



Zero Emissions Trucks for Goods Movement Request For Information (RFI)

RESULTS SUMMARY

Issued in collaboration with the California Air Resources Board,
the California Energy Commission,
and the Ports of Los Angeles and Long Beach



Webinar Housekeeping

Q&A

Submit your questions to the host using the Q&A box in the upper right-hand corner.

Technical Issues

Call **213-358-6550** for assistance with any technical issues.

Presentation

A recording of today's webinar will be posted on LACI's website, and you will be emailed a link in the next 24 hours.



Agenda

1. Context
2. RFI Proposal Statistics
3. Respondents' Concerns and Recommendations; State of Technologies
4. Pilot Project Concepts
5. RFI Partner Recommendation and Next Steps
6. Q&A

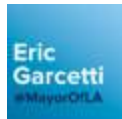


The Transportation Electrification Partnership

Formed by LACI in May 2018, this is an unprecedented multi-year partnership among local, regional, and state stakeholders to accelerate progress towards transportation electrification and zero emissions goods movement in the Greater LA region in advance of the 2028 Olympic and Paralympic Games.

“That’s why we are moving toward an additional 25 percent reduction in GHG emissions and air pollution, through accelerating transportation electrification, by the time the world arrives in Los Angeles for the 2028 Olympic and Paralympic Games.”

**TRANSPORTATION ELECTRIFICATION LEADERSHIP GROUP,
SEPTEMBER 2018**





RFI Partners Subscribe to Two Main Types of Goals...

This RFI was issued on behalf of the following partners: LACI, California Air Resources Board (CARB), the Ports of Los Angeles (POLA) and Long Beach (POLB), and the California Energy Commission (CEC). The results aim to inform viable projects that address the following goals held by each of the RFI partners to reduce greenhouse gas emissions and improve air quality through accelerated adoption of zero emission (ZE) vehicles.

Reduce GHG Emissions/Improve Air Quality

- Reduce GHG emissions by 40% relative to 1990 levels by 2030 (AB32/SB32)
- Improve freight system efficiency by 25% by increasing the value of goods and services produced from the freight sector relative to the amount of carbon that it produces in 2030 (Sustainable Freight Action Plan)
- Reduce GHGs from port-related sources to 40% below 1990 levels by 2030, 80% by 2050 (CAAP)
- Move towards a further 25% reduction in GHG emissions and air pollution in LA County through transportation electrification by 2028 (ZE2028 Roadmap 1.0, Transportation Electrification Partnership Goals)

Accelerate Adoption of ZE vehicles

- Mayors' Joint Declaration to transition all on-road trucks that visit the Ports to ZE by 2035 (CAAP)
- Deploy over 100,000 freight vehicles and equipment capable of zero emission operation by 2030 (Sustainable Freight Action Plan)
- Pending approval, require OEMs to meet a target sales volume of zero emission vehicles and offer incentives to those that exceed that target (Advanced Clean Truck regulation, due for approval in 2019)
- **Achieve the following benchmarks in LA County by 2028 (ZE 2028 Roadmap 1.0, Transportation Electrification Partnership Goals)**
 - 25 – 50% penetration of medium-duty EV delivery trucks
 - 10 – 40% penetration of heavy-duty ZE drayage trucks
 - 5 – 25% penetration of heavy-duty ZE long haul trucks
 - 10,000 – 100,000 ZE chargers installed for goods movement



The RFI Achieved its Intent to Inform Partner Activities

This RFI was designed to **inform the following ongoing activities by RFI partners:**

- Solicitation and distribution of CARB funding
- CEC funding for advanced freight technologies
- Achieve Ports' goals as defined in the 2017 Climate Air Action Plan Update (CAAP)
- Development of future pilots and demonstrations
- Legislation by state and regional policy makers and regulatory agencies

To support this need for information, the **results of this RFI specifically provide:**

- Insights into the current and future state of zero emission medium and heavy-duty truck technologies, along with related infrastructure needs
- Understanding of potential synergies and partnerships between organizations for zero emission truck deployment, infrastructure, and concepts for pilots
- Stakeholder needs and recommendations for policymakers' future incentive programs



RFI Introduction and Proposal Statistics

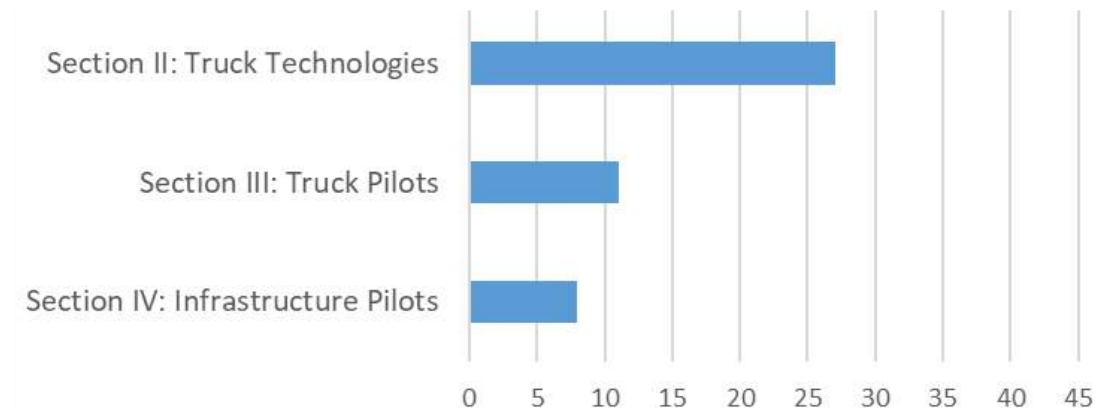


Responses by RFI Section

The RFI was designed to capture information in four key areas:

- I. Organizational background
 - II. Current and future technology offerings (vehicles, engines, fueling infrastructure)
 - III. Zero emission truck pilot concepts
 - IV. Zero emission fueling infrastructure pilot concepts for the I-710 and other freight corridors.
- The RFI was issued on 9/5/2018
 - An informational webinar was held on 9/24/2018.
 - Submissions were received by 11/5/2018
 - This allowed for a two-month response period.
 - **LACI received 39 responses.**

The Number of Responses to Each RFI Category:





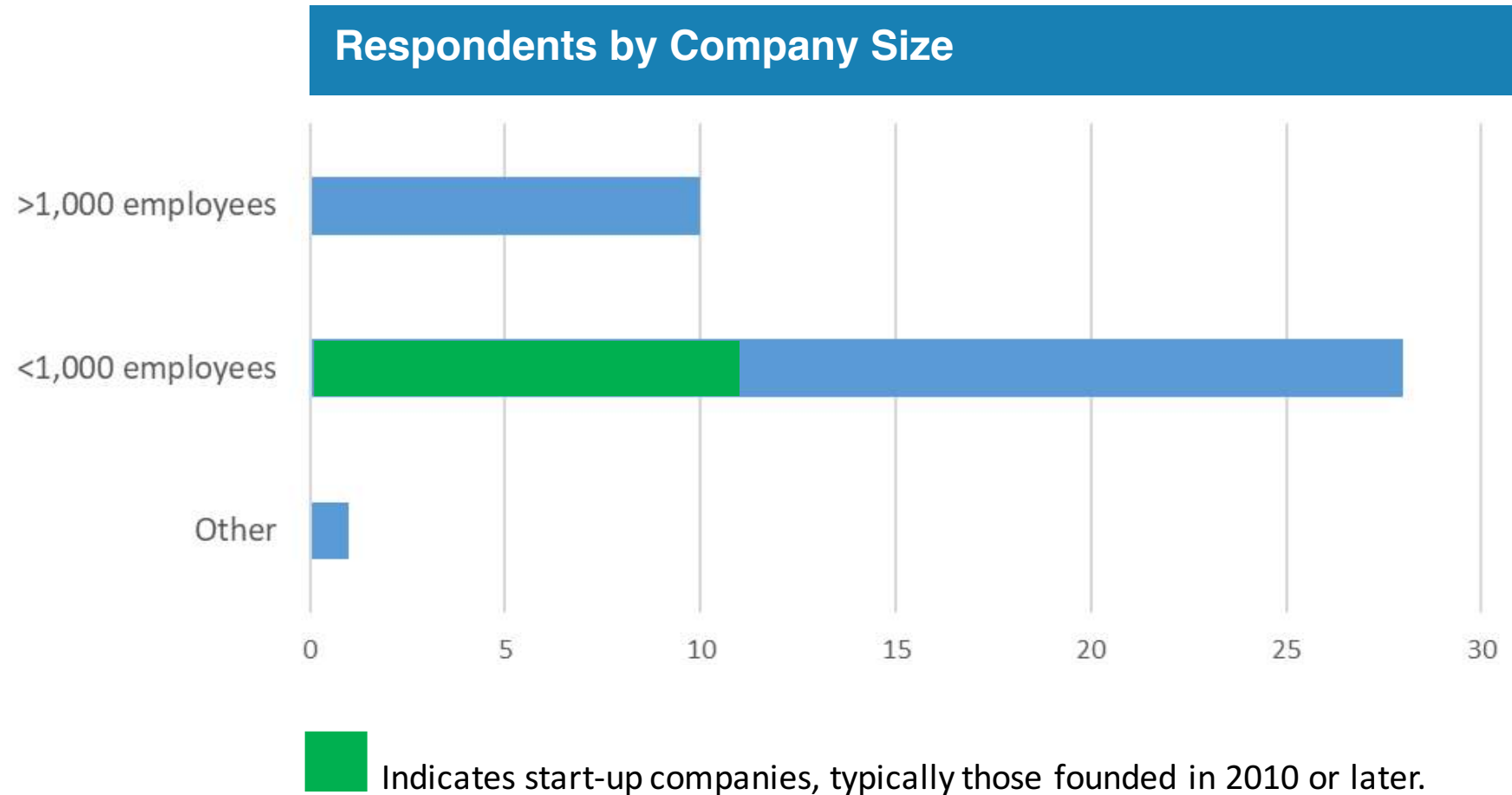
Full List of Respondents

- | | | |
|---|---|------------------------------------|
| 1. ABB Inc. | 13. FreeWire Technologies | 26. Plug Power, Inc. |
| 2. Agility Fuel Solutions | 14. Fuel Cell and Hydrogen Energy Association | 27. Siemens Industry Inc. |
| 3. AMPLY Power, Inc. | 15. Greenlots | 28. Siemens Mobility GmbH |
| 4. Ballard Power Systems, Inc. | 16. Hydrogenics USA Inc. | 29. Thor Trucks / XOS |
| 5. Black & Veatch Transformative Technologies | 17. Lightning Systems | 30. Transpower, Peterbilt, Meritor |
| 6. BYD Motors LLC | 18. Motiv Power Systems | 31. Tritium Technologies LLC |
| 7. Chanje Energy, Inc. | 19. Nikola Motor Company | 32. Urban Mobility Systems |
| 8. ChargePoint., Inc. | 20. Nordresa International Inc. | 33. US Hybrid Corporation |
| 9. CityFreighter Inc. | 21. Nuvera Fuel Cells, LLC | 34. VIA Motors, Inc. |
| 10. Daimler Trucks North America | 22. OneH2, Inc. | 35. Volvo Group |
| 11. Einride | 23. Orange EV LLC | 36. WAVE, Inc. |
| 12. EVgo Services LLC | 24. Pacific 9 Transportation, Inc. | 37. Zenith Motors, LLC |
| | 25. Phoenix Motorcars, LLC | 38. [REDACTED] |
| | | 39. [REDACTED] |



Range of Company Sizes

Respondents varied widely in terms of company status, size and market history. Some were established more than 100 years ago, and some within the past few years. Some were founded in California, some in the US more broadly, and many were founded internationally. The "Other" category represents an industry association.



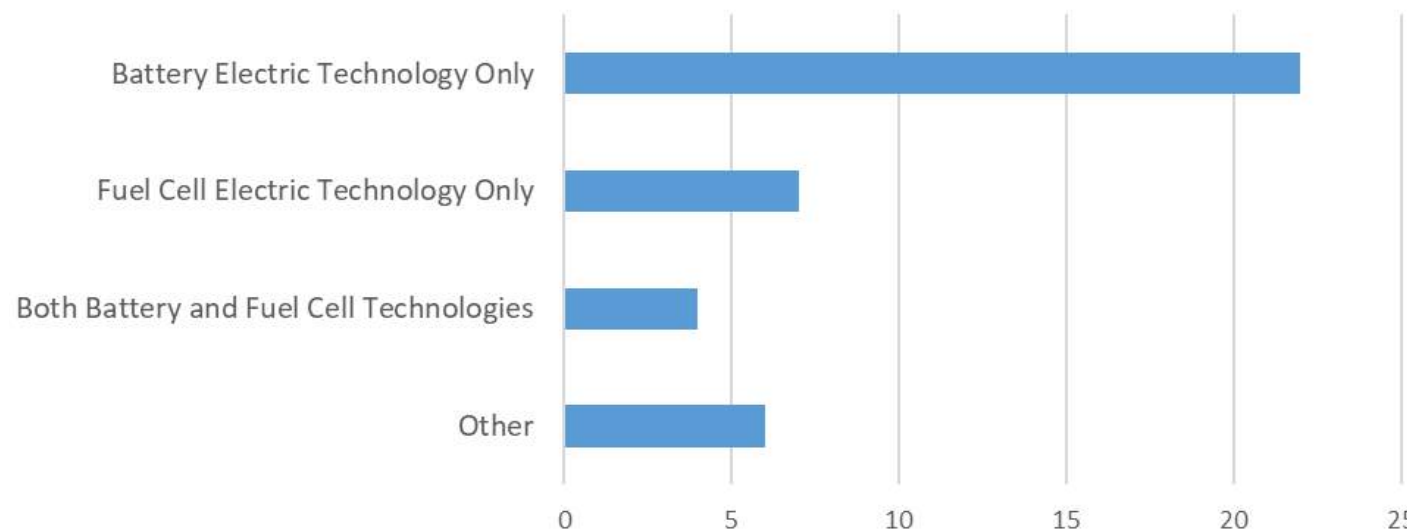


The Majority of Respondents Specialize in BEV Technologies Only

The RFI called for information on trucks that are powered by batteries, hydrogen fuel cells, or any other type of technology that has zero tailpipe emissions.

Nearly three times as many responses provided information solely on battery electric technology as those providing information solely on fuel cell technology. Five respondents included information on both technology types. The “Other” category includes a catenary electric rail proposal, a fleet, and a hydrogen advocacy association.

Respondents by Fuel Technology Type

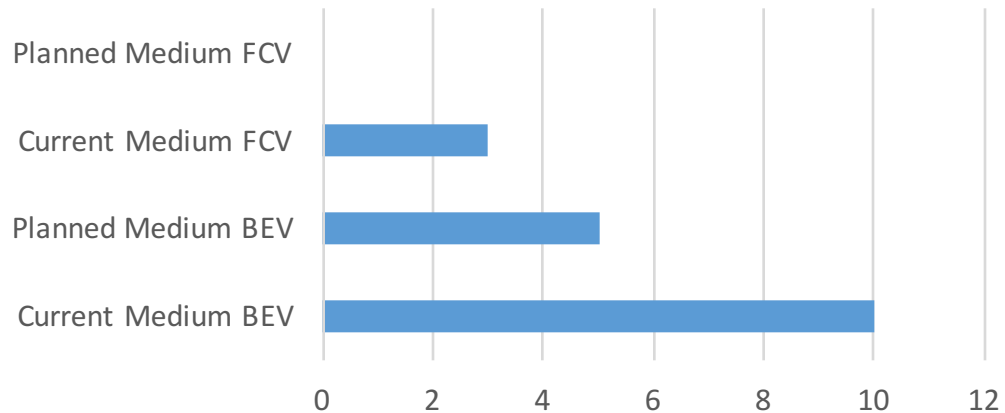




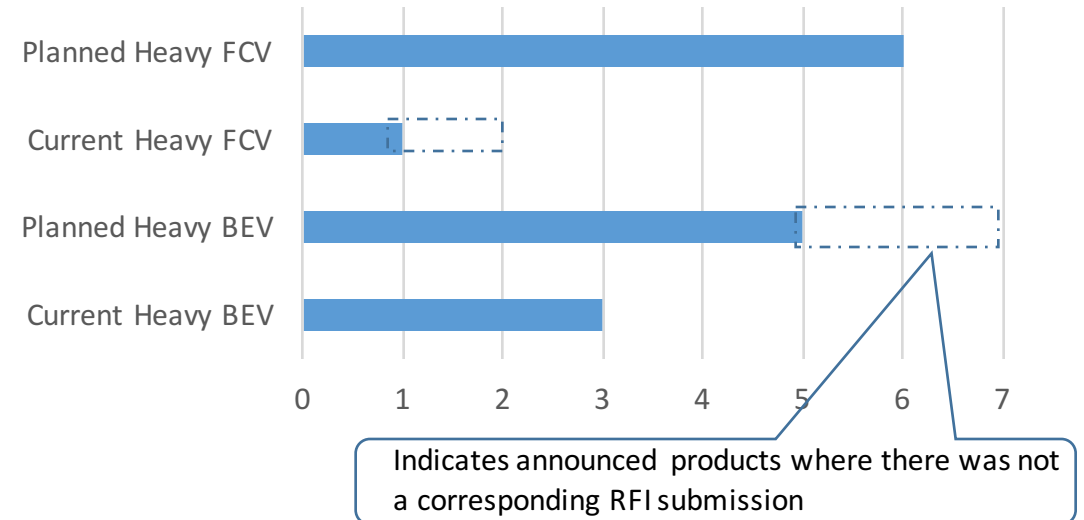
BEV medium-duty vehicles leading today, planned products point towards increased offerings in BEV heavy-duty

The RFI called for information on both medium and heavy-duty battery electric vehicle (BEV) and fuel cell vehicle (FCV) trucks for goods movement. The charts below represent the number of products in qualifying proposals by truck class, technology and production status.

Medium Duty Truck Technologies Current & Planned



Heavy Duty Truck Technologies Current & Planned





Results: Technologies, Risks & Barriers



Concerns/Recommendations Identified by BEV Respondents

	Concerns	Recommendations
Multiple	<ul style="list-style-type: none">• Upfront capital investment is high• Limited supply chain• Limited charging infrastructure• Long, unpredictable charging infrastructure timeline• Weak knowledge base among customers and stakeholders• Skepticism of young brands	<ul style="list-style-type: none">• Allocate more resources for upfront capital• Facilitate more engagement with fleets• Increase knowledge of fleet routes• Facilitate closer alignment with key permitting agencies
Singular	<ul style="list-style-type: none">• Performance• Certification requirements• Battery production at scale• Battery lifecycle and recycling• Infrastructure requirements constrain areas of operation• Rate schedules, energy legislations and trade tariffs• Slow grant reimbursement process• Customers request test periods, demos before committing to buy	<ul style="list-style-type: none">• Gather more, better data to demonstrate profitability including one-time switching cost• Allocate more resources for developing prototype vehicles/products• Issue more RFPs through public fleets that allow BEVs• Provide better EV Service training for technicians



Concerns/Recommendations Identified by FCV Respondents

	Concerns	Recommendations
Multiple	<ul style="list-style-type: none">• Upfront capital investment is high• Incremental costs of infrastructure deployment• Developing, certifying hydrogen stations takes a long time• Developing, certifying hydrogen trucks takes a long time	<ul style="list-style-type: none">• Facilitate closer alignment with key permitting agencies and authorities
Singular	<ul style="list-style-type: none">• Fear of hydrogen as a fuel among stakeholders in a local community• Planning even temporary fueling infrastructure requires knowledge of truck and duty cycle• Planning requires anticipating lots of schedule changes• Cost of electricity varies by region• Lack of manufacturing experience for building a production facility and hydrogen station network• Lack of capital for building a production facility and hydrogen station network	<ul style="list-style-type: none">• Fund multi-year, large-scale projects with volume deployments to create economies of scale






Summary of Current ZE Truck Technologies

Battery Electric						
		Class 4	Class 5	Class 6	Class 7	Class 8
Legacy						
New Entrant						

Fuel Cell						
	Companies	Class 4	Class 5	Class 6	Class 7	Class 8
Legacy						
New Entrant						

We have organized the respondents according to the following criteria:

-  Major Manufacturer/Market Leader
-  Meaningful Market Player
-  Final Product Details Still Emerging



Summary of Additional Planned ZE Truck Technologies

Battery Electric						
	Companies	Class 4	Class 5	Class 6	Class 7	Class 8
Legacy						
New Entrant						

Fuel Cell						
	Companies	Class 4	Class 5	Class 6	Class 7	Class 8
Legacy						
New Entrant						

We have applied the same categorization for Future Technologies, due to the relative inability to evaluate a manufacturer's future performance:

- Major Manufacturer/Market Leader
- Meaningful Market Player
- Final Product Details Still Emerging



Results: Pilot Project Concepts



Interest in the 50-100 On-road Drayage Truck Pilot at the Ports

We did not request detailed information about specific proposals for the 50 to 100 On-Road Drayage Truck Pilot via this RFI. Rather, we asked which companies would be interested in participating in the 50 to 100 truck pilot detailed in the Mayors' Joint Declaration and CAAP. **Seven OEMs** responded and LACI will be approaching these companies for further details in the coming weeks.

Trucks	
1.	
2.	
3.	
4.	
5.	
6.	
7.	



Unique Project Proposals for Consideration

The following slides describe proposals for unique pilot projects submitted under RFI sections III (ZE truck pilots) and IV (ZE infrastructure pilots), which met our criteria for consideration.

- These proposals were flagged because the proposal content was considered robust and actionable, and/or because the proposing entity is considered a strong potential partner.
- Our inclusion of these proposals in this summary section does not directly indicate LACI's endorsement.
- At the end of the presentation, we provide the RFI Partner recommendation, drawing on submitted content that the partners consider most feasible and impactful based on our knowledge of this market.



Truck Pilot Concept: Pilot Class 4-6 trucks in airport, port contexts

Description: Pilot Class 4-6 electric trucks on the Isuzu and Peterbilt 220 chassis for use in airport ground support, utility, and freight movement operations – for transportation of goods and freight in the surroundings of the ports. Use of night charging interface. A high voltage charging station would be required to meet maximum charging capability.

Timeline: Trucks could be delivered by May 2019.

Costs: \$200K-340K, depending on chassis and vehicle size.



Trucks	Infrastructure	Fleets
<ul style="list-style-type: none">• Isuzu• Peterbilt	<ul style="list-style-type: none">• SCE• LADWP	<ul style="list-style-type: none">• TBD• Airports

Nordresa upfits existing vehicles with its own electric powertrains. It has participated in several EV pilot projects in Canada and the USA, and has experience with electric vehicles from manufacturers including Isuzu, Peterbilt, Ford, LTS marine, Tesla Motors, Segway, and NovaBus. It has established relationships with Isuzu Commercial Trucks of America, DANA-TM4, Peterbilt and Navistar. Discussions with DANA-TM4 around becoming a preferred direct drive and eAxle integrator have led to the development of several on- and off- road products.



Truck Pilot Concept (BEV + infrastructure): Provide on demand charging services to fleets



The Concept

Outfit Chanje vehicles with high-capacity battery systems and bi-directional chargers to provide flexibility to charge medium- and heavy-duty EVs where charger networks do not meet demand.

The Benefits

- Managing queues and overflows at fleet charge stations.
- Increased range and schedule flexibility for fleets/drivers.
- Support platooning EV trucks.
- Emergency charging services for trucks and light duty EVs.
- Manage peak charging loads and grid stress.
- Accelerate EV adoption by overcoming range anxiety.



FreeWire manufactures the Mobi and Boost EV Charger systems, battery-integrated EV chargers designed to minimize the impact on grid infrastructure and avoid utility upgrades and deployment delays while providing high-power charging. The Mobi is a level 2 charger that integrates energy storage onto a mobile drivetrain. The Boost is an innovative battery-integrated DC fast charger that outputs 120kW to the vehicle while only drawing 22kW from the grid. FreeWire is seeking support for modifications to its products to support fast charging for medium and heavy duty vehicles, which may require up to 1,000 volts for charging. Additionally, DC input could be added as a feature for mobile or fleet applications that require faster recharge of the charger battery. FreeWire welcomes a discussion on potential funding for such modifications and piloting its solution in advance of the Olympic games.



Infrastructure Pilot Concept: Commercial Drayage Starter Kit



ChargePoint is a mature leader in the EV charging space, and counts Daimler Trucks & Buses, Chevron Technology Ventures, Quantum Energy Partners, Siemens, and BMW iVentures among its leading investors. The company supports various commercial fleet segments, and is currently working on a yard tractor electrification effort with the Port of Long Beach. If cost-effective, its proposal provides a scalable solution so the need for reliable charging solutions between fleet bases and distribution centers, and within port terminals.

Approximately 2,000 trucking companies, accounting for more than 17,000 tractors (or semi-trucks), are registered at the Ports of Los Angeles and Long Beach. Roughly 90% of tractors are owned by independent contractors, which means the majority of the emissions reduction opportunity is distributed across many small operators. Drayage trucks are typically parked 13-14 hours per day and log 200-300 miles per day, equating to 400-600 kWh.

Description: Develop a commercial drayage truck fueling 'starter kit' enabling parking operators and third-party logistics companies to charge 3 or more trucks at various power levels. Three (3) DC fleet dispensers supported by a 156kW Power Block (containing 5 power modules at 31.25kW each).

Timeline: 6-12 months, not including electric utility upgrades.

Costs: \$350K

Trucks

- OEMs

Charging System

- ChargePoint

Parking

- Vehicle Velocity Group
- Loves/Trillium



Infrastructure Pilot Concept: L2 and DC Fast Charging at Truck Stops



greenlots
A Member of the Shell Group

Hardware Partners

- Varying Hardware providers with HPC models

Infrastructure Partners

- Burns & McDonnell
- Black & Veatch

Utility Partner

- Southern California Edison
- LADWP

Recent Projects

- Volvo Trucks
- Penske

Description: Expand EV Charging services at existing gas stations and truck stops, and increase the number of locations that are able to handle high power charging. Two charging scenarios would be deployed: opportunity charging (150 kW) and overnight charging (50 kW). The project would include distributed energy resource (DER) solutions including backup batteries, networked software, and on-site solar panels.

Timeline: Approximately 8 months, excluding site visits and utility upgrades.

Costs: Approximately \$55K - \$200K per charger for charger equipment and installation, with \$75K-\$135K for the solar canopy. Additional Costs for backup batteries to be evaluated.

Greenlots has been a leader in EV charging network services. Its recent acquisition by Shell reflects its leadership role and ability to provide additional resources for pursuing new pilot concepts.



Infrastructure Pilot Concept: DC Fast Charging at Truck Stops



Description: Partner with established truck stops (Pacific Pride and Pilot Flying J) along the I-5 and I-710 corridors to install DC fast charging infrastructure custom-fitted to the specific operations of the piloting hubs and delivered with performance guarantees.

Timeline: 2 years overall consisting of 1 year of implementation and 1 year of data gathering, measurement and verification. The 1 year of data gathering is important to cover all 12 months of the year on seasonal variation across customer usage and winter/summer utility tariffs.

Costs: \$1M per truck stop (5 chargers @ 250kW each) + 20% annually for operations, maintenance and energy use. This does not include utility infrastructure upgrades.

Trucks	Infrastructure	Project Management
<ul style="list-style-type: none">• N/A	<ul style="list-style-type: none">• AMPLY• ABB• WAVE	<ul style="list-style-type: none">• AMPLY

The main goal of the project is to establish industry benchmarks for uptime, availability, and fuel costs with fleet operators and the Port of Long Beach. A secondary objective is to qualify project debt financing of high-availability charging infrastructure.



Infrastructure Pilot Concept: Develop 2-5 DC Fast Charge Corridors in LA area

Description: Develop between two and five high-powered truck charging corridors in the LA metro area, including at depots, by leveraging existing relationships with OEMs, fleet owners and site operators.

Timeline: 2020-2021 Pending availability class 6-8 electric trucks in large volume

Costs: \$1M+ per station



Trucks

- Phase 1: Class 4-6 trucks for local deliveries
- Phase 2: Class 8 long haul trucks

Infrastructure

- Depots with 20-150 kW DCFC
- Corridor charging at 150-350 kW or higher depending on vehicle support

Fleets

- Local delivery fleets and fixed route trucking

EVgo owns and operates the largest public DCFC network in the US with over 1,100 DC fast chargers nationwide



Truck/Infrastructure Pilot Concept: FCV Class 8 Trucks in Commercial Operation



Description: Deploy up to ten Nikola Two beta hydrogen trucks with supporting fuel production and fueling infrastructure near Anheuser-Busch's brewery in Van Nuys, CA. The project will be the first of its kind to demonstrate a fleet of zero emission long range Class 8 vehicles in normal commercial operation.

Timeline: Q1 2020 - Q2 2021 (Installation and commissioning of the on-site hydrogen station; deployment of trucks; completion of pilot)

Costs: Approximately \$50M cost to procure and install a 8,000 kg/day hydrogen station + land and all equipment included with 10 Nikola Two beta trucks. Nikola will be building Hydrogen Stations with help from Nel, who will supply electrolyzers and related equipment.

Nikola is building the first-ever zero emissions, hydrogen fuel cell powered Class 8 semi-trucks with 100% electric drivetrain along with an infrastructure of hydrogen stations. Project specs including cost, location, number of trucks, and size of station are preliminary and subject to change.



Partner Recommendations and Next Steps



Partner Process and Pilot Concepts Considered

On March 6th, LACI presented the full RFI results to key staff from:

- CARB
- CEC
- Port of LA and Mayor Garcetti's Office
- Port of Long Beach and Mayor Garcia's Office

Pilot #1 – Heavy-Duty Drayage Trucks (BEV)

A project connecting heavy-duty BEV manufacturers (OEMs, Tier 1 Suppliers and Upfitters) with additional goods movement fleets to move cargo between the Ports and the Inland Empire would provide meaningful pre-commercial opportunities. It would also address several recommendations and concerns flagged by multiple RFI respondents, as well as RFI partner goals of accelerated ZE penetration in the goods movement industry.

Pilot #2 – Mobile Charging for Medium and Heavy-Duty Trucks (BEV)

A project to address gaps in the opportunity charge networks for medium and heavy-duty vehicles, which could be met by flexible mobile charging. Use cases include: managing the queues at charging stations; increasing flexibility in range/schedules for fleet operators; managing peak charging loads and stress on grid; and emergency charging services for stranded trucks.

Pilot #3 – Charging Infrastructure for Heavy-Duty Trucks (BEV)

A project to establish charging options for trucks traveling on the I-710 and/or I-5, focused on charging options at yards, truck stops and/or a corridor approach that is agnostic of specific siting. The projects may offer DC fast charging alone or a combination of DC fast charging and L2. Projects may also include fleet optimization services.



RFI Partner Recommended Pilot Concept for Funding

Pilot Concept

Heavy-Duty Drayage + Medium-Duty Distribution Hubs + Charging (BEV)

Proposal: As fleets plan to transition their operations, many fleets that use hub-and-spoke distribution methods will need to coordinate their medium-duty solutions with their heavy-duty solutions based on site needs and operational challenges.

This pilot concept would establish heavy-duty drayage routes supported by medium-duty distribution hubs serving as both cargo transfer points and charging stations. Additional charging options would be established at third-party logistics yards, truck stops and/or via mobile charging solutions.

This would achieve the RFI partner goals of zero emission penetration in specific markets and address the repeated need for stronger charging infrastructure.



Next Steps

LACI's Next Steps:

- LACI is **working with the RFI Partners to determine next steps, including potentially a solicitation for funding.**
- LACI will **conduct market analysis** that uses the RFI responses and direct research to understand the gaps in emerging tech from established players (OEMs, Tier 1 Suppliers, Upfitters) and startups to further inform the RFI partners for future funding allocations.



Q&A



Thank you!

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