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TO: California Energy Commission IEPR Docket
FROM: Jamie Hall, Policy Director
RE: Docket No. 14-IEP-1B – Integrated Energy Policy Report

CALSTART appreciates the opportunity to provide input into the Integrated Energy Policy Report. As a follow-up to the April 10 Workshop on Transportation Technology over the Next Ten Years, we are providing brief written comments. Our comments focus on two areas: medium and heavy duty vehicle investments, and (2) coordination of workplace charging to facilitate electric vehicle deployment.

Medium- and Heavy-Duty Vehicles

CALSTART President and CEO John Boesel spoke on the medium- and heavy-duty vehicle technology panel at the workshop. As noted in his presentation, there is tremendous potential for progress in this sector, but there are also many barriers that need to be addressed. The Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) provides an extremely valuable tool for addressing these needs. Cap and trade revenues could provide even greater resources.

As laid out in the attached CalHEAT Roadmap, the suite of technologies that can play a role in the trucking sector is quite large, with different options for different applications. These are summarized in the table below.

Pathway	Technology	Class 7-8 Urban	Class 8 OTR	C 3 – 8 Work Site	Class 3 – 8 Urban	Class 3 – 8 Rural	Class 2b – 3 Vans/ trucks
Electrification	Hybrid Electric	●	◑	●	●	●	●
	Electrified Auxiliaries	●	●	●	●	◑	●
	E-Trucks	●	○	◑	●	◑	◑
	Electric Power Take-off	○	○	●	○	○	○
	Plug-in Hybrids	●	○	●	●	●	●
	Electrified Corridor	●	○	○	◑	○	○
	AF Hybrid	●	◑	◑	●	●	◑
Engine and Driveline	Hydraulic Hybrid	◑	○	○	●	●	●
	Optimized AF Engine	●	●	●	●	●	●
	Waste Heat Recovery	●	●	○	●	◑	◑
	Engine Optimization	●	●	●	●	●	●
	Alternative Power Plants & Combustion Cycles	●	●	◑	◑	◑	◑
	Transmission and Driveline	●	●	●	●	●	●

The 13 technology strategies deemed most feasible by the CalHEAT research are shown in this chart. Solid circles represent the technologies in the Roadmap that are expected to contribute to noticeable CO_2e reductions by 2020. Half circles represent technologies expected to be implementable after 2020 with noticeable results. The empty circles indicate technologies not expected to offer significant results in that truck category.

California Hybrid, Efficient and Advanced Truck Center Research

In order to move these crucial medium- and heavy-duty technology pathways forward, investments are needed across all stages of technology development and commercialization. This includes everything from studies and standards through

technology development, pilot demonstrations, larger pre-commercial demonstrations, and early commercial deployments.

- ***Studies and Standards:*** Funding is needed for business case studies, technology feasibility studies, complex modeling, and simulations, as well as the creation of standards. These needs are especially important for zero-emission trucks and buses as well as enabling technologies such as electrified accessories and fueling infrastructure. Examples include energy storage standards, business case studies, and consensus building around roadway power systems. Investments in this stage are small relative to later stage technology work, but they are vitally important and often overlooked.
- ***Technology Development:*** Early-stage funding is needed for development of components, subsystems, and complex drivetrain systems. These investments are necessary to enable zero emissions M-HDVs, especially in heavier long-haul applications. Current state programs do not place sufficient priority on these earlier stages of the innovation process. Key investment examples include development of advanced engine designs such as camless engines, development of improved fuel cell bus technologies, and waste heat recovery systems for M-HDV applications.
- ***Small Scale Technology Demonstrations:*** Funding is needed to fully integrate new technologies into 1-5 vehicles to evaluate their performance. Examples include evaluation and benchmarking of alternative fuel hybrid trucks and pilot demos of smart charging systems for e-trucks. We would recommend increased funding for technology demonstrations, as well as funding for coordination and planning around investment priorities.
- ***Larger Pre-Commercial Demonstrations:*** Funding is needed for real-world demonstrations involving greater numbers of vehicles to evaluate "real world" performance in the field. These deployments may include up to 50 vehicles that have already gone through small scale demonstrations to prove technological viability. It is important to note that these demonstrations will often require coordinated funding for both vehicles and infrastructure. Examples include demonstrations of improved e-trucks with longer ranges and faster charging capabilities, dual-mode hybrid and range-extended electric drayage trucks, and technologies appropriate for long haul applications in the valley. Further technology refinement based on the results of these demonstrations would precede commercial production.
- ***Purchase Incentives for Commercial Deployments:*** After technologies are successfully demonstrated in large-scale pre-commercial demos, they will need funding for early commercial deployment. Public investments and incentives are needed at this stage to help new technologies achieve economies of scale and become commercially viable. Vehicle purchase incentives should be simple, streamlined, and combined as appropriate with funding for fuel infrastructure. Industry generally prefers a first-come, first-served point-of-sale voucher approach.

The ARFVTP funds can play a very important role in meeting the investment needs outlined above. While the administration has shown a real interest in focusing on goods movement technologies, we note that there are opportunities in transit buses and off-road technologies as well.

Bus investments will have "spillover benefits" for the truck sector. Buses are a proving ground for advanced technologies. This is due in large part to the fact that the federal

government helps subsidize bus purchases. Many of the major electric drive providers in the medium and heavy duty space today initially entered the market in bus applications. This business allowed them to engineer heavy duty electric drive vehicles at a systems level, and develop a deeper knowledge of energy storage systems, vehicle software controls, and supply chains.

Technologies proven in on-road applications also have spillover benefits for off-road. We know that CEC is already involved in some off-road demonstration projects and we see considerable opportunities for progress there.

To provide significant additional detail on technology status and specific investment needs for truck technologies in particular, we are also submitting two additional documents as attachments to the docket:

- **California Hybrid, Efficient, and Advanced Truck Research Center (CalHEAT) Research and Market Transformation Roadmap for Medium- and Heavy-Duty Trucks.** This report provides a detailed roadmap for investment needs across 13 technology pathways.
- **I-710 Project Zero-Emission Truck Commercialization Study: Final Report.** This report provides a "deeper dive" on investments and policies needed to enable zero emission drayage trucks in the I-710 region.

Investment needs for the medium and heavy duty sector are large and complex. This is partly due to the fact that the market is fragmented and the manufacturers and suppliers have limited resources. The major OEMs are not vertically integrated and are often not the ones investing in advanced technologies. Zero emissions drivelines or hybrid systems may be integrated into vehicles by late-stage technology integrators or after-market up-fitters. Many of these are start-up companies with limited budgets. Fleet budgets are similarly limited, meaning that high incremental costs can be an insurmountable barrier without incentives. Over the longer term, investments in cost-reductions are vitally important.

Given the scale and complexity of the challenge, we believe additional funding is needed for this category. We are therefore pleased to see that the Governor's proposed budget includes funding for cleaner freight and for purchase incentives. We also recommend investing some time and resources in planning and prioritizing investments, ensuring coordination amongst the relevant agencies, and incorporating expert input on technology and investment needs.

Workplace Charging

To support the state's goals of 1.5 million ZEV by 2025 a reliable number of charging locations is needed. While home charging will remain the most common location for PEVs to charge, we see workplace charging as the second most important. It has been shown that increasing the number of PEV chargers at places of work can increase adoption of PEVs as commuter vehicles. This has been observed by employers that have adopted workplace charging and regional PEV Councils themselves.

The number of companies that offer workplace charging in the state remains small. In order to significantly grow this number we believe a coordinated statewide effort of education and outreach is needed in the state. PEV planning has traditionally been done on a regional basis. However the issues that are relevant to address workplace charging are very much the same throughout the state, regardless of the region, and are best conducted as a statewide effort. Coordinated statewide outreach promoting awareness through outreach and education to workplaces, businesses, and property managers has the potential to engage a broad number of companies to adopt workplace charging at their sites. We recommend funding a statewide effort to engage employers and provide the information and resources for workplace charging.