether those vehicles can deliver a return on investment that will make them not just commercially available, but commercially viable.

This comment, "Near-zero emission technologies are nearing commercialization," is also speculative, since those technologies have not been demonstrated in real-world truck applications. The steps towards commercialization for a major OEM are far greater than for smaller companies, requiring significant investments in durability/reliability testing, certification, technical documents, dealer training, supplier agreements, etc. From this perspective, near-zero emission technologies still remain far from commercialization.

a. Zero Emission Vehicles/Equipment and Hybrids (p. 8)

"Technologies are considered commercially available when they are produced and distributed for sale."

This statement is not based on fact, in our view, since it reflects only a part of what a "commercially viable" technology must do. We believe just having a technology available is only a small part of the equation. Sustainable commercial viability is the key metric that must be used for new technologies. That viability is maintained by a manufacturer's investment in new spare parts, retrained technicians, new repair & diagnostic tools, etc.

Using such a metric may delay the period of introduction of a new technology, but when it is brought to market, it should have a better chance of success.

A key element left out of the discussion of commercialization, early commercialization, demonstration and pilot deployments is the critical need for integration of new technology. In Volvo Group's experience, technology integration can be a long and expensive process. Technology brought to market

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without proper integration faces not only the prospect of market failure, but raises the specter of casting that technology in a negative light for some time.

The reference to the benefit for the heavy-duty sector from light-duty zero emission technology is misplaced. While light-duty advances like battery cell technology *could* benefit heavy-duty application, no components can be shared, hence there are no economies of scale between the light-duty and medium/heavy-duty markets. Component requirements are completely different due to different power, voltage and current levels as well as vastly different usage environment and durability targets. The technology may, in some cases, be scalable to heavy-duty applications, but to date a business case for those technologies has not been made. Without a business case, this is just good technology seeking a market.

Hybrid technologies (p. 14)

The document mentions fuel economy benefits from mild hybrids. We strongly believe that hybridization is not an optimal choice for the majority of heavy-duty vehicles. Efficiency from hybridization is heavily dependent on duty cycle and driver habits, and has not demonstrated adequate improvement in most heavy duty applications, especially in a business case analysis due to the high cost of this technology.

(p.18) “Based on prior Vision modeling work and this technology assessment work, staff believes that low carbon fuels, vehicle and engine efficiency improvements, and zero emission vehicles will all be necessary to achieve California’s GHG goals and the Governor’s petroleum reduction goals.”

Volvo Group heartily endorses the above statement and encourages CARB to act on it by supporting not only zero and near-zero emission technology, but vehicle and engine efficiency improvements. To keep the state moving towards its aggressive goals it will take the advancement of all technologies, not simply a favored few, i.e. electric drive.

Electrification of individual auxiliary components as a path to increasing the efficiency of a combustion engine would increase cost, weight, complexity and

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packaging constraints since most components targeted for electrification often have high power or torque requirements, thereby making it a less-than-optimal means to improve vehicle efficiency. Electrifying powertrain or chassis auxiliaries also potentially creates reliability and durability concerns as well as issues of cost, weight and packaging that have been an obstacle to commercialization. Industry's preferred approach has been to look for mechanical ways to improve these auxiliaries.

Volvo is exploring in advanced technology projects within California and elsewhere approaches that could achieve the benefits expected from electrification of accessories through improvements in the overall system and its components. Such an approach avoids the negatives of component electrification while realizing similar benefits in emissions reductions.

ii. Well-to-Wheels Analysis (p. 18)

Volvo Group believes the WTW analysis is critical not only to the measurement of GHG reductions, but also can play a role in gauging criteria pollutant reductions. We believe this is a critical factor that should be considered at all parts of the technology assessment.

iv. The Role of Renewable Fuels (p. 20)

This section mentions two key words – *where feasible.* We believe feasibility, instead of what could be read as wishful thinking, should be a cornerstone of California policy. New technologies will clearly be needed and must be encouraged and incentivized, but policy direction should not be built upon them until they have proven themselves as viable in the marketplace. A corollary of this is that the advancement of current technology and fuels also should receive similar encouragement to maximize progress on all fronts.

b. Vehicle/Equipment Efficiencies (p. 20)

(p. 20) *Incremental efficiency improvements to heavy-duty engines and vehicles/equipment can provide substantial GHG reductions, on the order of 40 percent or more in some sectors.*

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While it is true that incremental efficiency improvements can provide substantial GHG reductions, it is important to remember that efficiency gains from individual technologies are not additive and can often conflict with one another. For example, waste heat recovery systems require additional cooling capacity which undermines potential aerodynamic gains and payload capacity. Figures near 40 percent have been cited due to the successes of the Department of Energy's SuperTruck program, but it is important to remember that these trucks are one-off experiments, built at a cost of tens of millions of dollars per vehicle. Technologies employed on these vehicles were not assessed for market viability and in some cases, are not even legally allowed. For this reason, a credible estimate of efficiency gains must be measured using technology packages similar to what is being done with current testing and simulation by SwRI. Integration of individual and combined technologies is the key to delivering real-world improvements in vehicle performance.

In fact, the percentage ranges for many of the technologies' fuel economy impacts appear to be speculative and not based on real-world duty cycle testing.

i. Heavy-Duty Truck Efficiency Improvements (p. 21)

The results of the SuperTruck program, which is referenced on p. 22, are used to determine what can be accomplished. Each SuperTruck has technologies that are developed purely for demonstration purposes on a route specifically selected to showcase the technology package without full consideration for safety, reliability, performance under non-ideal conditions, or cost. Like the NAS report that was referenced in an earlier staff workshop, SuperTruck results provide a starting point to investigate what might be feasible, not an end point.

The material references a typical 2009 baseline mpg of 5.5 to 6.5 mpg as compared to a demonstration of 10.7 mpg. Unlike the typical baseline vehicle, the SuperTruck figure does not reflect impacts from congestion, urban operation, overnight idling or other conditions of "typical" trucks. Since commercially operable trucks do not run at constant, unrestricted highway speed, it is inaccurate to compare such numbers to establish improvement percentage targets.

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d. Improved Combustion Technologies (p. 24)

Paying closer attention to the potential real-world gains from increased emissions standards is an important step for CARB to take. Our informal calculations show that regulations such as the Low-NOx standard, while appearing to require engines to meet a 90 percent emissions reduction in certification, might only deliver only slightly more than half that reduction in real-world duty cycles due to the operating characteristics of aftertreatment equipment.

i. Role of Near-Zero Emissions Technologies (p. 26)

"Near-zero emissions technologies are nearing commercialization …"

As we stated previously, we do not agree with the characterization of technologies that are not yet introduced to the market even in limited quantities as "nearing commercialization."

When assessing near-zero emission technologies requiring additional emissions equipment you must acknowledge that there will be a period of adjustment that may negatively affect reliability and/or durability of the overall emissions system. This has been experienced in past emissions treatment technology transitions. As stated on p.26 (which we endorse strongly and have added emphasis): "proper engineering systems integration and the use of advanced aftertreatment is the key to achieving much deeper criteria pollutant and GHG reductions control along with improved durability."

This underscores that the demonstration of a capability to meet a certain standard is not the same as putting a technology into production or making it available for sale, nor integrating it into an engine and vehicle that can perform the tasks for a given sector of the heavy-duty market.

ii. On-Road Truck Optional Lower NOx Standards (p. 26)

Again, demonstration is not production with a consideration for durability and long-term positive impact in the real world. This is a critical aspect of any new

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regulation. We believe the performance issues encountered with the equipment designed to meet 2007 and 2010 heavy-duty engine regulations underscore the need to closely scrutinize any new regulatory move with an eye to potential negative impacts as well as the more obvious positive ones.

iii. On-Road Truck Required Lower NOx Standards (p. 27)

It is imperative that before CARB proposes a mandatory low-NOx standard, it first should figure out what to measure, i.e., what cycle of testing reveals the closest measure of real-world emissions. We are convinced that simply requiring a lower NOx standard based on current test cycles will not yield the real-world emissions reductions desired. In fact, this approach may deliver less than half the intended NOx reductions.

vi. Off-Road Equipment Potential Reductions (p. 27)

This initial statement, "The path to near-zero is not as clear in the off-road sector," could also be applied to the on-road sector because of the diverse duty cycles.

ix. National and International Standards Harmonization (p. 29)

Volvo strongly supports efforts to harmonize standards. Common standards can help free up significant engineering and financial resources that could be directed toward innovation of new technologies, rather than developing multiple products to comply with multiple regulatory standards.

e. Automation, Connected Vehicles, and Intelligent Transportation Systems (p.29)

"…significant efficiencies can be gained…"

Volvo, one of the worldwide leaders in ITS, believes this is a critical area, one on which CARB should focus as it works to reduce emissions. Volvo has demonstrated some potential gains from this technology in the ports and with buses.

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ii. Truck Platooning (p. 30)

Volvo is active in this area and is in the process of documenting the real-world potential for platooning in a California-based project. Platooning offers significant potential benefits, but faces legal and public acceptance challenges. Moreover, since emissions reduction and energy savings only accrue when a truck is actually in a platoon, it remains unclear how a platoon-capable truck would be given efficiency credits.

f. Need for Continued Integrated Planning for Technology and Fuel Deployment (p. 32)

In addition to the previously stated opinion that new technology needs to be evaluated critically on its effectiveness in the duty cycles of on- and off-road equipment, a screen for cost-effectiveness should be added to the evaluation criteria. Because of the nature of heavy-duty equipment, their ability to become a part of a business case for use is very important.

"Government incentives and regulations have and are expected to continue to play a major role in accelerating technology development and commercialization."

Volvo agrees with this statement, but would like to add that the government needs to be mindful of two dynamics of the heavy-duty vehicles industry:

1. Early technology funding is "cheaper" but is farther from the market; incentives and market pull come much later and are much more expensive. The former approach also carries with it a higher risk factor.

2. Development of a technology and deploying it in the market, even if not in a fully commercialized form, are very far apart on the technology assessment scale in both dollars and time. We do not see clear distinction between those categories in some of the proposed incentives in the AQIP/Low Carbon Transportation funding.

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Finally, even though Volvo Group is no longer involved in the light-duty market, we understand it quite well and do not believe accomplishments there are analogous for the heavy-duty market.

That said, one dynamic is similar in the two markets: While regulations can spur innovation, they also can consume enormous amounts of engineering focus and development capital. This is why clear regulatory direction is so important. As well, industry might perceive this as a mixed message – that there is a desire for zero/near-zero emissions technologies as well as the continued advancement of current technology, but CARB has placed almost all development and incentive money on the first category.

Volvo requests that CARB consider carefully what will deliver both near-term and long-term progress towards its ambitious goals and work with industry to make sure that all paths that might lead toward its goals are endorsed and incentivized.

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