October 6, 2014

California Air Resources Board

1001 “I” Street

Sacramento, CA, 95812

**RE: Volvo Group Comments on CARB Technology and Fuel Assessment Workshop Presentations for Trucks - September 2, 2014**

The Volvo Group appreciates the opportunity to comment on the technology assessment work done 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 in any way we can.

The 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. The Volvo Group, which employs about 110,000 people, has production facilities in 18 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.

**Overall**

The engine/powerplant optimization slides cite several credible references including many from academic, governmental or non-profit studies which, though valuable, cannot accurately reflect the extensive commercialization considerations and cost implications of incorporating various technologies into a new vehicle. There is heavy reliance on the NAS committee report for estimated improvement potential, however this should only be seen as a starting point for evaluating possible technologies.

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. Alternatively, waste heat recovery on a highly aerodynamic truck will likely not generate as much improved efficiency. 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.

The “Heavy-Duty Hybrid Vehicle” slides mention that fuel economy is a driver for hybrids, however 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 been able to demonstrate adequate improvement in most heavy duty applications, especially in a business case analysis due to the high cost of this technology.

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

We strongly support the comment in the conclusion slide #46 in the engine/powerplant optimization section that “best options depend on truck class and duty cycle.” Trucks are built to provide greatest freight efficiency and lowest overall cost of ownership to our customers. Not all technologies make sense or add value by this definition to all customers. As a result, it is critically important to test technologies as part of a package, or from a complete system approach to realize estimated gains in real world applications.

The presentation does not include any mention of vehicle to infrastructure (V2I) technology. One such example would include traffic signal synchronization with vehicles to better adjust speeds and avoid stop/starts.

**Supertruck**

SuperTruck results 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, 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.

**Specific Technologies**

**Waste Heat Recovery**

Although waste heat recovery is deployed in Volvo’s SuperTruck, we do not expect that the technology is directly applicable across all duty cycles and engine/driveline combinations.  If deployed with larger engines, the tractor aero performance cannot be maintained.  Volvo’s work does not indicate that electric turbo-compound is more efficient than mechanical. We question whether the costs provided account for necessary work on reliability development, controls, OBD or other commercialization considerations. We also believe the

6-10% FE improvement is greatly overstated for any reasonable composite duty cycle and that the negative impact on vehicle weight and aerodynamics have not been considered.

**Aerodynamics**

Aerodynamic improvements estimated in the presentation are realistic, but only assuming a baseline trailer without existing aero improvements (which is not the case in California due to the use of Smartway technology under the state’s tractor-trailer greenhouse gas regulation. With regard to specific estimated savings in slide 41 of the engine/powerplant optimization handout, it should be noted that the 2% fuel efficiency assigned to the trailer gap cannot be guaranteed since the fifth wheel is under operator control and can be moved.  As for the 3% savings assigned to the tractor, this would likely require a whole new cab, normally not done more than once every 15-20 years.  Finally the aero configuration on slide 42 covers the wheels which precludes opportunity for inspection and is therefore not currently feasible.

**Advanced Transmissions and Engine Downsizing**

Slide 34 in the engine/powerplant optimization section claims a 0-9.5% efficiency improvement from transmission technology.  In fact, today’s typical mechanical transmission is 97-99% efficient so not more than 1% improvement can be directly attributed to transmissions, at least for the tractor fleet.  Transmissions do enable greater engine efficiency by facilitating down-speeding and down-sizing but this is already counted in engine efficiency.  There is no clear path to crediting transmission technology in the various regulatory schemes.  A complete vehicle simulation will include the impact of down-speeding and downsizing the engine, but engine standards do not include this.

**Stop-Start**

We believe the 5-10% fuel efficiency estimate for stop-start on slide 36 of the presentation slides is highly unrealistic, except possibly in heavy urban traffic. Cost estimates fail to account for greatly increased engine wear which may force rebuilds at a cost of over $10,000.  Also, starters will need regular replacement and we question whether the $600-$900 estimated cost accounts for maintaining cab comfort during the shutdown intervals, as well as higher cost of batteries capable of deeper charge/discharge cycles to provide seamless power to e.g. exterior lights, on-board electronics, etc.

**Longer Combination Vehicles (LCVs)**

On slide 49 of the engine/powerplant optimization handout, it should be noted in the remedies column that telematics-based monitoring solutions (which are required elsewhere in the world) could help mitigate potential negative safety impacts, as well as ensuring that LCVs would not operate outside of roads where they are permitted.

**Predictive Cruise Control (PCC)**

Slide 58 in the handout shows predictive cruise control only having applicability for long haul vehicles. While these would see the greatest gains, benefits could be realized across all segments.

We believe the 1-3% estimated improvement from predictive cruise control is appropriate; however, all of these systems can be deployed or turned off by operators, which traditionally undermines the credit value of such systems by regulators.

Omitted from this slide are potential benefits of connected PCC, where vehicles exchange this data between one another.

**Platooning**

Platooning offers significant potential benefits, but faces legal and public acceptance challenges. Moreover, since savings only accrue when a truck is actually in a platoon, it remains unclear how a platoon capable truck would be given efficiency credits.

**Other**

In the presentation on Natural Gas and other Alternative Fuel Engines, slide 26 mentions anticipated limited production of DME trucks in 2015. This date is no longer accurate. More time and support will be needed from CARB and other industry stakeholders to validate the technology and target lower NOx levels.

DME technology, using a compression ignition principle, is at least 15% more efficient than a comparable spark-ignited engine and can be more easily combined with hybrid/plug-in hybrid technology than natural gas due to lesser packaging concerns. It also offers higher potential CO2 reductions from current fossil diesel fuel when a well-to-wheel approach is taken (potentially up to 80% if produced form bio sources).

Sincerely,

Dawn D. Fenton

Director, Government Relations & Public Affairs