October 1, 2014

California Environmental Protection Agency (CalEPA)
California Air Resources Board (CARB)
1001 "I" Street
Sacramento, CA 95814

Re: Technology Assessments for Sustainable Freight Strategy

Clean Transportation Technologies and Solutions

www.calstart.org

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CALSTART

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CALSTART appreciates the opportunity to provide brief overarching comments on the technology assessments that ARB is conducting to support the sustainable freight strategy. As outlined in the California Hybrid, Efficient, and Advanced Truck Research Center (CalHEAT) Technology and Market Transformation Roadmap, accelerating progress in this sector will require a nuanced approach to technology and where it is in the commercialization process, segmentation of which applications different technologies best address, and both carrots and sticks in the regulatory tool kit. The optional low NOx standard is an important starting point for driving emissions reductions from freight, and the passage of SB 1204 (Lara and Pavley) provides some of the structure for investments in this sector. The technology assessment work is very important to lay the groundwork for future regulations and investments around sustainable freight.

We are impressed with the tremendous amount of effort that has gone into this technology assessment process in a relatively short period of time. The purpose of our comments here is to provide high-level feedback in response to the information presented at the recent workshops, particularly on trucks and buses. We will provide more detailed feedback from sector experts in separate staff discussions.

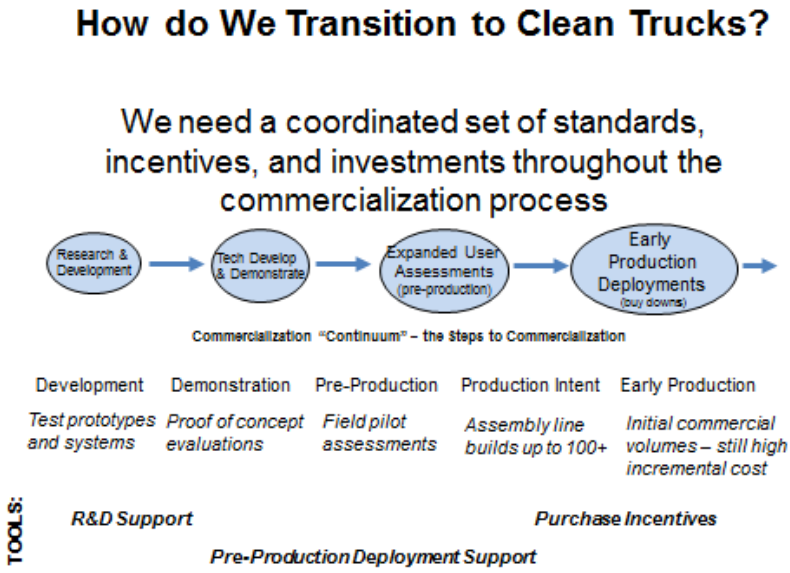
Overarching Input and Recommendations

We commend staff for undertaking this technology assessment and for seeking outside input. Overall we think this represents a solid starting point and we look forward to continuing to work with staff on technology assessments, sustainable freight and investment strategies. Top-level overarching reactions are below.

- **Diverse portfolio approach:** the technology assessments underscore the need for a diverse portfolio of fuel and technology strategies. We think staff has done a good job of highlighting the potential role of different technologies in different applications, including acknowledging the importance of the continuing role of cleaner-emitting ICE systems as part of the complete portfolio for sustainable freight. In order to adequately lay out the vision for future technology advancement, it may be necessary to do even more granular technology assessments and pathway analyses. With focused attention, we believe each of the technology categories examined can play an important role achieving in both long-term and near-term goals, particularly if advanced vehicle efficiency technologies are combined with low-carbon renewable fuels.
- **Certification processes for innovative technologies:** the technology assessments underscored the need for innovation and progress across a wide range of vehicle

and fuel types. In order to accelerate this process, we recommend a tiered approach to certification that minimizes barriers for innovative new technologies just starting to enter the market. The regulatory requirements could scale as volumes – and therefore the impact of these technologies – increase.

- **Commercialization stages, timing, and process:** we commend staff for reflecting a thoughtful and reasonable stage and process flow for commercializing technology products. With some slight differences of terminology, this reflects the general stages CALSTART follows and is based broadly on accepted industry practices. It is extremely useful to adopt stages that reflect the development gates industry uses, and we commend staff for leveraging existing work around these commercialization stages, timing, and process. We do believe some of the deployment numbers cited at various stages could be debated – however, most fall within an accepted range. We would note the numbers shown in the charts at the early stages correspond best to what is needed per supplier or platform. However, the numbers, particularly at the commercialization stage, correspond best to what is needed from multiple suppliers across multiple platform types. We highly recommend further leveraging the *CalHEAT Final Report* which contains some of the next level down detailed information on steps to market needed to help support product development.[1] Similarly, the recently completed *I-710 Project Zero-Emission Drayage Truck Commercialization Study Final Report* contains more detailed analysis of the specific pathway to zero emission drayage truck production that should have direct application to the ARB assessment.[2]



From: CALSTART Tech Commercialization Process

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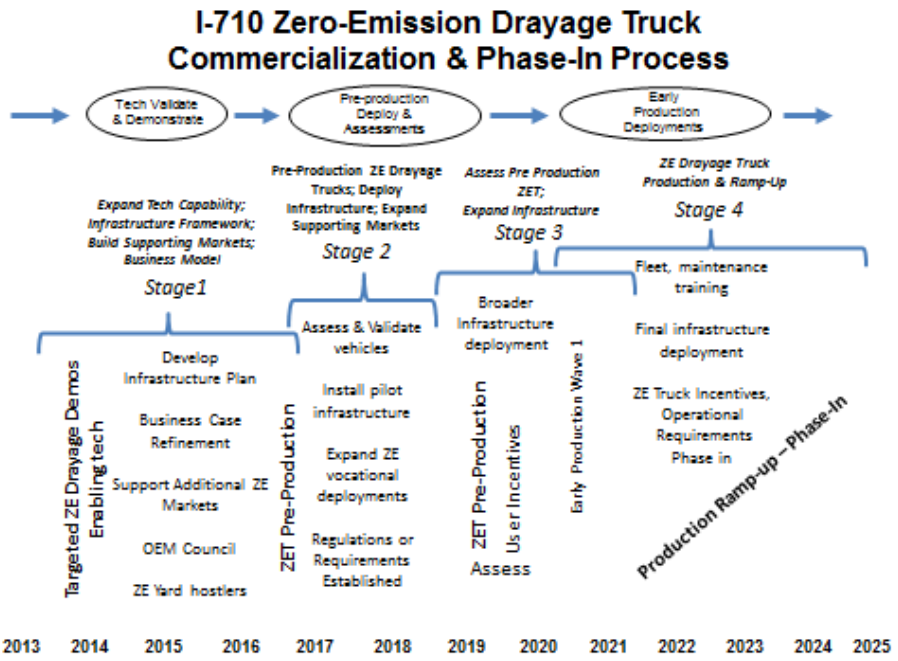
1 http://www.calstart.org/Libraries/CalHEAT_2013_Documents_Presentations/CalHEAT_Roadmap_Final_Draft_Rev_7.sflb.ashx

2 http://www.calstart.org/Libraries/I-710_Project/I-710_Project_Zero-Emission_Truck_Commercialization_Study_Final_Report.sflb.ashx



From: I-710 ZE Drayage Truck Commercialization Plan Report

- **Biofuels and Renewable Natural Gas:** we strongly recommend acknowledging the critical role of renewable fuels in the sustainable freight portfolio. One of the key findings of the CalHEAT Technology and Market Transformation Roadmap was the need to combine low-carbon fuels with high-efficiency technologies and engines in order to meet 2050 GHG reduction goals. This is particularly important in the Class 8 line haul sector, where zero emission strategies may not be applicable. Such fuels include renewable diesel, DME and biomethane. As an example of a pathway, existing natural gas engines and infrastructure can be made increasingly low carbon via the increased blending of biomethane, which is effectively a "drop in" fuel. While such fuels are currently available only in limited volumes, this can be mitigated in the future by combining them with other fuel reduction strategies, such as down-sized engine designs and range-extender electric architectures.
- **Formalized structure for ongoing industry input:** building on the CalHEAT and I710 reports, we recommend considering the formation of an industry advisory council to continually vet and improve the technology assessment process. We found the technical advisory committee for CalHEAT to be invaluable and believe a similar structure could provide value for the sustainable freight work and to encourage vehicle and engine original equipment manufacturers (OEMs) and primary suppliers to engage.
- **Cost and benefit methodologies:** in order to allow for comparisons across technologies, we recommend a standardized approach to cost and benefit calculations.

CALSTART is providing specific sector comments to ARB staff on several of the specific tech assessment categories. What follows is a short high level encapsulation of some key issues raised.

Natural Gas and Other Alternative Fuels

We commend staff for recognizing the important role that natural gas, biofuels, and other alternatives such as dimethyl ether (DME) will continue to play for freight. With clear regulatory signals and investments in this sector, significant emissions reductions are possible and these fuels can be a longer term solution for freight challenges in California and around the country. High level feedback is below:

- **Natural gas Class 8 tractor deployments can support long term goals**. Investments in deploying current natural gas Class 8 tractors can enable an important pathway for multiple state goals. It can build the fleet market and infrastructure for successfully introducing future low-NOx natural gas engines. It can create a fuel backbone to accept blending of an exceptionally low carbon fuel, renewable natural gas (biomethane), as it becomes increasingly available. And it can provide the fueling infrastructure and investments to support natural gas range-extended electric drivelines which can support future zero emission miles in heavy-duty applications.
- **Consider opportunities for engine optimization.** Significant improvement in efficiency and emissions can be achieved through optimized alternative fuel engines. We recommend a forward-looking analysis that includes consideration of engines that are optimized to use alternative fuels.
- **Expand the recognition of the importance of renewable fuels.** Renewable natural gas, renewable diesel, advanced biodiesel, and renewable DME can all improve emissions performance. We recommend increased focus on renewable fuels as an important pathway to long term goals.
- **Recognize the value of fuels today that have future renewable blend capability.** Besides the potential to offset or replace diesel with a renewable diesel fuel in the future, biomethane (renewable natural gas) provides an important drop-in fuel alternative and blend for natural gas that can help address current concerns around leakage and other issues. This is a prime consideration for natural gas, given its strong potential to also achieve low NOx emission levels.
- **Recognize the role of natural gas, hydrogen and other biofuels to drive zero emission miles via range extended electric architectures.** A key enabler of zero emission heavy-duty truck miles is the range-extended electric or plug-in hybrid architecture. Natural gas or other low emission, low carbon biofuel engines, or small hydrogen fuel cells, are the ideal component to enable this capability.

Hybrid

Hybrid technologies are important in their own right, as well as being an enabler of the supply chain and production capability for full and partial zero emission vehicles. We commend ARB staff for recognizing the role that hybrid trucks, buses, and off-road equipment can play in California. As noted in the staff presentation, “hybrid” in the context of these discussions has been used as a broad catch-all phrase that includes a wide range of technologies, from mild hybridization to extended range alternative fuel hybrids with significant zero emission mile capabilities. Timelines and needs for these technologies vary widely. Overarching comments on hybrid technologies are below.

- **Focus on root causes in emissions.** As relates to hybrid emission issues, we think it is crucial, as you have noted in the truck In-use presentation, to focus on the underlying diesel engine emission issue that is at the core of in-use and off-cycle emission concerns. Hybrids may exacerbate this condition by reducing the work load of the engine but do not appear to be the root cause of it.
- **Do not paint with a broad brush; follow a nuanced approach**. It is also worth differentiating that gasoline hybrids seems to exhibit none of these issues based on test results. Similarly, series hybrids may have some operational differences that eliminate the issue. We strongly recommend ARB move forward in a nuanced manner where hybrid emissions are concerned. ARB runs the unintended risk of stopping in its tracks a needed core and bridge technology, currently offered by mostly small providers or small units of larger companies. The current supply chain is fragile and needs support, not barriers. The underlying issues are of greater impact and should be the focus.
- **Outline and follow a multi-strategy approach**. Also as noted, we stress the importance of taking a more nuanced look at hybrid technology; "hybrid" Is not one monolithic system type, but rather it has varied architectures and designs that follow a continuum to eventual full zero emission operation. These approaches each offer their own value propositions and are each at different stages of commercialization. This is salient to ARB planning and support actions.

Battery Electric

Battery electric trucks, buses, and off-road equipment can contribute to state goals in several applications. Some of these vehicles are already in a pilot stage/ early market stage for several vocational truck applications and transit bus operations. These applications are best defined by known routes, return-to-base operations and home base refueling. Because of low volumes and high component costs, including energy storage, the incremental costs of these early vehicles can be significant. However, there can be a business case with targeted placement and incentives. Key considerations:

- **This is still an early stage technology and product segment**. BEV trucks are still several years behind in commercialization compared to the passenger car BEVs now in the market. The supply chain is still fragile for medium and heavy-duty (M/HD) systems and the arena is **very dynamic**. It is a nascent market that needs to be nurtured before fully robust commercial products can be produced.
- **Leverage early and parallel markets**. BEV (and fuel cell) transit buses offer an early market for deployment that can build volumes of comparable components and sub systems to medium-duty commercial trucks.
- **Find pathways leading to future goals – even if not achieving them today**. Range extended, plug in hybrid and hybrid architectures can help drive key volumes for components and build the production capability for full BEVs.
- **Leverage industry and stakeholder processes**. CALSTART is operating an E-Truck Task Force (http://www.calstart.org/Projects/htuf/E-Truck-Project.aspx) to identify and address market and production issues. We recommend that ARB staff take part in and leverage the Task Force process as part of its tech assessment, pilot and demonstration activities. Part of this includes infrastructure issues, including charging levels, charging facility capacity and demand charges, each of which can impact deployment.

Fuel Cells

While considered farther out in the commercialization process than some of the other technologies listed, fuel cell systems share many of the vehicle level issues with BEVs and hybrids, and the fueling system issues with natural gas. Much like hybrids, it is extremely important to look on fuel cells as not one monolithic technology segment, but rather as a series of different architectures, strategies and applications.

- **Leverage early and parallel markets** There is a lot of synergy around the pathways for technology development for the bus industry and the M/HD Truck Industry for fuel cells. FC transit bus driveline and components should transition to drayage and delivery trucks due to similar component sizing. Similarly, scaling fork lift FC successful designs up to range-extended architectures which leverage production costs would be a promising strategy, such as scaling FC stacks to range-extending truck sizes (30-60kw).
- **Find pathways leading to future goals – even if not achieving them today.** In the early stages, rather than full fuel cell-powered vehicles, promising demos of the driveline components in trucks should focus on range extended EV with FC extender. This can also leverage range extended FC bus architectures such as battery dominant fuel cell bus configurations for drayage and delivery truck. Fuel Cells may also break into the Class 8 Over-the-Road market by starting with hotel loads, then advancing to accessory loads, and on from there. There are many nuances in technology advances and market demands and should not presume that it is necessary to jump directly to a full fuel cell powered truck.

CALSTART and its technical staff appreciate the openness of ARB and its staff to evaluate, discuss and assess these and other issues. While happening rapidly, we applaud the rational and transparent process and look forward to continuing to collaborate with staff and industry partners to baseline the current state of commercialization in low carbon, low emitting technologies and fuels, and outline the best tools and approaches to moving these capabilities into sustainable market volumes.

Sincerely,

Bill Van Amburg
Senior Vice president