An Investment Blueprint for

Heavy-Duty Charging to Support Battery-Electric Drayage

ALONG THE I-710 CORRIDOR

LACI

April 2023

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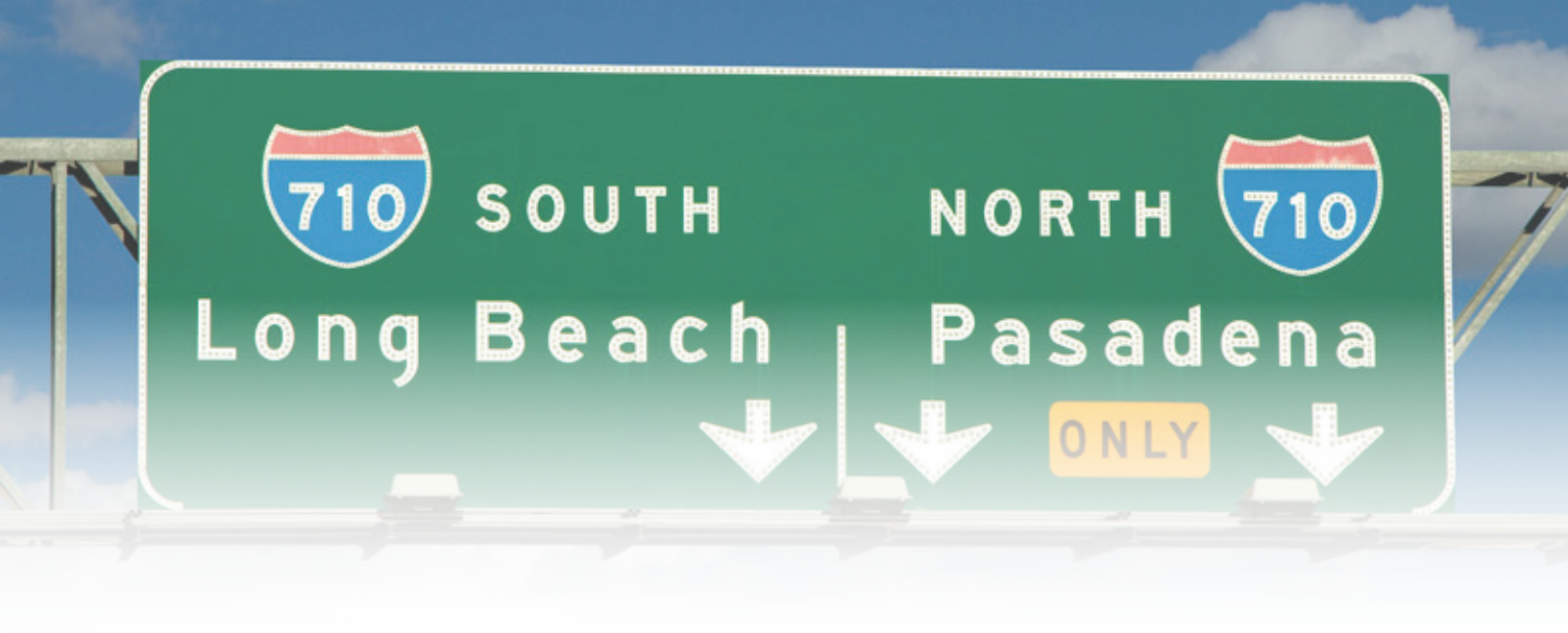

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EXECUTIVE SUMMARY

As California experiences the impacts of climate change – unprecedented wildfires, heat waves, and related setbacks to air quality improvements in the region – there is an even more urgent need to fast-track efforts to reduce emissions and increase vehicle electrification across the transportation sector, especially for heavy-duty trucks traveling on one of the most heavily traveled freight corridors in the United States. The Los Angeles Cleantech Incubator (LACI), with the public-private Transportation Electrification Partnership, identified through an RFI process in 2018 a critical need for charging infrastructure installation to catalyze battery electric truck deployments. Five years later, charging infrastructure installations have not kept sufficient pace. To catalyze the needed investment, LACI has developed an investment framework for the I-710 corridor to address the charging infrastructure needs of a significant portion of the San Pedro Bay Ports' drayage trucks.

The Los Angeles Cleantech Incubator (LACI), The Los Angeles Cleantech Incubator (LACI), with partners Coalition for Environmental Health and Justice (CEHAJ) and bp pulse (formerly AMPLY Power), and supported by regional stakeholders Southern California Edison (SCE), Los Angeles Department of Water & Power (LADWP), and the Harbor Trucking Association (HTA), executed a California Energy Commission (CEC) Medium and Heavy-Duty Zero Emissions Vehicle Infrastructure Blueprint grant to evaluate the investment opportunities for siting drayage truck charging depots around the I-710 South Corridor (pictured below). Portions of this critical corridor support up to 39,000 truck trips daily (most associated with San Pedro Bay Ports freight), an amount that may increase as much as 50 percent by 2035.[1] Furthermore, the San Pedro Bay Ports estimate that 30% of this drayage truck traffic stays within this area, delivering cargo to the local warehouses, transloading centers and East LA railyards. To understand how to invest in the charging infrastructure to support this traffic, LACI implemented a selection framework to identify specific locations primed to support charging depots based on the existing truck traffic, grid capacity, and community priorities. Prioritizing infrastructure at cost-effective sites with business models that can address fleets of all sizes, LACI has modeled a selection framework for infrastructure locations and financing mechanisms that can be applied to California's other freight corridors.

[1] Metro LB-ELA Goods Movement Truck Patterns Presentation; Nov. 11th, 2022

The Blueprint identifies sixteen candidate sites for charging infrastructure

based on traffic, grid capacity, and community priorities, such as proximity to sensitive communities and investment in underserved neighborhoods. To narrow this list to four candidate sites primed for investment, LACI, bp pulse, and CEHAJ conducted outreach to ascertain the site owner's interest and capability in deploying charging infrastructure. The project team ultimately chose four distinct facility types: one storage yard, one private fleet, one warehousing complex, and one public parking lot. bp pulse then conducted an in-depth site assessment of the four facilities to evaluate the capital costs and operating costs of an infrastructure deployment. For the remainder of the sites, the project team created a more high-level assessment of only capital costs. All sites were evaluated from a qualitative perspective for various EV charging business models.

Location of 710 South Freeway within project study area

Through the mapping process and development of investment and operating models, the project team has developed the following conclusions and recommendations:

INVESTMENT STRATEGY

LACI and the public-private Transportation Electrification Partnership (TEP) set a target for 40 percent of drayage trucks serving the San Pedro Bay Ports (Ports) to be zero emission by 2028. This will ensure steady progress towards the goal set by the Ports, and then reinforced by Governor Newsom's Executive Order N-79-20, for 100 percent of drayage trucks to be zero emission by 2035, a target to be reinforced by the California Air Resources Board in their pending Advanced Clean Fleets Rulemaking. In our Blueprint research, LACI only addressed the investment needed to ensure the drayage fleet that operates ***predominantly within the I-710 South Corridor*** in Southeast Los Angeles County can meet these 2028 and 2035 targets. Because twice as many trucks use I-170 for only a small portion before heading east into Riverside and San Bernardino counties (where they will need charging infrastructure), it is worth noting the region will need ***at least triple*** the below figures for the entire San Pedro Bay Ports drayage fleet to transition to zero emissions.

Through this Blueprint research, LACI has calculated that, for drayage trucks operating exclusively within the I-710 South Corridor to reach the 2028 target, charging infrastructure investment just within the I-710 South Corridor will need to total at least **$280 million**. LACI identified this funding as necessary to deploy at least 135 public chargers and 620 private chargers required supporting 1,760 drayage trucks that operate around the I-710 South Corridor. In practice, this assumed ratio of public to private chargers may differ based on uptake of shared access or Transportation-as-a-Service business models and fleets' preference for relying fully on private charging in the early stages of the transition.

To reach the 2035 target, the total investment will need to be at least **$700 million,** an additional **$420 million** after 2028. This funding is needed to deploy at least 620 public chargers and 1,540 private chargers required to support 4,400 trucks that operate primarily around the I-710 South Corridor. Again, this only represents ***a third*** of the entire drayage fleet; thus, the entire fleet will require over $2 billion of infrastructure investment to meet goals of the San Pedro Bay Port Clean Air Action Plan and Executive Order N 79-20. Long-term, the effects of AB5 implementation (which will limit Licensed Motor Carriers' ability to use independent contractors) and the high capital costs associated with the transition to zero emissions technology may affect the degree to which the Ports drayage fleet is 'purpose-built' (i.e. the assets are more exclusively committed to drayage), which would in turn affect these estimates.

In addition to the financial commitment, deploying charging infrastructure requires a significant real estate commitment. Building off previous studies on charging station footprints, this Blueprint estimates that, to reach 40% zero emission drayage **by 2028,** the I-710 South Corridor will need to commit **877,700 sqft** to charging infrastructure (approximately 20 acres), spread across an estimated **28 separate facilities.**

To reach 100% zero emission drayage **by 2035,** that number will increase to **2,007,500 sqft** (approximately 46 acres), spread across an estimated **70 separate facilities** (ranging from 1 MW - 10 MW anticipated peak loads) within the corridor. While these allocations may seem daunting, it is worth noting that fleets can readily transform space currently used for truck parking into space used for truck parking *and charging*. Creatively taking advantage of space at different nodes in the goods movement network that trucks already visit is necessary to optimizing space efficiencies and costs. It is also important to note that this real estate requirement only covers on-site space and does not include and space required for dedicated customers substations (if necessary) or expanded transmission and distribution infrastructure.

Proposed Funding Scenarios - 2028

The good news is that reaching this funding threshold in the near term is readily achievable given the public and private sector commitments made to invest in medium and heavy-duty (M/HD) truck infrastructure. Below, LACI proposes one scenario for how the region can collaboratively fund the necessary charging infrastructure. All amounts listed below represent realistic funding allocations to 710 South Corridor charging infrastructure based on total statewide or regional funding opportunities. The one exception would be the federal funding; however, accumulating match funding across all of these sources for a federal grant application should competitively position the region.

Stakeholder & Source	Amount
Metro - ZE Truck Program	$30,000,000
CEC - Drayage Infrastructure Carveout Funding	$60,000,000
CEC - EnergIIZE	$10,000,000
MSRC - '21-'24 Work Program	$10,000,000
Ports - Clean Truck Fund	$30,000,000
Federal Funding (US Dept of Transportation/Energy)	$30,000,000
Los Angeles Department of Water and Power	$5,000,000
SCE - Charge Ready Transport	$25,000,000
Private Capital - Fleets & Energy Service Providers	$80,000,000
TOTAL	**$280,000,000**

Below are specific recommendations related to the geographical locations of charging depots, the financial requirements, and the policies that can best effect change.

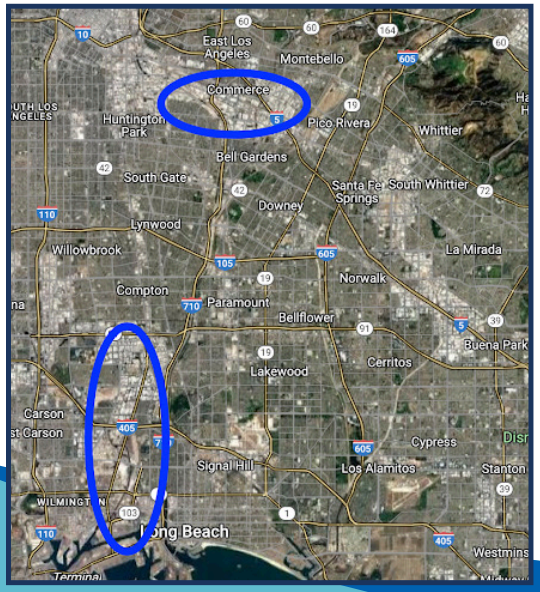
GEOGRAPHIC RECOMMENDATIONS

- Deploying infrastructure to support battery-electric trucks is an opportunity to manage the drayage truck traffic patterns along the I-710 corridor by encouraging them to recharge in the industrial areas they already visit consistently.

- Following from the above principle, charging infrastructure planning along the I-710 corridor should be approached in two ways: 1) a barbell approach, with sufficient charging infrastructure both near the Ports and near the East LA railyards and 2) along Alameda Street south of I-105 (former State Road 47) adjacent to the warehousing and industrial facilities (circled areas on map below).

- Certain substations and circuit capacities in these areas are adequate for now, but others with fewer than 10 MW of power will not be able to support more than two large (>50 trucks simultaneously) private overnight charging depots or one large (>20 trucks simultaneously) public opportunity charging depot without grid upgrades or distributed energy resources, the implementation of both requiring significant extra time. Utilities will need to be proactive with investments in these areas to prevent over-crowded substations from slowing EV deployments in dense industrial areas (more in Policy Recommendations below).

- Some cities along the corridor that have adjoining industrial and residential areas (such as Compton and South Gate) will need to upgrade the grid infrastructure to support charging and manage traffic patterns to avoid burdening the community if they wish to sustain industrial trucking activity.



- Given space requirements to park Class 8 trucks, there are few areas in the corridor where the trucks stay for a prolonged period of time, given more high-value uses (like container and trailer chassis storage). However, there are opportunities to identify where a truck naturally stops for shorter windows (at warehouse loading docks, at marine terminals), and intermittent charging along each node of the goods movement network can increase the daily range of a battery-electric truck without requiring extra space.

FINANCING RECOMMENDATIONS

- Public charging infrastructure – deployed with no utilization contract (an agreement between a station operator and a fleet committing the fleet to purchase a given amount of energy) – will require public investment in the form of not only financing the infrastructure, but also providing the real estate. Privately funded charging infrastructure can require the operators to amortize the capital costs over each kWh dispensed at a rate too high to encourage adoption of battery-electric trucks. Public funding (with supportive policies) is needed to remove the utilization risks in the early stages of adoption. Public entities can require competitive leasing rates for property under their control, but public entities with a stake in securing the zero emissions transition will need to use existing holdings to provide a market signal to early adopters that there will be charging available for drivers, which will provide them the flexibility in their operations that the drayage industry requires.

- The region can affordably accelerate the investment in the necessary infrastructure if businesses (fleets, property owners, energy service providers or otherwise) procuring or converting their M/HD fleets to electric leverage Southern California Edison's Charge Ready Transport program, legislated through SB 350 in 2018. This program can cover a substantial portion of the estimated capital costs in most cases of private fleet deployments (the program is not available for public charging yet), drastically reducing the investment burden for other private sector stakeholders. The program can be constraining, as it is tightly regulated by the CPUC; current program requirements include procuring at least two EVsand ten year agreements, among others. Funding is not guaranteed but developing operations around the constraints can unlock the value of fleets transitioning to electric powertrains, while halving the additional investment required for the region.

- Innovative partnerships between public and private entities can unlock value and mitigate risk; specifically, allocating private real estate to public charging is a difficult proposition at this stage in battery-electric truck adoption. Allocating public agency land to charging infrastructure can bring private sector investment off the sideline and the two entities can structure agreements to appropriately allocate risk and upside.

With this information in hand, LACI aims for regional agencies and stakeholders to move quickly and cooperatively to deploy infrastructure that can support the region's goods movement transition with the endorsement of the I-710 communities.

POLICY RECOMMENDATIONS

- Utilities need to be allowed to invest in 'least-regrets' infrastructure in a manner that does not overly burden ratepayers. This would entail upgrading specific substations in areas (especially by the Ports and the rail yards) where the utility can adequately plan for a large increase in electrical demand.

- Public funding for publicly available infrastructure must continue to be a priority for state, regional, and federal governments as a catalyst for vehicle adoption among fleets without dedicated home facilities. By focusing this investment in the areas most burdened by pollution, public agencies can make the greatest impact with their resources.

- Regional collaboration is paramount to ensure that assets across Southern California complement each other, and each agency can fulfill its operational and financial role in securing a transition to zero emission transportation for all. Working together with one vision will best position the region to secure transformative federal funding as well.

Acknowledgments

LACI would like to thank the California Energy Commission for granting LACI this award and enabling this research project. LACI would like to especially thank our Commission Agreement Manager, Marc Perry, for assisting us throughout the project, and Commissioner Monahan, who serves as an ex-officio adviser to LACI's Transportation Electrification Partnership.

LACI acknowledges the continued guidance of members of the Transportation Electrification Partnership (TEP) focused on the transition to battery electric goods movement; since 2017, TEP has pushed for more state and regional focus on the needs of charging infrastructure, and LACI hopes this effort can catalyze the required investment. Specifically, LACI would like to thank bp pulse, City of Los Angeles, East Bay Community Energy, Electrify America, Los Angeles Department of Water and Power, Los Angeles Metropolitan Transportation Authority, Southern California Edison, Shell Recharge Solutions, all of whom provided peer-review at one stage of this Blueprint's development.

LACI appreciates the other companies in the freight sector who provided input on their perspectives on drayage electrification, including Volvo Trucks North America, Daimler Trucks North America, Tesla and Black & Veatch.

LACI would also like to thank the many members of the Coalition for Environmental Health and Justice, without whose input this planning project would not merit the implementation we hope to collectively achieve. These include, East Yard Communities for Environmental Justice, EarthJustice, National Resources Defense Council, Long Beach Alliance for Children with Asthma, and Communities for a Better Environment.

Lastly, LACI would like to thank the state and regional agencies that are working in concert to transform the I-710 freeway from a 'diesel death zone' into the first electric freight corridor in the country; namely, Los Angeles Metropolitan Transportation Authority, California Air Resources Board, California Transportation Commission, California Department of Transportation, the Ports of Los Angeles and Long Beach, and South Coast Air Quality Management District.

Definitions

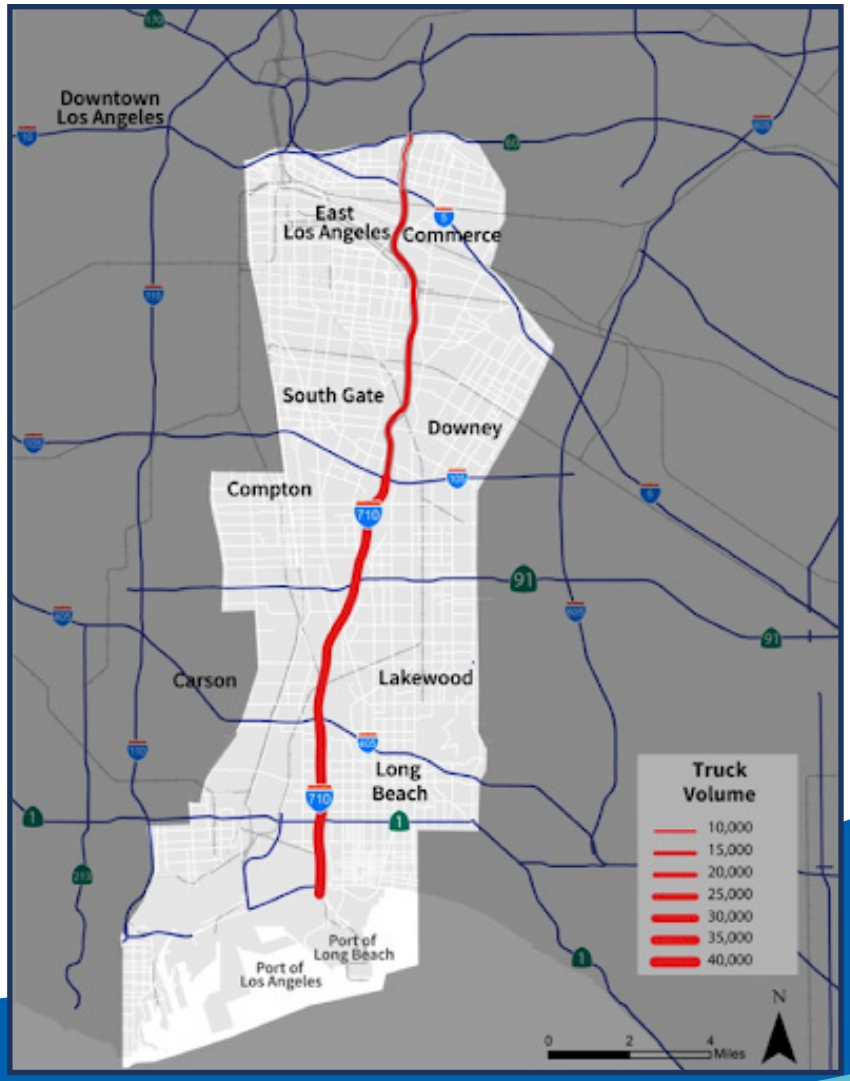
BEV	Battery Electric Vehicle
CARB	California Air Resources Board
CaaS	Charging-as-a-Service
CEC	California Energy Commission
CEHAJ	Coalition for Environmental Health and Justice
Class 8	Truck Weight Class with GVWR >33,000 lbs
CPUC	California Public Utilities Commission
DER	Distributed Energy Resources
EVSE	Electric Vehicle Supply Equipment
HTA	Harbor Trucking Association
ICE	Internal Combustion Engine
IOU	Investor Owned Utility
kV	kilovolt (one thousand volts)
kW	kilowatt
kWh	Kilowatt-Hour
LACI	Los Angeles Cleantech Incubator
LADWP	Los Angeles Department of Water and Power
M/HD	Medium and Heavy-Duty
SCAB	Southern California Air Basin
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SPBP	San Pedro Bay Ports
TEU	Twenty-foot Equivalent Unit

INTRODUCTION

Background

The Long Beach Freeway, or I-710, is a north-south interstate highway that connects the San Pedro Bay Ports with east Los Angeles and the City of Long Beach. This freeway is the main route used by trucks to transport marine cargo containers to and from the Ports of Los Angeles and Long Beach, which is the largest sea ports complex in the Western Hemisphere. The twin ports handle approximately 31 percent of all container freight for the entire United States; this freight is connected to 1 in 9 jobs in the region, serving as an economic driver for Southern California. Though a small section of freeway, the I-710 plays an outsized role in regional truck traffic. In a webinar LACI hosted with the Harbor Trucking Association, surveys showed that the majority of fleets have headquarters within 10 miles of the Ports complex as well as trucks that travel on the portion of the I-710 south of SR-91 for every container pull they make, undergirding the importance of identifying charging opportunities adjacent to this critical corridor.

Broadly, M/HD trucks comprise the second largest categories of greenhouse gas emissions in the transportation sector in the US. Specific to Los Angeles, goods movement represents the region's largest source of air pollution and the I-710 is the densest conduit of this truck traffic. Much of this is freight transiting on heavy-duty diesel trucks, creating long-standing community concerns about traffic congestion, safety, air quality, public health, noise, blight, and damage to



Location of 710 South with proportionate truck volumes

local streets. Additionally, low-income communities and communities of color surrounding the I-710 freeway experience disproportionate rates of respiratory and other harmful illnesses stemming from exposure to truck emissions. These communities experience 36% more particulate matter in the environment, leading to twice as many emergency room visits from asthma attacks.[2]

To address this climate and public health emergency, local and state leaders – with the urging of public health organizations, community groups, environmental organizations, industry leaders, startups, and labor organizations – are advancing critical initiatives to transition this drayage fleet to zero emission technologies. CARB's Advanced Clean Trucks rule, passed in 2020, requires manufacturers to sell an increasing percentage of zero emission trucks starting in 2024. CARB is also in the later stages of developing its Advanced Clean Fleets (ACF) rule, which would require 100 percent in-use drayage trucks at California's ports by 2035. This rule aligns with the San Pedro Bay Ports Clean Air Action Plan, requiring 100 percent in-use by 2035 while also preventing combustion vehicles from entering the Port Drayage Truck Registry starting in 2024. All of these rulemakings support the vehicle deployment targets set out by Governor Newsom in EO N-79-20.

LACI and the Transportation Electrification Partnership

The Los Angeles Cleantech Incubator (LACI) is creating an inclusive green economy for the people of Los Angeles through unlocking innovation, working with startups to accelerate the commercialization of clean technologies, transforming markets through partnerships with policymakers, innovators, and market leaders in zero emission transportation, clean energy, and sustainable cities, and enhancing communities through workforce development, pilots, and other programs. Founded as an economic development initiative by the City of Los Angeles and Los Angeles Department of Water & Power (LADWP), LACI is recognized as one of the most innovative business incubators in the world by UBI Global. Since 2011, LACI has helped 375 portfolio companies raise $858 million in funding, generated $335 million in revenue, and created 2,626 jobs throughout

[2] https://www.kcet.org/neighborhood-data-for-social-change/community-health-in-the-i-710-corridor

the Los Angeles region, with a projected 5-year economic impact of more than $585 million. The organization utilizes a unique and integrated approach to spur the green economy to reduce statewide greenhouse gas emissions, improve air quality, create jobs, and generate local economic impact.

To advance these efforts, in May 2018, LACI launched the Transportation Electrification Partnership (TEP), an unprecedented multi-year, multi-sectoral partnership with leadership including the City of Los Angeles, LADWP, County of Los Angeles, CARB, CEC, Southern California Edison (SCE), and LA Metro, among others. This visionary partnership set an aggressive goal to achieve an additional 25 percent emissions reduction – beyond existing commitments – in Los Angeles County through transportation electrification by 2028, the year that the Olympic and Paralympic Games arrive in Los Angeles. TEP pursues bold targets, pilots, initiatives, and policies that are equity-driven, create quality jobs, and grow the economy. As part of this effort, TEP – in coordination with the San Pedro Bay Ports – set an aspirational interim target for 40 percent of the drayage fleet serving the Ports to be zero emission in time for the 2028 Olympic and Paralympic Games in Los Angeles. Achieving this interim target will ensure steady progress towards the local and state goals for 100 percent zero emission drayage by 2035.

Realizing these truck deployment goals will not be possible without the rapid deployment of infrastructure to support this drayage fleet. In fall 2018, LACI partnered with the CEC, CARB, and the San Pedro Bay Ports to issue a Request for Information (RFI) on Zero Emissions Trucks, Infrastructure and Pilot Concepts for Goods Movement. With 39 respondents across startups and incumbents, vehicle manufacturers and infrastructure providers, the RFI demonstrated significant product development in the battery-electric truck space. It also made clear that while the battery-electric drayage truck market is developing rapidly, the lack of sufficient charging infrastructure is a top barrier to making the transition to zero emissions. Recognizing the need to rapidly scale charging infrastructure investment in order to reach vehicle deployment goals, the TEP 2028 Roadmap [3] calls for 95,000 chargers for goods movement by 2028 to support the targeted goal of 60% zero emissions medium-duty vehicles as well as the drayage target. Although today there are fewer than 50 battery-electric drayage trucks currently in the Port Drayage Registry and fewer than 300 medium-duty battery-electric vehicles registered in Los Angeles County [4], these numbers will grow exponentially, as will the infrastructure to support it.

[3] https://laincubator.org/wp-content/uploads/LA_Roadmap2.0_Final2.2.pdf

[4] CARB Fleet Database tool. https://arb.ca.gov/emfac/fleet-db

Infrastructure Need

Depot infrastructure remains a key barrier to early battery-electric adoption, given the cost and complexity associated with installing the advanced equipment needed to meet the demanding duty cycles of drayage operations. These operations consist of many short-haul trips, with predictable downtime between shifts that make them optimal candidates to charge at centrally-located depots. However, because massive facility upgrades can make many sites uneconomic to electrify on a large scale, there needs to be focused efforts prioritizing affordable infrastructure deployments. By identifying sites positioned to effectively leverage existing infrastructure, the region can minimize needed investment to catalyze this transition.

Additionally, many drayage operations are smaller fleets which, even at an optimal facility, would not have the capacity to finance the charging equipment or handle the project management required to install the specialized technology. These may be situations where a third party can provide a service deploying and managing the infrastructure. Additionally, a large shared or public depot can provide fleets with dedicated access to centrally-located chargers, only paying for electricity. Such depots will be critical to providing charging access to smaller fleets (comprising fewer than 20 trucks), which comprise 45 percent of trucks regularly serving the San Pedro Bay Ports. Maximizing the competitiveness of early adopters will require tailored plans that fit the unique needs of small and mid-size drayage fleets, so it is imperative that the siting and choice of infrastructure is economically and operationally sound. By pursuing an optimization framework for identifying sites that can accommodate public or shared access, LACI and the project team created an investment plan for addressing the charging needs of all fleets along the I-710 corridor.

Goods movement is critical to California's prosperity, and there is financial and social momentum in the public and private sector to invest in the transition to electric trucks. After decades of investment in battery technology, motor propulsion, and power electronics, battery-electric trucks are primed to haul freight throughout California. In the drayage industry, advancing these demonstration and pilot projects will require a sustainable, competitive operating model.

Purpose and Goals

With this CEC Blueprint for Medium and Heavy-Duty Zero Emission Vehicle Infrastructure grant, LACI created an investment plan for the deployment of infrastructure to support electrification of heavy-duty goods movement along the I-170, with a framework that can apply to other freight corridors.

LACI's investment blueprint will also serve as a model framework for leveraging existing infrastructure and intermodal operations to rapidly deploy heavy-duty electric trucks. LACI's goals are for the Blueprint to provide the following information to stakeholders:

- **Fleets:** Knowing the costs associated with deploying a large infrastructure deployment; understanding the different business models available to them and associated operating costs; knowing what areas of the corridor have adequate capacity and could serve as a depot with minimal utility-side upgrades
- **Utilities:** Knowing in which areas of the corridor to expect greater concentrations of charging infrastructure and understanding longer-term expansion plans
- **Regional agencies:** Provide a picture of opportune properties for M/HD infrastructure, associated costs per depot, and community preferences for goods movement infrastructure
- **Private capital:** Identify best properties for immediate development of charging infrastructure

While supporting priority deployments for the San Pedro Bay Ports, the framework can be applied to other intermodal regions with investors looking to electrify M/HD trucks across California and the country. Optimizing capital expenditures for sustainable intermodal operations, LACI and the Blueprint's project partners have developed a scalable framework for developing ready-to-implement heavy-duty charging infrastructure projects along corridors in need of alleviating pollution.

Partners

The primary community partner in this project was the Coalition for Environmental Health and Justice (CEHAJ), a coalition that comprises East Yard Communities for Environmental Justice, Communities for a Better Environment, Earthjustice, Long Beach Alliance for Children with Asthma and the Natural Resources Defense Council among others. CEHAJ has a long history working to ensure improved air quality, public health and overall quality of life for residents living along the I-710 corridor. LACI partnered with CEHAJ to solicit input on the Priority Depot Site Selection process, learning which high-traffic facilities are community priorities for air pollution mitigation, given proximity to sensitive populations and other factors.

LACI alumni and TEP partner bp pulse (formerly AMPLY Power) aims to smooth the adoption of electric powered fleets by optimizing the delivery of power, making refueling seamless and efficient with charging-as-a-service. In the project, bp pulse sought to determine how depot infrastructure installation can place as little burden as possible on the fleet operating costs, while developing a model for multi-fleet charging.

The Harbor Trucking Association (HTA) is a coalition of intermodal fleets that advocates, educates and promotes strategies with other goods movement stakeholders and policy makers that will sustain emission reductions, provide a dialog for intermodal truck efficiency, and to expand cargo and jobs at America's west coast ports. HTA assisted LACI in convening drayage fleets and facilitating a conversation about operating requirements to consider when developing a business model for battery-electric drayage truck infrastructure.

LADWP and SCE) – both TEP partners – supported the project with their technical knowledge of grid infrastructure and transportation electrification programs. Understanding how different grid circuits can power charging depots with minimum upgrades is key to maintaining cost-effective investments in heavy-duty charging.

LACI also coordinated with the Port of Los Angeles (POLA) for cost-savings on data procurement. The resulting project findings are also meant to inform POLA's goods movement and infrastructure planning.

Additionally, LACI met with regional agencies, including Los Angeles County Metropolitan Transportation Agency (Metro) and Gateway Cities Council of Governments (Gateway Cities COG), periodically throughout the development of the Blueprint to share methodology and interim results while encouraging these agencies to consider strategies for near-term funding opportunities. The Blueprint provides these planning organizations concrete, vetted opportunities to make transformative infrastructure investments needed to advance their zero emission drayage goals.

Process

By sequentially narrowing potential sites, LACI developed a replicable system for identifying opportunities to deploy large charging depots by high traffic corridors. Structuring the tasks in the below order created a regional specific blueprint that funnels near-term priority site developments, only evaluating and budgeting those with the greatest potential while also creating a replicable blueprint for other intermodal areas.

Truck Mapping

First, the project team examined truck traffic data to determine locations amenable to overnight (or between-shift) and opportunity charges. The project team identified locations adjacent to the I-710 freight corridor where trucks' absence of movement exhibits characteristics amenable to receiving a charge for a certain amount of time. The ultimate deliverables were a series of maps that showed densities of trucks at locations where existing drayage operations offered charging windows of certain lengths. While some operational adjustments can unlock the greatest benefits to electrification, the supply chain still needs to run every day throughout the transition to zero emissions. Therefore, **the task's goal was to identify locations that could serve drayage trucks' existing operations to increase the near-term utilization necessary for justifying these investments.**

Grid Analysis

The second tenet for building a viable investment thesis, calculating the cost of deploying infrastructure at specific sites and ongoing fueling costs for the fleet, required eliminating facilities lacking strong electrical infrastructure from consideration. This reduces the risks of costly investments or unsustainable operating costs, ensuring a viable depot development plan that would avoid the time and costs of large utility-side

infrastructure upgrades. LACI collaborated with LADWP and SCE to analyze the estimated available resources, with **the goal of illustrating the ideal grid circuits that could support heavy-duty charging based on grid transmission and distribution layouts and capacities.**

Facility Identification

With the grid capacity and truck traffic maps created, the next step was for CEHAJ to identify the facilities they prioritized for electrification, adding the third, and gating, factor into the selection framework. LACI also developed auxiliary map layers showing local points of interest (hospitals, parks, schools) to help CEHAJ in their selection process. The goal of this task was to **develop a roster of facilities with the potential to host a truck charging depot while ensuring that any resultant investment in goods movement infrastructure would not come at odds with community priorities for improved air quality, public health and overall quality of life for residents living along the I-710 corridor.**

Site Assessments and Business Model

The project team then reached out to the list of community-vetted sites to gauge interest in participating in the project, offering the facilities with a complementary site assessment to feature in final evaluations. After evaluating the facilities' interest in participating, the project moved forward to fulfill the task's **goal of performing in-depth site walks to create a capital and operational budget for deploying infrastructure at four facilities.** As an added benefit, the project team created desktop analyses, a stripped-down version of a site assessment conducted solely with satellite imagery, for those facilities deemed to have less interest in a near-term deployment.

Investment Blueprint

To complete the regional Blueprint, LACI applied existing resources to the project-generated cost estimates **to assess the high-level investment (both in finances and real estate) in the 710 South Corridor required to reach 40 percent zero emission drayage by 2028, and 100 percent by 2035,** including assumptions on the breakdown on depot types and business models.

Drayage Operations and Defining Charging Opportunities

Given the high initial capital expense of battery-electric trucks, drayage fleets want to operate the trucks for two shifts per day to get an acceptable return on the asset. The paragraphs below do not reflect the entire universe of drayage operations as exists today, but rather the ideal operational setup for fleets to economically deploy battery-electric trucks.

For employee-based fleets (the dominant fleet type of early-adopters), between the first and second shift, the truck may be stationary anywhere from 10 to 60 minutes as the first driver finishes and second driver begins, traditionally occurring between 3:00-6:00 PM. This window is not consistent, as fleets may 'slip-seat' trucks; in this arrangement, the same truck is used for two shifts by two different drivers, with a hand-off in between shifts. Although this arrangement keeps the truck in operation across two shifts, there can still be a half-hour between the first shift ending and second shift beginning. ***This has the potential to serve as an 'opportunity charge' for the truck, though the charger placement and charging process must be readily accessible (or autonomous/inductive) to ensure success.*** Additionally, this charging should only be performed with a high-capacity charger (at least 250 kW, preferably 500kW-1MW) to ensure ample energy transfer during this window.

After a second shift, the truck is parked overnight for 3-5 hours before the next day's first shift. ***This will serve as the option for an overnight charge.*** This window is plenty of time for a slower charger (150kW) to fully recharge a truck before the next morning's shift. However, due to container volume at the Ports or driver availability, not every truck during every work day operates two shifts, and trucks may sit idle for prolonged periods, where an even slower charge (50 kW) could fill a battery pack before the next driver needs a truck.

When considering charging mid-shift (right before or after picking up or dropping off a container at the Ports or a warehouse–but not between first and second shift), the fleets expressed skepticism based on their current business models. Currently, fleets use a mobile diesel refueler that visits the fleet every other day to refuel the trucks at an overnight parking lot to avoid paying truck driver labor for non-driving activities (i.e. fueling).

With this setup, charging opportunities during a shift are limited for employee-based fleets. For any applicability, the chargers must be 1) as fast as the truck-side architecture will allow 2) located almost immediately adjacent to a popular warehouse or the Ports, or, better yet, use inductive charging, though economic viability of inductive charging requires further dedicated research. Essentially, drayage truck drivers cannot be expected to drive out of their way, and spend time, to charge during a shift. The calculus of time required may be different for owner-operator drivers, though the need to minimize time spent driving to a charger would remain the same.

When defining truck characteristic and data parameter needs, the project team identified the two best charging opportunities for employee-driver, asset-based fleets:

Opportunity "Fast" Charging
Where the truck is stationary for thirty minutes at any point during the day.

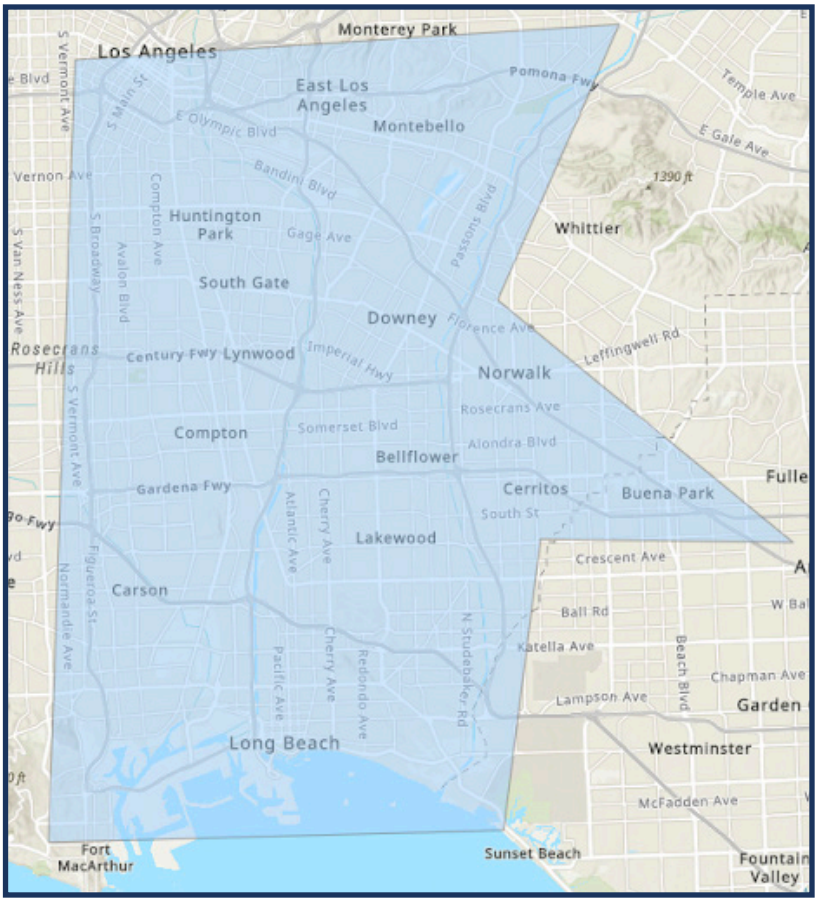
Overnight "Slow" Charging
Where the truck is stationary for at least three hours at any point during the day

Project Geographic Boundaries

LACI first met with CEHAJ to solicit input and recommendations from community members on what locations to prioritize for evaluation, informing the truck traffic data LACI requested from GeoStamp, a company that leverages location data and predictive analytics on its geospatial platform to deliver throughput, optimization, and intelligence for the supply chain and logistics industry.

CEHAJ provided important feedback on what to look for in the truck traffic data that goes beyond just the time windows when a truck could charge. Specifically, CEHAJ identified the need to pay close attention to

the corridors of heavy truck traffic that are adjacent to residential communities and how charging infrastructure could be installed to divert truck traffic away from these sensitive areas. Transitioning to battery-electric drayage is an opportunity to shift the traffic patterns that have historically made communities unsafe. In many areas close to the Ports, industrial areas are directly adjacent to residential areas, causing truck traffic to cut through residential streets, which can create acute noise and air pollution while also risking accidents. By considering how charging infrastructure can draw truck traffic and reshape the previous deleterious land use decisions, the region can improve the lives of community members. CEHAJ provided the LACI team with some specific street sections that should receive attention, including areas adjacent to I-710 exits by the rail yards in Commerce.



Study Area contemplated by project team within which to evaluate truck traffic, grid capacity, and potential site assessments

Additionally, the CEHAJ team commented on the shape of the proposed cordon within which the analysis should prioritize truck traffic. LACI had initially considered a rectangle bounded on all sides by the major freeways and the Ports' complex. CEHAJ noted that new warehousing developments are operating in an area east of the I-605 off of SR-91, resulting in increased truck traffic. Therefore, LACI included this area (right) in the evaluation, with the eastern border of analysis being adjacent to the LA County/Orange County border.

Heat Mapping

After procuring the raw truck data (details in *Appendix A*), creating the heat map involved coordinating with GeoDecisions, a partner organization of GeoStamp, to create new data points, primarily combining 'Time', 'Longitude', and 'Latitude', to identify instances of a truck occupying the same 25 meter radius circle for at least thirty minutes or at least three hours, logging that location as an instance of a charging opportunity. GeoDecisions then turned these new data points into heat maps depicting the frequency and location of these instances of truck charging opportunities.

LACI did not focus on a smaller radius to identify situations where trucks may be in dense traffic at a marine terminal gate or making small moves within a warehouse complex as opportunities to charge. This would require a form of en-route charging by the Ports or a disciplined operation to avoid small moves within warehouse complexes (and instead charge), but these opportunities must be considered by fleets, Ports, and warehouses if stakeholders are to unlock the full potential of battery-electric trucks.

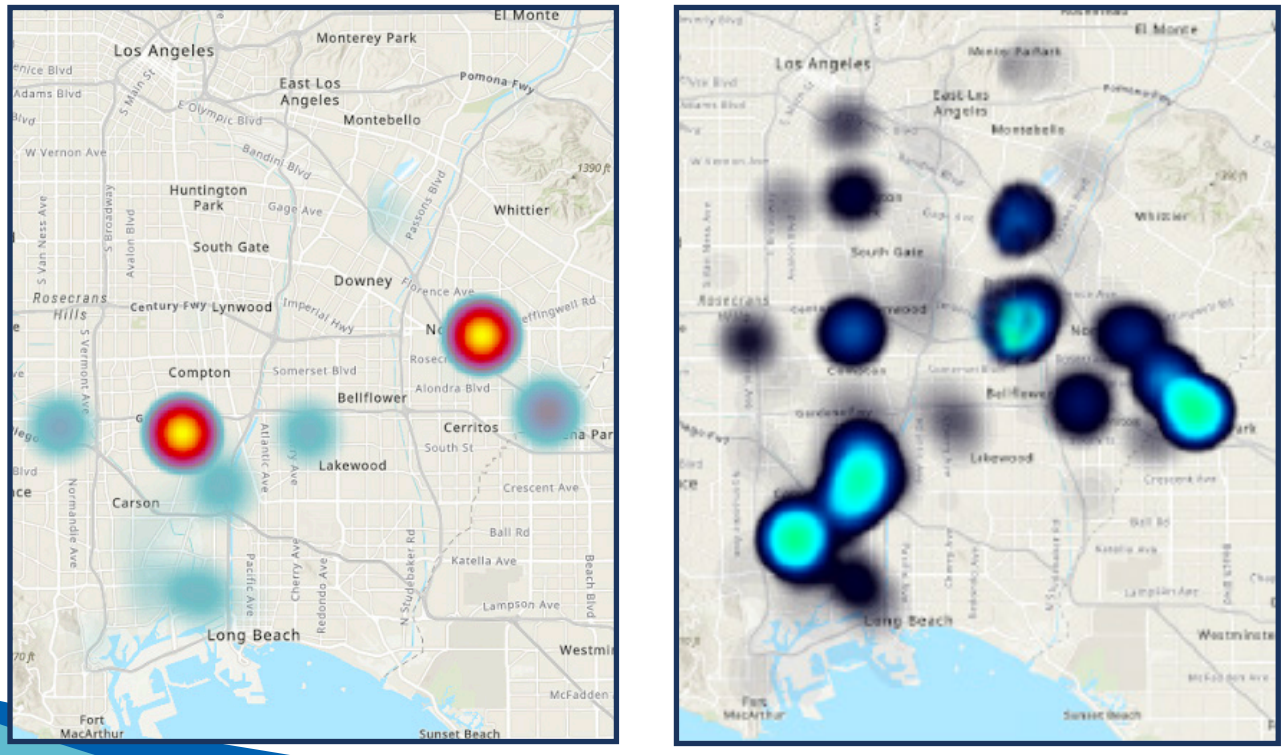
Ultimately, GeoDecisions provided LACI with shapefiles of two different map layers: one showing locations and frequencies of trucks stationary for at least 30 min (Opportunity "Fast" Charging), and one showing locations and frequencies of trucks stationary for at least three hours (Overnight "Slow" Charging). It is important to note that a truck stationary for two and a half hours would be reflected in the Fast Charging map, though charging for that amount of time would significantly replenish a battery's energy.

On the interactive web map, the densities are shown based on the view considered. For instance, if looking at the entire geographic area considered, there seem to be few instances of Slow Charging opportunities in the northern half of the corridor. However, when zoomed into the northern half of the corridor, the locations of Slow Charging opportunities become apparent. Everything is portrayed on the online map with relative densities based only on visible territory.

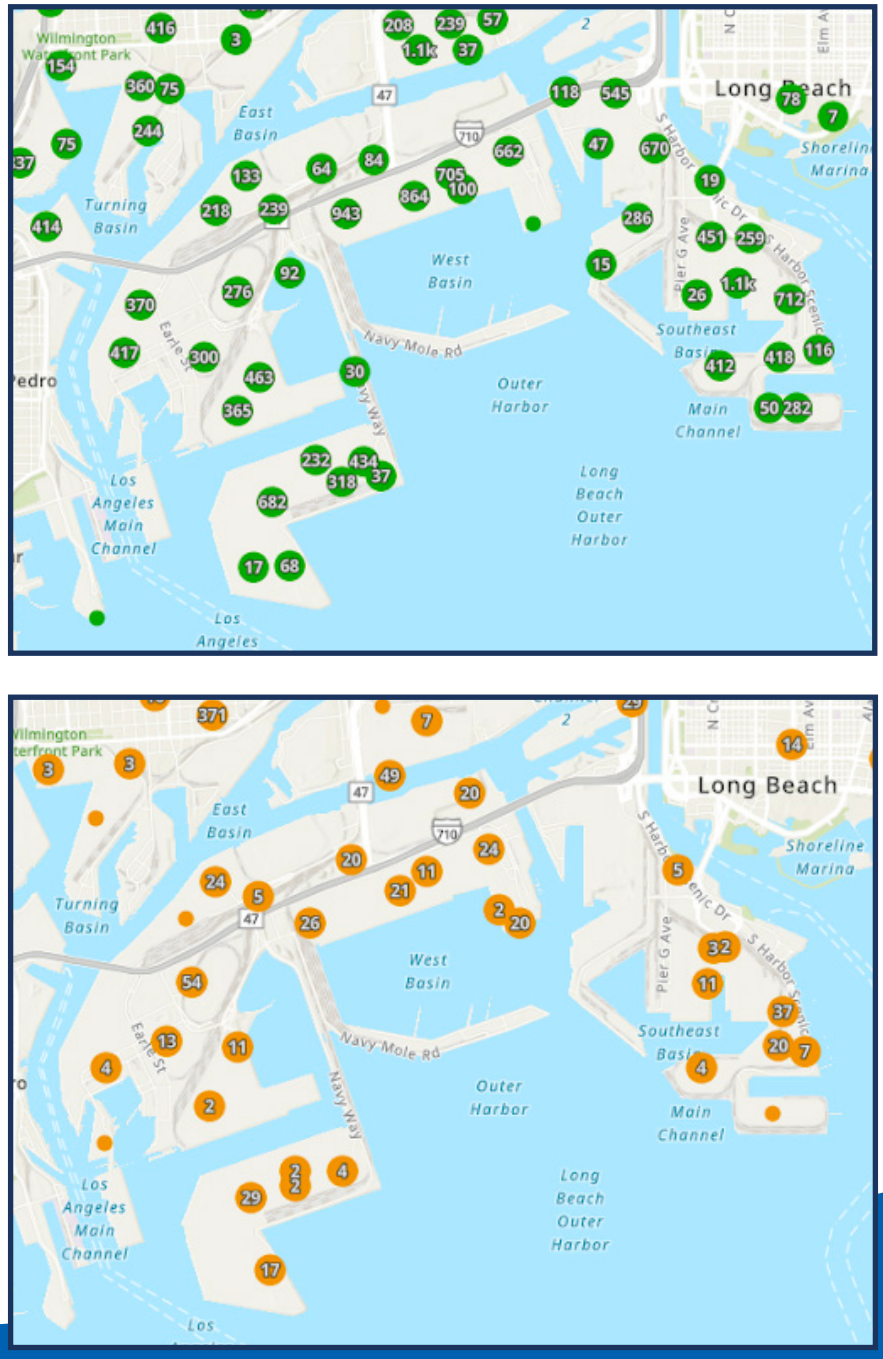
Takeaways

Slow Charging opportunities in the I-710 corridor region were far less geographically diverse than the Fast Charge opportunities. Stops approaching (but falling short of) three hours would explain some of this as, given the binary nature of the data visualization, stops on either side of the three hour mark by just a few minutes would register as different data points. This may mean that some areas displaying a high density of Fast Charge opportunities could have trucks coming very close to meeting the criteria for a slow charge opportunity. Given data visualization parameters, the length of each stationary instance is not reflected below but is parsable in a more granular analysis. Another factor is the dataset acquisition. By using one telematic provider, the dataset is self-selected for companies using that telematic provider. This is why a majority (roughly two-thirds) of total Slow Charge instances in the region (approximately 300,000) occur in two locations: near the intersection of Wilmington Ave & SR 91 in the center of the map and near the intersection of I-5 & Imperial Hwy. Given the anonymity of data, the exact identity of these fleets was not verified, though additional research shows there are warehouses and potential home depots for fleets at these locations. For other trucks and fleets using the Geostamp telematic service, it is likely that they garage outside of the zone contemplated by this study.

Heat map indicating ideal fast charging opportunity areas (30 minutes to 3 hours)



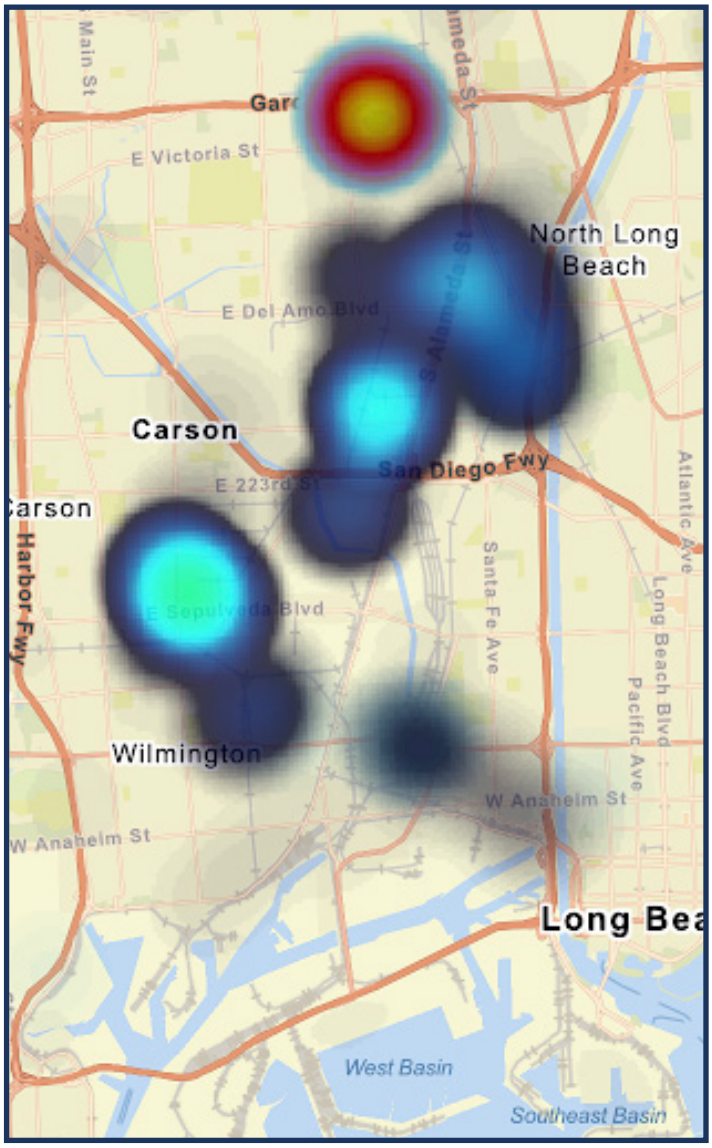
Fast Charge opportunities are far more frequent and more geographically diverse. Any warehouse in the region is liable to have a truck stay on premise for half an hour. The Ports were a popular location as well, with hundreds of instances over the course of the dataset received, seen in the maps below. Additionally, some of these drivers may be on the side of the street eating lunch or waiting for their next load assignment, providing potential opportunities for innovative curbside or in-queue charging.



Quantity of instances from dataset of a >30min stationary truck (green) and a >3hr stationary truck (orange) at the Port complex

Though diverse across the region, a preponderance of these stops are situated in the square bounded by the Ports to the south, I-710 to the east, SR-91 and I-110 to the west, including Carson, Rancho Dominguez, and Compton. This area (map below) is full of industrial facilities and warehouses that are popular destinations for the short-haul drayage and transload activities.

When considering this data for site selection, the importance of providing charging infrastructure within 10 miles of the Ports for trucks looking (or able) to charge in a location not far from their ongoing operations is crucial for public (or shared-access) stations. For private deployments, there is no bad option given the fleets ability to control for a truck's daily duty cycle and tailor operations accordingly. Even so, public charging near the Ports would serve as a valuable safety net for those fleets.



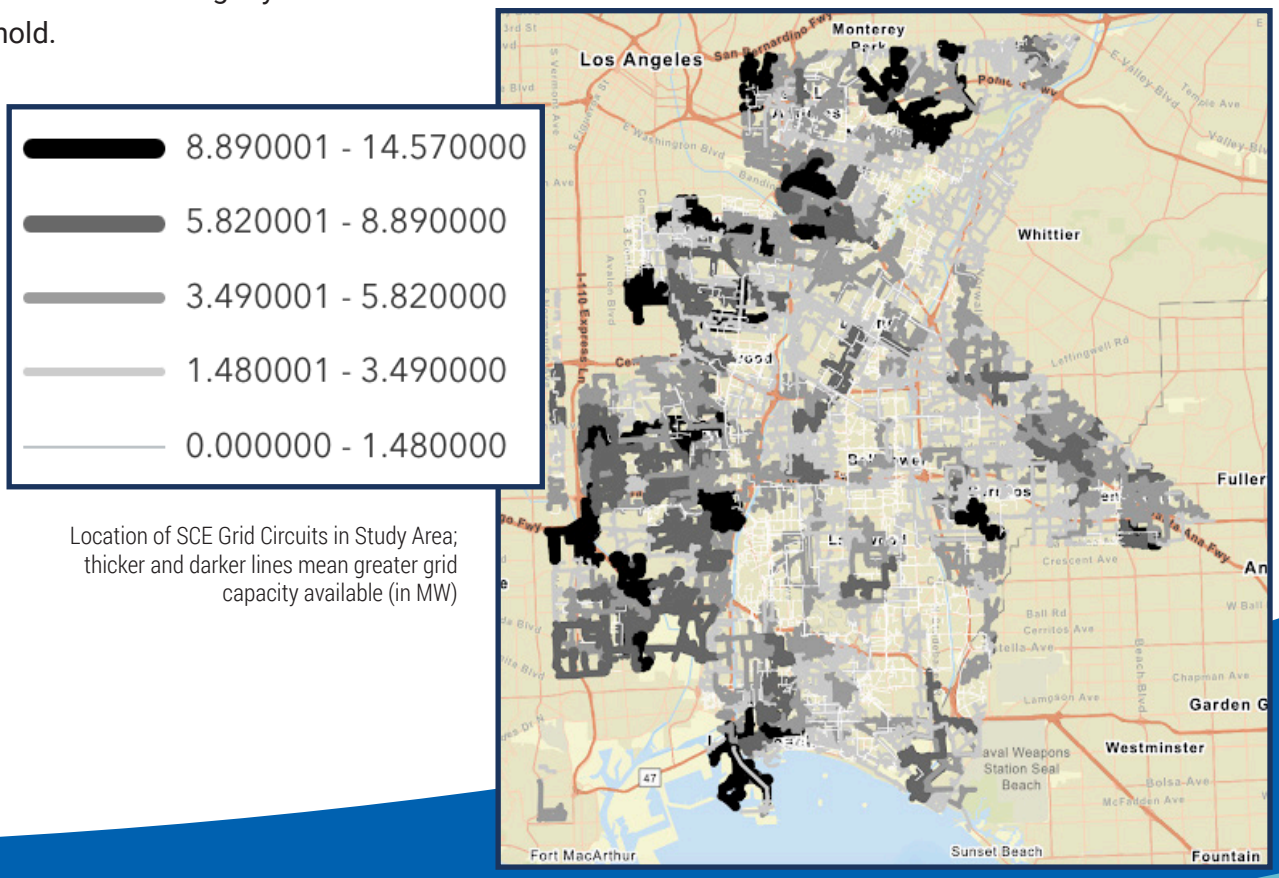
Subset of truck traffic map showing both >30min stationary trucks (blue/green) and >3hr stationary trucks (yellow/orange)

GRID ANALYSIS

Southern California Edison Grid and Interconnection Evaluations

As an investor-owned utility (IOU), SCE is subject to CPUC Rulemaking 14-08-13, which requires IOUs to create a Distribution Resources Plan; follow-on rulemaking led to SCE's creation of the Distribution Resources Plan External Portal (DRPEP), which provides circuit and subcircuit level data on the SCE electrical grid, a resource relied heavily upon for the purposes of this project. Specifically useful for this project was the Grids Needs Assessment (GNA) layer that showed the estimated available power on each circuit, projected out for the next five years.

LACI was able to create maps that highlighted circuits of a certain capacity up to four years into the future. The project team chose to evaluate estimated circuit capacity three years into the future to accommodate the anticipated time required for any resulting infrastructure deployments to be designed, permitted, constructed, and energized. Ultimately, the version of the map (above) LACI provided to partners showed a gradation of circuit capacity (in MW) by geography, to provide context for where power capacity was strongest, while also not eliminating a circuit from consideration just because it was slightly below a threshold.



Location of SCE Grid Circuits in Study Area; thicker and darker lines mean greater grid capacity available (in MW)

Additionally, various DRPEP resources could provide:

a. locations of substations, and circuits connected to a specific substation
b. substation capacity
c. amount of distributed energy resources able to interconnect to the grid on any circuit
d. transmission and subtransmission high-voltage lines

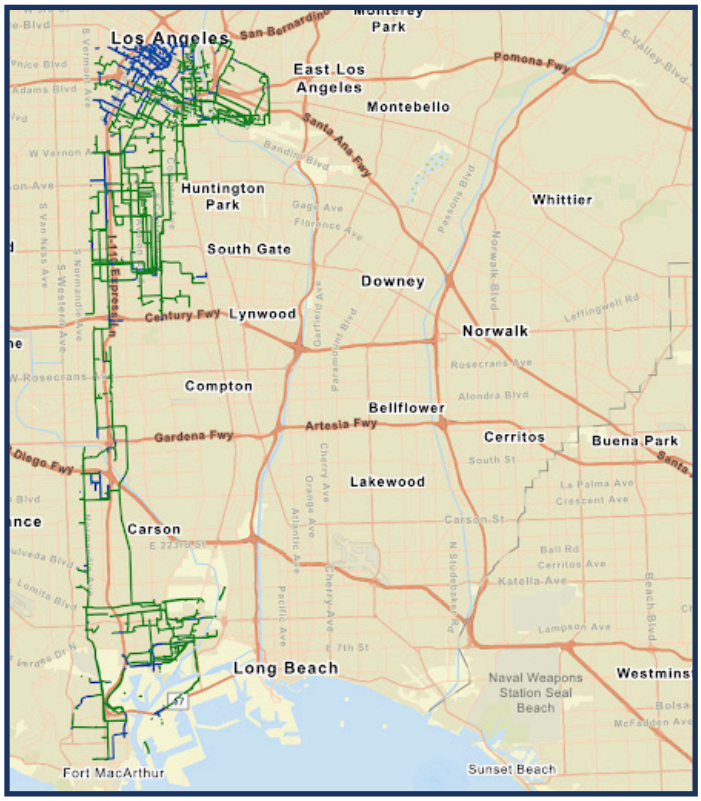
LACI met with SCE staff responsible for upkeep and updating of DRPEP to confirm this interpretation of various attributes associated with a given circuit or substation. One important note is that attribute values represent a snapshot in time, in this case, the data reflects the grid's status *as of the end of 2021*. There may be interconnection projects in the pipeline that account for some portion of available capacity, but these are only reflected through yearly updates. It is also worth noting that SCE updated this resource most recently on January 24th, 2023, reflecting capacities as of the end of 2022. The site selection process of this project did not include this updated version of the resource, though LACI has updated the online map to reflect current realities.

The Grids Needs Assessments (GNA), Interconnection Capacity Assessments, and other resources found in California IOU's Distributed Resource Plans mandated by the CPUC are incredibly useful resources for developers and public agencies to survey potential truck depots.

LADWP Grid and Interconnection Evaluations

As LADWP is a municipally-owned utility and not subject to CPUC rulemaking, it has not faced the same requirements to create a resource similar to SCE's DRPEP guide. However, the City of LA has been working closely with LADWP to make data available on the location of certain high-voltage networks, and LACI was able to use this resource in this research.

In the LADWP system, there are two primary grid networks from which a commercial or industrial customer could draw power. One is the distribution system, which operates on 4.8 kV (4,000 volts), and the other is the sub-transmission system, which operates on 34.5 kV. When considering the power requirements of a



Locations of LADWP 34.5kV lines within Study Area.
Blue is underground, Green is overhead.

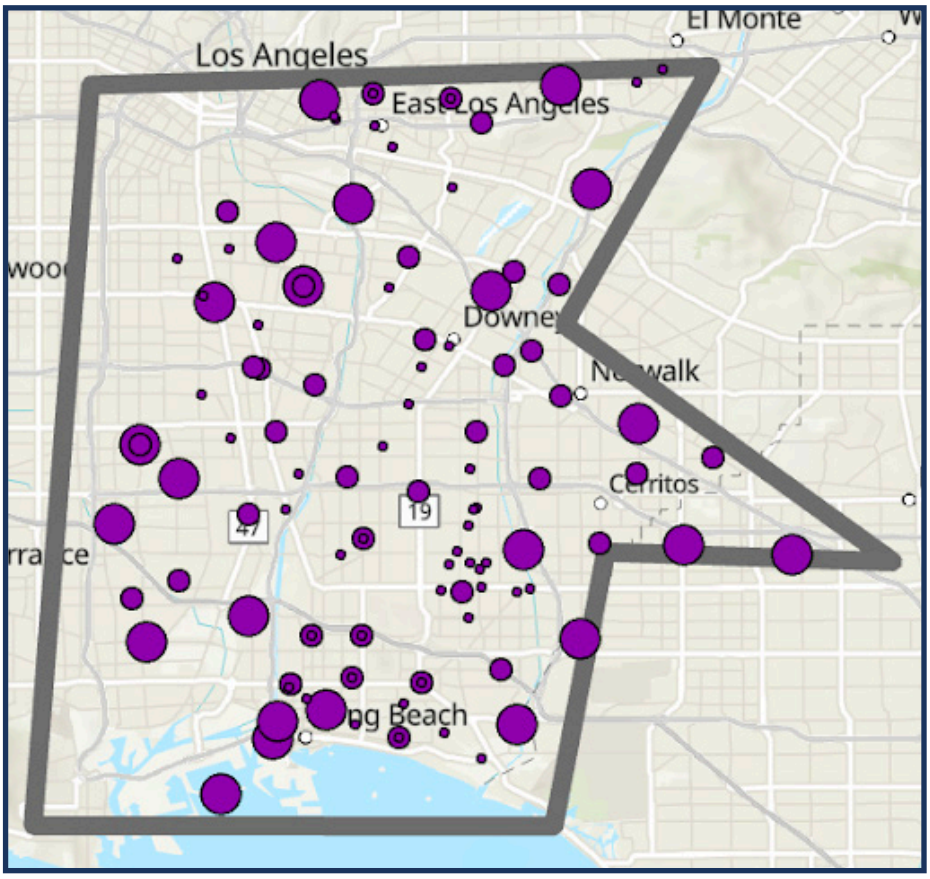
truck charging depot, and the desire to reduce the amount of expensive behind-the-meter equipment, LADWP recommended that LACI only consider the subtransmission system (pictured right) as adequate for interconnecting large (1MW+) power draws.

Though not as detailed as the SCE DRPEP analysis, accessing the LADWP maps of potential circuits serves to narrow down the possibilities for depots in LADWP territory. The area of study was predominantly in SCE territory, and, as seen in the collection of site assessments and desktop analyses, only two sites are in LADWP territory.

Takeaways

The mapping demonstrates that there are few locations across the corridor that can host a large charging depot. In the above map, only the lightest two (of five shades) circuit displays indicate a circuit with at least 4MW available. When considering that the tool does not account for interconnections requested over the last year, it's important to provide a buffer when evaluating circuit capacities. Additionally, LACI did not want to preclude certain sites from being selected by CEHAJ based on capacities, and instead would adjust the recommended project size based on available power. Some facilities located on circuits with less than 4 MW may be well suited for a private depot with 10-20 trucks charging overnight. Once expanding the number of trucks located on any one circuit, or planning for more than a few MCS chargers (Megawatt Charging Standard, a plug standard in final stages of development that can provide 3+ MW charging speeds), grid upgrades may become necessary. Alternatively, microgrids can provide additional load capacity, assuming there can be adequate space for any solar or storage.

Geographically, the ideal circuits for large overnight depot garages or multiple MCS opportunity chargers are located in the regions containing large warehouse complexes and industrial facilities. This makes intuitive sense as SCE would have planned to provide more power to these facilities and less to residential or light commercial areas. In fact, along most of the I-710 corridor, especially the southern half of the corridor, the freeway creates a stark dividing line with higher capacity circuits to the west and lower capacity circuits to the east. Similar to the truck traffic patterns, the largest collective grouping of high capacity circuits is south of SR-91. Moving north, there are still patches of higher capacity circuits in South Gate with many more in the Commerce and railyards area of East LA.



Location of SCE substations; large circles are substations >20MW, small circles are substations with <20MW

SCE's GNA model is helpful for identifying the capacities available at each particular substation as well. Even in the regions with circuits holding adequate capacity, competing demand for a limited supply of power from the connected substation could reduce capacity on any one connected circuit. Data shows that multiple

substations in the region do not have 20 MW of available capacity (an amount estimated by the West Coast Clean Transit Corridor Initiative as needed for one large-scale public M/HD charging station). For the purposes of this study, 20 MW could adequately power no more than 130-200 drayage trucks charging overnight (assumed at 100-150kW). The adjacent map shows three levels of substations power availability: less than 5MW, less than 20 MW and more than 20 MW. The projected 4,400 battery-electric drayage trucks operating primarily in the I-710 South Corridor by 2035 could require 440 MW of overnight charging. Looking at the substations best positioned to power the ideal locations for truck depots, there is a current aggregate capacity shortfall of over 200 MW, with many specific substations (see above map) falling short of 20 MW capacity. Rapidly moving to upgrade substations, or install new ones, should be a regional investment priority.

FACILITY IDENTIFICATION

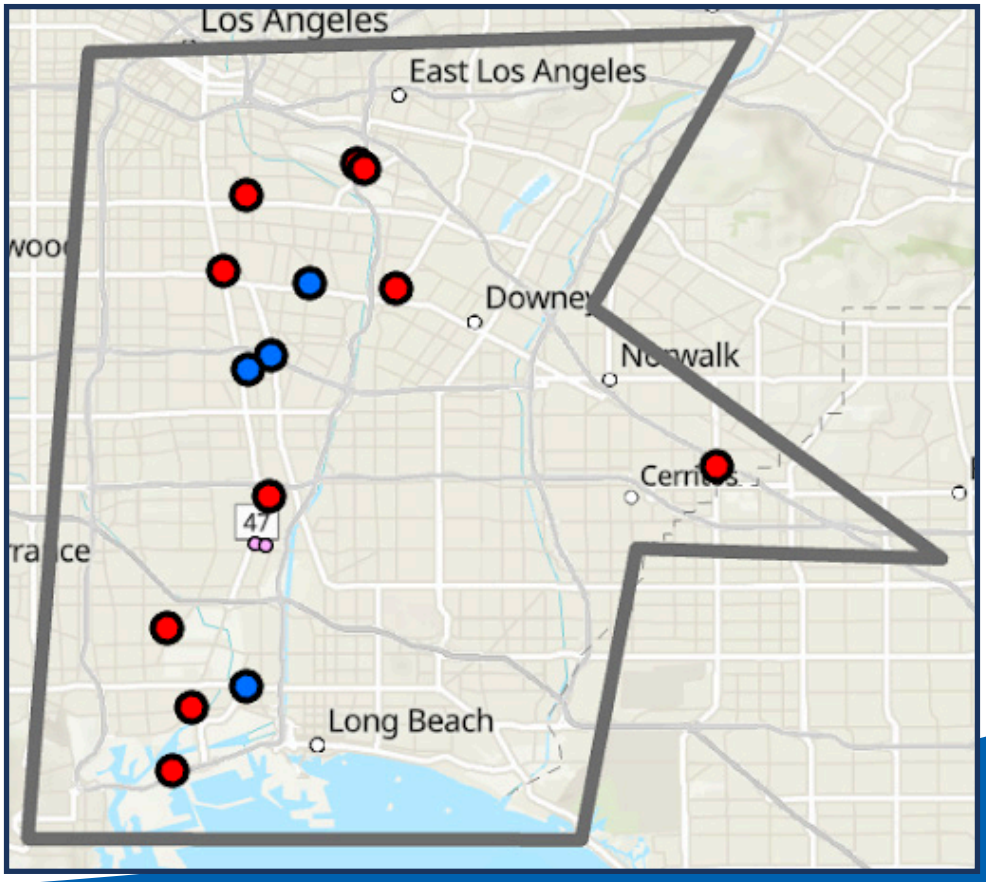
In identifying priority facilities, CEHAJ focused on community health along the I-710 corridor. As a starting point, it was noted that site selection should not induce more traffic in disproportionately impacted areas, that sites should improve air quality in areas where there is significant air pollution from goods movement infrastructure, and selected sites should not pose a safety risk for the community. CEHAJ also learned a lot about the grid capacity, which informed the priority areas. CEHAJ took these initial considerations to community members who amplified these factors. CEHAJ also wanted to use infrastructure decisions to actually divert traffic in areas that have safety/health issues, and identified nearby facilities that would be impacted if infrastructure should exist (on a case by case basis), such as schools, unhoused facilities, parks, residential areas, etc.. Lastly, CEHAJ prioritized providing opportunities to support small trucking businesses who often do not have the resources to install this infrastructure. Many in the communities along the corridor have direct economic ties to the goods movement industry, and as the transition to zero emission technology ramps up, ensuring that smaller fleets with roots in the community have access to low-cost, high-availability infrastructure is a regional priority. CEHAJ then identified promising facilities distributed along the corridor.

Facility Outreach

Per the grant agreement, the project required four distinct site assessments to evaluate the different opportunities for business models available and charging investments needed. After CEHAJ selected the initial sixteen sites to prioritize for truck charging infrastructure deployments, LACI and bp pulse collaborated to contact the property owners or managers of each facility with the following goals: 1) identifying a contact able to authorize capital improvements at a facility; 2) share the project background and purpose; and 3) gauge their interest in deploying M/HD infrastructure in the near-term. LACI and bp pulse leveraged existing contacts, cold-called facilities, and knocked on doors to ascertain answers to the above three questions. In many cases, the fleet or tenant residing at the property was not the entity with ultimate authority to install charging infrastructure. Establishing contact with the owners of some properties turned out to be a challenge, and, without the use of subscription-based real estate information software available to bp pulse, would have been challenging to even identify.

Through these efforts, LACI and bp pulse identified three site candidates that fulfilled the aforementioned criteria; however, there was not a fourth and final facility confidently identified as interested in deploying charging infrastructure. Therefore, LACI presented the project team with additional facilities that LACI was aware met the above three criteria, in addition to fulfilling the truck traffic and grid capacity requirements. After presenting these options to CEHAJ and discussing their merits, the group chose the fourth facility to prioritize for a site walk.

Additionally, the project group decided that, in addition to the four in-depth site walks, bp pulse and their subcontractor would perform 'desktop analyses' for the other facilities not chosen for a full site walk. These desktop analyses would provide an even more high-level estimate of the capital costs of deploying infrastructure, because there was no defined layout chosen. These analyses also did not receive an estimate of operating expenses, including energy costs and Charging-as-a-Service costs. Still, the project team felt creating and sharing these resources with the facilities could provide more knowledge to facility owners to help them move towards implementation.



Map depicting breakdown of site assessments and desktop analyses (red indicates desktop analysis, blue indicates site assessment, gray indicates passed for both).

SITE ASSESSMENTS AND BUSINESS MODELS

Overview

Through these site assessments and business model developments, the project team identified the nearest utility infrastructure primed for interconnection and the best spots for siting high-voltage Electric Vehicle Supply Equipment (EVSE). In addition to determining the best options for physical layouts, these site walks evaluated behind-the-meter (not utility side) capital costs of installations based on the deployment contemplated by the facility owner and operating costs based on observed truck traffic and estimated charging demand. High-level takeaways include:

All-in capital costs have declined markedly since 2020, when LACI last conducted a series of site assessments and found all-in capital costs to be approximately $200,000-$250,000 per 150 kW charger deployed. Across the four site assessments and ten desktop analyses, the all-in charger costs for 175 kW chargers (the only chargers evaluated in these assessments) ranged from $125,000-$150,000. This represents all of the costs associated with 'behind-the-meter' (or 'customer-side') equipment and construction. The bulk of this cost decrease stems from the decreased cost of procuring the EVSE equipment.

Operational costs, however, have largely stayed consistent, as EV tariffs at Southern California Edison (SCE) have not changed (all four site assessments were in SCE territory). However, as demand charges begin to get phased back into tariffs in 2026, there should be an expectation that fleets and infrastructure owners will need to adjust operations or pricing structures to avoid costly demand charges.

Most importantly, it is clear that incentives are still needed to subsidize the installation of both public and private charging infrastructure. Utility programs, such as Southern California Edison's Charge-Ready Transport Program, can fund much of the utility-side upgrades and construction, but only in select circumstances can fund the EVSE, which was found to be roughly half of most estimates. If fleets are subject to pay, whether directly or indirectly through an Energy Service Provider, the full cost of infrastructure and amortize the costs over each kWh consumed, the fuel costs of a Class 8 battery-electric truck are only marginally better than a Class 8 diesel truck (assuming 8 mpg diesel and $6/gallon, amounting to $0.75/mile) in this scenario. Fuel costs for battery-electric trucks are generally expected to be significantly lower than those for ICE trucks. However, the findings from this study show that the fuel price for battery-electric trucks is less competitive when you have to charge fleets the amortized capital costs in low-utilization investments. Paying more than $0.30/kWh cuts into those fuel savings, and demand charges are expected to occur at facilities charging multiple, heavy-duty trucks. Drayage operations will also likely be unable to avoid charging during the 4-9 pm peak rate period if the fleet plans on getting two shifts out of the truck. This need for public funding is even more true for public charging, where lower utilization rates will increase the amortized cost per kWh consumed.

Cost Factors

CAPITAL COSTS

When considering the behind-the-meter capital costs associated with the M/HD charging infrastructure deployments, the report identified three types of costs (important to note these behind-the-meter nominal costs can vary widely depending on project specifics):

1 Fixed Costs

Flat fees (mostly) regardless of the size of the deployment
Project Management; Design, Permitting, and Engineering

Increasing the number of chargers contemplated for any one project will decrease the costs per unit. For line items like project management, there is a one-time cost that, for the most part, does not increase with an increased number of chargers contemplated (though crossing a certain power draw threshold may require additional engineering considerations). Practically, this means that fleets can maximize impact by planning for their entire deployment from the outset. Though there may be marginal variation depending on the complexity of the sites, the Design, Permitting, and Engineering should only be done once – even if not all the chargers are installed. Additionally, most of the Project Management costs will be incurred during any initial trenching and construction that prepares the facility for a full build-out. Installing the remaining chargers down the road will require minimum project management - as long as deployment plans and timing don't drastically change - as managers will have already defined the criteria and processes.

2 Linear Costs

Per unit costs corresponding to number of chargers deployed
Installation - Material and Labor; Commissioning

These costs are difficult to reduce on a per-charger basis: labor needs to trench a set amount of space and run a set amount of wiring per charger installed. Similarly, commissioning requires a set length of time per charger and is not done on a holistic project basis. Therefore, these costs, while appropriate to track, may not vary from site to site but will depend almost entirely on the project size.

3 Variable Costs

Costs that can decrease with increasing number of chargers deployed- ***Cost per EVSE; Utility Service***

Variable costs have two distinct flavors to them: The first is a general 'economies of scale' factor, where the more material purchased, the less a project can expect to pay. This holds true for EVSE, but mostly on the lower end of the project size; i.e. the per-unit EVSE cost decreased when expanding the project from 5 units to 10 units; however, there was no difference in EVSE cost between 10 units and 20 or 40 units. This is likely explained by the need for EVSE suppliers to focus on larger projects that can enable scaled production – one and two unit deployments will need to pay a premium. However, the lack of additional discounts above 10 or more units could indicate that demand is outstripping supply at this stage. Suppliers are sensibly unwilling to provide volume discounts when they could sell at full price to others.

The second key variable cost, and a key focus of the project, is identifying facilities where grid capacity can meet the desired deployment size without a time-consuming and costly upgrade. This project used the SCE Grid Needs Assessment resources to determine that, at current loads, each of the sites could handle the hypothetical deployment without upgrading the poles, wires, or other front-of-the-meter equipment. However, this should be noted as a substantial variable cost that projects will incur if they are not conscious of local grid constraints.

OPERATING COSTS

The operating costs examined in the four site assessments is the total $/kWh defined as the sum of CapEx +OpEx $/kWh and Energy $/kWh. This total $/kW is broken down into two factors under two scenarios each, with a set of assumptions in *Appendix D*.

Factor 1: CapEx + OpEx/kWh

This factor addresses the bundled costs of the capital expenses and ongoing expenses over a five year period, amortized over each kWh delivered to a vehicle, an amount that differs based on utilization (see Scenarios below). These costs include design and deployment of the charging infrastructure, maintenance for the chargers and the active charge management system deployed by bp pulse.

Factor 2: Energy Costs

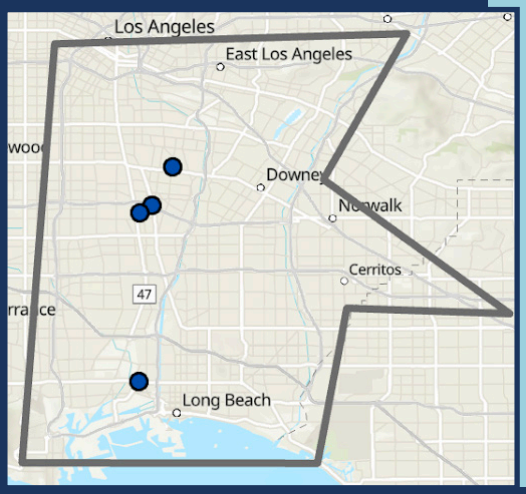
The energy $/kWh remains largely the same, as all deployments were assumed to be SCE's TOU-EV-9 tariff for these deployments, all of which fall into the highest commercial EV tariff based on max power draw. It should be noted that this tariff is without a demand tariff until 2026. Once the demand tariff is reintroduced, the expected and maximum utilization scenarios should project different energy $/kWh sub-components as greater utilization may not offset higher power utility costs, and maximum utilization assumes not only more utilization across a given year but a larger quantity of vehicles charging simultaneously, i.e., drawing power, at any given time.

Scenario 1: Expected Utilization

A conservative estimate to allow for greater sense of predictability and projection of future costs. The demand inputs for expected utilization are either derived from the observed truck traffic that could use the chargers when stationary in a 1-mile radius. These utilization estimates are primarily between 14-20 percent, which assumes 14-20 percent of trucks within one mile, stopped for an amount of time that qualifies as a charging session, would use this infrastructure (e.g. one in five or six trucks stopped in the area will want to charge).

Scenario 2: Maximum Utilization

A scenario where the uptake of usage is more aggressive, allowing for capital and operational costs to be spread across a greater amount of kWhs. This assumes that the trucks will be using the chargers regularly when available, with an appropriate amount of constant availability assumed to accommodate the fact that there will always need to be available chargers for drivers who need to recharge. These utilization rates were assumed to be 40 percent, or approximately 10 hours per day. In practical terms, this would entail every charger being used for an overnight charge as well as one between or mid-shift charge.

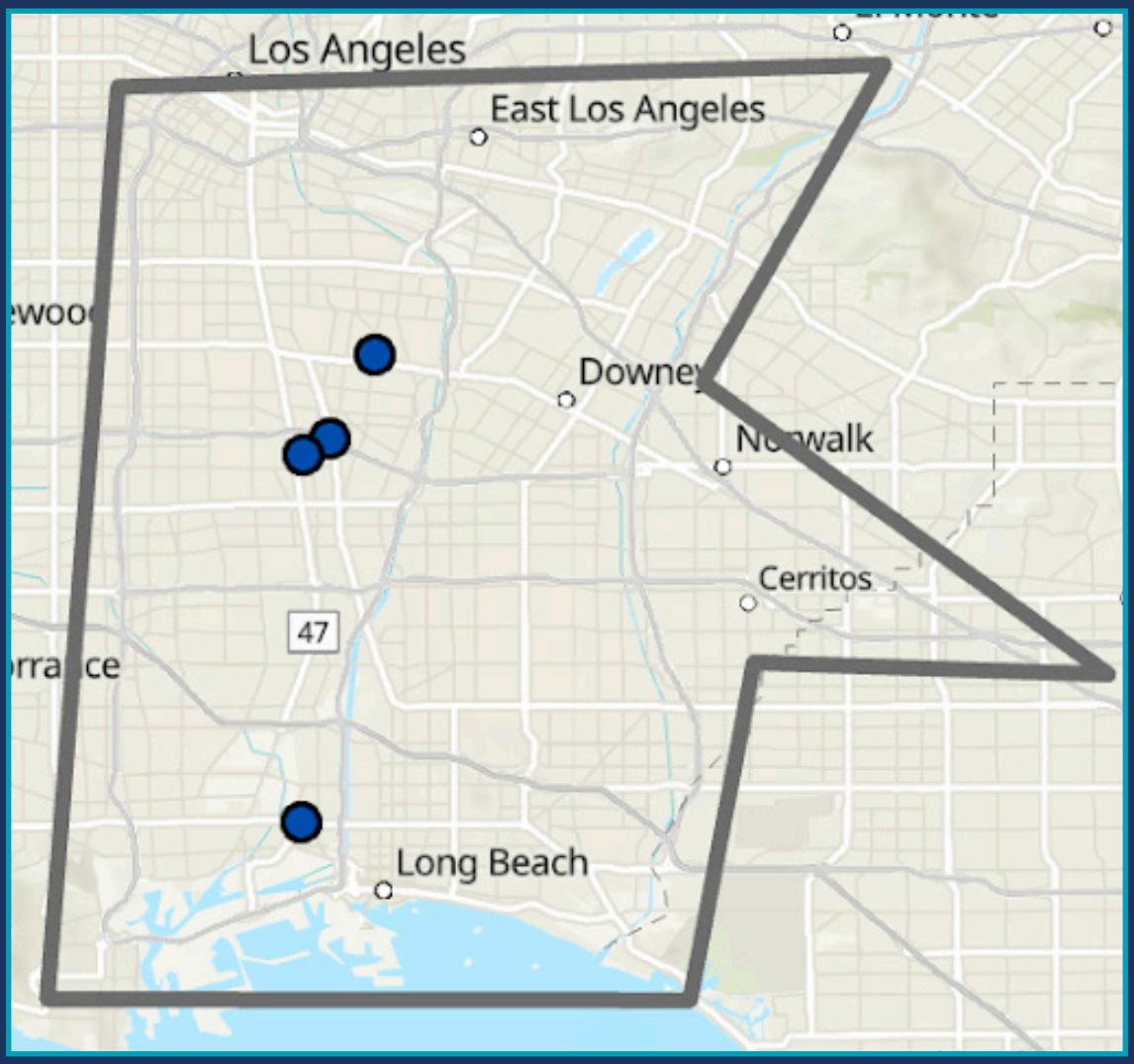


The differences in utilization rates primarily affects the CapEx + OpEx/kWh charge, as the investment in CapEx can be amortized over more kWh. For the expected scenarios, where utilization is lower, these costs can be half or more of the total $/kWH cost. As deployments reach the maximum utilization, these costs tally closer to a third of the total $/kWh cost.

Site Assessments

In four comprehensive site assessments, the project looked at a range of facilities: one storage yard, one private fleet, one warehousing complex, and one public parking lot. Each of these assessments include a breakdown of the types of capital costs associated with each deployment, a satellite image of each facility with potential charger locations, high-level site information, potential operating model analysis, and a qualitative evaluation of the site's prospective role in the region's charging network.

LOCATION OF CONDUCTED SITE ASSESSMENTS



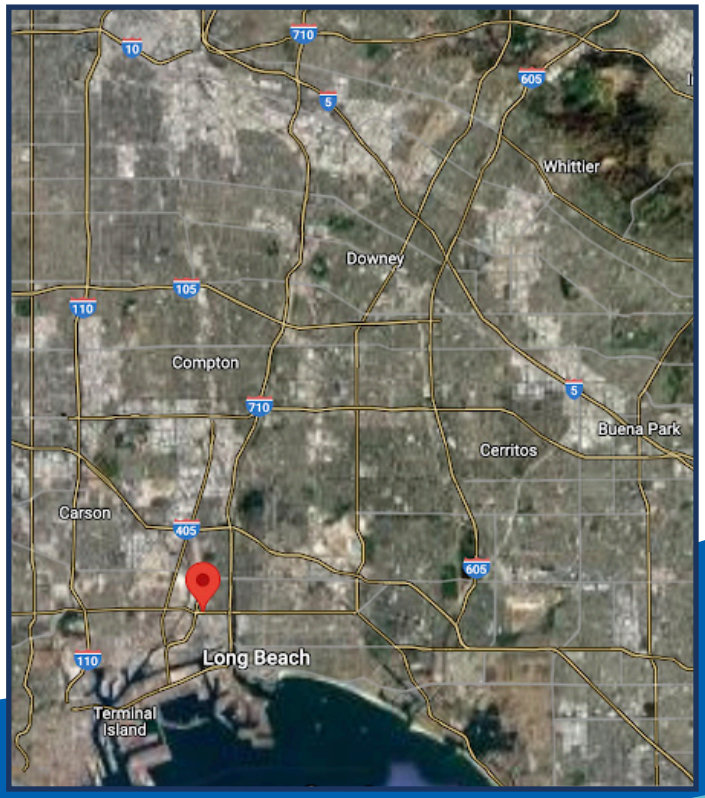
SITE ASSESSMENT 1

Prologis - Technology Place

Prologis is the largest owner of logistics real estate in the world and a key stakeholder in ensuring the transition to zero emission freight; in Los Angeles County alone, Prologis operates over 28 million square feet of warehouse space. Prologis' core operations are to own warehouse space that it then leases to logistics companies. Part of these leases can include the equipment inside or outside the warehouse, as a form of Infrastructure-as-a-Service. Essentially, access to charging and electricity can be folded into a tenant's lease with Prologis. Prologis will work with its tenants to provide the needed infrastructure to support their transition to zero emissions by regulated timelines, but specific facility electrification will depend on the specific tenant's timelines. To that point, Prologis has already led installations of charging infrastructure for Class 8 trucks at two facilities in Southern California–one in Commerce and one in Santa Fe Springs.

With Prologis' large presence, it was unavoidable that the project team would want to examine an opportunity to evaluate infrastructure opportunities for such a consequential entity. In fact, without prior ownership knowledge, three of the sixteen properties identified by CEHAJ as candidates for evaluation were Prologis properties. Two are along the Alameda corridor warehousing district, and the third is in Long Beach, at 2161 Technology Place. This property is owned by the University of California and leased to Prologis.

The project group ultimately chose the Technology Place location for evaluation for three reasons: the first being the facility's proximity to the Ports and the I-710, right off of the Pacific Coast Highway, a main east-west street connecting the I-710 with the southern portion of the Alameda Corridor warehouse complex and Union Pacific's Intermodal Container

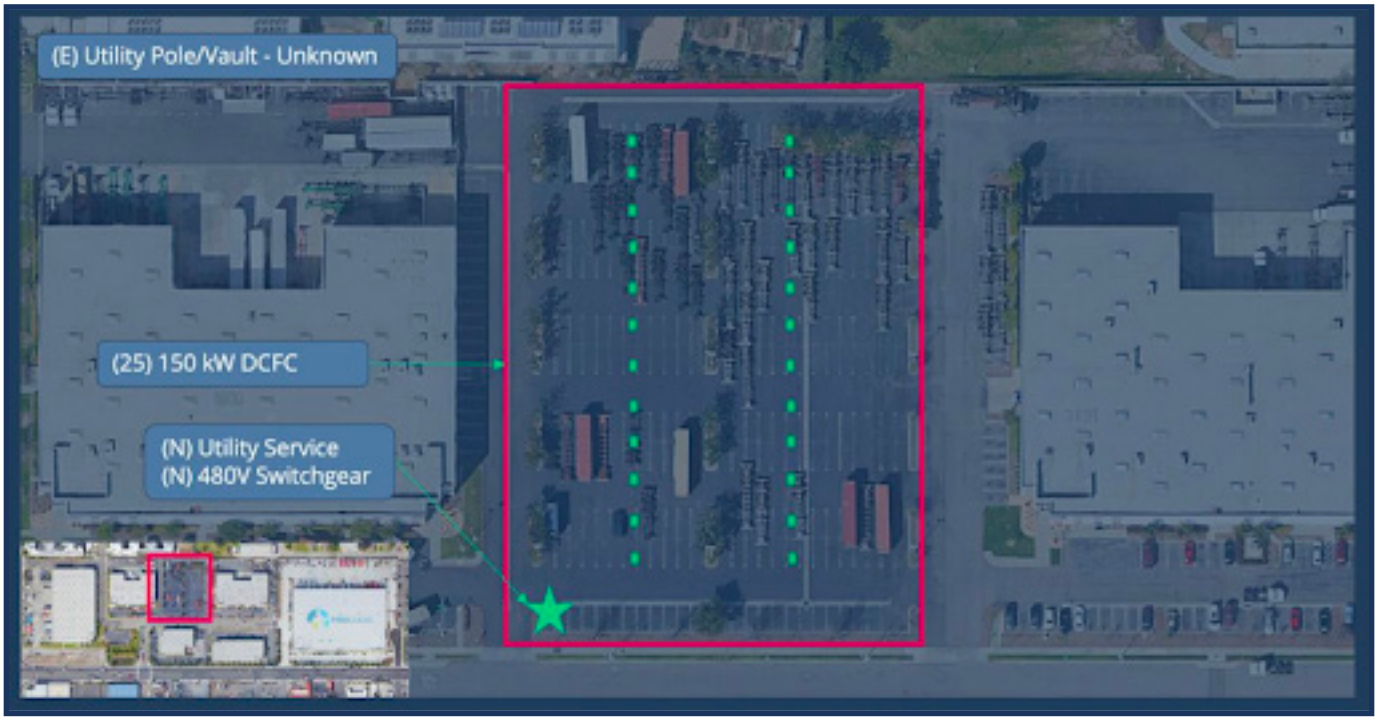


Location of 2161 Technology Place, Long Beach

Transfer Facility. Second, the facility is unique among Prologis facilities for its ample parking lots that hold charging trucks. Lastly, because of the facility's proximity to both a senior living community and a high school, the project team wanted to prioritize improving local air quality.

Site Information	
Site Name	Prologis 2161
Address	2161 Technology Place, Long Beach, CA
Acreage	2.54
Site Owner	California State University Long Beach, RES FNDN Lessor Prologis
Depot Type	Private
Utility Provider	Southern California Edison (SCE)

In general, Prologis is actively deploying charging infrastructure across Southern California both in anticipation of tenants' needs and in response to tenant requests. The project team did not identify a tenant at 2161 Technology Place that had actively requested an infrastructure installation, though, in conversations with Prologis, the facility is a candidate for an anticipatory installation. Ownership by the U.C. system may present some additional inspections and safety protocols, though the U.C. system may be keen to contribute to advancing electrification and/or leverage the facility for workforce training curriculum uses.



EVSE Overview			
Equipment	Description	kW	Quantity
Chargers	All-in-one 150 kW max output EV Charger with CCS1 cable to enable charging for 1 electric truck	150	25
Site Controller	bp pulse edge device that monitors site power in real-time and works in conjunction with bp pulse omega cloud service to optimize charging activity	N/A	2

Estimated Charging Infrastructure Costs

Cost		
Category	Description	Estimated Cost (US$)
Design, Engineering, and Permitting	Create design documents for permitting, construction, and as-builts	$139,870
EV Chargers	EV Chargers and bp pulse site controller	$1,565,688
Installation - Material	Conduit, wire, concrete pads, consumables, etc	$125,000
Installation - Labor	Installation labor, equipment rentals, travel, etc	$485,469
Utility Service	Cost to interconnect into new utility service. Costs for new utility service are excluded from this analysis	$31,250
Project Managment	Project management and overhead	$35.835
Commissioning	Commissioning of EV chargers and configuration to charge management software	$62,500
	TOTAL	**$2,445,612**

Operating Models and Duty Cycle

Forecasted Duty Cycle Analysis				
Rate Structure	Utilization	Approxinate Miles/ Year	kWh/year	Annual Capacity Factors (%)
SCE TOU-EV-9	Expected	1,916,250	4,790,625	14.58%
SCE TOU-EV-9	Max	5,256,000	13,140,000	40.00%

CaaS for Private/Public Charging			
	CAPEX + OPEX $/kWh	Yr 1 Energy $/kWh	Total $/kWh
Exp. Utilization	$0.2118	$0.2175	$0.4294
Max Utilization	$0.1082	$0.2175	$0.32

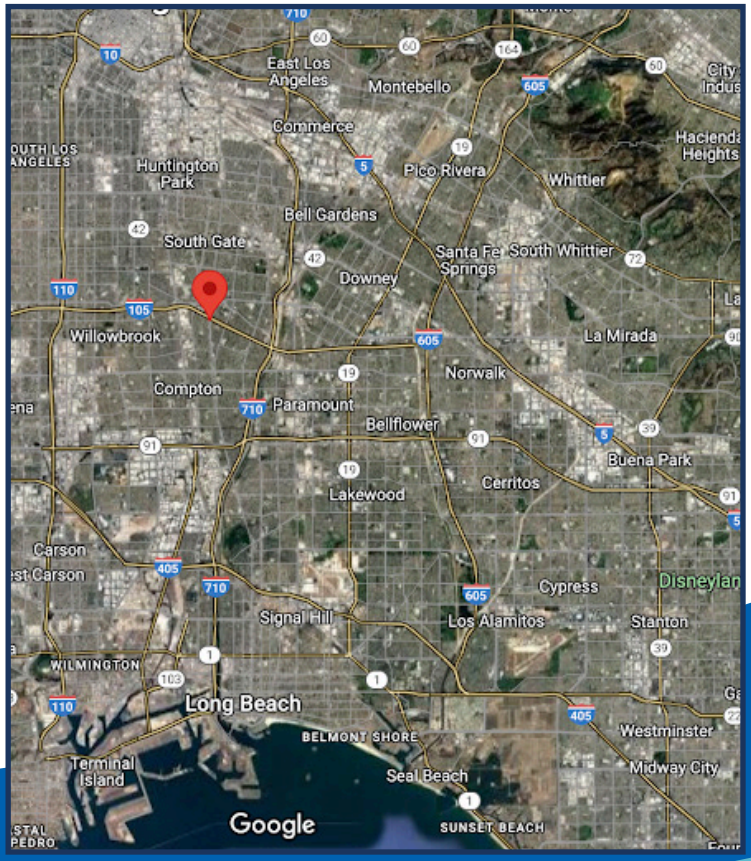
SITE ASSESSMENT 2

Metro Park and Ride

The project team, especially CEHAJ and LACI, has been deeply involved with Metro in the development of their I-710 South Corridor project. As part of that program, Metro is committed to investing $50M, with an additional $200M of other public funding as leverage, in zero emission M/HD truck infrastructure that is *publicly accessible*. Fully publicly accessible (no utilization guarantees) M/HD charging is economically challenging at this stage, and thus private property owners are not yet willing to risk dedicating space for this purpose. It follows that public charging not only needs to be subsidized, but also is best suited in the near-term for situating on public lands as a means of mitigating private sector risk. With this in mind, the project team identified a large Metro Park and Ride at the intersection of I-105 and Long Beach Boulevard in Lynwood that could serve as a public charging facility.

CEHAJ testimony, and project team observations, evaluated this site as severely under-utilized as a Park and Ride, both in proportion and volume. Additionally, the facility is right next to a major interstate, a large collection of warehouses, and general goods movement real estate. Lastly, the facility is directly adjacent to restaurants and other amenities that can serve truck drivers. In fact, while conducting the site assessment, multiple medium-duty trucks were parked in the otherwise empty lot, the drivers having a morning coffee, and four Class 8 trucks were parked at the adjacent motel. No passenger cars were utilizing this space for its intended purpose.

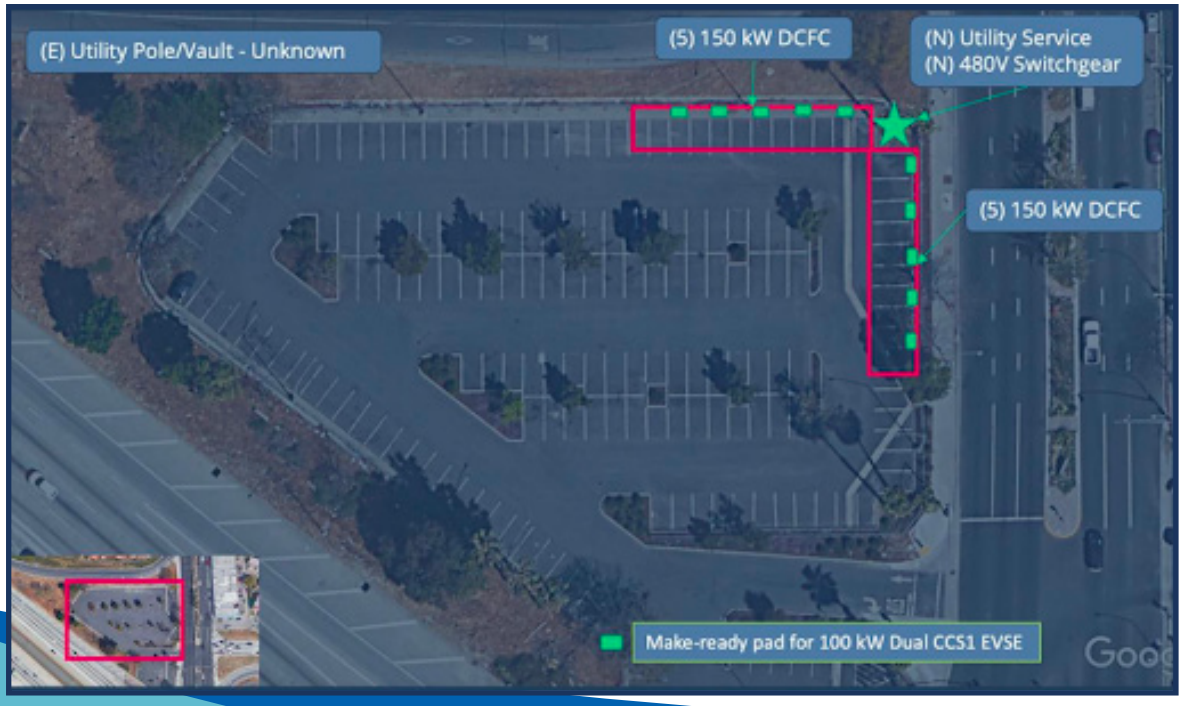
Though there is adequate surrounding truck traffic, there would need to be significant layout modifications made to the site and ingress/ egress traffic patterns to allow for Class 8 trucks



Location of 11508 Long Beach Boulevard, Lynwood

to use the facility. However, Class 6 and smaller vehicles would not face any challenges or impose any burdens to charge at this location. Given the space available, Metro's interest in electrifying Park and Rides, and Metro's aims to invest in public zero emission truck infrastructure identified by communities as desirable, the Park and Ride would make for an effective public charging depot. The project team will work with Metro to further assess viability of turning a portion of this facility into medium-duty charging.

Site Information	
Site Name	L.A. Metro
Address	11508 Long Beach Boulevard, Lynwood, CA 90262
Site Owner	N/A
Depot Type	Public
Utility Provider	Southern California Edison (SCE)
Summary	This site location has more than ample space to accommodate the proposed equipment. Site egress allows for south bound exit only but otherwise there is good access into the site via traffic light. There are many amenities close to the site within less than a 5-minute walk. The quality and location of this site are both desirable. Consultation with SCE to high power lines is advised. Consultation with Caltrans to change traffic lights to improve site exit/egress is advised.



EVSE Overview			
Equipment	Description	kW	Quantity
Chargers	All-in-one 150 kW max output EV Charger with CCS1 cable to enable charging for 1 electric truck	150	10
Site Controller	bp pulse edge device that monitors site power in real-time and works in conjunction with bp pulse omega cloud service to optimize charging activity	N/A	1

Estimated Charging Infrastructure Costs

Cost		
Category	Description	Estimated Cost (US$)
Design, Engineering, and Permitting	Create design documents for permitting, construction, and as-builts	$139,870
EV Chargers	EV Chargers and bp pulse site controller	$636,775
Installation - Material	Conduit, wire, concrete pads, consumables, etc	$50,000
Installation - Labor	Installation labor, equipment rentals, travel, etc	$13,594
Utility Service	Cost to interconnect into new utility service. Costs for new utility service are excluded from this analysis	$31,250
Project Managment	Project management and overhead	$35.385
Commissioning	Commissioning of EV chargers and configuration to charge management software	$25,000
	TOTAL	**$1,131,874**

Operating Models and Duty Cycle

Forecasted Duty Cycle Analysis				
Rate Structure	Utilization	Approxinate Miles/ Year	kWh/year	Annual Capacity Factors (%)
SCE TOU-EV-9	Expected	876,000	2,190,000	16.67%
SCE TOU-EV-9	Max	2,102,400	5,256,000	40.00%

CaaS for Private/Public Charging			
	CAPEX + OPEX $/kWh	Yr 1 Energy $/kWh	Total $/kWh
Exp. Utilization	$0.2109	$0.2206	$0.4314
Max Utilization	$0.1153	$0.2206	$0.3359

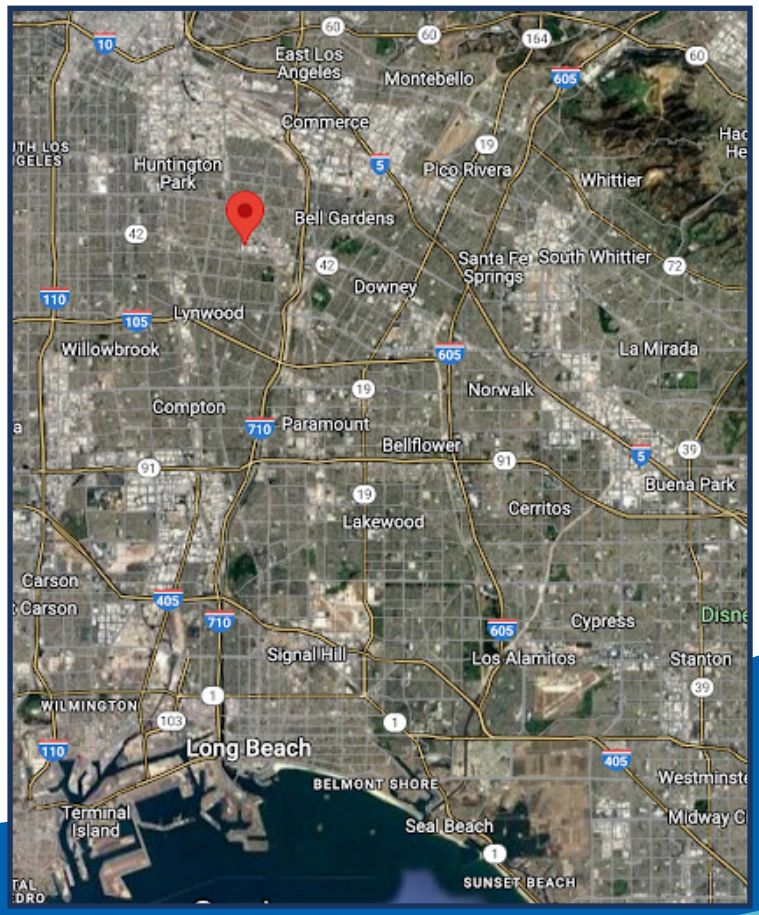
SITE ASSESSMENT 3

Fleet Yards, Inc.

Fleet Yards Incorporated (FYI) operates a network of yards across Southern California that offer clients storage of equipment, whether that be empty or full containers, chassis, or trucks. FYI works with many different fleet or cargo owner clients; in some cases, a specific yard may be entirely devoted to one client or shared among multiple. In many ways, this business model should be highly responsive to fleets looking to transition to battery-electric: if they are already parking vehicles at the facility, adding charging can be an additional service FYI offers. However, this will require a close examination of the square footage costs.

FYI would need to compare the revenue from square footage devoted to storing a container or chassis to revenue from offering charging and parking. If required to pay full cost for the charging infrastructure, that upfront capital investment will reduce the long-term ROI for offering charging to clients.

FYI operates two yards in very close proximity in South Gate (Alameda St. and Independence Ave), separated by about a mile. FYI informed the project team that a client of their Alameda St. yard is purchasing battery-electric vehicles, so they agreed to participate in the project. However, the project team maintained a desire to evaluate the Independence Ave. yard as a priority with the thought that the facility could 1) draw traffic away from a nearby intersection with safety concerns and 2) provide more near-term air quality benefits to the proximal residential communities. Upon furnishing FYI with the details of the site assessment, the project team anticipates FYI being able to decide if they can include charging on-site as part of their client offerings.



Location of 4223 Independence Ave, South Gate

Site Information	
Site Name	Fleet Yard 4223
Address	4223 Independence Ave, South Gate, CA 90280
Site Owner	South Gate Industrial Center C/O Heger Industrial
Depot Type	Private
Utility Provider	Southern California Edison (SCE)
Summary	The site access is narrow, and the yard requires logistical reconfiguration. There is ample room on site for equipment and new infrastructure. There is access to an existing power poll for a new service that will not need to cross the railroad tracks. Security and existing parking lot infrastructure is adequate for industrial and fleet vehicles.

EVSE Overview			
Equipment	Description	kW	Quantity
Chargers	All-in-one 150 kW max output EV Charger with CCS1 cable to enable charging for 1 electric truck	150	5
Site Controller	bp pulse edge device that monitors site power in real-time and works in conjunction with bp pulse omega cloud service to optimize charging activity	N/A	1

Estimated Charging Infrastructure Costs

Cost		
Category	Description	Estimated Cost (US$)
Design, Engineering, and Permitting	Create design documents for permitting, construction, and as-builts	$139,870
EV Chargers	EV Chargers and bp pulse site controller	$318,388
Installation - Material	Conduit, wire, concrete pads, consumables, etc	$40,000
Installation - Labor	Installation labor, equipment rentals, travel, etc	$91,719
Utility Service	Cost to interconnect into new utility service. Costs for new utility service are excluded from this analysis	$31,250
Project Managment	Project management and overhead	$35,385
Commissioning	Commissioning of EV chargers and configuration to charge management software	$12,500
	TOTAL	**$669,112**

Operating Models and Duty Cycle

Forecasted Duty Cycle Analysis				
Rate Structure	Utilization	Approxinate Miles/ Year	kWh/year	Annual Capacity Factors (%)
SCE TOU-EV-9	Expected	383,250	958,125	14.58%
SCE TOU-EV-9	Max	1,051,200	2,628,000	40.00%

CaaS for Private/Public Charging			
	CAPEX + OPEX $/kWh	Yr 1 Energy $/kWh	Total $/kWh
Exp. Utilization	$0.3074	$0.2333	$0.5406
Max Utilization	$0.1612	$0.2333	$0.3944

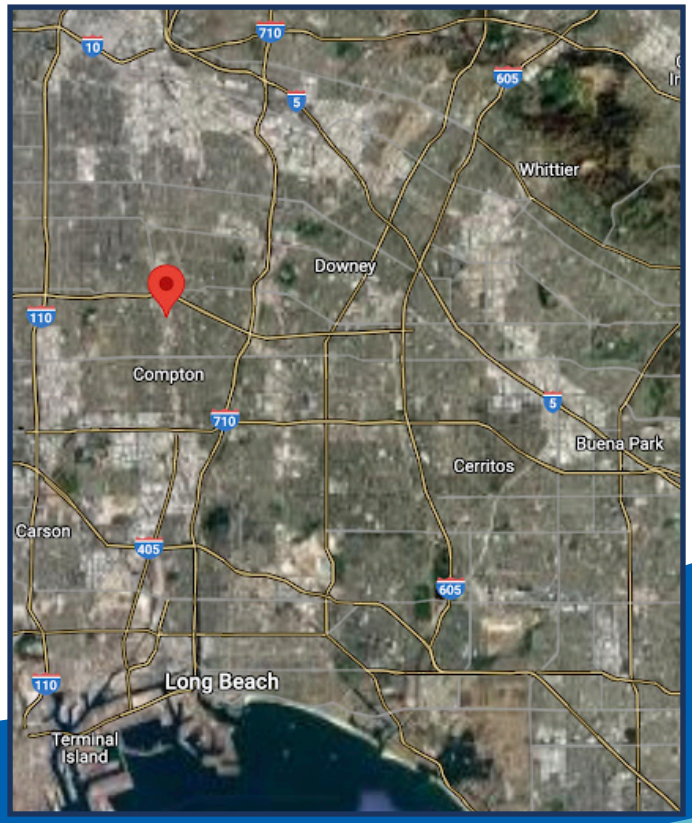
SITE ASSESSMENT 4

MDB Transportation

MDB Transportation is a fleet with company-owned trucks and employee drivers that has demonstrated a range of alternative fuel vehicles in the pursuit of improving sustainability and complying with CARB and Ports' regulations. MDB has occupied the yard at 435 E Weber St. since 2018, and has plans to expand into adjacent parcels in the near future. This facility would be suited to serve the charging needs of MDB's personal fleet, which includes a pending order for 40 battery-electric trucks. As this is a facility that MDB controls, with privately-owned trucks, utilization would be highly predictable and would benefit from a sophisticated charging management system that could maintain a power draw below a penalizing level. This is seen in the Expected Utilization for MDB's infrastructure being 20 percent higher than the other three sites. Because of this, the opportunity here is more straightforward, though there is still a need for subsidies to ensure that long-term operating costs provide economic value to MDB Transportation.

One manner in which MDB has considered ensuring the economic viability of the infrastructure deployment is to 1) install up to 100 chargers and 2) partner with a Transportation-as-a-Service provider to guarantee utilization for a set proportion of those 100, until MDB acquires enough battery-electric trucks to require use of all the chargers.

The site was chosen in part because of bp pulse's existing relationship with US Gain, a provider of alternative fuels to fleets that operates a natural gas station on the property, and in part because of the project team's desire to see Compton, a city with myriad goods movement facilities, represented in the study. Lastly, MDB's pending order for electric trucks makes this facility certain for a near-term installation.



Location of 435 E Weber Ave, Compton

Site Information	
Site Name	MDB Transportation 435
Address	435 E Weber St, Compton, CA
Site Owner	423 E Weber LLC
Depot Type	Mixed - Public and Private
Utility Provider	Southern California Edison (SCE)
Summary	The site is 1.2 miles from I710. The sites are accessible from Weber; however, the sites will have to be reconfigured for access and turnaround.

EVSE Overview			
Equipment	Description	kW	Quantity
Chargers	All-in-one 150 kW max output EV Charger with CCS1 cable to enable charging for 1 electric truck	150	25
Site Controller	bp pulse edge device that monitors site power in real-time and works in conjunction with bp pulse omega cloud service to optimize charging activity	N/A	2

Estimated Charging Infrastructure Costs

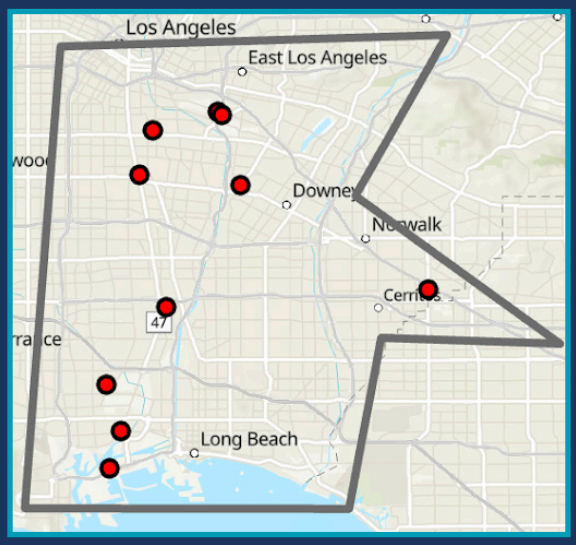
Cost		
Category	Description	Estimated Cost (US$)
Design, Engineering, and Permitting	Create design documents for permitting, construction, and as-builts	$38,133
EV Chargers	EV Chargers and bp pulse site controller	$1,565,688
Installation - Material	Conduit, wire, concrete pads, consumables, etc	$125,000
Installation - Labor	Installation labor, equipment rentals, travel, etc	$485,469
Utility Service	Cost to interconnect into new utility service. Costs for new utility service are excluded from this analysis	$31,250
Project Managment	Project management and overhead	$35,385
Commissioning	Commissioning of EV chargers and configuration to charge management software	$62,500
	TOTAL	**$2,445,612**

Operating Models and Duty Cycle

Forecasted Duty Cycle Analysis				
Rate Structure	Utilization	Approxinate Miles/ Year	kWh/year	Annual Capacity Factors (%)
SCE TOU-EV-9	Expected	2,737,500	6,843,750	20.83%
SCE TOU-EV-9	Max	5,256,000	13,140,000	40.00%

CaaS for Private/Public Charging			
	CAPEX + OPEX $/kWh	Yr 1 Energy $/kWh	Total $/kWh
Exp. Utilization	$0.1260	$0.2014	$0.3274
Max Utilization	$0.0835	$0.2014	$0.2849

Desktop Analyses



To provide facility owners and stakeholders with an idea of what an infrastructure deployment would require, the project team provided a 'desktop analysis' for ten of the remaining sites that could plausibly host charging infrastructure in either a public, shared, or private setting. Ultimately, some of these locations may be able to move faster to deployment if interests can align, especially in the cases of privately held fleets, but the project team was not able to command sufficient interest from the facility owners to warrant creating an operating model or in-depth capital cost estimate for these facilities. Two sites, both Prologis warehouses, did not receive a desktop analysis, given the project would provide Prologis with an assessment of a separate site, a resource Prologis could use to make informed decisions on their additional sites. The facilities for which the project team conducted a site assessment are in the table below.

Site	Address	Typology	Charger Count	Estimated Cost US$
Capital Food Group	16424 Valley View Ave La Mirada, CA 90638	Private Fleet	10	$1,280,271
Commerce Truck Stop	4560 E Washington Blvd Commerce, CA 90040	Public - Truck Stop	8	$1,024,216
Fleet Yard Inc - 8440	8440 Alameda St South Gate, CA 90001	Shared	5	$700,526
Gatwick Group	4817 Sheila St Commerce, CA 90040	Private or Public	10	$700,526
Parkhouse Tire	5960 Shull St Bell Gardens, CA 90201	Private	10	$1,279,821
Port of Long Beach	960 New Dock St San Pedro, CA 90731	Public or Shared	40	$5,099,552
Port of Los Angeles	1519 East I St Wilmington, CA 90744	Public	20	$2,486,696
Shason Inc.	5525 S Soto St Vernon, CA 90058	Private or Shared	20	$2,486,696
Universal Logistics Holdings	18020 S Santa Fe Ave Compton, CA 90221	Private or Shared	25	$3,187, 220
Watson Land Company	23610 Banning Blvd Carson, CA 90745	Private or Shared	10	$1,280,271

Because the evaluations did not account for specific location of the nearest utility interconnection, location of chargers on the property, or other site-specific details, bp pulse and their subcontractor developed high-level capital costs applicable to all desktop analyses by using past experience to estimate an expected cost. For specific utility providers or municipalities, there were adjustments based on past experience. Additionally, bp pulse and the subcontractor applied an additional 30 percent contingency on each project cost, given the larger unknowns at each site. A table outlining the costs applied to the desktop analyses are below. Specifics (layout, costs) for each site can be found in *Appendix E*.

Category	Estimated Cost (US$)
Design, Engineering, and Permitting (per project)	$37,546 - $225,275
EV Chargers (per unit)	$78,372
Installation – Material (per unit)	$6,500
Installation – Labor (per unit)	$28,000
Utility Service (per project)	$38,462 - $76,923
Project Management (per project)	$35,385 - $70,769
Commissioning (per unit)	$3,077
Total (5-40 units)	**$700,526 - $5,099,052**

710 Corridor Charging Infrastructure Investment Blueprint

QUANTITY OF CORRIDOR CHARGERS

When LACI initially contemplated developing an infrastructure investment plan for this Blueprint project, the intention was to use the CEC HEVI-Load tool, a modeling tool developed by the CEC per AB 2127 to assess quantities and locations of M/HD infrastructure throughout California. LACI anticipated for the CEC to make this tool public during the Summer 2021, though after conversations with the CEC team in charge, the tool will not be available until Q1 2023, and has not been made public as of this writing. However, that tool, while taking drayage truck traffic into account, would not be able to identify chargers needed specifically for the drayage industry.

In September 2021, Port of Long Beach (POLB) published a study, "Fueling the Future of the Fleet", (hereafter 'POLB Study') with the goal of identifying specific properties on POLB land that could meet the criteria necessary to host a public charging depot. Included in that report are a set of assumptions, both drawn from additional literature and developed for the purposes of that report, that LACI adapted for the purposes of this Blueprint. These assumptions are laid out in *Appendix C*. In most cases, LACI has made conservative assumptions that there will be *more* trucks requiring more chargers.

Using these assumptions, the table below outlines how many chargers of each typology the 710 Corridor Study Area will need to deploy to reach the 2028 target and 2035 requirement for ZE drayage trucks.

Year	BEV Trucks	BEV Trucks in I-710 South	BEV Trucks in I-710 South Using Public Chargers	BEV Trucks in I-710 South Using Private Chargers	I-710 South Public Chargers	I-710 South Private Chargers	Total I-710 South Chargers
2028 (40%)	5,900	1,760	530	1,230	135	620	755
2035	14,700	4,400	1,320	3,080	330	1,540	1870

COST OF CORRIDOR CHARGERS

When calculating the cost of installing all of these chargers, it is important to estimate what proportion of charging depots present in 2028 and 2035 will be public, shared, or private, as well as their anticipated size. This last part is key, as deployments larger than 4 MW, if not located on the right circuit, may require substation upgrades (or potentially microgrids). For purposes of this modeling, LACI has assumed that any depot hosting more than 25 trucks will require a substation upgrade at a cost of $10,000,000 (an estimate from the West Coast Clean Transit Corridor–see below). It is fair to assume that any similarly sized microgrid may have the same capital cost (the benefit would likely be reduced operating costs).

(This planning project did not contemplate the presence of microgrids or distributed energy resources at (This planning project did not contemplate the presence of microgrids or distributed energy resources at facilities, as the primary focus was identifying the specific locations that would be a good fit based on truck traffic, grid capacity and community priorities. Under the right regulatory structure, it is clear that rooftop solar and battery storage can reduce the maximum draw from the power grid and decrease operating expenses through forgoing charging from the grid at peak hours (avoiding charging from 4-9pm is a difficult requirement for drayage operations to abide by). However, these resources require more complicated engineering, project management as well as square footage, an asset of utmost importance in the I-710 Corridor.)

LACI uses additional cost estimates of $340,000 for the high-voltage equipment, an estimate included in the POLB Study. For Project Management, the figures provided by bp pulse do not address costs associated with the high-voltage equipment deployment; therefore LACI will use the CPUC's estimate for project management in their Medium and Heavy-Duty Transportation Electrification budget [5], which is 10 percent of total project costs. A further 30 percent contingency has been assumed (on top of the 10 percent contingency included in all of bp pulse's assessment numbers).

As a last step, LACI estimated the total quantities of depots "the Blueprint sites" (and quantities of chargers at each site) evaluated in this project would not get the region close to the needed amount of chargers. Thus,

[5] California Public Utilities Commission, "Decision on the Transportation Electrification Standard Review Projects," Application 17-01-020. Issued June 6, 2018.

LACI has assumed the quantities of certain types of depots, assuming a mix of different sizes that may serve different purposes to be built between now and 2028, and now and 2035. With this hypothetical depot distribution and using the above calculations for chargers required throughout the I-710 corridor and estimated costs per charger installation, and additional equipment and auxiliary costs, LACI estimates the total cost of deploying charging infrastructure below:

2028

Depot Size	# of Depots	Charger Cost (all-in)	High Voltage Equipment	Substation Upgrade	Project Management and Design	Contingency	Total Investment
10	10	$14,000,000	$3,400,000	0	$1,740,000	$5,742,000	
25	10	$35,000,000	$3,400,000	0	$3,840,000	$12,672,000	
50	8	$56,000,000	$2,720,000	$80,000,000	$13,872,000	$45,777,600	
Depot Total	28	$105,000,000	$9,520,000	$80,000,000	$19,452,000	$64,191,600	**$278,163,600**
Charger Total	750						

2035

Depot Size	# of Depots	Charger Cost (all-in)	High Voltage Equipment	Substation Upgrade	Project Management and Design	Contingency	Total Investment
10	25	$35,000,000	$8,500,000	0	$4,350,000	$14,355,000	
25	25	$87,500,000	$8,500,000	0	$9,600,000	$31,680,000	
50	20	$140,000,000	$6,800,000	$200,000,000	$34,680,000	$114,444,000	
Depot Total	70	$262,500,000	$23,800,000	$200,000,000	$48,630,000	$160,479,000	**$695,409,000**
Charger Total	1875						

Crucially, there are two additional cost factors not included in this total. The first is the cost of environmental report development. Though chargers should be encouraged as improvements on the environment, most large projects are likely required to undergo an EIR, which will add cost. Second, and relatedly, sites will likely require improvements, whether remediation or paving/striping etc. that will increase costs. The POLB Study has an estimate of $275,000 per acre for previously unpaved lots. What sites ultimately selected are paved or unpaved is hard to estimate. Out of the fourteen sites included in the Blueprint site assessments or desktop analyses, six were unpaved. A third related cost is below:

Real estate allocated to charging infrastructure is an important cost to operators and property managers, so LACI has included an estimate in this Blueprint as well. The POLB study provides a good conservative estimate based on the deployment of chargers at the Clean Truck Center in Long Beach, seen in the below table:

Site Space Requirements for Opportunity and Overnight Charging

	Opportunity	Overnight
Per Charger	2,600 ft^2	700 ft^2
Power Supply Equipment	5,000 ft	
Administration/Miscellaneous (large sites only)	10,000 ft	

Diving into the assumptions behind these estimates, and a LACI visit to the site, it's clear that these are extremely conservative estimates, and that future projects may be able to get creative, especially with overnight charging, as the Clean Truck Center layout did not have trucks parking nose-to-nose, but up against the wall. Typically, stationing chargers with their backs to each other (and the trucks noses' facing each other) while charging can save on charging pad and conduit space. For the purposes of this estimation, LACI will use the numbers from the POLB study.

It is difficult to estimate what the breakdown of opportunity chargers to overnight chargers will be, especially when there could be hybrids, like an MCS charger that serves 'opportunity' needs for trucks without a trailer. This situation would be less likely over the road, but there are reasons to believe it would be common at the Ports.

Drayage trucks often pick up a full container without returning an empty container, and could leverage near-dock opportunity charge without an attached trailer. Therefore, LACI has made the following assumptions regarding space:

1. All private chargers are overnight chargers requiring 700 sqft per charger
2. Half of public chargers are opportunity chargers requiring 2,600 sqft per charger
3. Half of public chargers are opportunity chargers requiring 700 sqft per charger

With those assumptions, the total square footage required to reach the region's 2028 and 2035 goals is:

2028

	Public	Private
Total Chargers	135	620
Overnight	67	620
Opportunity	68	
Total Charger Sqft	223,700	434,000
Total # of Sites	28	
Total # of Large Sites	8	
Total High Voltage and Admin Sqft	220,000	
Total Sqft	**877,700**	

2035

	Public	Private
Total Chargers	330	1540
Overnight	115	1540
Opportunity	115	
Total Charger Sqft	379,500	1,078,000
Total # of Sites	70	
Total # of Large Sites	20	
Total High Voltage nd Admin Sqft	550,00	
Total Sqft	**2,007,500**	

This analysis shows that by 2028, facilities will need to dedicate 877,700 sqft (approx. 20 acres) to truck charging and 2,007,500 (approx. 46 acres) by 2035 in the 710 South Corridor alone. This is a substantial amount of room required for charging, but, in the case of overnight charging, this is room mostly already accounted for by truck *parking,* which occurs throughout the region already. Still, there is a threat that truck parking space will decrease at the margins with the installation of charging equipment as charging hardware, high voltage equipment, and their protective bollards could require space formerly used by truck parking.

This need presents the opportunity to consider other ways to charge trucks as they operate their daily duty cycles. Whether it is installing charging at depots where trucks normally park, near or in terminal queues, or within loading bays, creative locations choices can fill the region's charging needs.

Public/Shared Charging Infrastructure

Business Model Assessment

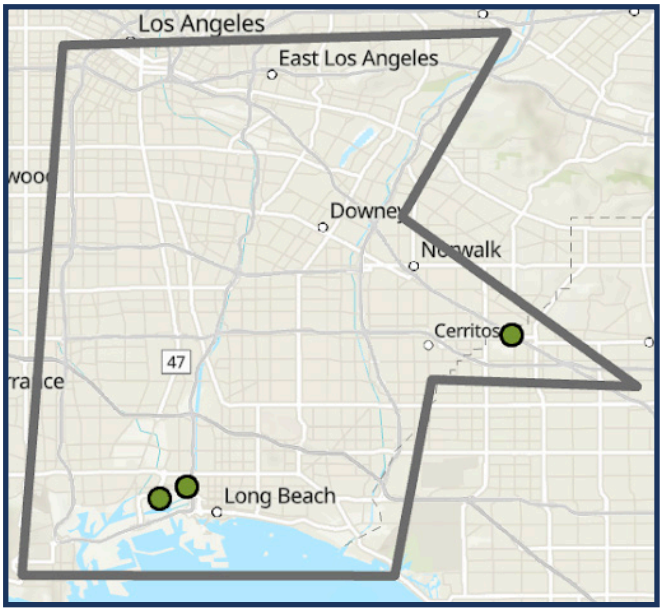
At this stage in the adoption of battery-electric trucks, public agencies have a pivotal role to play in providing public charging, both in siting and funding the equipment. For fleets to avoid the capital costs of installing infrastructure, and leverage exclusively public charging, the energy service provider must amortize the capital costs over each kWh delivered. Below a certain level of utilization, this amortized capital cost per kWh can be prohibitively expensive – potentially negating the energy efficiency benefits of the electric powertrain. Additionally, once demand does pick up, uncontrolled public charging is liable to incur demand charges, both in LADWP territory and in SCE territory starting in 2024 – charges that have the potential to wipe out any cost savings. This downside risk makes private investment a difficult proposition – both for reserving the land for charging and investing in the charging hardware itself. Distributed energy resources (such as solar and/or storage) could mitigate demand charges, though deployment would add amortized capital costs to the (unknown) amount of kWh consumed. Fortunately, there are private sector business models developing to partner with public agencies in a manner that addresses these risks and provides public agencies with upside potential as well.

Planned Locations

The WattEV case study at the end of the report is likely to be the first large-scale operational public or subscription-shared charging station in the corridor, though there are other pending plans or expansions as well. This is a snapshot of known projects as of January 2023, and through MSRC's funding opportunity (explained in the section Regional Funding Approach) it is likely more projects will be announced in the coming months.

Volvo Trucks has partnered[6] with Shell Recharge Solutions and TEC Equipment, a prominent west coast truck dealership, to provide public charging at locations across California. One of these locations is TEC Equipment in La Mirada (15000 Firestone Blvd) with two chargers deployed as part of the Volvo LIGHTS project. This location will serve as a foundation from which Volvo and TEC Equipment will grow the remainder of the corridor, and there are plans to expand the La Mirada site as battery-electric truck adoption grows. LACI looks forward to seeing this site develop as TEC Equipment - La Mirada is immediately adjacent to one of the desktop analysis sites and a locus of truck traffic at the intersection of I-5 and SR-91, as seen in the truck traffic density mapping. TEC Equipment - La Mirada is a site that also fits the criteria for the West Coast Clean Transit Corridor Initiative.

The West Coast Clean Transit Corridor Initiative (WCCTCI) is a consortium of utility companies planning for a network of charging stations along Interstate 5, providing charging for M/HD trucks across the entire western US border. As part of the criteria, the WCCTCI has recommended no fewer than twelve charge ports per site initially, and sites no further than 50 miles apart. The project's study area does overlap with I-5 on the northeast, and, as mentioned above, the TEC Equipment - La Mirada would be an ideal candidate to incorporate into the WCCTCI and regional public charging network.
In addition to the planned WattEV location referenced



Location of known planned public charging depots within corridor

[6] https://www.volvotrucks.us/news-and-stories/press-releases/2022/july/constructing-california-electrified-charging-corridor-for-medium-and-heavy-duty-electric-vehicles/

in the case study, POLB allocated space at their Clean Truck Center at 1265 Harbor Ave for two public truck chargers, complete with enough space for the truck to charge with a trailer attached.

Applicable Blueprint Locations

In addition to the **Metro Park and Ride** and **Fleet Yards 4223** facilities included in the site assessments, the desktop analysis sites below could serve as public fleet (or publicly shared) charging locations

The WCCTCI also addressed the main corridors of I-5 across the West Coast, which includes the I-710. The WCCTCI recommends at least one public charging depot to be situated immediately adjacent to the Ports. To this end, **POLB** and **POLA** have both contemplated hosting further public charging options on their properties. One site included as a desktop analysis is 1519 East I St, Wilmington CA 90744, a site that POLA has previously submitted for grant funding to install charging infrastructure. The POLB desktop analysis site could fit this identified need as well, and LACI included both Port sites in its response to the Mobile Source Air Pollution Reduction and Review Committee (MSRC) Public ZE Infrastructure RFI. In fact, by developing just the sites identified as possible for public charging on POLA and POLB properties, the region could reach 100 publicly available chargers by 2028, assuming development started in the immediate future.

Commerce Truck Stop is a public truck stop immediately adjacent to the East LA rail yards on Washington Blvd, a main roadway for trucks visiting either rail yard. Commerce Truck Stop is the roadway's primary Class 8 truck fueling stop. The facility has a small convenience store as well. In its current form, the facility could only maintain 3 or 4 pull-through charging stalls for truck+container, or 10 depot charging spots. Any further expansion would require retiring the diesel fueling assets. BNSF Railway owns the parcel and would need to support any charging deployment. As of yet, BNSF has not expressed interest in using its property for truck charging – that stance has primarily focused on their yards and not the auxiliary properties adjacent to their yards that host supportive businesses (tire shops, mechanics, etc.) along Washington Blvd. Ultimately, BNSF will need to consider what support and service businesses for railroad intermodal trucking should occupy these parcels as the fleet moves to 100% zero emission.

Fleet Yards Inc's facility at 8440 Alameda St is a larger version of FYI's facility on 4223 Independence Ave, serving multiple clients for container and chassis storage, as well as parking. Located right on Alameda, a highly-trafficked corridor for local warehousing, this location could be a better fit than 4223 Independence Ave. FYI has a client fleet planning a battery-electric truck deployment based out of 8440 Alameda as well that could drive the infrastructure installation. FYI's business model is based on specific clients reserving access to space, so it is unlikely that they would adopt a fully public public access model. This could be a shared model though with any chargers deployed accessible to FYI clients. There is not enough space at the facility for charging a truck+trailer combination. Importantly, FYI does not own these locations, so there will need to be investment from the industrial land owner and broader decisions, with community concerns addressed, about how to manage these industrial locations.

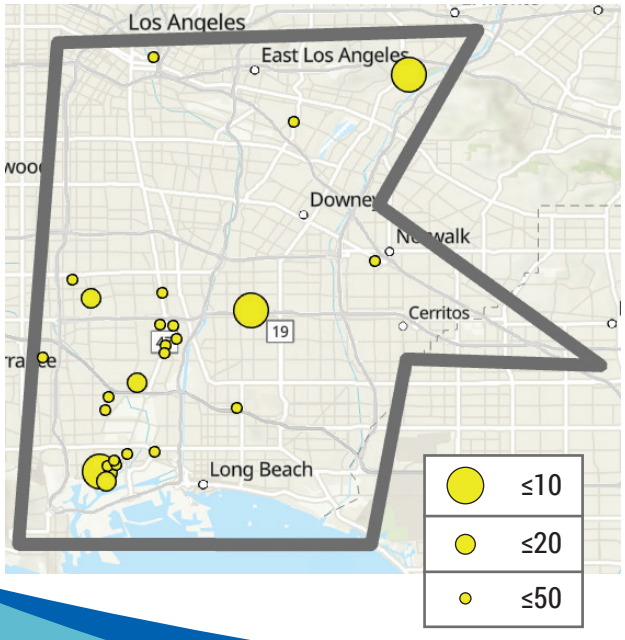
Gatwick Group holds a parcel currently undergoing remediation, though it is under the same owner as adjacent parcels forming a contiguous trapezoid bounded by Sheila St, I-710, Washington Blvd, and Atlantic Ave. Each parcel is either undeveloped or supporting truck parking, container storage, vehicle service shops, or other industrial functions. This stretch of Sheila St could be ideal for hosting a large depot for trucks serving the rail yards or requiring easy access to I-710, and it could be public or private. However, LACI's conversations with the landowner revealed that there were other plans in place for the parcels. LACI also spoke with the real estate broker who confirmed that property developers were aiming to get the area rezoned in order to build mixed commercial-residential buildings on the property. Its location immediately next to I-710 makes this location a questionable option for housing, but cities across the region are rightfully pressured to increase the housing stock where possible. Broader land-use planning across the region for charging infrastructure will need to take this tension into account.

Shason Inc. operates a warehouse on Soto St, one of many like it in Vernon, housing goods brought by ship or rail and ultimately destined for the Los Angeles region market. Currently, trucks only visit the warehouse to pick up or drop off a container. This may take half an hour, but any charging solution would need to integrate into the loading docks of the facility to enable any truck (with appropriate integrated charging technology) visiting 'multi-task', plausibly providing a shared charging facility. There is currently container storage in the parking lot, and like many cases in the goods movement network (FYI, for instance) the facility could house truck parking if clients paid an appropriate $/sqft to park their truck.

Private Charging Infrastructure

BUSINESS MODEL ASSESSMENT

The business models and funding available for private fleets are somewhat more straightforward. With careful planning, fleets can calculate the exact optimization of chargers and thus control both the amount of capital cost amortization per kWh and the peak demand across the site. As observed in the ongoing Joint Electric Truck Scaling Initiative (JETSI) project, sophisticated fleets can tailor their operations to maximize utilization of chargers, deploying ratios of even 1 charger : 3 trucks. The two main options for a fleet would be to partner with an energy service provider to adopt an integrated Charging as a Service model (see Appendix B) or keep the charging management in-house, procuring the needed hardware and software and project managing the installations. The latter would require far more time and attention on behalf of the fleet, though the benefits could include a lower overall capital cost (especially if the fleet has access to a lower cost of capital) and a lower operating cost based on the receipt of Low Carbon Fuel Standard (LCFS) revenue. Typically, energy service providers capture the LCFS revenue (like in WattEV case study), or provide a split of the revenue that can be opaque and variable, in no small part because of the fluctuating price of LCFS credits and energy service providers must hedge against downside turns in the market price. Ultimately, without a fleet purchasing a truck, there would be no LCFS credits generated, so fleets deserve some of the upside of LCFS revenue.



PLANNED LOCATIONS

There has already been considerable investment in behind-the-fence private drayage trucks and associated charging. Though not a comprehensive list, the example below shows HVIP vouchers claimed in 2021 specifically for drayage trucks in the 710 Corridor. While the vouchers were claimed in 2021, and the infrastructure likely not in place until late 2023, these early actions demonstrate considerable progress towards the 2028 targets. While

Location and Quantities of Drayage Truck HVIP Vouchers Claimed in 2021 (credit: Calstart)
Legend refers to number of trucks at the site.

the quantity of charging infrastructure is unknown (the information tracks only vehicles, not chargers), 2021's drayage truck HVIP vouchers along the corridor total 282 trucks, roughly one-sixth of the total trucks anticipated to operate in the corridor by 2028. As more vouchers have been claimed, and more charging deployments planned, the region has continued to make valuable progress. However, ensuring timely deployments of chargers – so that fleets don't receive the trucks without a place to charge them – and adequate grid capacity for the next round of large-scale depot interconnections, will be important to maintain momentum of private fleet deployments.

APPLICABLE BLUEPRINT LOCATIONS

In addition the **MDB Transportation** and **Prologis** facilities included in the site assessments, the desktop analysis sites below could serve as private fleet (or private multi-fleet) charging locations

Capital Foods is a distributor of commodity ingredients for food processing, especially grains and oils. Capital Foods operates a private fleet of 15-20 trucks for its internal operations, and, depending on the duty cycles, this fleet could be a good fit for electrification in the near term. Once Capital Foods decides to deploy electric trucks, this facility would serve well as a home charging depot. Of note: TEC Equipment of La Mirada, one of the first public truck charging installations in California, is nearby.

Parkhouse Tire is a tire distributor based in Bell Gardens that owns the above parcel, which is best suited for a private deployment of infrastructure for trucks serving Parkhouse Tire distribution needs. It is unclear if Parkhouse Tire has a company-owned fleet, or contracts out the work. If Parkhouse Tire has a company-owned fleet, this would be a straightforward private installation to support that fleet. If they use contractors, installing infrastructure at this location would have a more difficult business case, as there wouldn't be guaranteed utilization, and Parkhouse would be less inclined to dedicate space to charging infrastructure for contracted trucks at their facility.

Universal Logistics Holdings is a national shipping company that operates across all levels of the supply chain: drayage, intermodal, full truckload, less than truckload etc. Currently, ULH uses the facility for temporary storage of customer goods, though there is a good amount of truck parking as well. ULH currently operates

with many owner-operators contracting for shipments. This ULH facility could play a role in providing charging infrastructure solely to their contracted owner-operators, so long as that arrangement does not violate pertinent labor laws. Alternatively, ULH may transition portions of its business model to be employee drivers and company-owned trucks; in that case, they could install private behind-the-fence infrastructure for its own fleet at this location.

Watson Land Company is a large owner of industrial logistics real estate in Southern California, with multiple warehouse parks across Los Angeles and the Inland Empire. Watson Land Company has a similar business model to Prologis; leasing warehouse space to a fleet or logistics company. Their options for installing charging infrastructure would thus be similar: 1) specific tenants with long-term leases could request infrastructure installation paid for by grants, or 2) Watson could pay to install infrastructure and amortize the costs over the course of leases (possibly taking utilization risk if they don't have tenants consistently secured), or 3) Watson could deploy a large depot of chargers for all tenants of a given industrial park to use. Most likely, warehouse owners will want to control the infrastructure installations and then include the cost of accessing that infrastructure in leases with tenants who are transitioning towards zero emissions. In that manner, these facilities would be private but shared – open to any fleet that is a tenant of Watson Land Company.

Regional Funding Approach

Public (regional, state, and federal) funding will need to complement private sector funding in investing the $280M over the next five years needed to reach the goal of 40% ZE drayage trucks by 2028. Fortunately, there are sufficient funding programs available to achieve this target, though it will require cooperation among the stakeholders. Public agencies throughout Southern California have made funding for charging infrastructure a priority over the past few years, and there are multiple opportunities available for projects to get significant portions subsidized, which can reduce the need for capital cost amortization in the operating expenses.

Additionally, Federal funding available over the coming years should be leveraged by these existing sources, especially as the region looks towards the investment required by 2035. Below is a proposed breakdown of stakeholder investments that can stack to reach the required investment.

STAKEHOLDER AND SOURCE	AMOUNT
Metro - ZE Truck Program	$25,000,000
CEC - Drayage Infrastructure Carveout Funding	$60,000,000
CEC - EnergIIZE	$10,000,000
MSRC - '21-'24 Work Program	$10,000,000
Ports - Clean Truck Fund	$25,000,000
Federal Funding (US DOT or DOE)	$30,000,000
LADWP	$5,000,000
SCE - Charge Ready Transport	$25,000,000
Private Capital - Fleets & Energy Service Providers	$90,000,000
Total	**$280,000,000**

Public Sector - Metro

Metro, a project partner, is currently developing their ZE Truck Program as part of their broader Long Beach - East LA Corridor project (formerly known as 710 Corridor project). LACI has been an integral member of that project, sharing updates on this Blueprint over the course of 2022 and informing Metro's intended investment strategy. In total, Metro has committed to investing $50M of revenue in ZE truck charging infrastructure as part of the Long Beach - East LA Corridor Project. Additionally, there is a board directive to seek an additional $200M (4 to 1) in match funding. However, not all of this funding can address the needs of the corridor, primarily because Metro is likely to require public accessibility for their investment and not all of the investment required in the region will fulfill this criteria. However, the selection framework of truck traffic, grid capacity, and community priorities has proved valuable to understanding the ideal sub-regions for large-scale projects.

Considering Metro's desire to support small fleets with truck purchasing assistance, LACI assumes Metro will invest **$25M** directly into charging infrastructure in the region. With required match (options outlined herein), this program could catalyze the majority of required chargers in the Corridor.

Public Sector - POLA/LB

The Ports of Los Angeles and Long Beach implemented their Clean Truck Fee in April 2022, collecting $10/TEU shipped by truck out of the terminal. In developing the program, both Ports committed funding towards deploying infrastructure throughout the first few years of disbursements. Neither Port has articulated how exactly the disbursements will occur or what types of projects they will fund, but they have committed to using at least 10% (POLA) and 25% (POLB) of funds in the first year for infrastructure, with future allocations to be determined. Additionally, it is very likely this funding goes to equipment installed on Port property, keeping this investment in the 710 Corridor study area. At ~$90M a year in total funds received, a conservative estimate of infrastructure investment derived from the Ports' CTF revenue over the next five years totals **$25M.**

Public Sector - LADWP

LADWP will offer up to $500,000 for any M/HD infrastructure project in their territory, regardless of public accessibility. Given ample LADWP contact needed for an infrastructure project, entities executing projects in LADWP territory would access this reimbursable funding to defray costs. The relevant LADWP territory is limited, so LACI does not consider this integral to the corridor-wide investment strategy, though it could contribute up to **$5M**, and has not included this funding in the projections.

Public Sector - MSRC

The Mobile Source Air Pollution Reduction Review Committee (MSRC) is tasked with funding projects to reduce air pollution through vehicle registration fees in the South Coast AQMD region. MSRC has made zero emission goods movement infrastructure the primary target of their 2021-2024 Work Program, with approximately $50M of funding to be administered on a case-by-case basis. MSRC has already closed an RFI related to this funding at the end of November 2022. MSRC funds projects across four counties, and strives for geographic equity in its funded projects. Providing slightly more weight to LA County, and the Ports area in particular, it is appropriate to expect a minimum of **$10M** to fund projects in the corridor. LACI submitted a response to the initial RFI outlining this Blueprint work. As LACI is not eligible to make decisions on capital improvements on any of the sites, LACI aimed to bring to MSRC's attention the Blueprint sites reviewed while offering to connect MSRC to the site hosts.

Public Sector - CEC

The California Energy Commission, at the direction of the California Legislature, has allocated $100M of funding towards drayage truck infrastructure over the next four years. It is unclear how the CEC will disperse this funding, whether through competitive grants, block grants, or voucher programs, but LACI pushed for this funding in the last legislative session and will continue to develop the funding strategy with CEC. Allocating this funding in proportion to the volume of California freight processed, the San Pedro Bay Ports should receive no less than **$60M.**

The CEC's Energy Infrastructure Incentives for Zero Emissions (EnergIIZE) program is a widely accessible program for the deployment of zero emission vehicle infrastructure across California. Though smaller in size, with a maximum $500,000 per project, anyone can apply with a straightforward application. EnergIIZE also offers a funding lane for public charging, where projects are reviewed on merit. LACI anticipates a high percentage of truck charging projects in the region to apply and receive this funding. Out of the projected need for 28 sites by 2028, LACI assumes that 20 could ultimately receive EnergIIZE funding, adding an additional **$10M** of funding.

Lastly, the CEC awarded the Research Hub for Electric Truck Technology Applications (RHETTA) to a Southern California consortium. The grant tasked the consortium with identifying locations for building a public charging network throughout the region, though it is unclear how many will be in the exact 710 Corridor studied in this Blueprint. If one RHETTA site is in the corridor, this will contribute another $1M-$2M, but, given the uncertainty, LACI has not included this funding source in the projections.

Public Sector - US Department of Transportation (US DOT)

Grant opportunities available to public agencies for goods movement infrastructure, made possible by the Bipartisan Infrastructure Law (BIL, or otherwise known as the Infrastructure Investment and Jobs Act) have begun to formulate over the past few months and will be good targets for supporting electrification of the 710 Corridor. The government's funding specifically aims to prioritize environmental justice as well, making the 710 Corridor a good candidate to receive these needed investments. Of immediate interest would be the US DOT's Charging and Fueling Infrastructure Discretionary Grant Program (CFI). This program, with a currently released Notice of Funding Opportunity, is a good opportunity for public agencies with infrastructure funding to receive the federal leverage critical to reaching our goals. Additional opportunities are likely to become available as the executive agencies continue to roll out the funding stipulated in the BIL.

Private Sector - Fleets and Energy Service Providers

Lastly, public stakeholders should expect private capital to invest in the needed infrastructure, especially on behind-the-fence private deployments and make up the remaining investment, estimated at **$80M** over the next five years. Many larger drayage fleets can internalize these costs and handle the investments, especially considering how CEC's EnergIIZE and SCE's Charge Ready Transport can help immediately defray the costs. Additionally, many private fleets will be eligible for incentives included in the recent federal Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA). The IRA will provide a 6% tax credit for any infrastructure deployment, up to $100,000, in addition to application based grant programs for M/HD infrastructure totaling in the tens of billions. LACI has been monitoring the development of these federal programs and will work with Metro, the Ports, and others to ensure the region is a prime candidate for additional federal money not directly contemplated in this funding strategy, though it is highly likely that Corridor stakeholders submit valid sites for federal funding programs.

[7] https://www.sce.com/sites/default/files/2019-08/sce_charge-ready-transport_handbook_v6.pdf

CASE STUDIES

Private Infrastructure Case Study

CARB and CEC issued a joint solicitation for large-scale deployments of Class 8 trucks, funding both the vehicles and the infrastructure. SCAQMD, with fleet partners NFI and Schneider, successfully won the award, with each fleet slated to deploy 50 BEV Class 8 trucks. For comparison purposes, NFI's slated deployment is more accurate, given their focus on drayage, while Schneider does not exclusively operate drayage duty cycles. And though not located in the corridor (the planned deployment is in Chino), this is a model for private truck fleet deployments that fleets in the 710 corridor can emulate.

NFI plans to install 35 150 kW chargers to support their 50 truck deployment. Initial cost estimates included in the grant application are $8,000,000 for the procurement and installation of the 35 chargers. Assuming $500,000 for the high voltage equipment (a total not present in this Blueprint's calculations), this comes out to approximately $215,000 per charger installed, a 50% higher cost than the estimates from this Blueprint. Adding to the costs of this deployment, NFI, partnering with Electrify America, is installing 1MW of onsite solar and 5MWh of onsite battery storage for added resiliency at a cost of at least $7,500,000. In order to minimize grid interconnection costs, ongoing energy costs, and resiliency disruptions, it's clear there are significant capital investments that operators may need to make. However, charging hardware EVSE costs have declined since 2020 (when this grant application was submitted), generating a majority of the cost differences between 2020 and 2023 estimations.

Public Charging Business Model Case Study

WattEV is a charging infrastructure and Transportation as a Service (TaaS) company that offers both subscription-based access to battery-electric trucks while also offering charging infrastructure to additional fleets at strategic locations in California. In February 2022, POLB released an RFI outlining potential sites on POLB property they were considering allocating towards charging infrastructure. WattEV's response secured a lease to operate a depot at 2404 Pier A Way that will ultimately include twenty-six charging stations up to 360 kW, plus eight pull-through charging lanes that will have 1.2 MW systems.

Because of WattEV's TaaS model with committed clients, they can expect a utilization floor while also offering charging to additional fleets in the area who need a charge. As the lease required POLB Board approval at the August 11th 2022 meeting, the details of the lease agreement are in the public record. Below are the high-level financials that other public agencies should model when considering hosting charging infrastructure (especially relevant in the case of LA Metro and the Park and Ride).

Monthly Lease: $12,000 (+ annual CPI adjustment)

Lease Per Sqft: Roughly $0.186 per square foot (1.48 acre site)

Lease Length: 10 years

Additional Rent: $.01/kWh for every kWh dispensed after 1200 MWh per quarter

This Additional Rent provision is key to ensuring the public agency can benefit as adoption of battery-electric trucking grows. Assuming 90 days in a quarter, and given the initial deployment of twenty-six chargers, POLB stands to receive additional rent income if each charger, on average, dispenses more than 512kWh per day for the entire quarter (or 13,333 kWh per day across the entire station). Additionally, POLB does not have a claim on any Low Carbon Fuel Standard credits generated, though WattEV is responsible for all utility interactions and capital upgrades to the property.

APPENDIX A: Data Procurement

The Blueprint team prioritized accessing raw truck traffic data, as select static maps may not provide answers to all of the questions which demand answers. Working with raw truck traffic data would allow for the project team to ask more questions about the traffic patterns of the trucks that could lead to better placement of charging infrastructure for the community.

LACI partnered with data vendor GeoStamp to acquire the necessary raw data to visualize truck charging opportunities. To leverage state funding best, LACI coordinated data procurement with Port of Los Angeles (POLA). LACI confirmed that POLA was undergoing a project that required similar GeoStamp data, centered around the origin and destination of drayage moves across the entire Southern California Air Basin (SCAB). However, the Blueprint team required additional time-stamped data on the truck locations that use GeoStamp's services. LACI was able to add to POLA's existing data request in a coordinated procurement with GeoStamp.

In total, LACI received data on approximately 2,200 trucks, with 8 specific months of data per truck: October 2019, October 2020, and September 2021-February 2022. The 2019 and 2020 October months were prioritized because that is historically the busiest month of imports leading up to the holiday season. The Blueprint Team also wanted a picture of traffic conditions post-COVID, to address any differences on truck traffic patterns and land availability the post-COVID supply chain snarls created in the Southern California logistics networks.

Data from trucks included the below set of parameters, pinging every ten seconds that the truck had the ignition on. The data collection could also recognize when a truck was shut off and turned back on, and register how long the gap was and if it fell into either of the "Overnight" three-hour category or the "Opportunity" thirty-minute category.

Final Parameters

- Unique, but scrambled identifiers for each vehicle
- VIN, with the last 4 digits blanked out
- Longitude
- Latitude
- Date
- Time
- Move data at available geofences

APPENDIX B:
Charging as a Service Overview

Charging-as-a-Service (CaaS) is a comprehensive, managed charging solution in which the fleet operator pays a fixed rate/amount based on the total kilowatt-hours (kWh) used. With CaaS, the customer has no upfront capital expense. This differs from the typical payment model that requires fleet operators to pay upfront costs for all charging aspects including cost of the equipment, software, installation, permitting, and maintenance.

CaaS shifts many duties from the fleet to their CaaS provider, all for an optimized fixed rate. The CaaS model allows the CaaS provider to assume responsibility for all charging aspects necessary to deploy EV charging, from EVSE procurement and installation to operations and maintenance. This adds a layer of predictability to operations and streamlines the onboarding process, allowing fleet operators to forecast and manage costs long-term. With CaaS, fleets can ensure they have a viable EV charging system without the burden of paying costs upfront and managing the transition to electric themselves.

In CaaS agreements, operators handle all project management – bundling CapEx, OpEx, energy costs, incentives, and charging management into optimized fixed rate, $/kWh consumed with a 99.9% uptime guarantee so fleets can focus on the core business with confidence that charging operations are seamless. CaaS ensures a fleet's charging system is fully managed – from site design through project implementation and beyond. CaaS can include:

- Engineering and Design
- EVSE Procurement
- Construction and Installation
- Automated Charging Operations
- Fueling Cost Management
- Operations and Maintenance
- 24/7 Support

“Expected” vs “Maximum” utilization?

When assessing projected CaaS $/kWh rates, the energy service provider investigates how higher utilization of the charging infrastructure could produce different CaaS rates to end-users. Expected utilization is a more conservative estimate to allow for greater sense of predictability and projection of future costs. “Max” utilization presents a scenario where the uptake of usage is more aggressive, allowing for capital and operational costs to be spread across a greater amount of kWhs. For both scenarios in SCE territory, the energy $/kWh remains the same due to SCE’s TOU-EV-9 tariff being without a demand tariff until 2026, at which point it may be reintroduced. If the demand tariff is reintroduced, the expected and maximum utilization scenarios should project different energy $/kWh sub-components as greater utilization may not offset higher power utility costs, as maximum utilization assumes not only more utilization across a given year but a larger quantity of vehicles charging simultaneously, i.e., drawing power, at any given time.

APPENDIX C: 710 Corridor Charging Infrastructure Investment Blueprint Assumptions

16,300 trucks in the Registry

The number of total trucks in the San Pedro Bay Ports (SPBP) Drayage Registry is upwards of 20,000. However, many of these trucks may rarely, or never, visit the Ports, and a more appropriate range of active drayage trucks (a truck that visits one port at least once per month) is 13,000-15,000. Accounting for small growth in the fleet, this analysis assumes a fleet of 16,300, which CARB also uses in their Initial Statement of Reasons (ISOR) for the Advanced Clean Trucks (ACT) rule. If the drayage fleet becomes more purpose-built, there will be fewer trucks needed (i.e. fewer trucks doing more turns per month), and this would reflect the likely consolidation in the industry with the 2023 forced retirements of pre-2010 trucks, the 2024 requirement for only ZEVs as new drayage trucks, and the 2027 retirement of pre-2014 trucks, but LACI will use current number for now and can adjust in the future.

90 percent of SPBP Drayage Registry will be battery-electric in 2035; 10 percent fuel cell

This assumption is also derived from CARB's ISOR for the ACT. Given many manufacturers' holding off production of fuel cell trucks until 2027 (based on timelines for fuel cell technology development and production) and general drayage duty cycles requiring less range than long-haul trucks, LACI believes this to be a fair assumption.

40 percent of trucks serving the San Pedro Bay Port will be zero emission by 2028

This is not an assumption, but TEP's interim target for the fleet.

70 percent of trucks will charge behind-the-fence at a private depot

In their 2019 Drayage Feasibility Assessment, the Ports quoted survey data that 70% of trucks garage in a depot. Tetra Tech (researcher for the Drayage Feasibility Assessment) assessed that, because of

space constraints required by charging infrastructure, this proportion will decrease over time, to as low as 40%. There are multiple reasons LACI believes the proportion of trucks charging behind-the-fence at a private depot will remain relatively higher. For one, AB5 has officially been enforced since 2019, which should increase the proportion of employee drivers at fleets with company-owned trucks–trucks almost certain to park at a designated depot every night. Secondly, and especially earlier in the transition to battery electric trucks, fleets will utilize behind-the-fence private charging as a means to secure charging availability. Therefore LACI maintains that 70 percent private charging and 30 percent public charging is a fair proportion to estimate.

30 percent of truck trips are less than 10 miles from the Ports

When the Ports conducted a study to determine their Clean Truck Fund rate, they analyzed truck traffic patterns around the corridor and found that 30 percent of trucks travel fewer than 10 miles from the Ports. 10 miles from the Port along I-710 is I-105, so this proportion is intuitive given the activity at the Intermodal Container Transfer Facility and the density of warehouse traffic in Carson, Rancho Dominguez and along Alameda Street. Though freight flows are dynamic and subject to change, LACI uses this 30 percent number as a minimum estimate of trips occurring completely within the corridor, which stretches 20 miles from the Ports to the railyards. There will certainly need to be chargers in the east LA railyard area as well, though drayage truck trips the entire length of the I-710 corridor are rare, given on-dock rail's ability to move containers from Port to East LA.

1 public charger : 4 trucks daily; 1 private charger : 2 trucks daily

This assumption has some uncertainty, as the transition to battery-electric drayage truck (in addition to AB5 enforcement) should alter the format of drayage operations, but time will tell as to how and to what degree. LACI has combined assumptions from previous studies and known deployments to estimate the number of trucks that could use one charger, either public or private.

In general, public charging – fully public, with no guaranteed utilization – does not exist yet, and may not for a few years, as the investment thesis is difficult without massive public intervention. There could be models developed where an 'anchor tenant' provides known utilization that can subsidize the operator to also host additional charging units with unknown utilization. Regardless, this charging typology will almost certainly require MCS charging to be incorporated into fleet operations.

In POLB's study, they estimated that 1 public charger could serve 6 trucks per day, assuming MCS chargers and highly coordinated queueing (i.e. one truck would start charging very soon after another truck stopped charging). LACI has taken a more conservative approach assuming one public charger could serve 4 trucks per day.

This assumption doesn't contemplate a high level of coordination and does assume that, over the next five years, these stations will not be MCS, but will be CCS chargers operating around 175kW. This would likely lead to longer dwell times (though 'topping-off' is still a possibility), and thus fewer trucks per charger.

Private chargers would be behind-the-fence, with known utilization schedules, and a predominantly slower pace of charging. Ongoing deployment projects have seen fleets plan for one charger to serve two trucks, timing the charging based on shift schedules, and though some sophisticated fleets may be able to increase the ratio, LACI has assumed for this analysis that one private charger could support two trucks, an assumption also made by POLB in their study.

Appendix D: Assumptions for Site Assessment Operating Costs

Before projecting a Charging-as-a-Service $/kWh rate, analysts develop a set of usage assumptions to drive the kWh utilization model. This analysis was based on the following assumptions:

1. Utilization projections are informed by bp pulse's analysis of the traffic demand data for fast and slow charging opportunities within a 1-mile-radius of the site.
2. Annual vehicle-miles traveled are calculated based on an average efficiency value of 2.5 kWh/mile for heavy-duty trucks.
3. Annual kWh utilization assumes a projected ramp-up rate of 20 percent for the first year, 60 percent for the second and third year, and then complete to 100 percent in the fourth year.
4. Annual Capacity Factor is the total annual volume of electricity dispensed divided by the product of the installed charging capacity and the number of hours over one year.
5. To set the term for kWh utilization, a term of 5-years is assumed.

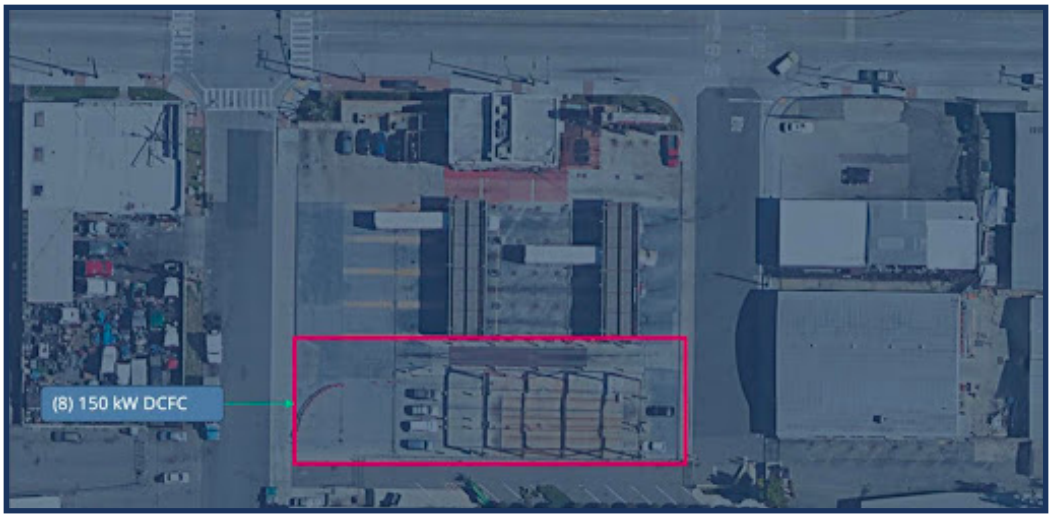
Appendix E: Desktop Analyses

1 CAPITAL FOOD GROUP

Site Information	
Site Name	Capital Food Group
Site Address	16424 Valley View Ave, La Mirada, CA 90638
Acreage	8.12
Site Owner	16424 Valley View LLC C/O GM Properties
Depot Type	Private
Utility Provider	Southern California Edison (SCE)
Summary	There is good access from the street and to the possible charger station. There is turnaround room for smaller fleet vehicles and trucks; however, larger vehicles may experience congestion and difficult logistics. This a clean site that is zoned well for new construction, has good freeway access but a low level of security.
Construction Feasibility Grade	B

2 COMMERCE TRUCK STOP

Site Information	
Site Name	Commerce Truck Stop
Site Address	4560 E Washington Blvd, Commerce, CA 90040
Acreage	1.27
Site Owner	BNFS Railway Company SBE 804-19-40V PAR 66ß
Depot Type	Private
Utility Provider	Southern California Edison (SCE)
Summary	There is good access from the street and to the possible charger station. There is a pull through for existing diesel station; however, larger vehicles may experience congestion and difficult logistics. This a clean site that is zoned well for new construction, has good freeway access, and a high level of security.
Construction Feasibility Grade	B

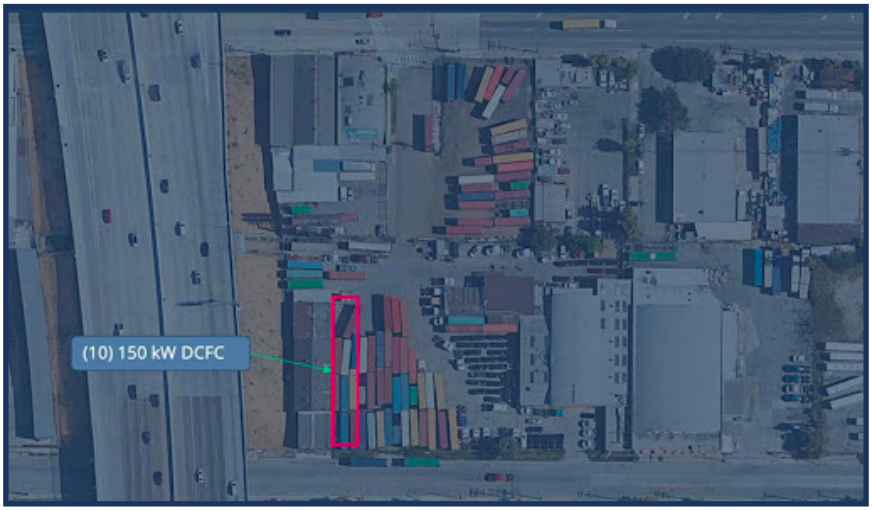


3 FLEET YARD 8440

Site Information	
Site Name	Fleet Yard Inc. 8440
Site Address	8440 Alameda St., South Gate, CA 90001
Acreage	2.94
Site Owner	Alameda Engle Properties LLC
Depot Type	Private
Utility Provider	Southern California Edison (SCE)
Summary	There is good access from the street and ample room for equipment. There is room for turnaround and vehicle wait area. Access to site amenities and services for employees is a concern and needs to be addressed in the overall site use plan.
Construction Feasibility Grade	B

4 GATWICK GROUP

Site Information	
Site Name	Gatwick Group Sheila Street
Site Address	4817 Sheila St, Commerce, CA 90040
Acreage	1.4
Site Owner	3D Investments IV LP Et Al, 45th Street LLC, C/O Behruz Gabbai
Depot Type	Public/Private
Utility Provider	Southern California Edison (SCE)
Summary	This site location has more than ample space to accommodate the proposed equipment, along with adequate site access and space for logistics/turn around. Given the ease of access, general blank slate for construction, proximity to free-ways and favorable zoning designation this is a good candidate for site construc-tion. Access to site amenities and services for patrons is a concern and needs to be addressed.
Construction Feasibility Grade	B



5 PARKHOUSE TIRE

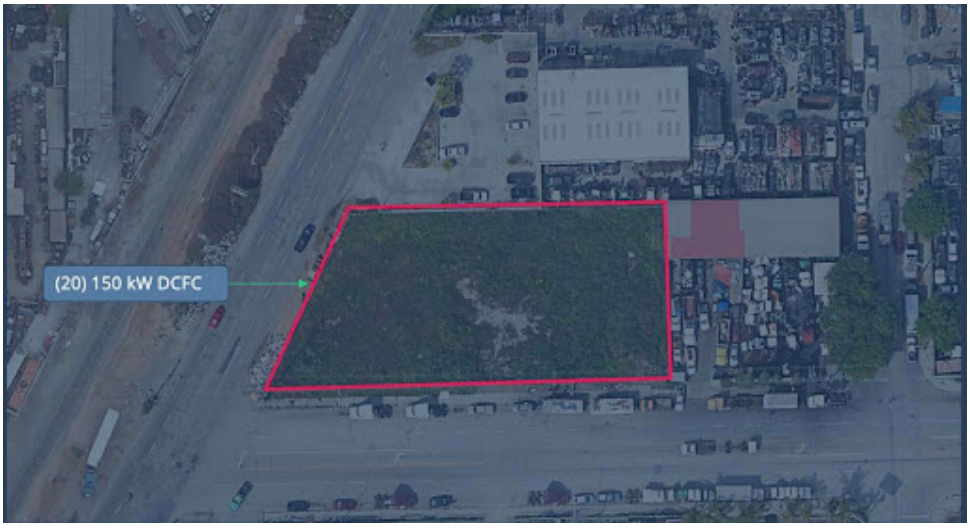
Site Information	
Site Name	Parkhouse Tire
Site Address	5960 Shull St., Bell Gardens, CA 90201
Acreage	2.34
Site Owner	Parkhouse James TR James Parkhouse Trust
Depot Type	Private
Utility Provider	Southern California Edison (SCE)
Summary	There is good access from the street and to the possible charger station. The site is close to multiple interstate / freeways. This site is zoned well for new construction, has good freeway access and a good level of security.
Construction Feasibility Grade	B

6 PORT OF LONG BEACH

Site Information	
Site Name	Port of Long Beach 960
Site Address	960 New Dock St., San Pedro, CA
Acreage	5.36
Site Owner	L.A. City Director Property Management Port of L.A.
Depot Type	Public
Utility Provider	Los Angeles Department of Water and Power (LADWP)
Summary	There is good access from the street and several freeways within 2- minutes of the site. This is a blank slate with good access and a site that has great ease of constructability. Coordination and cooperation with the City of L.A. is key to the project's success. The site is extremely secure; however, bathrooms, shade and concessions/amenities need to be incorporated into the overall site use plan.
Construction Feasibility Grade	B

7 PORT OF LOS ANGELES 1519

Site Information	
Site Name	Port of LA 1519
Site Address	1519 East I St., Wilmington, CA 90744
Acreage	0.33
Site Owner	L.A. City
Depot Type	Public
Utility Provider	Los Angeles Department of Water and Power (LADWP)
Summary	There is good access from the street and numerous highways with in 10 minutes of the site. This is a blank slate with good access and a site that has great ease of constructability. Coordination and cooperation with the City of L.A. is key to the project's success.
Construction Feasibility Grade	B



8 SHASON INC.

Site Information	
Site Name	Shason Inc.
Site Address	5525 Soto St., Vernon, CA
Acreage	17.83
Site Owner	5525 S Soto St. Associates Sears Roebuck Co 768Tax B2-116A
Depot Type	Private
Utility Provider	Vernon Public Utilities Department
Summary	There is good access from the street and to the possible charger station. The site is far from the interstate/freeway but there are many surface streets. This a clean site that is zoned well for new construction, has good freeway access, and a high level of security. It also has ample space for new equipment such as transformers and cabinets on site.
Construction Feasibility Grade	B

9 UNIVERSAL LOGISTICS HOLDINGS

Site Information	
Site Name	Universal Logistics Holdings
Site Address	18020 South Santa Fe Avenue, Compton, CA
Acreage	1.52
Site Owner	Santa Fe Enterprises LLC C/O James Byron
Depot Type	Private
Utility Provider	Southern California Edison (SCE)
Summary	There is good access from the street and ample room for equipment. There is turnaround room for smaller fleet vehicles and trucks. This site is zoned well for new construction, has good freeway access and a high level of security.
Construction Feasibility Grade	B

10 WATSON LAND COMPANY

Site Information	
Site Name	Watson Land Company
Site Address	23610 Banning Boulevard, Compton, CA
Acreage	3.54
Site Owner	Watson Land Company
Depot Type	Private
Utility Provider	Southern California Edison (SCE)
Summary	There is good access from the street and ample room for equipment. There is turnaround room for smaller fleet vehicles and trucks. This site is zoned well for new construction, has good freeway access, and a high level of security – making it operations feasible.
Construction Feasibility Grade	A

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