JANUARY 2020

CONCEPT WHITE PAPER

ZERO-EMISSIONS LARGE-SCALE DRAYAGE TRUCK PILOT PROGRAM

An implementation strategy for a zero-emission 50-100 Drayage Truck Pilot Program to assess the challenges and opportunities associated with a full transition towards zero emission drayage fleets operating at Ports

Port of LONG BEACH

THE PORT OF LOS ANGELES

A. INTRODUCTION

The Port of Long Beach and Port of Los Angeles (together, the "Ports") are pleased to introduce their concept for a Zero-Emissions Large Scale Drayage Truck Pilot Program (Truck Pilot Program) as part of their efforts to implement the 2017 Clean Air Action Plan (CAAP) Update. The following Concept White Paper presents the Ports' joint initiative to deploy a Truck Pilot Program and to begin the process of pulling together both funding and demonstration partners to successfully implement the Program.

The Ports comprise one of the world's premier seaport complexes and are recognized as global leaders in environmental stewardship. Over the past 13 years, the Ports have made dramatic strides in reducing air emissions from port-related mobile sources such as on-road heavy-duty (HD) trucks through the trailblazing CAAP. According to the Ports' 2018 Emission Inventories, particulate matter from HD trucks visiting the Ports has dropped 97% since 2005. However, the Ports' ambitious environmental stewardship programs are far from complete and there exists a momentous opportunity to reduce emissions and fully transform the fleet of trucks that operate at the Ports.

On June 12, 2017, City of Los Angeles Mayor Eric Garcetti and City of Long Beach Mayor Robert Garcia announced a joint declaration to commit to a zero-emissions (ZE) goods movement and Port industry. As part of their declaration, the Mayors established the need for a ZE Large-Scale Drayage Truck Pilot Program in order to advance production of clean technologies, demonstrate feasibility, and provide meaningful data in real world Port operations. In support of the Mayors' declaration, the CAAP Update in 2017 included a bold new goal to ultimately transition to a ZE on-road drayage fleet servicing the Ports by 2035. The 2017 CAAP Update reiterated the Mayors' call for a Truck Pilot Program and committed the Ports to work with state and local regulatory agencies in order to design, fund, and implement such an ambitious Program.

Federal, state, and local regulatory agencies have aggressively funded research, development, and demonstration of ZE and near-zero emissions HD trucking technologies in California over the last several years. The Ports have partnered with the California Air Resources Board, the California Energy Commission, the South Coast Air Quality Management District (AQMD), and other diverse partners to test a variety of prototype and early pilot drayage trucks projects. Many of these projects are now moving towards completion, and equipment manufacturers and demonstrators have developed subsequent models to address early concerns.

The focus has begun to shift towards understanding how these advanced technology trucks will work as part of a large-scale fleet. Individual trucks are being demonstrated and showing promising results, and major Original Engine Manufacturers (OEMs) have begun preparing their commercialization plans. The next step in the process is to test a fleet-scale deployment in order to answer vital questions about infrastructure and operational schedules required to fully transition the drayage fleets to ZE. The following Concept White Paper is intended to outline a framework for a Port Truck Pilot Program as envisioned by the Ports, while providing flexibility to incorporate funding agency requirements and goals.

B. ZERO-EMISSIONS LARGE-SCALE DRAYAGE TRUCK PILOT PROGRAM

The Truck Pilot Program intends to evaluate at least 50 Class 8 on-road ZE drayage trucks operating in routine duty cycles at the Ports. The Program would aim to evaluate short, medium, and long-haul drayage runs. Participants will be expected to follow the roll-out process prescribed by the San Pedro Bay Ports Zero/ Near-Zero Emissions Drayage Truck Testing & Demonstration Guidelines[1] in order to have a consistent measure of performance. This will leverage the previous experience the Ports have in demonstrating drayage trucks and will provide the operators an opportunity to assess the performance of a ZE fleet performing drayage shifts. The Truck Pilot Program will be designed to build off previous and current demonstration efforts to further push

[1] https://cleanairactionplan.org/documents/san-pedro-bay-ports-zeronear-zero-emissions-drayage-truck-testing-demonstration-guidelines.pdf/

the capabilities of ZE truck technology towards the necessary benchmarks for widespread adoption within the goods movement industry.

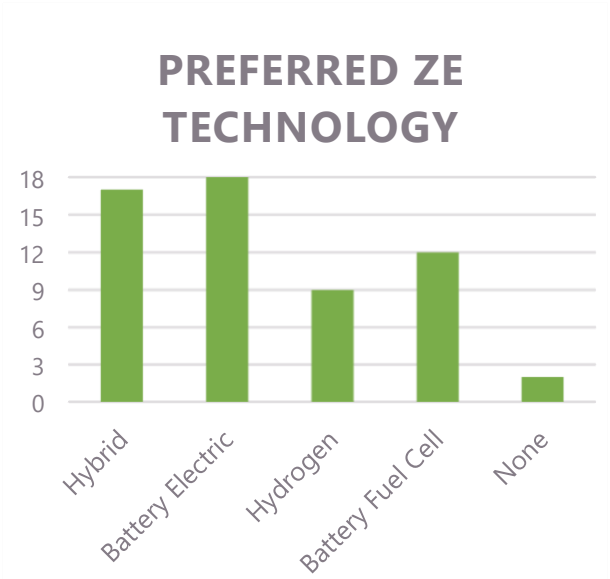
Under the Truck Pilot Program, the Ports intend to pull together project partners including agencies such as AQMD, Los Angeles County Metropolitan Transportation Authority, electric utilities, licensed motor carriers (LMCs) and trucking associations, ZE incubators, OEMs, and technology developers among others. The Ports currently estimate that a ZE Large-Scale Truck Pilot Program will require tens of millions of dollars to fund at least 50 ZE trucks and supporting infrastructure, likely in a handful of fleets. The Ports are financially committed to the ultimate success of this project and, as a demonstration of their support, will provide their own financial contributions in addition to coordinated funds from other stakeholders to build a robust funding pool to effectively implement this vision.

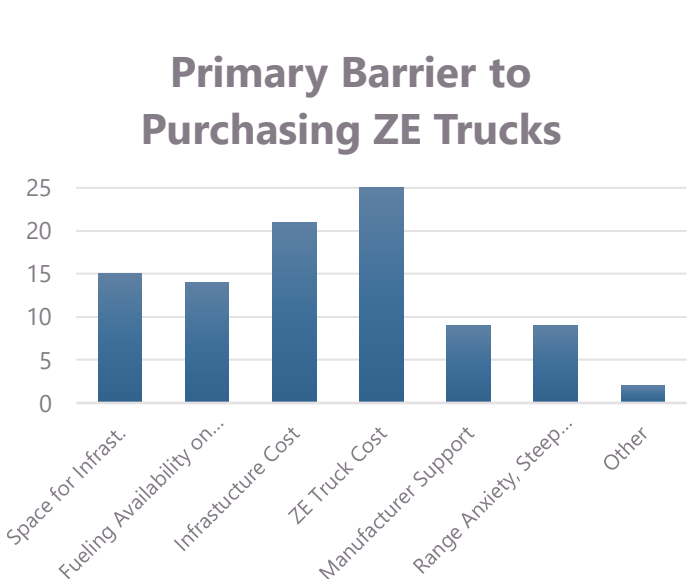
C. CURRENT CHALLENGES TO A ZERO-EMISSIONS DRAYAGE INDUSTRY

The Ports conducted outreach in 2019 from various stakeholders such as truck operators and OEMs who could potentially participate in the Truck Pilot Program. These efforts included a survey of the drayage fleets that service the Ports, and a Request for Information to ZE technology vendors, which was coordinated by the Los Angeles Clean Tech Incubator. The results of the survey showed cost as the largest barrier to ZE truck adoption. ZE trucks have higher upfront capital costs compared to their diesel counterparts and require significant investments in infrastructure. Historically, incentives have played a major role in spurring drayage truck replacement and will continue to do so as the Ports seek to transition the 16,000+ trucks servicing the Ports to ZE. In addition, the survey found fleets varied significantly in their preference for cleaner technology, indicating the chosen ZE solution would vary by truck operator.

2018 Drayage Fleet Survey Results:

- 43% of responding fleets were **interested** in a large-scale ZE demonstration.
- Fleets indicated a **varied mix** of preferred ZE technologies.
- Primary barriers to purchasing ZE trucks varied from fleet to fleet, but the most common response was the **cost** of the truck and associated infrastructure.





The Ports released the 2019 Feasibility Assessment for Drayage Trucks[2] (Assessment) in April 2019. The Assessment's overarching objective was to characterize feasibility for near-term, large-scale deployments of drayage trucks as it stood in 2019.[3] As shown in the Assessment, ZE technology has yet to be proven fully feasible or showcased in a large-scale pilot deployment. A Truck Pilot Program thus represents the next key step in the Ports' efforts to achieve their ZE truck goal. A large-scale production of trucks from a single OEM will be difficult based on manufacturer timelines, user preference, and duty cycle.

Another current challenge for ZE on-road drayage trucks, whether they are battery or fuel-cell powered, are range limitations when compared to their diesel counterparts. The limited or non-existent HD charging infrastructure and hydrogen fueling stations along key corridor routes, exacerbate this challenge immensely. These issues are further accentuated in Southern California due to the long-haul distances that trucks must often travel to transport containers to the Inland Empire and other regions. The Ports also face the challenge of having limited real estate for infrastructure buildouts on or near Port property, which will require working together with regional partners so an adequate and compatible ZE infrastructure network comes to fruition.

D. PORTS' TRUCK PILOT PROGRAM GOALS

The Ports' Truck Pilot Program will evaluate:

- Operational Feasibility.[4] The Truck Pilot Program will assess whether ZE trucks can be utilized by LMCs to complete standard drayage operations throughout Southern California. The Ports and project partners intend to consider the following items to assess operational feasibility:
  - Capability of a larger ZE fleet to achieve per-shift and daily range requirements found in San Pedro Bay drayage.
  - Speed and frequency of fueling and/or charging such that operating times are not significantly reduced.
  - Existence of, and timely access to, all replacement parts needed to conduct scheduled and unscheduled maintenance procedures.
  - Ability of LMCs to gain affordable access to the necessary facility upgrades and modifications required to house, service, maintain, and/or refuel/recharge a given drayage truck fuel-technology platform.
- Commercial Availability. The Truck Pilot Program seeks to assess whether ZE drayage truck fleets can be manufactured/delivered/supported by OEMs within similar timeframes as baseline technologies (Class 8 diesel internal combustion engine trucks). The Ports and project partners will consider the following items to assess commercial availability:
  - Current and projected network of dealerships available to meet demand and the servicing and maintenance needs of fleets.
  - Expeditious delivery of ZE truck orders.

[2] https://cleanairactionplan.org/documents/final-drayage-truck-feasibility-assessment.pdf/

[3] The Ports will perform updates to the Truck Feasibility Assessment, at least every 3 years.

[4] ZE vehicle technologies that are a part of the Truck Pilot Program will be required to have been previously proven/demonstrated by the manufacturer to meet short haul drayage performance specifications including power, torque, gradeability, operation of accessories, etc.

- Availability of Supporting Infrastructure. Supporting infrastructure will be evaluated to determine whether refueling/charging infrastructure is capable of servicing a large fleet of ZE drayage trucks. The frequency and speed to refuel/recharge will need to match a drayage company's needs without significant impacts to revenue generating operations. The following items will be considered when evaluating supporting infrastructure:

  – Access to fueling infrastructure where the fleet can be fueled/charged conveniently and affordably at public or private stations.

  – Construction of additional infrastructure at a pace consistent with fleet deployments.

  – Availability of ZE fueling/charging technologies that could accommodate typical work breaks, or other downtime compatible with trucking company schedules and operational needs.

The Ports plan to use the outcomes of the Truck Pilot Program to evaluate and assess these parameters, and share lessons learned with all stakeholders so that the electric vehicle community can fill any gaps.

E. TRUCK PILOT PROGRAM EXPECTATIONS

In partnership with stakeholders, and informed by previous outreach and technology demonstrations, the Ports have compiled the following list of preferred requirements for a viable, successful project.

Licensed Motor Carrier Expectations

- Participating LMCs would need to be registered in the Ports Drayage Truck Registry. Project trucks shall have a valid, activated, and properly registered radio-frequency identification tag in advance of the initiation of the Truck Pilot Program. This will ensure that the ZE trucks can operate at marine terminals at the Ports, reducing localized impacts on the Ports neighboring disadvantaged communities. LMCs, in partnership with project stakeholders, will identify primary routes/destinations to be used during the demonstration.

- LMCs shall own and insure the ZE trucks as part of their fleet.

- LMCs shall include *at least* 10 ZE trucks as part of each individual project. A large-scale proposal for one LMC is encouraged, though it is recognized that such a large deployment for one fleet may be difficult.

- More than one OEM may be selected by each LMC. Fleets may wish to utilize specific models/OEMs for portions of their operations, and this will likely allow for larger numbers of trucks at a given site. This will aid in determining the true commercial availability and ability to produce fleets by different manufacturers.

- Prior to application, LMCs will prepare a *high-level* infrastructure plan, in coordination with their utility and/or fueling/technology provider, to indicate how the trucks would be charged and/or fueled.

Original Engine Manufacturer Expectations

The following are proposed requirements for OEMs participating in the Truck Pilot Program through a partnership with an applicable LMC:

- Class 8 HD ZE capable trucks should be based on one of the following technologies: fuel cell, battery electric plug-in, or battery electric with fuel cell range extender. In all cases, each truck *must* produce zero tailpipe emissions under all operating conditions.

- Selected Class 8 HD ZE trucks shall be proven, through previous *prototype* testing, to be durable and meet the demands of the drayage truck duty cycle for a complete shift(s). Previous prototype testing must have been analyzed in a similar manner as prescribed in the Ports' "Zero/Near-Zero Emissions Drayage Truck Testing and Demonstration Guidelines"[5].

- Selected Class 8 HD ZE trucks shall have regulatory approval for public road usage. This includes having completed and documented Department of Transportation inspections as well as the Biennial Inspection of Terminals.

- OEMs will work with the chosen technology or fueling provider and LMCs in order to ensure the charging/fueling infrastructure, as detailed in the high-level infrastructure plan, is compatible with the ZE trucks.

- OEMs shall provide a bumper-to-bumper warranty on the trucks during the demonstration/ performance period. An extend warranty may be discussed between the LMC and OEM.

F. TRUCK PILOT PROGRAM DEVELOPMENT

The process below details the steps forward the Ports envision as the clearest way to implement this project.

1. Secure Partnerships and Match Funding

   Ultimately, the implementation of the Truck Pilot Program is entirely dependent upon securing grant and match funding. This is not possible without committed and valuable project partners. The Ports envision partnerships to include the local air regulatory agency — AQMD, Los Angeles County Metropolitan Transportation Authority, California Air Resources Board, Southern California Edison, City of Los Angeles Department of Water & Power, and the Los Angeles Clean Tech Incubator, among others. Match funding would be required of all project partners, including cash or in-kind match. Letters of commitment must be signed by all project partners in a timely fashion in preparation of grant funding applications. Additional details of steps 2 through 4 would be developed in collaboration with these partners.

2. Project Selection and Operator Commitments

   The project partners will convene interested LMCs and operators, along with their designated truck manufacturer(s), technology developers, utilities and/or fuel providers to facilitate partnerships. The individual fleet projects, and scope of work and project budgets, will be developed from these discussions. Scopes of work and project budgets may ultimately be largely impacted by the requirements of funding availability for such a large-scale project.

   Preference will be given to the following projects:

   a. Larger ZE truck deployments by a single operator or OEM
   b. Demonstration of ZE trucks with greater range capabilities per single charge or "fill"
   c. Large-scale infrastructure deployment at a single site
   d. LMC experience with proposed OEM

3. Apply for Grant Funds

   A project leader must be identified for the Truck Pilot Program. The Ports may not be the appropriate entities for such a large-scale pilot project, and other project leaders should be considered. The project

[5] https://cleanairactionplan.org/documents/san-pedro-bay-ports-zeronear-zero-emissions-drayage-truck-testing-demonstration-guidelines.pdf/

leader would be responsible for overseeing grant funding applications and coordinating with project partners. All project partners and operators will be involved in molding any applicable solicitation concepts and providing match funding as cash or in-kind. A project leader will be identified prior to submission of any grant funding application.

4. Implementation of Project

Upon award of grants funds, the project leader will initiate a contract with the funding agency and facilitate project kick-off meeting(s) to confirm schedules and project milestones. Any subcontracts shall be executed in a timely fashion, not impeding project start. The project leader shall manage the budget and schedule for truck procurement, infrastructure deployment, commissioning, demonstration, and data collection.

The truck fleet(s) will be demonstrated for at least 1 year. Reporting requirements will be developed to ensure key performance indicators are tracked, monitored, and reported by operators. The project leader will be responsible for any regular reporting to a funding agency.

G. PROPOSED DEMONSTRATION GUIDELINES

As discussed in the expectations above, the following demonstration guidelines provide the framework the Ports propose to include in a large-scale truck demonstration.

- Proposed projects shall follow the Ports' demonstration test plan and reporting requirements (as identified in the San Pedro Bay Ports Zero/Near-Zero Emissions Drayage Truck Testing and Demonstration Guidelines).

- The Truck Pilot Program will propose to have infrastructure in place within 2 years of contract execution (allowances given for permitting or other delays beyond the control of the LMC) and the truck demonstration to begin upon infrastructure commissioning.

- The demonstration project shall require up to 40% in match funding.

- Each LMC shall demonstrate a fleet of *at least* 10 trucks, with possible fleet expansion in five truck increments. A larger deployment of ZE trucks by one operator and/or OEM will be given preference, however, it is recognized this may not be feasible for fleets.

- Participation of fewer OEMs as part of the Truck Pilot Program is encouraged, either within one fleet project or the entire project, but is not required.

- ZE trucks demonstrated must be able to operate at least 100 miles per charge or "fill".

- LMCs shall provide a high-level infrastructure plan to indicate how they would charge and/or fuel the trucks. This plan should include the expected permits needed, and an estimated timeline for obtaining such permits and approvals.

- At least 90% of participating truck hours of operation must be spent servicing port drayage.

- LMCs shall own and insure the trucks as a part of their fleet.

- Trucks shall operate for a minimum number of hours to be deemed a successful demonstration (as identified in the San Pedro Bay Ports Zero/Near-Zero Emissions Drayage Truck Testing and

Demonstration Guidelines). Exceptions will be allowed for those trucks that experience maintenance issues.

- The LMC(s) shall demonstrate the ZE drayage trucks for a minimum of 12 months.
- Over the 12-month demonstration period, data collection will be required for at least 6 months.

H. PROPOSED REPORTING GUIDELINES

Data collection will be vital to gathering valuable information that will ultimately serve to accelerate the commercialization of ZE trucks within the larger goods movement industry. Monthly reporting shall be required of the project leader. To measure and quantify actual project benefits, the project team shall assemble and execute a data collection test plan that each LMC must implement. These key metrics will include, but are not limited to, the items listed in the table below.

Metric	Unit	Method
Port Calls	#	Driver manifests
Vehicle Miles Traveled	miles	Mileage logs
Driver/Fleet Experience Surveys	--	Field forms
Electricity Dispensed	kWh	SCE/LADWP meters
Hydrogen Fueled	gal	LMC records
Infrastructure Up-Time	hrs	Infrastructure maintenance report
Vehicle Hours of Operation	hrs	Onboard data logger
Vehicle Downtime	days	Maintenance report
Vehicle Maintenance Inspections/Findings	--	Vehicle maintenance report
Total Cost of Ownership	$	Looking at the costs of the purchases, electricity/fuel costs, maintenance, etc.
Diesel Displaced	DGE	Calculated based on historic diesel use and electricity consumption
GHG Emissions	MT	Calculated based on electricity, hydrogen and/or LNG consumption (hybrid vehicles)
Evaluation of the Current and Future Technology Readiness for Fleet Operability	--	Per the Ports' Feasibility Studies

Notes:

kWh = kilowatt hour
gal = gallons
hrs = hours
SCE = Southern California Edison
LADWP = Los Angeles Department of Water & Power
DGE = diesel gallon equivalent
GHG = greenhouse gas
MT = megatons
LNG = liquified natural gas

The Truck Pilot Program success requires the feedback and support from funding partners and port stakeholders to fully realize the broader potential and applicability of the Truck Pilot Program. The Ports intend to develop and implement a Truck Pilot Program that not only supports the emission reductions goals set forth in the 2017 CAAP Update but also realizes emissions benefits needed to reach goals established by the region and state. The Truck Pilot Program will build upon previously funded demonstrations to further push the technology market towards full commercial viability and provide key information in determining the next steps for the trucking community in the de-carbonization of the freight transportation industry**.**