



Global Commercial Vehicle Drive to Zero Program

A Coordinated Strategy to Speed Clean Commercial Vehicle Technology Introductions to Meet 2050 Climate Targets

CALSTART has launched a program which over the next five years that will both enable and accelerate the growth of the global near- and zero-emission medium- and heavy-duty vehicle (MHDV) sector. Progress in this area will help countries achieve the greenhouse gas emissions targets established under the Paris Accord. Outside of the United States, particularly in China, India, and Mexico, emission reductions from this sector will have a large impact as commercial vehicles represent a higher percentage of the total transportation market. The name of the new Initiative is “Global Commercial Vehicle Drive to Zero.”

Working in technical support of the California Air Resources Board (CARB), CALSTART working with industry developed the beachhead¹ strategy, which identified the segments of the commercial vehicle market where zero emission technology is most likely to succeed in the near term due to the following factors: technology readiness, duty cycle and use, industrial activity, and economics. The beachhead strategy was incorporated into CARB’s three-year investment plan that was approved by the Board in December of 2017 and updated in 2018.

While noting that public policy, regulations and incentives will play an important role in their success, several major global commercial vehicle OEM’s have validated and affirmed CALSTART’s analysis. They have also indicated that these segments are global in nature and not California specific. CALSTART is actively leading and working on a variety of strategies to advance the beachhead markets in California, and increasingly in other US states, by securing funding for purchase incentives, changing utility regulatory policy to support investment infrastructure, developing and managing programs to develop next generation technology, and supporting progressive policy development.

CALSTART has continued to validate its analysis with a larger number of stakeholders, assessed tools to support beachhead growth, conducted outreach to potential partners, developed ideas for an on-going program, and confirmed a list of target nations and regions. Seed funding from the ClimateWorks Foundation enabled CALSTART do some early preparation and organizing of a one-day beachhead workshop in San Francisco during the week of the Global Climate Action Summit (GCAS). CALSTART used the workshop to secure buy-in and officially launch the multi-year program to coordinate and foster successful collaboration that will result in the beachhead markets being commercially viable by 2025 in China, India, Mexico, Canada, the European Union and the United States (led by California). The diversity and size of these beachheads are very significant and would lead to the development of a far larger ecosystem that would enable zero emission technology to expand to other major commercial vehicle segments in the 2025-2035 timeframe. The goal would be for 80 percent or more of all commercial vehicles sold globally by 2040 have zero tailpipe emissions and be powered by low carbon electricity or hydrogen.

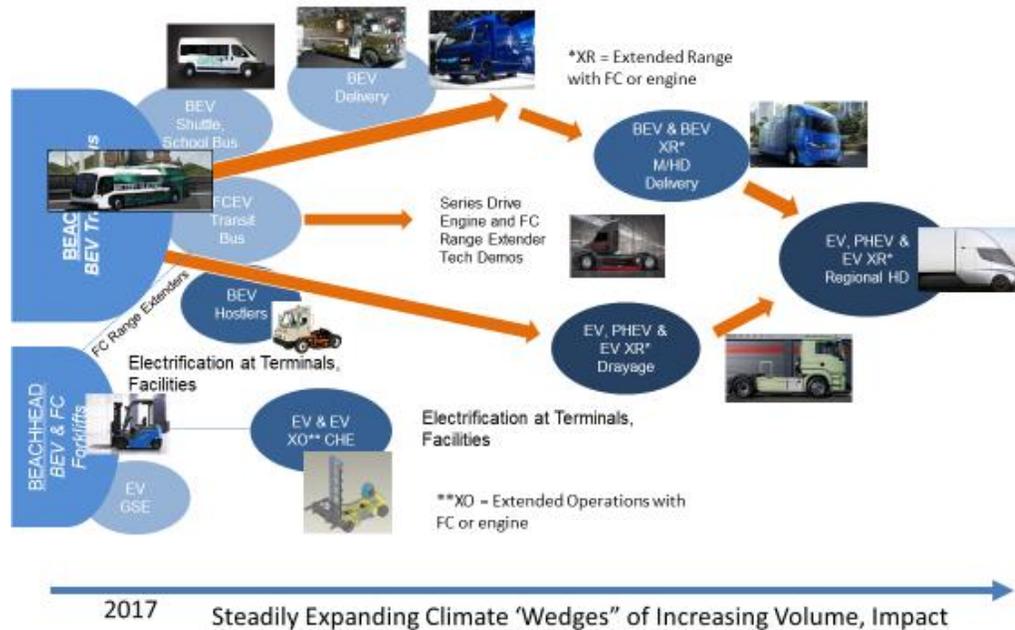
¹ The term beachhead while common in the United States is not widely understood in other countries. The definition defines the term as a) the area that is the first objective of a military force landing on an enemy shore; b) a secure initial position that has been gained and can be used for further advancement. From CALSTART’s perspective, the enemy to be conquered is harmful greenhouse gas emissions.



The Best Early Segments – the Beachheads²

The table below identifies the early segments of the large and diverse commercial vehicle market that have the best opportunity to become leaders in terms of zero emission technology. As shown in the chart, the beachhead markets are: transit buses, shuttle vans, package and delivery vans and trucks, terminal tractors, port equipment, and regional drayage (freight) trucks. In almost all of these applications, the vehicle returns to its base at night and can easily be charged. Over time, as the beachhead markets mature and succeed, CALSTART envisions the industrial ecosystem evolving and supporting a much wider array of commercial vehicles, many of which will not come back to a depot each night. Multiple global and national manufacturers and suppliers are bringing product to the various beachhead markets though they are at various stages of their commercialization of the technology.

M-HDV Zero Emission Beachhead, Pathways



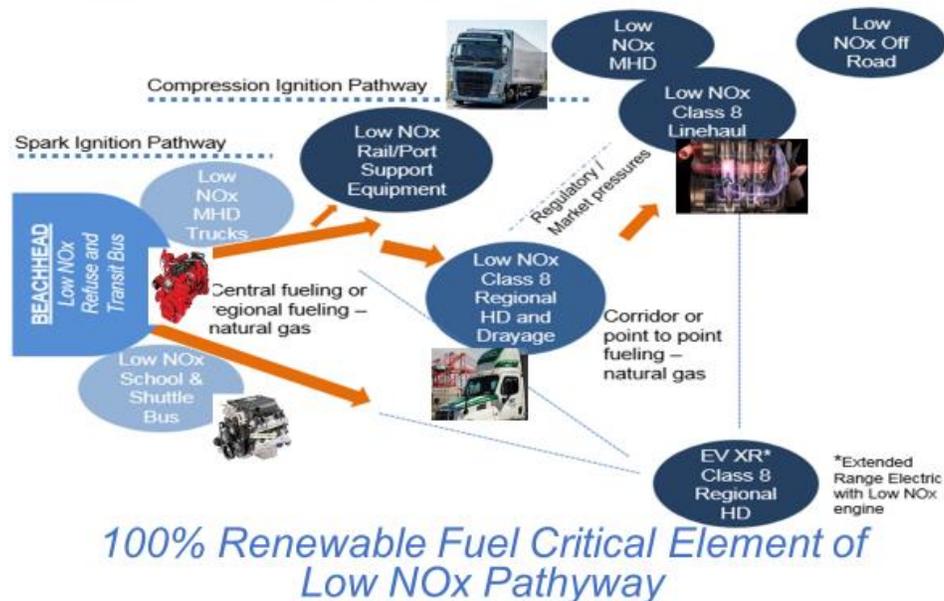
In dialog with manufacturers and suppliers, CALSTART appreciates the challenge of getting to zero emission trucks and buses for heavy long-haul routes. If we are successful and zero emission vehicles penetrate meaningfully in sales in the identified beachhead segments by 2025 (see chart above), it's very possible that the technology will expand and be cost competitive in almost all segments of the medium- and heavy-duty vehicle market globally in 2040. As a result, the overwhelming focus of this program will be on making these markets successful over the next six years. Having said that, between

² Described in two California Air Resources Board (CARB) Three Year Investment Strategy for Heavy-Duty Vehicle documents: https://www.arb.ca.gov/msprog/agip/fundplan/proposed_1718_funding_plan_final.pdf (pages 123-172) https://www.arb.ca.gov/msprog/agip/fundplan/proposed_1819_funding_plan.pdf (Appendix D)



now and 2040, for the long-haul, heavy-truck market, there are alternatives to diesel that will produce far fewer criteria and greenhouse gas emissions. In the chart below, a combination of ultra-low polluting engines when used with 100 percent low carbon fuels can produce very positive results for the environment and public health. For example, under the CARB wells-to-wheels analysis, a Class 8 truck³ using an ultra-low NOx engine, running on 100 percent renewable natural gas, would produce far fewer greenhouse gas emissions than would a 100 percent battery electric truck charged from the grid. There won't be enough low carbon fuels, whether it be renewable diesel or renewable natural gas, to meet the entire needs of the class 8 sector, but when possible should be used to replace trucks using diesel engines powered by fossil-diesel fuel. This Low NOx Beachhead pathway is part of the CARB 3-year investment plan (2018-2021).

Low NOx Beachhead, Pathways



Vehicle Beachheads AND Geographic Beachheads

In addition to the vehicle applications that we refer to as “beachheads” this new global program will also be targeting specific regions and nations for deployment. The map below graphically depicts the target regions: China, India, Japan, Mexico, Canada, the United States (specific states will lead), and Europe. These countries and regions were selected because they represent industrialized countries with significant commercial vehicle populations, have expressed interest in reducing emissions from the sector, and, if collectively work together would have an impact on the entire global market. If the vehicles in the beachhead applications are commercially viable in these beachhead regions, the entire world will benefit from the technology having reached economies of scale and cost-effectiveness.

³ In the United States, medium- and heavy-duty vehicles are broken into classes ranging from 3-8 based on weight and carrying capacity. The largest truck carrying the most weight are Class 8 trucks. A package and delivery van larger than what is available for the consumer market is usually a Class 3 vehicle.



REGIONS WITH POTENTIAL FOR CONCURRENT BEACHHEAD LAUNCHES

DRIVING GLOBAL VOLUMES FOR COMMON SUPPLY CHAIN, PRODUCTS



Over the course of the program, it is possible that additional countries may want to be included in the program. For example, in organizing for Affiliate event related to this program at the Global Climate Action Summit, CALSTART has become aware of interest in the program from South Korea, Columbia, and Australia. While it will be important to keep a focus on the vehicle applications, and addressing the issues associated with getting to scale, it may be beneficial to be more inclusive and to expand the number of countries, state, provinces, and even cities involved with the program.

The Tools in the Tool Chest

To support global action and progress in the ZE M-HDV sector. Policymakers, NGO's, fleets and others will need to understand what policies and options are at their disposal. With funding from CWF, CALSTART has identified the following list of potential tools that can used to advance this important market:

Purchase Incentives: In California, New York, and purchase incentives are being used to make the upfront cost of zero emission M-HDV's comparable to those of diesel.

Congestion Zones and Pricing: In London, congestion pricing is serving as a strong incentive for fleets to switch to zero emission trucks and buses;

Port Access Fees: Some ports are starting to reduce access fees for trucks with zero or near-zero emissions.

Zero Emission Truck Only Lanes: Many global ports and urban corridors are experiencing major congestion issues. Under a contract with the planning authority for the greater Los Angeles Metropolitan area, CALSTART conducted a study identifying the feasibility of adding truck only lanes to



the highway servicing the combined Ports of Long Beach and Los Angeles. In the study, CALSTART affirmed that it would be viable to limit those new lanes to zero emission only trucks.

Mandates: California is currently considering policies that would require the purchase of zero emission vehicles used in transit operations and certain segments of the truck market.

Exclusion Zones: Very effective in European are policies that ban the use of internal combustion engine vehicles in certain city districts. As more megacities emerge, Mayors will become increasingly aware of the zero emission and noise benefits of electric trucks and buses.

Utility Regulatory Policy: In 2018 the California Public Utilities Commission gave approval for the use of more than \$800 million in ratepayer funds primarily to deploy infrastructure to support fleets using zero emission vehicles. The commission also supported new pricing policies that are favorable to the fleets and avoid costly demand charges.

Most of these policies are just beginning to be deployed and will need to be refined and optimized over time. During this program CALSTART expects to develop a vetted portfolio of these options for use by partner regions, as well as identify and help advance other new and innovative ideas.

5 and 1 Year Operational Game Plans

CALSTART is serving as the Executive Secretariat of the Global Commercial Vehicle Drive to Zero Program. The goal of the program is to coordinate actions and provide information that would enable the beachhead markets to grow far faster than they would if nations, states, and cities were not collaborating. If the global manufacturers of trucks, buses, and non-road equipment see the demand for zero emission vehicles growing quickly in California alone, they will respond but at a much slower pace. If they see similar market signals coming from California, China, Europe, India, Canada, and Mexico it will be an entirely different ball game. The faster demand builds, the faster the product will improve and costs will come down. Working in isolation is not an option if we are serious about hitting the global 2050 greenhouse gas emission reduction targets.

In its role as Executive Secretariat, CALSTART envisions its primary role to be a momentum builder. CALSTART already recognizes that there is significant interest in the target regions in zero emission trucks and buses. What we don't have is a single coordinating body, with the resident expertise, to bring people together, and give them the tools and knowledge to break down barriers, and spur market growth. Specifically, CALSTART intends to perform the following work:

Bringing Stakeholders Together: CALSTART will conduct annual meetings of key stakeholders from industry, government, and the NGO sectors from each of the six countries/regions. At these annual ZE-M-HDV beachhead meetings, CALSTART will discuss the progress being made in each of the beachhead markets. Information and analysis will be provided to assess the progress in each segment, and identify strategies to accelerate their growth.

Honest Broker: CALSTART will be collecting information from fleets around the world to understand the true costs and benefits of operating zero emission commercial vehicles. CALSTART will share this information with its partners and stakeholders so they address challenges and overcome potential obstacles.



Global Commercial Vehicle Drive to Zero Program

www.globaldrive2zero.org

Sharpening the Tools: CALSTART will work with its global partners to identify and assess which tools are working and which ones need improvement. CALSTART will also work with partners in the individual countries to explore which tools might be most appropriate for that region.

Regional Meetings: Every other year, in each of the regions, CALSTART will identify and leverage a related conference to hold a beachhead workshop. These regional conferences and workshops will enable CALSTART to work more intensively with its regional stakeholder group and address the challenges in that country.

Best Practices: From scaling infrastructure to implementing a metropolitan exclusion zone there is a lot to learn. Much of what is being attempted has not been done before. Many US transit fleet are contacting CALSTART now because they want assistance in determining the best way to charge 150 electric buses in one depot. CALSTART will conduct analysis and identify best practices. CALSTART will share these papers with the beachhead network.

Raising Awareness: CALSTART will use social media to help promote success and victories in the beachhead markets globally. Social media will also be used to support leading policymakers and encourage other cities and governments to take part in the movement.

Current Activities and Next Steps

The Drive to Zero program is now fully active and CALSTART is actively growing the program via the following actions:

- Recruit and work with global stakeholders
 - In discussions with several national/regional governments, cities, manufacturers
 - We encourage you to join with us
- Compile a compendium of policies, approaches and best practices that regions are using globally to drive on- and off-road commercial vehicle change, sharing and validating that with partners
 - Case Studies
- Identify available and emerging vehicle platforms by manufacturer, application and geographical region and provide this tool to and maintain for partners
- Assess market volume opportunities in the global beachhead regions to help manufacturers and governments plan
- Hold webinar meetings, open to pledge signers and stakeholders, to outline learnings to date and next steps – provide assistance to regions as requested
- 2019 meeting of the Drive to Zero partners – Vancouver, Canada in May

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SAVE THE DATE

Next Global Stakeholder Meeting:
Vancouver, Canada

Planned Date: **May 28, 2019**

Concurrent with Clean Energy Ministerial (CEM 10)

Topics: Policy Tools to Support Zero/Near Zero HDVs; New Vehicle Introduction Timing & Needs; Stakeholder Expansion

Information: globaldrive2zero.org