



Southern California Zero-Emission Truck Infrastructure Study

June 2026



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EXECUTIVE SUMMARY

I. INTRODUCTION

The Southern California Association of Governments (SCAG) led the "Southern California Zero-Emission Truck Infrastructure (ZETI) Study" to develop strategies and recommendations for a network of public charging and fueling stations for zero emission (ZE) trucks throughout the region that will also support statewide efforts to transition medium- and heavy-duty (MD-HD) trucks to alternative fueling technologies. The study included a phased approach to recommendations for station deployment and how the infrastructure could meet the operational needs of various truck markets. A technical advisory committee (TAC), consisting of stakeholders from the public and private sectors, provided input throughout the study to help provide a holistic view of the ZE landscape.

The ZETI study developed tools and scenarios to help quantify the potential number, locations, and features of charging and fueling stations required to support ZE trucks in the future. This information contributed to regional planning, supported related efforts, and will be incorporated into the Electric Truck Research and Utilization Center (eTRUC) Project, funded by the California Energy Commission's (CEC) Research Hub for Electric Technologies in Truck Applications (RHETTA) Program.

SCOPE OF THE STUDY

The ZETI study assessed regional and site-specific infrastructure needs for ZE truck operations. It used a truck simulation model combined with an energy model to estimate demand, considering various truck markets and operational needs. The hydrogen fuel cell scenario focused on potential hydrogen demand in 2040, aligning with state projections. At the site level, 24 locations were evaluated for deployment feasibility, including site features, costs, and other key factors.

TECHNOLOGY ASSESSMENT

The study focused on battery electric and hydrogen fuel cell truck technologies, exploring their infrastructure requirements and how they could be integrated into a regional network. The study identified how infrastructure could support diverse operational models and regional zero emission goals. The study also outlined how different technologies could complement each other to address varying operational needs. The infrastructure recommendations reflected this mix of technologies and operational needs.

SCENARIO PLANNING AND STAKEHOLDER ENGAGEMENT

The study developed scenarios for 2030, 2035, and 2040 to assess infrastructure needs over time. Stakeholder engagement, including feedback from truck operators, fleet managers, and public agencies, helped refine recommendations and align them with real world operations.

SUPPORTING STATEWIDE AND REGIONAL EFFORTS

The ZETI study contributes to both regional and statewide efforts to transition to ZE truck operations, providing insights into infrastructure needs and investment decisions to reduce emissions from goods movement. Its findings have been incorporated into the statewide eTRUC Project, aligning regional and statewide programs. The study lays the foundation for expanding ZE truck charging and fueling networks across California.



II. LITERATURE REVIEW

POLICIES AND REGULATIONS

State and local governments in Southern California are working to reduce air pollution from MD-HD by promoting zero emission vehicles (ZEVs). Governor Gavin Newsom's 2020 targets aim for 100 percent zero emission MD-HD trucks by 2045, with drayage trucks by 2035. The California Air Resources Board (CARB) mandates that a growing percentage of MD-HD trucks sold must be zero emission by 2035, with all MD-HD vehicles to be ZEVs by 2036. Public transit agencies must transition to zero emission buses by 2035. Achieving these goals requires significant infrastructure upgrades, including 157,000 additional chargers by 2030. State legislation such as Assembly Bill 1236 aims to streamline EV infrastructure permitting, while local initiatives in the SCAG region support deployment. The National Zero Emission Freight Corridor Strategy, introduced in 2024, focuses on improving infrastructure along freight corridors, particularly near major ports, through 2040.

EXISTING FUNDING AND INCENTIVE PROGRAMS

Incentive programs are critical for advancing charging and fueling infrastructure for ZEVs. Various funding opportunities at the federal, state, and local levels support the deployment of MD-HD ZEVs and infrastructure in Southern California. State agencies like CARB and the CEC offer programs to promote the purchase of ZE trucks, buses, and infrastructure. SCAG provides local incentives complementing federal and state efforts, while the South Coast Air Quality Management District (SCAQMD) oversees additional initiatives. Federal funding, including the Inflation Reduction Act and the Infrastructure Investment and Jobs Act, supports these efforts. In 2022, the U.S. Department of Energy and the Alliance for Renewable Clean Hydrogen Energy Systems announced a \$12.6 billion agreement, vital to advancing the California Hydrogen Hub. To ensure long-term sustainability, diversifying funding sources beyond state and federal support is essential, as political climates and resource availability may change.



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III. OUTREACH

The project team engaged a diverse group of individuals and agencies involved in freight movement within the SCAG region and across California. This included fleet owners, warehouse operators, real estate developers, original equipment manufacturers (OEMs), community groups, and public sector stakeholders like the Los Angeles County Metropolitan Transportation Authority, California Department of Transportation (Caltrans), SCAQMD, as well as quasi-public sector stakeholders such as ports and utility companies. A variety of outreach methods were used to solicit feedback, including a truck fleet survey with over 100 participants. The fleet survey helped gain an understanding of operators' perspectives, familiarity with zero emissions programs, and the current status of the transition. Section 2 Outreach and

Engagement provides important feedback from that survey. Additionally, focus groups were gathered to understand how fueling and charging sites impact local agencies and communities, and one-on-one interviews with freight industry experts provided valuable insights on the ZEV transition.

The project's TAC also provided ongoing perspective and guidance. Table ES-1 below provides a summary of the key takeaways during the outreach process.

Stakeholders also provided ideas for potential recommendations to support or address focus areas and key findings. These recommendations from community members, agencies, and freight industry experts illustrate how these stakeholders see opportunities and a path forward for the zero emissions transition. The recommendations are organized by theme area.

TABLE ES-1 Key Takeaways and Themes

THEME AREA	KEY FINDING
Funding	Broad education and targeted incentives need to be made available to help businesses, especially small businesses, transition to ZEVs.
Electric Grid Capacity and Available of Hydrogen	- Grid capacity needs to be addressed, especially for peak hour usage - The focus groups had limited information on hydrogen fueling availability, so a range of locations need to be considered. There needs to be enough fueling sites available to ensure that it is a viable fuel option moving forward.
Public vs Private Depots	- Public sites may need megawatt charging or a fast-charging system, to meet charging needs without disrupting operations. - For public charging, ensure that surrounding land uses can accommodate amenities for truck drivers. - Caltrans owned right-of-way may be a good starting point for public charging stations, may align with existing CTC or trucking corridors.
Timelines	- Supply chain issues for EVCS equipment can add to delays in installation of chargers and support equipment. - Streamlining the permitting process (California AB 1236, 2015 and AB 970, 2021) and potentially the CEQA/ environmental process can help improve the speed of installation.
Equity of Locations	- The environmental effects of the charging sites should be reviewed to ensure that communities that already face the brunt of environmental challenges are not burdened even more. - Community members can offer their expertise on identifying truck routes and areas where trucks idle and provide insights on land use. It is critical that these conversations occur on the local level and be required as part of the siting process. - Ensure that safety is considered, as having an increase of truck trips in communities with overnight or depot charging sites could pose additional traffic or public safety concerns.



FUNDING

Recommendations include providing education and technical support to improve access to grants, funding pilot programs to test ZEV impacts, leveraging innovative funding mechanisms like the California Infrastructure and Economic Development Bank, and scaling existing pilot programs. Collaboration between government agencies and private entities is essential to accelerate the development of charging facilities.

GRID CAPACITY

Grid capacity and hydrogen fueling availability require focused leadership from utilities and transportation agencies. Recommendations include co-locating charging infrastructure with transportation routes, facilitating hydrogen fuel site installations, and exploring diverse technologies to meet the needs of different truck markets while addressing grid constraints.

PUBLIC VS. PRIVATE DEPOTS

The distinction between public and private charging depots highlighted the need for government involvement in developing public charging stations, as smaller fleets may lack the resources to build on-site infrastructure. Recommendations include increasing redundancy in the EV charging network, creating inventories of charging locations, and establishing standards for interoperability across networks.

TIMELINES

Implementation timelines present a challenge, with stakeholders calling for interim solutions while utilities expand grid capacity. Recommendations include streamlining permitting processes, expediting utility installations, developing simplified environmental review procedures, and funding microgrid pilot projects to address temporary charging infrastructure gaps.

EQUITY OF LOCATIONS

Equity in site selection is crucial to avoid disproportionate impacts on disadvantaged communities. Early engagement with local stakeholders, implementing local hire programs, and incorporating equity criteria into decision-making processes are key to ensuring equitable outcomes.

The most important recommendations focus on collaboration among agencies. This includes local jurisdiction working with each other as well as regional agencies like SCAG. Strong government leadership is vital to addressing funding and technological challenges. Planning and support are essential to facilitate the trucking industry's transition to ZEVs, reduce greenhouse gas emissions, and improve air quality.



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IV. MODELING APPROACH FOR TRUCK TRAVEL AND ENERGY NEEDS

The modeling approach for SCAG's ZETI study is comprised of trip data analysis, market segmentation, energy modeling, and model smoothing to assess truck travel behavior and energy demand, that build the technical foundation for this work. The goal of the modeling work is to understand how freight travels throughout the SCAG region and to align the truck movements with energy needs to understand how much and where zero emission infrastructure is required to facilitate the transition to ZE trucks.

The first part of the analysis focuses on analyzing truck travel patterns to create a detailed trip roster database for energy modeling. The second part focuses on modeling the energy consumption, charging events, and load profiles for various truck market segments. The last element focuses on the final smoothing process to ensure results align with overall zero emissions understanding.

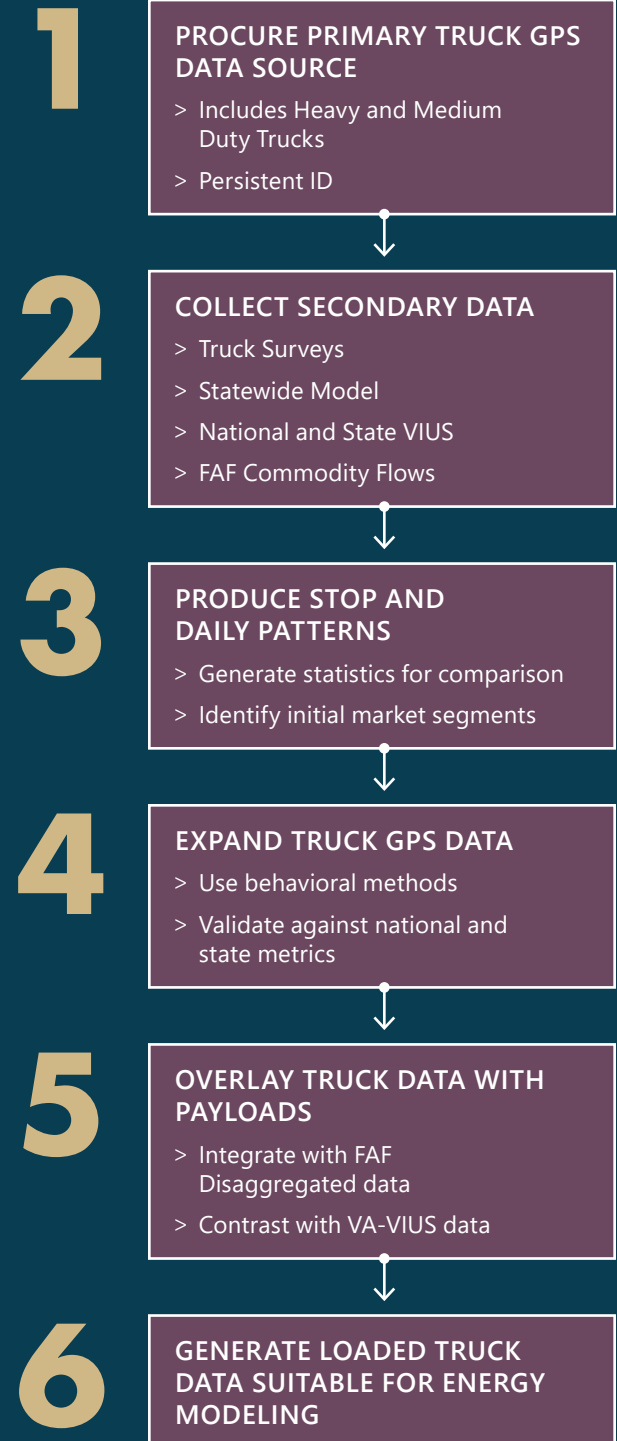
The chart to the right shows the key steps involved in creating a database to support truck energy modeling.

DATA SOURCES

This analysis utilizes truck global positioning system (GPS) data from INRIX as the primary source to study truck travel patterns. INRIX's dataset includes medium- and heavy-duty trucks, representing three to ten percent of all trucks across the United States. To ensure data privacy, each truck is assigned a device ID that changes every 24 hours. For a more accurate representation of truck movements in California, data from four separate weeks in 2021 and 2019 were selected.

In addition to the primary GPS data, several secondary data sources were used to complement and validate truck GPS data, including the Freight Analysis Framework (FAF), California Vehicle Inventory and Use Survey (CA-VIUS), the California Statewide Freight Forecasting and Travel Demand Model (CSF2TDM), and commercial vehicle surveys.

KEY STEPS IN THE DESIGN OF A NEW TECHNICAL FRAMEWORK TO STUDY TRUCK ELECTRIFICATION



DATA ANALYSIS AND MODELING

The data underwent a cleaning process to improve accuracy by adjusting for trip representation and removing outliers. Data expansion was then applied to represent all truck trips, incorporating surveys and known behavioral methods to adjust for unrepresented travel patterns. Validation checks compared the expanded data with other datasets to ensure accuracy.

MARKET SEGMENTATION

Market segmentation was conducted to identify different truck segments based on travel behavior, such as port drayage trucks, which are expected to adopt electrification more quickly. Segmentation was performed using criteria like total vehicle miles traveled, stop frequency, and truck weight class. These segments help assess the potential for electric vehicle adoption and future energy demand related to truck electrification.

While the chart provides detailed information, below is a brief description of each market segment. All segments are categorized as either medium or heavy duty:

- **Drayage:** Short truck trips that visit a port.
- **Regional Return-to-Base:** Non-port trucks with daily travel mileage under 300 miles and a frequent base location.
- **Regional Non-Home:** Non-port trucks with daily travel mileage under 300 miles and no frequent base location.
- **Long-Haul:** Non-port trucks with daily travel mileage exceeding 300 miles.

OVERLAY COMMODITY FLOWS ONTO TRUCK ORIGIN AND DESTINATION

The final steps in the data cleaning and modeling process focused on evaluating whether expanded truck trips could support the volume of goods transported between counties and regions, and creating a trip roster that measures payloads carried on each leg of the journey. FAF data was disaggregated to prepare county-level commodity flow values by tonnage, with the majority of travel flows handled by heavy-duty trucks. Payload calculations were based on data from the California Vehicle Inventory and Use Survey (CA-VIUS), considering full, partially-loaded, and empty trucks. Commodity flows between counties were matched using county-level data and CSF2TDM regional data where needed.

A framework was developed to identify whether trucks were picking up, dropping off, or servicing loads, resulting in a matrix of daily truck patterns. This

TABLE ES-2 Truck Demand Market Segments

TRUCK MARKET SEGMENT	PORT TRUCK		TRUCK TYPE		TOTAL MILEAGE		FREQUENT LOCATION	
	Yes	No	Heavy	Medium	0-300 mi	>300 mi	Yes	No
Drayage Heavy Duty (HD)	✓		✓		N/A	N/A	N/A	N/A
Drayage Medium Duty (MD)	✓			✓	N/A	N/A	N/A	N/A
Regional Return-to-Base: HD		✓	✓		✓		✓	
Regional Return-to-Base: MD		✓		✓	✓		✓	
Regional Non-Home: HD		✓	✓		✓			✓
Regional Non-Home: MD		✓		✓	✓			✓
Long-Haul: HD		✓	✓			✓	N/A	N/A
Long-Haul: MD		✓		✓		✓	N/A	N/A

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approach effectively mirrored truck travel and accurately captured the volumes of goods transported, which were then benchmarked against CA-VIUS and FAF data. The methodology successfully replicated regional and county-level commodity flows across California.

FINAL DATABASE TO SUPPORT ENERGY MODELING

The final output of this process is a detailed trip roster database that supports energy modeling. Each record represents a truck trip, including information on timestamps, locations, truck weight, payloads, market segments, and expansion weights. The expanded truck database was scaled to reflect projected growth for the years 2030, 2035, and 2040, using population and employment data from the Caltrans statewide model. This scaling process will provide key inputs for future energy modeling and energy needs assessments.

ENERGY MODELING

The Medium- and Heavy-Duty Electric Vehicle Infrastructure Load Operations and Deployment (HEVI-LOAD) model uses an agent-based simulation approach to model truck travel behavior, refueling patterns, and duty cycles of medium- and heavy-duty trucks. The model generates energy consumption, charging events, and load profiles for different truck market segments. By simulating the specific movements and energy needs of MHD ZEVs, the model provides insight into infrastructure requirements, including energy consumption by charging accessibility (public vs. private) and charger types.

ASSUMPTIONS

The HEVI-LOAD model was updated to include truck travel patterns in its charging framework, using forecasts for 2030, 2035, and 2040 aligned with the Caltrans statewide demand model and Additional Achievable Transportation Electrification Scenario 3 (AATE3) adoption projections, which predict significant EV growth but limited MD-HD hydrogen vehicle adoption due to high fuel prices. Three charging options were considered: private depot, public en-route, and public destination charging, focusing on public sites. A list of over 1,000 public charging sites in the SCAG region was developed. The base electrification scenarios follow AATE3 adoption targets, with additional scenarios assessing varying adoption rates and infrastructure needs, including hydrogen adoption. Energy modeling uses travel demand patterns to guide charging capacity utilization without limiting site capacity.

AGGREGATE SUMMARIES

The energy requirements for each forecast year are consistent with the AATE3 scenarios. Table ES-4 outlines the total energy demand by county for all years, while Table ES-5 shows the energy need and share of total demand for public charging sites shown in parentheses.

TABLE ES-3 HEVI-LOAD Modeling Scenarios

SCENARIO NAME	2030	2035	2040
Baseline	AATE3	AATE3	AATE3
Miss ZEV Goal	AATE3 (-10%)	AATE3 (-15%)	AATE3 (-10%)
Exceeds ZEV Goal	AATE3 (+5%)	AATE3 (+15%)	AATE3
Hydrogen	N/A	N/A	AATE3



TABLE ES-4 Total Energy (MW-h) Requirements by County – Horizon Years

COUNTIES	2030	2035	2040
Los Angeles	2,440	6,210	9,880
Riverside	1,190	2,200	3,610
San Bernardino	1,710	3,060	4,910
Orange	830	1,950	2,780
Ventura	340	640	1,180
Imperial	170	340	620
Total	6,680	14,400	22,980

TABLE ES-5 Public Charging Energy (MW-h) Requirements by County – Horizon Years

COUNTIES	2030		2035		2040	
Los Angeles	1,200	(49%)	3,500	(56%)	5,990	(61%)
Riverside	450	(38%)	960	(43%)	1,530	(42%)
San Bernardino	520	(30%)	1,460	(48%)	2,750	(56%)
Orange	240	(29%)	680	(35%)	1,220	(44%)
Ventura	200	(59%)	240	(38%)	610	(52%)
Imperial	70	(43%)	180	(53%)	280	(45%)
Total	2,680	(40%)	7,020	(49%)	12,370	(54%)



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SMOOTHING ENERGY OUTPUTS

The HEVI-LOAD simulation aligns with AATE3 energy requirements at a high level, but discrepancies arise at a granular level, such as inconsistent spikes in energy demand which overrepresent peak demand, significant variability in temporal profiles at adjacent sites, and not accounting for operational behavioral observation such as high energy costs during midday. To address this, outputs were post-processed to consider spatial, temporal, and operational factors, such as fleet behavior, site needs, and cost constraints. Energy demand from 1,000 public

charging sites was aggregated into 175 statewide zones, with adjustments for truck travel patterns, market segments, and time-of-day variations. Charging was capped at 35 percent of regional home market needs per hour and 20 percent for others. Excess demand from 6 a.m. to 6 p.m. was allocated to depot and regional-home trucks, while other market charging occurred throughout the day. Results were validated against truck movement patterns, with scenarios tested for site count, charger quantity, and grid capacity.

TABLE ES-6 Business Case for Post-Processing Energy Outputs

PERFORMANCE INDICATOR	MODEL OUTPUTS	BEHAVIORAL ADJUSTMENT TO BE DESIGNED
Energy Demand by Geography	We observe significant variability in energy demand and temporal profiles at adjacent sites—this is an expected outcome of simulation.	In real life, load balancing will occur (as in highway travel) and we expect somewhat consistent load profiles to show up in nearby sites.
Energy Demand by Time-of-Day	Does not account for electricity rates—charging occurs purely based on travel demand.	Over time, especially domiciled trucks, will charge during off-peak hours. Some business logic needs to be applied.
Peak Energy Demand	Unconstrained charging results in spiky peak hours thereby driving up peak capacity.	Significant unused capacity means sites are unlikely to be developed.
Site Sizing	Larger sites need more land and significant investment in utility upgrades.	Different combinations of number of chargers and charger capacity can provide more creative solutions to meet energy needs.



V. MODEL RESULTS

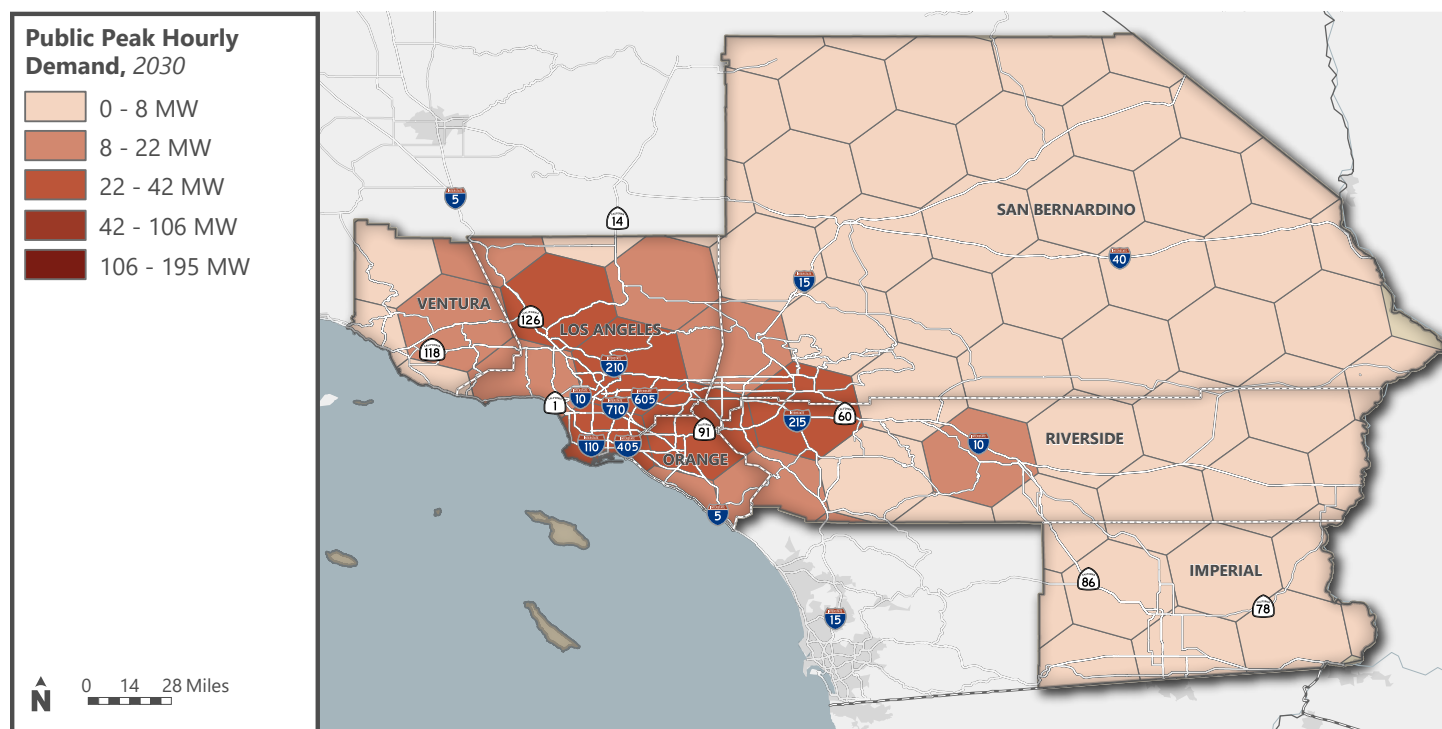
To understand where we need to build ZE truck infrastructure in the future, we need to understand where demand will be in the future. This section of the report focuses on those the modeling results and where we expect to see demand in future years. As discussed in the previous section, for EV charging we developed three forecast scenario years—2030, 2035, and 2040—which were coupled with different adoption rate scenarios to understand which areas within the SCAG region will need the most EV charging investment. For hydrogen fueling, only the 2040 forecast year was available, but it still provides the region and stakeholders with an understanding of where future demand will be, even without intermediate years to track incremental growth.

ELECTRIC VEHICLE CHARGING

The energy requirements are visualized using the H3 geospatial indexing system¹, with data aggregated at resolution 4 level, representing approximately a 15-mile radius. This classification was applied to 2030, 2035, and 2040 for the Southern California region. The larger hex bin approach allows for flexibility in assessing regional energy demand over time, supporting different configurations and addressing potential model limitations while enabling stakeholders to guide final site selection.

Key observations include identifying the highest short-term energy demand in 2030 and areas where demand will grow by 2040. This increase is driven by the Advanced Clean Fleets regulation, requiring more ZE trucks, and near-full adoption of ZEVs. The anticipated demand highlights the need for a robust network of charging facilities and sufficient energy capacity to support the transition to ZEVs, particularly in regions expecting significant growth by 2040. Figures ES-2, ES-3, and ES-4 illustrate the projected spatial distribution of public charging energy demand for 2030, 2035, and 2040. Section 5 of the report provides a county-level analysis for each of the horizon years.

FIGURE ES-1 Public Peak Hourly Demand for the SCAG Region in 2030



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FIGURE ES-3 Public Peak Hourly Demand for the SCAG Region in 2035

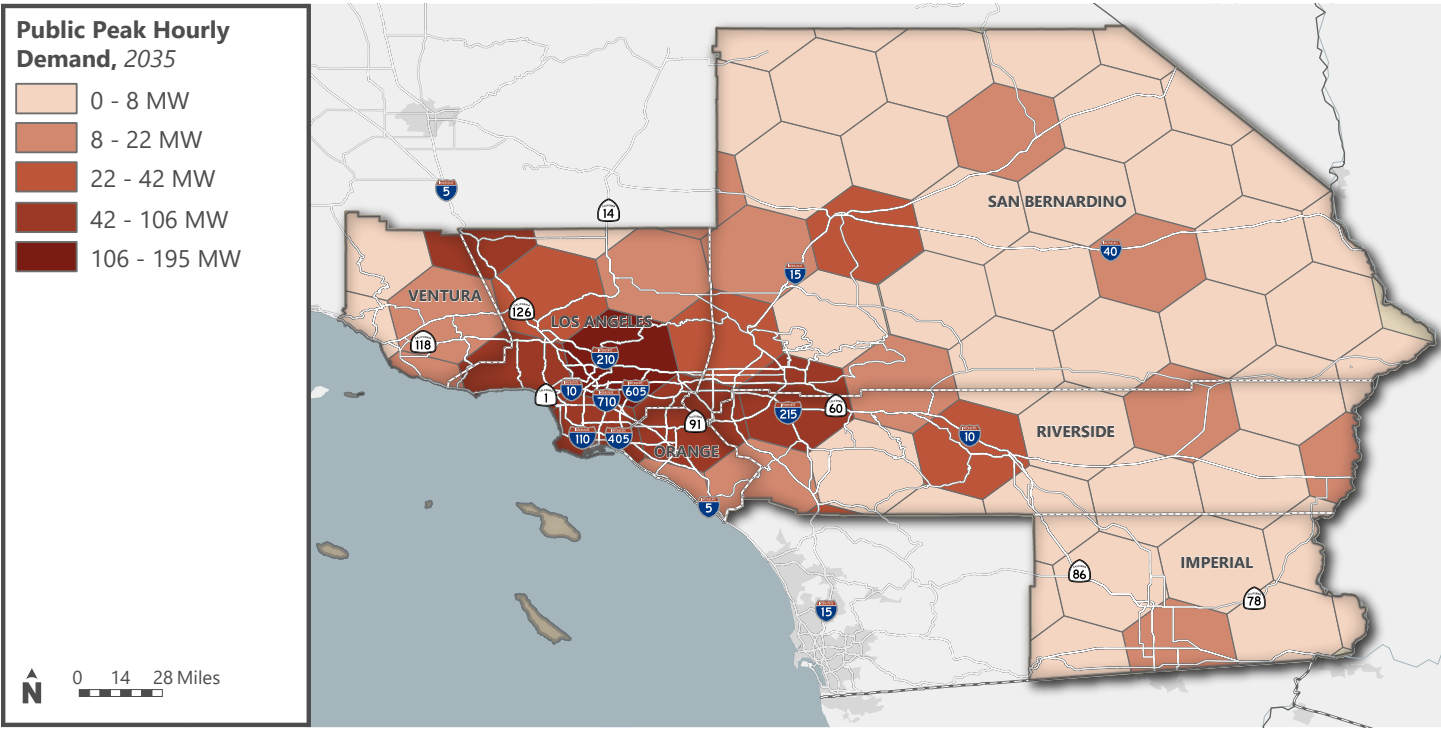


FIGURE ES-2 Public Peak Hourly Demand for the SCAG Region in 2040

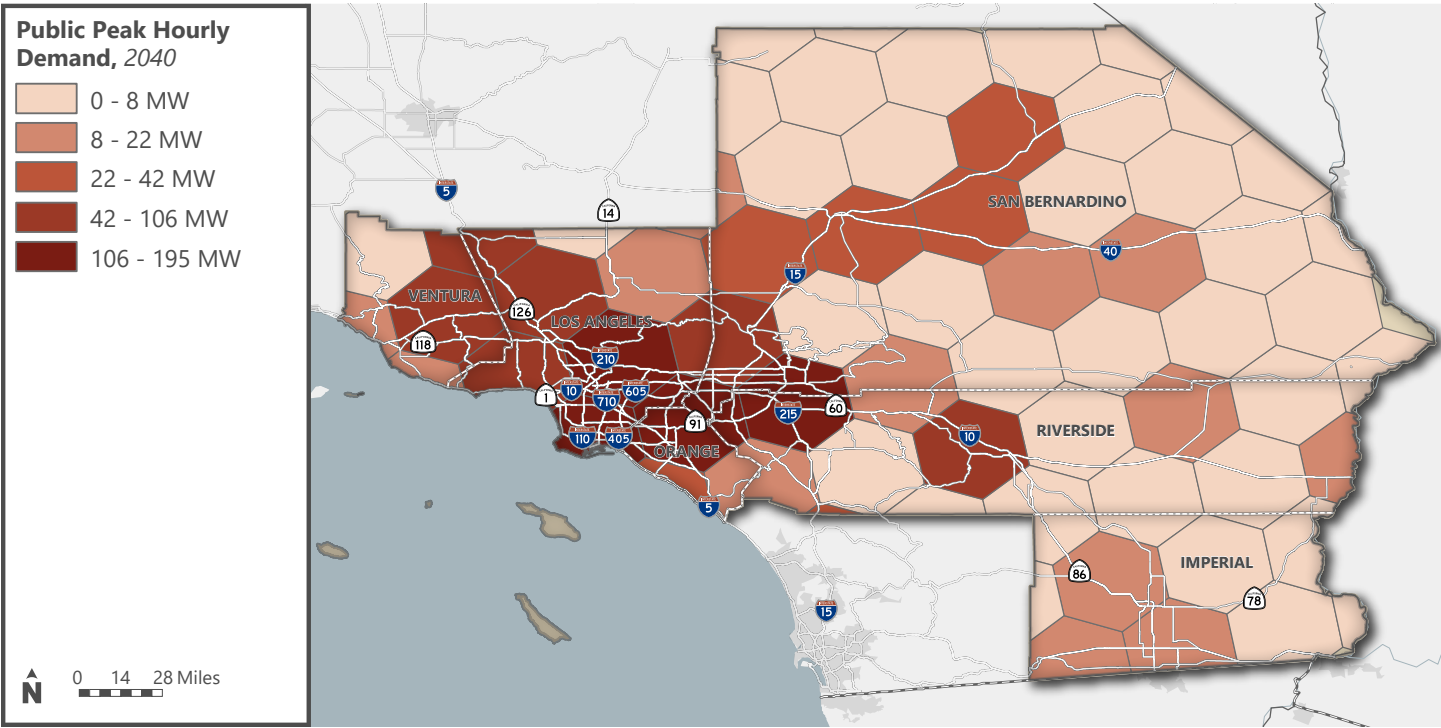




TABLE ES-7 Energy Demand at the County Level*

COUNTY	2030		2035		2040	
Los Angeles	2,380	(1,160)	5,800	(3,180)	8,900	(5,290)
San Bernardino	1,240	(440)	2,380	(1,330)	3,990	(2,460)
Riverside	1,120	(410)	2,390	(1,070)	3,850	(1,850)
Orange	770	(310)	1,610	(700)	2,630	(1,390)
Ventura	280	(160)	740	(350)	1,360	(790)
Imperial	110	(80)	220	(170)	490	(330)
Total (Public)	5,890	(2,560)	13,150	(6,790)	21,220	(12,110)

* Aggregated at the Hex 4 level. The numbers in parentheses represent the energy demand for public charging sites.

The SCAG region includes six counties: Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura. As shown in Table 5, Los Angeles County accounts for the largest share of energy demand, representing 40 percent of total demand and 45 percent of public demand. San Bernardino accounts for 21 percent of total demand and 17 percent of public demand, while Riverside follows with 19 percent of total demand and 16 percent of public demand. This reflects the concentration of warehousing facilities in Los Angeles and the Inland Empire.

Below is a summary of each county within the SCAG region, highlighting key locations that drive energy demand.

In Los Angeles County, key areas of high energy demand include the San Pedro Bay ports and East Los Angeles. The ports of Los Angeles and Long Beach, the largest container port complex in the United States, are surrounded by warehouses and distribution centers near major highways like I-710, I-405, I-110, and I-605. East Los Angeles, including Pomona, with BNSF and Union Pacific Intermodal facilities, serves as a crucial logistical hub connecting Los Angeles to the Inland Empire. High-demand areas along I-5 are essential for transporting agricultural and industrial goods to the Central Valley.

In San Bernardino County, energy demand will be high in Ontario, home to a major industrial base and Ontario International Airport, as well as in logistics hubs like Rancho Cucamonga, Fontana, and Rialto, which benefit from proximity to I-10 and I-15 highways.

Riverside County's energy demand will grow in Moreno Valley, with numerous industrial parks and logistics centers, especially with the proposed World Logistics Center. The city of Riverside, a warehousing and manufacturing hub, benefits from its access to I-215, I-10, and I-15. Indio, with its expanding retail and e-commerce sectors, is increasing energy demand in the Coachella Valley.

In Orange County, areas like Irvine, Anaheim, Santa Ana, and Garden Grove will experience high energy needs due to industrial and logistics centers and proximity to rail lines. In Ventura County, the demand is focused in the eastern portion, particularly around Simi Valley, Thousand Oaks, and Moorpark, with access to I-5 and U.S. 101. The Oxnard Industrial Cluster, near the Port of Hueneme, is a major trade hub for automobiles and agriculture. Imperial County has the lowest energy demand but is poised for growth due to its strategic location near San Diego and the U.S.-Mexico border with access to I-8.

Energy demand in the SCAG region is primarily driven by heavy-duty trucks (HDTs), particularly the Long Haul HDTs segment, which consumes the most energy in most areas. Regional Non-Home HDTs are the next largest contributors. Drayage trucks, like those in the San Pedro Bay ports area, account for a smaller share, while medium-duty trucks (MDTs), especially Regional Non-Home MDTs, typically make up a smaller portion of the total energy demand.

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ENERGY MODELING TO INFRASTRUCTURE

Energy modeling calculates both peak hour energy demand and total energy requirements, which are essential for determining charger capacity and site specifications. Peak hourly demand influences the necessary charger capacity and overall site requirements. Utilization is assessed by comparing charger capacity to hourly energy demands. To estimate site sizes, the number of chargers, required infrastructure, and site typologies were developed: small sites accommodate up to 10 chargers, medium sites host 25, and large sites include 40 chargers.

Site and charger selection is not solely based on energy needs but also on location within the SCAG region. For example, a large site in downtown Los Angeles may be impractical due to space constraints. While higher-capacity chargers may strain the grid in dense areas, they can save space by reducing the need for multiple lower-capacity chargers. To address this, the project team created a site selection and EV charger mix approach that accounts for area density, scaling site and charger development accordingly. These guidelines are regional, but they can be adjusted to meet specific community needs, with the size, number of chargers, and power levels tailored to each location.

HYDROGEN FUELING

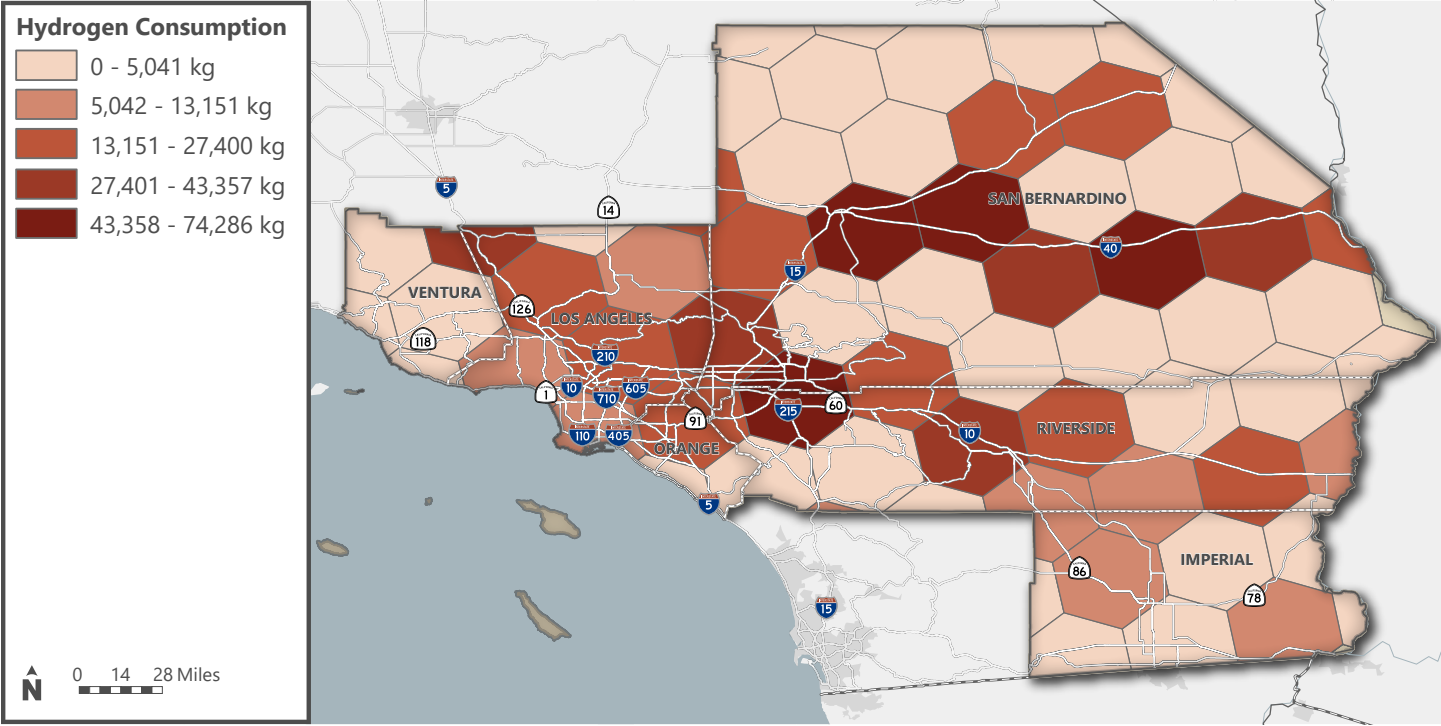
Over the next decade, hydrogen fuel demand in Southern California is projected to rise as the region's hydrogen fuel infrastructure expands. The projects from the AATE3 scenario for hydrogen fuel consumption are based on a full transition to hydrogen in 2040, rather than a future scenario of mixed ZE trucks. As such, no battery electric trucks are simulated in the hydrogen fueling scenario for 2040. The state has yet to develop a mixed scenario to model a potential future with both EV and hydrogen-fueled trucks. As this infrastructure develops, the demand for hydrogen is expected to continue growing. Table 6 outlines hydrogen fuel consumption by county. Unlike energy requirements for ZEVs, hydrogen fuel consumption in 2040 is highest in San Bernardino and Riverside counties, followed by Los Angeles County. San Bernardino County alone accounts for over half of the projected hydrogen fuel consumption, while Riverside County accounts for 21 percent and Los Angeles County accounts for 14 percent. Across the region, hydrogen fuel demand is concentrated along major interstates, particularly I-10, I-15, and I-40, where freight and long haul HDTs are key contributors to consumption.

TABLE ES-8 Total Hydrogen Fuel Consumption in 2040 by County

COUNTY	TOTAL H2 FUEL CONSUMPTION (KG)	EQUIVALENT EV ENERGY CONSUMPTION (KW-H)
Imperial	29,370	978,896
Los Angeles	104,663	3,488,405
Orange	16,811	560,323
Riverside	160,339	5,344,099
San Bernardino	415,560	13,850,625
Ventura	13,452	448,339
Total	740,195	24,670,686



FIGURE ES-4 Hydrogen Fuel Consumption for the SCAG Region in 2040



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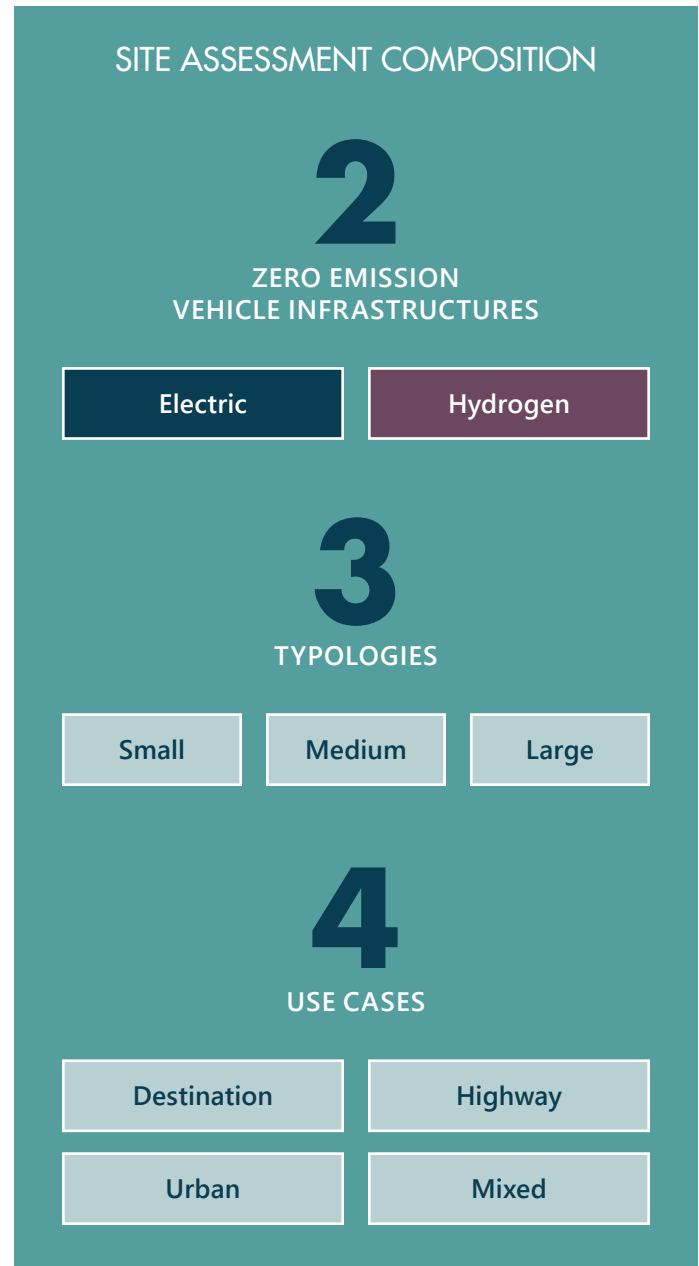
VI. SITE ASSESSMENTS AND SITE PRIORITIZATION TOOL

SITE ASSESSMENTS

As part of the SCAG ZETI study, 24 sites are assessed as potential locations for EV charging and hydrogen fueling stations. These sites serve as examples of use cases that provide planners and developers with key insights into the infrastructure needs for medium- and heavy-duty vehicles. The assessments also include important information that can be used to secure grants and incentives for infrastructure development. The assessments offer a range of location examples for ZEV infrastructure deployment across the region. The full report has 24 sites assessments representing the two types of zero emissions technologies, the three size typologies developed for the study (small, medium, and large) and the four use cases: highway refueling, destination refueling stations, urban refueling facilities, and mixed-use. The chart to the right illustrates the typologies and use cases, the full report has detailed definitions for all of the typology size and use case.

Each site for charging or hydrogen refueling infrastructure is evaluated based on 15 criteria developed with the SCAG ZETI TAC. These criteria help assess the site's suitability for supporting ZEV operations. Key factors include:

1. **ZEV Energy Demand:** Estimation of energy needs based on truck movements in the site's vicinity.
2. **Daily Mileage:** Distribution of vehicle distances to assess demand for refueling or recharging.
3. **Existing Truck Parking:** Presence of existing parking, which simplifies site development.
4. **Scalability:** Site's potential to expand infrastructure for future demand.
5. **Land Price:** Cost of land, influencing the feasibility of development.
6. **Amenities:** Availability of services like restaurants and fuel stops to enhance site appeal.
7. **Access, Congestion, Safety:** Site's proximity to highways and ease of access for trucks.
8. **Proximity to Existing Infrastructure:** Distance from other ZEV facilities, with more distant sites scoring higher.
9. **Load Capacity:** Ability to handle the electrical load for charging.
10. **DER Integration:** Potential to incorporate renewable energy sources like solar or wind.



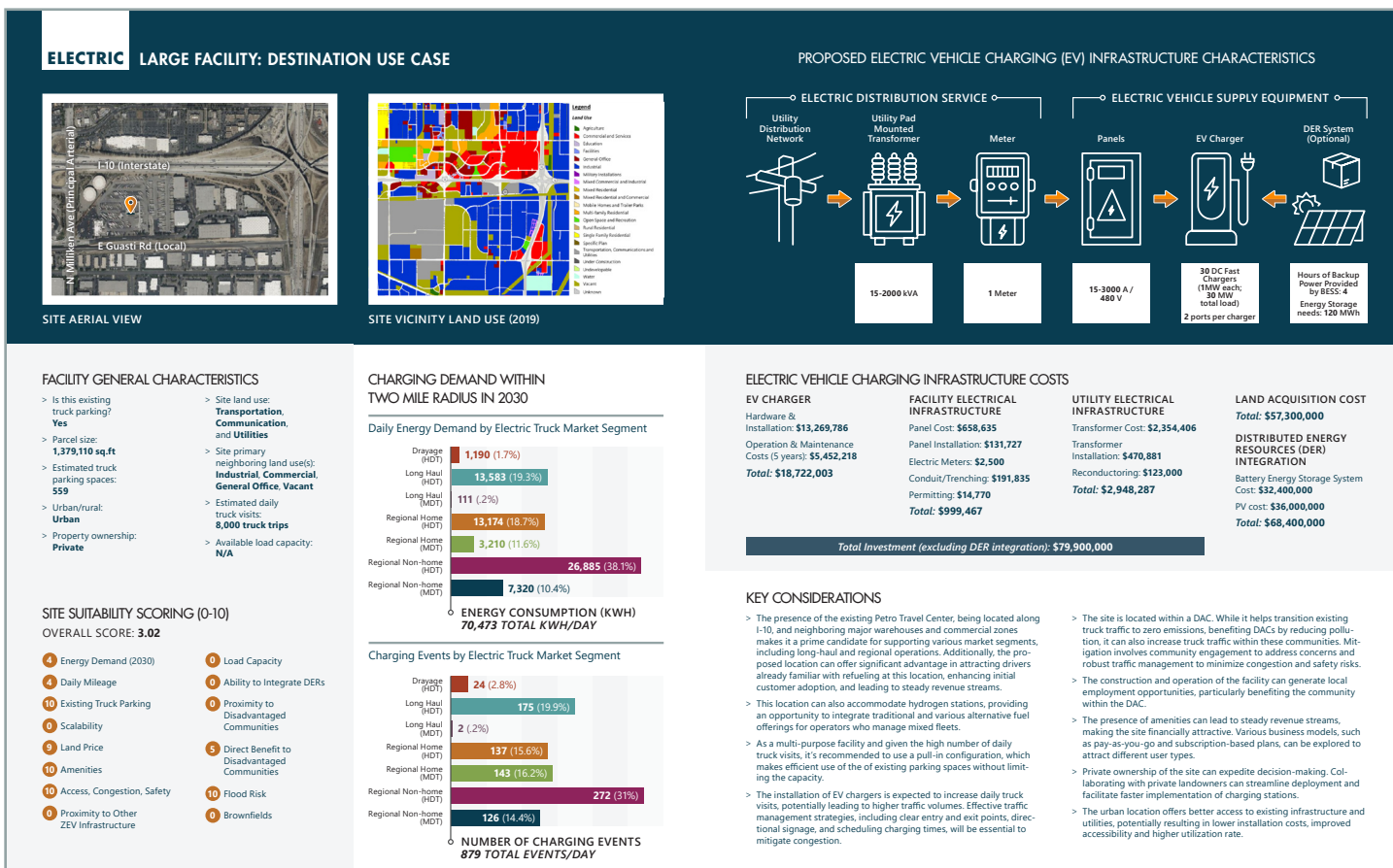
11. **Proximity to Disadvantaged Communities (DACs):** Site location relative to DACs to ensure equitable access to clean transportation.
12. **Direct Benefits to DACs:** Impact on nearby disadvantaged communities, improving air quality and economic opportunities.
13. **Flood Risk:** Potential flood exposure affecting infrastructure resilience.
14. **Brownfield Status:** Consideration of environmental and regulatory challenges if the site is a brownfield.
15. **Proximity to Hydrogen Supply Chain:** Distance to the nearest hydrogen supply chain critical for hydrogen refueling infrastructure.

Each site assessment provides estimates of energy demand and the number of charging events within a two-mile radius, based on the HEVI-LOAD model. This analysis

predicts the frequency of charging for various electric truck market segments, offering insights into truck types, use cases, and duty cycles expected to visit the site. These findings inform the site's design, including the selection of charger configurations. For example, pull-through configurations are ideal for large, long-haul trucks, allowing for easy entry and exit, while pull-in/back-out setups are better for sites with limited space, such as urban locations or distribution centers, where trucks are parked longer during loading or unloading.

Site assessments provide an overview of the EV charging and hydrogen fueling infrastructure requirements, including recommendations for the number of chargers and their power levels, based on parking capacity, use case, and aerial inspections. The analysis covers both utility-side and facility-side electrical infrastructure, with detailed cost estimates for chargers, transformers,

FIGURE ES-5 Example Site Assessment



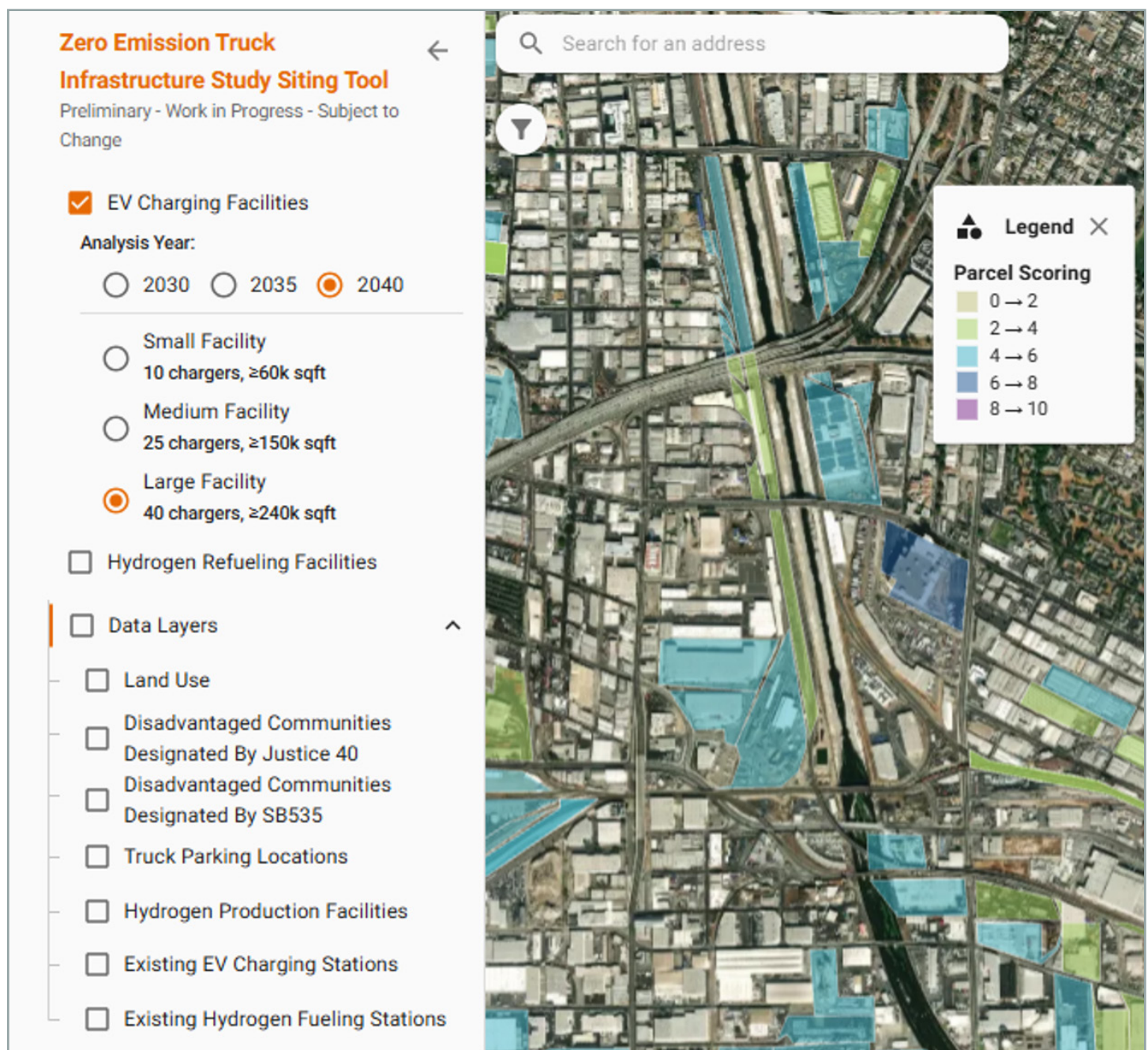
EXECUTIVE SUMMARY

electrical panels, wiring, meters, and other components. Additionally, it includes estimates for distributed energy resources like battery storage and solar systems to improve the resilience and sustainability of the infrastructure. Figure 7 provides an example of a site assessment for a large mixed-use electric facility.

SITE PRIORITIZATION TOOL

The Site Prioritization Tool was developed to assist in the strategic planning and deployment of ZEV infrastructure, including EV charging stations and hydrogen refueling sites, across Southern California. Its primary objective

FIGURE ES-6 Example of Site Prioritization Tool - Parcel Scoring





is to provide actionable insights for the near-term implementation of ZEV infrastructure while supporting agencies in securing state and federal grants. By identifying optimal locations for ZEV infrastructure, the tool aims to enhance grant success and help guide developers and agencies in line with the SCAG ZETI blueprint.

While highly effective for identifying potential ZEV infrastructure sites, the tool should be used alongside other planning and regulatory frameworks. It provides a high-level analysis and scoring of parcels based on currently available data and projections up to 2040. However, it does not account for granular factors such as site-specific infrastructure costs, local policies, or permitting processes. As such, local governments and developers must conduct detailed feasibility studies, including site visits and technical evaluations, to confirm the suitability of sites.

TOOL DEVELOPMENT AND APPROACH

The tool was developed with input from local agencies, private developers, and stakeholders, including the ZETI TAC, to ensure relevant and effective metrics. The siting criteria used for the tool are categorized into five broad groups: utilization, land, equity, grid capacity, and environmental conditions, with data sourced through a comprehensive literature review and stakeholder feedback.

Using geographic information systems and a Multi-Criteria Decision Analysis (MCDA) framework, the tool evaluates parcels within the SCAG region. Each parcel is scored from 0 to 10 based on how well it meets specific siting criteria, with higher scores reflecting ideal conditions. These criteria are divided into continuous, categorical, and exclusionary types, allowing for a nuanced analysis of potential ZEV infrastructure sites.

The Site Prioritization Tool serves as a valuable resource for strategic decision-making, helping to identify the most suitable sites for ZEV infrastructure deployment while complementing more detailed local assessments.

PRIORITIZATION METHODOLOGY

The prioritization methodology for selecting parcels for ZEV infrastructure follows a four-step process:

1. **Initial Screening:** Excludes parcels that don't meet basic requirements, such as land size or appropriate land use, ensuring only suitable sites proceed.
2. **Scoring Criteria:** Remaining parcels are scored from 0 to 10 based on specific subcriteria for each group, following a predefined methodology.
3. **Assigning Weights:** Subcriteria are weighted based on stakeholder input, with the option for users to adjust the weights according to their preferences.
4. **Calculating Scores:** Scores for each criterion are multiplied by their respective weights and summed to generate an overall suitability score for each parcel.

This method ensures a systematic, transparent evaluation for identifying optimal ZEV infrastructure locations.



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VII. NEXT STEPS

The SCAG ZETI study serves as a tool for public agencies, utilities, the private sector, and stakeholders to understand the challenges and future needs for zero emission freight infrastructure, helping to meet state regulations and goals. Achieving these goals requires a collaborative and coordinated effort across all sectors to create a cleaner, more sustainable future.

The transition to ZE freight faces significant funding challenges, including high costs for trucks, charging infrastructure, and land acquisition. Addressing these challenges involves collaborating with SCAG and other agencies on grant opportunities, exploring low-cost lease agreements with private operators, and fostering public-private partnerships for ZE site development. Aligning electric infrastructure with freight needs, utilizing existing truck parking sites for infrastructure, and coordinating hydrogen pipeline development are essential steps. Finally, equity in site selection is a major concern, with an emphasis on engaging disadvantaged communities early in the planning process and incorporating local hire programs and safety measures.

The full report provides a series of recommendations that can help mitigate these challenges and help move ZE infrastructure forward. The SCAG ZETI study is just part of the effort SCAG is investing into ZE and regional freight planning. SCAG looks to play a significant role in supporting its regional partners during the ZE transition and facilitating the installation of charging and fueling sites. SCAG has invested heavily in building tools, datasets, and information to support those seeking to develop sites and hopes to be a valuable resource in coordinating efforts to secure regional funding. Together, as a region, a clean and equitable ZE freight future can be developed, benefiting both local communities and the industry moving forward.

EXECUTIVE SUMMARY ENDNOTES

i Hex Bin Geospatial indexing system. <https://h3geo.org/docs>



1. INTRODUCTION

The Southern California Association of Governments (SCAG) led the Zero Emission Truck Infrastructure (ZETI) Study to develop strategies and recommendations for a network of public charging and fueling stations for zero emission (ZE) trucks throughout the region that will also support statewide efforts to transition medium- and heavy-duty trucks to alternative fueling technologies. The study included a phased approach to recommendations for station deployment and how the infrastructure could meet the operational needs of various truck markets. A Technical Advisory Committee (TAC), consisting of stakeholders from the public and private sectors, provided input throughout the study, help provide a holistic view of the ZE landscape.

The ZETI Study developed tools and scenarios to help quantified the potential number, locations, and features of charging and fueling stations required to support ZE trucks going into the future. This information contributed to regional planning and supported related efforts, and will be incorporated into the Electric Truck Research and Utilization Center (eTRUC) Project, funded by the California Energy Commission's (CEC) Research Hub for Electric Technologies in Truck Applications (RHETTA) Program.

SCOPE OF THE STUDY

The ZETI Study examined regional and site-specific infrastructure needs to support ZE truck operations. At a regional scale, the study conducted a truck travel analysis to estimate demand using a truck simulation model, which was paired with an energy demand model to provide a more detailed understanding of energy demand across the trucking fleet's conversion to ZE equipment. This approach considered how different truck markets and operational needs would shape charging and fueling requirements, as well as how the transition to zero emission technologies might evolve over time. A hydrogen fuel cell scenario focused on potential hydrogen demand in 2040 that aligns with the state's projections for adoption. At a site-specific level, up to 24 locations were selected for detailed evaluation of deployment needs, including site features, cost information, and key considerations.

Key components of the study include a regional plan for charging and fueling infrastructure based on a comprehensive needs assessment, mapping proposed station locations in phases, and reviewing public and private site development and capital expenditure plans. The study also involved detailed outreach with industry stakeholders such as truck drivers, fleet operators, warehouse operators, real estate developers, and community organizations to align the infrastructure recommendations with operational and community needs, as well as to understand the existing and potential challenges.





TECHNOLOGY ASSESSMENT

The study focused on battery electric and hydrogen fuel cell truck technologies, exploring their infrastructure requirements and how they could be integrated into a regional network. The study identified how different approaches to infrastructure deployment could support diverse operational models and achieve regional zero emission goals. The study also outlined how different technologies could complement each other to address varying operational needs, such as how battery electric trucks are suitable for shorter routes with predictable daily operations like drayage or hub-and-spoke delivery, while hydrogen fuel cell trucks offer longer ranges and potentially faster refueling, making them more appropriate for interregional and long-haul applications. The infrastructure recommendations reflected this mix of technologies and operational needs.

SCENARIO PLANNING AND STAKEHOLDER ENGAGEMENT

The ZETI Study developed future year energy demand scenarios (2030, 2035, 2040) to assess charging and fueling infrastructure needs as they evolve over time. This change over time will help to understand where investment needs to be targeted and when. This approach allowed for incremental progress while addressing immediate needs and planning for future demand. The study mapped potential station locations across the region, identifying areas where infrastructure deployment can support the expected truck movements.

Stakeholder engagement was a central part of the study, with input gathered from truck operators, fleet managers, warehouse operators, public agencies, ports, and other stakeholders. Their insights helped refine the infrastructure recommendations and align them with real-world operations. The study also engaged with organizations to address potential concerns and incorporate public and private perspectives into the planning process. Additional details of their feedback is captured within the report.

SUPPORTING STATEWIDE AND REGIONAL EFFORTS

The ZETI Study will support both regional and statewide efforts to transition to zero emission truck operations. Its findings will provide insights into infrastructure requirements and informed investment decisions that will contribute to broader goals for reducing emissions from goods movement. The study's findings will be directly incorporated into the statewide eTRUC Project, providing data and recommendations to align regional and statewide programs.

The study's overall strategies and recommendations, modeling scenarios, and stakeholder engagement efforts offered a foundation for advancing zero emission transportation infrastructure. By addressing regional needs and contributing to statewide strategies, the ZETI Study provides a framework for expanding ZE truck charging and fueling networks across California.

2. LITERATURE REVIEW

POLICIES AND REGULATIONS

Medium- and heavy-duty vehicles (MD-HD) significantly contribute to air quality issues in Southern California. In response, state and local governments have set ambitious goals to reduce greenhouse gas emissions and promote zero emission vehicles (ZEVs).

In September 2020, Governor Gavin Newsom announced targets for achieving 100 percent zero emission MD-HD trucks by 2045, with drayage trucks targeted for 2035. The California Air Resources Board (CARB) has introduced regulations that require a growing percentage of MD-HD trucks sold in California to be zero emission by 2035 and mandated all MD-HD vehicles sold by 2036 to be zero emission. Additionally, public transit agencies are required to transition to zero emission buses by 2035.

To support these goals, significant infrastructure improvements are necessary. California estimates it will need 157,000 additional chargers by 2030.¹ State legislation, including AB 1236, aims to streamline permitting for electric vehicle (EV) infrastructure, while local initiatives within the SCAG region further enhance the deployment of charging and fueling infrastructure.

On the federal level, the National Zero Emission Freight Corridor Strategy, introduced in March 2024, seeks to improve access to EV charging and hydrogen refueling along freight corridors, focusing on creating infrastructure around major ports from 2024 to 2040.² Table 1 provides a summary of statewide and local ZE MD-HD policies, regulations, planning efforts, and legislative actions.

TABLE 1 A summary of statewide and local ZE MD-HD policies, regulations, planning and legislative efforts.

POLICY, PROGRAM, AND PLAN	YEAR	DESCRIPTION	STATE OR LOCAL
California Executive Order No. N-79-20	2020	Governor Newsom’s Executive Order that requires all new sales of passenger vehicles be zero emission (ZE) by 2035 and 100 percent ZE MD-HD vehicles in the State by 2045 for all operations where feasible	State
Innovative Clean Transit ³	2018	Requires transit agencies to transition to ZE bus fleet	State
Zero Emission Airport Shuttle ⁴	2019	Requires airport shuttle operators to transition to ZEV technologies by the end of 2035	State
Advanced Clean Truck ⁵	2020	Requires manufacturers to make a percentage of Class 2b - 8 truck and bus sales ZE	State
Advanced Clean Fleets ⁶	Expected 2023	Requires drayage, public, and high priority fleets with Class 2b - 8 trucks to accelerate transition to ZE	State
Zero Emission Truck Measure	Expected 2028	Requires fleets to replace combustion engine trucks not impacted by the ACT or ACF regulations with new or used ZEVs	State
California Freight Mobility Plan ⁷	2020	Governs the immediate and long-range planning activities and capital investments by the state with respect to freight movement	State
2022 Scoping Plan ⁸	2022	Lays out a path to achieve targets for carbon neutrality and reduce anthropogenic greenhouse gas (GHG) emissions by 85% below 1990 levels no later than 2045	State
2022 State Strategy for the State Implementation Plan ⁹	2022	Includes measures and commitments to reduce emissions from State-regulated sources to support attainment of the 70 parts-per-billion standard in all nonattainment areas across California	Both
Assembly Bill 8	2013	Assembly Bill 8 directs CARB and the California Energy Commission to evaluate hydrogen fueling station development and operation against a standard of financial self-sufficiency.	State

POLICY, PROGRAM, AND PLAN	YEAR	DESCRIPTION	STATE OR LOCAL
Assembly Bill 1236 ¹⁰	2015	Requires all California cities and counties to develop an expedited, streamlined permitting process for electric vehicle charging equipment	State
Assembly Bill 2127 ¹¹	2018	Requires the California Energy Commission to biennially assess the electric vehicle charging infrastructure needed to meet the state's goals of putting at least 5 million zero emission vehicles on California roads by 2030 and reducing greenhouse gas emissions to 40% below 1990 levels by 2030	State
Assembly Bill 1100 ¹²	2019	Mandates that parking spaces equipped for EV charging or designated for future EV charging count toward minimum parking requirements, with accessible spaces counting as two standard spaces.	State
Assembly Bill 841 ¹³	2020	Requires the California Public Utilities Commission to direct electrical corporations to file applications for programs and investments to accelerate widespread transportation electrification to reduce dependence on petroleum	State
Assembly Bill 970 ¹⁴	2021	This bill establishes timelines for approving applications to install electric vehicle charging stations and requires cities and counties to reduce parking space requirements to accommodate the stations, while maintaining local utility responsibilities for safety and service provision.	State
Assembly Bill 2061 ¹⁵	2022	This bill requires the Energy Commission, in consultation with the Public Utilities Commission, to develop uptime recordkeeping and reporting standards for electric vehicle chargers and charging stations by January 1, 2024. It requires the PUC to assess the 'uptime performance' (operational and used) of charging infrastructure funded by the PUC's ratepayer funded rebates.	State
Assembly Bill 98 ¹⁶	2024	This bill sets statewide standards for new or expanded logistics developments, including building design, parking, truck routes, and air quality monitoring, and requires cities to update their circulation plans for truck routes and signage by 2028, while also ensuring community input and addressing potential air pollution impacts in the South Coast Air Quality Management District.	State
CPUC Transportation Electrification Program	2022	The California Public Utilities Commission (CPUC) adopted the Transportation Electrification Program. The program offers rebates for EV infrastructure investments at commercial, industrial, and residential sites beginning in 2025, 70% of funds go toward charging for medium- and heavy-duty vehicles.	State
Senate Bill 671 ¹⁷	2021	Requires the California Transportation Commission to prepare a Clean Freight Corridor Efficiency Assessment to identify freight corridors, or segments of corridors, and the infrastructure needed to support the deployment of MD-HD ZEVs	State
Senate Bill 1000 ¹⁸	2018	Updates zoning and regulation in regards to electric vehicle charging infrastructure. It requires the Public Utilities Commission to adopt a tariff specific to heavy-duty electric vehicles or electric trucks and buses to encourage the use of charging stations when there is excess grid capacity.	State
Senate Bill 676 ¹⁹	2019	Requires the PUC to explore strategies and quantifiable metrics to maximize the use of feasible and cost-effective electric vehicle grid integration by January 1, 2030. It requires any electric provider over 700 gigawatt hours of annual demand to consider establishing electric vehicle grid integration strategies.	State
LA Zero Emission 2028 Roadmap ²⁰	2019	Outlines visions and actions to accelerate the deployment of ZE electric cars, buses and trucks across the Los Angeles region	Local
2022 South Coast Air Quality Management Plan ²¹	2022	Presents regional blueprint for achieving air quality standards and healthful air and a comprehensive analysis of emissions, meteorology, regional air quality modeling, regional growth projections, and the impact of control measures.	Local
South Coast AQMD Warehouse Actions and Investments to Reduce Emissions Program ²²	2021	Requires warehouses greater than 100,000 square feet to directly reduce NOx and DPM emissions, or to otherwise reduce emissions and exposure of these pollutants in nearby communities	Local
San Pedro Bay Clean Truck Fund Rate ²³	2022	Generates funds to accelerate the deployment of clean trucks, in support of achieving the goal of a ZE drayage truck fleet by 2035	Local

EXISTING FUNDING AND INCENTIVE PROGRAMS

California's ZE regulations prioritize vehicle adoption, making incentive programs essential for developing charging and fueling infrastructure that will support their operation. Table 2 presents various funding opportunities and incentives at the federal, state, and local levels that promote zero emissions initiatives, include some targeted for MD-HD ZEVs and infrastructure deployment in Southern California.

State agencies like CARB and the California Energy Commission offer programs to encourage the purchase of zero emission trucks and buses, replace older diesel vehicles, and establish ZE infrastructure. Additionally, SCAG provides local incentives through the Last Mile Freight Program that complement federal and state initiatives overseen by the South Coast Air Quality Management District (AQMD).

At the federal level, funding is available through the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act/Bipartisan Infrastructure Law (IIJA/BIL). In 2022, the U.S. Department of Energy (DOE) and the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) announced a landmark agreement valued at \$12.6 billion. This includes up to \$1.2 billion in federal funding and \$11.4 billion in matching investments aimed at advancing the California Hydrogen Hub, which is vital to the state's clean energy strategy.²⁴

To ensure the sustainability of these investments, it is crucial to diversify funding sources beyond state and federal support. The current political climate and available resources for infrastructure projects may not be permanent. Expanding revenue streams will help secure the necessary funding for future infrastructure development.

TABLE 2 A summary of available funding and incentive programs across Southern California at federal, State, and local levels.

PROGRAM	MD-HD CHARGING AND HYDROGEN FUELING INFRASTRUCTURE ELIGIBLE	FEDERAL, STATE OR LOCAL
Clean Transportation Program ²⁵	Yes	State
Hybrid and Zero Emission Truck and Bus Voucher Project ²⁶	Yes	State
Carl Moyer Program ²⁷	Yes	State
Carl Moyer Voucher Incentive Program	No	State
AB 617 Community Air Protection Incentives ²⁸	Yes	State and Local
Volkswagen Environmental Mitigation Trust for California ²⁹	No	State
Truck Loan Assistance Program ³⁰	No	State
Energy Infrastructure Incentives for Zero Emission Commercial Vehicles ³¹	Yes	State
Low Carbon Fuel Standard ³²	Yes	State
Commercial Electric Vehicle and Fuel Cell Electric Vehicle Tax Credit ³³	No	Federal
Alternative Fuel Infrastructure Tax Credit ³⁴	Yes	Federal
National Electric Vehicle Infrastructure Formula Grant ³⁵	No	Federal
Charging and Feuling Infrastructure	Yes	Federal
Diesel Emissions Reductions Act	Yes	Federal
Regional Clean Hydrogen Fuel Hubs	Yes	Federal
Charge Ready Transport Program ³⁶	Yes	Local
Los Angeles Department of Water & Power Commercial EV Charging Station Rebate Program ³⁷	Yes	Local
I-710 Clean Truck Program ³⁸	Yes	Local
Joint Electric Truck Scaling Initiative ³⁹	Yes	Local
Regional Clean Hydrogen Hubs ⁴⁰	Yes	Federal

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3. OUTREACH AND ENGAGEMENT

To achieve the goal for the SCAG ZETI Study, an extensive outreach process was undertaken. The project team engaged a wide variety of people and agencies involved in the movement of freight within the SCAG region and throughout California. This includes but is not limited to fleet owners, warehouse operators, real estate developers, original equipment manufacturers (OEMs), community groups, public sector stakeholders, such as Los Angeles County Metropolitan Transportation Authority (LA Metro), Caltrans, South Coast Air Quality Management District (SCAQMD), and quasi-public sector stakeholders such as ports and utility companies. A variety of outreach methods were used, including a truck fleet survey to understand operators' perspective and familiarity with zero emissions programs and the current status of the transition. Focus groups were gathered to understand how sites impact local agencies and communities, and one-on-one interviews with freight industry experts to understand their perspective and insight on the ZEV transition. Throughout the effort, the study team worked to ensure that respondents were candid about the issues and challenges they face. In addition to this direct engagement of stakeholders, the project's Technical Advisory Committee (TAC) helped provide perspective and guidance throughout the project.

INDUSTRY SURVEY

The industry survey aimed to analyze the operations of Southern California fleets, focusing on their awareness of ZEV regulations and incentives, their transition plans to ZEVs, and their public charging infrastructure needs. To capture insights from fleet operators of varying sizes, the survey team utilized databases such as InfoUSA, ZoomInfo, and the California Vehicle Inventory and Use Survey (CA-VIUS), alongside information from SCAG and local ports. The survey was conducted by phone and achieved a 4.5 percent response rate, with 103 firms participating over six weeks, aided by incentives to encourage more fleet managers to respond. A wide variety of trucking operators participated in the survey, helping capture a well rounded perspective.

The findings provided valuable insights that will inform recommendations for transitioning to ZEVs. The top three barriers identified were range limitations, vehicle acquisition costs, and grid readiness. Small fleets (1-4 trucks) expressed significant concern over insufficient public fueling and charging infrastructure. In contrast, larger fleets demonstrated more proactive planning for the transition, while many smaller fleets (fewer than 50

HOW WE ENGAGED



TAC STAKEHOLDER MEETINGS



SURVEYS OF TRUCKING PROFESSIONALS



INTERVIEWS OF PUBLIC AND PRIVATE STAKEHOLDERS



FOCUS GROUPS OF PUBLIC AND PRIVATE STAKEHOLDERS

trucks) had not yet initiated preparations. Smaller fleets with fewer than 20 trucks were less informed about federal and state incentives. These insights help shape the blueprint for implementation ZEV and play an important role in recommends for incentive programs, technical assistance, and prioritization would be structured to benefit smaller fleets who are less resourced to make the transition to ZEVs.

Of the industry stakeholders surveyed, approximately 86 percent had fleet size with fewer than fifty vehicles. This generally mirrors national industry figures, with a majority of trucking companies operating a small fleet.

In Southern California, while there are a lot of small companies and owner-operators, there are also major companies that operate large fleets. These fleets account for a high number of trucks and having them transition to ZE trucks would signify major progress. While incentives for small fleets is important, working with large operators that can transition large fleets can also help accelerate the region's transition to ZE trucks. Over half of respondents were in the transportation and warehousing industry, while approximately 17 percent were in construction. Figures 1 and 2 provide a breakdown of the participants by fleet size and industry.

FIGURE 1 How many Class 3+ trucks (10,000 or more lbs.) are operating out of this location?

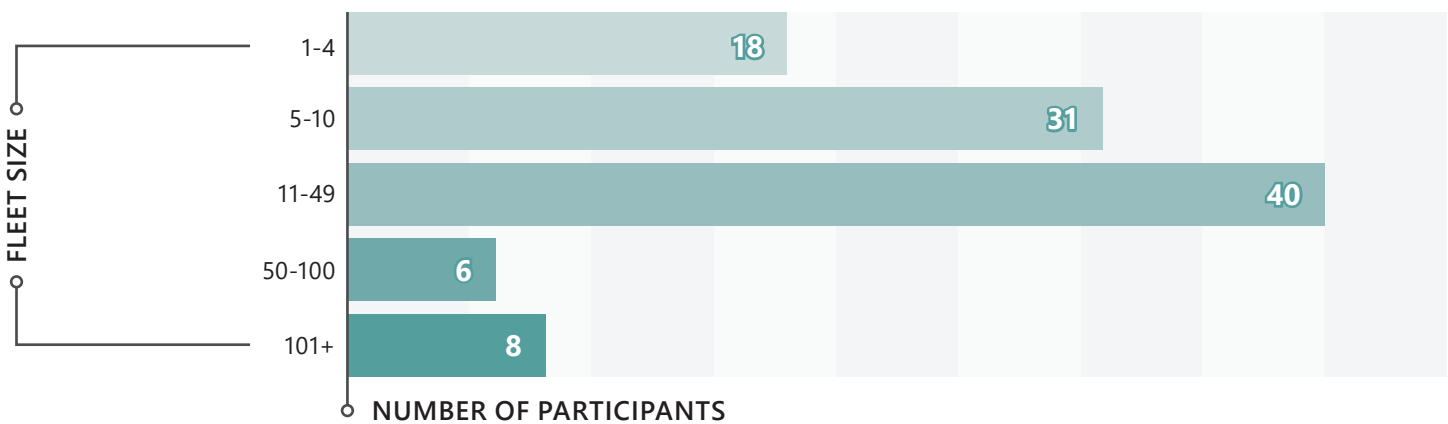
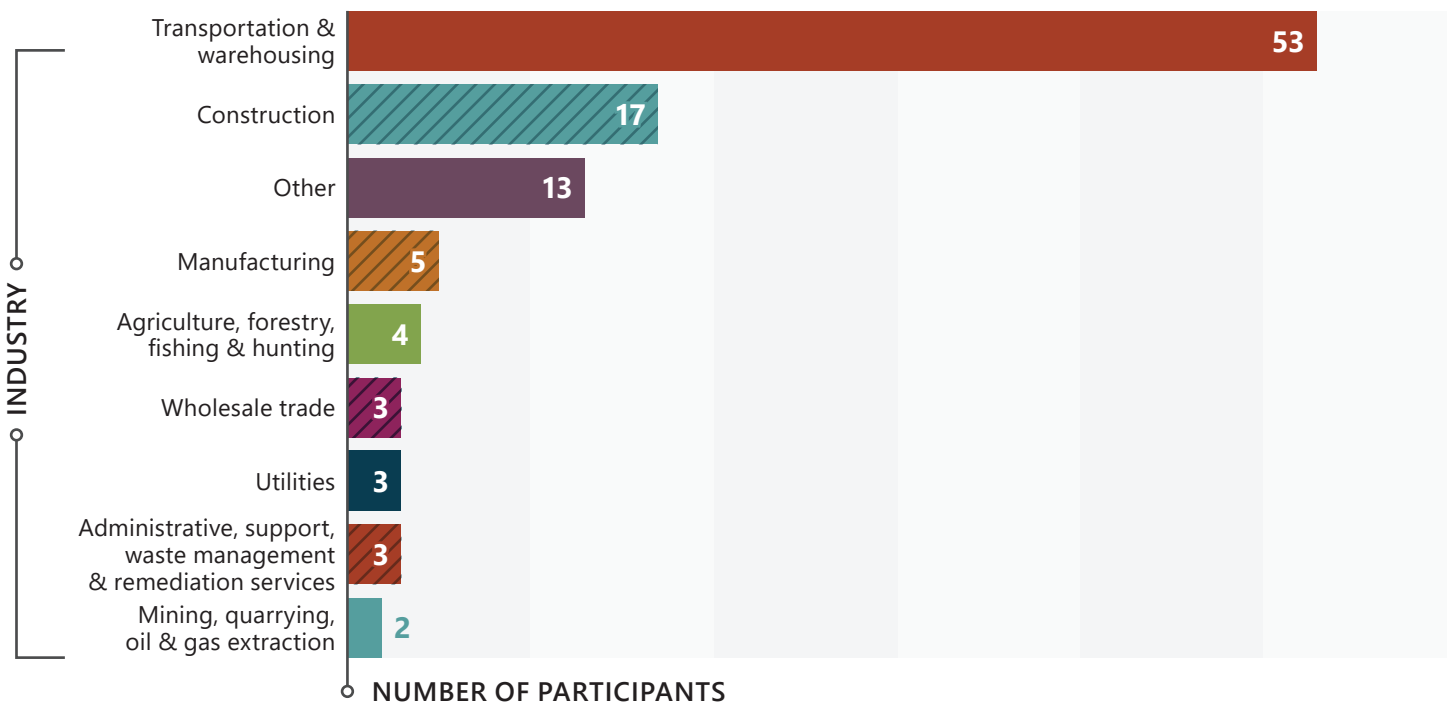


FIGURE 2 Which of the following best describes the industry for your organization?



Figures 3 and 4 illustrate the travel patterns of the trucks surveyed. Approximately one-third of the trucks were headed to warehouses, distribution centers, or ports. Around 10 percent typically traveled to retail outlets, service businesses, manufacturing facilities, or

truck terminals. Half of the respondents reported that they primarily operate within Southern California, and nearly a quarter travel within thirty miles of their yard or dispatch facility.

FIGURE 3 What are the most common types of destinations for these trucks?

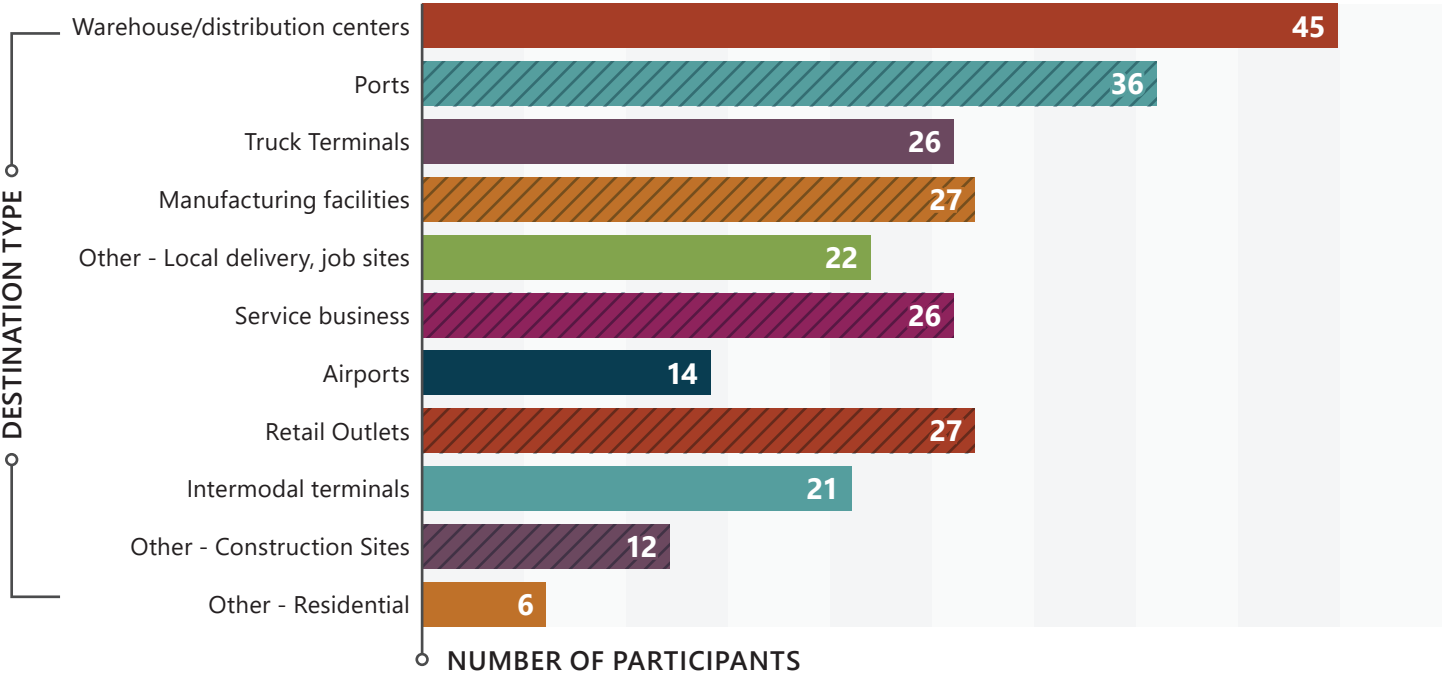
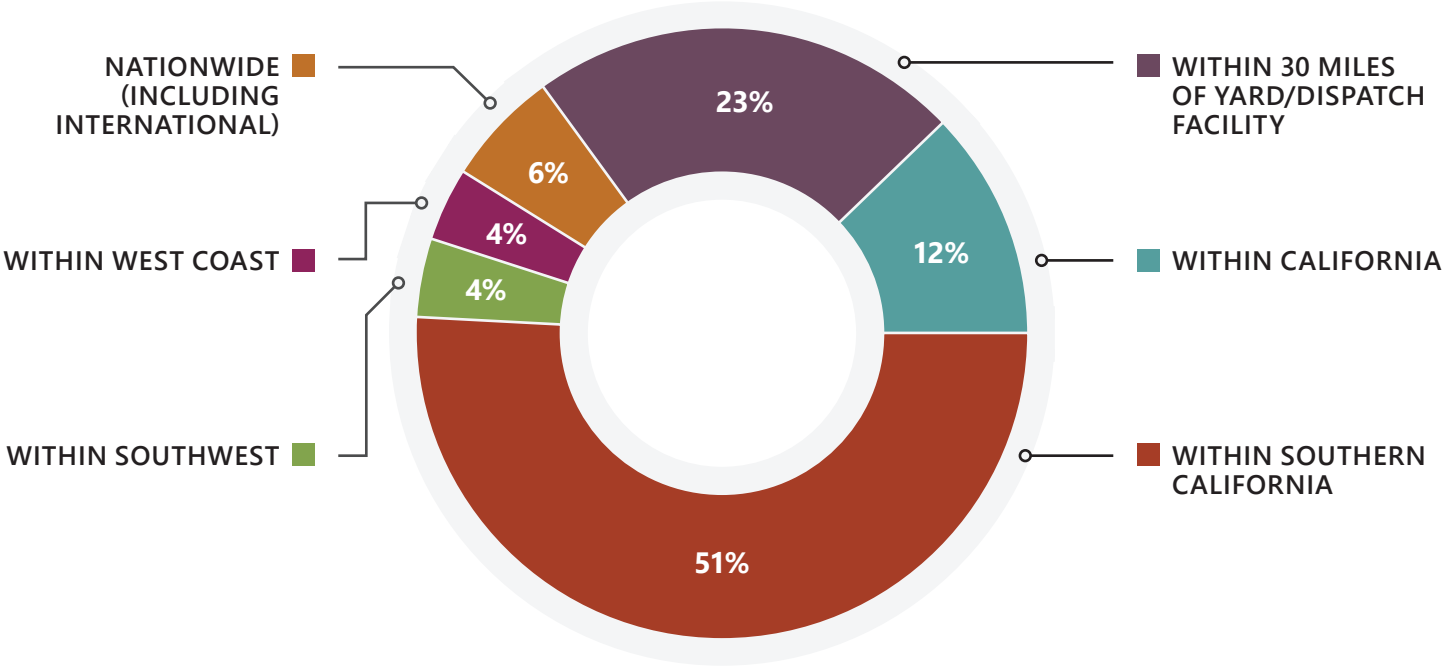


FIGURE 4 Which of the following best describes the primary travel area for these trucks?



Figures 5 and 6 focus on operating characteristics of the fleets. Understanding how far they travel and how many stops they make help us determine how EV charging and hydrogen fueling can be integrated into operations and where they may have an impact. Figure 5 shows

that nearly 60 percent of respondents make an average of two to five stops each day, while almost 20 percent report making between six to ten stops daily. Figure 6 reveals that over half of the respondents typically drive an average daily mileage of either 50 to 99 miles or 100 to 199 miles.

FIGURE 5 Which of the following best describes the average number of stops a truck make per day?

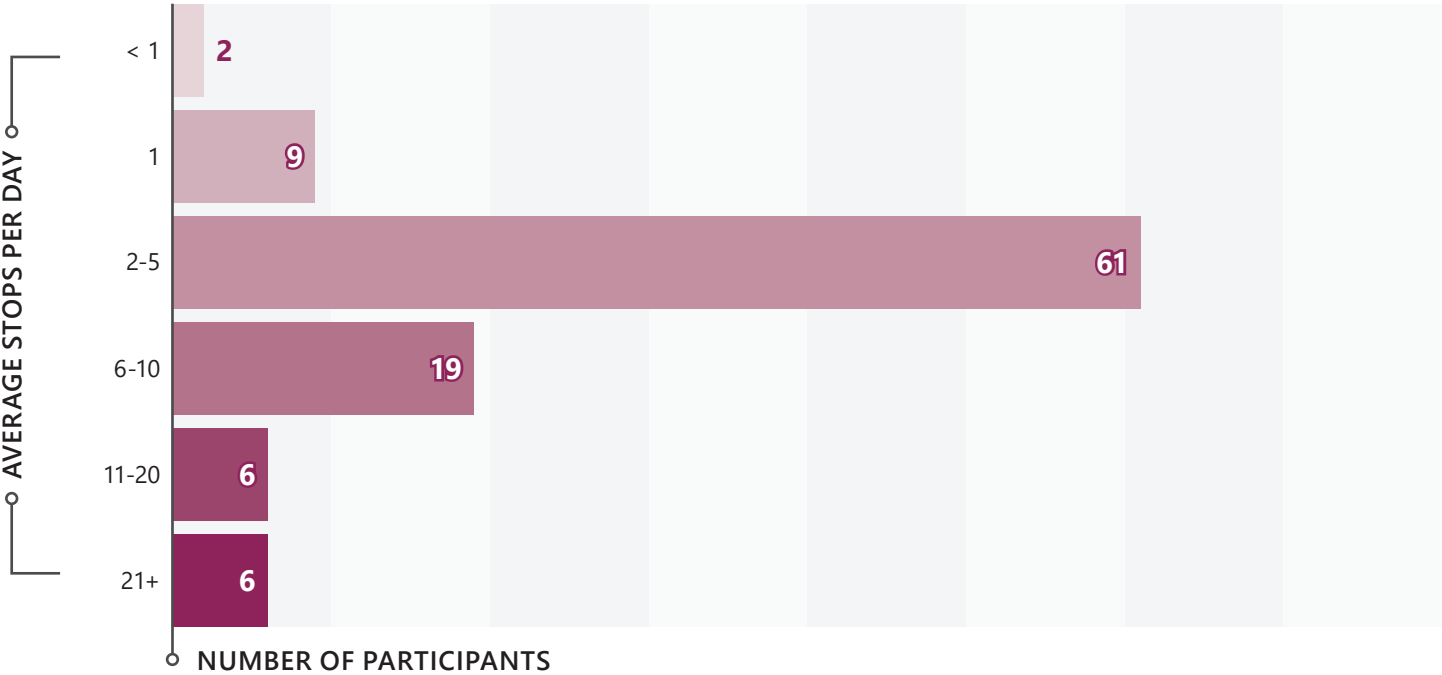
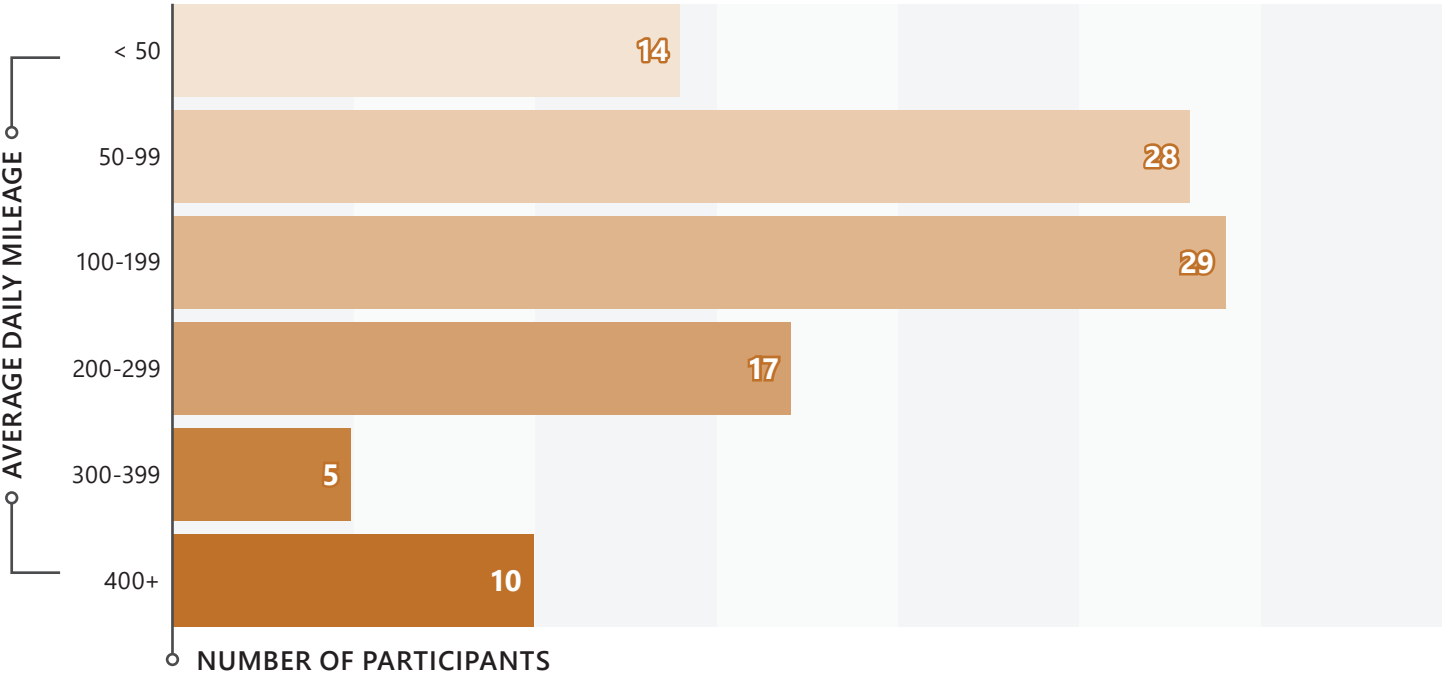


FIGURE 6 Which of the following best describes the average daily mileage for trucks in your fleet?





One-third of respondents indicated that they plan to replace their vehicles only at the end of their economic life. In contrast, over 40 percent intend to begin their transition to new vehicles before 2030 (Figure 7).

Additionally, approximately 20 percent of respondents expressed that they do not plan to make the switch, citing reasons such as impending retirement or plans to leave the state before the new regulations take effect.

FIGURE 7 When are you likely to start transitioning your fleet to zero emission vehicles?

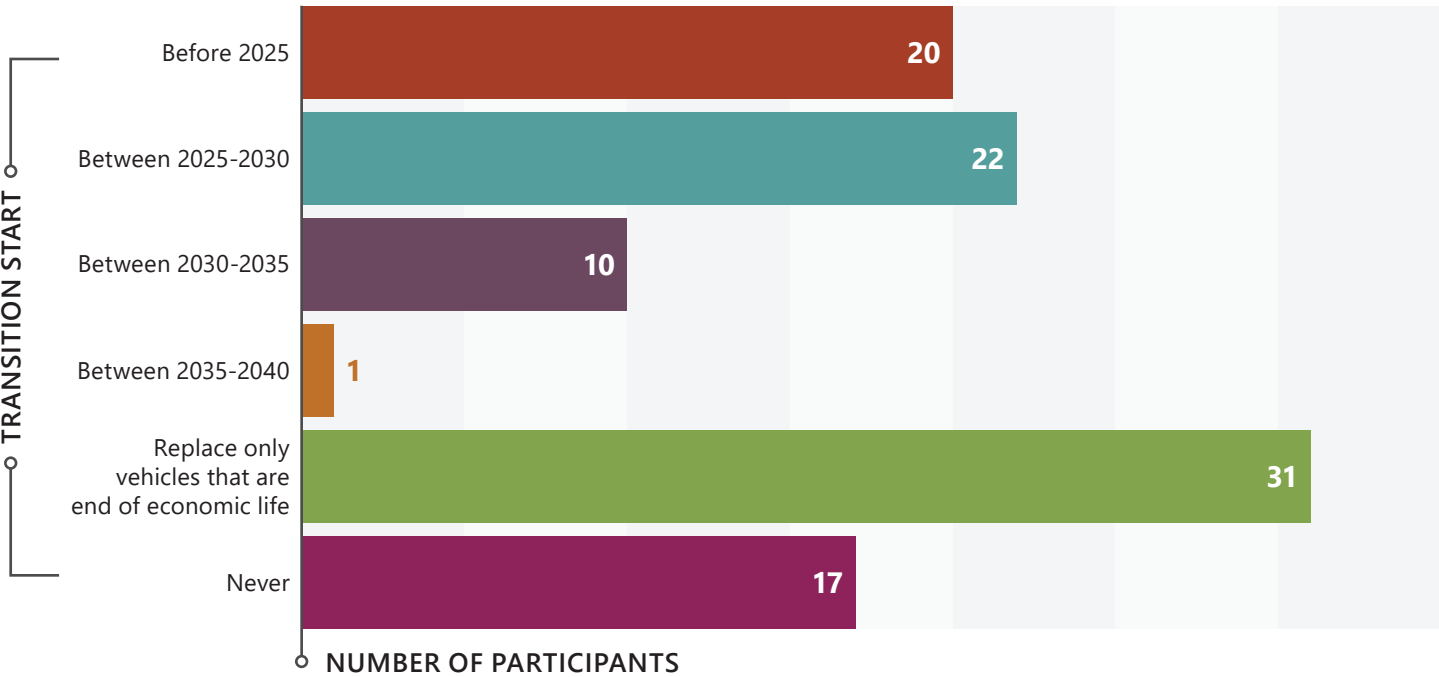
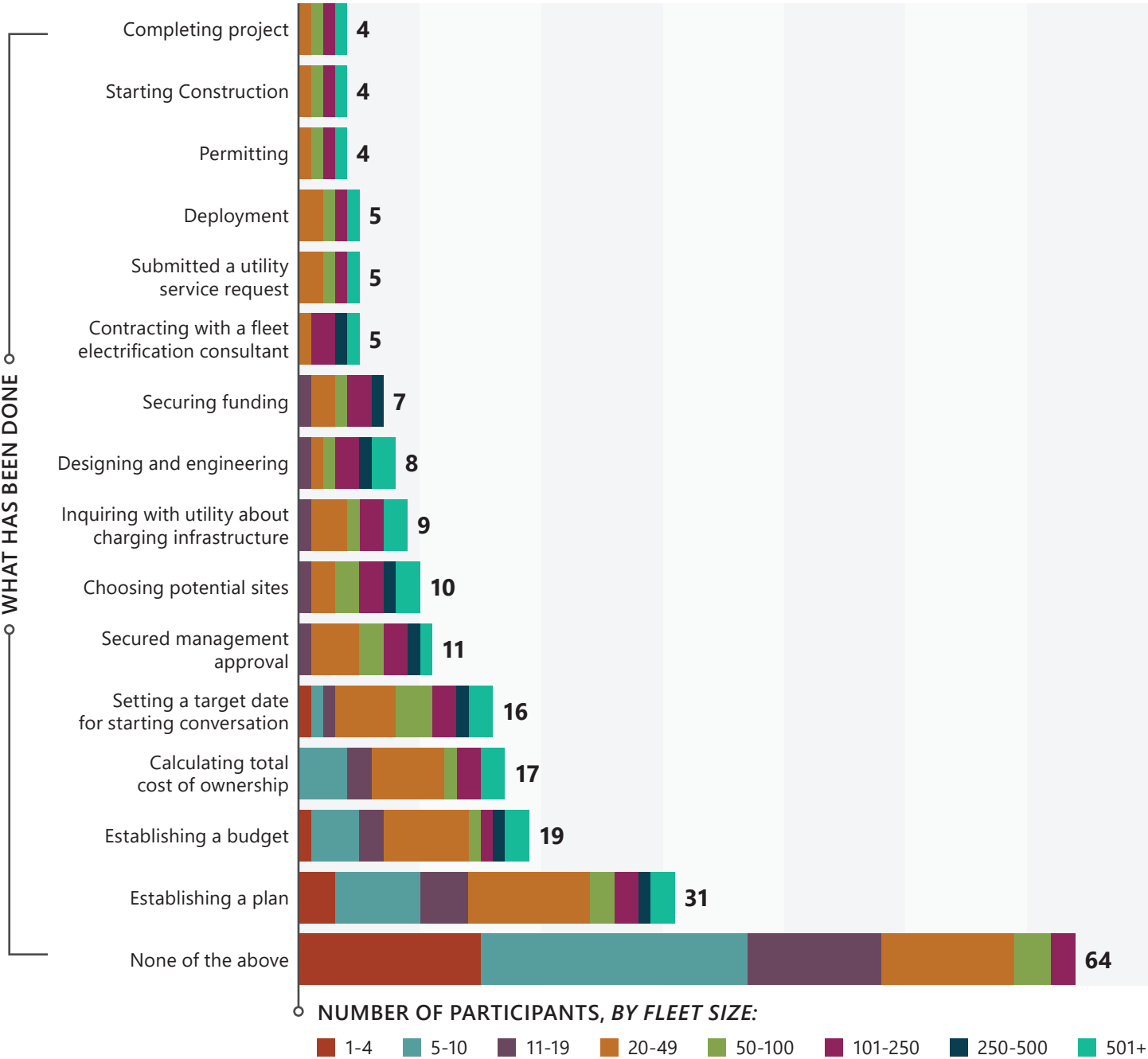


Figure 8 illustrates the steps some operators have taken to transition their fleets to ZE trucks categorized by fleet size. The majority of respondents indicated that they have not yet started planning for this transition. Although some have developed a plan and budget, calculated the total cost of ownership, and set a target date for beginning the conversion, only a few have begun implementing their plans.

When analyzed by fleet size, the actions taken toward converting to ZE trucks varied significantly. Among

respondents who have not started planning, 58 percent operate fleets with fewer than ten vehicles, whereas only three percent of those with fleets over one hundred have yet to initiate any conversion plans. More than 70 percent of respondents with fleets under fifty have established a plan and budget, along with calculating the total cost of ownership. Notably, only those with at least twenty trucks have engaged a fleet electrification consultant, submitted a utility service request, applied for permits, begun deployment, started construction, or completed their conversion project.

FIGURE 8 Which of the following, if any, has your organization done toward converting your fleet to Zero Emission trucks?



Figures 9 and 10 illustrate respondents' intentions concerning the development of charging and fueling infrastructure at their locations. About 27 percent indicated that they were very likely to implement electrical charging capabilities on-site. Responses varied widely, with many expressing that they were somewhat likely, uncertain, or very unlikely to establish electrical charging facilities at their sites.

FIGURE 9 How likely is your organization to develop truck electrical charging capabilities at your location?

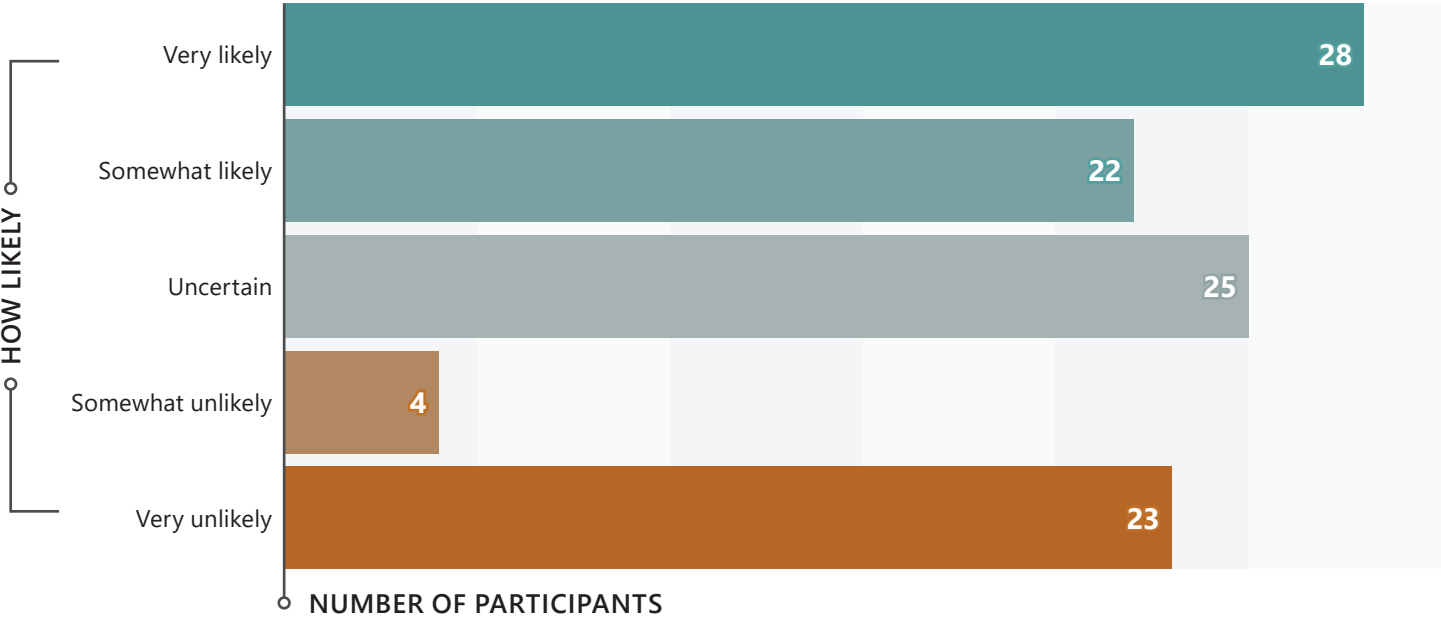
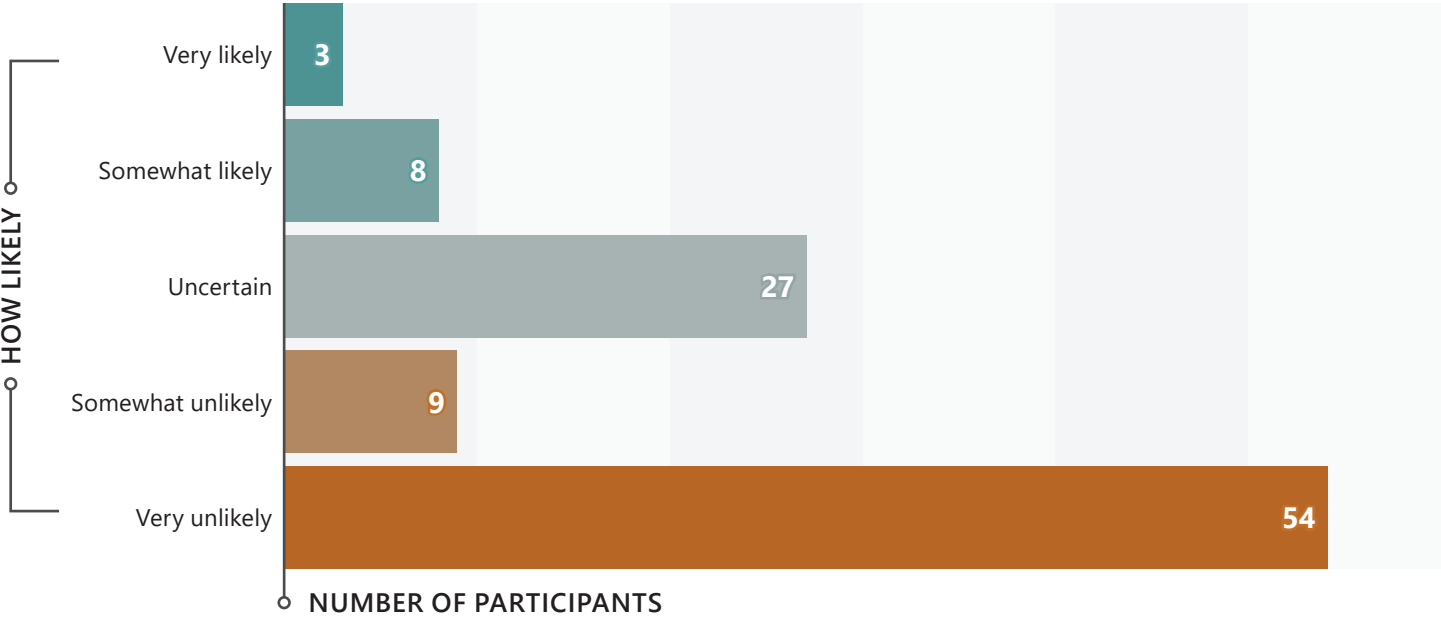


FIGURE 10 How likely is your organization to develop truck hydrogen fueling capabilities at your location?



Respondents identified several barriers to transitioning to zero emission trucks, as illustrated in Figure 11. The primary obstacles were range limitations and vehicle purchase costs, followed by concerns about grid readiness and infrastructure costs. Only 8 percent of respondents cited maintenance issues as a challenge to moving to zero emission trucks. When analyzed by fleet size, approximately 60 percent of respondents with fleets of fewer than 20 vehicles consistently identified cost,

technology, and grid limitations as significant barriers. In contrast, only about 10 percent of respondents with fleets of at least one hundred vehicles reported these challenges.

Figure 12 shows which zero emission fuel technology organizations were most likely to pursue. Approximately 36 percent of respondents said they are considering electric trucks and around a third said they were still unsure.

FIGURE 11 Barriers to converting to Zero Emission trucks

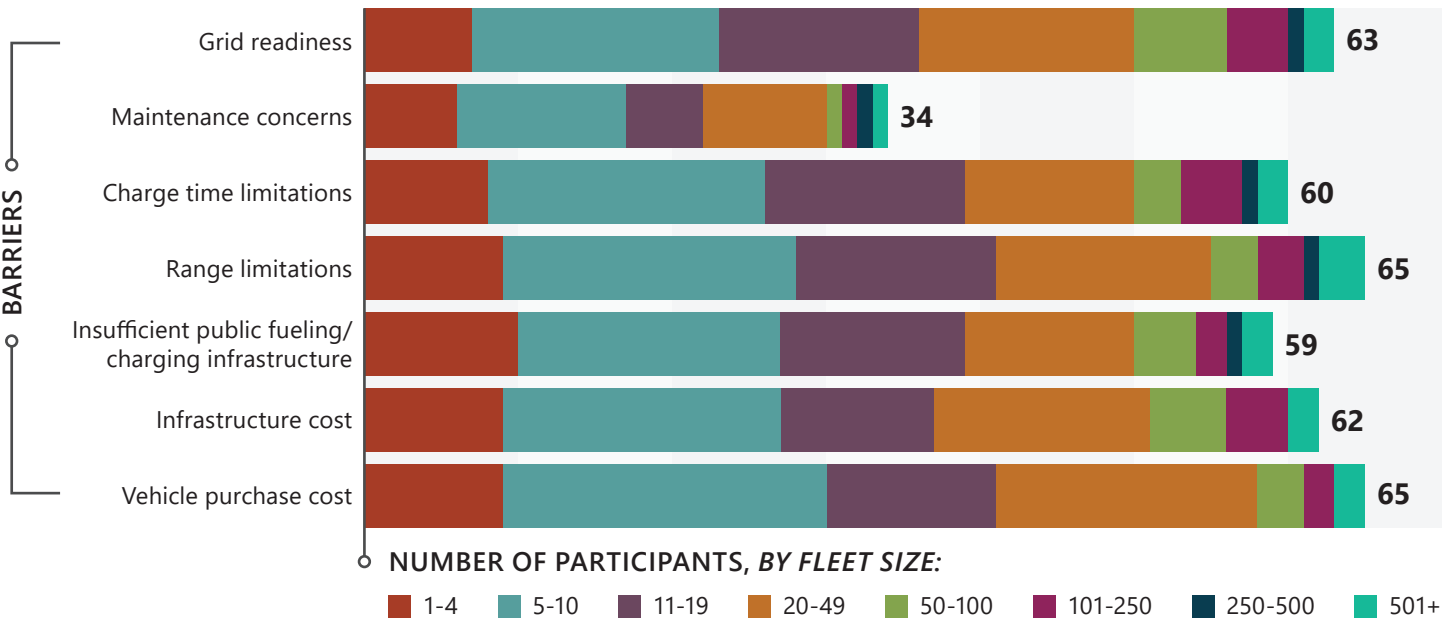
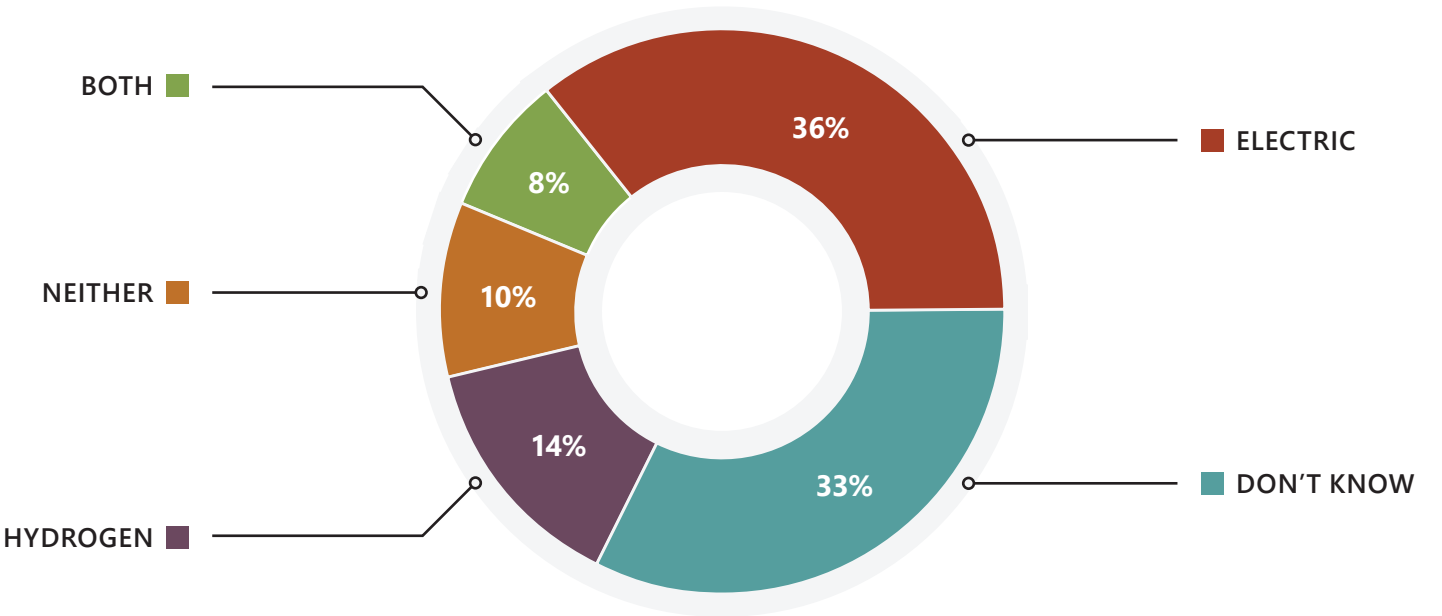


FIGURE 12 Which Zero Emission Fuel technology, electric or hydrogen, do you think you are more likely to pursue?



While most respondents have heard of state and federal incentives, over half were not familiar with the specifics (Figures 13 and 14). Fewer than 15 percent reported that they have applied for government incentives, and nearly 20 percent stated they have not heard of them at all. This indicates a need for increased education and outreach to inform consumers about the incentives available to assist in their transition to zero emission trucks.

FIGURE 13 How would you rate your familiarity with California state incentives to support the purchase of Zero Emission commercial vehicles?

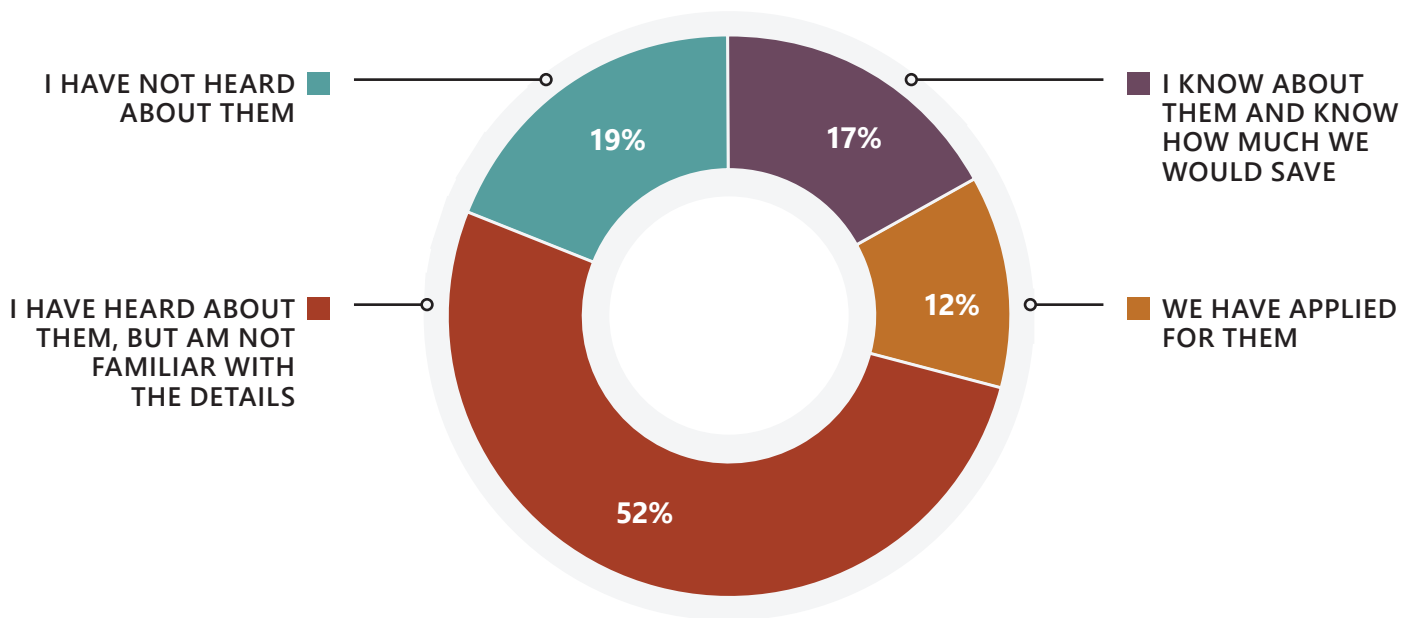
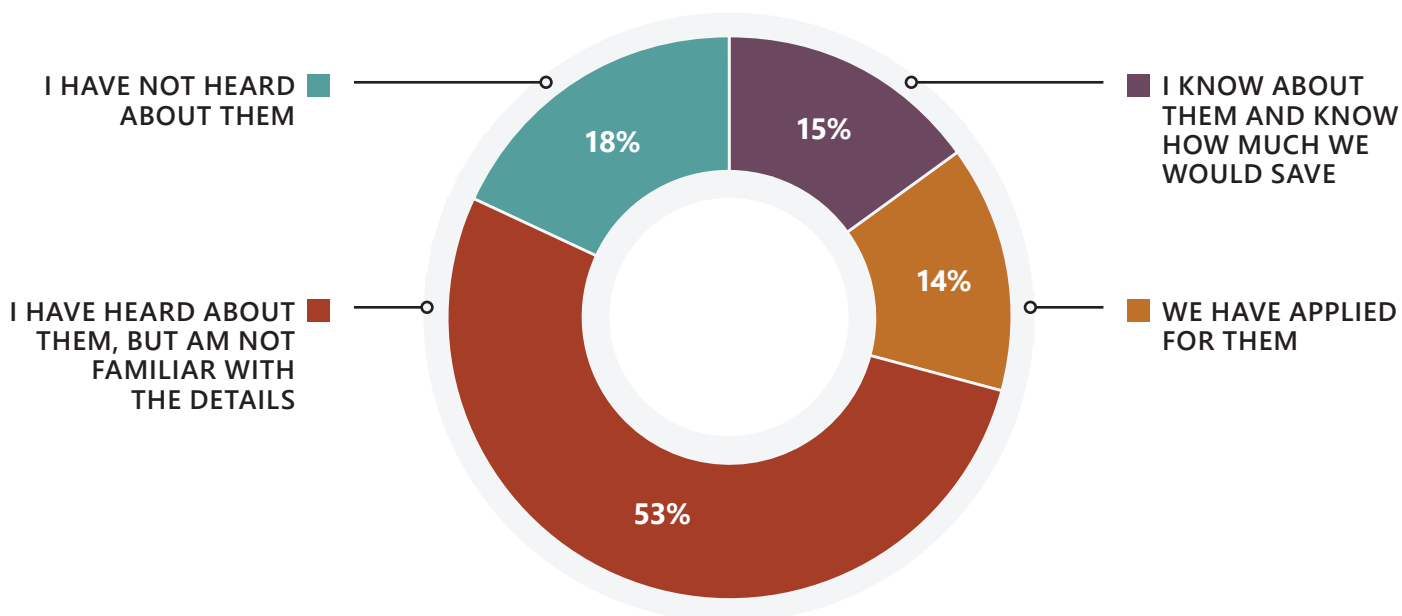


FIGURE 14 How would you rate your familiarity with Federal incentives to support the purchase of Zero Emission commercial vehicles?



FOCUS GROUPS

Three focus group meetings were held on August 24, August 28, and August 31 to gather a range of perspectives from research institutions, community organizations, regulatory agencies, transportation agencies, and utilities on topics related to electrification and the future of trucking. These discussions began with an overview of the project, followed by a review of its goals, objectives, and phases. Participants were introduced to the role of the focus groups and the outreach strategies. Key discussion areas included public and private sector roles in electrification, the location of EV truck charging sites, and the future of trucking.

Participants highlighted several challenges and opportunities in transitioning to ZEVs. There were concerns about mismatched timelines for installing ZEV infrastructure and delivering vehicles, the limited availability of charging sites, and grid capacity constraints. Utility providers face delays in upgrading infrastructure, and there is a need for streamlined permitting processes. Hydrogen as an alternative fuel was considered less viable due to infrastructure gaps and operational inefficiencies for heavy-duty trucks. Participants also shared a need for broader education, incentives, and metrics to support the transition for both large and small operators.

The focus groups also shared the importance of equity in locating EV charging sites. Participants advocated for avoiding further environmental burdens on disadvantaged communities and involving local stakeholders in site selection processes. Public and private depots should consider operational needs, such as amenities for truck drivers and fast-charging systems, while aligning with local land use plans. Safety considerations, proximity to major freight corridors, and co-location with existing infrastructure were recommended as site selection criteria. Participants also discussed leveraging industrial zones and existing logistics hubs to mitigate and potentially minimize disruption to residential areas.

Discussions also focused on the future of trucking, touching on advancements in telematics and autonomous vehicle technologies. Participants recognized the potential for technologies such as telematics and autonomous vehicles to improve safety and operational efficiency within the trucking industry while contributing to emissions reductions. However, they highlighted uncertainties regarding the long-term viability of these technologies and the need for clear regulatory frameworks to support their implementation. The discussions drew on existing studies and resources, including regional ZEV blueprints and utility grid capacity assessments, to guide planning for charging infrastructure.

TABLE 3 Key Takeaways and Themes

THEME AREA	KEY FINDING
Funding	Broad education and targeted incentives need to be made available to help businesses, especially small businesses, transition to ZEVs.
Electric Grid Capacity and Available of Hydrogen	- Grid capacity needs to be addressed, especially for peak hour usage - The focus groups had limited information on hydrogen fueling availability, so a range of locations need to be considered. There needs to be enough fueling sites available to ensure that it is a viable fuel option moving forward.
Public vs Private Depots	- Public sites may need megawatt charging or a fast-charging system to meet charging needs without disrupting operations. - For public charging, ensure that surrounding land uses can accommodate amenities for truck drivers. - Caltrans owned right-of-way may be a good starting point for public charging stations, may align with existing CTC or trucking corridors.
Timelines	- Supply chain issues for EVCS equipment can add to delays in installation of chargers and support equipment. - Streamlining the permitting process (California AB 1236, 2015 and AB 970, 2021) and potentially the CEQA/ environmental process can help improve the speed of installation.
Equity of Locations	- The environmental effects of the charging sites should be reviewed to ensure that communities that already face the brunt of environmental challenges are not burdened even more. - Community members can offer their expertise on identifying truck routes and areas where trucks idle and provide insights on land use. It is critical that these conversations occur on the local level and be required as part of the siting process. - Ensure that safety is considered, as having an increase of truck trips in communities with overnight or depot charging sites could pose additional traffic or public safety concerns.

It is important to bring green jobs to communities and conduct a just transition from diesel to ZEVs. This entails identifying corridors instead of using the power of eminent domain. Local property owners should benefit from this change. ISRs need to be clear to the community who should have a chance to weigh in on the rules.

Utilities take 12 to 36 months to bring infrastructure to site, as opposed to the 6 to 9 months to purchase the ZEV. If an organization has a ten-year plan, they need to let utility providers know when they will be purchasing the new vehicle so it can be worked into the utility provider's ten-year plans.

Take safety into consideration. Truckers should be able to park, turn around, and safely leave their vehicles. Charging areas should be well lit with low conflict points and decent visibility. For land use, it is important to be consistent with local and land use plans, and be cognizant of nonconforming uses as truck lots tend to bring seedy activities. Please provide effective and efficient access to highways and arterials, as well as national, state, and local truck routes. Locate them near logistics centers where the exchange of goods occurs.

FOCUS GROUPS

INTERVIEWS

We have to be able to charge faster to meet the operational needs of trucking. It would be difficult to see a future where we could adapt to longer wait times, except in a return to home situation.

We are hoping that pilots allow drivers to try out an EV truck, see how it works for their operations. Hopefully this will alleviate some of the concerns about range and charging ability. It's hard though there aren't many chargers out for the public so unless you've got a charging option at private depot it's hard to test.

Technical assistance will be important for helping smaller fleets and owner operators. They don't have the capacity on staff to investigate, write, and manage a grant. We may need a more flexible approach to getting funds to the smaller firms.

Megawatt charging or high-capacity charging is going to be needed. We have to figure out that tech, and then get it out there. It may be good to have some universal standards if we can find some common ground for OEMs and EV charging manufacturers.

There are a lot of assumptions regarding infrastructure for EV charging. Where we are now, I have a hard time believing we will be fully built out by 2040. That's going to require hundreds of chargers to be built every year and I'm not sure how that's going to be possible considering the backlog of letters to serve.

We need leadership from the state to align all of these various parties, it needs to be everyone's priority as it's such a massive undertaking. It will take everyone pulling in the same direction.

INDUSTRY INTERVIEWS

As part of the SCAG ZETI project, the study team conducted 11 one-on-one interviews between August and September. These interviews aimed to gather perspectives on the barriers and challenges facing the adoption of zero emission medium- and heavy-duty trucks. Unlike the focus groups, which brought together multiple stakeholders to discuss industry challenges collectively, the interviews provided individual stakeholders the opportunity to detail company-specific issues. Interviewees included representatives from trucking associations, OEMs, new service providers like Truck-as-a-Service, and regional and national developers. These additional insights complemented survey data and focus group discussions, offering private industry perspectives on transitioning to ZE trucks.

The interviews highlighted several recurring themes, supporting the findings from the focus groups while introducing additional challenges. A primary concern was the need for public charging infrastructure. There is a significant gap in the availability of public, non-

subscription charging stations suitable for heavy-duty trucks, especially near freight origins, destinations, and along major routes. Depot charging alone cannot meet industry requirements, particularly for smaller fleets or independent owner-operators. Another pressing issue is insufficient utility infrastructure. The limited grid capacity of SCE and the Los Angeles Department of Water and Power (LADWP) is a major barrier to expanding charging infrastructure. Challenges include shortfalls in substation capacity, transmission line availability, and a backlog of commitments to existing developments that take precedence over truck charging needs.

The financial burden of adopting ZE trucks was also a key theme. Multiple interviewees said, “the high cost of heavy-duty ZE trucks and the associated charging infrastructure exceed initial estimates, creating challenges for fleets to meet regulatory timelines.” Grants and financial assistance programs provide some relief but are insufficient to cover the escalating costs, particularly for drayage tractors and depot chargers. Interviewees provided ideas for potential funding to help small businesses purchase trucks and help develop publicly

TABLE 4 Key Takeaways and Themes

THEME AREA	KEY FINDING
Funding	- Continued grant funding is needed for companies to make the transition to ZE trucks. Small businesses face high costs for purchasing of trucks and larger fleets needs assistance with funding of EV charging infrastructure. - Important to develop a path forward to funding the utilities upgrades needed for the electrical grid.
Electric Grid Capacity and Available of Hydrogen	- There were also concerns about the grid’s capacity to support ZEV infrastructure especially during peak hours, as well as uncertainties about regulations and the state’s long-term plans for ZEV infrastructure. - Some operators consider hydrogen as less risky, especially considering its use of infrastructure which is more similar to diesel and maintains operations in term of refueling times. - The existing ZEV infrastructure is limited, and scaling that to the trucking fleet is daunting, especially as utilities already have backlogs.
Public vs Private Depots	- Understand that we need both, as return home operations that have site ownership can have overnight depot charging set-ups, but smaller fleets or single-owner will need public charging. - Public charging stations should be located at major freight corridors, ports, and areas where trucks are clustered. - Surrounding land uses should support amenities for truck drivers. - Since private site deployments will not be opening their charging stations to other operators, alternative business models to the subscription charging services need to be considered.
Timelines	- Incongruent timelines in installing infrastructure and purchasing ZEVs. Transportation industry and utilities have completely different timelines on when and where capacity will be needed. - There needs to be leadership to align timelines and priorities. - Streamlining the permitting and CEQA/NEPA can help improve the speed of installation.
Equity of Locations	- Do not overload any singular disadvantaged community with too many charging stations. - Educating the community and creating clear requirements for siting charging stations and grid and transmission infrastructure is important. A decision tree documenting the criteria for siting these fueling stations would be helpful to practitioners. - While many charging stations may need to be located near the Ports, warehousing districts, and highways, consideration of community impacts, particularly for priority equity communities, must be part of the decision-making process.

accessible charging stations. The interviews mentioned specific funding tools such as the California Infrastructure and Economic Development Bank (IBank), and cap-and-trade funds. They thought that existing funds could be prioritized for this EV charging and for ZE trucks. They mentioned that other programs are available and that it would be beneficial to continue using them, but efforts should be made to keep the programs consistent so they are well-known within the industry.

Interviewees raised concerns about technical and operational uncertainties. Limited experience with ZE trucks, particularly in heavy-duty applications, has led to uncertainties regarding battery performance, range, charging rates, and infrastructure requirements. This lack of perceived reliability hampers planning and adoption efforts. Hydrogen fueling was identified as a potential alternative to battery-electric trucks due to faster refueling rates. However, participants noted a lack of experience with hydrogen-powered trucks and questions about the cost and infrastructure for hydrogen supply.

TECHNICAL ADVISORY COMMITTEE (TAC)

The TAC for the SCAG ZETI Study is comprised of planning agencies, ports, regulators, truck operators, private developers, electrification sites developers, hydrogen developers, utility providers, and more. This broad range of participants provided the project team with guidance, feedback, and their experience in the field to help ensure the study considered multiple vantage points and perspectives. The TAC met six times throughout the project, from the beginning during the kick-off of the project to the end providing feedback on the final report and siting tool. Their input and ability to help ground-truth analysis and modeling outputs have resulted in a living document that can help shape the installation of zero emissions facilities, as it was guided by the people who will be tasked with installing that zero emissions network.

OUTREACH SUMMARY

The stakeholder engagement process provided key insights into the challenges and considerations for transitioning the trucking industry to ZEVs. Participants identified barriers related to funding, grid capacity, hydrogen availability, public and private charging depots, implementation timelines, and equitable site selection. These insights offer actionable recommendations to guide planning efforts.

Funding challenges were a major concern, particularly for smaller fleets and owner-operators. Recommendations include providing education and technical support to improve access to grants, funding pilot programs to test ZEV impacts on operations, leveraging innovative funding mechanisms like the IBank, and scaling existing pilot programs. Collaboration between government agencies and private entities is necessary to expedite charging facility implementation.

Grid capacity and hydrogen fueling availability require focused leadership from utilities and transportation agencies. Recommendations include co-locating charging infrastructure with transportation patterns, facilitating hydrogen fuel site installations, and exploring diverse technologies to meet the needs of different truck markets while addressing grid constraints.

Public vs. private charging depots identified the need for government involvement in developing public charging stations, as smaller fleets may lack the capacity to build on-site infrastructure. Recommendations include increasing redundancy in the EV charging network, creating inventories of charging locations, and establishing standards for charging networks to ensure interoperability.

Implementation timelines remain a challenge, with stakeholders advocating for interim solutions while utilities expand grid capacity and fleet operators procure trucks and install charging equipment. Recommendations include streamlining permitting processes, expediting utility installations, developing simplified environmental review procedures, and funding microgrid pilot projects to address temporary gaps in charging infrastructure.

Equity in site selection emphasized the importance of avoiding disproportionate impacts on disadvantaged communities. Early engagement with local stakeholders, implementing local hire programs, and incorporating equity criteria into decision-making processes are critical to achieving equitable outcomes.

Collaboration among agencies like SCAG, Electric Power Research Institute (EPRI), and CalSTART, along with government leadership, will address funding and technological challenges. Planning and support are required to facilitate the trucking industry's transition to ZEVs, reduce greenhouse gas emissions, and improve air quality.



4. MODELING APPROACH FOR TRUCK TRAVEL AND ENERGY NEEDS

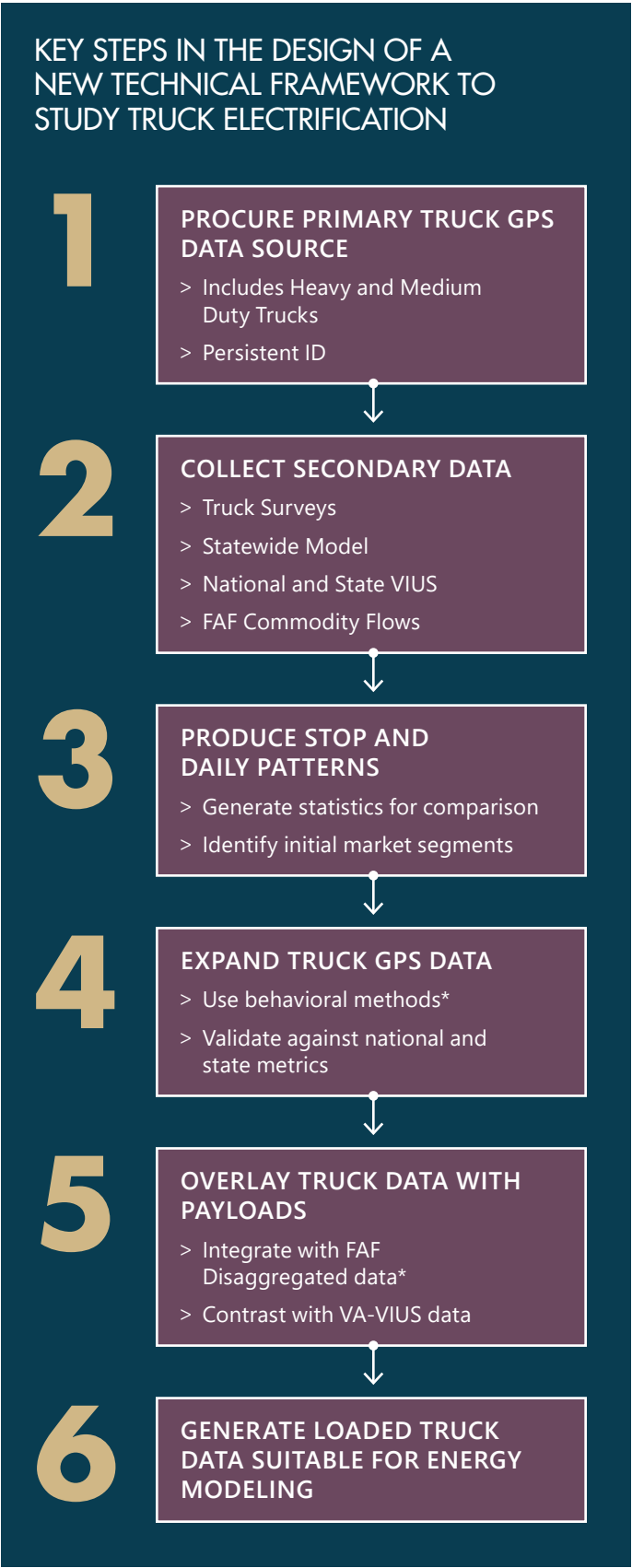
This section summarizes the modeling approach used for the SCAG ZETI Study. The goal of the modeling work is to understand how freight travels throughout the SCAG region, and to align the truck movements with energy needs to understand how much and where zero emission infrastructure is needed to facilitate the transition to ZE trucks. This approach is comprised of trip data analysis, market segmentation, energy modeling, and model smoothing to assess truck travel behavior and energy demand, which form the technical foundation for this work. The first part of this section focuses on analyzing truck travel patterns to create a detailed trip roster database for energy modeling. The second part of this section focuses on modeling the energy consumption, charging events, and load profiles for various truck market segments. The last element focuses on the final smoothing process to ensure results align with overall zero emissions understanding. This new modeling approach required several teams and a series of technical memos that provide more in-depth information on the methods used in this analysis. The technical memos can be found in the background material for this report. Below is a high-level summary of the technical analysis used for the Study.

DATA ANALYSIS, MARKET SEGMENTATION, AND MODELING

As we approached this project, understanding how and when trucks traveled was a paramount question. To best understand truck travel, the team used granular device-level GPS trace data for trucks sourced over multiple days. These truck trips were combined to create truck tours to understand details about the length of trips and the number of stops. This information was integrated with other datasets to build a comprehensive dataset for developing a detailed framework to evaluate public charging infrastructure for MD-HD. This detailed dataset required the following elements:

- Granular device-level GPS trace data for trucks, which can help analyze daily truck movements.
- Assigning payloads to truck flows, as this affects the discharge rate of electric vehicles.
- Validating truck movements and payloads using state and national data sources.
- Identifying truck market segments that are more likely to adopt electrification.
- Creating a well-structured and user-friendly database to support truck energy modeling.

The graphic below describes the key steps undertaken in this approach and outlines the new analytical steps being implemented for the first time at scale (indicated by asterisks).



DATA SOURCES

PRIMARY SOURCE

This analysis uses truck GPS data from INRIX as its primary data source. INRIX's truck waypoint data is a sample dataset that includes medium and heavy-duty trucks, representing an estimated three to ten percent of all trucks traveling across the U.S. Each truck in the dataset is assigned a device ID, which changes every 24 hours to ensure data privacy. Since the ID remains the same for 24 hours, the data can be used to analyze daily truck travel patterns, but not multi-day travel behavior.

To capture seasonal variations and provide a more accurate representation of truck movements in California, data from four separate weeks from across two years, 2019 and 2021, was used.

SECONDARY SOURCE

Several secondary data sources were used to complement and validate truck GPS data. These sources, collected from national, state, and local jurisdictions, include:

- **FAF Data:** The Freight Analysis Framework (FAF), produced by the Bureau of Transportation Statistics and the Federal Highway Administration, integrates various data sources to measure freight movement across states and major cities.
- **CA-VIUS:** The California Vehicle Inventory and Use Survey (CA-VIUS) collected data from over 14,000 trucks between 2016 and 2018, providing information on annual mileage, payloads, and fleet sizes. The CA-VIUS is the largest statewide commercial vehicle data collection effort in the US.
- **CSF2TDM:** The California Statewide Freight Forecasting and Travel Demand Model (CSF2TDM) offers modeled truck information for present and future years, using econometric frameworks to predict changes in truck movement.
- **Commercial Vehicle Surveys:** These surveys provide an in-depth understanding of the number of truck trips by truck type produced by different employment categories. This serves as an input to the expansion of truck GPS data by providing control totals.

DATA ANALYSIS AND MODELING

DATA CLEANING

To ensure data quality, the data underwent a cleaning process, adjustments were made to help correct for any over or underrepresentation of trip, clustering of

stop locations to improve accuracy, and to remove any malfunctioning devices or outlier data. More details are found in appendix B.

DATA EXPANSION

For all modeled travel data, there is the need for expansion to represent all truck trips. The standard practice serves to account for full representation of truck travel in the study area. Similar to the data cleaning process, the use of surveys, existing truck travel datasets, and known behavioral methods were used to adjust the truck trips. It is important to note that since electrification modeling was simulated at the truck (device) level, all trips made by the same truck were assigned the same expansion weights.

Additional checks were performed to validate the expansion results as seen in the expansion results as seen in Appendix B. These included comparing the expanded data with the statewide travel demand model and FAF data after applying average payloads from CA-VIUS to FAF tonnages.

MARKET SEGMENTATION

Market segments help us understand where trucks travel, the distance traveled, and where they end their day. Certain truck market segments, such as port drayage trucks, are expected to adopt electrification faster than others. It is important to identify these market segments within the truck GPS data for later steps in the analysis. However, the truck GPS dataset lacks information about the fleet to which each truck belongs or the age of the vehicle. Additionally, with the average travel duration for heavy-duty trucks in the sample being only 1.5 days, it is difficult to determine whether vehicles have a home base. Without this information, market segmentation can be established using the truck GPS dataset using these criteria:

- Total vehicles miles traveled over a 24-hour period;
- Number of stops made during a 24-hour period;
- Frequency of stopping at most common stop over a 24-hour period;
- Whether the truck traveled to a specific location such as a port (i.e. drayage trucks); and
- Truck weight class

This market segmentation provides a framework to test different rates of EV adoption and public charging to assess future energy demand. Table 5 shows the market segments used in this analysis.

TABLE 5 Truck Demand Market Segments

TRUCK MARKET SEGMENT	PORT TRUCK		TRUCK TYPE		TOTAL MILEAGE		FREQUENT LOCATION	
	Yes	No	Heavy	Medium	0-300 mi	>300 mi	Yes	No
Drayage Heavy-Duty	✓		✓		N/A	N/A	N/A	N/A
Drayage Medium-Duty	✓			✓	N/A	N/A	N/A	N/A
Regional Return-to-Base: HD		✓	✓		✓		✓	
Regional Return-to-Base: MD		✓		✓	✓		✓	
Regional Non-Home: HD		✓	✓		✓			✓
Regional Non-Home: MD		✓		✓	✓			✓
Long-Haul: HD		✓	✓			✓	N/A	N/A
Long-Haul: MD		✓		✓		✓	N/A	N/A

- Drayage refers to short truck trips that make at least one stop at a port within the SCAG region.
- Regional return-to base is a non-port truck whose daily travel mileage is less than 300 miles with a frequent base location.
- Regional no-home is a non-port truck whose daily travel mileage is less than 300 miles without a frequent base location.
- Long-haul truck is a non-port truck whose daily travel mileage is more than 300 miles.

OVERLAY COMMODITY FLOWS ONTO TRUCK ORIGINS & DESTINATIONS

The last two steps in the data cleaning and modeling process was to develop a methodology to evaluate whether the expanded truck trips can support the volume of goods being transported between counties and regions, and develop a trip roster of truck movements that measures payloads carried on each leg of the journey.

FAF data was disaggregated to allow for the preparation of county-level commodity flow values by tonnage. The majority of the travel flows reported in the FAF are carried out by heavy-duty truck models. For payload calculations, data from the CA-VIUS is used, with average payloads by truck and commodity type generated. These average payloads account for truck movements across the full spectrum, from empty to partially-loaded and fully-loaded trucks. The assignment of commodities is a crucial step, with county-to-county commodity flows serving as targets for this process. In cases where counties are smaller, CSF2TDM region data is used instead. Payloads are assigned to tours and individual trips to ensure an accurate and comprehensive allocation.

Finally, a framework was utilized to determine at each truck stop whether the truck is picking up or dropping off loads, or doing neither (i.e., service truck). This framework produces a matrix of daily truck patterns that not only accurately mirrors overall truck travel but also effectively captures the volumes of goods being carried, which are then benchmarked against CA-VIUS and FAF data. Overall, the process worked well to replicate regional and county flows of commodities throughout California.

FINAL DATABASE TO SUPPORT ENERGY MODELING

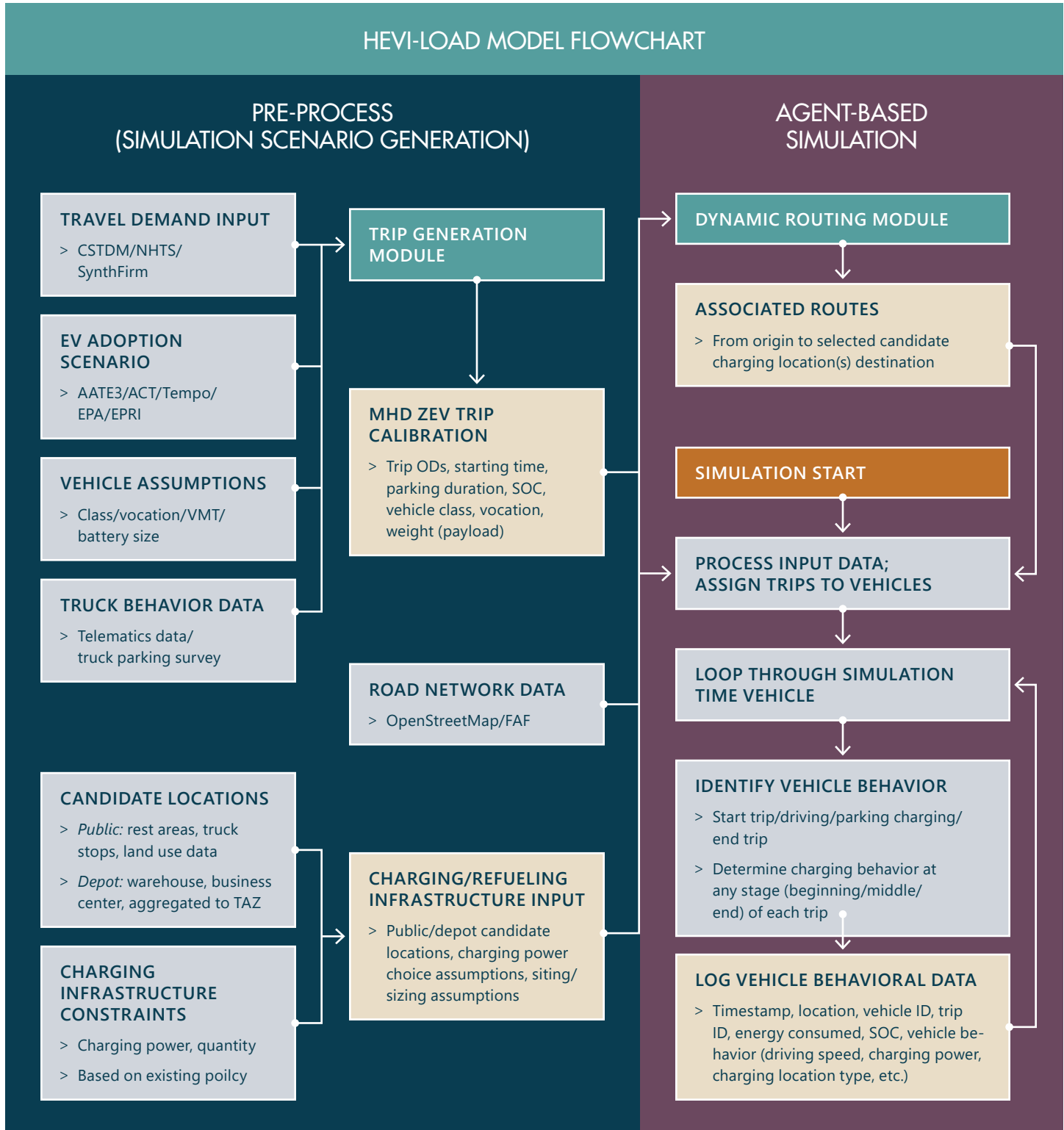
After completing the truck GPS trip analysis and modeling, a detailed trip roster database was created to support energy modeling. Every row in the database represents an observed trip made by a truck in the truck GPS dataset. Additional information such as timestamps, locations, truck weight, payloads, market segmentation, and expansion weights are also included.

The expanded truck database is scaled further to better reflect growth conditions for three future years: 2030, 2035, 2040. The scaling methodology involves using population and employment data from the Caltrans statewide model to grow truck trip control totals at a zonal level. The expansion process is then repeated, using the “loaded” truck database as input, with no further adjustments for FAF future year loads. All other features, such as timestamps, locations, truck weights, and market segments, remain unchanged from the base scenario. These future year databases will serve as key inputs for energy modeling and energy needs assessments in future years.

ENERGY MODELING

The Medium and Heavy-Duty Electric Vehicle Infrastructure Load Operations and Deployment (HEVI-LOAD) uses an agent-based simulation approach to model truck travel behavior, refueling patterns, and duty cycles of medium and heavy-duty trucks. The model generates energy consumption, charging events, and load

profiles for different truck market segments. By simulating the specific movements and energy needs of MD-HD ZEVs, the model provides insight into infrastructure requirements, including energy consumption by charging accessibility (public vs. private) and charger types. The flowchart below presents the framework of the HEVI-LOAD model.



ASSUMPTIONS

For this study, the HEVI-LOAD model was updated to incorporate truck touring and daily travel patterns into its charging decision-making framework. Truck travel forecasts for 2030, 2035, and 2040 were developed in alignment with the Caltrans statewide travel demand model. The energy modeling process adjusted truck travel data to reflect the Additional Achievable Transportation Electrification Scenario 3 (AATE3) assumptions for ZEV adoption.⁴¹ AATE3 predicts significant growth in electric vehicle adoption, which will influence electricity demand and inform resource procurement and grid planning. However, AATE3 also forecasts limited adoption of MD-HD hydrogen vehicles, primarily due to high hydrogen fuel prices that reduces their feasibility in the truck choice model. The baseline scenario adopts the AATE3 adoption rates for the forecast years, though alternative scenarios are also explored to assess outcomes if adoption rates fall short of AATE3 expectations. Table 6 presents the AATE3 scenarios.

Three primary charging options are considered: private depot charging, public en-route charging, and public destination charging, with a focus on public charging sites. A preliminary list of over 1,000 public charging sites was created, including additions along interstates and truck facilities in the SCAG region.

Base electrification scenarios (2030, 2035, and 2040) follow AATE3 ZEV adoption targets, providing benchmarks for ZEV energy and infrastructure needs. Additional scenarios assess the impact of different adoption rates and infrastructure demands for 2030 and 2035, including a scenario for hydrogen fuel cell adoption for 2040.

Other key assumptions include that the energy modeling approach allows travel demand patterns to drive charging capacity utilization without limiting capacity at individual sites. Additionally, travel assignments in the energy modeling are based on free-flow speeds.



TABLE 6 HEVI-LOAD Modeling Scenarios

SCENARIO NAME	2030	2035	2040
Baseline	AATE3	AATE3	AATE3
Miss ZEV Goal	AATE3 (-10%)	AATE3 (-15%)	AATE3 (-10%)
Exceeds ZEV Goal	AATE3 (+5%)	AATE3 (+15%)	AATE3
Hydrogen	N/A	N/A	AATE3

AGGREGATE SUMMARIES

The energy requirements for each horizon year align with the energy summaries outlined in the AATE3 scenarios. Table 7 presents the total energy requirements by county for all forecast years. Table 8 shows the energy needs and share of total demand for public charging sites shown in parentheses. Figure 15 displays a heat map illustrating the spatial distribution of public charging energy demand across sub-regions defined by hexagonal grids with approximately 15-mile radius zones for the years 2030, 2035, and 2040. These maps show how energy demand

for public charging is going to grow over time, with increasing concentration for demand in Los Angeles County and in western portions of San Bernardino and Riverside County. This concentration of demand aligns with high active warehousing and freight transloading sites such as Hobart Yards. While these locations show the highest growth and concentration over time, the overall demand for public charging expands eastward by 2040 and show growth in Imperial County, eastern Riverside, and northeastern San Bernardino where Barstow is expected to be a critical hub over time.

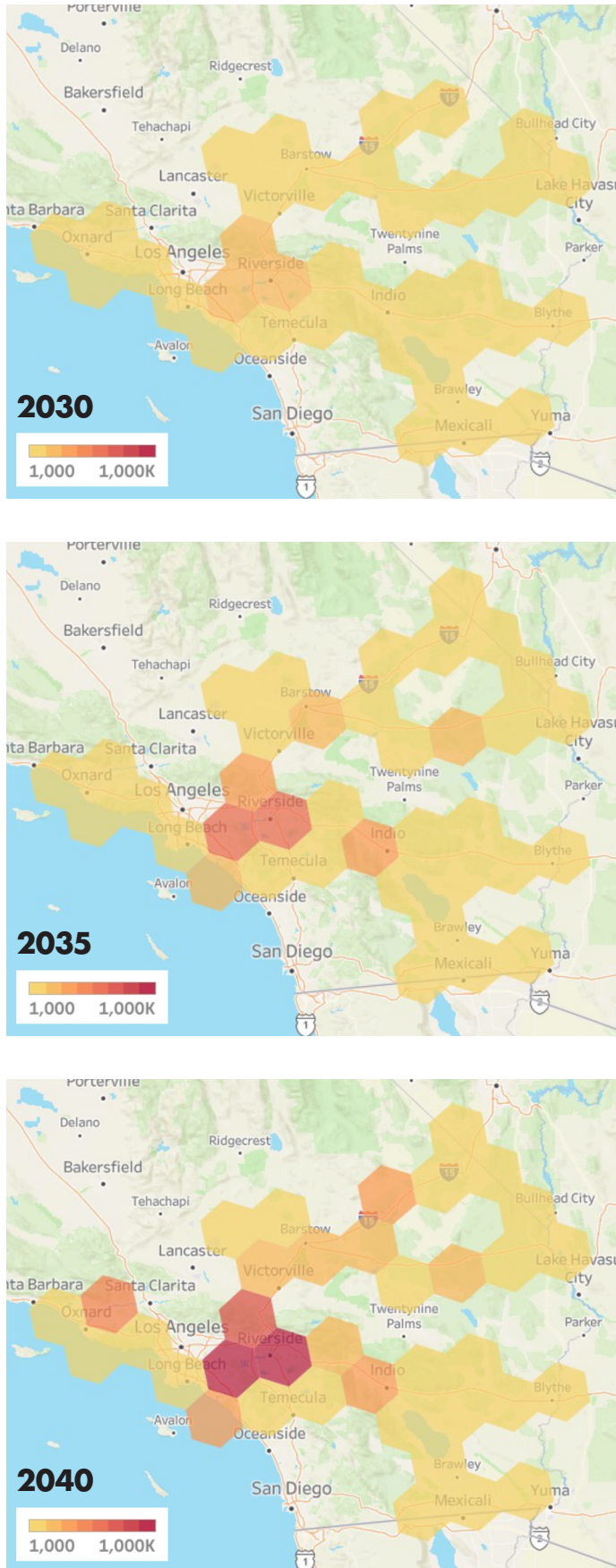
TABLE 7 Total Energy (MW-h) Requirements by County – Horizon Years

COUNTIES	2030	2035	2040
Los Angeles	2,440	6,210	9,880
Riverside	1,190	2,200	3,610
San Bernardino	1,710	3,060	4,910
Orange	830	1,950	2,780
Ventura	340	640	1,180
Imperial	170	340	620
Total	6,680	14,400	22,980

TABLE 8 Public Charging Energy (MW-h) Requirements by County – Horizon Years

COUNTIES	2030		2035		2040	
Los Angeles	1,200	(49%)	3,500	(56%)	5,990	(61%)
Riverside	450	(38%)	960	(43%)	1,530	(42%)
San Bernardino	520	(30%)	1,460	(48%)	2,750	(56%)
Orange	240	(29%)	680	(35%)	1,220	(44%)
Ventura	200	(59%)	240	(38%)	610	(52%)
Imperial	70	(43%)	180	(53%)	280	(45%)
Total	2,680	(40%)	7,020	(49%)	12,370	(54%)

FIGURE 15 SCAG Region Public Energy Demand Heat Map Horizon Years



SMOOTHING ENERGY OUTPUTS

The HEVI-LOAD simulation produces energy requirements that are consistent with AATE3 scenarios at an aggregate level. However, when these results are analyzed at a more granular level, some inconsistencies arise, such as inconsistent spikes in energy demand which overrepresent peak demand, and significant variability in temporal profiles at adjacent sites which did not account for operational behavioral observation such as high energy costs during midday. To address this, the HEVI-LOAD outputs were post-processed to ensure they are relevant for agencies, developers, and operators. This includes aggregating at a larger area scale to normalize adjacent sites, smoothing peak demand to represent truck operations, and developing site charger combinations that align with truck movement. Table 9 summarizes the key performance indicators and necessary adjustments.

The post-processing step integrates spatial and temporal logic, as well as real-world operational norms, including fleet behavior, site operator requirements, and cost constraints. Energy demand from 1,000 public charging sites across California is aggregated into 175 statewide zones, focusing on public charging needs in specific regions. Energy requirements are further adjusted based on truck travel patterns and market segments, with time-of-day considerations. Charging is limited to 35 percent of regional home market energy needs and 20 percent for other markets per hour. Excess demand between 6 pm and 6 am is allocated to depot and regional-home trucks for overnight charging, while public charging for other segments is spread throughout the day based on travel patterns. The results are then validated to ensure alignment with truck movement, with different combinations of site count, charger quantity, and peak grid capacity tested to meet the projected energy needs.

This extensive data collections, analysis, and modeling components of the SCAG ZETI Study help provide confidence in the modeling results. The innovative approach for data analysis and modeling provide our best understanding of future truck travel and energy and fueling needs in the future years.



TABLE 9 Business Case for Post-Processing Energy Outputs

PERFORMANCE INDICATOR	MODEL OUTPUTS	BEHAVIORAL ADJUSTMENT TO BE DESIGNED
Energy Demand by Geography	We observe significant variability in energy demand and temporal profiles at adjacent sites – this is an expected outcome of simulation.	In real life, load balancing will occur (as in highway travel) and we expect somewhat consistent load profiles to show up in nearby sites.
Energy Demand by Time-of-Day	Does not account for electricity rates – charging occurs purely based on travel demand.	Over time, especially for domiciled trucks, will charge during off-peak hours. Some business logic needs to be applied.
Peak Energy Demand	Unconstrained charging results in spiky peak hours thereby driving up peak capacity.	Significant unused capacity means sites are unlikely to be developed.
Site Sizing	Larger sites need more land and significant investment in utility upgrades.	Different combinations of number of chargers and charger capacity can provide more creative solutions to meet energy needs.

SECTION ENDNOTES

- 41** Presentation Material - 2023 IEPR Forecast Overview and Transportation Forecast and Additional Achievable Transportation Electrification (AATE). California Energy Commission. Presentation document, <https://www.bing.com/ck/a?!&&p=3d7db73d0c6122a76d4127e6df95cbda13cf6d5b7bf2167e5e2748b100bf8c8fJmldtHM9MTczNzkzNjAwMA&ptn=3&ver=2&hsh=4&fclid=13a2f7b9-805a-6890-3cc4-e5a1811569d7&psq=Achievable+Transportation+Electrification+Scenario+3+AATE&u=a1aHR0cHM6Ly9lZmlsaW5nLmVuZXXJneS5jYS5nb3YvR2V0RG9jdW1lbnQuYXNweD90bj0yNTMwOTQmRG9jdW1lbnRD90b250ZW50SWQ9ODgyOTg&ntb=1>

5. MODEL RESULTS

To understand where we need to build ZE truck infrastructure in the future, we need to understand where demand will be in the future. This section of the report focuses on those the modeling results and where we expect to see demand in future years. As discussed in the previous section, for EV charging we developed three (3) forecast scenario years, 2030, 2035, and 2040, which were coupled with different adoption rate scenarios to understand which areas within the SCAG region will need the most EV charging investment throughout each of those years and scenarios. For hydrogen fueling we only had 2040 forecast year but that still provides the region and stakeholders with an understanding of where the future need will be and even without step years to understand the incremental growth.

This section will provide an overview of the overall modeling outputs for the SCAG region and each county. The regional understanding helps provide a perspective on overall demand and visualization of growth over time and how intensely each county will grow respective of each other. These will include high level takeaways about growth over time, some of which confirm general consensus that our major freight corridors such as the I-5 and I-10 see significant growth in demand for energy and fueling needs and that the San Pedro Port Complex and downtown Los Angeles region will experience significant demand.

The county by county review provides additional details on how each county will grow and potentially how subregions within the county will change over time. The intent of these results is not to provide a parcel by parcel analysis but to provide a regional view to help guide local stakeholders; local partners have deep insights into their communities and are best equipped to understand which specific parcel or areas can support different site sizes, exact number of chargers and number of hydrogen pumps needed.

The SCAG ZETI modeling outputs will be driving the overall action plans highlighting the need to build now but with an eye to the future, to properly plan for growth and to best account for development moving forward.

MODEL OUTPUT

ELECTRIC VEHICLE CHARGING

The modeling outputs are visualized using the H3 geospatial indexing system. For our Study the energy requirements are aggregated at the H3 resolution 4 level. The hex regions offer a regional-scale view of energy demand over time, with each hexagon representing approximately a 15-mile radius, encompassing charging demand within that area. This hex classification was applied for the years 2030, 2035, and 2040 across the Southern California region. Over this decade, energy demand is expected to evolve, as indicated by the HEVI-LOAD outputs. The larger H3 system approach provides flexibility in assessing energy demand within an area and supports the development of different configurations, addressing potential limitations of the HEVI-LOAD model, and allowing for local stakeholders to direct final site selection.

From the data outputs and analysis, two key observations can be made: first, the highest energy demand can be identified in the short term (2030), and second, the areas where demand will grow over time can be observed. By 2040, a significant increase in demand is anticipated, driven by the Advanced Clean Fleets regulation, which mandates a substantial rise in ZE trucks, and the AATE3 scenario indicating near-full adoption of zero emission heavy-duty and medium-duty trucks. This underscores the need for a robust network of electric vehicle facilities and sufficient energy capacity to support this transition. As energy demand grows with the shift to ZEVs, this change emphasizes the need to future-proof regions expected to experience significant demand by 2040.

Figures 16, 17, and 18 illustrate the spatial distribution of public charging energy demand across sub-regions for 2030, 2035, and 2040. These maps highlight how energy demand for public charging is projected to evolve and identify areas with rising demand.



FIGURE 16 Public Peak Hourly Demand for the SCAG Region in 2030

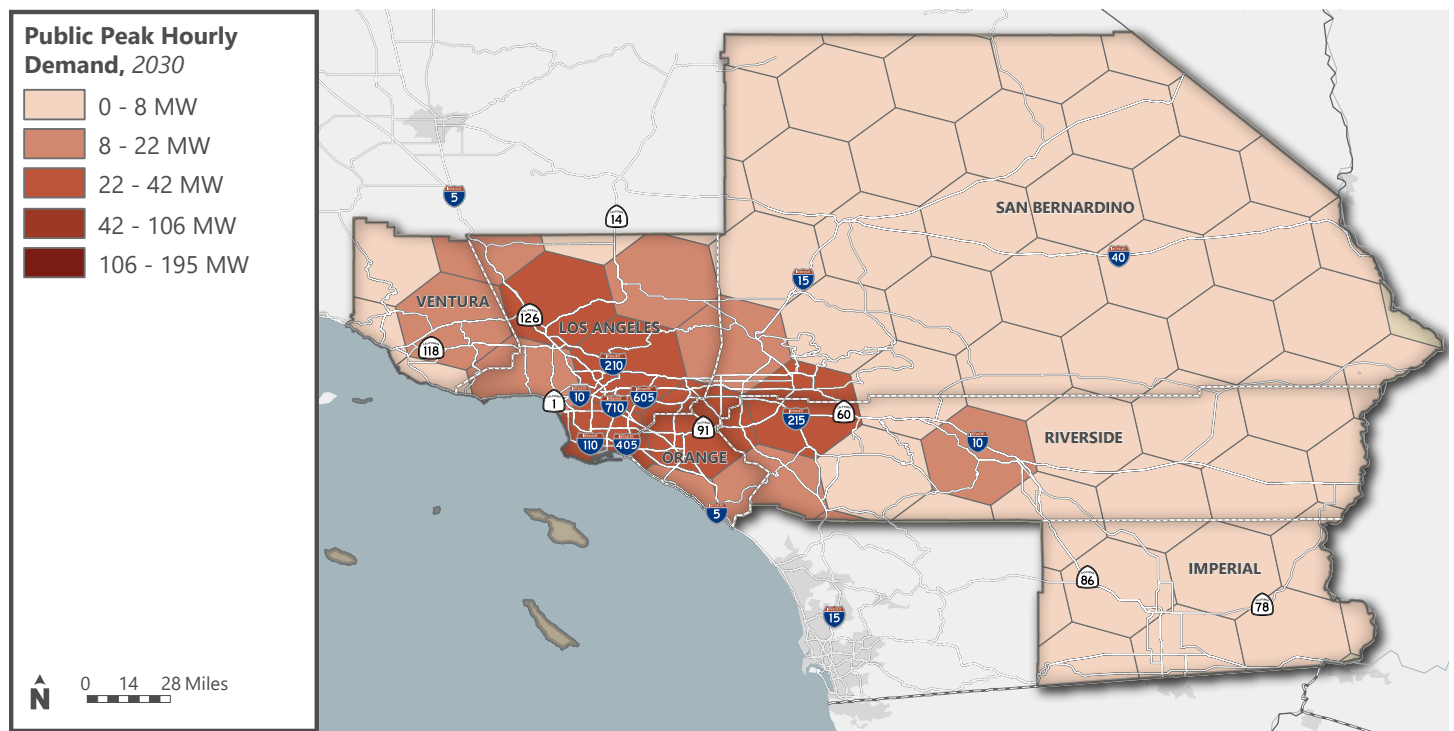


FIGURE 17 Public Peak Hourly Demand for the SCAG Region in 2035

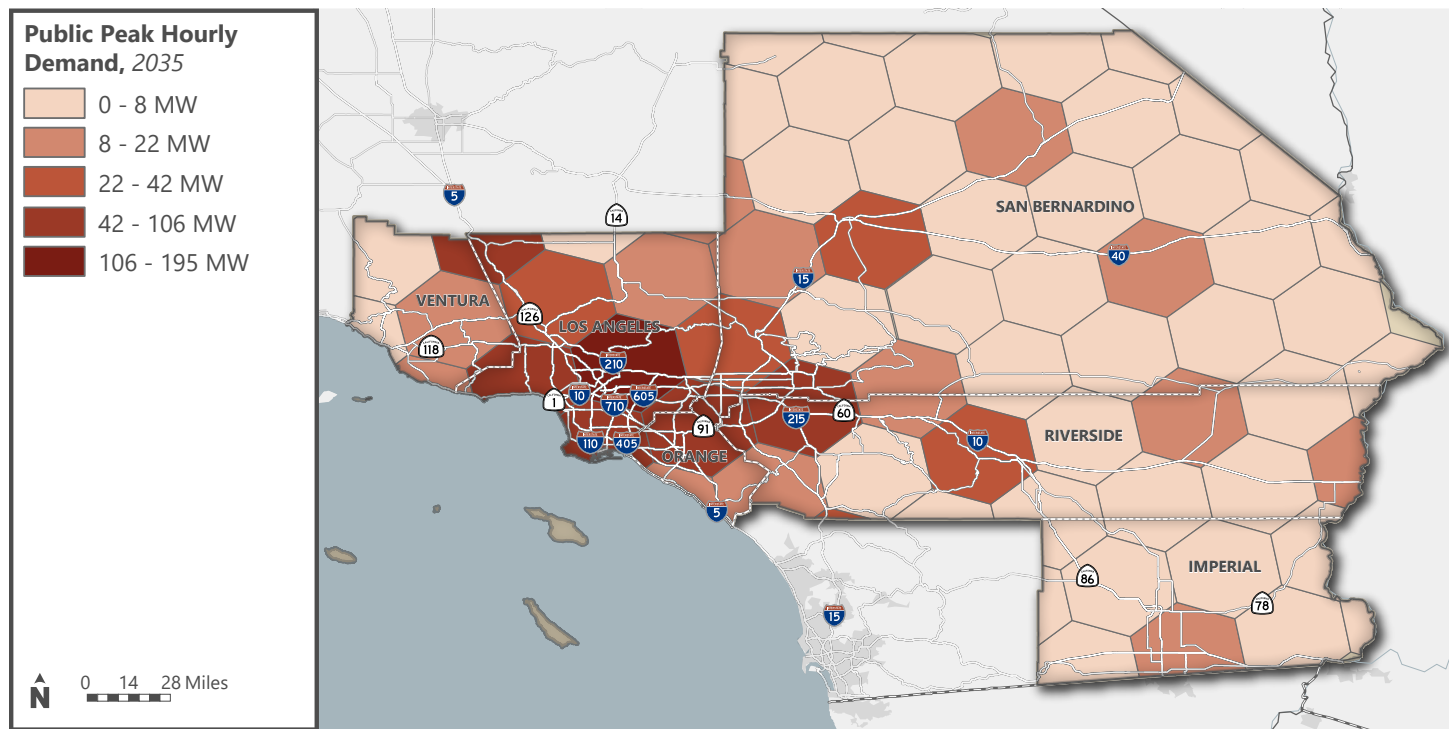


FIGURE 18 Public Peak Hourly Demand for the SCAG Region in 2040

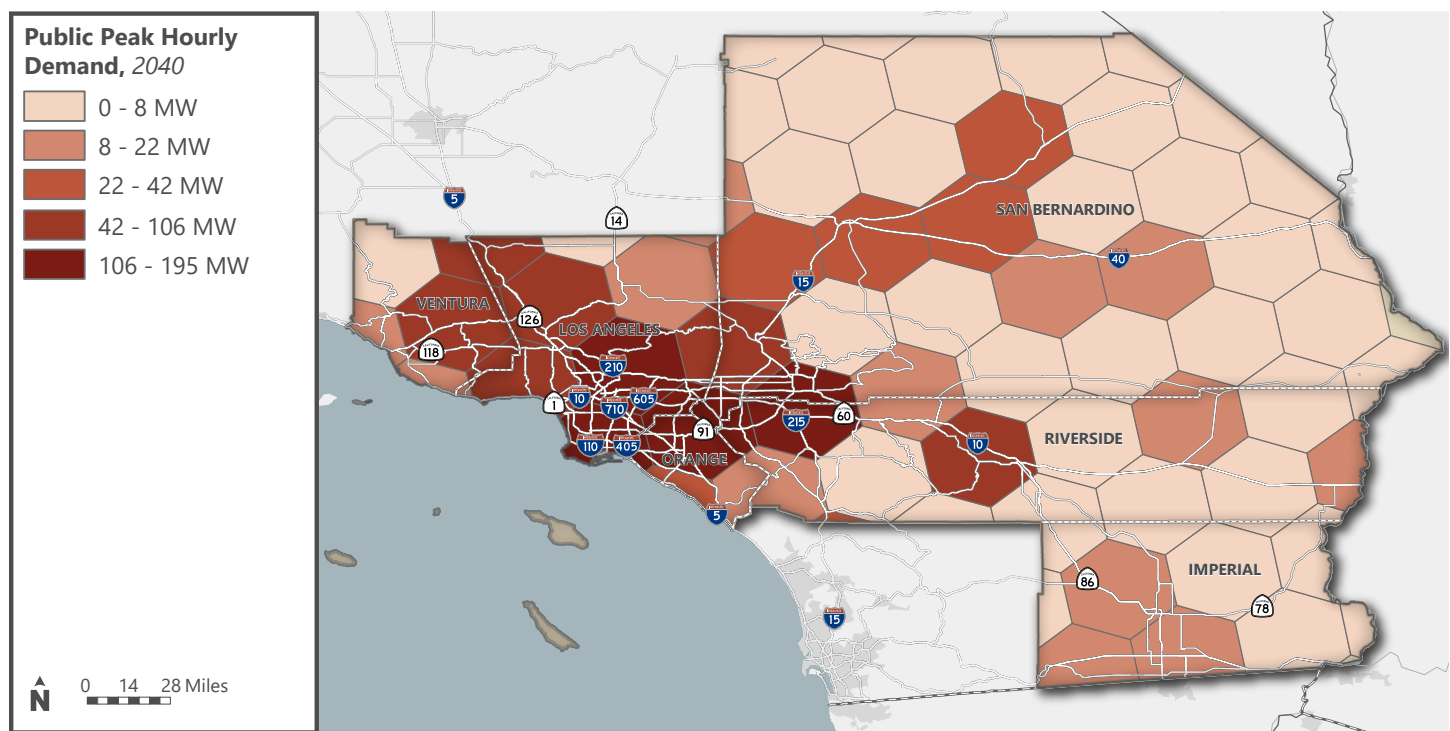


TABLE 10 Energy Demand at the County Level*

COUNTY	2030		2035		2040	
Los Angeles	2,380	(1,160)	5,800	(3,180)	8,900	(5,290)
San Bernardino	1,240	(440)	2,380	(1,330)	3,990	(2,460)
Riverside	1,120	(410)	2,390	(1,070)	3,850	(1,850)
Orange	770	(310)	1,610	(700)	2,630	(1,390)
Ventura	280	(160)	740	(350)	1,360	(790)
Imperial	110	(80)	220	(170)	490	(330)
Total (Public)	5,890	(2,560)	13,150	(6,790)	21,220	(12,110)

* Aggregated at the Hex 4 level. The numbers in parentheses represent the energy demand for public charging sites.

TABLE 11 Energy Demand by Market Segment

MARKET SEGMENT	2030	2035	2040
Drayage - HDT	287,810	291,800	288,395
Long Haul - HDT	1,388,028	4,505,541	8,410,000
Long Haul - MDT	7,849	18,755	38,855
Regional Home - HDT	308,547	207,495	248,966
Regional Home - MDT	3,470	8,407	13,137
Regional Non-home - HDT	88,660	563,129	1,320,228
Regional Non-home - MDT	478,095	1,196,375	1,789,266
Total	2,562,458	6,791,502	12,108,847

While the regional comparison over time in the SCAG region provides a broader view, it is crucial to focus on the county level to better understand how energy demand and its locations will change over time. As shown in Table 10, Los Angeles County accounts for the largest share of energy demand, representing 40 percent of total demand and 45 percent of public demand. Riverside follows with 19 percent of total demand and 16 percent of public demand, while San Bernardino accounts for 21 percent of total demand and 17 percent of public demand.

As shown in Table 10, energy demand in the SCAG region is primarily driven by HDTs, particularly the Long Haul HDT segment, which accounts for the largest share of energy consumption in most areas. Regional Non-Home HDTs are the next major contributors. Drayage trucks represent a smaller portion of the demand, such as in the hex area covering the San Pedro Bay ports. MDTs, especially Regional Non-Home MDTs, typically make up a smaller share of the total energy demand due to the smaller number of trucks in the market segment, as well as short routes and smaller batteries.

ENERGY MODELING TO INFRASTRUCTURE

Energy modeling generates both peak hour energy demand and total energy requirements, which are crucial for determining charger capacity and site specifications. Peak hourly energy demand directly influences the capacity needed for chargers and the overall site requirements. Utilization is assessed by comparing charger capacity to hourly energy demands. To develop

an understanding for the site sizes, the number of chargers per site and infrastructure needs, as well as site typologies were developed. In general, small sites have up to ten (10) chargers, medium sites have 25 chargers, and larger sites have 40 chargers. The details of the site typologies can be found in Section 6 Site Assessments.

The amount of energy needed is not the only factor in the selection of sites and chargers; their location within the SCAG region also plays a role. For instance, it would be unreasonable to expect a large site in downtown Los Angeles. While higher capacity chargers may strain the grid in dense areas, they can also save space by reducing the need for multiple lower-capacity chargers. To ensure that our analysis addressed for this, the project team created a site selection and EV charger mix approach that accounted for density of an area and scaled the development of sites and chargers accordingly. These sites can be located throughout SCAG. To help with potential locations, the project team developed potential candidate sites from existing truck parking, well-defined warehousing locations, and at critical points along the interstate and state highway system. These are meant as a regional guide. The exact size of sites, number of chargers, and power levels, can be tailored to fit community context and needs depending on the implementing agency.

TABLE 12 Site Selection Mix

DENSITY	SITE TYPE			
	SMALL	MEDIUM	LARGE	TOTAL
High	50%	50%	0%	100%
Medium	30%	50%	20%	100%
Low	25%	25%	50%	100%

TABLE 13 EV Charger Mix

POPULATION AND EMPLOYMENT DENSITY	CHARGER TYPE IN KW-H				
	150	350	750	1000	TOTAL
High	20%	20%	50%	10%	100%
Medium	30%	30%	30%	10%	100%
Low	30%	40%	30%	0%	100%

TABLE 14 Chargers and Site Requirements for the SCAG Region

PEAK HOUR PUBLIC CHARGING ENERGY DEMAND (KW-H)		2030	2035	2040
Number of Chargers	150 kW Chargers	134	364	498
	350 kW Chargers	136	382	739
	750 kW Chargers	271	705	1,294
	1000 kW Chargers	55	133	248
	Total Chargers	596	1,584	2,779
Number of Sites	Small Sites	36	50	71
	Medium Sites	21	46	76
	Large Sites	0	3	13
	Total Sites	57	99	160

HYDROGEN FUELING

Over the next decade, hydrogen fuel demand in Southern California is projected to rise as the region's hydrogen fuel infrastructure expands. The projects from the AATE3 scenario for hydrogen fuel consumption are based on a full transition to hydrogen in 2040 and not future a scenario of mixed ZE trucks, so no battery electric trucks are simulated in the hydrogen fueling scenario in 2040. The state has yet to develop a mixed scenario to model a potential future of both EV and hydrogen-fueled trucks. As this infrastructure develops, the demand for hydrogen, especially in the long-haul transportation sector, is expected to continue growing. Table 15 outlines hydrogen fuel consumption by county. Unlike energy requirements for ZEVs, hydrogen fuel consumption in 2040 is highest in San Bernardino and Riverside counties, followed by Los Angeles County. San Bernardino alone accounts for over half of the projected hydrogen fuel

consumption, while Riverside accounts for 21 percent and Los Angeles accounts for 14 percent. Across the region, hydrogen fuel demand is concentrated along major interstates, particularly I-10, I-15, and I-40, where freight and Long Haul HDTs are key contributors to consumption. It is important to note that hydrogen fuel consumption or demand is based on total demand for fuel, whereas EV charging demand is measured at peak capacity, which is why the equivalent EV energy consumption is higher than the aggregated total at the county level.

Table 16 presents the hydrogen site requirements for 2040. Medium sites are expected to make up 44 percent of the total. As shown in Table 16, hydrogen fuel consumption in the SCAG region is primarily driven by the Long Haul HDT segment, which accounts for 65 percent of the total consumption. Regional Non-Home HDTs follow with 27 percent, while Regional Home and Drayage trucks represent a smaller share, accounting for less than 10 percent.

TABLE 15 Total Hydrogen Fuel Consumption in 2040 by County

COUNTY	TOTAL H2 FUEL CONSUMPTION (KG)	EQUIVALENT EV ENERGY CONSUMPTION (KW-H)
Imperial	29,370	978,896
Los Angeles	104,663	3,488,405
Orange	16,811	560,323
Riverside	160,339	5,344,099
San Bernardino	415,560	13,850,625
Ventura	13,452	448,339
Total	740,195	24,670,686



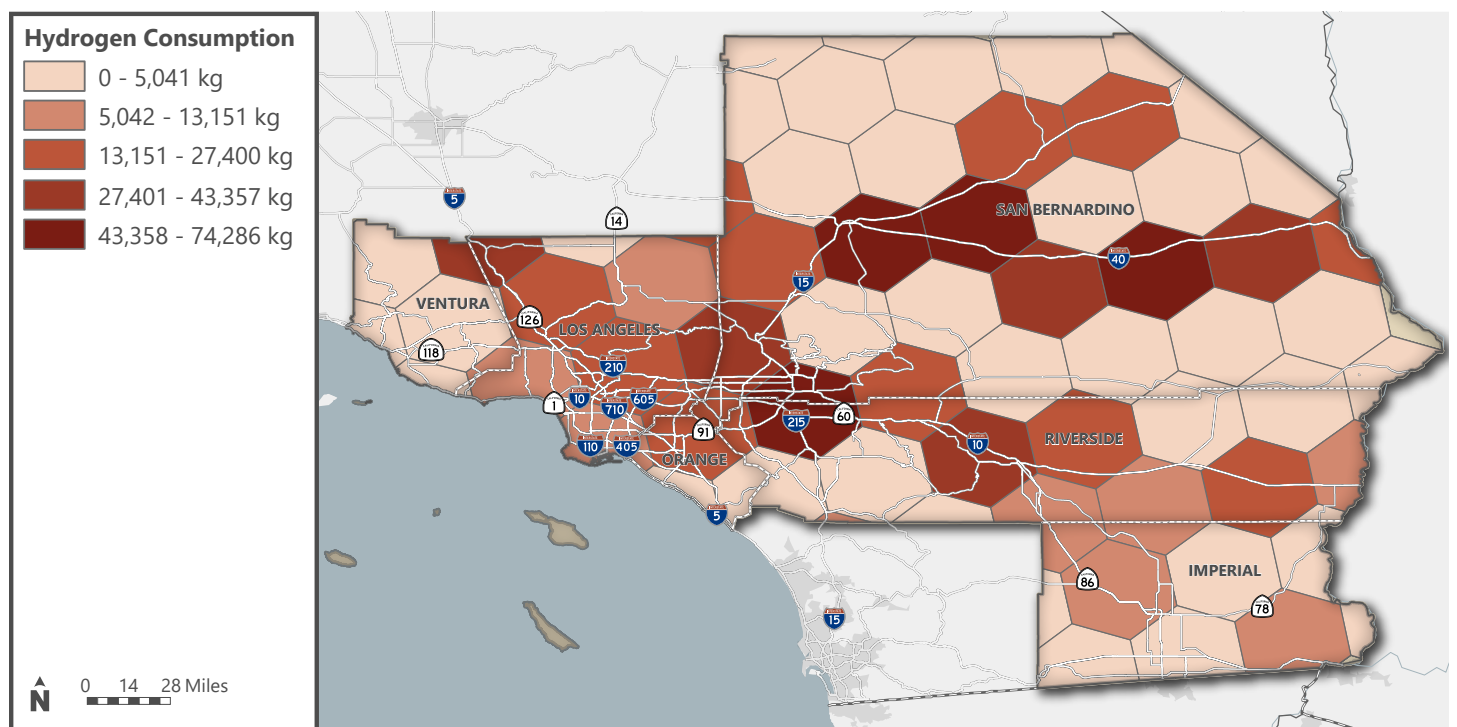
TABLE 16 Hydrogen Site Requirements for the SCAG Region

NUMBER OF SITES	2040
Small Sites	95
Medium Sites	118
Large Sites	53
Total Sites	266

TABLE 17 Total Hydrogen Fuel Consumption for the SCAG Region by Market Segment

MARKET SEGMENT	2040
Drayage - HDT	288,395
Long Haul - HDT	8,410,000
Long Haul - MDT	38,855
Regional Home - HDT	248,966
Regional Home - MDT	13,137
Regional Non-home - HDT	1,320,228
Regional Non-home - MDT	1,789,266
Total	12,108,847

FIGURE 19 Hydrogen Fuel Consumption for the SCAG Region in 2040



CHARGING AND FUELING NEEDS BY COUNTY

The SCAG region encompasses six counties: Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura. This section provides a detailed breakdown of the energy demand, charging needs, and potential site locations in each county. Los Angeles County has the highest energy demand and density of potential locations, followed by the Inland Empire, which includes San Bernardino and Riverside counties, for 2030 and 2040. This reflects the distribution of warehousing facilities in Los Angeles County, as well as the rapid growth of warehousing facilities in Riverside and San Bernardino counties.

As discussed above, the largest need for hydrogen is in San Bernardino and Riverside counties in 2040 and is primarily driven by Long Haul HDTs along major interstate corridors. In addition to hydrogen fueling needs by county, there will be a recommendation for the potential number of fueling nozzles to help understand the scale of infrastructure needed to support the demand in the region.



LOS ANGELES COUNTY

EV CHARGING

Los Angeles is projected to have the highest energy requirements in the region, with the greatest demand expected in the hex areas covering the San Pedro Bay ports, Los Angeles International Airport, and East Los Angeles. The Ports of Los Angeles and Long Beach, which comprise the San Pedro Bay Ports, form the largest container port complex in the country. These areas are home to a high concentration of warehouses, logistics, and distribution centers, and are located near major highways including I-710, I-405, I-110, and I-605. Similarly, East Los Angeles is a crucial industrial and logistical hub, linking Los Angeles to the Inland Empire. Other regions with high projected energy requirements include hex areas along I-5, which is vital for transporting agricultural and industrial products to the Central Valley. Figures 20, 21, and 22 illustrate how the energy demand evolves over time.

Energy demand is primarily driven by HDTs, with Long Haul HDTs accounting for the majority of consumption, as shown in Table 18. MDTs, particularly Regional Non-Home MDTs, contribute a smaller portion in these regions. Across all hex areas in the county, at least 60 percent of energy demand is driven by Long Haul HDTs. In some areas, this proportion is even higher. For example, the hex area on the edge of the study area boundary along I-5, leading to the Central Valley, relies entirely on HDTs, with 100 percent of the energy demand coming from these vehicles. Of this, 94 percent is used by Long Haul HDTs, and 5 percent by Drayage HDTs.

There is more truck market segment variability in other parts of LA County. For instance, the hex area covering the San Pedro Bay ports sees 66 percent of the energy demand from Long Haul HDTs, 18 percent from Regional Non-Home MDTs, 10 percent from Regional Non-Home HDTs, and 6 percent from Drayage HDTs. Similarly, in the hex region that includes East Los Angeles, Long Haul HDTs account for 66 percent of the energy demand, followed by 24 percent from Regional Non-Home MDTs and 8 percent from Regional Non-Home HDTs. The variety of truck market segments in this region is directly related to the freight activity at the Port and intermodal yards.

In some cases, the hex region spans two counties. For example, Pomona is located within a hex region that covers both LA and Orange counties. Pomona is home to BNSF and Union Pacific Intermodal facilities, as well as warehousing and distribution centers. While results show high activity for an entire hex, specific locations can be the main drivers for energy demand and freight activity.

FIGURE 20 Public Peak Hourly Demand for LA County in 2030

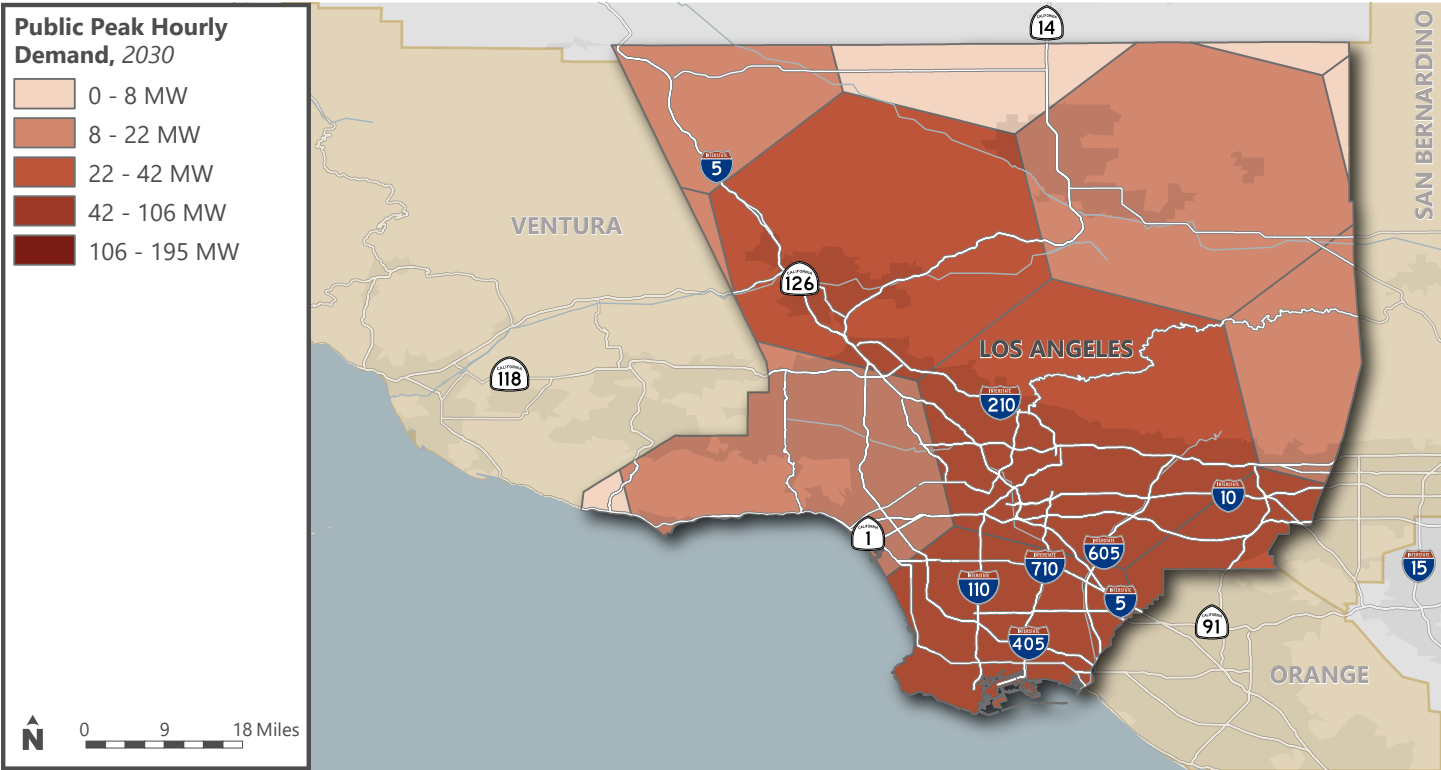


FIGURE 21 Public Peak Hourly Demand for LA County in 2035

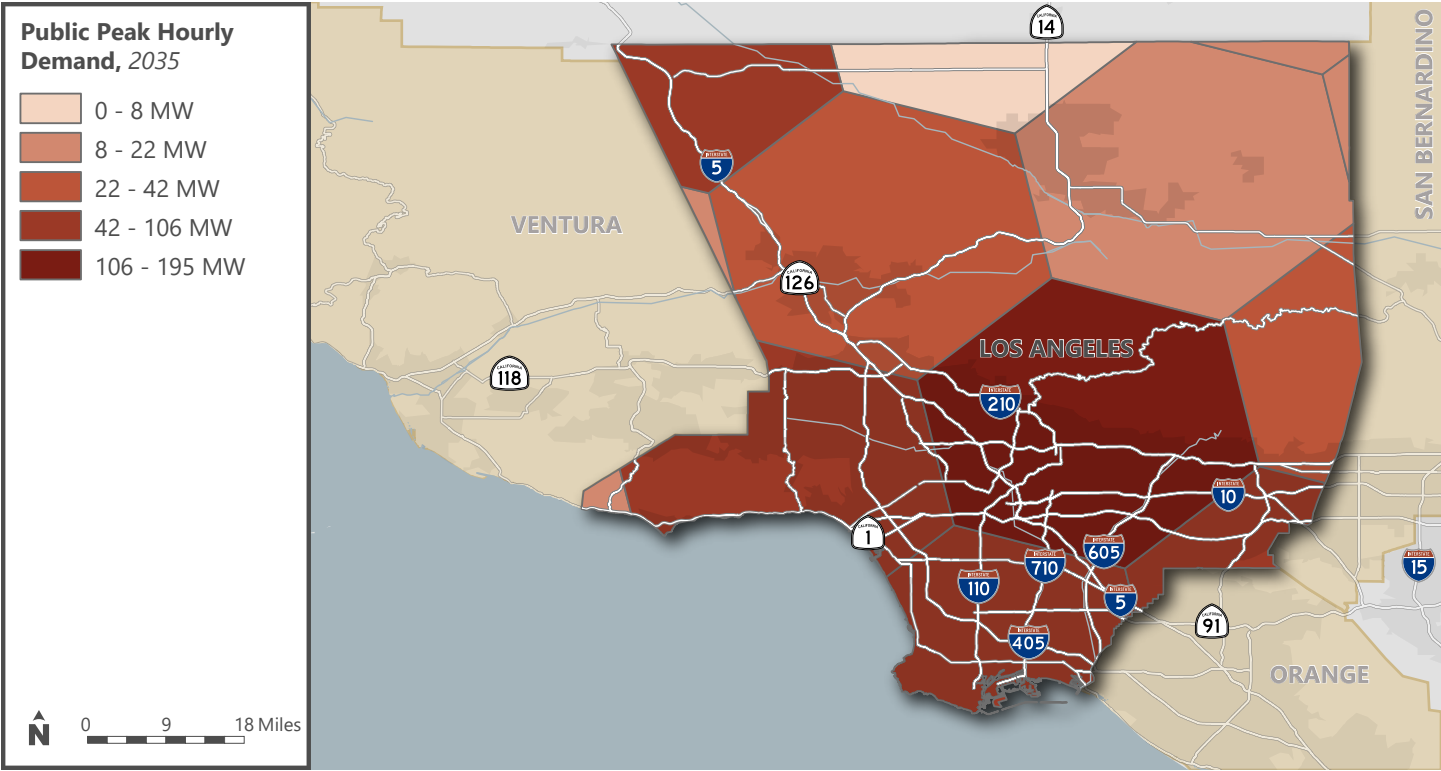


FIGURE 22 Public Peak Hourly Demand for LA County in 2040

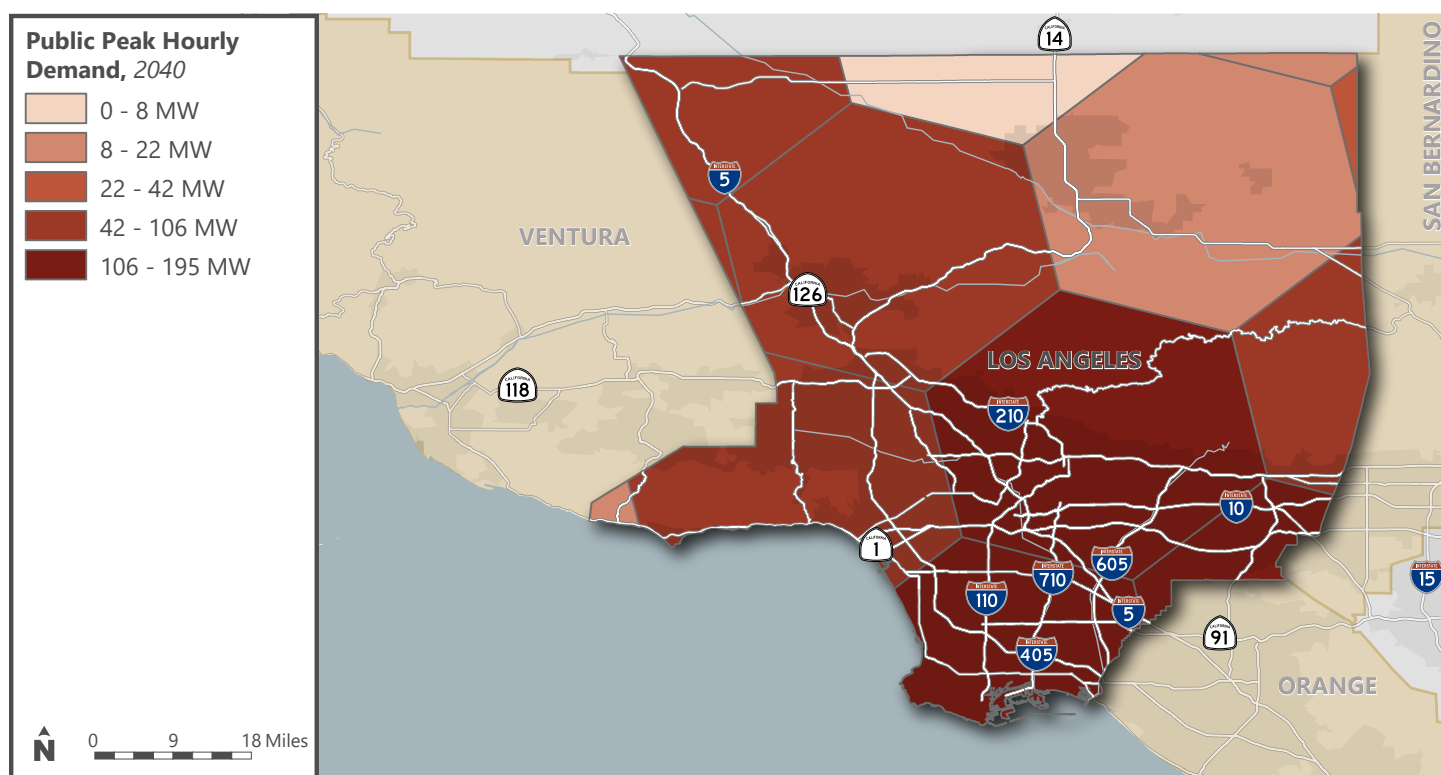


TABLE 18 Energy Demand by Market Segment for Los Angeles County*

MARKET SEGMENT	2030		2035		2040	
Drayage - HDT	204,772	(149,895)	183,868	(122,394)	171,199	(119,448)
Long Haul - HDT	742,925	(636,056)	2,389,571	(2,031,041)	4,144,157	(3,639,014)
Long Haul - MDT	2,870	(2,392)	7,136	(6,216)	15,559	(12,726)
Regional Home - HDT	370,655	(45,038)	597,197	(86,994)	569,963	(102,552)
Regional Home - MDT	449,321	(772)	961,274	(1,816)	1,383,219	(2,568)
Regional Non-home - HDT	98,568	(37,945)	420,147	(208,055)	772,476	(336,487)
Regional Non-home - MDT	509,139	(288,540)	1,240,985	(719,471)	1,847,796	(1,072,200)
Total	2,378,251	(1,160,637)	5,800,177	(3,175,985)	8,904,369	(5,284,994)

* Aggregated at the Hex 4 level. The numbers in parentheses represent the energy demand for public charging sites.

Los Angeles County has the highest number of charger requirements and the greatest density of potential EV charging sites in the region. The potential number of chargers is expected to rise significantly, from 235 in 2030 to 1,103 between 2030 and 2040, using the EV charger power mix, reflecting a substantial increase in charging demand. Similarly, the number of charging site locations is projected to grow from 15 in 2030 to 63 in 2040. Table 19 shows a breakdown of the site and charging requirements in the county.

As shown in Figure 23, most potential charging locations are concentrated near major freeways such as I-5 and I-10, in the South Bay area, and around the Port of Long Beach and Port of Los Angeles. By 2040, charging demand is expected to further concentrate in downtown areas and along freeways. Given the high demand, it is unlikely that any single parcel will be able to accommodate all the trucks and chargers required in the Downtown Los Angeles area.

FIGURE 23 Potential Site Locations in LA County

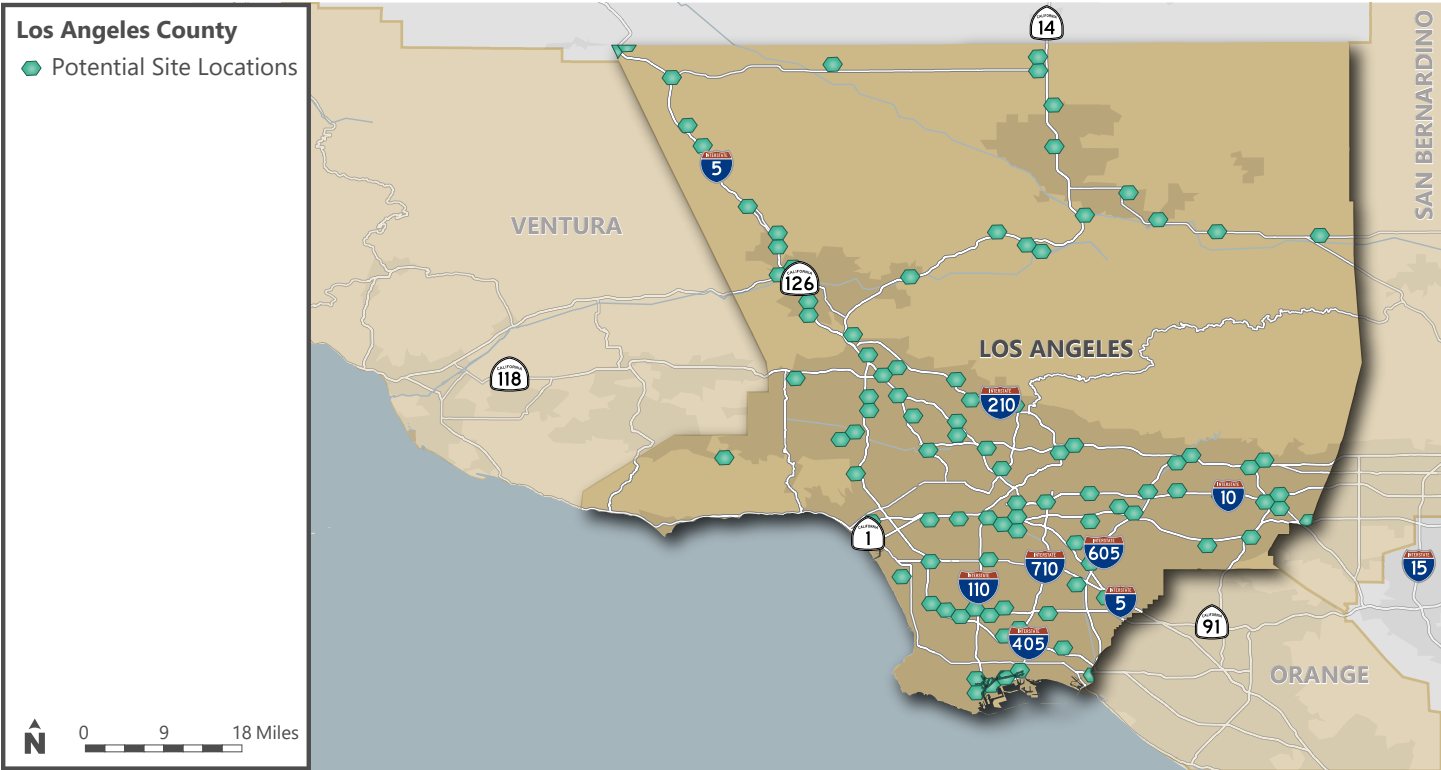
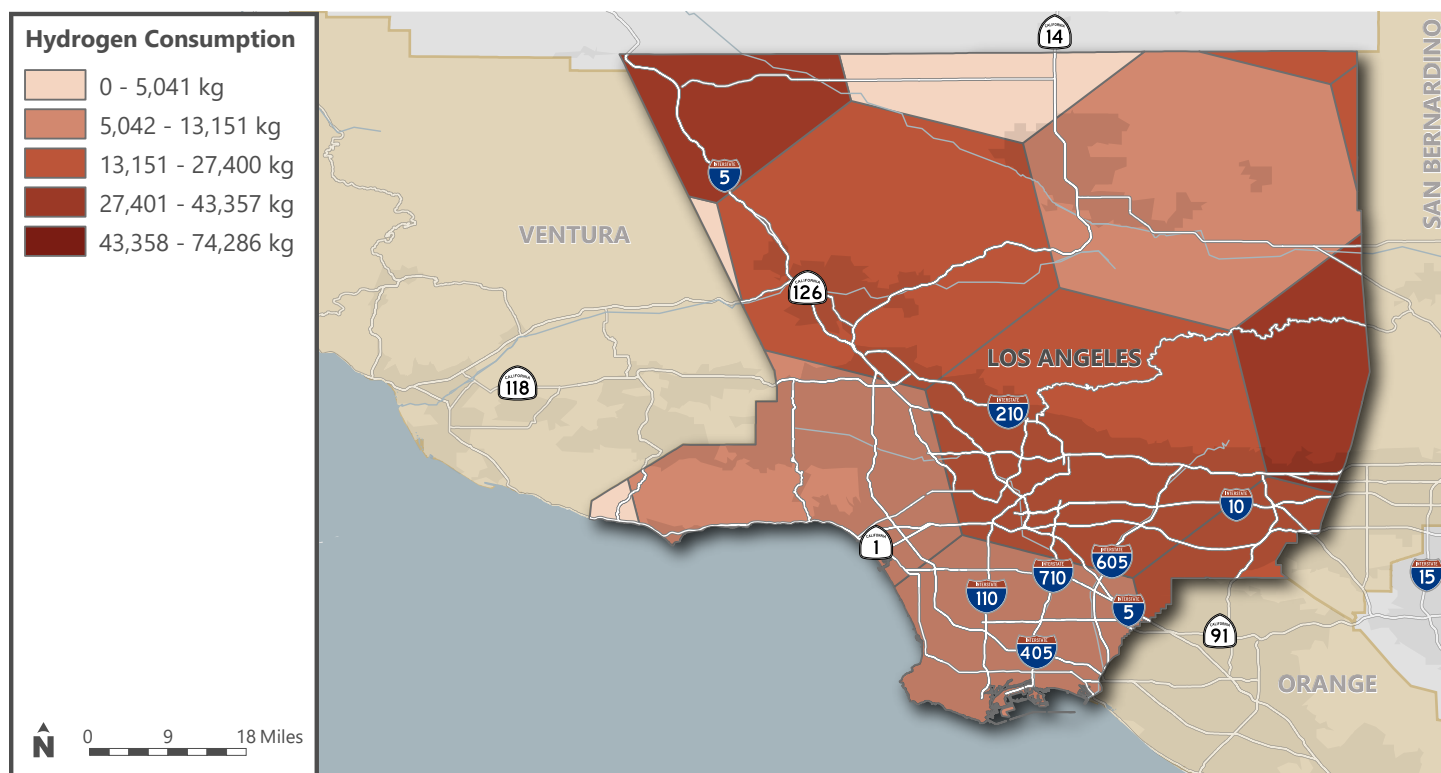


TABLE 19 Chargers and Site Requirements in LA County

PEAK HOUR PUBLIC CHARGING ENERGY DEMAND (KW-H)		2030	2035	2040
Number of Chargers	150 kW Chargers	47	135	227
	350 kW Chargers	48	137	228
	750 kW Chargers	115	322	540
	1000 kW Chargers	25	64	108
	Total Chargers	235	658	1,103
Number of Sites	Small Sites	6	17	29
	Medium Sites	9	20	33
	Large Sites	0	0	1
	Total Sites	15	37	63



FIGURE 24 Hydrogen Fuel Consumption for Los Angeles County in 2040



HYDROGEN FUELING

Los Angeles County has the third-highest hydrogen fuel requirements in the region, following San Bernardino and Riverside. Long haul HDTs drive 70 percent of the demand, with Regional Non-Home HDTs accounting for 20 percent. After Imperial County, Los Angeles has the highest share of demand from drayage trucks at 7 percent. Although the San Pedro Bay ports are expected to replace diesel-powered cargo-handling equipment with hydrogen fuel cell equivalents, the highest demand remains along the I-5. Figure 24 illustrates the projected hydrogen fuel consumption.

Table 20 presents the hydrogen site requirements for 2040 in Los Angeles County, with medium sites projected to comprise 53 percent of the total, followed by small sites at 45 percent. As indicated in Table 21, hydrogen fuel consumption in the county is predominantly driven by the Long Haul HDT segment, which accounts for 68 percent of total consumption.

TABLE 20 Hydrogen Site Requirements in Los Angeles County

NUMBER OF SITES	2040
Small Sites	22
Medium Sites	26
Large Sites	1
Total Sites	49

TABLE 21 Total Hydrogen Fuel Consumption by Market Segment for Los Angeles County

MARKET SEGMENT	2040
Drayage - HDT	7,113
Long Haul - HDT	71,091
Regional Home - HDT	4,667
Regional Non-home - HDT	21,791
Total	104,663

* Aggregated at the Hex 4 level.

SAN BERNARDINO COUNTY

EV CHARGING

San Bernardino County has the second-highest energy demand, with the majority of this demand concentrated in the southwestern part of the county.

Key areas with high energy demand include Ontario and Rancho Cucamonga, both of which house significant industrial and logistics infrastructure. Ontario is home to the Ontario International Airport, a major air cargo hub in the Inland Empire, and numerous distribution centers and industrial parks serving major retailers. As shown in Table 22, energy demand in these areas is primarily driven by HDTs, with Long Haul HDTs and Regional Non-Home HDTs being the largest contributors. In the hex region covering Ontario and Rancho Cucamonga, HDTs are responsible for 89 percent of the total energy consumption by 2040, with MDTs contributing the remaining 11 percent. Of the HDT energy demand, 72 percent is attributed to Long Haul HDTs, while 9 percent comes from Regional Non-Home HDTs.

The hex area covering Bloomington, Rialto, and Fontana is also projected to experience high energy demand, driven by key facilities such as the Inland Empire Intermodal Terminal in Fontana, along with industrial parks in Rialto and Fontana. These areas benefit from their proximity to major highways, including the I-10 and I-15. The energy demand distribution in this area is 66 percent for Long Haul HDTs, 16 percent for Regional Non-Home HDTs, and 11 percent for Regional Non-Home MDTs.

Over time, energy requirements in San Bernardino County are projected to increase, particularly in hex areas along the I-15 and I-40 corridors. Barstow is a key location, home to significant rail yards operated by both Union Pacific Railroad and BNSF Railway. Additionally, several warehouse and distribution centers are situated in Barstow and the surrounding areas, especially along the I-15 and I-40 highways. This rising demand is largely driven by HDTs, with the greatest contributions from Long Haul and Regional Non-Home HDTs.



FIGURE 25 Public Peak Hourly Demand for San Bernardino County in 2030

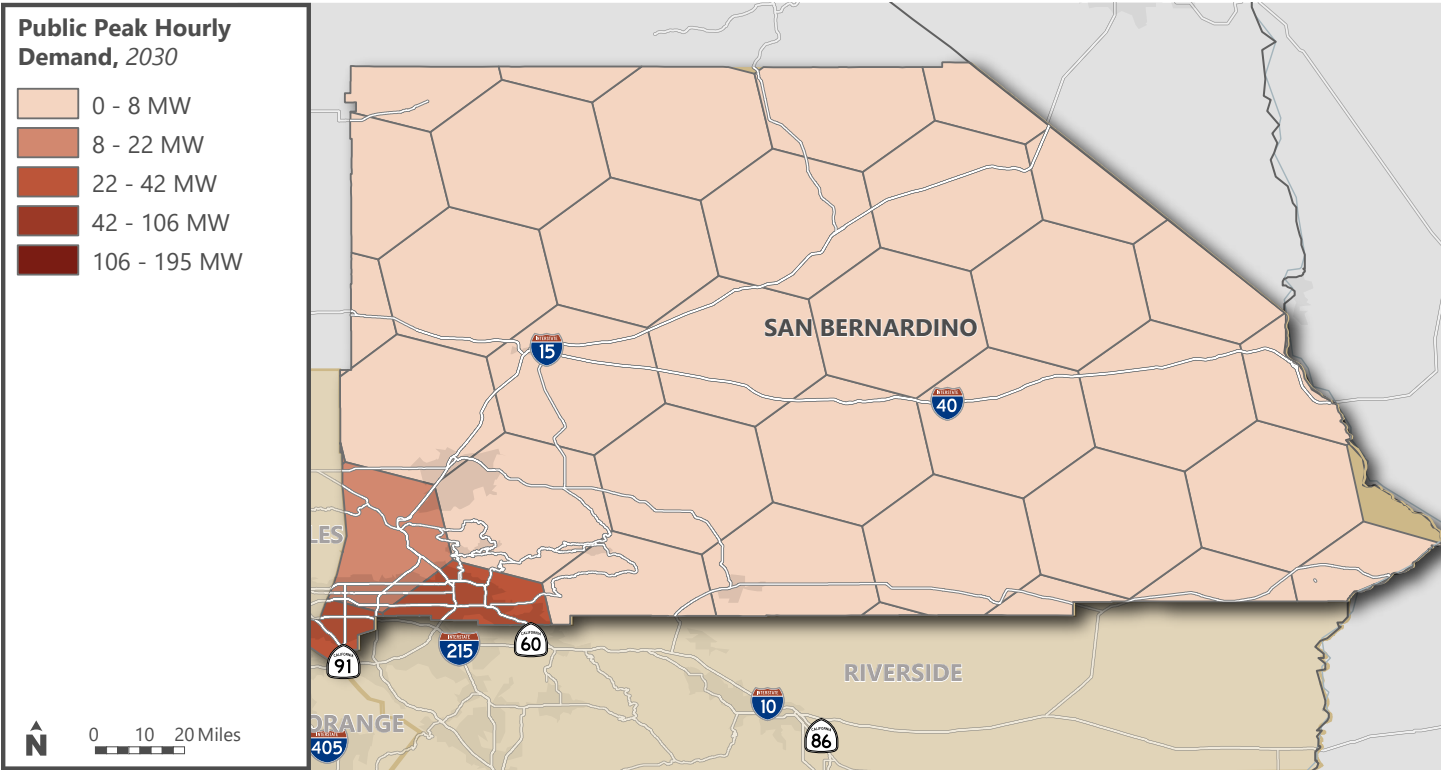


FIGURE 26 Public Peak Hourly Demand for San Bernardino County in 2035

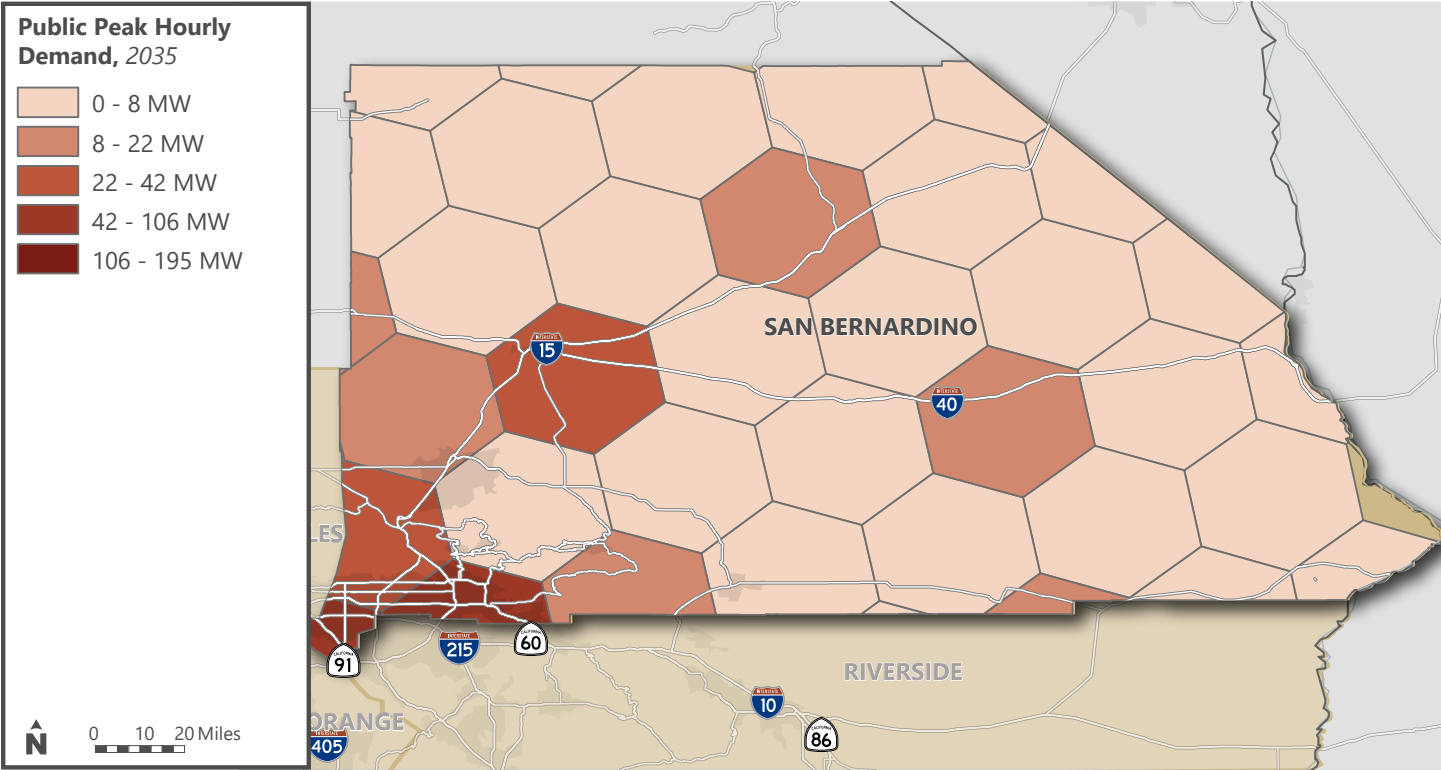


FIGURE 27 Public Peak Hourly Demand for San Bernardino County in 2040

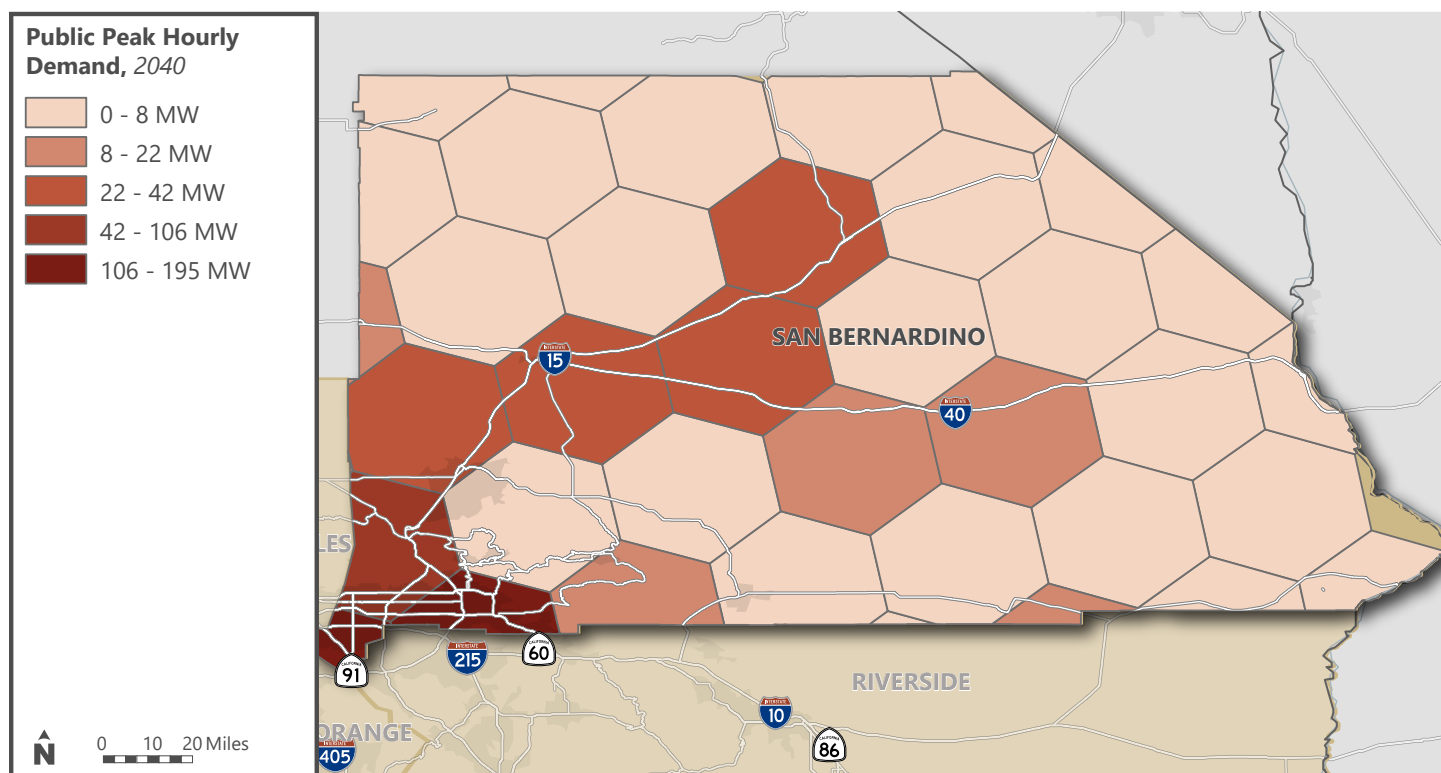


Table 23 presents the charging and site requirements for San Bernardino County over time. The potential number of chargers is projected to increase significantly, from 124 in 2030 to 520 between 2030 and 2040, reflecting rising demand. Similarly, the total number of sites is expected to double from 18 in 2030 to 36 in 2040.

Figure 28 illustrates the distribution of potential charging locations, with the majority concentrated along the I-10, I-15, and I-40 corridors. Notable clusters of charging sites are also found in Barstow, Ontario, and Bloomington. By 2040, two charging locations along the I-15 emphasize the need for en-route charging sites, which are not tied to specific trip ends or destinations.

TABLE 22 Energy Demand by Market Segment for San Bernardino County*

MARKET SEGMENT	2030		2035		2040	
Drayage - HDT	82,242	(60,341)	92,310	(78,734)	92,087	(78,530)
Long Haul - HDT	488,729	(255,901)	1,205,897	(947,441)	2,373,556	(1,930,062)
Long Haul - MDT	3,050	(2,575)	7,232	(5,342)	14,109	(10,948)
Regional Home - HDT	290,797	(52,194)	263,648	(58,420)	267,947	(69,067)
Regional Home - MDT	97,124	(1,560)	214,517	(3,929)	310,705	(6,310)
Regional Non-home - HDT	184,882	(24,772)	371,968	(131,510)	580,477	(208,843)
Regional Non-home - MDT	91,760	(42,987)	227,919	(105,327)	348,629	(160,247)
Total	1,238,585	(440,330)	2,383,492	(1,330,703)	3,987,510	(2,464,006)

* Aggregated at the Hex 4 level. The numbers in parentheses represent the energy demand for public charging sites.

FIGURE 28 Potential Site Locations in San Bernardino County

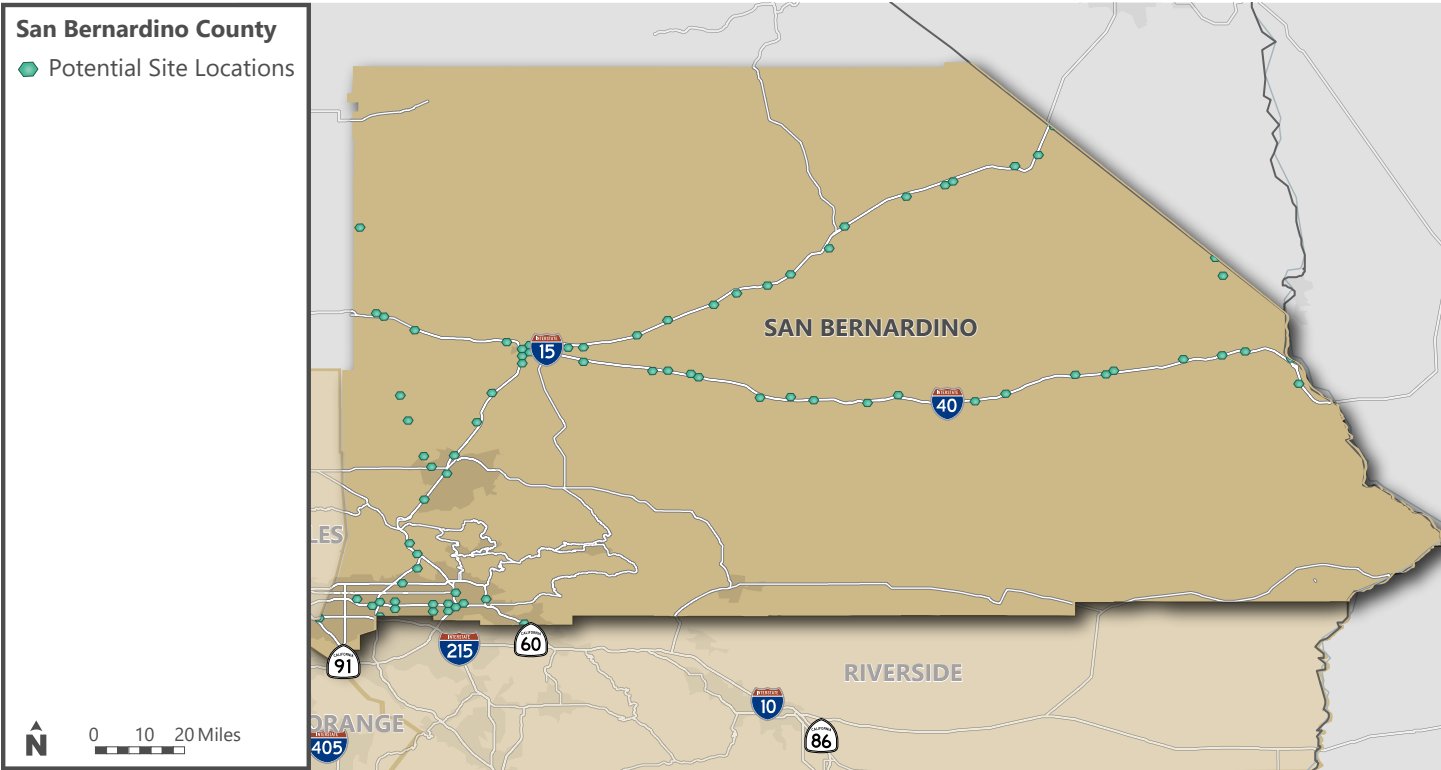
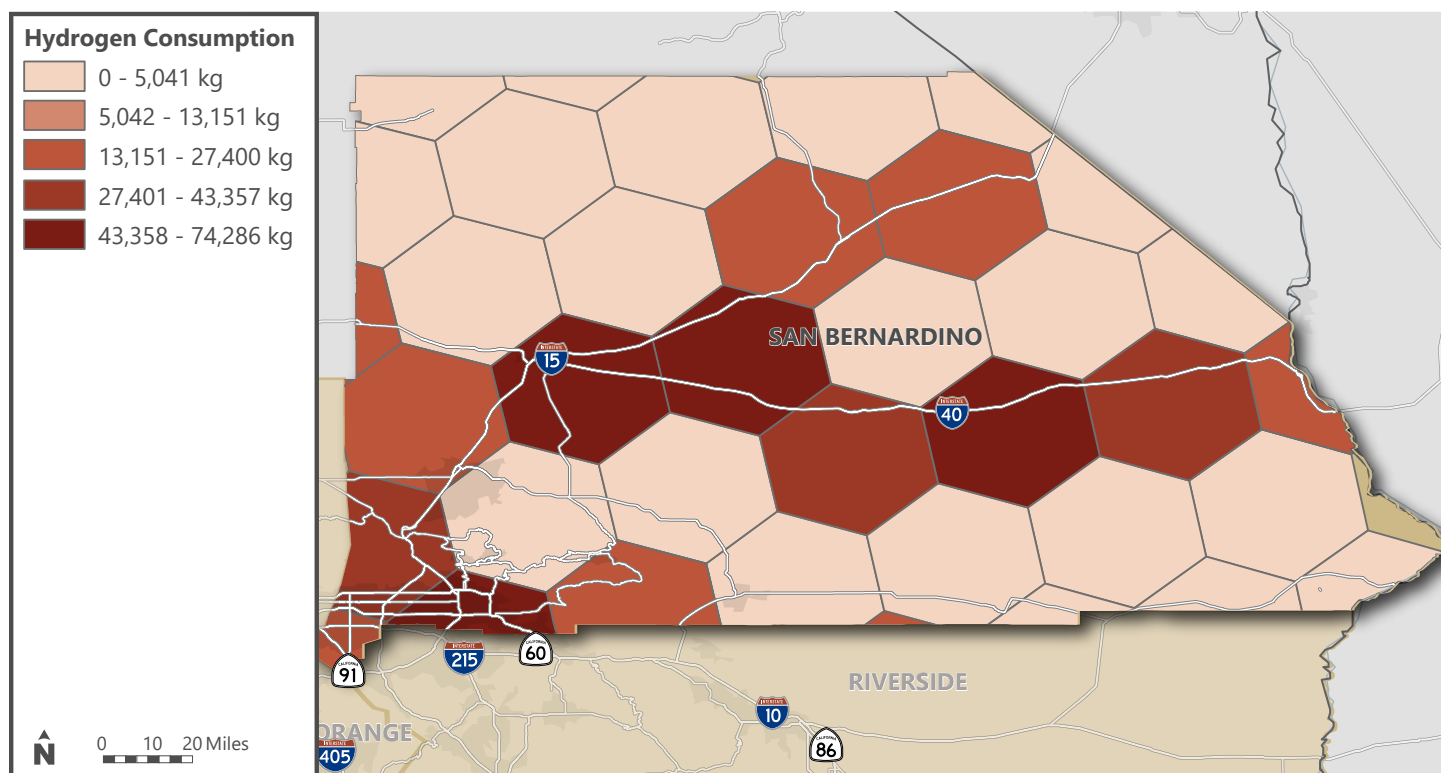


TABLE 23 Chargers and Site Requirements in San Bernardino County

PEAK HOUR PUBLIC CHARGING ENERGY DEMAND (KW-H)		2030	2035	2040
Number of Chargers	150 kW Chargers	35	108	1
	350 kW Chargers	34	111	220
	750 kW Chargers	47	135	260
	1000 kW Chargers	8	22	39
	Total Chargers	124	376	520
Number of Sites	Small Sites	14	12	15
	Medium Sites	4	9	13
	Large Sites	0	3	8
	Total Sites	18	24	36



FIGURE 29 Hydrogen Fuel Consumption for San Bernardino County in 2040



HYDROGEN FUELING

San Bernardino County has the largest hydrogen fuel requirements in the SCAG region by 2040. This demand is primarily driven by Long Haul HDTs, which account for 65 percent. Regional Non-Home HDTs follow at nearly 30 percent, the largest share in the region. Meanwhile, Regional Home HDTs and drayage trucks together make up just over 5 percent. The highest demand is concentrated in areas along the I-15 and I-40. Figure 29 illustrates the projected hydrogen fuel consumption.

Table 24 shows the hydrogen site requirements for 2040 in San Bernardino County, which is expected to have the highest number of sites across the counties. Medium sites are projected to make up 40 percent of the total, with small and large sites each accounting for roughly 30 percent. As shown in Table 25, hydrogen fuel consumption in the county is primarily driven by the Long Haul HDT segment, which accounts for 64 percent of total consumption.

TABLE 24 Hydrogen Site Requirements in San Bernardino County

NUMBER OF SITES	2040
Small Sites	39
Medium Sites	52
Large Sites	38
Total Sites	129

TABLE 25 Total Hydrogen Fuel Consumption by Market Segment for San Bernardino County

MARKET SEGMENT	2040
Drayage - HDT	9,940
Long Haul - HDT	265,616
Regional Home - HDT	14,462
Regional Non-home - HDT	125,543
Total	415,560

* Aggregated at the Hex 4 level.

RIVERSIDE COUNTY

EV CHARGING

Riverside County is projected to have the third-highest share of energy requirements, largely driven by the distribution and warehousing sectors in the Inland Empire. In 2030, energy demand is primarily concentrated in the western areas of the county, but over time, demand increases in regions including Indio and along the I-10 corridor, extending toward Arizona.

Moreno Valley, with its numerous industrial parks and logistics centers, is expected to see growing energy demand, especially with the proposed World Logistics Center, which will further enhance warehousing and distribution operations. The City of Riverside, also a hub for warehousing, distribution, and manufacturing, benefits from its proximity to major highways such as I-215, I-10, and I-15.

In the hex area encompassing Riverside and Moreno Valley, which overlaps with San Bernardino County, HDTs account for 88 percent of the total energy demand, with MDTs contributing 12 percent. Within the HDT segment, 66 percent of energy demand comes from Long Haul HDTs, 16 percent from Regional Non-Home HDTs, and 11 percent from Regional Non-Home MDTs. Table 26 provides a breakdown of energy demand by market segment.

In Indio, several industrial parks and distribution centers are fueling the growth of the Coachella Valley's retail and e-commerce sectors. The hex area covering Indio shows a strong reliance on HDT demand, with 63 percent of energy consumption coming from Long Haul HDTs and 28 percent from Regional Non-Home HDTs.



FIGURE 30 Public Peak Hourly Demand for Riverside County in 2030

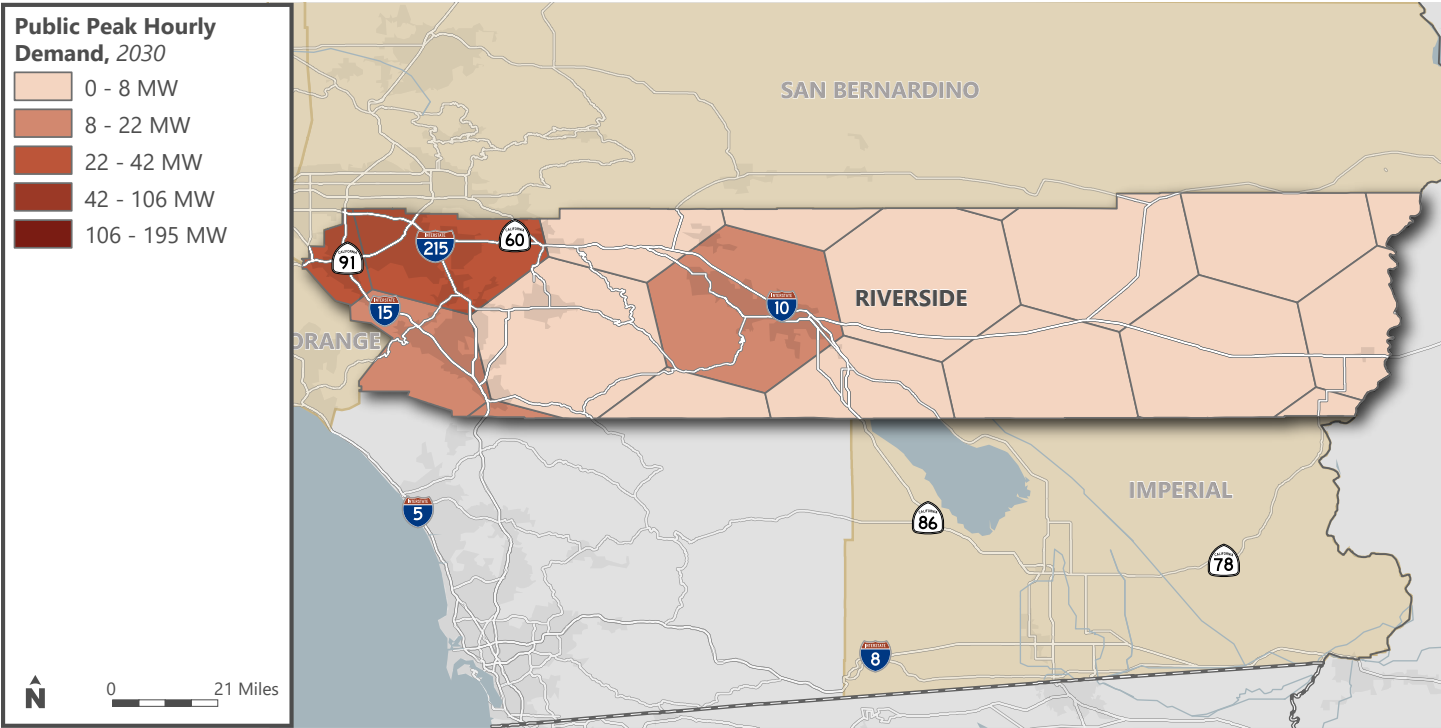


FIGURE 31 Public Peak Hourly Demand for Riverside County in 2035

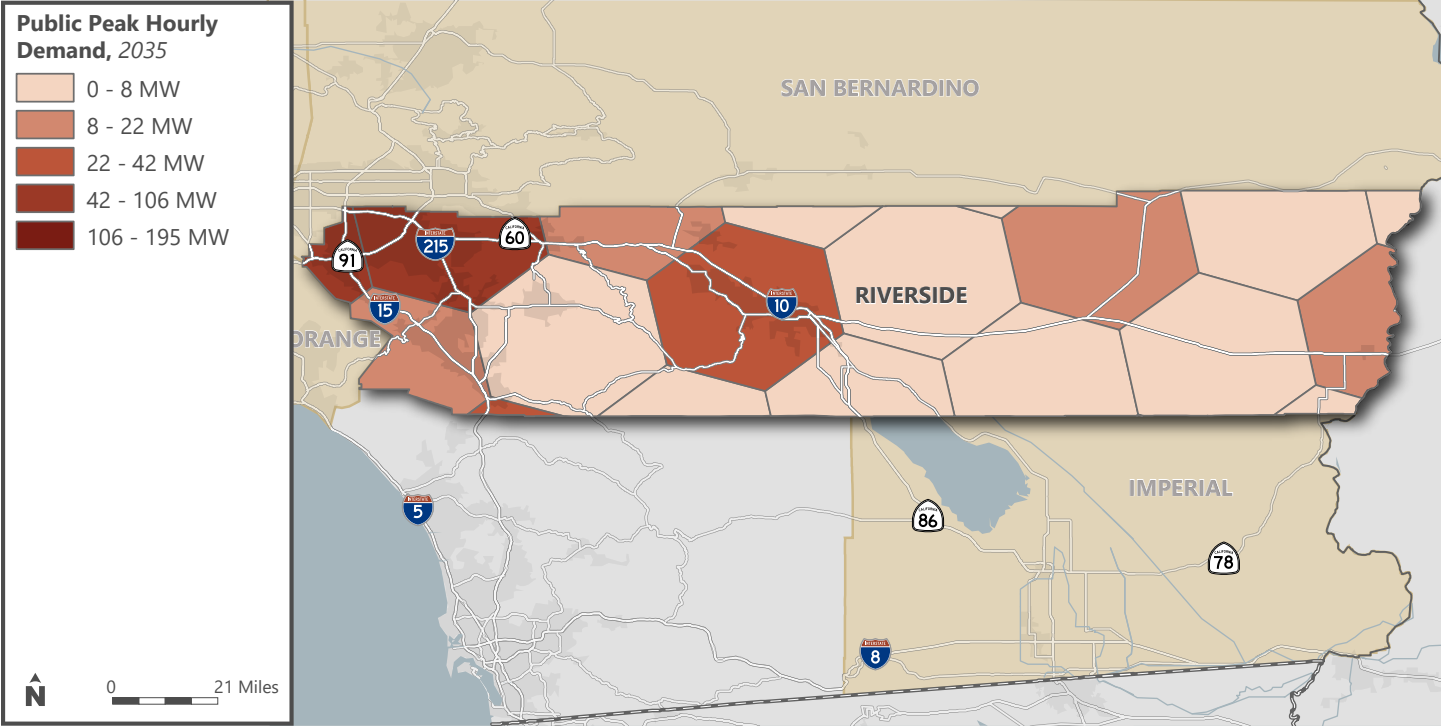


FIGURE 32 Public Peak Hourly Demand for Riverside County in 2040

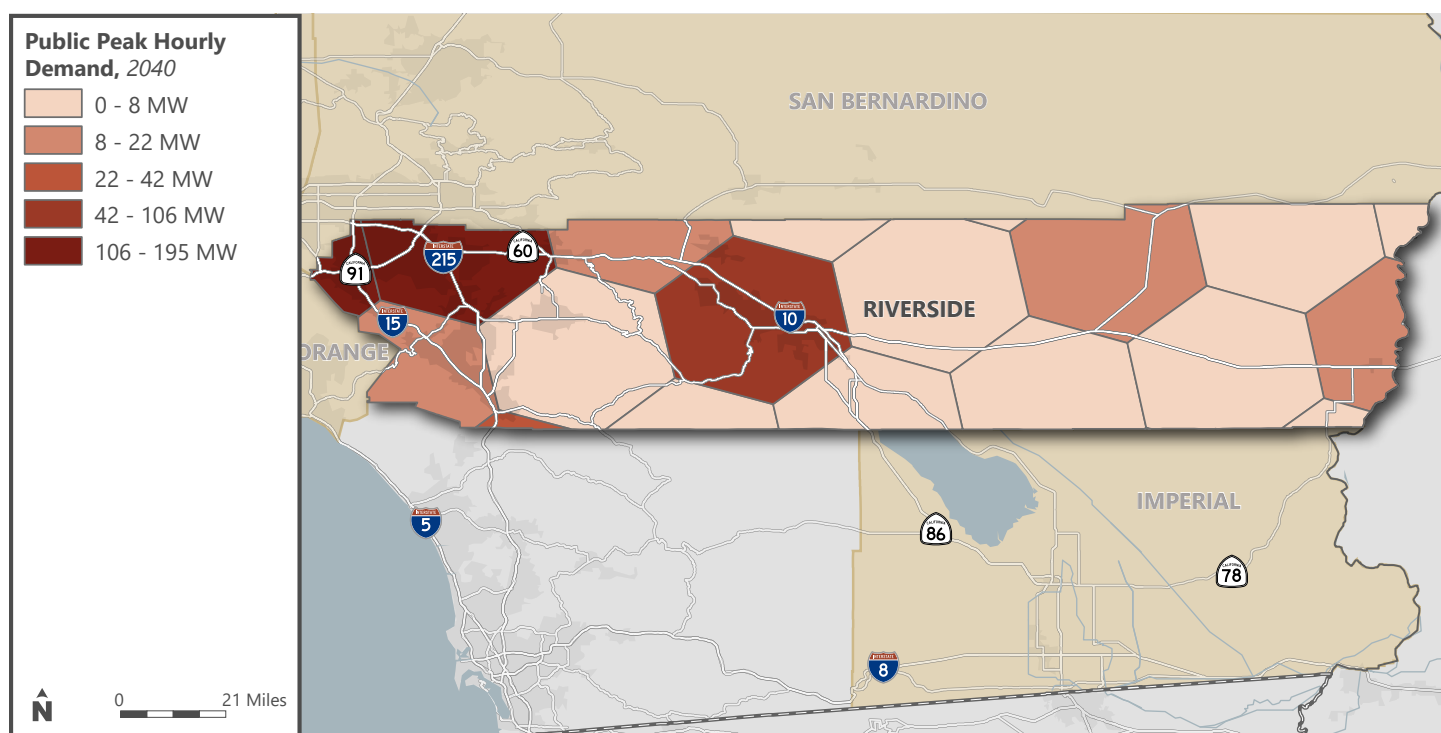


Table 27 presents the charging and site requirements for Riverside County over time. The number of chargers is projected to increase from 104 in 2030 to 475 by 2040, while the number of sites is expected to increase from 11 in 2030 to 27 in 2040. Figure 33 highlights the potential charging locations, with most current and future facilities concentrated along I-215, I-15, and I-10, areas that are

home to substantial warehousing and intermodal freight operations. The rise in truck charging demand will align with the expected growth in freight-related development. As warehousing continues to expand across Riverside, San Bernardino, and Imperial counties, there is a clear opportunity to integrate EV charging infrastructure and support this development.

TABLE 26 Energy Demand by Market Segment for Riverside County*

MARKET SEGMENT	2030		2035		2040	
Drayage - HDT	35,136	(28,408)	51,779	(34,401)	52,371	(33,286)
Long Haul - HDT	354,814	(223,104)	1,079,551	(735,105)	1,789,999	(1,263,107)
Long Haul - MDT	2,552	(1,699)	4,928	(3,442)	10,605	(8,282)
Regional Home - HDT	410,505	(91,881)	363,061	(54,395)	369,709	(68,653)
Regional Home - MDT	122,012	(933)	251,321	(1,603)	365,269	(2,406)
Regional Non-home - HDT	71,397	(13,579)	342,352	(110,345)	810,193	(282,850)
Regional Non-home - MDT	120,847	(53,409)	298,089	(127,289)	452,836	(193,136)
Total	1,117,262	(413,013)	2,391,082	(1,066,580)	3,850,983	(1,851,720)

* Aggregated at the Hex 4 level. The numbers in parentheses represent the energy demand for public charging sites.

FIGURE 33 Potential Site Locations in Riverside County

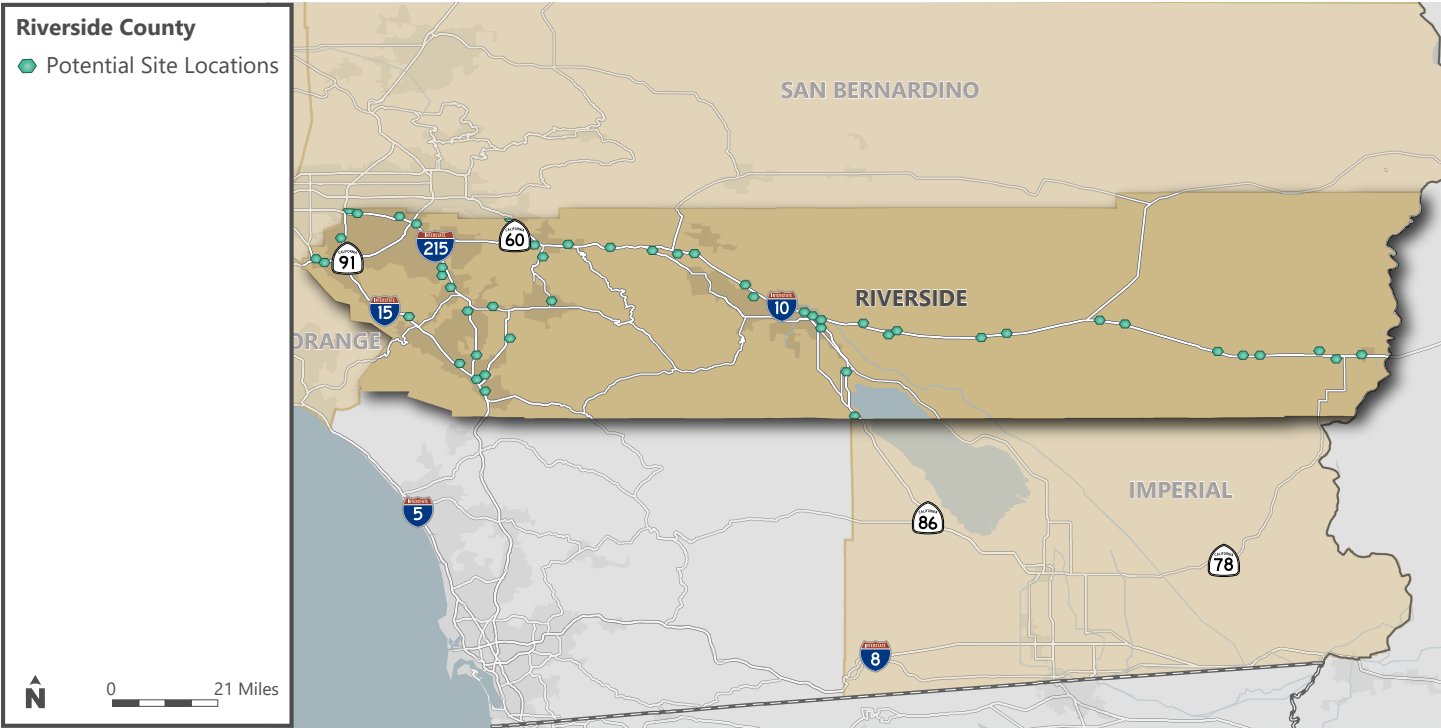
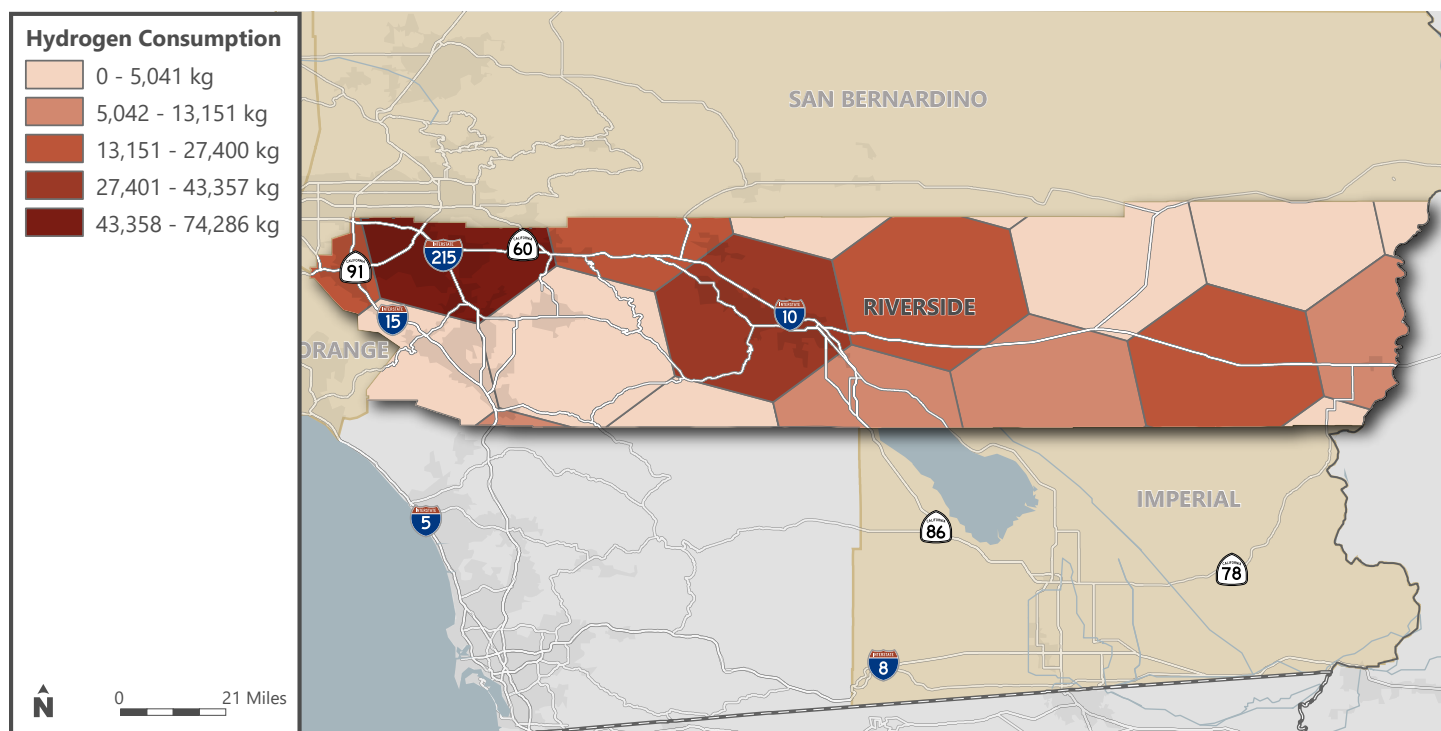


TABLE 27 Chargers and Site Requirements in Riverside County

PEAK HOUR PUBLIC CHARGING ENERGY DEMAND (KW-H)		2030	2035	2040
Number of Chargers	150 kW Chargers	22	57	106
	350 kW Chargers	25	64	117
	750 kW Chargers	49	114	210
	1000 kW Chargers	8	20	42
	Total Chargers	104	255	475
Number of Sites	Small Sites	8	10	13
	Medium Sites	3	8	14
	Large Sites	0	0	0
	Total Sites	11	18	27



FIGURE 34 Hydrogen Fuel Consumption for Riverside County in 2040



HYDROGEN FUELING

Riverside County ranks second in total hydrogen fuel requirements by 2040. While Long Haul HDTs still account for the largest share of demand at 63 percent, this is the lowest percentage across the county. Regional Non-Home HDTs follow at 28 percent, the second highest in the region. Regional Home HDTs account for 6 percent, and drayage trucks contribute 3 percent. The highest demand is concentrated in areas along the I-10. The demand is highest in western Riverside near the highest concentration of industrial and warehousing sites in the county. Figure 34 illustrates the projected hydrogen fuel consumption.

Table 28 outlines the hydrogen site requirements for 2040 in Riverside County, which is projected to have the second-highest site requirements after San Bernardino. Medium sites are expected to make up 46 percent of the total, with small sites accounting for 40 percent. As shown in Table 29, hydrogen fuel consumption in Riverside County, similar to other counties, is primarily driven by the Long Haul HDT segment, which accounts for 64 percent of total consumption.

TABLE 28 Hydrogen Site Requirements in Riverside County

NUMBER OF SITES	2040
Small Sites	26
Medium Sites	30
Large Sites	9
Total Sites	65

TABLE 29 Total Hydrogen Fuel Consumption by Market Segment for Riverside County

MARKET SEGMENT	2040
Drayage - HDT	4,129
Long Haul - HDT	103,070
Regional Home - HDT	10,673
Regional Non-home - HDT	42,468
Total	160,339

* Aggregated at the Hex 4 level.

ORANGE COUNTY

EV CHARGING

Energy demand is highest in the hexagonal area that encompasses much of Orange County, including cities such as Anaheim, Santa Ana, and Irvine, and extends into parts of Los Angeles, San Bernardino, and Riverside counties.

In this region, 80 percent of energy consumption comes from HDTs with the remaining 20 percent coming from MDTs, as shown in Table 30. The demand breakdown is as follows: 71 percent of HDT energy consumption comes from Long Haul HDTs, 20 percent from Regional Non-Home MDTs, and 7 percent from Regional Non-Home HDTs.

Irvine has a significant concentration of industrial and logistics centers, and its proximity to rail lines supports intermodal transportation. Santa Ana, located just a short distance from Mission Viejo, is home to several industrial parks and is well-connected by major highways such as I-5 and I-55, along with proximity to rail networks. Anaheim and Garden Grove also feature numerous large-scale warehousing, distribution, and logistics centers.

In the Costa Mesa hexagonal area, which benefits from its proximity to I-405 and Irvine, the energy mix is split similarly to the broader region, with 80 percent of demand from HDTs and 20 percent from MDTs. Of the HDT demand, 58 percent is from Regional Non-Home HDTs, 20 percent from Long Haul HDTs, and 20 percent from Regional Non-Home MDTs.



FIGURE 35 Public Peak Hourly Demand for Orange County in 2030

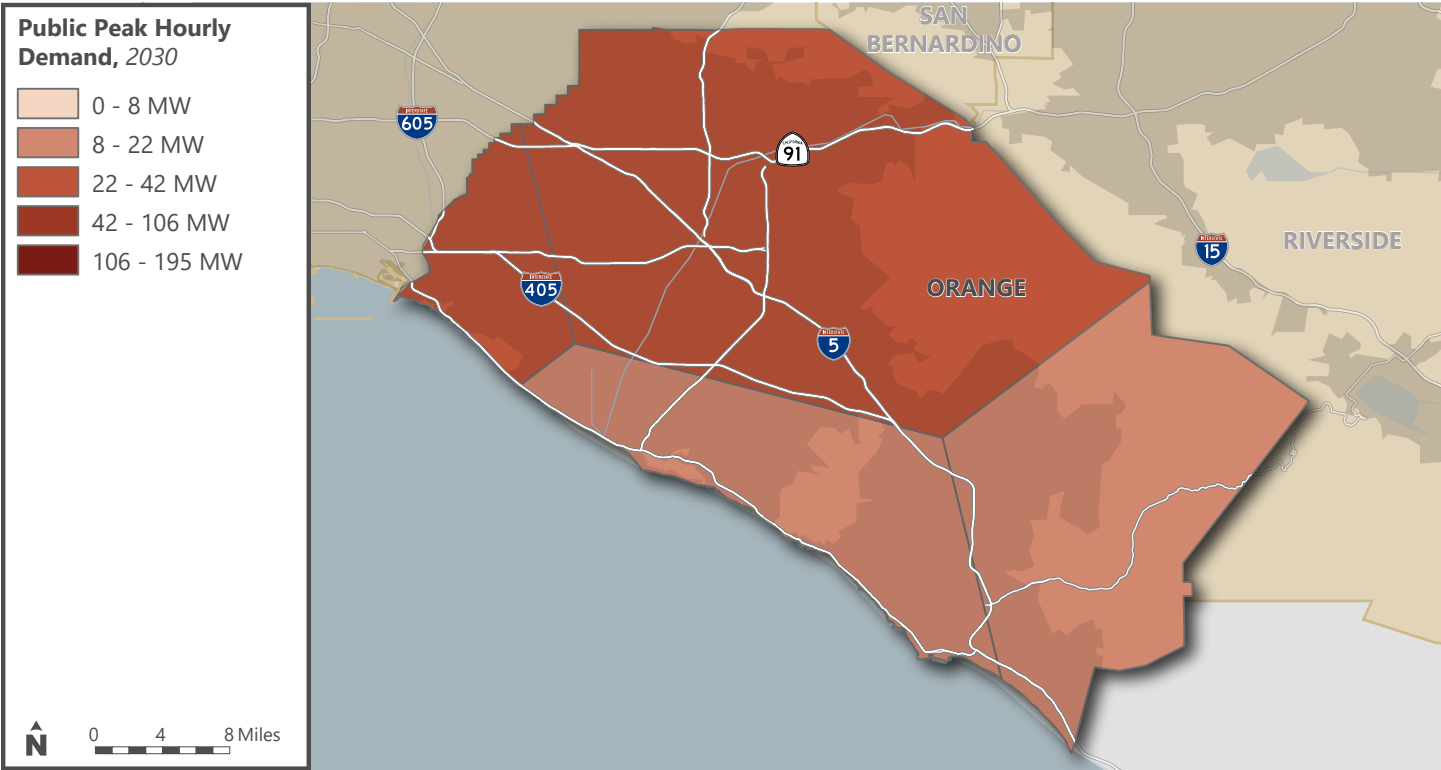


FIGURE 36 Public Peak Hourly Demand for Orange County in 2035

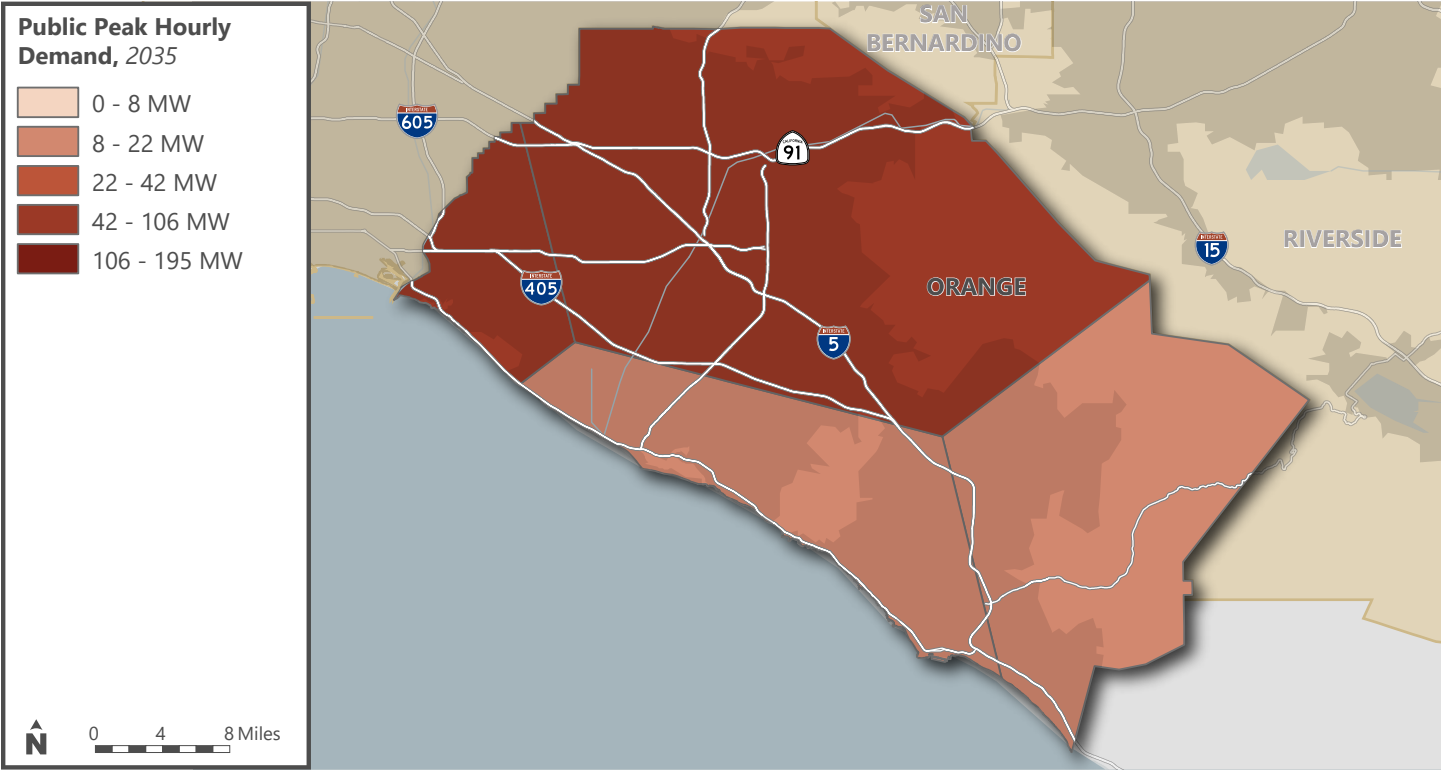


FIGURE 37 Public Peak Hourly Demand for Orange County in 2040

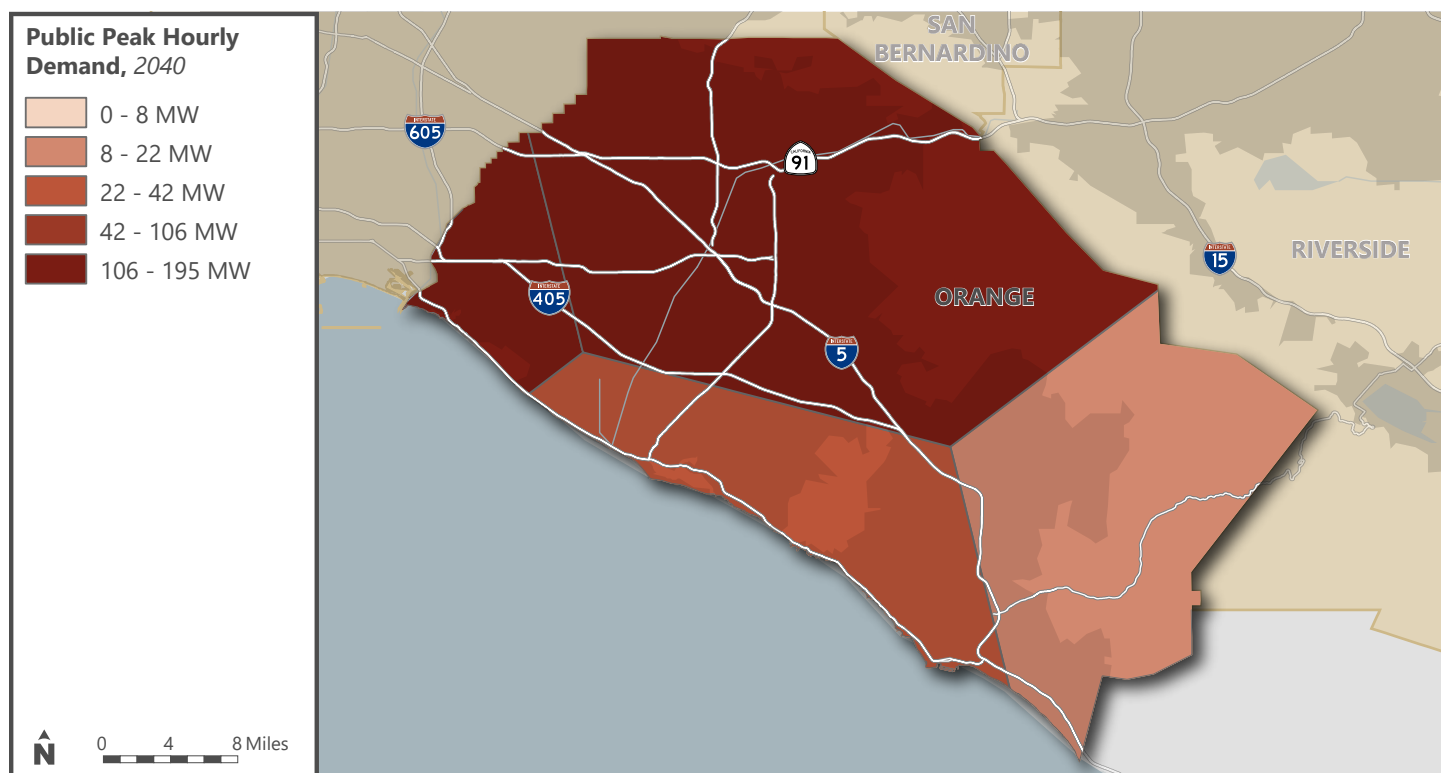


TABLE 30 Energy Demand by Market Segment for Orange County*

MARKET SEGMENT	2030		2035		2040	
Drayage - HDT	50,719	(38,962)	38,581	(31,622)	37,791	(30,676)
Long Haul - HDT	124,150	(89,751)	561,709	(375,621)	1,028,249	(810,201)
Long Haul - MDT	868	(793)	2,117	(1,690)	3,987	(2,858)
Regional Home - HDT	229,998	(108,772)	130,046	(6,328)	105,626	(7,494)
Regional Home - MDT	152,784	(95)	315,716	(720)	453,957	(1,282)
Regional Non-home - HDT	66,587	(5,813)	200,946	(103,129)	447,759	(262,818)
Regional Non-home - MDT	144,438	(69,090)	360,391	(182,280)	548,199	(270,335)
Total	769,544	(313,275)	1,609,506	(701,390)	2,625,568	(1,385,664)

* Aggregated at the Hex 4 level. The numbers in parentheses represent the energy demand for public charging sites.

As with all counties, Orange County is expected to experience higher energy demand in areas located near key highways I-5, I-405, and SR-91. Table 31 presents the charging and site requirements for the county over time. The number of chargers is projected to increase from 71 in 2030 to 326 by 2040. This includes a growing need

for EV charging infrastructure in the southern portion of Orange County. Potential charging locations in this area could serve as critical stops for trucks heading toward San Diego, where there are fewer charging options along the highway due to military land use and coastal development restrictions.

FIGURE 38 Potential Site Locations in Orange County

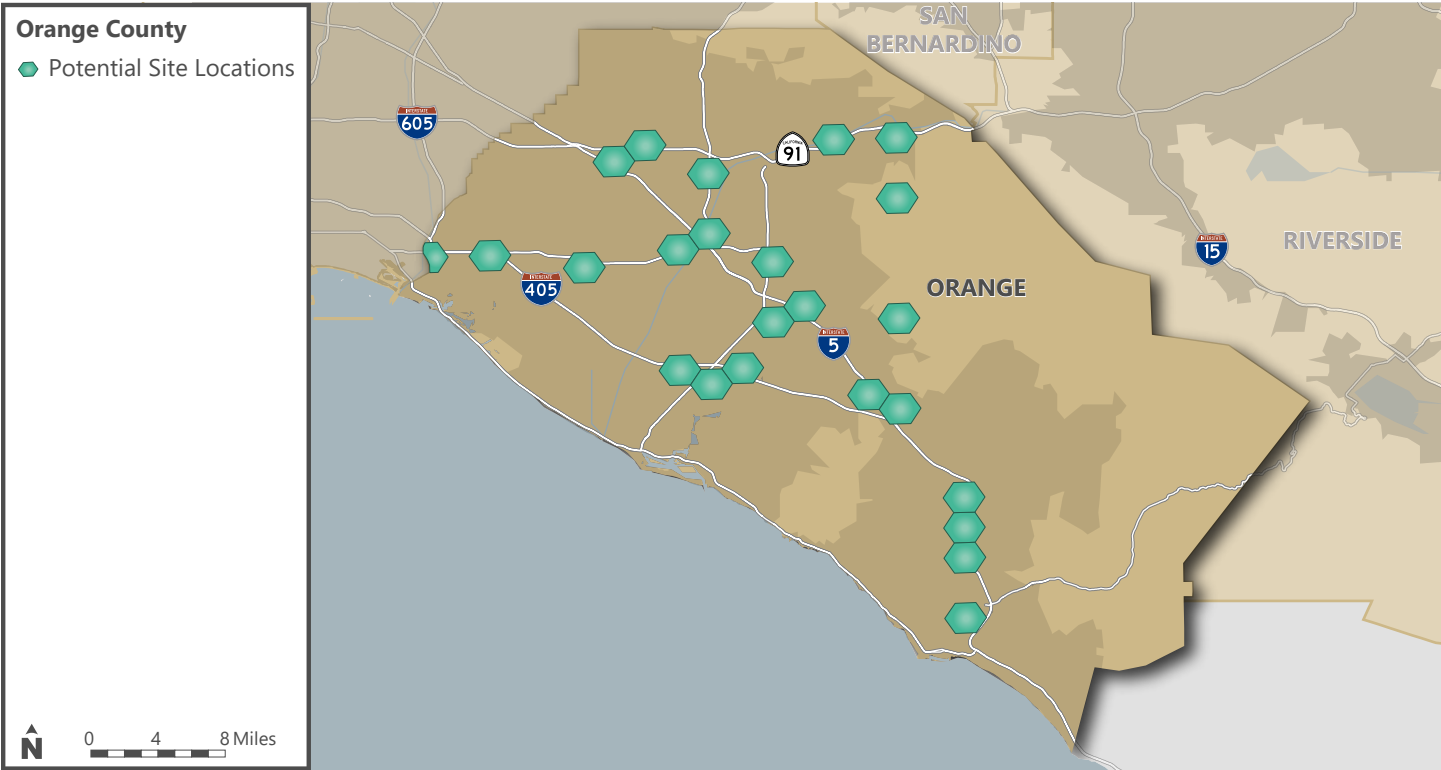
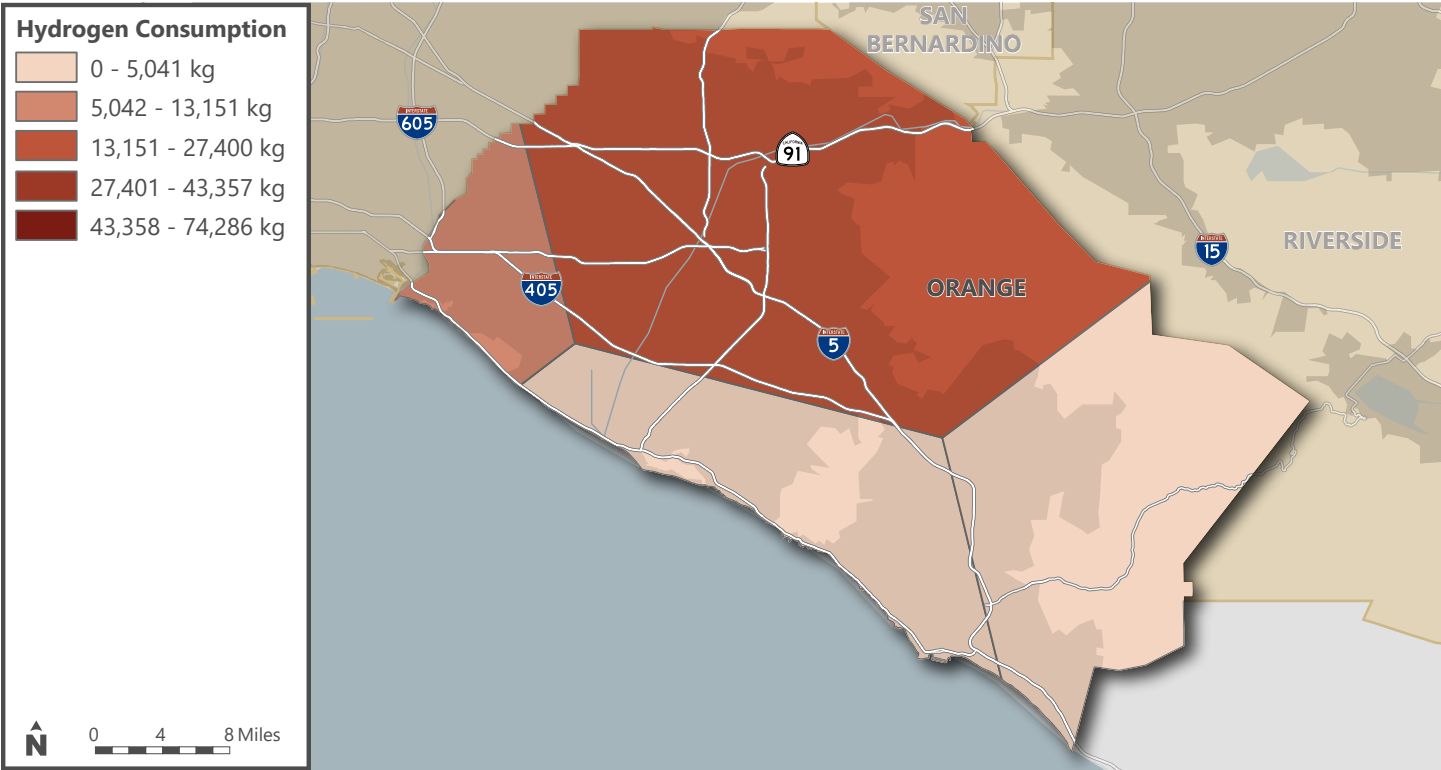


TABLE 31 Chargers and Site Requirements in Orange County

PEAK HOUR PUBLIC CHARGING ENERGY DEMAND (KW-H)		2030	2035	2040
Number of Chargers	150 kW Chargers	22	57	106
	350 kW Chargers	25	64	117
	750 kW Chargers	49	114	210
	1000 kW Chargers	8	20	42
	Total Chargers	104	255	475
Number of Sites	Small Sites	2	5	8
	Medium Sites	3	5	8
	Large Sites	0	0	1
	Total Sites	0	10	17



FIGURE 39 Hydrogen Fuel Consumption for Orange County in 2040



HYDROGEN FUELING

Orange County is projected to have the second-lowest hydrogen fuel consumption in the region by 2040. The demand is primarily driven by Long Haul HDTs at 71 percent, followed by Regional Non-Home HDTs at 20 percent. Drayage demand is higher than Regional Home HDTs, accounting for 6 percent compared to 4 percent, respectively. The highest demand is concentrated in areas such as Santa Ana, Irvine, and Tustin, which border Los Angeles and the Inland Empire. Unlike EV charging demand, there is not the same demand in the southern portion of Orange County, highlighting some of the differences between EV charging demand and hydrogen at the county level. Figure 39 illustrates the projected hydrogen fuel consumption in 2040.

Table 32 outlines the hydrogen site requirements for 2040 in Orange County. Compared to other counties, the county is expected to have a total of 9 sites, including 5 small sites and 4 medium sites. As shown in Table 33, similar to other counties, hydrogen fuel consumption is primarily driven by the Long Haul HDT segment, which accounts for 73 percent of total consumption.

TABLE 32 Hydrogen Site Requirements in Orange County

NUMBER OF SITES	2040
Small Sites	5
Medium Sites	4
Large Sites	0
Total Sites	9

TABLE 33 Total Hydrogen Fuel Consumption by Market Segment for Orange County

MARKET SEGMENT	2040
Drayage - HDT	1,255
Long Haul - HDT	12,283
Regional Home - HDT	575
Regional Non-home - HDT	2,699
Total	16,811

* Aggregated at the Hex 4 level.

VENTURA COUNTY

EV CHARGING

In Ventura County, energy demand is concentrated in the eastern portion of the county in areas closer to Simi Valley, Thousand Oaks, and Moorpark, which benefit from direct access to I-5 and U.S. 101—key transportation routes connecting Central and Northern California to the broader Southern California logistics network. Additionally, the Oxnard Industrial Cluster, located along U.S. 101 and in close proximity to the Port of Hueneme, plays a critical role in international trade, especially for automobiles and agriculture, and also supports the offshore oil industry. This concentration of industrial and logistics activity drives higher energy demand. Agriculture is a crucial sector in Ventura and contributes to the overall demand in the region.

Table 34 shows that the primary drivers of energy consumption in the region are Long Haul HDTs, followed by Regional Non-Home MDTs and HDTs. Figures 40, 41, and 42 illustrate how public peak hourly demand is projected to evolve in 2030, 2035, and 2040. Notably, energy requirements in the hexagonal area encompassing Moorpark and Camarillo are expected to see a significant increase by 2040.

In the hex area covering Thousand Oaks, 64 percent of energy consumption is attributed to HDTs, with the remaining 36 percent coming from MDTs. Within the HDT segment, Long Haul HDTs dominate at 64 percent, while 35 percent of the energy demand comes from Regional Non-Home MDTs. In the hex area that includes Moorpark, Camarillo, and the Oxnard Industrial Cluster, 93 percent of the energy demand is driven by HDTs, with 7 percent from MDTs. Of the HDT demand, 60 percent comes from Long Haul HDTs, and 33 percent is attributed to Regional Non-Home HDTs.



FIGURE 40 Public Peak Hourly Demand for Ventura County in 2030

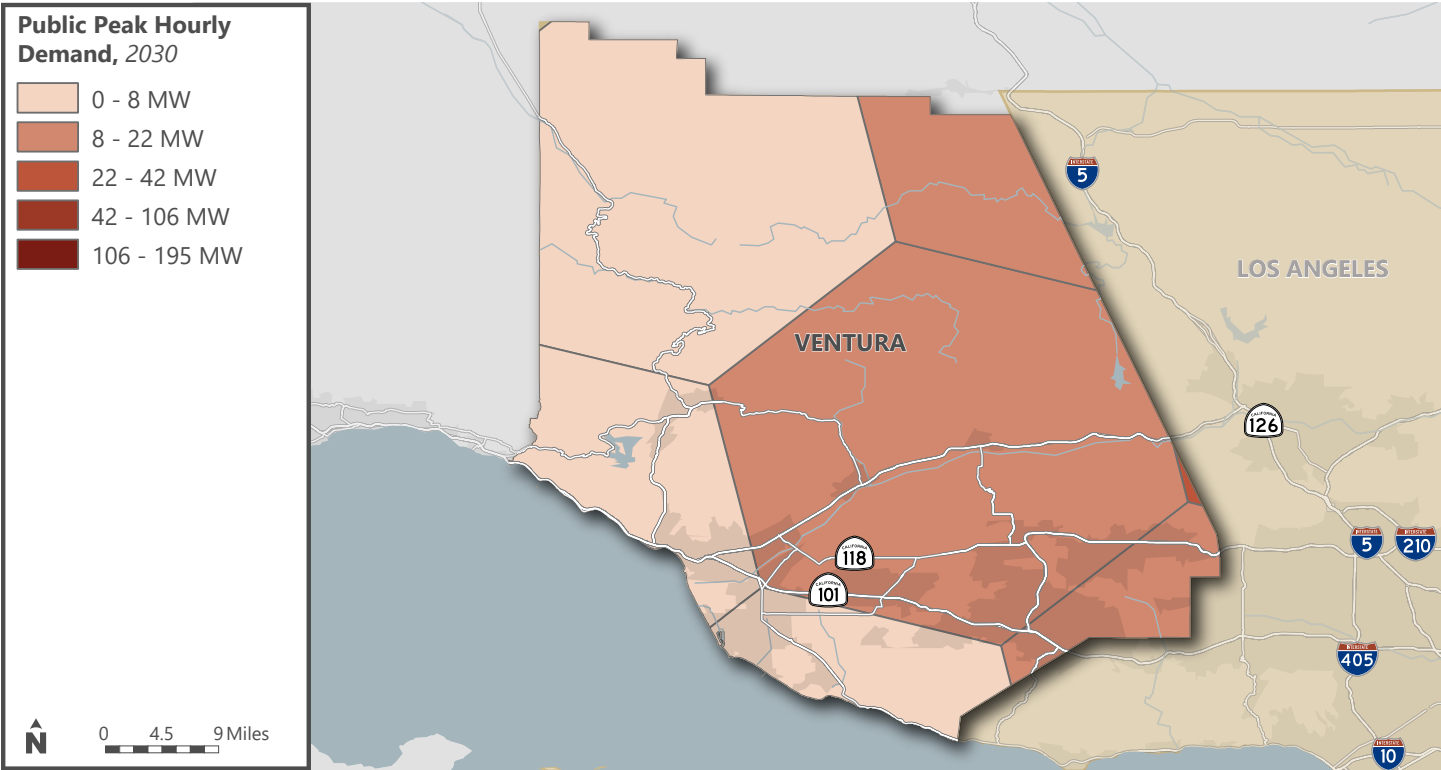


FIGURE 41 Public Peak Hourly Demand for Ventura County in 2035

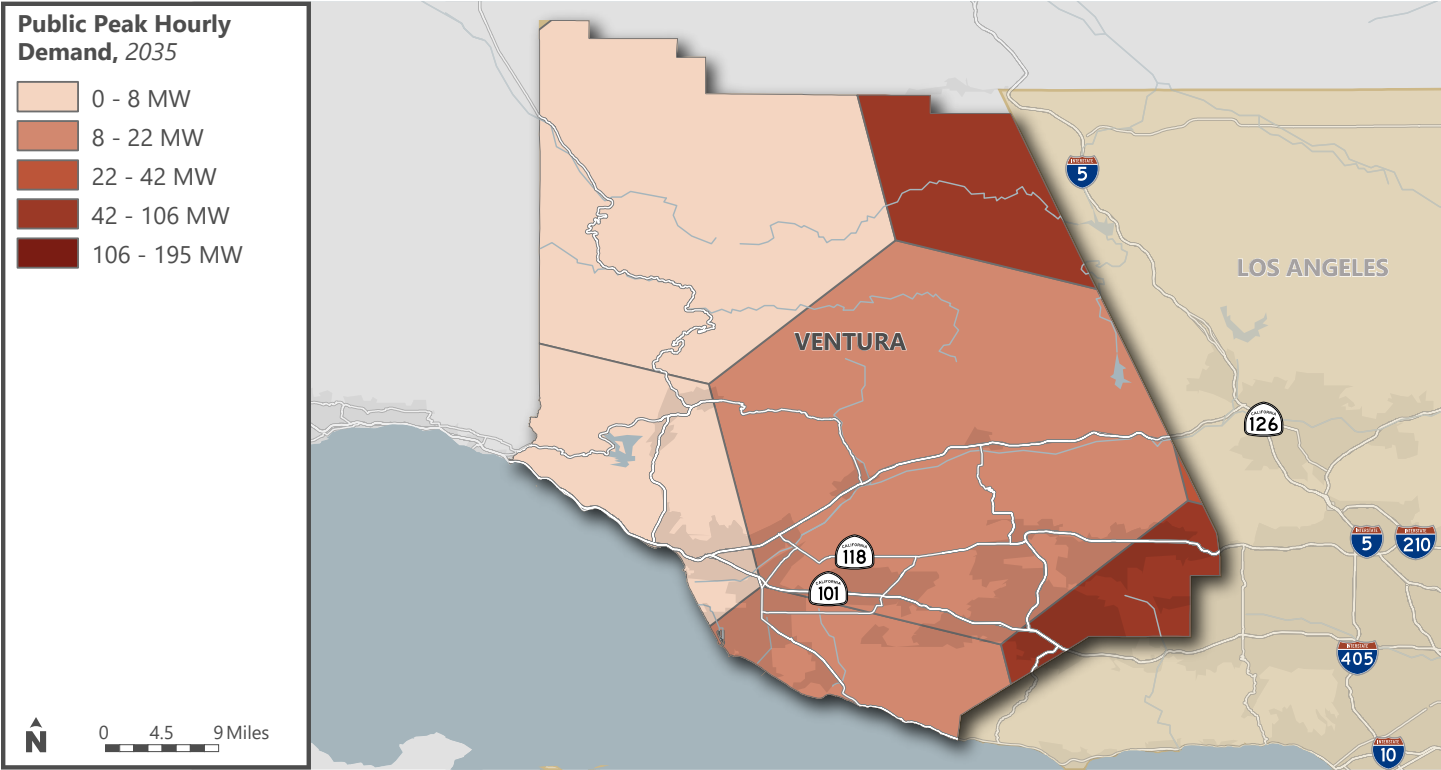


FIGURE 42 Public Peak Hourly Demand for Ventura County in 2040

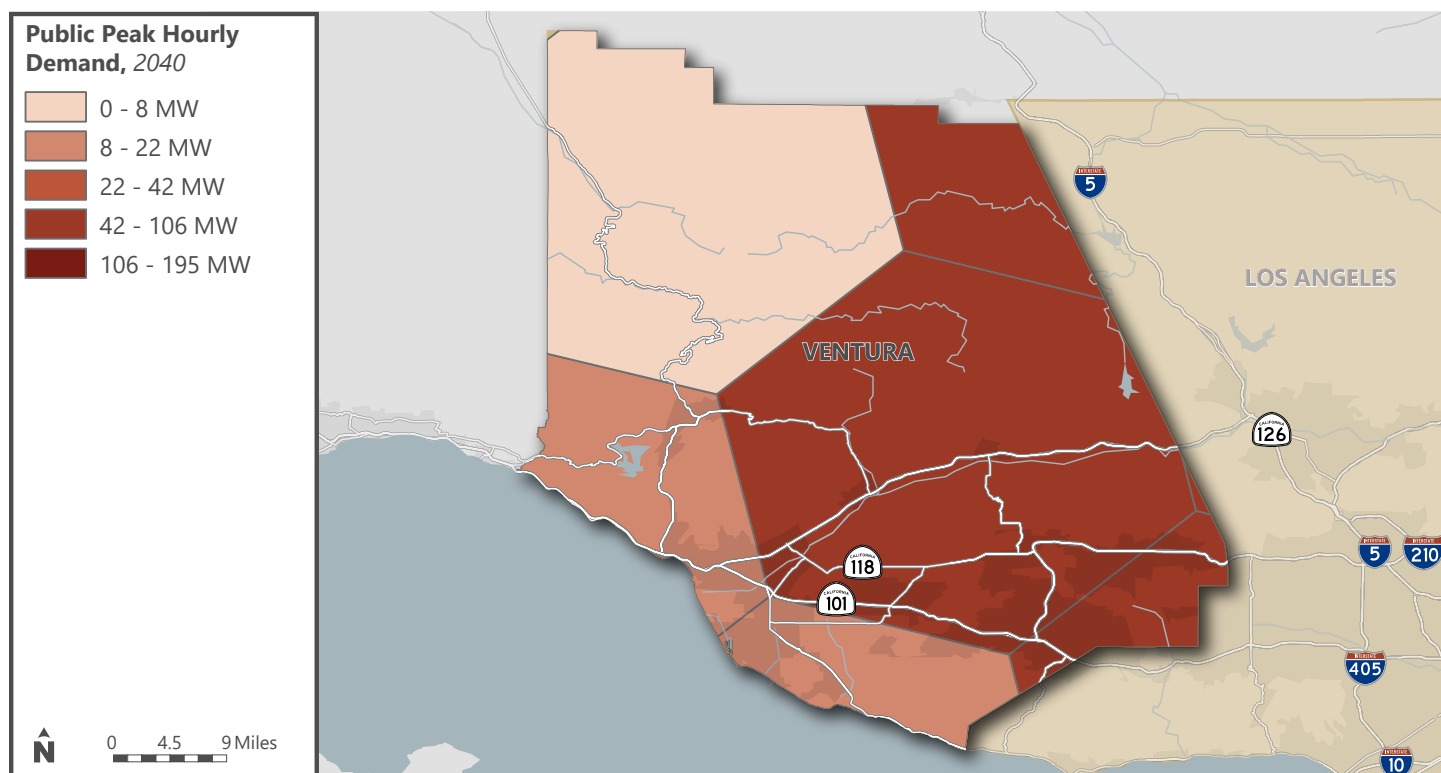


TABLE 34 Energy Demand by Market Segment for Ventura County*

MARKET SEGMENT	2030		2035		2040	
Drayage - HDT	8,126	(7,325)	21,135	(18,124)	23,069	(20,283)
Long Haul - HDT	141,266	(116,021)	295,946	(270,286)	574,550	(544,711)
Long Haul - MDT	144	(140)	1,097	(1,071)	2,930	(2,170)
Regional Home - HDT	25,291	(9,509)	90,407	(257)	106,339	(259)
Regional Home - MDT	46,934	(37)	99,182	(113)	143,775	(255)
Regional Non-home - HDT	1,313	(844)	103,124	(2,406)	321,125	(142,019)
Regional Non-home - MDT	52,258	(21,971)	128,305	(56,462)	190,138	(84,689)
Total	275,333	(155,849)	739,197	(348,719)	1,361,926	(794,385)

* Aggregated at the Hex 4 level. The numbers in parentheses represent the energy demand for public charging sites.

Table 35 shows the charging and site requirements for Ventura County over time. The number of chargers is expected to increase significantly from 36 in 2030 to 208 between 2030 and 2040, reflecting growing demand. Similarly, the number of sites will increase from 0 in 2030 to 11 in 2040.

Figure 43 highlights the potential charging locations, with most concentrated around Oxnard and additional locations spread across Thousand Oaks, Simi Valley, and Moorpark. Further analysis is needed to understand the vehicle breakdown for those utilizing these facilities.

FIGURE 43 Potential Site Locations in Ventura County

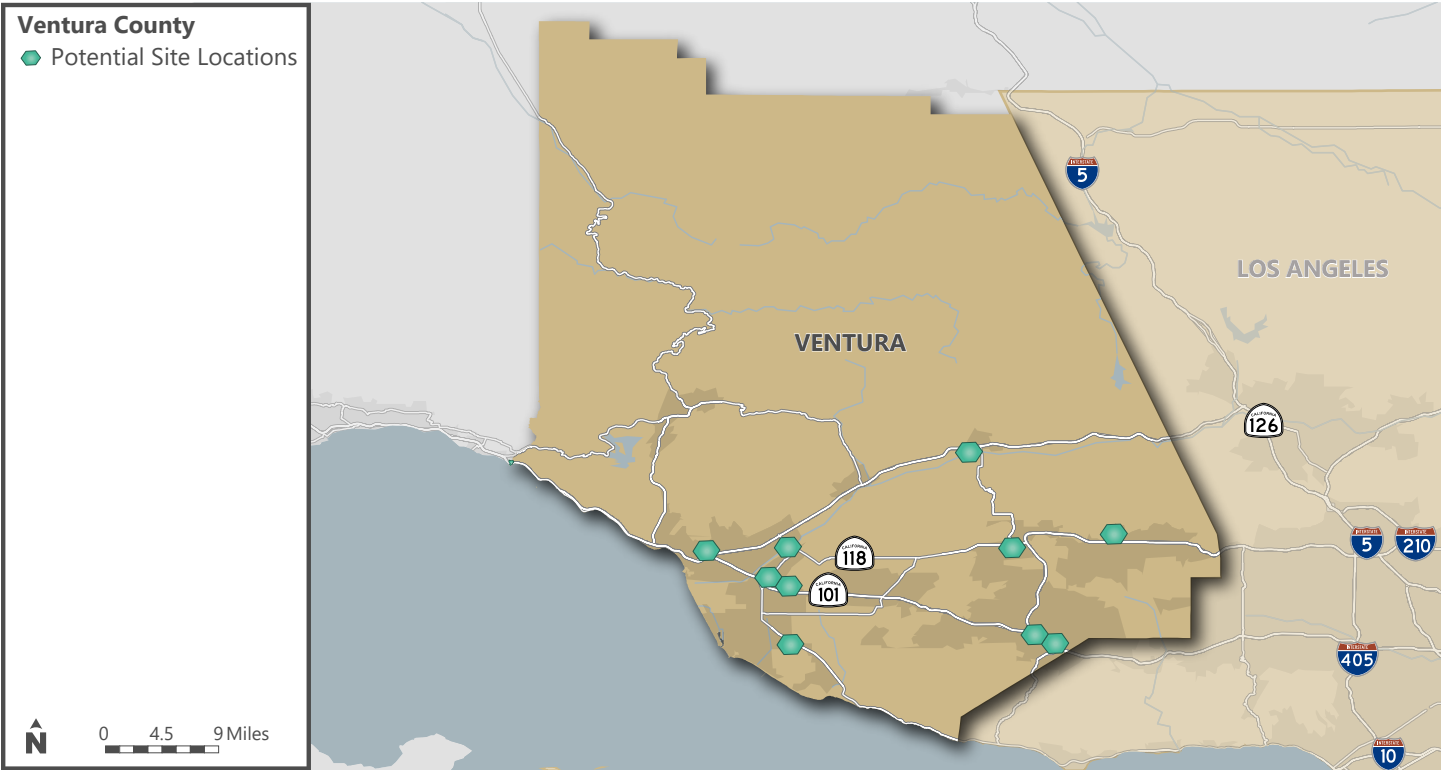
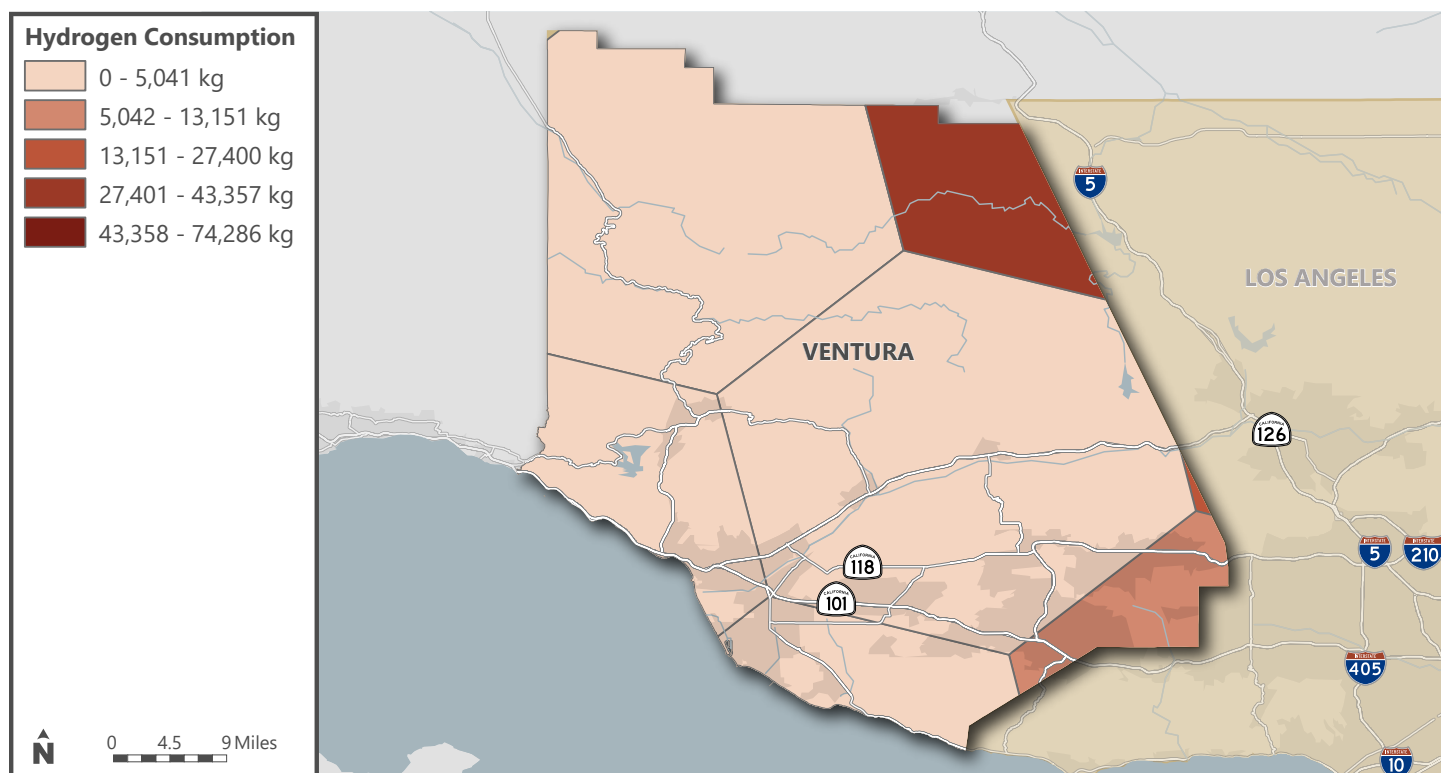


TABLE 35 Chargers and Site Requirements in Ventura County

PEAK HOUR PUBLIC CHARGING ENERGY DEMAND (KW-H)		2030	2035	2040
Number of Chargers	150 kW Chargers	8	21	44
	350 kW Chargers	7	21	46
	750 kW Chargers	17	41	97
	1000 kW Chargers	4	8	21
	Total Chargers	36	91	208
Number of Sites	Small Sites	2	2	5
	Medium Sites	1	3	6
	Large Sites	0	0	0
	Total Sites	0	5	11



FIGURE 44 Hydrogen Fuel Consumption for Ventura County in 2040



HYDROGEN FUELING

Ventura County is projected to have the lowest hydrogen fuel consumption in the region by 2040. The demand is primarily driven by Long Haul HDTs, which account for nearly 80 percent, followed by Regional Non-Home HDTs at 17 percent. Regional Home HDTs make up 3 percent, while drayage trucks account for less than 1 percent. The highest demand is concentrated in areas near I-5. Figure 44 illustrates the projected hydrogen fuel consumption.

Table 36 presents the hydrogen site requirements for 2040 in Ventura County. In comparison to other counties, Ventura is projected to have a total of 7 sites, consisting of 3 small sites, 3 medium sites, and 1 large site. As shown in Table 37, hydrogen fuel consumption in the county, like in other regions, is predominantly driven by the Long Haul HDT segment, which accounts for 78 percent of total consumption.

TABLE 36 Hydrogen Site Requirements in Ventura County

NUMBER OF SITES	2040
Small Sites	3
Medium Sites	3
Large Sites	1
Total Sites	7

TABLE 37 Total Hydrogen Fuel Consumption by Market Segment for Ventura County

MARKET SEGMENT	2040
Drayage - HDT	1,255
Long Haul - HDT	12,283
Regional Home - HDT	575
Regional Non-home - HDT	2,699
Total	16,811

* Aggregated at the Hex 4 level.

IMPERIAL COUNTY

EV CHARGING

Imperial County has the lowest energy requirements in the SCAG region. While it currently lacks the industrial and intermodal infrastructure of larger urban centers like Los Angeles or San Bernardino, Imperial County benefits from its location near the larger San Diego and Southern California logistics hubs, as well as its location near the U.S.-Mexico border. Major highways, including I-8, connects the county to other parts of California, including the San Diego metropolitan area and major logistical hubs.

Figures 45, 46, and 47 show that energy demand in the county is expected to increase over time, particularly in the southwest areas of Brawley and El Centro. These cities have industrial zones focused primarily on agriculture, food processing, and light manufacturing.



FIGURE 45 Public Peak Hourly Demand for Imperial County in 2030

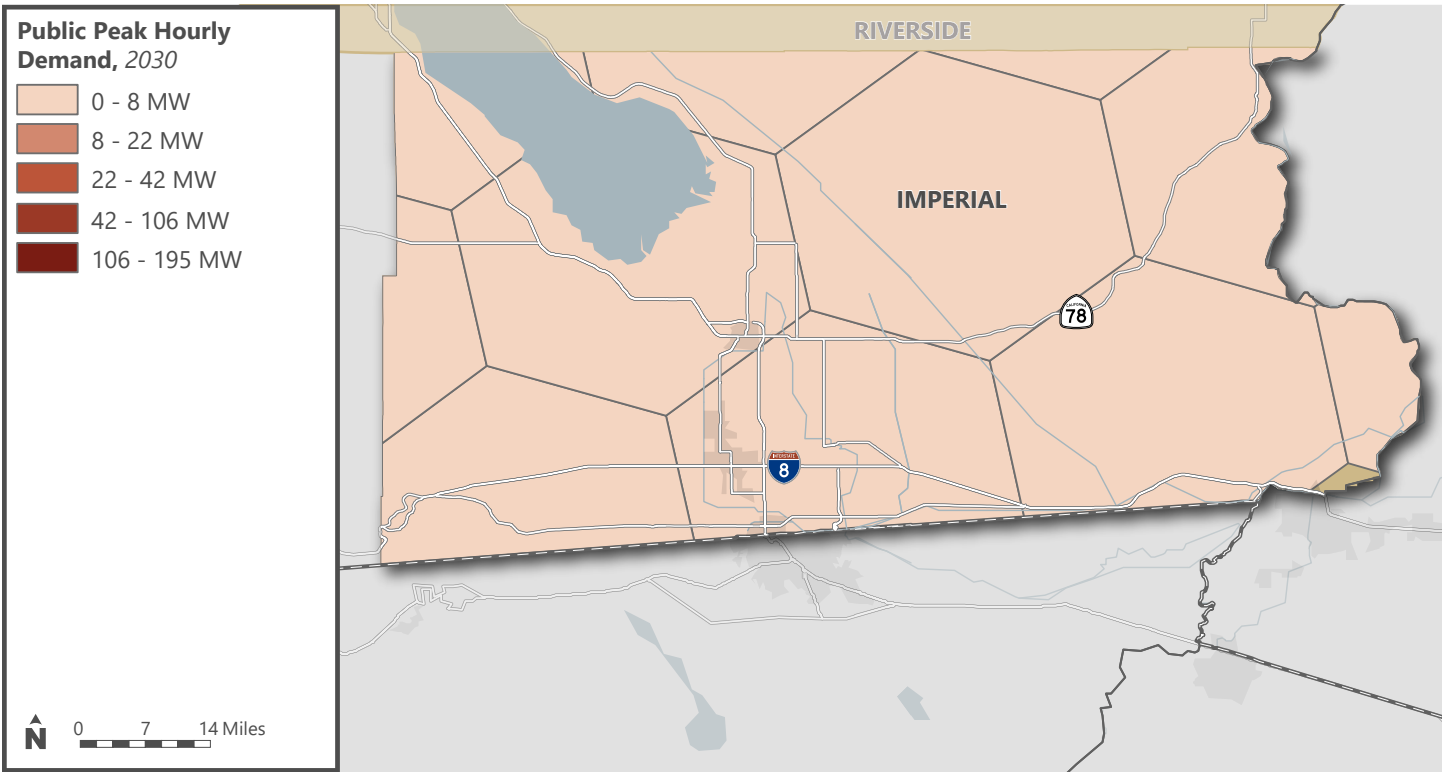


FIGURE 46 Public Peak Hourly Demand for Imperial County in 2035

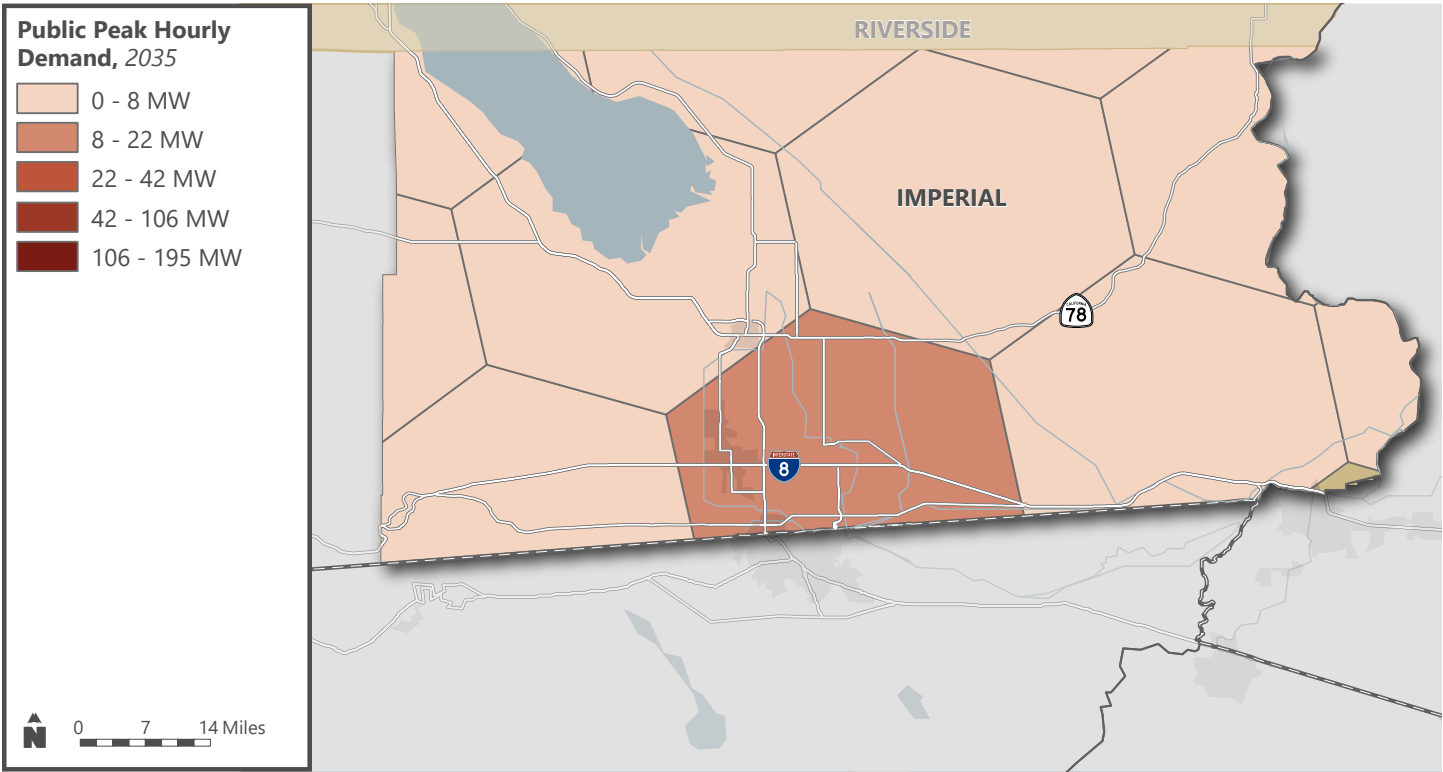


FIGURE 47 Public Peak Hourly Demand for Imperial County in 2040

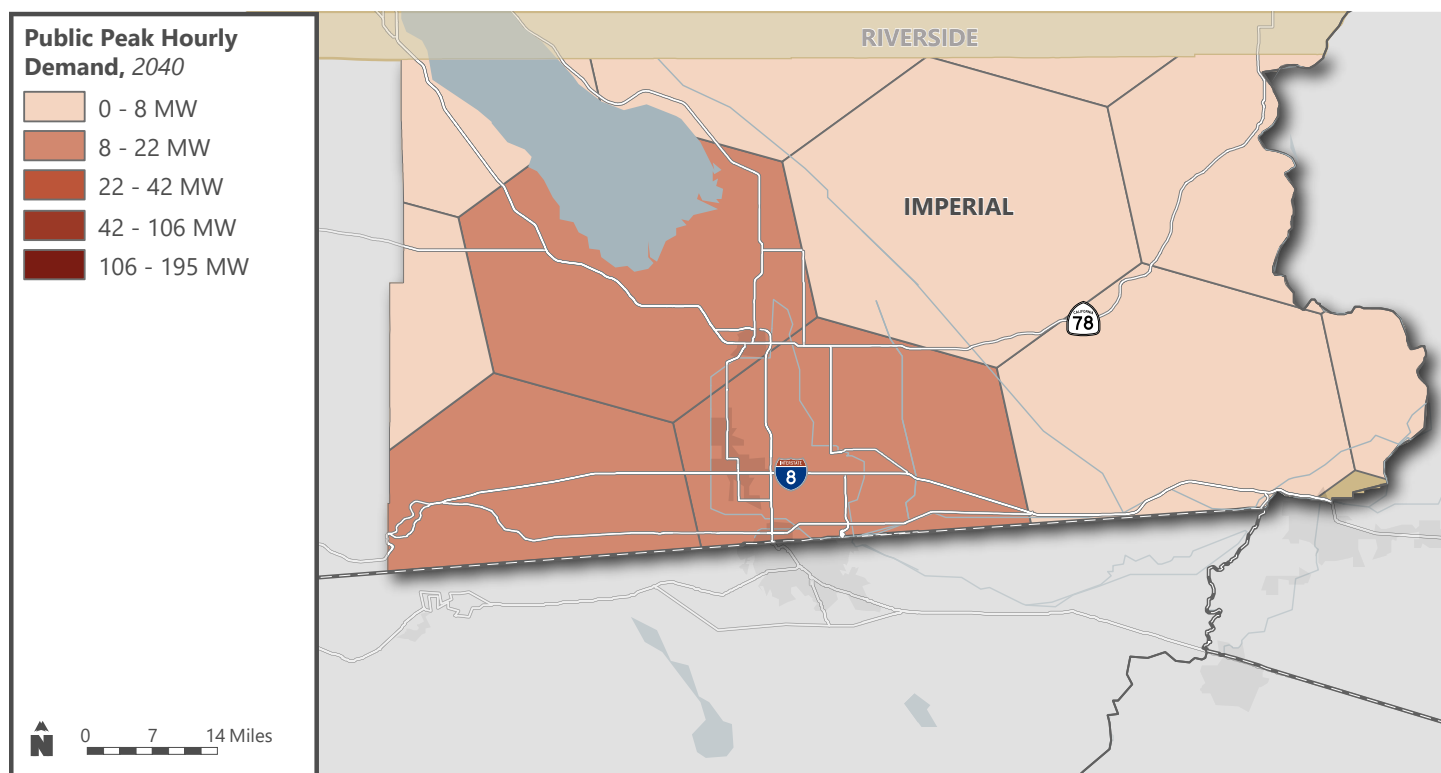


TABLE 38 Energy Demand by Market Segment for Imperial County*

MARKET SEGMENT	2030		2035		2040	
Drayage - HDT	4,890	(2,879)	12,460	(6,525)	11,991	(6,173)
Long Haul - HDT	72,533	(67,196)	154,465	(146,048)	319,293	(222,904)
Long Haul - MDT	250	(250)	1,007	(993)	2,030	(1,870)
Regional Home - HDT	12,733	(1,152)	12,368	(1,102)	13,225	(842)
Regional Home - MDT	5,954	(73)	14,055	(227)	19,737	(318)
Regional Non-home - HDT	10,924	(5,707)	18,802	(7,684)	103,774	(87,211)
Regional Non-home - MDT	4,128	(2,098)	10,796	(5,546)	17,508	(8,659)
Total	111,413	(79,354)	223,952	(168,125)	487,559	(328,077)

* Aggregated at the Hex 4 level. The numbers in parentheses represent the energy demand for public charging sites.

Imperial County also has the lowest number of charger requirements and the lowest density of potential EV charging sites in the region. The number of chargers is expected to increase from 36 in 2030 to 208 by 2040.

As shown in Figure 48, these charging locations are likely to be concentrated along I-8, with additional clusters in Brawley and near the U.S.-Mexico border. As freight activity flows into Imperial County to facilitate trade with Mexico, travel along Highway 86 from Riverside County to Imperial County is expected to drive increased charging demand. It is important to note that the modeling was based on current active trucks and expected growth, and does not account for unpredictable factors such as nearshoring or the potential development of lithium mines near the Salton Sea.

FIGURE 48 Potential Site Locations in Imperial County

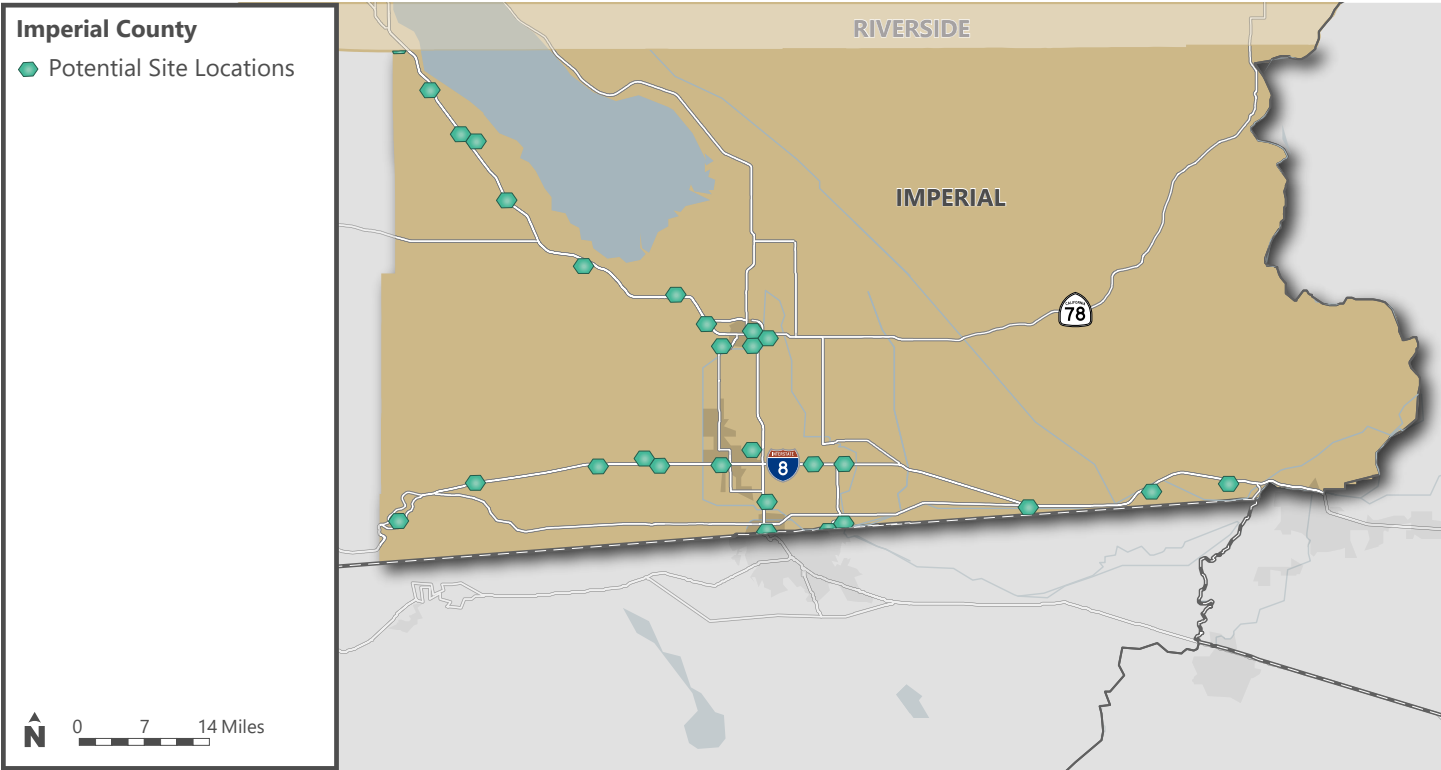
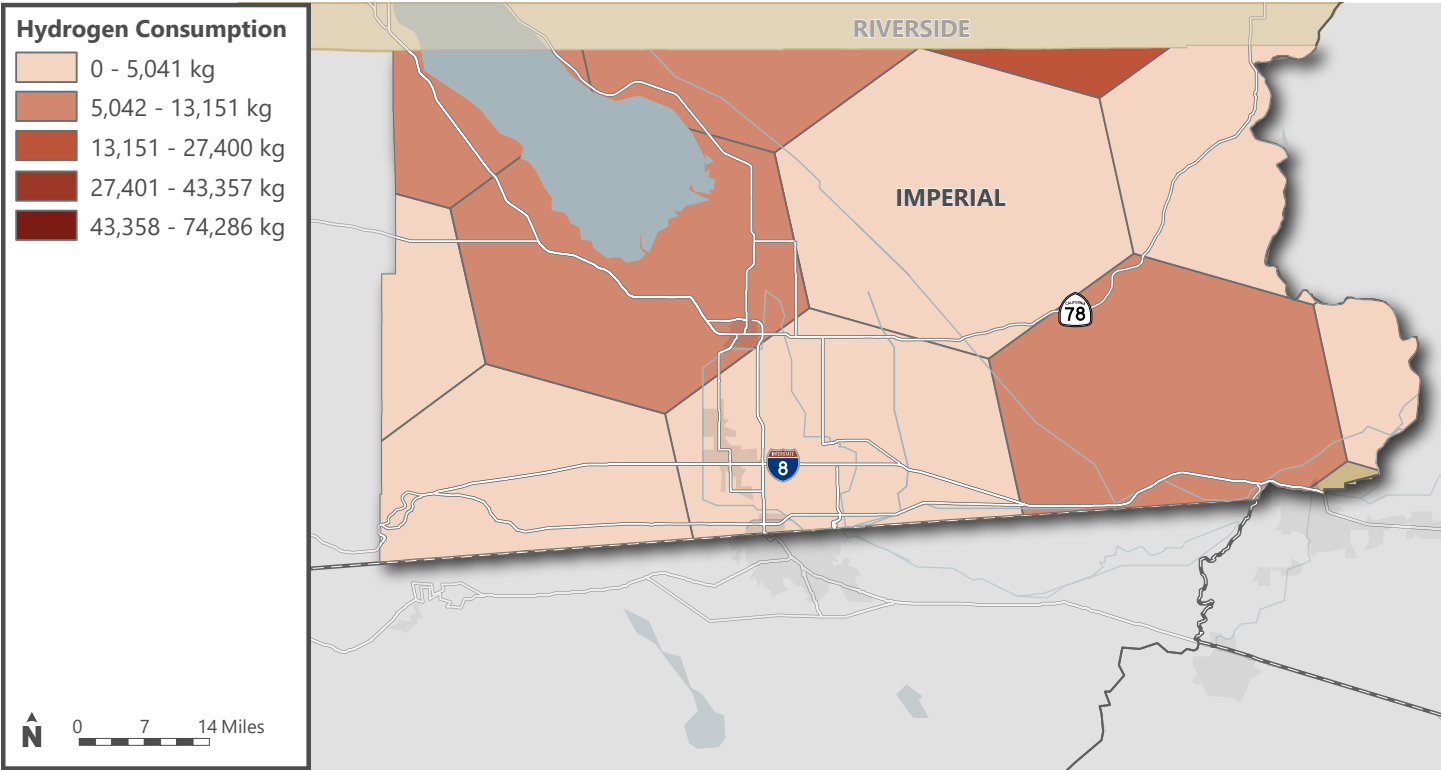


TABLE 39 Chargers and Site Requirements in Imperial County

PEAK HOUR PUBLIC CHARGING ENERGY DEMAND (KW-H)		2030	2035	2040
Number of Chargers	150 kW Chargers	8	21	44
	350 kW Chargers	7	21	46
	750 kW Chargers	17	41	97
	1000 kW Chargers	4	8	21
	Total Chargers	36	91	208
Number of Sites	Small Sites	4	4	1
	Medium Sites	1	1	2
	Large Sites	0	0	3
	Total Sites	5	5	6



FIGURE 49 Hydrogen Fuel Consumption for Imperial County in 2040



HYDROGEN FUELING

Although Imperial County has the lowest ZEV energy requirements in the region, it ranks fourth in estimated hydrogen fuel consumption, following San Bernardino, Riverside, and Los Angeles. Demand is highest in areas around the Salton Sea and the southeastern part of the county near the U.S.-Mexico border. The hydrogen fuel demand is primarily driven by Long Haul HDTs, accounting for 70 percent of the total, followed by Regional Non-Home HDTs at 24 percent. Drayage trucks account for nearly 8 percent of hydrogen fuel consumption, the highest share in the study area. Figure 49 illustrates the projected hydrogen fuel consumption across the county.

Table 40 presents the hydrogen site requirements for 2040 in Ventura County. Likewise, Imperial County is projected to have a total of 7 sites, with 3 medium sites and 4 large sites. As shown in Table 41, hydrogen fuel consumption in the county, similar to other regions, is largely driven by the Long Haul HDT segment, which accounts for 66 percent of total consumption.

TABLE 40 Hydrogen Site Requirements in Imperial County

NUMBER OF SITES	2040
Small Sites	0
Medium Sites	3
Large Sites	4
Total Sites	7

TABLE 41 Total Hydrogen Fuel Consumption by Market Segment for Imperial County

MARKET SEGMENT	2040
Drayage - HDT	2,083
Long Haul - HDT	19,534
Regional Home - HDT	429
Regional Non-home - HDT	7,324
Total	29,370

* Aggregated at the Hex 4 level.



MODEL OUTPUT CONCLUSION

The modeling outputs provide a detailed understanding about the areas of growth for EV charging and hydrogen fueling going to in the future. The maps and charts are focused on the baseline scenarios through each of the future years. The rate of adoption and availability of ZE trucks and supporting infrastructure will impact the transition and development of the ZE market. Understanding that potential future allows agencies to prepare and go beyond high level planning toward implementation.

Additionally, both EV charging and hydrogen fueling site mix and charging/nozzle mix analysis provide a projected overall number of chargers and potential power levels that will be needed to meet that demand. For hydrogen, it estimated the potential number of fueling nozzles to meet fueling needs in the future. These general numbers provide a regional understanding and are helpful for thinking about the scale of investment needed to support the ZE transition. As agencies prepare for the next step of planning, focused on specific sites, the next section on site assessments and site prioritization tool will help agencies identify sites, plans for sites, and have a reasonable understanding of what to expect when building in their community. Working directly with SCAG will provide additional information and data to help inform site selection, development of technical understanding and funding pursuits to help build the ZE truck infrastructure future.

SITES ASSESSMENTS

prescribing specific development sites, the examples highlight a range of potential locations that could be considered for zero emission infrastructure deployment across the region.

Small Facilities: Small EV charging facilities are designed to cater to low to moderate demand. They can feature ten dual-port chargers (each charger at 300 kW on average)

FIGURE 50 Location of the 24 site assessments



capable of charging 20 vehicles simultaneously. These facilities can vary in size depending on the number of chargers but for ten dual port chargers, it may require 60,000 square feet of land and a grid capacity of approximately 3 MW. As an example a truck stop with at least 20 parking spots, these facilities can handle up to 500 of truck trips per day, assuming each truck stops for an hour during 24-hour facility operation. While this is an extreme scenario, based on light-duty vehicle charging infrastructure, it is generally assumed that the maximum utilization of a charging station without significant wait times is around 20% .

Medium Facilities: Medium EV charging facilities are scaled up to meet larger demand compared to small facilities. They include 25 dual-port chargers, each rated at 300 kW, allowing for the simultaneous charging of 50

vehicles. These facilities require a minimum of 150,000 square feet of land and a grid capacity of around 7.5 MW.

Large Facilities: Large EV charging facilities are designed for higher demand. They feature 40 dual-port chargers, each rated at 300 kW, capable of charging 80 vehicles concurrently. These facilities require a minimum of 240,000 square feet of land and a grid capacity of 12 MW.

Table 42 outlines the parameters and assumptions used to define the key characteristics for EV charging facilities. Table 43 provides the calculations and definitions for estimating typology characteristics of EV charging facilities based on the parameters specified in Table 42. The typologies of hydrogen facilities, categorized based on their production capacity, infrastructure, and land requirements, are described as follows:

TABLE 42 Parameters and assumptions used (EV charging facilities)

PARAMETER	VALUE	ASSUMPTIONS AND SOURCES
Number of chargers at facility	Small facilities: 10	Increasing number of chargers from small to large facilities
	Medium facilities: 25	Informed by the electric truck charging stations at the Port of Long Beach ^{42, 43} , (WattEV and Forum Mobility), San Diego (Truck Net) ⁴⁴ , and at Bakersfield (WattEV) ^{45, 46}
	Large facilities: 40	
Average area per truck charging space	3,000 sq.ft	Average space per stall, including drive aisles and turning radius
		Measurements via Google Earth and information reported based on: a) the electric truck charging stations at the Port of Long Beach and at Bakersfield; existing truck parking locations available through the Caltrans Truck Parking Study ⁴⁷
Charger type and power level	DCFC 300 kW	DCFC is considered due to the higher energy demands and larger battery capacities of trucks
		A 300-kW baseline provides a foundation that can accommodate various charger configurations, including those with lower power outputs
		Informed by the electric truck charging stations at the Port of Long Beach, San Bernardino ⁴⁵ , Bakersfield, Ohio (One Energy) ⁴⁸
Number of ports per charger	2	Dual-port chargers optimize space and infrastructure investment by serving more trucks with fewer installations ⁴⁹
		Based on electric truck charging stations at the Port of Long Beach and at Bakersfield
Facility operation hours	24 hours	It ensures accessibility for truck drivers at all times, aligning with typical operation hours of existing and planned EV charging stations and truck rest areas
		Based on characteristics of existing or in development EV charging stations for medium and heavy-duty vehicles ⁵⁰
		Typical operation hours of truck rest areas ⁵¹

TABLE 43 Estimation of typology characteristics (EV charging facilities)

TYPOLOGY CHARACTERISTIC	DEFINITION	ESTIMATION
Number of parking spots	Number of spaces available for trucks to park and charge at the facility	Number of ports per charger × number of chargers
Land size	Area of land needed to accommodate the facility, including space for truck parking and movement	Average area per truck × number of parking spots

Small Facilities: Small hydrogen facilities are designed to produce and dispense a moderate amount of hydrogen. They produce approximately 1,000 kg of hydrogen per day and include 2 dispenser units. These facilities are estimated to serve around 32 trucks per day, assuming each truck fills with hydrogen using tanks of 31 kg capacity. They typically require around 10,000 square feet of land and a grid capacity of approximately 2.1 MW would be required if all hydrogen is sourced from on-site generation using grid electricity. However, it is recognized that this approach may not always be feasible. For larger facilities, it is highly likely that hydrogen will be transported in rather than produced on-site.

Medium Facilities: Medium hydrogen facilities scale up to meet larger hydrogen production and dispensing needs. They produce around 3,000 kg of hydrogen per day and include 6 dispenser units. These facilities can serve around 96 trucks per day and require a minimum of 30,000 square feet of land. They need a grid capacity of around 6.3 MW if the hydrogen production relies entirely on grid electricity. As with smaller facilities, it is acknowledged that producing all hydrogen on-site may not always be practical, and hydrogen delivery is also likely to be used.

Large Facilities: Large hydrogen facilities are designed for significant hydrogen production and distribution. They produce about 6,000 kg of hydrogen per day and include 12 dispenser units. These facilities are capable of serving around 193 trucks per day, requiring a minimum of 60,000

square feet of land. They also need a grid capacity of around 12.5 MW for hydrogen production if dependent on grid electricity. Given the scale, it is likely that these facilities may more frequently rely on hydrogen transport rather than on-site generation.

SITE USE CASES

In addition to defining different typologies, the project team selected four distinct use cases to demonstrate the diverse applications of ZEV infrastructure across Southern California. These use cases include highway charging, destination charging, urban charging, and mixed-use typologies. Each use case reflects unique operational demands and site requirements, helping to illustrate the flexibility and adaptability needed to support medium and heavy-duty ZEV infrastructure across a range of environments.

Highway refueling stations are assumed to be strategically located along major highways and trucking routes, where they often incorporate pull-through configurations to allow large vehicles to drive in, charge, and drive out without needing to back up—an important feature for these sizable trucks. To enable quick charging for electric vehicles and minimal downtime, these facilities can also be designed to support megawatt charging systems (1 MW or more per charger), ensuring rapid turnaround for vehicles on long-haul routes. Hydrogen stations may require larger storage tanks to accommodate high-volume traffic or trucks with larger capacity fuel tanks.

TABLE 44 Parameters and assumptions used (Hydrogen facilities)

PARAMETER	VALUE	ASSUMPTIONS AND SOURCES
Number of dispenser units	Small facilities: 2	Increasing number of dispensers from small to large facilities
	Medium facilities: 6	Assumption informed by Fulton et al. (2023) and layout of existing refueling stations in California ⁵²
	Large Facilities: 12	
Vehicle tank capacity	31 kg	Based on the Hyundai Xcient specifications (first fuel cell heavy-duty truck) Hyundai Xcient Fuel Cell Truck
Average area per truck	5,000 sq.ft	Based on minimum area reported in the literature for hydrogen stations for heavy-duty vehicles as well as measurements via Google Earth at an example location
		Informed by Fulton et al. (2023) ⁵³ and natural gas station layout at Fontana Rest Area
Energy consumption	50 kwh/kg	The energy required to produce one kilogram of hydrogen through electrolysis. It reflects typical electrolysis efficiency in hydrogen production based on the literature. This value is applicable only if the hydrogen is produced on-site using electricity.
		Antonia and Saur (2012)
		Mazloomi and Gomes (2012)
Facility operation hours	24 hrs	It ensures accessibility for truck drivers at all times, aligning with typical operation hours of existing and planned EV charging stations and truck rest areas
		Based on characteristics of existing or in development EV charging stations for medium and heavy-duty vehicles (CALSTART mapping tool)
		Typical operation hours of truck rest areas (FHWA Jason’s Law Truck Parking Survey)

TABLE 45 Estimation of typology characteristics (Hydrogen facilities)

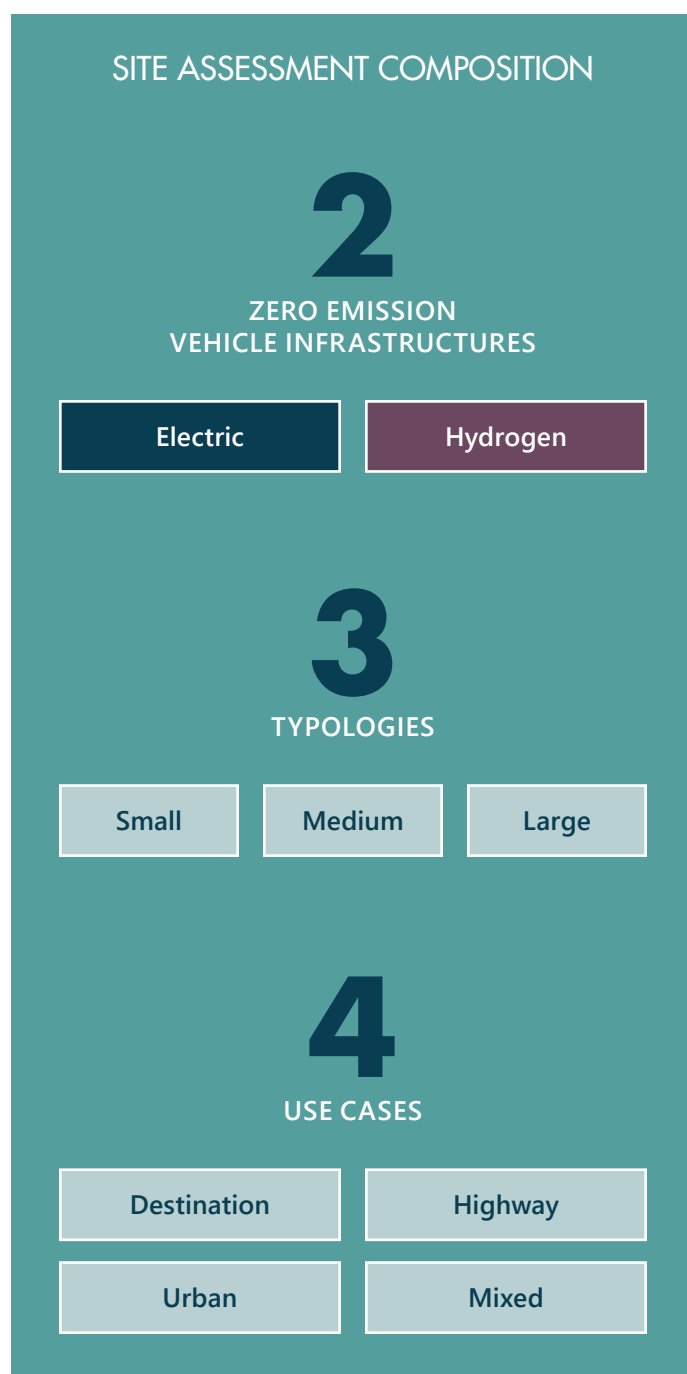
TYOLOGY CHARACTERISTIC	DEFINITION	ESTIMATION
Daily truck trips	Number of truck visits (rounded) that the facility can handle in a day based on the facility's hydrogen capacity and the size of each truck's tank (High-end scenario)	H2 capacity/vehicle tank capacity
Land size	Land area needed for the facility based on the number of dispensers and the space required for each truck	Number of dispenser units × average area per truck
Power needed to produce hydrogen	Electrical power required for hydrogen production, reflecting the efficiency of the process and the daily production goal	Energy consumption × H2 capacity/ facility operation hours (Divide by 1000 to convert to MW)

Destination refueling stations, on the other hand, are situated near ports, warehouses, or distribution centers, supporting vehicles during longer stays or loading/unloading periods. These stations typically use pull-in configurations, allowing trucks to decouple their trailers and park to charge. The power level of chargers at these sites ranges on average from 350 kW to 800 kW, providing moderate charging capacity that aligns with the operational pace of freight logistics at such destinations. Hydrogen stations may require moderate to large storage capacities tailored to the specific refueling needs of nearby operations.

Urban refueling facilities cater to trucks operating on shorter, repetitive routes within cities, where frequent recharging is necessary to maintain uptime. Located close to delivery routes or service areas, these urban stations often utilize pull-in configurations due to space constraints. Chargers at these facilities may provide moderate power (150-350 kW) suitable for Class 8 trucks, enabling recharging within 1-2 hours, while hydrogen stations are designed with storage capacities that meet the demands of urban fleets.

Finally, **mixed-use typologies** combine elements of highway, destination, and urban charging use cases. These versatile facilities may include both pull-in and pull-through configurations, tailored to serve various vehicle types and operational needs. By offering a mix of charging options, these sites can accommodate a broader range of medium and heavy-duty vehicles, supporting the evolving infrastructure requirements of the ZEV landscape.

With the three typologies and four use cases for each technology – whether EV charging infrastructure or hydrogen refueling infrastructure—the project team developed 12 distinct site assessments, totaling 24 assessments across both technologies. Each of these assessments begins with an aerial view of the site, along



In addition to these visuals, each site assessment provides general characteristics of the site, offering insights into aspects like whether it serves as a truck parking location, the typical parcel size and available land space, the number of truck parking spaces, and its urban or rural setting. The assessments also identify whether the site is publicly or privately owned, detail the specific land use type of the site, and describe the land use types of surrounding parcels. Furthermore, the site assessments estimate the potential daily truck visits to each location if ZEV infrastructure were established there, offering a forecast of demand and site utilization.

In addition to the general characteristics, each site assessment includes a site suitability scoring based on 15 different criteria, which were developed in coordination with the ZETI Study's TAC input and feedback. These criteria help evaluate the overall potential of a site for establishing charging or hydrogen refueling infrastructure, providing a comprehensive view of each location's suitability. Below is a description of each criterion:

ELECTRIC LARGE FACILITY: DESTINATION USE CASE

SITE AERIAL VIEW

SITE VICINITY LAND USE (2019)

PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS

ELECTRIC DISTRIBUTION SERVICE

- Utility Distribution Network
- Utility Pad Mounted Transformer (15-2000 kVA)
- Meter (1 Meter)

ELECTRIC VEHICLE SUPPLY EQUIPMENT

- Panels (15-3000 A / 480 V)
- EV Charger (30 DC Fast Chargers (1MW each; 30 MW total load), 2 ports per charger)
- DER System (Optional) (Hours of Backup Power Provided by BESS: 4, Energy Storage needs: 120 MWh)

FACILITY GENERAL CHARACTERISTICS

- Is this existing truck parking? **Yes**
- Parcel size: **1,379,110 sq.ft**
- Estimated truck parking spaces: **559**
- Urban/rural: **Urban**
- Property ownership: **Private**

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

Daily Energy Demand by Electric Truck Market Segment

Segment	Energy Demand (kWh)	Percentage
Drayage (HDT)	1,190	1.7%
Long Haul (HDT)	13,583	19.3%
Long Haul (MDT)	111	0.2%
Regional Home (HDT)	13,174	18.7%
Regional Home (MDT)	3,210	4.6%
Regional Non-home (HDT)	26,885	38.1%
Regional Non-home (MDT)	7,320	10.4%

ENERGY CONSUMPTION (KWH) 70,473 TOTAL KWH/DAY

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

Category	Cost
EV CHARGER	
Hardware & Installation	\$13,269,786
Operation & Maintenance Costs (5 years)	\$5,452,218
Total	\$18,722,003
FACILITY ELECTRICAL INFRASTRUCTURE	
Panel Cost	\$658,635
Panel Installation	\$131,727
Electric Meters	\$2,500
Conduit/Trenching	\$191,835
Permitting	\$14,770
Total	\$999,467
UTILITY ELECTRICAL INFRASTRUCTURE	
Transformer Cost	\$2,354,406
Transformer Installation	\$470,881
Reconductoring	\$123,000
Total	\$2,948,287
LAND ACQUISITION COST	
Total	\$57,300,000
DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION	
Battery Energy Storage System	\$32,400,000
PI cost	\$36,000,000
Total	\$68,400,000

Total Investment (excluding DER integration): \$79,900,000

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **3.02**

Category	Score
Energy Demand (2030)	4
Daily Mileage	10
Existing Truck Parking	10
Scalability	0
Land Price	9
Amenities	10
Access, Congestion, Safety	10
Proximity to Other ZEV Infrastructure	0
Load Capacity	0
Ability to Integrate DERs	0
Proximity to Disadvantaged Communities	0
Direct Benefit to Disadvantaged Communities	5
Flood Risk	10
Brownfields	0

Charging Events by Electric Truck Market Segment

Segment	Charging Events	Percentage
Drayage (HDT)	24	2.8%
Long Haul (HDT)	175	19.9%
Long Haul (MDT)	2	0.2%
Regional Home (HDT)	137	15.6%
Regional Home (MDT)	143	16.2%
Regional Non-home (HDT)	272	31%
Regional Non-home (MDT)	126	14.4%

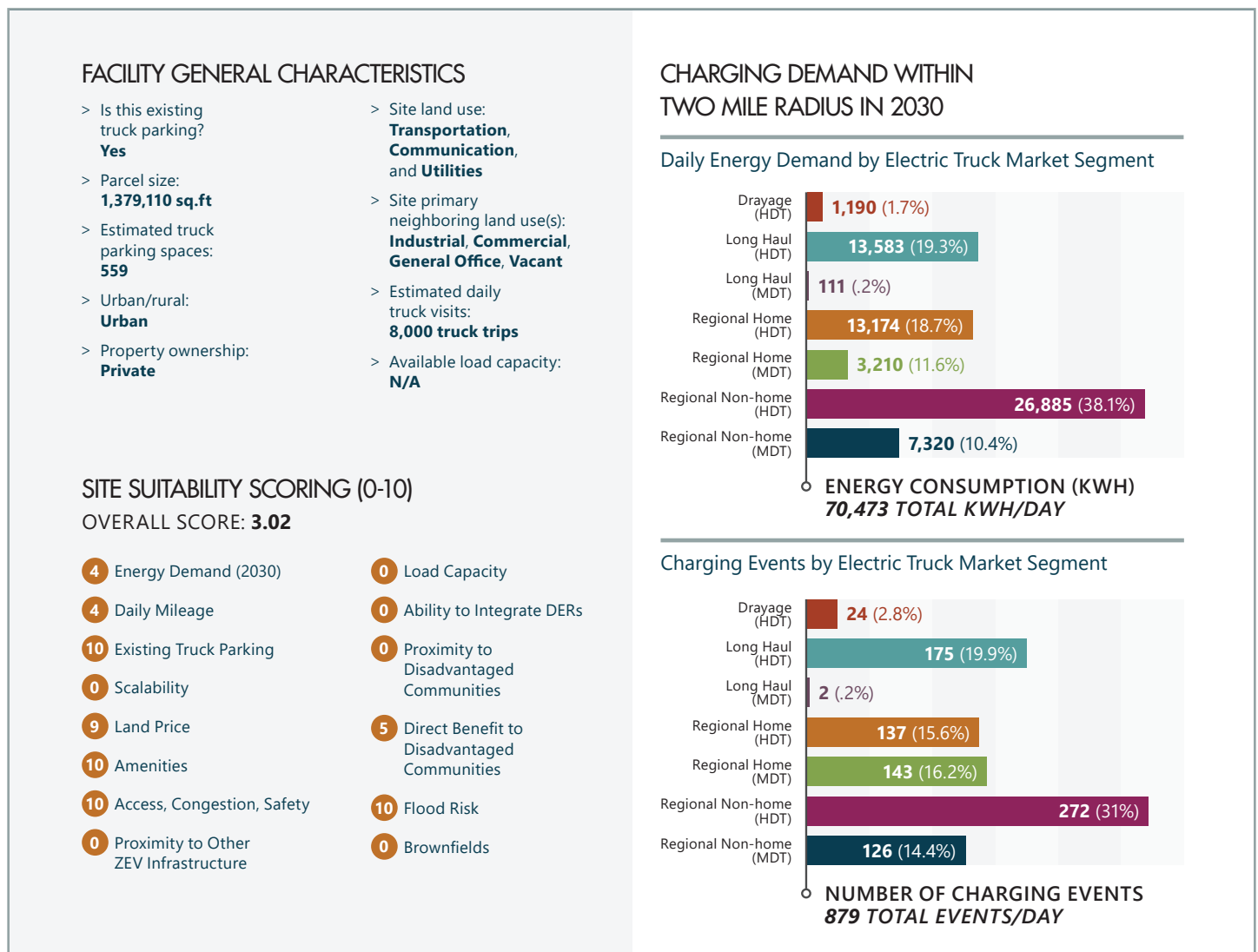
NUMBER OF CHARGING EVENTS 879 TOTAL EVENTS/DAY

KEY CONSIDERATIONS

- The presence of the existing Petro Travel Center, being located along I-10, and neighboring major warehouses and commercial zones makes it a prime candidate for supporting various market segments, including long-haul and regional operations. Additionally, the proposed location can offer significant advantage in attracting drivers already familiar with refueling at this location, enhancing initial customer adoption, and leading to steady revenue streams.
- This location can also accommodate hydrogen stations, providing an opportunity to integrate traditional and various alternative fuel offerings for operators who manage mixed fleets.
- As a multi-purpose facility and given the high number of daily truck visits, it's recommended to use a pull-in configuration, which makes efficient use of the existing parking spaces without limiting the capacity.
- The installation of EV chargers is expected to increase daily truck visits, potentially leading to higher traffic volumes. Effective traffic management strategies, including clear entry and exit points, directional signage, and scheduling charging times, will be essential to mitigate congestion.
- The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- The construction and operation of the facility can generate local employment opportunities, particularly benefiting the community within the DAC.
- The presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.

1. **Zero Emission Vehicle Energy Demand:** Represents the estimated energy demand from trucks traveling to, through, or within the site vicinity, indicating the level of infrastructure support needed.
2. **Daily Mileage:** Reflects the distribution of distances traveled by vehicles ending within a two-mile radius of the site, which helps assess the demand for refueling or recharging.
3. **Existing Truck Parking:** Indicates whether the location is currently a truck parking site, which can facilitate ease of access to trucks and eliminate the need for site development or land acquisition in certain cases.
4. **Scalability:** Evaluates the site's capacity to scale up infrastructure in the future to accommodate increased demand or additional capacity needs.
5. **Land Price:** Assesses the cost of land at the zip code of that location, which impacts the overall feasibility and investment required for infrastructure development.
6. **Amenities:** Examines the presence of amenities such as restaurants or fuel stops, which can enhance the location's appeal for drivers.
7. **Access, Congestion and Safety:** Considers the site's proximity to entrance or exit ramps on major highways to evaluate the ease of access and potential traffic safety.
8. **Proximity to Existing Infrastructure:** Scores the site based on its distance from other medium- and heavy-duty zero emission vehicle infrastructure. A site farther from existing infrastructure may score higher due to a lack of nearby alternatives.
9. **Load Capacity:** Reflects the grid's capacity to support the level of charging required for each typology, ensuring the site can handle the electrical load.
10. **Ability to Integrate Distributed Energy Resources (DER):** Assesses the grid's ability to accept energy from DER sources such as solar or wind to support the resiliency of the site and use of renewable sources of electricity.
11. **Proximity to Disadvantaged Communities (DACs):** Evaluates whether the site is near disadvantaged communities, helping to align infrastructure placement with equity goals. It is crucial to ensure that the siting of ZEV infrastructure provides tangible benefits to nearby communities, particularly those historically disadvantaged, by improving access to clean transportation options and reducing local emissions. Placing infrastructure in or near these communities can offer cleaner air, better economic opportunities, and an overall improvement in quality of life. However, a careful balance must be maintained to prevent these sites from inadvertently attracting increased truck traffic, which could introduce new safety risks, increase noise, and contribute to traffic congestion that undermines community wellbeing. This is why this criterion prioritize sites on the periphery of DACs rather than directly within them.
12. **Direct Benefits to DACs:** Determines if the infrastructure placement will directly benefit nearby disadvantaged communities. Specifically, this criteria examines how the placement of ZEV infrastructure can facilitate a transition of existing truck travel within DACs to zero emission alternatives.
13. **Flood Risk:** Considers whether the site is located in a flood-prone area, which could affect long-term viability and resilience of the infrastructure.
14. **Brownfield Status:** Identifies if the site is a brownfield (previously developed, possibly contaminated land), which could present environmental or regulatory considerations for infrastructure development.
15. **Proximity to Hydrogen Supply Chain (Hydrogen-Specific):** Scores a site based on its distance to the nearest hydrogen supply chain, which is crucial for ensuring consistent access to hydrogen and minimizing costs associated with transporting hydrogen to the facility. This proximity can enhance the site's viability by reducing hydrogen supply costs and improving logistical efficiency.

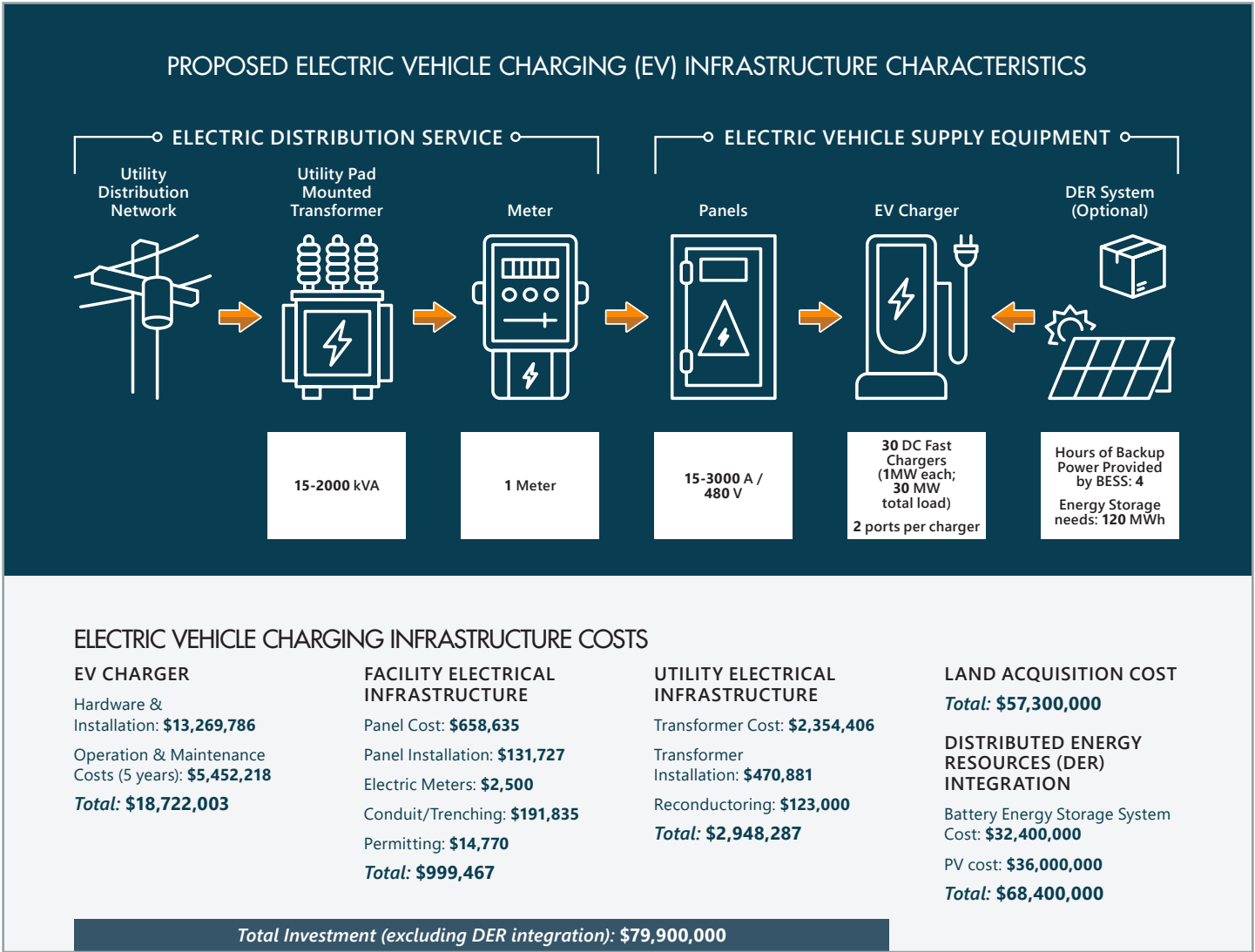
FIGURE 52 Site Characteristics for EV Charging Site



Additionally, each site assessment provides an estimate of potential energy demand within a two-mile radius of the site, along with projections for the number of necessary charging events by various electric truck market segments. These insights were generated using the HEVI-LOAD model, which calculates the anticipated energy needs for each site's vicinity and predicts the frequency of charging events for different types of electric trucks. These two charts are designed to provide an understanding of both the energy demand and the volume of charging events expected at each site, as well as insights into the types of trucks and use cases anticipated to visit the site or its vicinity in the future. This analysis showcases the expected mix of truck types, operational use cases, and duty cycles, which are essential for guiding site design.

This includes determining the appropriate charger configurations – whether pull-through, pull-in/back-out, or a combination of options. A pull-through configuration may allow trucks to enter, charge, and exit in a straight line without needing to reverse, which is ideal for large, long-haul trucks. It minimizes maneuvering requirements and is especially useful at highway charging stations, where quick entry and exit are crucial for reducing downtime. In pull-in/back-out configuration, trucks pull into a designated charging spot and back out when ready to leave. This configuration is suitable for locations with limited space, such as urban or destination charging sites near warehouses or distribution centers, where trucks may remain parked for longer periods during loading/unloading.

FIGURE 53 Detailed Costs for EV Charging Sites



In addition to describing each site’s general characteristics and its suitability for establishing charging infrastructure, the site assessments also provide a high-level overview of the EV charging and hydrogen fueling infrastructure requirements. This analysis includes a recommendation on the number of chargers to be installed on-site and the charger power levels. These recommendations are mainly informed by the number of parking spots, the site’s use case, and a visual inspection conducted through aerial imagery. Moreover, it includes an evaluation of both the utility-side and facility-side electrical infrastructure needed to support EV charging and hydrogen refueling operations, along with a breakdown of the various components that must be considered when developing these sites. For EV charging infrastructure, the assessments include estimates for the sizing of transformers and electrical panels, along with

detailed cost estimates for EV chargers. These estimates encompass costs related to hardware, installation, operation, and maintenance. On the facility side, they cover electrical infrastructure components such as copper wiring, panel installation, electrical meters, conduit, trenching, and permitting. Utility-side components include costs for transformer installation and potential upgrades to the distribution network. The assessments also provide estimates for distributed energy resources, such as battery energy storage systems and photovoltaic solar systems, which can enhance the resilience and sustainability of the charging infrastructure.

The methodology used to determine these infrastructure requirements and cost estimates is outlined in a separate section of this report. These estimates are grounded in industry-standard practices for grid distribution planning

KEY CONSIDERATIONS

- > The presence of the existing Petro Travel Center, being located along I-10, and neighboring major warehouses and commercial zones makes it a prime candidate for supporting various market segments, including long-haul and regional operations. Additionally, the proposed location can offer significant advantage in attracting drivers already familiar with refueling at this location, enhancing initial customer adoption, and leading to steady revenue streams.
- > This location can also accommodate hydrogen stations, providing an opportunity to integrate traditional and various alternative fuel offerings for operators who manage mixed fleets.
- > As a multi-purpose facility and given the high number of daily truck visits, it's recommended to use a pull-in configuration, which makes efficient use of the of existing parking spaces without limiting the capacity.
- > The installation of EV chargers is expected to increase daily truck visits, potentially leading to higher traffic volumes. Effective traffic management strategies, including clear entry and exit points, directional signage, and scheduling charging times, will be essential to mitigate congestion.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The construction and operation of the facility can generate local employment opportunities, particularly benefiting the community within the DAC.
- > The presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.

and facility electrical assessments. They draw on widely recognized reference materials for electrical equipment and charging infrastructure, offering developers and planners a reliable resource for understanding the financial requirements of establishing EV charging or hydrogen refueling infrastructure.

In addition to these infrastructure components, the assessments also account for potential site acquisition costs. **However, site acquisition is not always necessary for establishing charging or refueling infrastructure.** For example, in the case of EV charging infrastructure, developers often collaborate with existing truck parking facilities to set up charging stations, paying a site host fee to the parking facility owner either monthly or annually. In some cases, hosting EV chargers can even increase business for truck parking facilities, prompting negotiations between developers and site hosts regarding fees. Similarly, hydrogen refueling infrastructure may occupy significant space at a truck parking facility, but arrangements can often be made to establish refueling infrastructure through lease agreements or shared revenue models. This flexibility means that acquisition costs may or may not apply, depending on the site arrangement.

While the project team has made every effort to provide accurate cost estimates, particularly for electrical infrastructure, these figures should be considered high-level calculations. Depending on the specific site layout and design, the requirements for transformers, panels, and other components could vary significantly, impacting

the overall cost. The estimates provided here offer an order-of-magnitude perspective, giving developers and planners a practical sense of the investment required to build out charging or refueling infrastructure and also serve as a valuable resource when applying for federal or state grants aimed at supporting medium- and heavy-duty vehicle infrastructure deployment across the region.

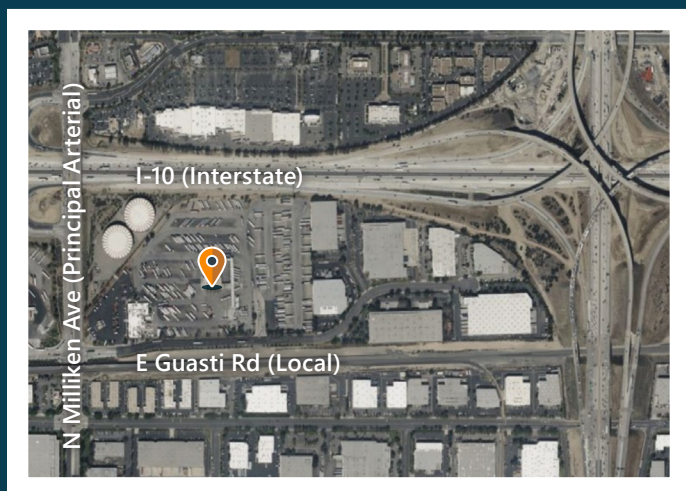
Finally, each site assessment includes key considerations for establishing charging or refueling infrastructure tailored to the specific technology and use case. These considerations encompass recommendations on the proximity to various types of facilities and amenities that can enhance a site's suitability. For example, locations near rest stops, restaurants, or retail areas can make a site more appealing to drivers, ensuring that essential services are readily available during charging or refueling. The project team recognizes that the presence of such amenities, alongside strategic proximity to relevant facilities like warehouses or distribution centers, can contribute to the efficiency and usability of the infrastructure for truck drivers and logistics operators.

Additionally, the considerations section addresses site configuration and planning measures necessary to ensure that the establishment of charging or refueling infrastructure does not adversely impact the safety and congestion levels within a community. This is particularly important in DACs, where residents often bear the brunt of truck traffic and its associated safety concerns. The assessments provide guidance on designing configurations that minimize congestion and ensure

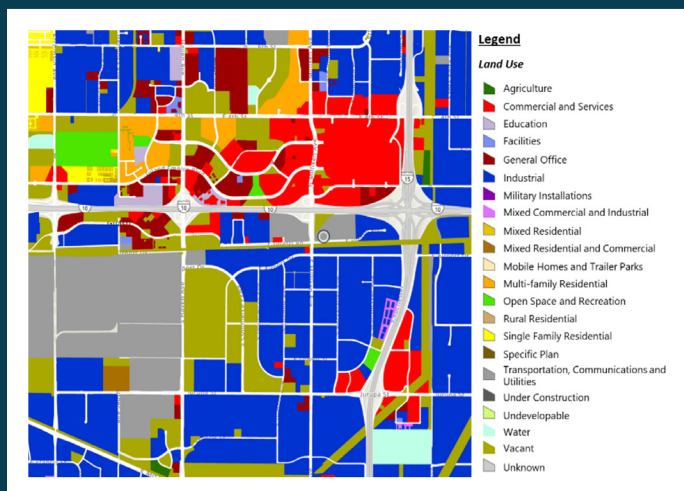
smooth flow, reducing the risk of increased truck-related safety issues in these areas. They also discuss the potential economic impact of these facilities, highlighting benefits such as job creation and local economic growth that can arise from developing zero emission vehicle infrastructure.

The assessments further offer insights into how planners and developers might navigate financing through public-private partnerships and joint ventures, which can be crucial for covering the substantial costs associated with such projects. Engaging with state and federal agencies to secure grants and incentives is emphasized as a vital strategy to offset significant portions of project costs, particularly for large-scale deployments.





SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
1,379,110 sq.ft
- > Estimated truck parking spaces:
559
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Transportation, Communication, and Utilities
- > Site primary neighboring land use(s):
Industrial, Commercial, General Office, Vacant
- > Estimated daily truck visits:
8,000 truck trips
- > Available load capacity:
N/A

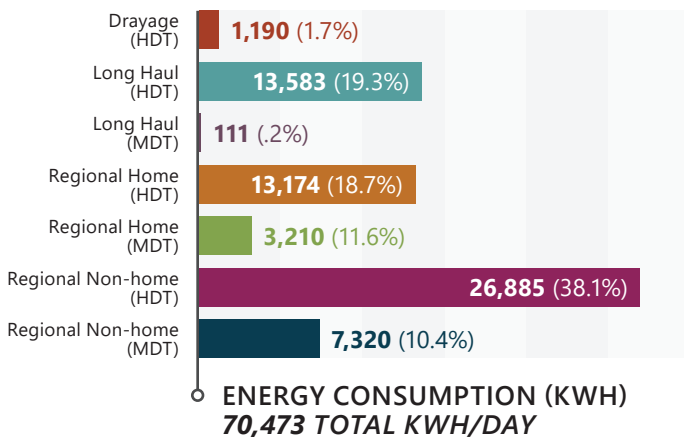
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **3.02**

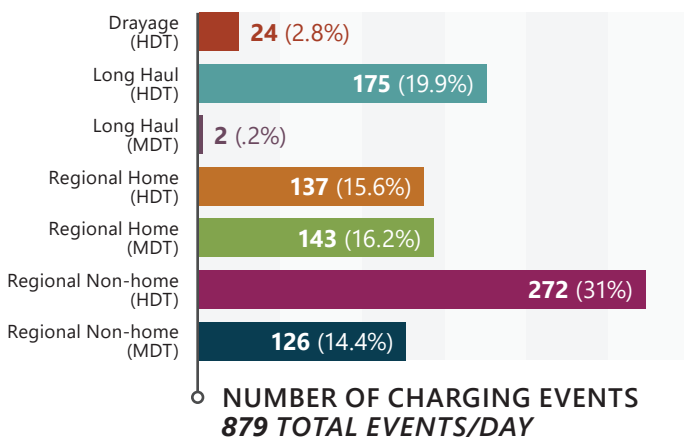
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|--|--|
| 4 Energy Demand (2030) | 0 Load Capacity |
| 4 Daily Mileage | 0 Ability to Integrate DERs |
| 10 Existing Truck Parking | 0 Proximity to Disadvantaged Communities |
| 0 Scalability | 5 Direct Benefit to Disadvantaged Communities |
| 9 Land Price | 10 Flood Risk |
| 10 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 0 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

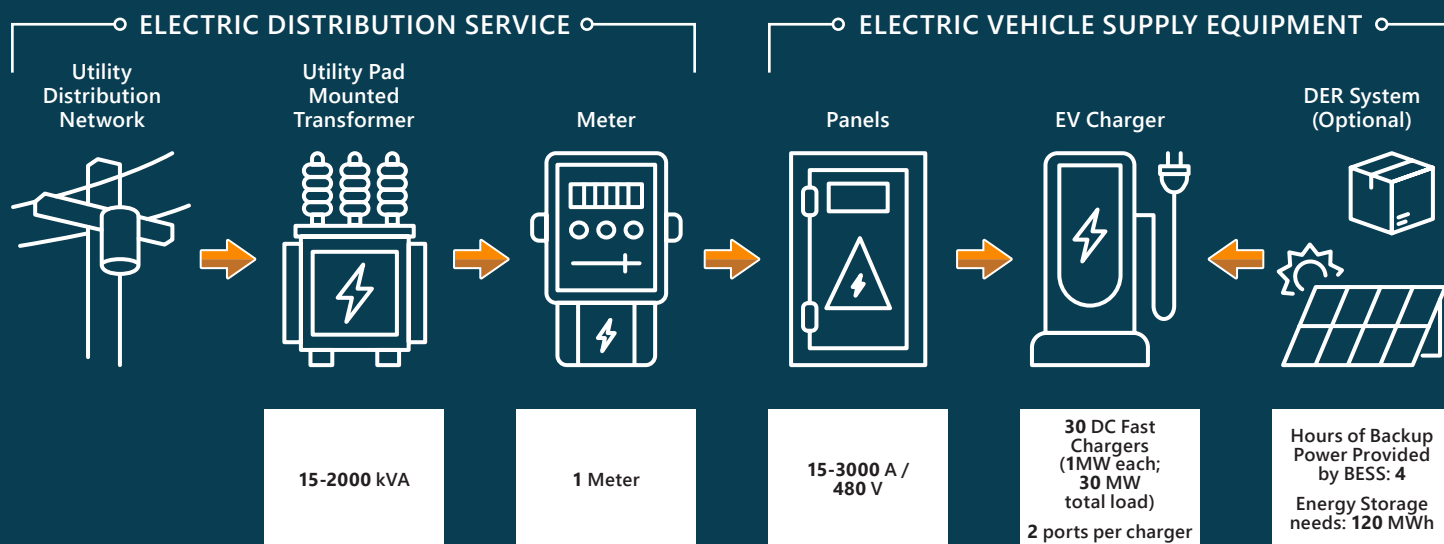
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$13,269,786**
 Operation & Maintenance Costs (5 years): **\$5,452,218**
Total: \$18,722,003

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$658,635**
 Panel Installation: **\$131,727**
 Electric Meters: **\$2,500**
 Conduit/Trenching: **\$191,835**
 Permitting: **\$14,770**
Total: \$999,467

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$2,354,406**
 Transformer Installation: **\$470,881**
 Reconductoring: **\$123,000**
Total: \$2,948,287

LAND ACQUISITION COST

Total: \$57,300,000

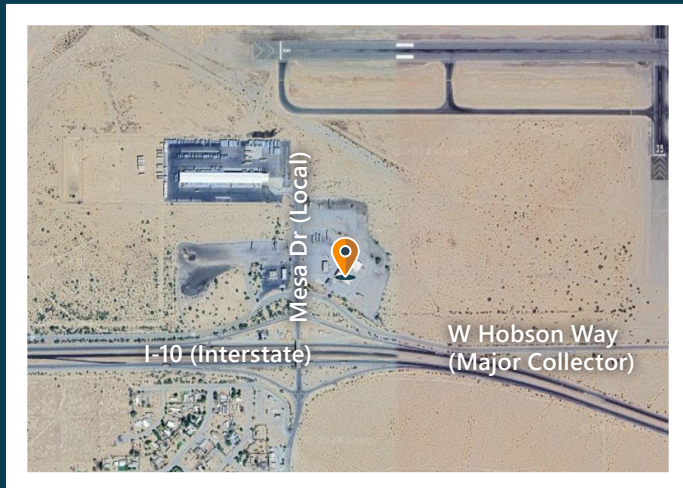
DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$32,400,000**
 PV cost: **\$36,000,000**
Total: \$68,400,000

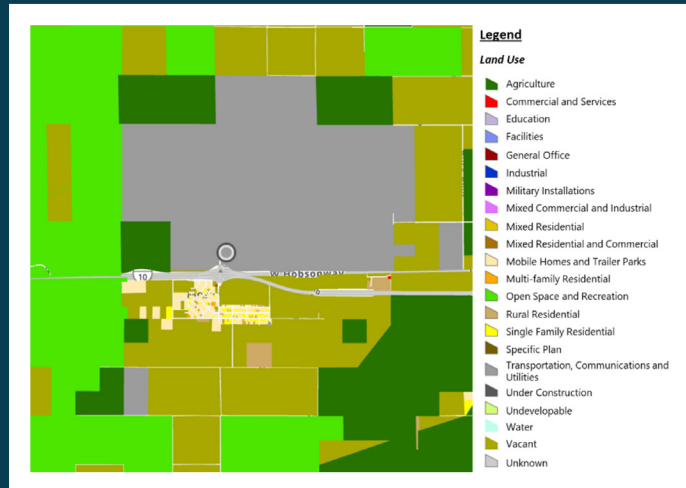
Total Investment (excluding DER integration): \$79,900,000

KEY CONSIDERATIONS

- > The presence of the existing Petro Travel Center, being located along I-10, and neighboring major warehouses and commercial zones makes it a prime candidate for supporting various market segments, including long-haul and regional operations. Additionally, the proposed location can offer significant advantage in attracting drivers already familiar with refueling at this location, enhancing initial customer adoption, and leading to steady revenue streams.
- > This location can also accommodate hydrogen stations, providing an opportunity to integrate traditional and various alternative fuel offerings for operators who manage mixed fleets.
- > As a multi-purpose facility and given the high number of daily truck visits, it's recommended to use a pull-in configuration, which makes efficient use of the existing parking spaces without limiting the capacity.
- > The installation of EV chargers is expected to increase daily truck visits, potentially leading to higher traffic volumes. Effective traffic management strategies, including clear entry and exit points, directional signage, and scheduling charging times, will be essential to mitigate congestion.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The construction and operation of the facility can generate local employment opportunities, particularly benefiting the community within the DAC.
- > The presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
927,828 sq. ft
- > Estimated truck parking spaces:
120
- > Urban/rural:
Urban
- > Property ownership:
Public
- > Site land use:
Transportation, Communication, and Utilities
- > Site primary neighboring land use(s):
Transportation, Vacant, Trailer Parks, Agriculture, Open Space
- > Estimated daily truck visits:
1,700-8,600 truck trips
- > Available load capacity:
N/A

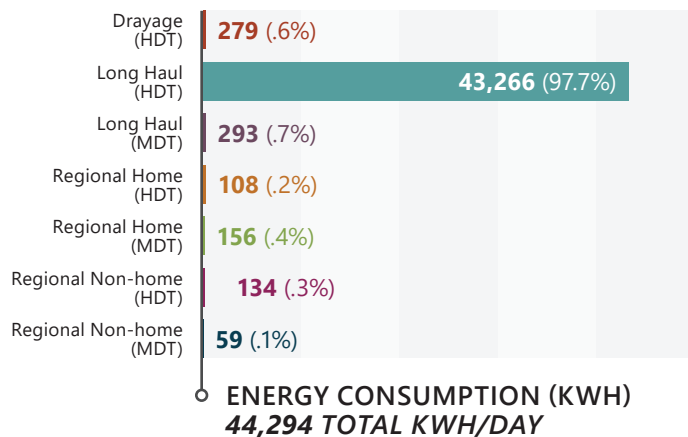
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.59**

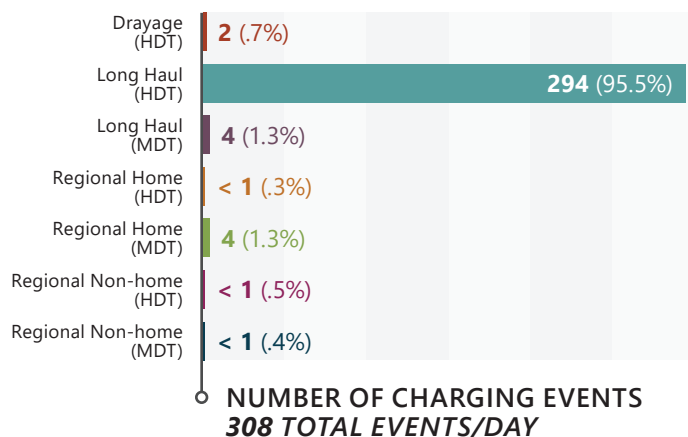
- | | |
|--|--|
| 1 Energy Demand (2030) | 0 Load Capacity |
| 2 Daily Mileage | 5 Ability to Integrate DERs |
| 10 Existing Truck Parking | 5 Proximity to Disadvantaged Communities |
| 0 Scalability | 1 Direct Benefit to Disadvantaged Communities |
| 10 Land Price | 0 Flood Risk |
| 5 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 5 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

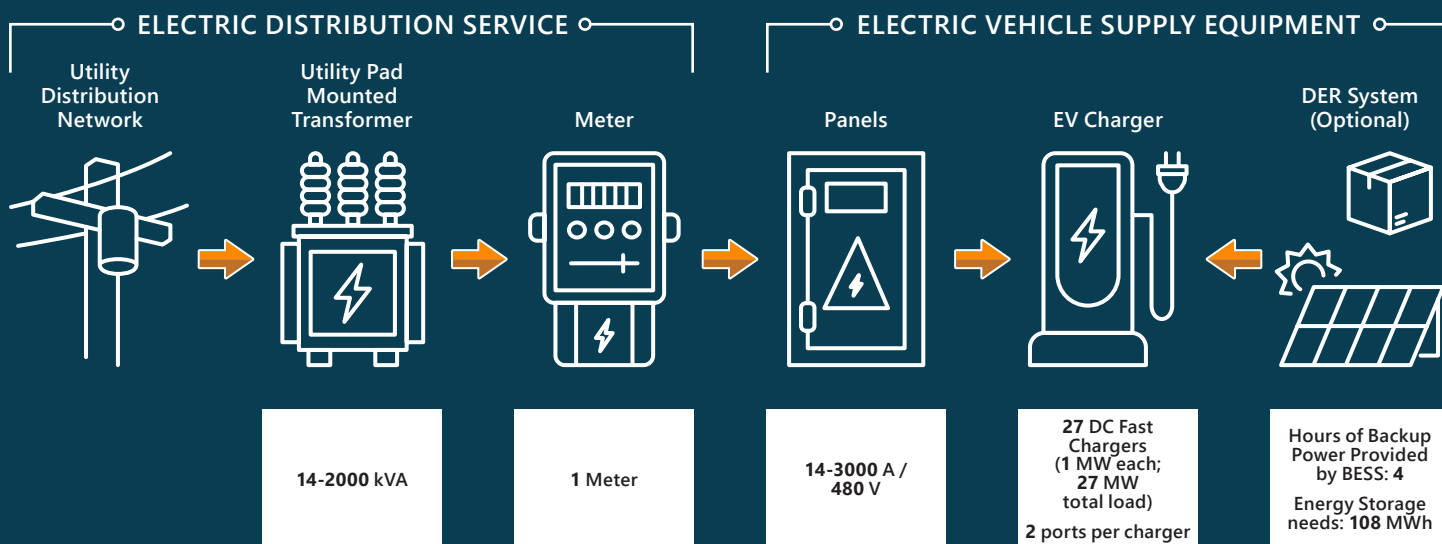
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$11,942,807**
 Operation & Maintenance Costs (5 years): **\$4,907,588**
Total: \$16,850,394

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$614,726**
 Panel Installation: **\$122,945**
 Electric Meters: **\$2,500**
 Conduit/Trenching: **\$174,825**
 Permitting: **\$13,725**
Total: \$928,721

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$3,009,109**
 Transformer Installation: **\$601,822**
 Reconductoring: **\$123,000**
Total: \$3,733,931

LAND ACQUISITION COST

Total: \$5,100,000

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$29,160,000**
 PV cost: **\$32,400,000**
Total: \$61,560,000

Total Investment (excluding DER integration): \$25,600,000

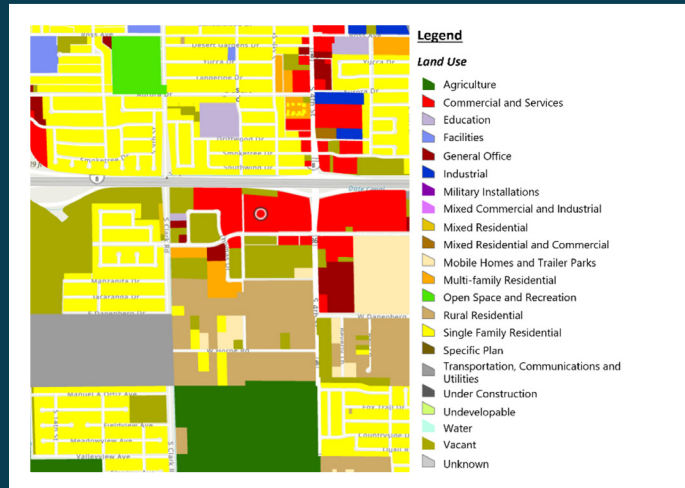
KEY CONSIDERATIONS

- > The presence of the existing truck stop and related amenities, being located along I-10, and neighboring the Blythe airport makes it a convenient location for supporting long-haul and regional operations. Additionally, the proposed location can offer significant advantage in attracting drivers already familiar with refueling at this location, enhancing initial customer adoption, and leading to steady revenue streams.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes.
- > The site has clear access from I-10 freeway and will require signage for trucks to minimize the risk of accidents and ensure smooth operation.
- > Despite the ample space of this large facility, given the relatively low expected energy demand per day, deploying a smaller number of dual-port chargers initially may be recommended. This approach ensures efficient use of resources while maintaining flexibility to scale up as demand increases.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution and noise levels, especially considering the existing noise levels due to the nearby airport.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Developing more amenities and placing smart business models, such as pay-as-you-go and subscription-based plans, can be explored to improve long-haul drivers' experience and attract users.
- > Public ownership may involve more stakeholders, which can extend decision-making timelines, but it ensures that the project aligns with community interests. Collaborating with public agencies can facilitate deployment while ensuring broad access and public benefit.
- > The urban location and proximity to Blythe airport offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.

ELECTRIC LARGE FACILITY: MIXED USE CASE



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
426,888 sq. ft
- > Estimated truck parking spaces:
108
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Commercial and services, General office, Vacant, Residential, Industrial
- > Estimated daily truck visits:
518-2,600 truck trips
- > Available load capacity:
N/A

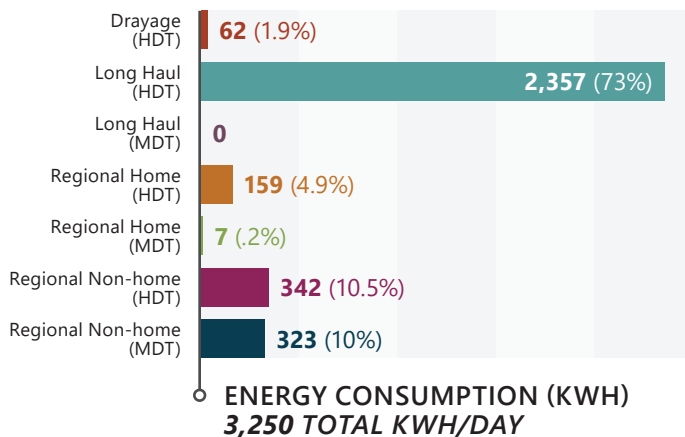
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **3.24**

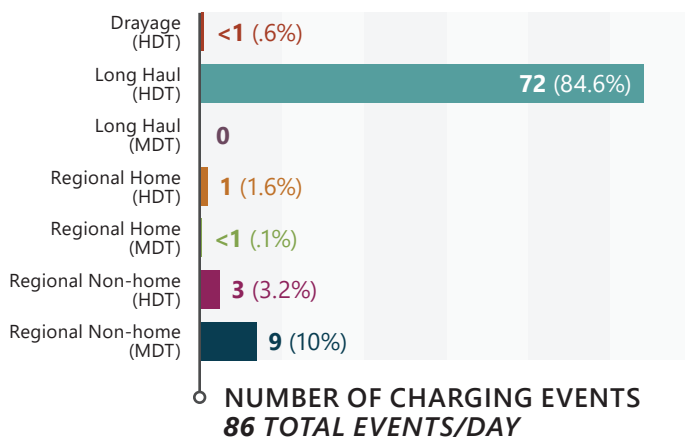
- | | |
|---|--|
| 0 Energy Demand (2030) | 0 Load Capacity |
| 0 Daily Mileage | 5 Ability to Integrate DERs |
| 10 Existing Truck Parking | 10 Proximity to Disadvantaged Communities |
| 0 Scalability | 0 Direct Benefit to Disadvantaged Communities |
| 10 Land Price | 10 Flood Risk |
| 10 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 10 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

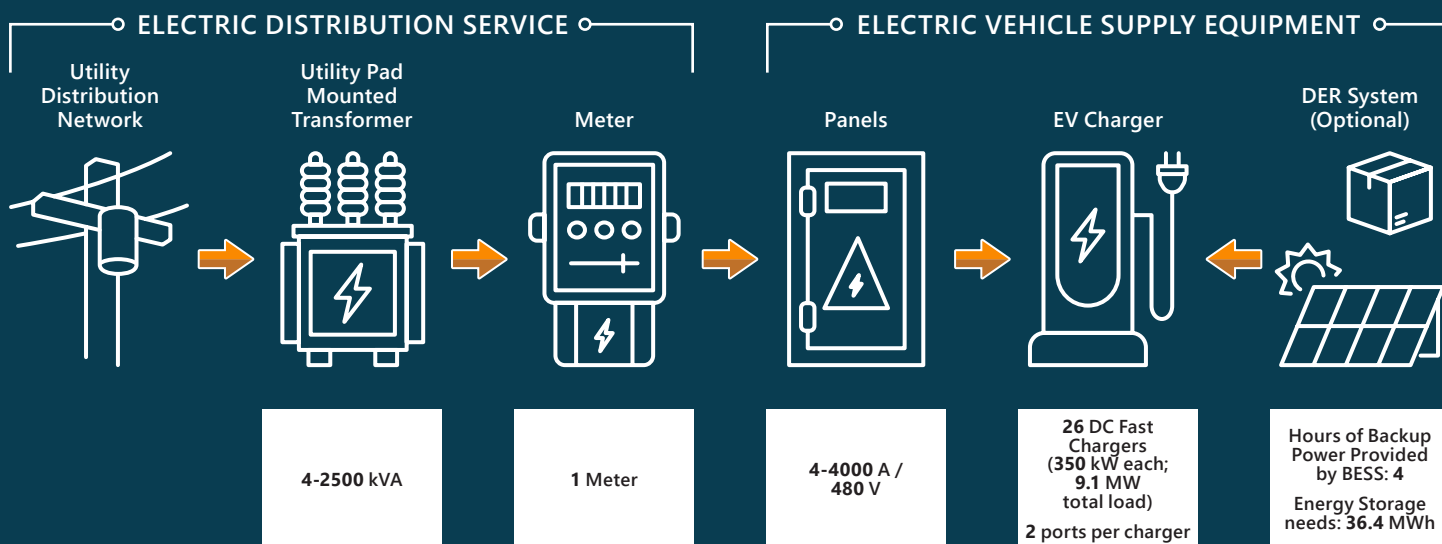
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$5,864,925**
 Operation & Maintenance Costs (5 years): **\$2,432,354**
Total: \$8,297,280

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$276,000**
 Panel Installation: **\$55,200**
 Electric Meters: **\$2,500**
 Conduit/Trenching: **\$167,832**
 Permitting: **\$7,523**
Total: \$509,055

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$725,860**
 Transformer Installation: **\$145,172**
 Reconductoring: **\$123,000**
Total: \$994,032

LAND ACQUISITION COST

Total: \$4,000,000

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

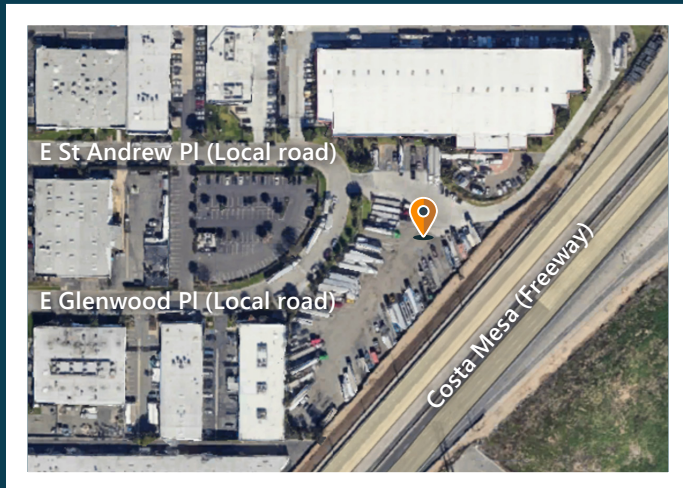
Battery Energy Storage System Cost: **\$9,828,000**
 PV cost: **\$10,920,000**
Total: \$20,748,000

Total Investment (excluding DER integration): \$13,800,000

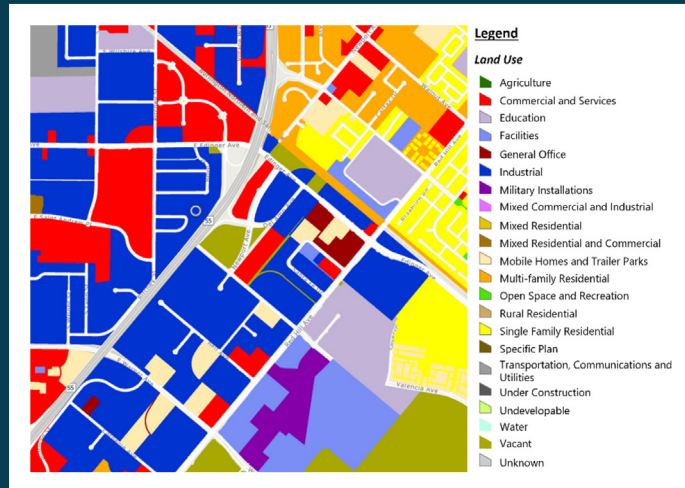
KEY CONSIDERATIONS

- > The facility's proximity to major highways, including I-8 and Hwy 86 enhances accessibility for regional and long-haul trucks. Located in an urban area, the facility can also serve local logistics operations.
- > Despite the ample space of this large facility, given the relatively low expected energy demand per day, deploying a smaller number of dual-port chargers initially may be recommended. This approach ensures efficient use of resources while maintaining flexibility to scale up as demand increases.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes.
- > The installation of EV chargers is expected to increase daily truck visits, potentially leading to higher traffic volumes. Effective traffic management strategies, including clear entry and exit points, directional signage, and scheduling charging times, will be essential to mitigate congestion.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The high traffic volume and presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > The small vacant parcel to the north may present opportunities for expansion, such as additional truck parking/charging infrastructure or amenities, which could enhance the facility's functionality.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.

ELECTRIC LARGE FACILITY: URBAN USE CASE



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
284,882 sq. ft
- > Estimated truck parking spaces:
60
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Industrial
- > Site primary neighboring land use(s):
Industrial, Commercial and services, Facilities, Residential
- > Estimated daily truck visits:
288-1,440 truck trips
- > Available load capacity:
2.39 MW

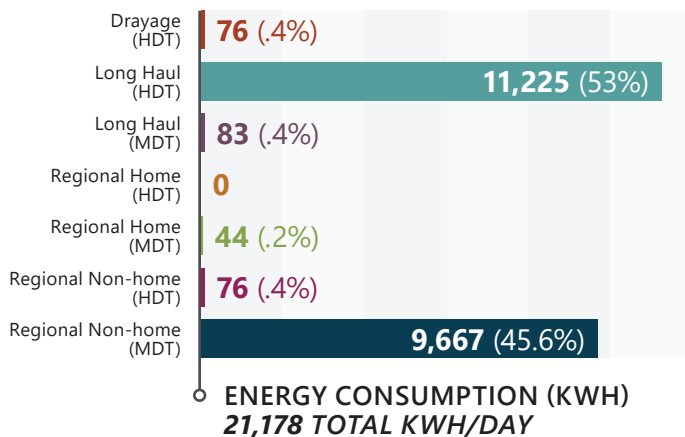
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **1.87**

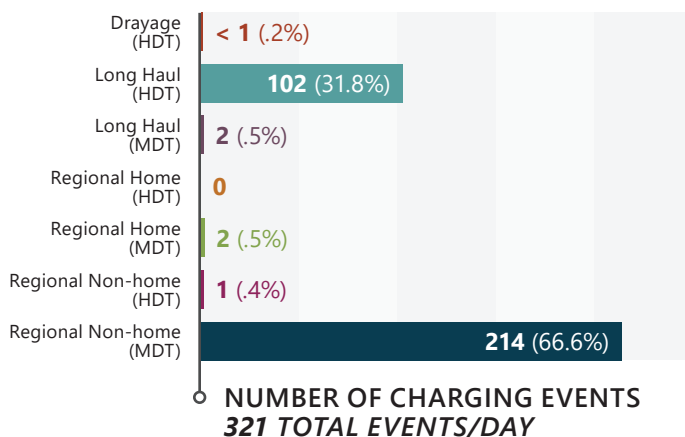
- 2** Energy Demand (2030)
- 1** Daily Mileage
- 10** Existing Truck Parking
- 0** Scalability
- 9** Land Price
- 0** Amenities
- 10** Access, Congestion, Safety
- 0** Proximity to Other ZEV Infrastructure
- 0** Load Capacity
- 0** Ability to Integrate DERs
- 0** Proximity to Disadvantaged Communities
- 2** Direct Benefit to Disadvantaged Communities
- 10** Flood Risk
- 0** Brownfields

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

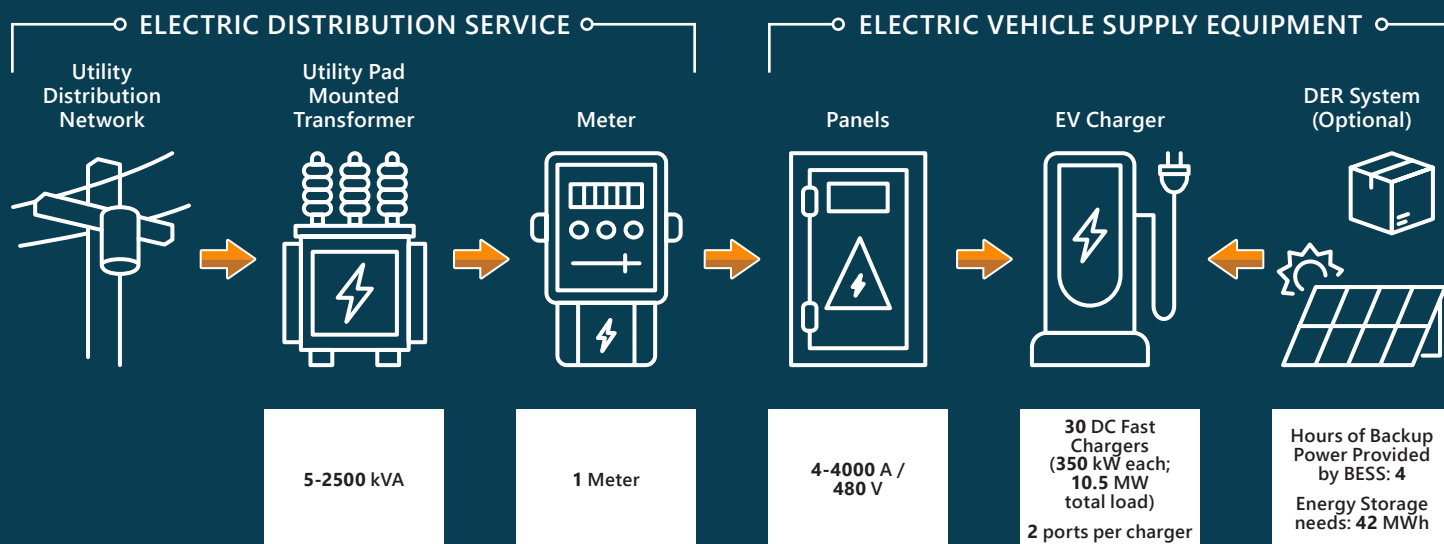
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$6,767,222**

Operation & Maintenance Costs (5 years): **\$2,806,725**

Total: \$9,573,947

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$276,000**

Panel Installation: **\$55,200**

Electric Meters: **\$2,500**

Conduit/Trenching: **\$194,250**

Permitting: **\$7,919**

Total: \$535,869

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$907,325**

Transformer Installation: **\$181,465**

Reconductoring: **\$123,000**

Total: \$1,211,790

LAND ACQUISITION COST

Total: \$16,100,000

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$11,340,000**

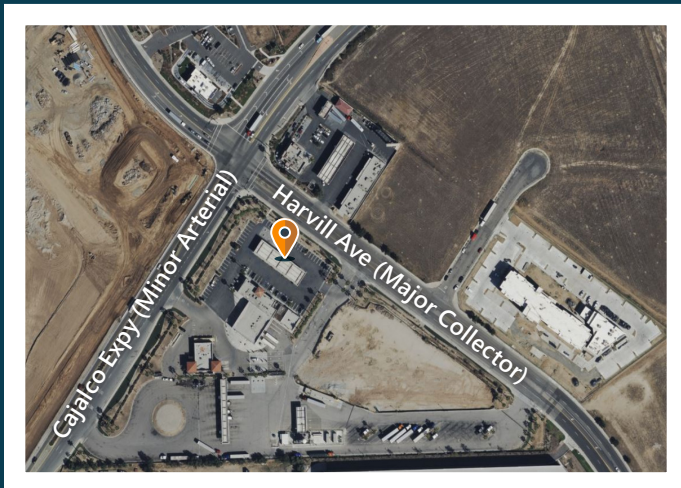
PV cost: **\$12,600,000**

Total: \$23,940,000

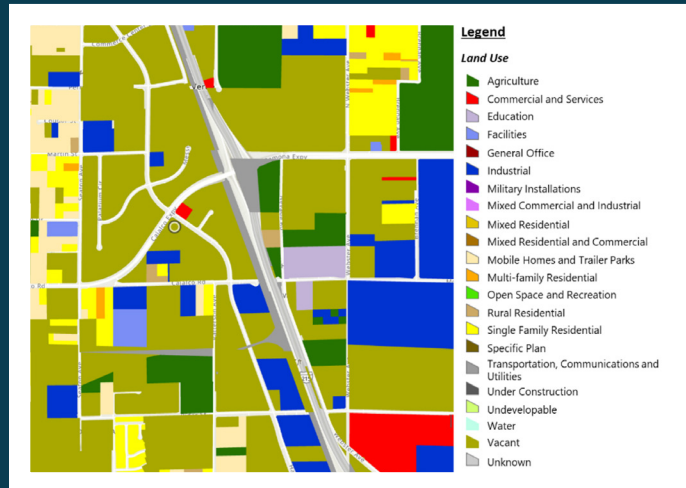
Total Investment (excluding DER integration): \$27,400,000

KEY CONSIDERATIONS

- > The facility is located within an industrial and commercial section of an urban area, primarily accessed via local roads. This location may support trucks operating on shorter delivery routes, enhancing operational efficiency for logistics in the surrounding region. Additionally, its proximity to the Costa Mesa Freeway may facilitate long-haul trucks serving the area. The site also includes a storage facility making it a convenient location for trucks to charge while loading or unloading.
- > Given the site's layout with trucks parked around a central space, a pull-in configuration is more practical. It utilizes the existing parking spots efficiently without requiring significant alterations.
- > The site will need clear signage to ensure smooth operation.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > The current traffic and presence of the storage facility can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
191,664 sq. ft
- > Estimated truck parking spaces:
40
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Vacant
- > Site primary neighboring land use(s):
Vacant, Industrial, Commercial, Agriculture, Residential
- > Estimated daily truck visits:
192-960 truck trips
- > Available load capacity:
N/A

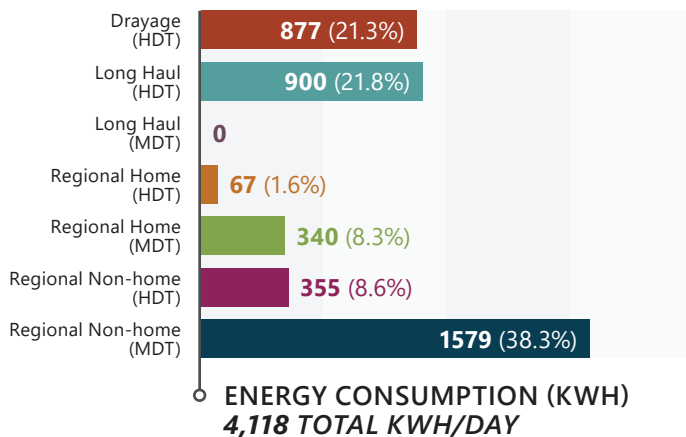
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.36**

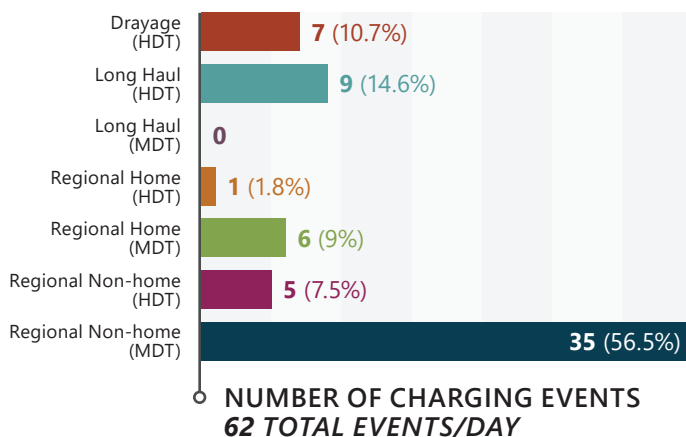
- 0** Energy Demand (2030)
- 0** Daily Mileage
- 10** Existing Truck Parking
- 0** Scalability
- 10** Land Price
- 10** Amenities
- 10** Access, Congestion, Safety
- 10** Proximity to Other ZEV Infrastructure
- 0** Load Capacity
- 5** Ability to Integrate DERs
- 0** Proximity to Disadvantaged Communities
- 0** Direct Benefit to Disadvantaged Communities
- 10** Flood Risk
- 0** Brownfields

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

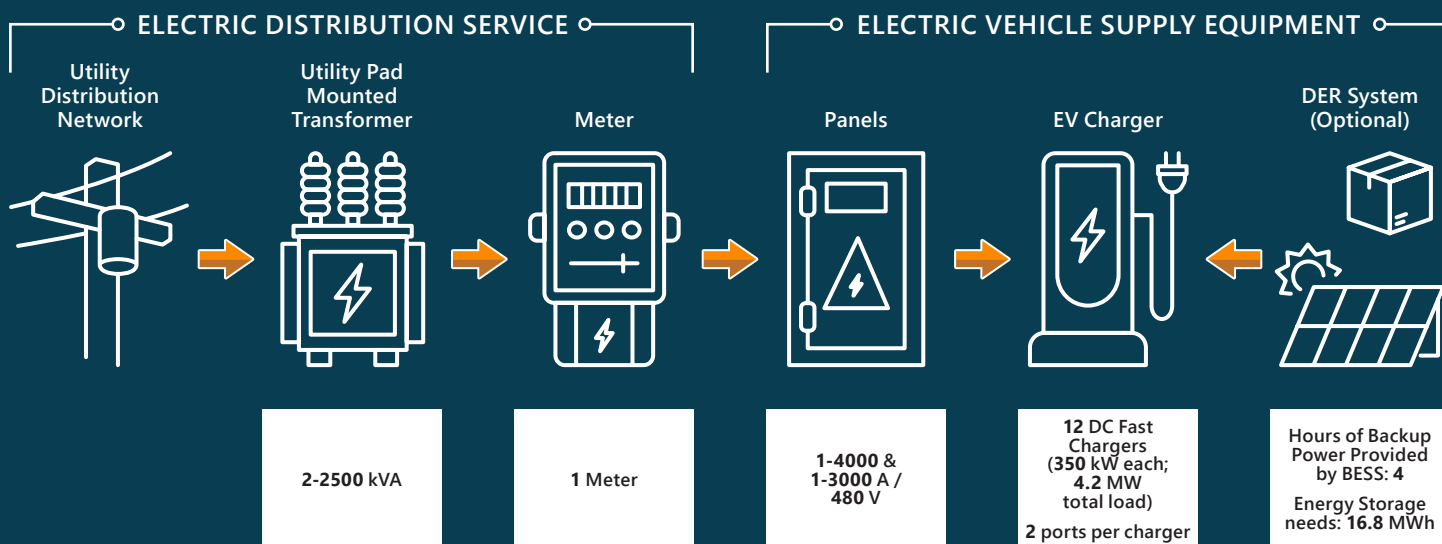
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$2,706,889**
 Operation & Maintenance Costs (5 years): **\$1,122,690**
Total: \$3,829,579

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$112,909**
 Panel Installation: **\$22,582**
 Electric Meters: **\$2,500**
 Conduit/Trenching: **\$55,500**
 Permitting: **\$2,902**
Total: \$196,393

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$362,930**
 Transformer Installation: **\$72,586**
 Reconductoring: **\$123,000**
Total: \$558,516

LAND ACQUISITION COST

Total: \$5,500,000

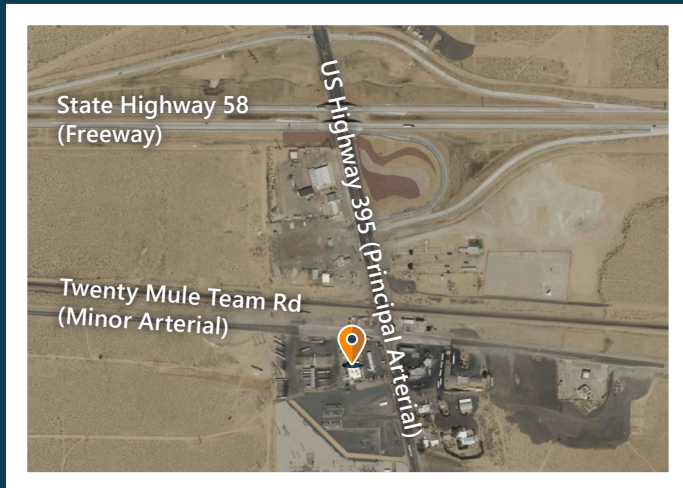
DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$4,536,000**
 PV cost: **\$5,040,000**
Total: \$9,576,000

Total Investment (excluding DER integration): \$10,100,000

KEY CONSIDERATIONS

- > The presence of the existing fuel stations, proximity to I-215, and neighboring major distribution centers makes it a prime candidate for supporting various market segments, including long-haul and regional operations, and optimizing route efficiency. Additionally, the proposed location can offer significant advantage in attracting drivers already familiar with refueling at this location, enhancing initial customer adoption, and leading to steady revenue streams.
- > Considering the site's layout with trucks parked along the curb, a pull-in configuration is more practical. It utilizes the existing parking spots efficiently without requiring significant alterations.
- > Given the relatively low expected energy demand per day, deploying a smaller number of dual-port chargers initially is more efficient use of resources while maintaining flexibility to scale up as demand increases.
- > The installation of EV chargers is expected to increase daily truck visits, potentially leading to higher traffic volumes. Effective traffic management strategies, including clear entry and exit points, directional signage, and scheduling charging times, will be essential to mitigate congestion.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
223,027 sq. ft
- > Estimated truck parking spaces:
50
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Transportation, Communication, and Utilities
- > Site primary neighboring land use(s):
Military, Commercial and services, Mixed Residential, Vacant
- > Estimated daily truck visits:
720-3,600 truck trips
- > Available load capacity:
N/A

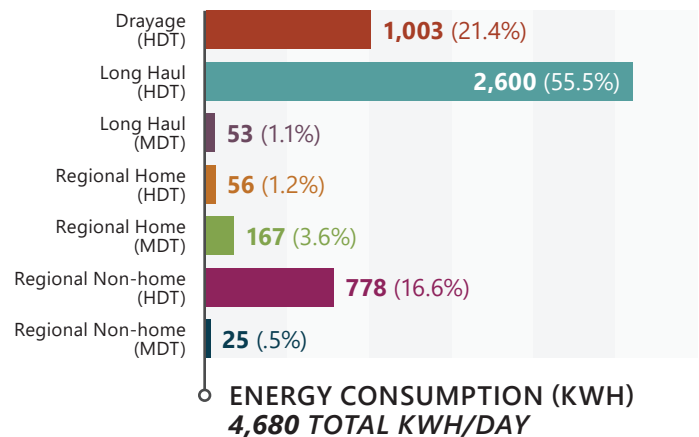
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.38**

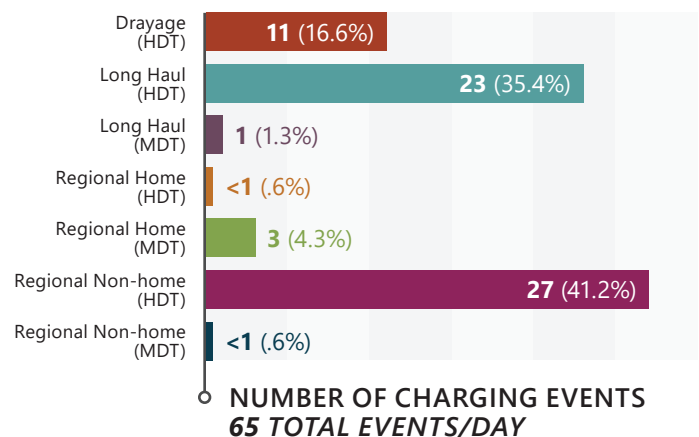
- | | |
|---|--|
| 0 Energy Demand (2030) | 0 Load Capacity |
| 0 Daily Mileage | 5 Ability to Integrate DERs |
| 10 Existing Truck Parking | 5 Proximity to Disadvantaged Communities |
| 0 Scalability | 0 Direct Benefit to Disadvantaged Communities |
| 9 Land Price | 0 Flood Risk |
| 10 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 10 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

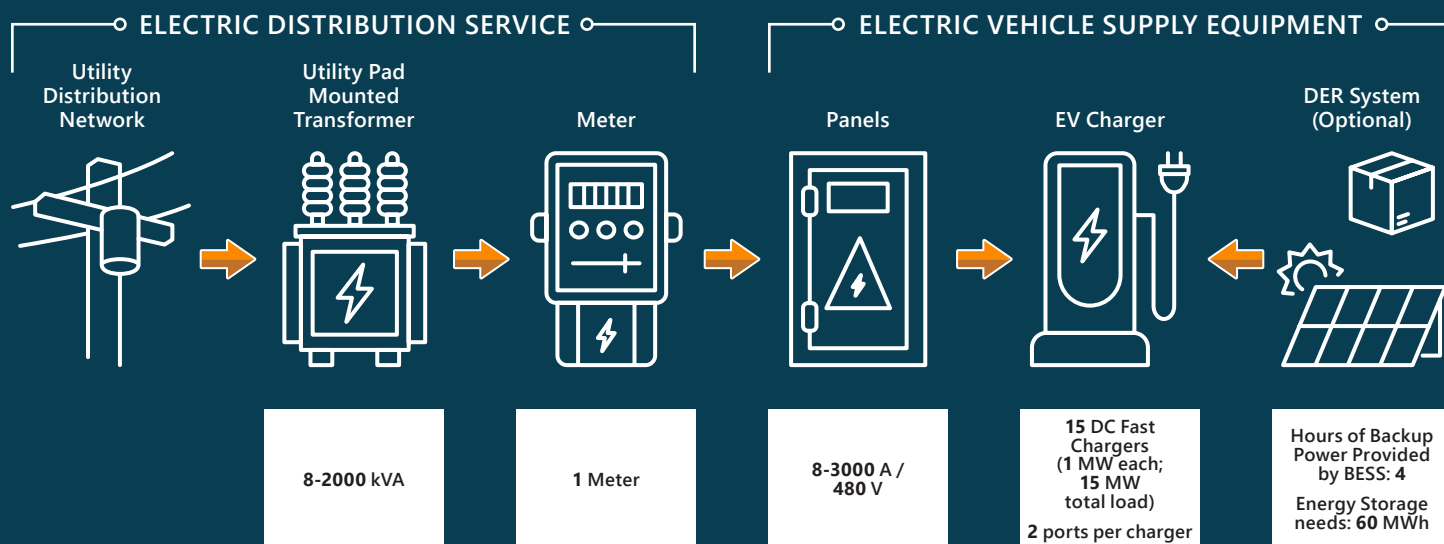
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$6,634,893**
 Operation & Maintenance Costs (5 years): **\$6,634,893**
Total: \$9,361,330

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$351,272**
 Panel Installation: **\$70,254**
 Electric Meters: **\$2,500**
 Conduit/Trenching: **\$69,375**
 Permitting: **\$7,401**
Total: \$500,802

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$1,255,683**
 Transformer Installation: **\$251,137**
 Reconductoring: **\$123,000**
Total: \$1,629,820

LAND ACQUISITION COST

Total: \$14,200,000

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$16,200,000**
 PV cost: **\$18,000,000**
Total: \$34,200,000

Total Investment (excluding DER integration): \$25,700,000

KEY CONSIDERATIONS

- > The presence of the existing Petro Travel Center and being located along the state highway CA-58 makes it a convenient location for trucks to charge while optimizing route efficiency and enhances the accessibility for long-haul and regional operations. Additionally, the proposed location can offer significant advantage in attracting drivers already familiar with refueling at this location, enhancing initial customer adoption, and leading to steady revenue streams.
- > Given the site's layout with trucks parked around a central space and adequate moving space, a pull-in configuration is more practical. It utilizes the existing parking spots efficiently without requiring significant alterations.
- > The site has clear access from CA-58 freeway and will require signage for trucks to minimize the risk of accidents and ensure smooth operation.
- > Despite the ample space of this facility, given the relatively low expected energy demand per day, deploying a smaller number of dual-port chargers initially may be recommended. This approach ensures efficient use of resources while maintaining flexibility to scale up as demand increases.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution and noise levels.
- > The presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > While classified as urban, the site is relatively far from the urban center. This implies the location offers ample space and lower land costs, which can be advantageous for large-scale installations. However, it may require more extensive infrastructure development, potentially leading to higher installation costs and a lower initial utilization rate, with the opportunity for long-term growth as demand increases.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
151,589 sq. ft
- > Estimated truck parking spaces:
30
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Industrial, Mixed residential and commercial
- > Estimated daily truck visits:
144-720 truck trips
- > Available load capacity (SCE):
0.77 MW

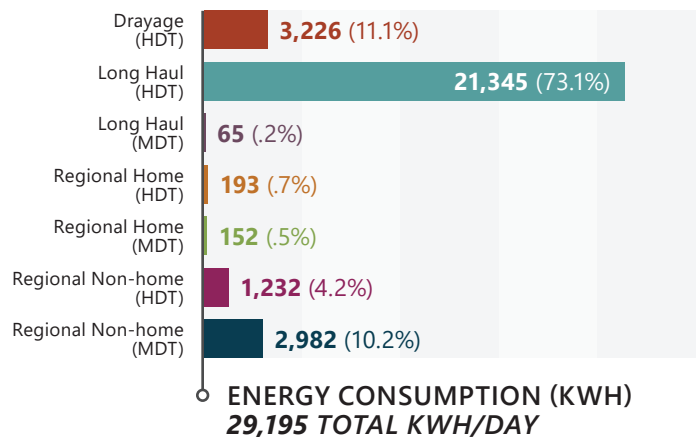
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **3.47**

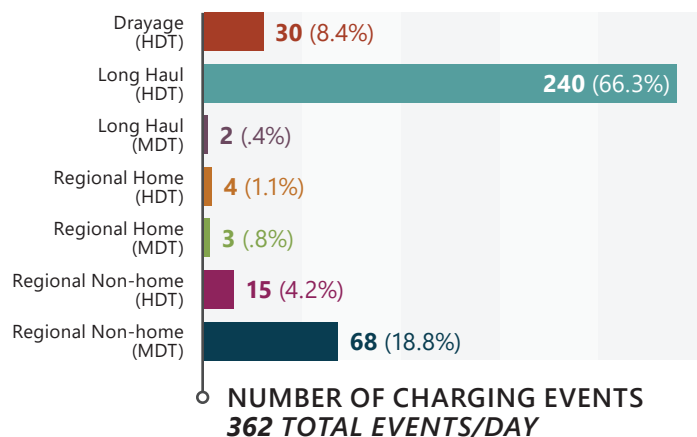
- | | |
|--|--|
| 4 Energy Demand (2030) | 0 Load Capacity |
| 2 Daily Mileage | 10 Ability to Integrate DERs |
| 10 Existing Truck Parking | 0 Proximity to Disadvantaged Communities |
| 0 Scalability | 2 Direct Benefit to Disadvantaged Communities |
| 10 Land Price | 10 Flood Risk |
| 10 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 0 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

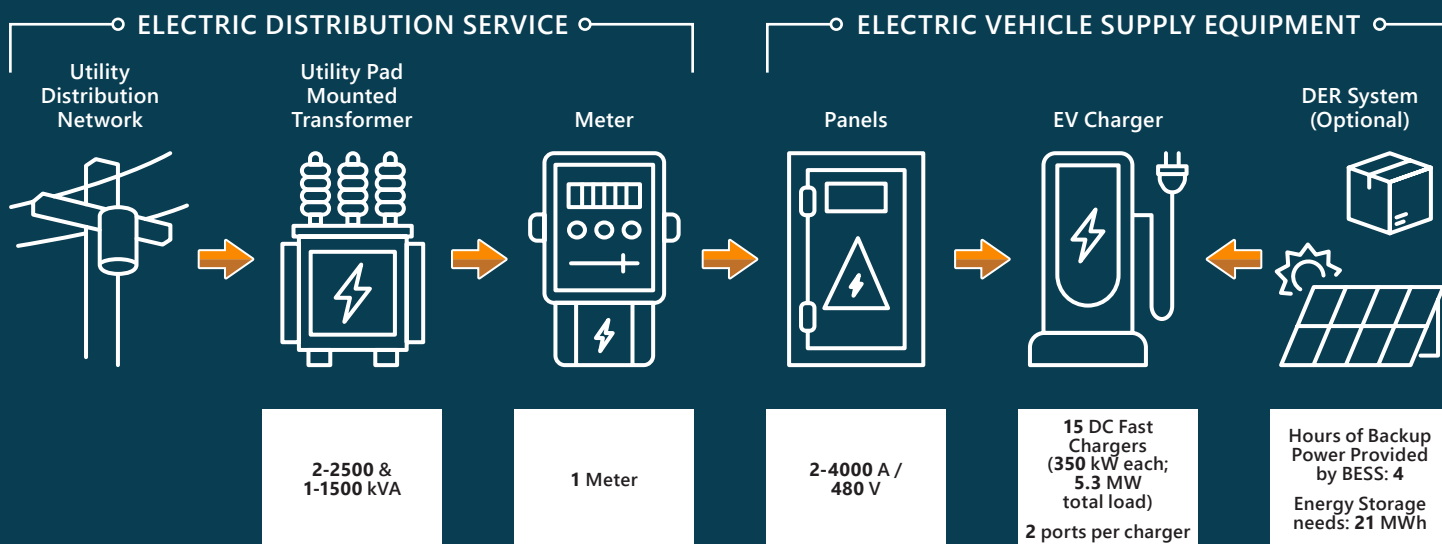
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$3,383,611**
 Operation & Maintenance Costs (5 years): **\$1,403,363**
Total: \$4,786,974

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$138,000**
 Panel Installation: **\$27,600**
 Electric Meters: **\$2,500**
 Conduit/Trenching: **\$69,375**
 Permitting: **\$3,562**
Total: \$241,037

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$447,079**
 Transformer Installation: **\$89,416**
 Reconductoring: **\$123,000**
Total: \$659,495

LAND ACQUISITION COST

Total: \$5,700,000

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$5,670,000**
 PV cost: **\$6,300,000**
Total: \$11,970,000

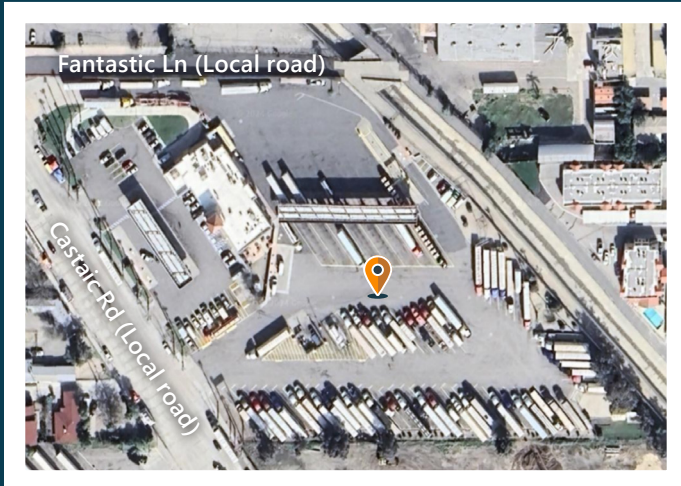
Total Investment (excluding DER integration): \$11,300,000

KEY CONSIDERATIONS

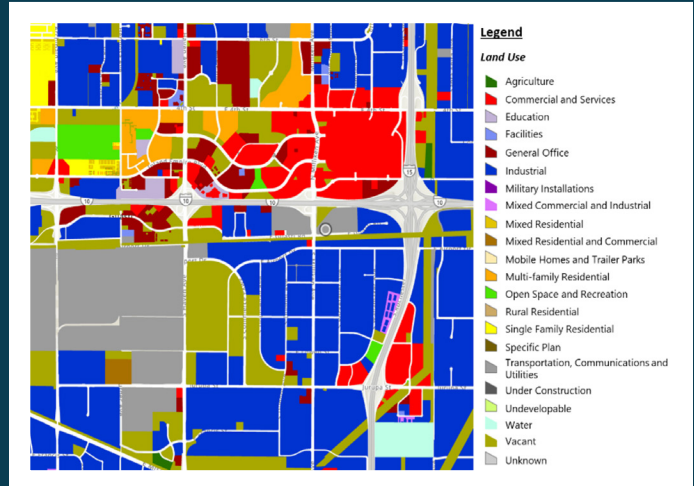
- > The site's proximity to major distribution centers makes it a convenient location for trucks to charge while optimizing route efficiency. It also ensures high utilization by heavy-duty long haul and regional non-home medium-duty trucks.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes.
- > The site will need clear signage and designated pathways for trucks to minimize the risk of accidents and ensure smooth operation.
- > If fully utilized, this site can attract up to 1,440 zero emission trucks to the facility (48 trucks per charging port over the course of the day). This is in addition to the traffic using this facility solely for parking. This could have implications for the traffic safety of the community, which must be considered throughout the site planning and development process.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address

concerns and robust traffic management to minimize congestion and safety risks.

- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > The high traffic volume and presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
222,156 sq. ft
- > Estimated truck parking spaces:
79
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Commercial and services, Industrial, Transportation, Communication and utilities, Residential, Open space
- > Estimated daily truck visits:
380-1,900 truck trips
- > Available load capacity (SCE):
6.72 MW

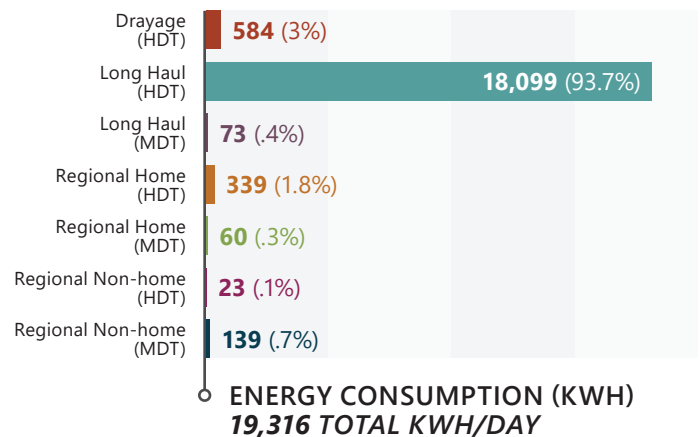
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.58**

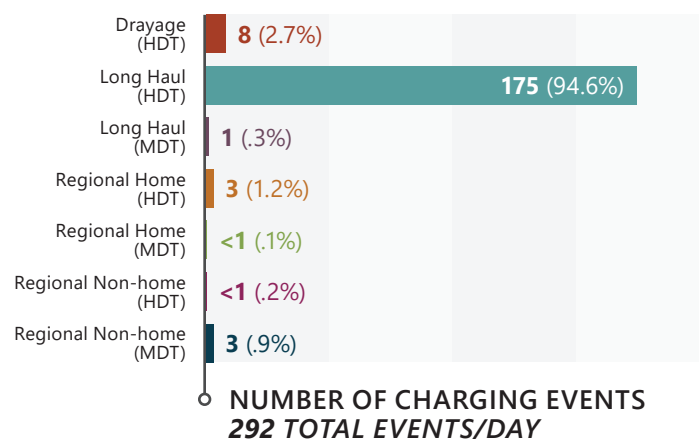
- | | |
|---|--|
| 3 Energy Demand (2030) | 0 Load Capacity |
| 1 Daily Mileage | 0 Ability to Integrate DERs |
| 10 Existing Truck Parking | 5 Proximity to Disadvantaged Communities |
| 0 Scalability | 0 Direct Benefit to Disadvantaged Communities |
| 10 Land Price | 0 Flood Risk |
| 10 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 10 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

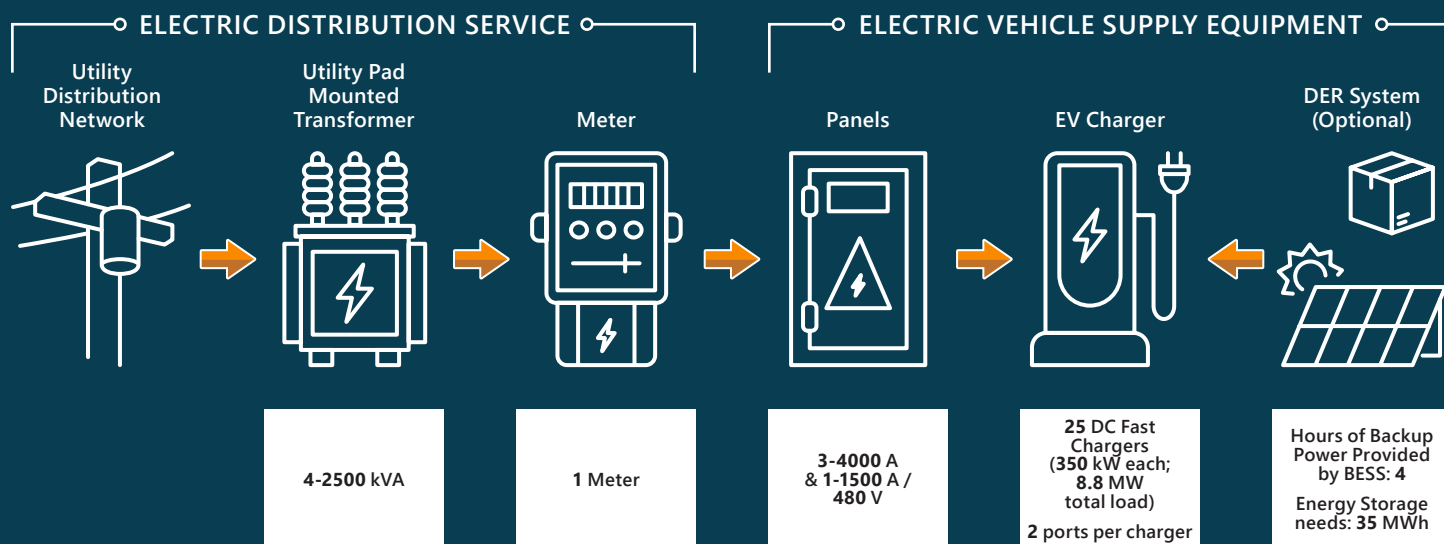
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$5,639,352**
 Operation & Maintenance Costs (5 years): **\$2,339,431**
Total: \$7,978,783

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$234,000**
 Panel Installation: **\$46,800**
 Electric Meters: **\$2,500**
 Conduit/Trenching: **\$163,688**
 Permitting: **\$6,705**
Total: \$453,693

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$725,860**
 Transformer Installation: **\$145,172**
 Reconductoring: **\$123,000**
Total: \$994,032

LAND ACQUISITION COST

Total: \$3,400,000

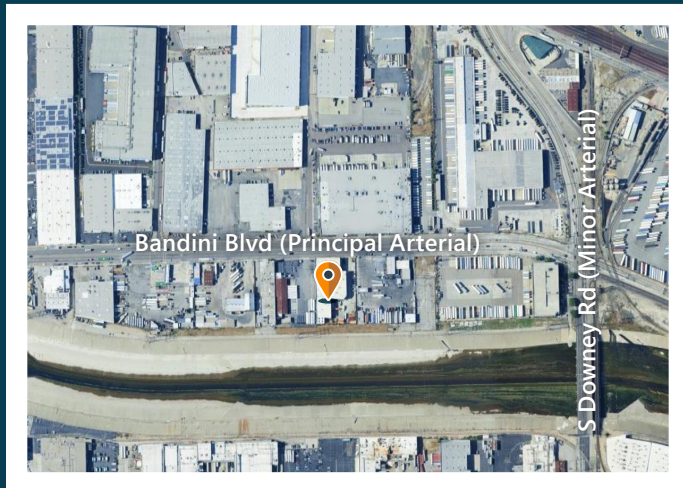
DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$9,450,000**
 PV cost: **\$10,500,000**
Total: \$19,950,000

Total Investment (excluding DER integration): \$12,800,000

KEY CONSIDERATIONS

- > The site is within an urban area with surrounding commercial services and amenities, supporting trucks that may need regular recharging or fueling close to delivery and service areas. While not directly adjacent to I-5, its proximity allows for quick access to major routes, accommodating both short-haul urban deliveries and long-haul trucks. The presence of numerous trucks parked at the site suggests potential for longer dwelling times and moderate charging solutions.
- > While the site is primarily an urban use case, typically favoring pull-in configurations, its layout can accommodate both pull-in and pull-through charging options. Pull-in chargers could be placed along or behind curbs, while pull-through configurations could be situated in parking spots located more centrally within the site.
- > The site will need clear signage and designated pathways for trucks to minimize the risk of accidents and ensure smooth operation.
- > While the site is in proximity to residential areas, the facility is generally separated from these neighborhoods, which helps mitigate direct impacts on residential traffic.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution while minimizing the potential negative impact of becoming a 'truck magnet' within those communities.
- > The high traffic volume and presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Although the absence of DAC status may limit certain government funding opportunities aimed at disadvantaged areas, there are still viable options for subsidizing initial setup costs. Private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
91,476 sq. ft
- > Estimated truck parking spaces:
25
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Industrial, Facilities, Commercial and services, Water
- > Estimated daily truck visits:
120-600 truck trips
- > Available load capacity:
8.1 kW

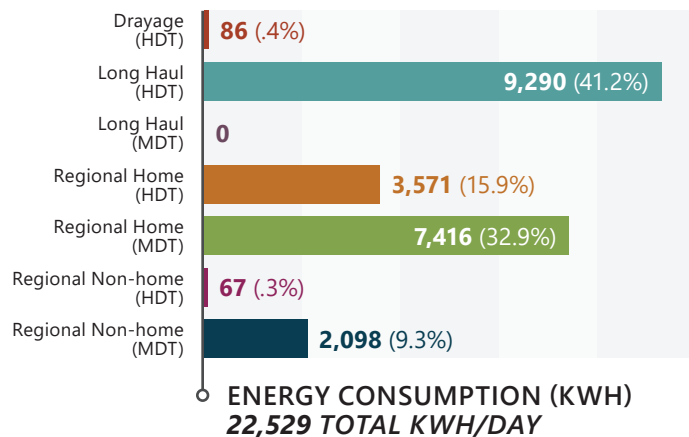
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **3.01**

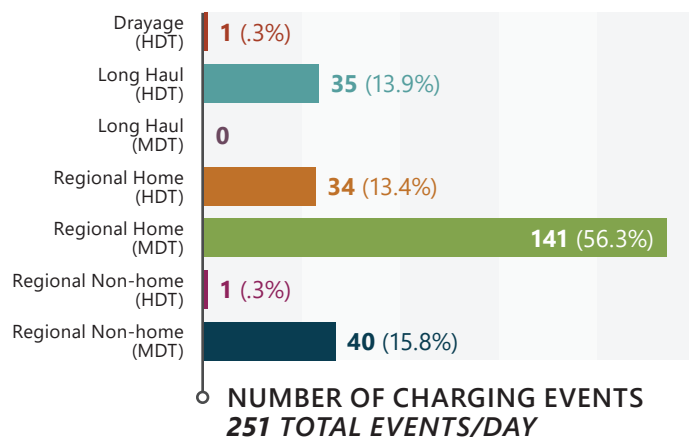
- | | |
|--|--|
| 8 Energy Demand (2030) | 0 Load Capacity |
| 0 Daily Mileage | 5 Ability to Integrate DERs |
| 10 Existing Truck Parking | 0 Proximity to Disadvantaged Communities |
| 0 Scalability | 0 Direct Benefit to Disadvantaged Communities |
| 9 Land Price | 0 Flood Risk |
| 5 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 0 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

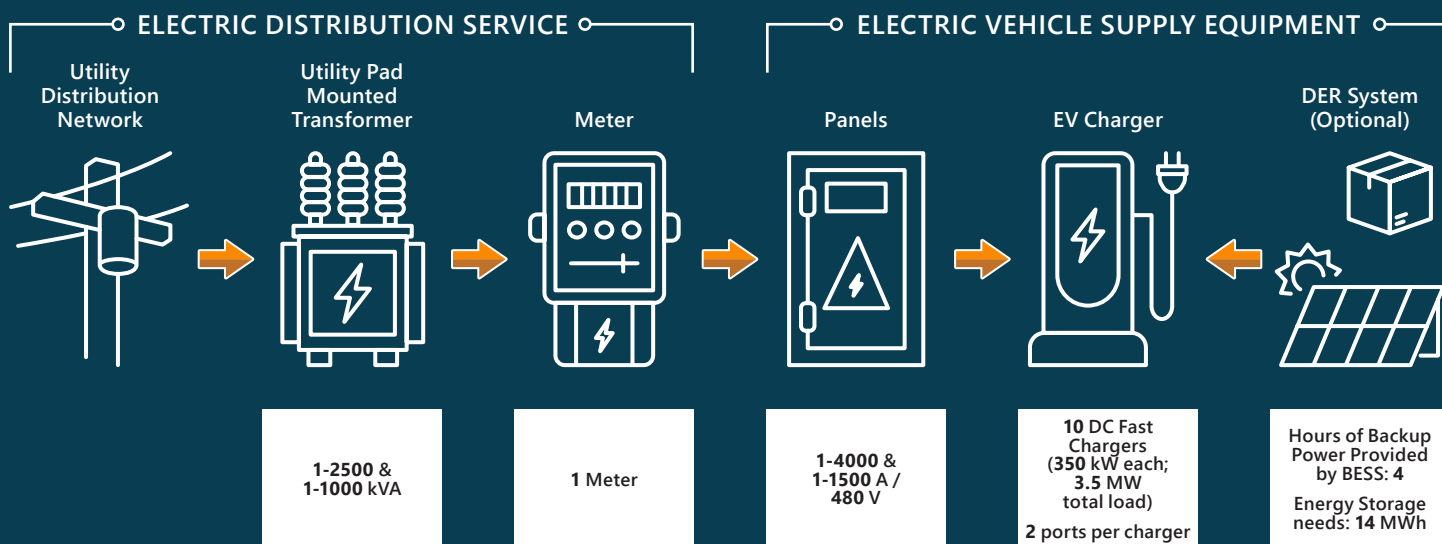
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$2,255,741**

Operation & Maintenance Costs (5 years): **\$935,575**

Total: \$3,191,316

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$96,000**

Panel Installation: **\$19,200**

Electric Meters: **\$2,500**

Conduit/Trenching: **\$46,250**

Permitting: **\$2,459**

Total: \$166,409

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$287,134**

Transformer Installation: **\$57,427**

Reconductoring: **\$123,000**

Total: \$467,561

LAND ACQUISITION COST

Total: \$5,800,000

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$3,780,000**

PV cost: **\$4,200,000**

Total: \$7,980,000

Total Investment (excluding DER integration): \$9,700,000

KEY CONSIDERATIONS

- > The site's urban setting, combined with its proximity to industrial and commercial facilities makes it a prime candidate for supporting destination use cases within urban area, including long-haul and regional deliveries.
- > While the site is primarily an urban use case, typically favoring pull-in configurations, its layout can accommodate both pull-in and pull-through charging options. Pull-in chargers could be placed along or behind curbs, while pull-through configurations could be situated more centrally within the site.
- > The proximity to dense urban district could signal the need for thoughtful traffic management to mitigate potential noise and congestion impacts from increased truck visits. If fully utilized, this site could attract up to 960 zero emission trucks to the facility (48 trucks per charging port over the course of the day). This is in addition to the traffic using this facility solely for parking. This could have implications for the local traffic congestion and safety, which must be considered throughout the site planning and development process.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution and noise levels.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Improving amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
65,776 sq. ft
- > Estimated truck parking spaces:
25
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Military, Vacant, Residential
- > Estimated daily truck visits:
96-480 truck trips
- > Available load capacity:
N/A

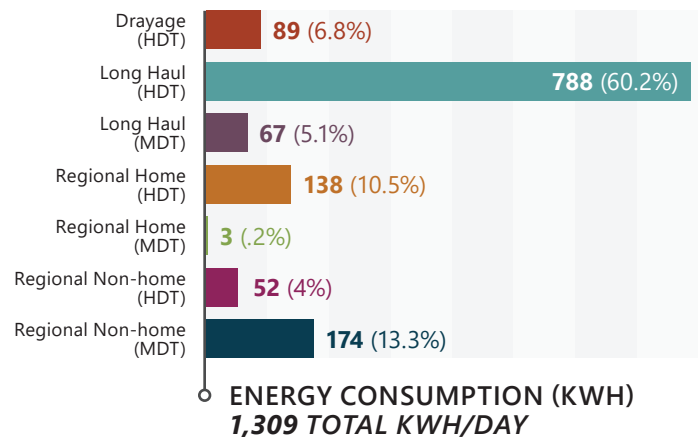
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.85**

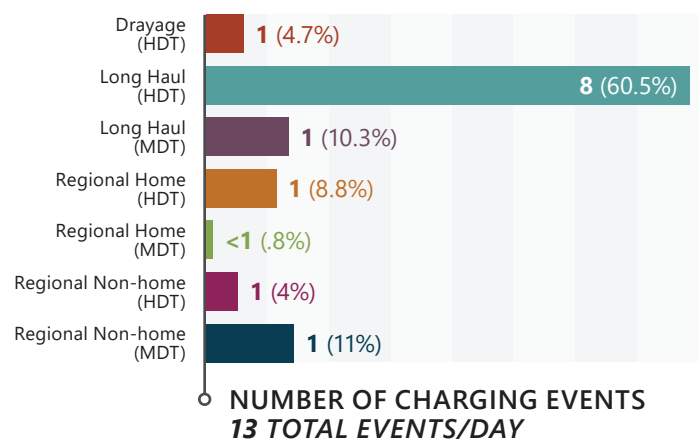
- 0** Energy Demand (2030)
- 0** Daily Mileage
- 10** Existing Truck Parking
- 0** Scalability
- 10** Land Price
- 10** Amenities
- 10** Access, Congestion, Safety
- 10** Proximity to Other ZEV Infrastructure
- 0** Load Capacity
- 5** Ability to Integrate DERs
- 10** Proximity to Disadvantaged Communities
- 0** Direct Benefit to Disadvantaged Communities
- 0** Flood Risk
- 0** Brownfields

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

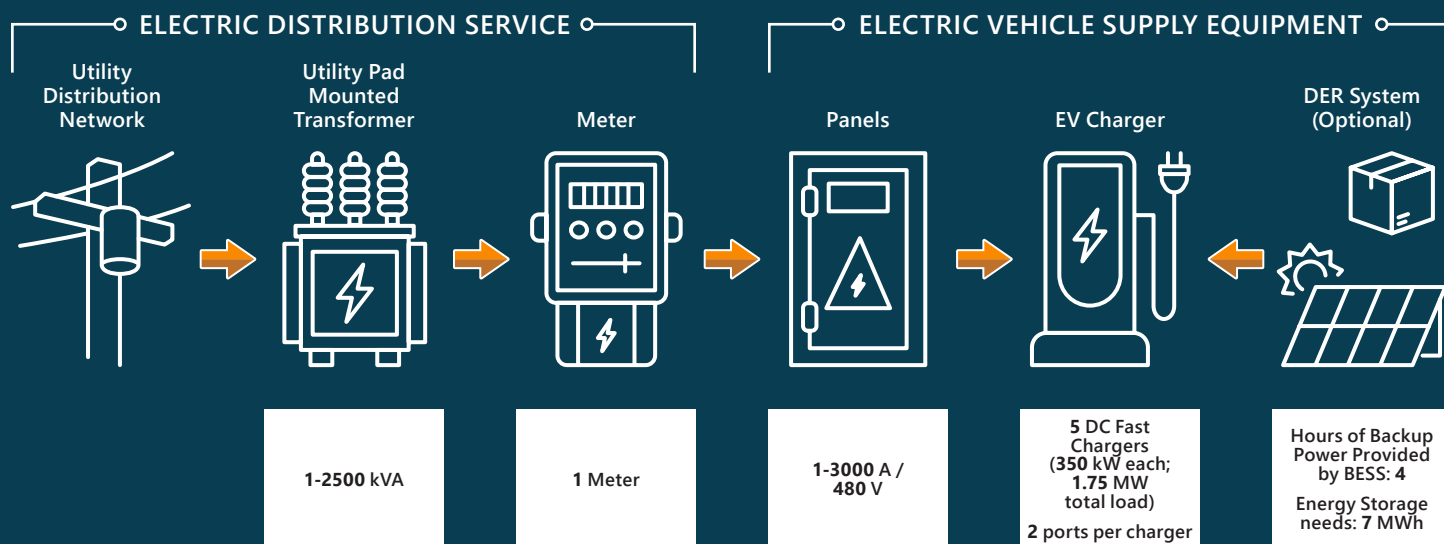
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$1,127,870**

Operation & Maintenance Costs (5 years): **\$467,788**

Total: \$1,595,658

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$43,909**

Panel Installation: **\$8,782**

Electric Meters: **\$2,500**

Conduit/Trenching: **\$23,125**

Permitting: **\$1,175**

Total: \$79,491

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$181,465**

Transformer Installation: **\$36,293**

Reconductoring: **\$123,000**

Total: \$340,758

LAND ACQUISITION COST

Total: \$35,519

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$1,890,000**

PV cost: **\$2,100,000**

Total: \$3,990,000

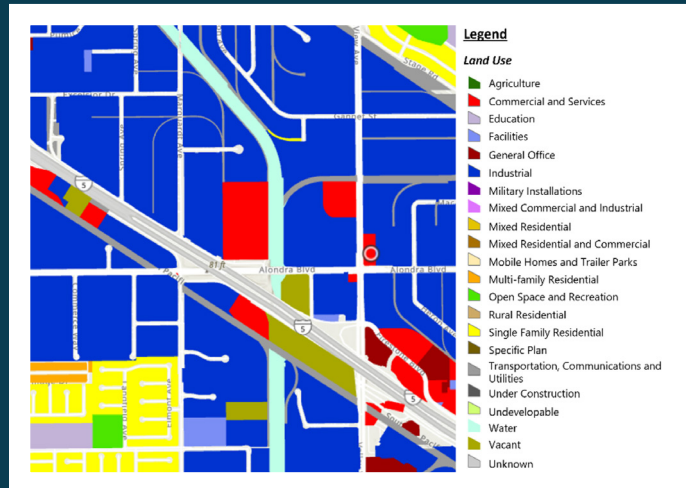
Total Investment (excluding DER integration): \$2,100,000

KEY CONSIDERATIONS

- > The presence of the existing Samra Travel Center and being located along I-10 makes it a prime candidate for supporting long-haul and regional operations. Additionally, the proposed location has vacant lands nearby and solar panels, that can imply availability for future expansion and accessibility to renewable sources.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes. Given the site's layout and long-haul truck activity, pull-in designs could make more efficient use of existing parking spaces without limiting the capacity.
- > The site has clear access from I-15 freeway and will require signage for trucks to minimize the risk of accidents and ensure smooth operation.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution and noise levels.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > The presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > While classified as urban, the site is relatively far from the urban center. This implies the location offers ample space and lower land costs, which can be advantageous for large-scale installations. However, it may require more extensive infrastructure development, potentially leading to higher installation costs and a lower initial utilization rate, with the opportunity for long-term growth as demand increases.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
No
- > Parcel size:
87,556 sq. ft
- > Estimated truck parking spaces:
13
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Commercial and services, Industrial, Residential, Vacant, General Office
- > Estimated daily truck visits:
63-312 truck trips
- > Available load capacity (SCE):
N/A

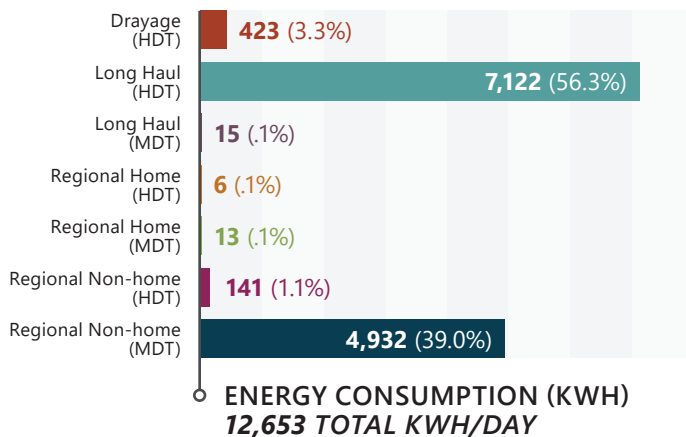
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **1.6**

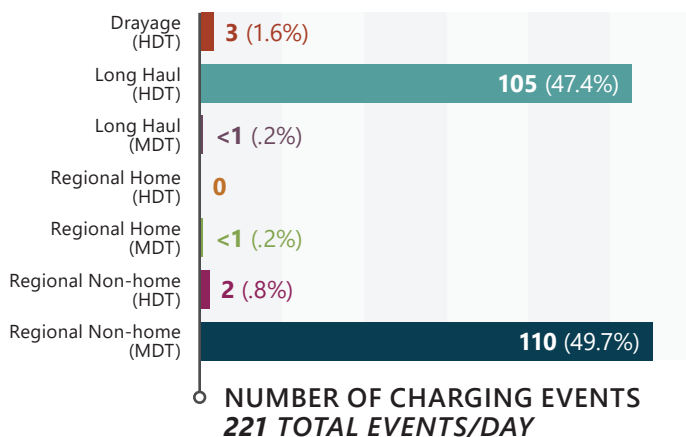
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|--|--|
| 2 Energy Demand (2030) | 0 Load Capacity |
| 1 Daily Mileage | 5 Ability to Integrate DERs |
| 0 Existing Truck Parking | 0 Proximity to Disadvantaged Communities |
| 0 Scalability | 1 Direct Benefit to Disadvantaged Communities |
| 9 Land Price | 0 Flood Risk |
| 10 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 0 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

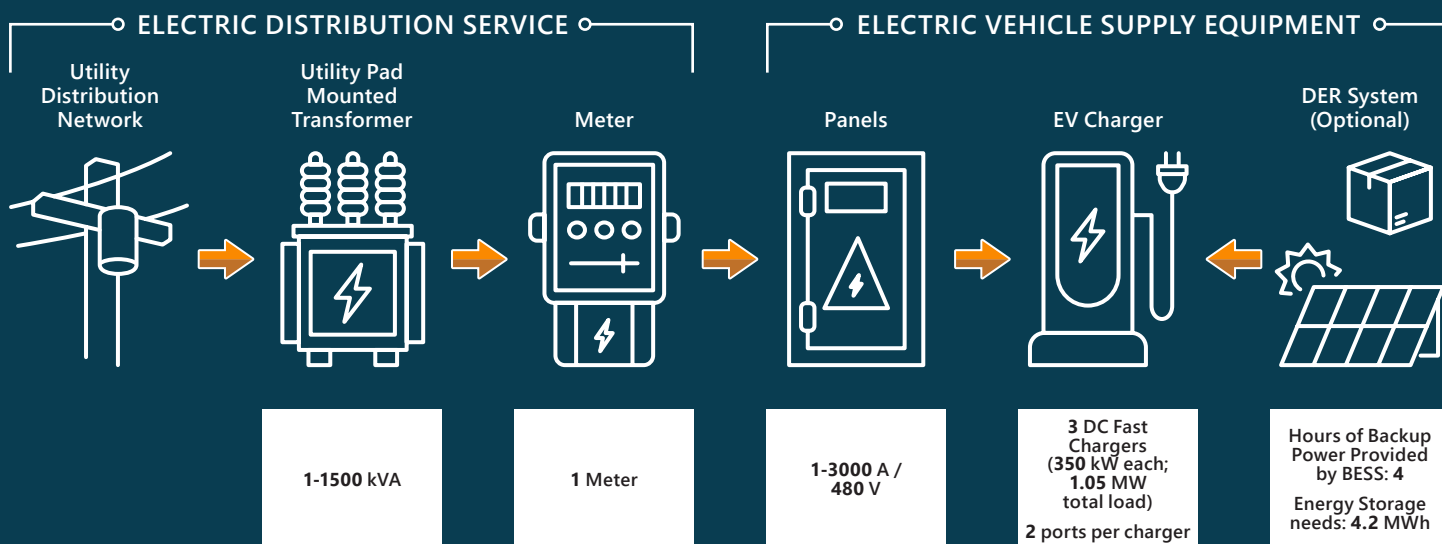
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$676,722**

Operation & Maintenance Costs (5 years): **\$279,968**

Total: \$956,690

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$43,909**

Panel Installation: **\$8,782**

Electric Meters: **\$2,500**

Conduit/Trenching: **\$12,025**

Permitting: **\$1,008**

Total: \$68,224

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$140,426**

Transformer Installation: **\$28,085**

Reconductoring: **\$123,000**

Total: \$291,511

LAND ACQUISITION COST

Total: \$3,600,000

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$1,134,000**

PV cost: **\$1,260,000**

Total: \$2,394,000

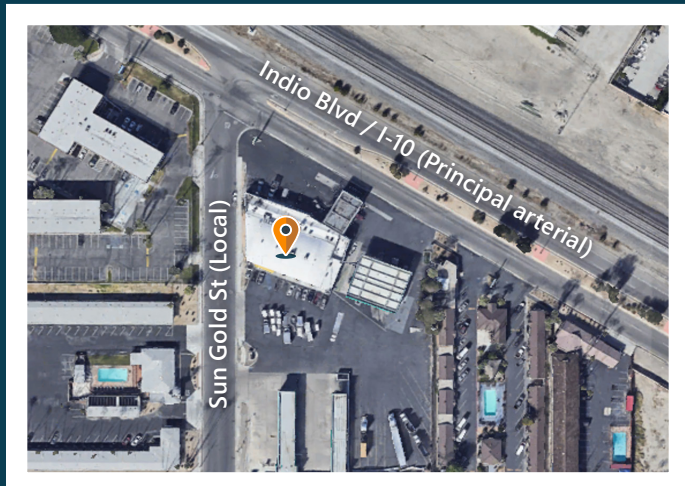
Total Investment (excluding DER integration): \$4,900,000

KEY CONSIDERATIONS

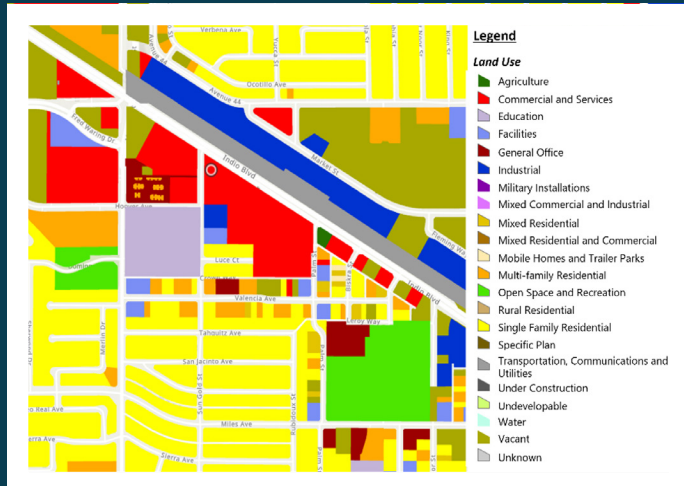
- > Situated at the intersection of Alondra Blvd and Valley Ave, the facility benefits from easy access to/from I-5/Santa Ana Freeway, making it appropriate for regional or long-haul routes. Additionally, its proximity to the Port of Long Beach positions it to potentially serve drayage trucks as well.
- > The site has fuel dispensers that can accommodate large trucks but lacks designated parking for heavy-duty trucks. Existing parking spaces primarily serve smaller vehicles, suggesting modifications will be needed to support heavy-duty electric trucks and charging infrastructure. Given the site's layout, a pull-in charger configuration would allow trucks to charge in the parking area across from the fuel dispensers (13 parking spaces).
- > The site's proximity to residential areas necessitates thoughtful traffic management to mitigate congestion impacts from the estimated daily truck visits. The site will need clear signage and designated pathways for trucks to minimize the risk of accidents and ensure smooth operation.
- > If fully utilized, this site could attract up to 288 zero emission trucks to the facility (48 trucks per charging port over the course of the day). This could have implications for the traffic safety of the com-

munity, which must be considered throughout the site planning and development process.

- > The site is located within a DAC. While BEV truck help with air quality and noise, mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The presence of amenities on-site enhances convenience for truck drivers, encouraging more frequent visits and integrating multiple services in one location. This can also lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > Public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be leveraged, while private investors and companies can manage the operation and maintenance of infrastructure.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

- > Is this existing truck parking?
Yes
- > Parcel size:
96,268 sq. ft
- > Estimated truck parking spaces:
10
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Single family residential, Commercial and services, Industrial
- > Estimated daily truck visits:
48-240 truck trips
- > Available load capacity:
N/A

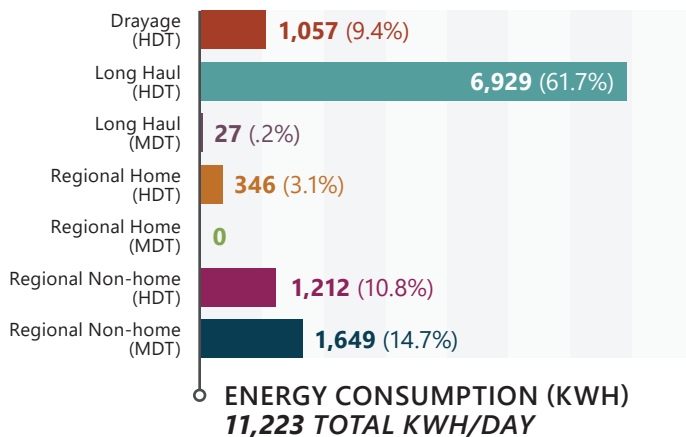
SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **3.25**

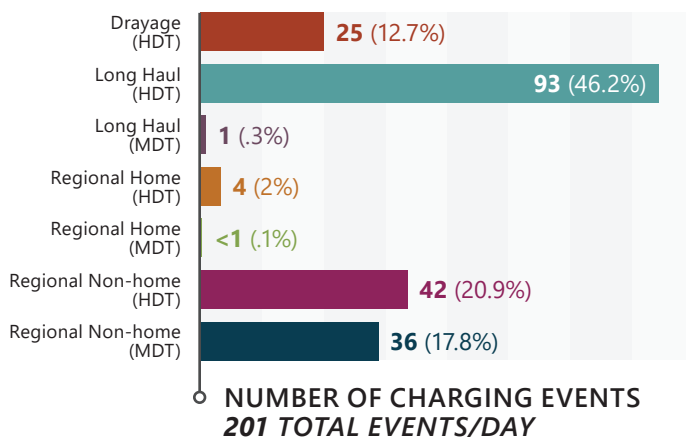
- | | |
|---|--|
| 5 Energy Demand (2030) | 0 Load Capacity |
| 0 Daily Mileage | 5 Ability to Integrate DERs |
| 10 Existing Truck Parking | 0 Proximity to Disadvantaged Communities |
| 0 Scalability | 0 Direct Benefit to Disadvantaged Communities |
| 10 Land Price | 10 Flood Risk |
| 10 Amenities | 0 Brownfields |
| 10 Access, Congestion, Safety | |
| 10 Proximity to Other ZEV Infrastructure | |

CHARGING DEMAND WITHIN TWO MILE RADIUS IN 2030

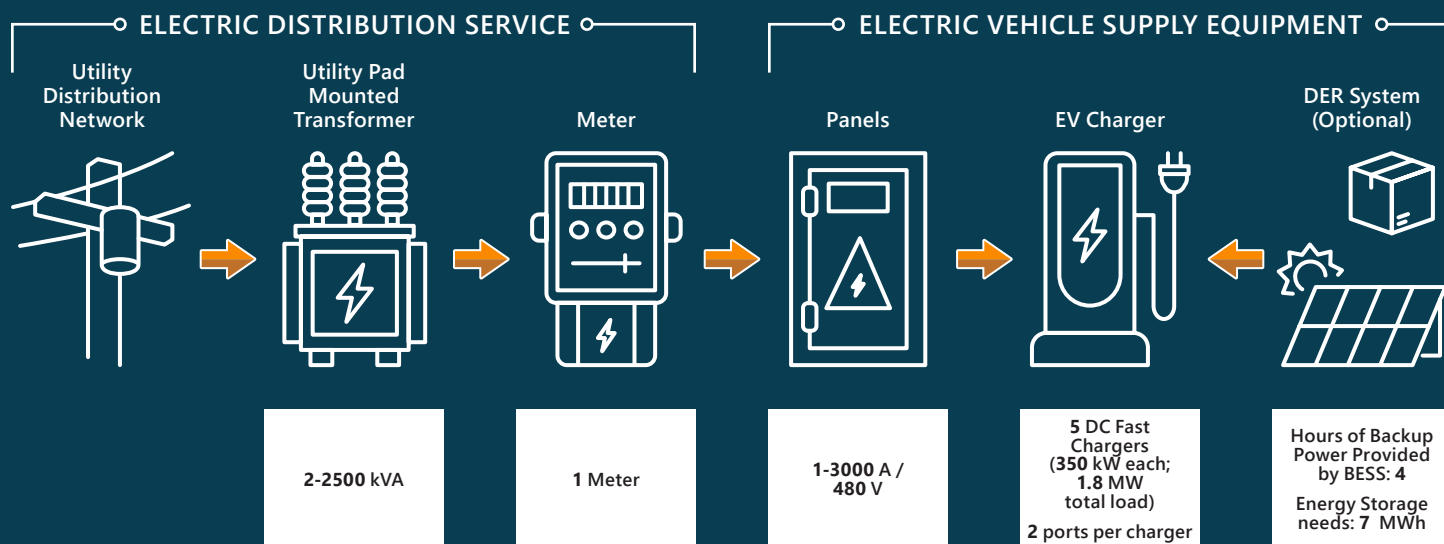
Daily Energy Demand by Electric Truck Market Segment



Charging Events by Electric Truck Market Segment



PROPOSED ELECTRIC VEHICLE CHARGING (EV) INFRASTRUCTURE CHARACTERISTICS



ELECTRIC VEHICLE CHARGING INFRASTRUCTURE COSTS

EV CHARGER

Hardware & Installation: **\$1,127,870**

Operation & Maintenance Costs (5 years): **\$467,788**

Total: \$1,595,658

FACILITY ELECTRICAL INFRASTRUCTURE

Panel Cost: **\$43,909**

Panel Installation: **\$8,782**

Electric Meters: **\$2,500**

Conduit/Trenching: **\$23,125**

Permitting: **\$1,175**

Total: \$79,491

UTILITY ELECTRICAL INFRASTRUCTURE

Transformer Cost: **\$181,465**

Transformer Installation: **\$36,293**

Reconductoring: **\$123,000**

Total: \$340,758

LAND ACQUISITION COST

Total: \$3,400,000

DISTRIBUTED ENERGY RESOURCES (DER) INTEGRATION

Battery Energy Storage System Cost: **\$1,890,000**

PV cost: **\$2,100,000**

Total: \$3,990,000

Total Investment (excluding DER integration): \$5,400,000

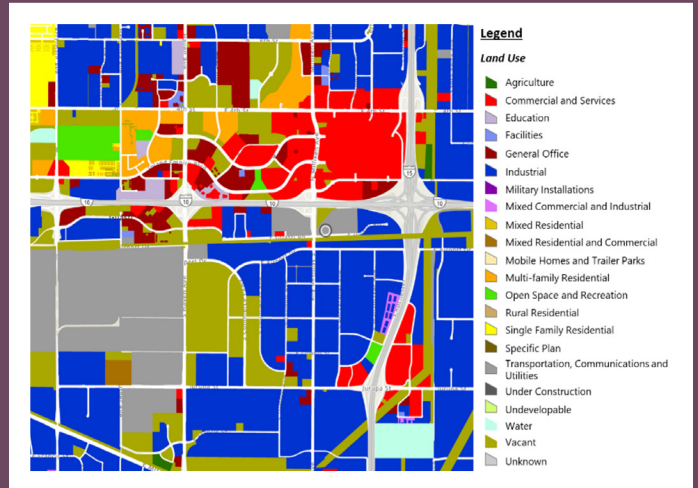
KEY CONSIDERATIONS

- > The site's urban setting, combined with its existing truck stop amenities—including a gas station, and U-Haul parking—makes it a prime candidate for supporting urban delivery routes and short-haul trips. Additionally, the site's frontage along Indio Boulevard/I-10 could also offer easy access to local and regional truck routes, as it is also indicated by the charging demand by market segment.
- > As a small facility, it's recommended to use a pull-in configuration, which is efficient for urban settings where space is limited and maneuvering larger vehicles can be challenging.
- > The proximity to residential areas could signal the need for thoughtful traffic management to mitigate potential noise and congestion impacts from increased truck visits. If fully utilized, this site could attract up to 480 zero emission trucks to the facility (48 trucks per charging port over the course of the day). This is in addition to the traffic using this facility solely for parking. This could have implications for the traffic safety of the community, which must be considered throughout the site planning and development process.
- > The site will need clear signage and designated pathways for trucks to ensure smooth operation.

- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The presence of amenities can lead to steady revenue streams, making the site financially attractive. Various business models, such as pay-as-you-go and subscription-based plans, can be explored to attract different user types.
- > Private ownership of the site can expedite decision-making. Collaborating with private landowners can streamline deployment and facilitate faster implementation of charging stations.
- > The urban location offers better access to existing infrastructure and utilities, potentially resulting in lower installation costs, improved accessibility and higher utilization rate.
- > Leveraging public private partnerships can help share the costs of infrastructure development and maintenance. Government funding can be used to subsidize the initial setup costs, while private investors and companies can manage the operation and maintenance, ensuring sustainability and efficiency.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

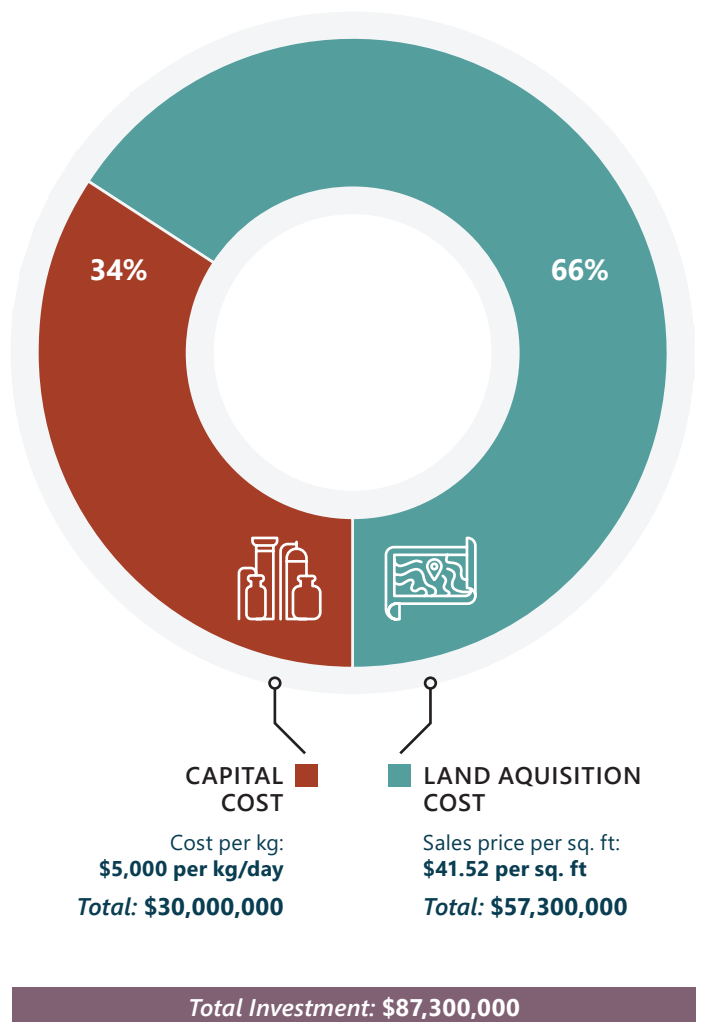
- > Has existing truck or fuel stop?
Yes
- > Parcel size:
1,379,110 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Transportation, Communication, and Utilities
- > Site primary neighboring land use(s):
Industrial, Commercial, General Office, Vacant
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to **194 trucks**
- > Projected volume in the census tract (2040):
18,480 trips

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **4.41**

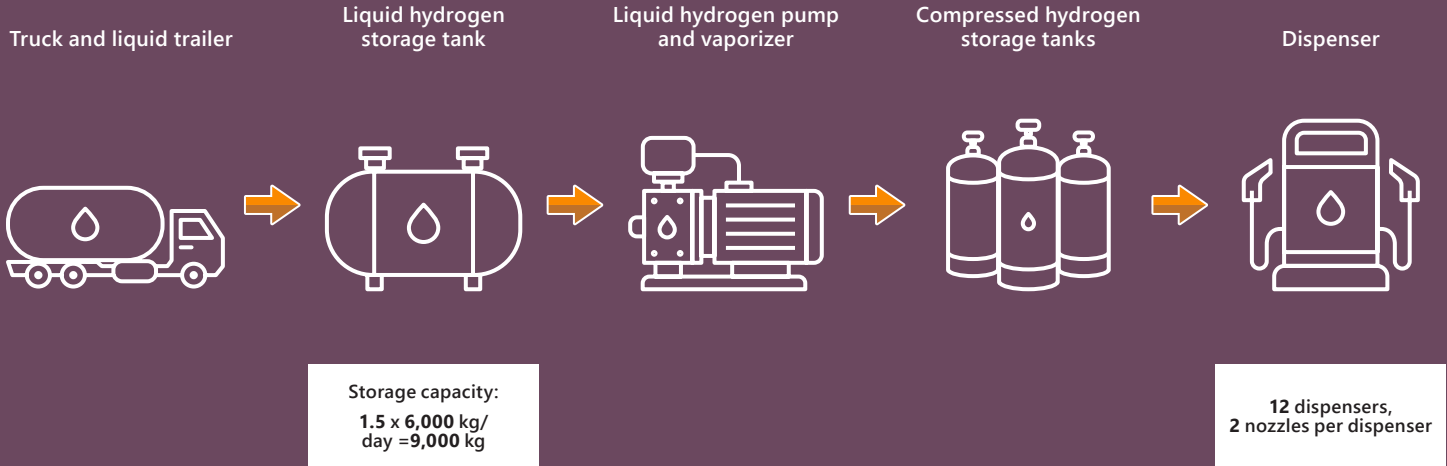
- | | |
|--|--|
| 10 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 4 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 0 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 5 Direct Benefit to Disadvantaged Communities |
| 10 Amenities | 10 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



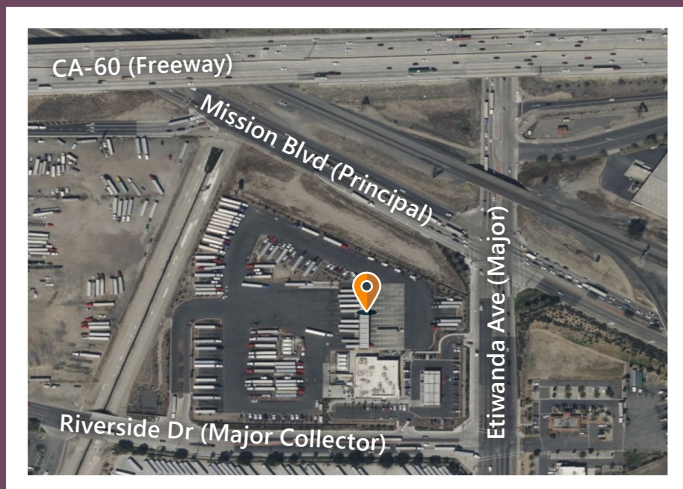
PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY

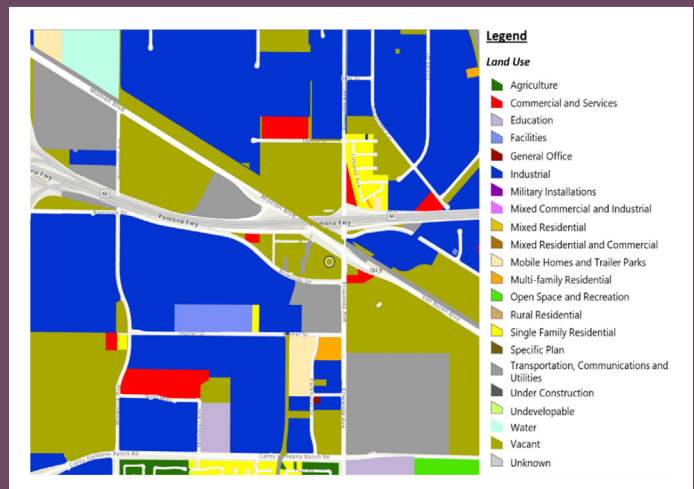


KEY CONSIDERATIONS

- > The presence of the existing Petro Travel Center, being located along I-10, and neighboring major warehouses and commercial zones can offer significant advantage in attracting drivers already familiar with refueling at this location, enhancing initial customer adoption, and leading to steady revenue streams. This location can also accommodate charging stations for electric trucks, providing an opportunity to integrate traditional and alternative fuel offerings for operators who manage mixed fleets.
- > The location's proximity to hydrogen production facilities is a key advantage, reducing transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site will likely attract more trucks once operational, clear entry and exit paths should still be planned to manage flow and prevent congestion, especially during peak logistics hours. Provisions for any queuing areas or designated refueling lanes could minimize potential traffic build-up.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes. Given the site's layout and high number of daily truck visits, pull-in designs could make more efficient use of existing parking spaces without limiting the capacity.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 24 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks
- > development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grant/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

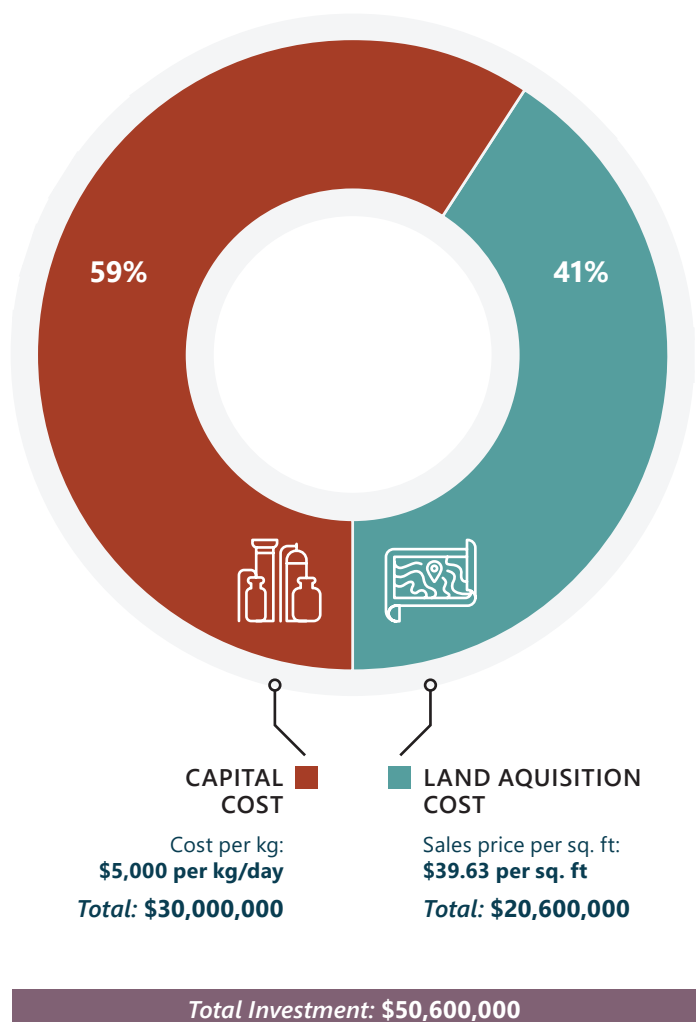
- > Has existing truck or fuel stop?
Yes
- > Parcel size:
520,978 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Vacant
- > Site primary neighboring land use(s):
Industrial, Transportation and Utilities Commercial, Facilities
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to **194 trucks**
- > Projected volume in the census tract (2040):
11,964 trips

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **3.34**

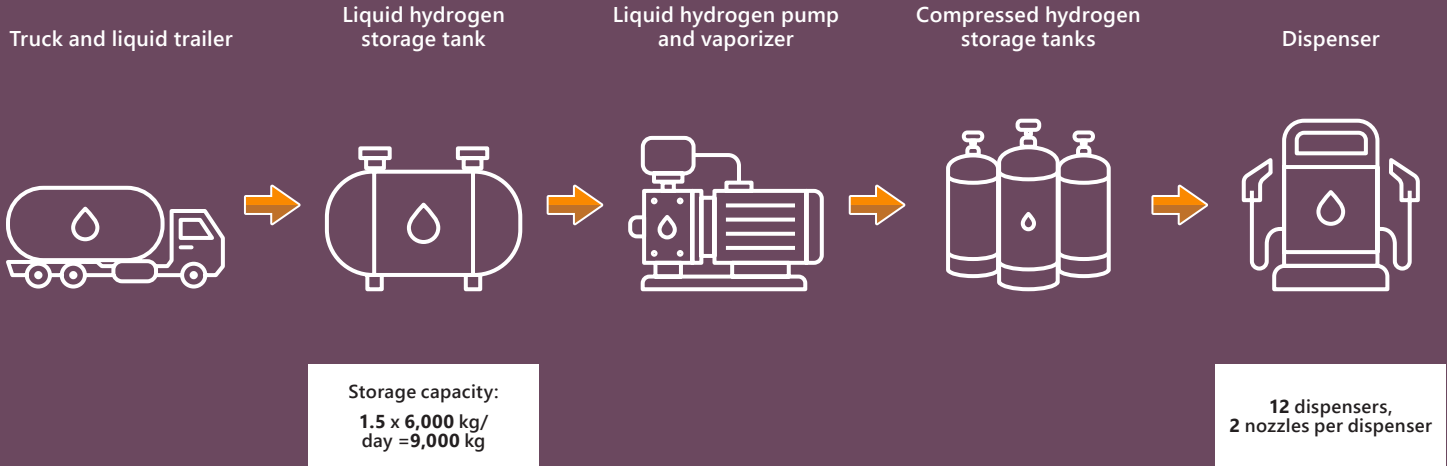
- | | |
|--|--|
| 6 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 5 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 0 Direct Benefit to Disadvantaged Communities |
| 10 Amenities | 10 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



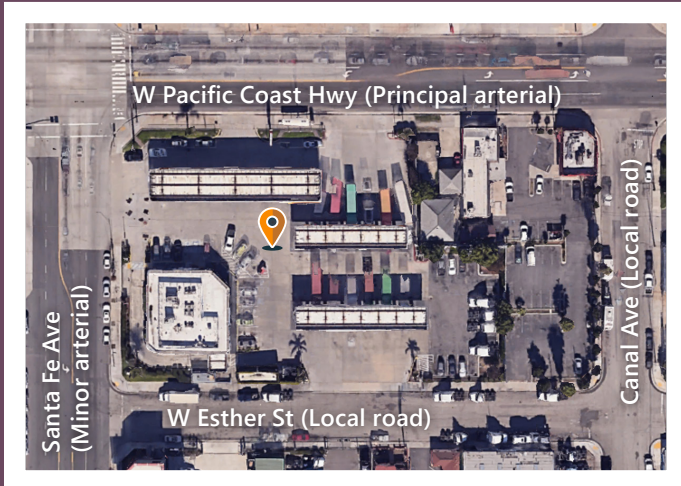
PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY

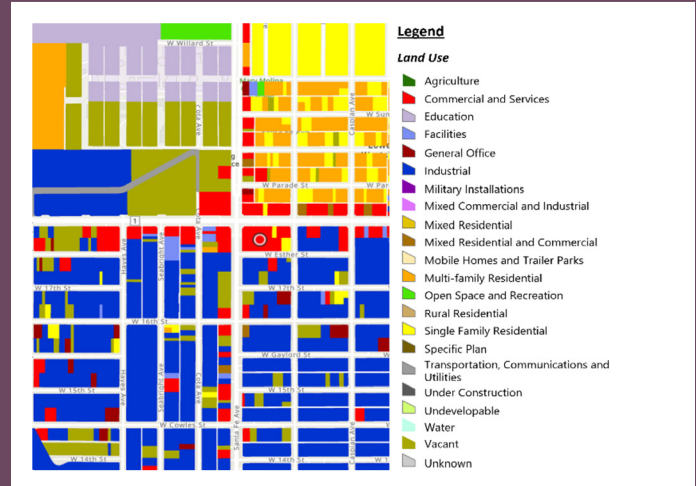


KEY CONSIDERATIONS

- > The presence of the existing Flying J Travel Center and being located along Highway 60 can well attract long-haul drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The station's proximity to hydrogen production facilities is a key advantage, reducing transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is located in an industrial zone with neighboring commercial and residential land uses, careful planning is needed to ensure smooth traffic flow in and out of the facility. A dedicated entrance for trucks can minimize congestion and reduce the risk of accidents with neighboring residential traffic.
- > Pull-through designs for trucks using hydrogen stations would be more appropriate avoiding the need for reversing.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 24 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

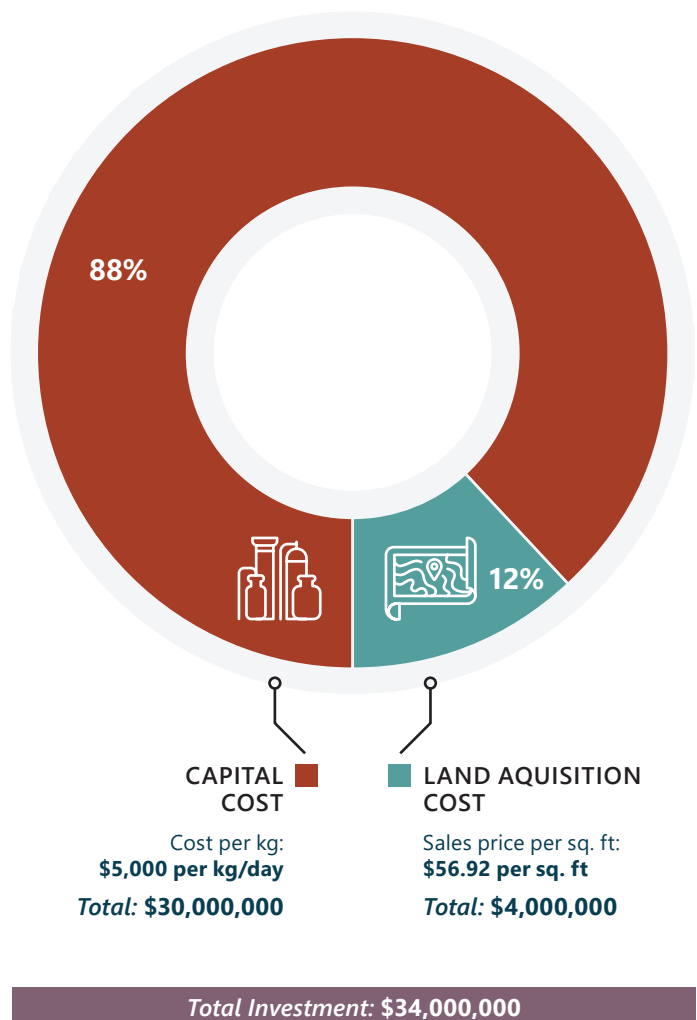
- > Has existing truck or fuel stop?
Yes
- > Parcel size:
69,696 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Industrial, Commercial and services, Vacant, Residential
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to **194 trucks**
- > Projected volume in the census tract (2040):
165 trips

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.04**

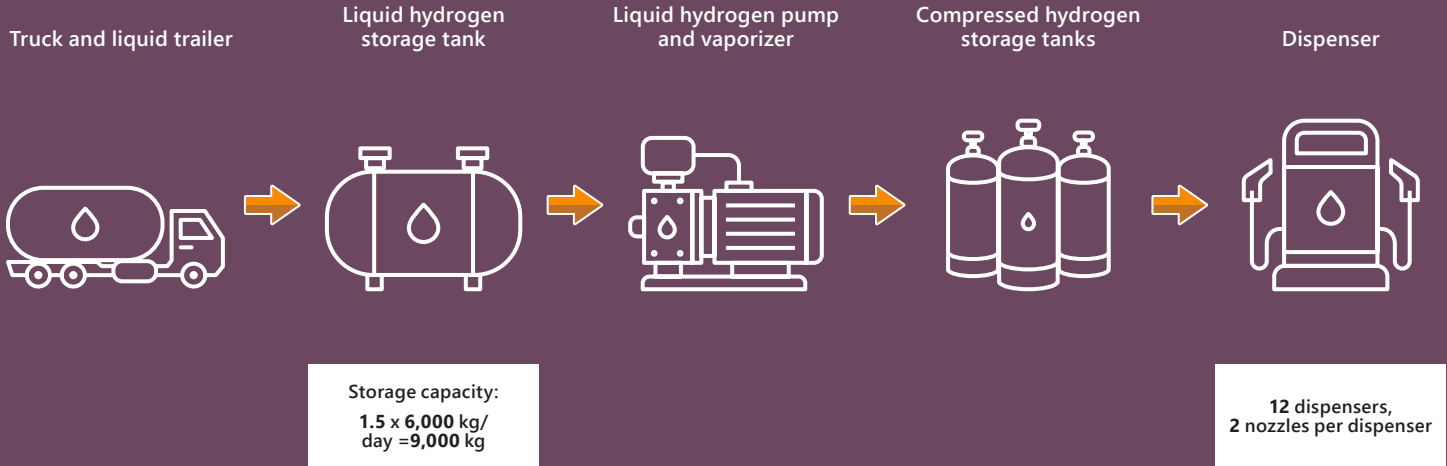
- | | |
|---------------------------------------|---|
| 0 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 5 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 0 Direct Benefit to Disadvantaged Communities |
| 10 Amenities | 10 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



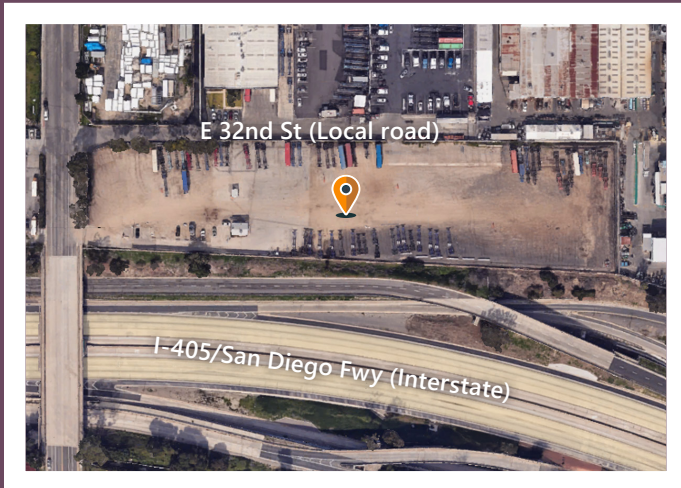
PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY

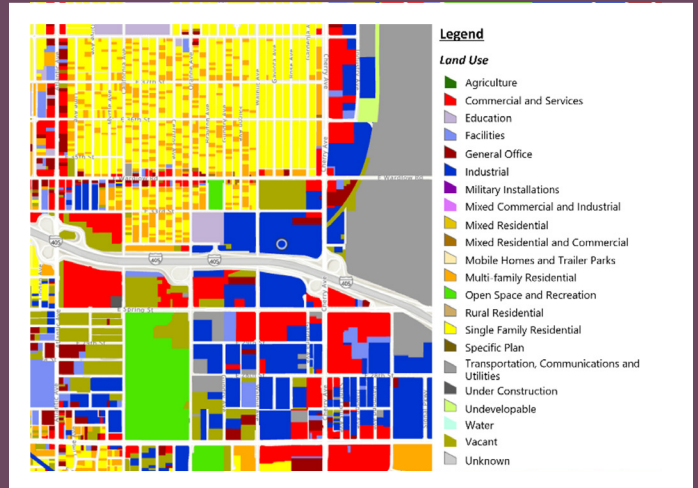


KEY CONSIDERATIONS

- > Located along Pacific Coast Highway and near the Port of Long Beach, this site can offer optimal connectivity for both long-haul and local deliveries, as well as servicing drayage trucks. The existing Long Beach travel center and fuel stop, along with related amenities, can attract drivers already familiar with refueling here, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The station's proximity to hydrogen production facilities can reduce transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is located in a commercial zone with neighboring industrial and residential land uses, careful planning is needed to ensure smooth traffic flow in and out of the facility. A dedicated entrance for trucks can minimize congestion and reduce the risk of accidents with neighboring residential traffic.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes. Given the site's layout, pull-in designs could make more efficient use of existing parking spaces without significant alterations.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 24 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution while minimizing the potential negative impact of becoming a 'truck magnet' within those communities.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

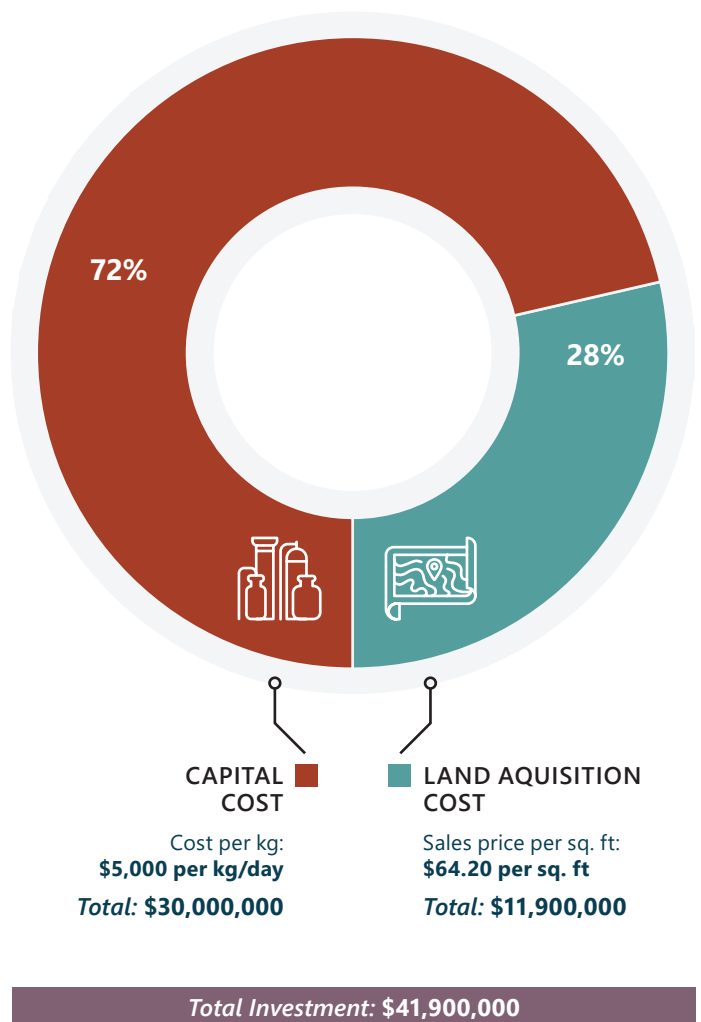
- > Has existing truck or fuel stop?
No
- > Parcel size:
185,130 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Industrial
- > Site primary neighboring land use(s):
Industrial, Commercial and services, General office, Vacant, Residential, Transportation, Communication and utilities
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to **194 trucks**
- > Projected volume in the census tract (2040):
24 trips

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.59**

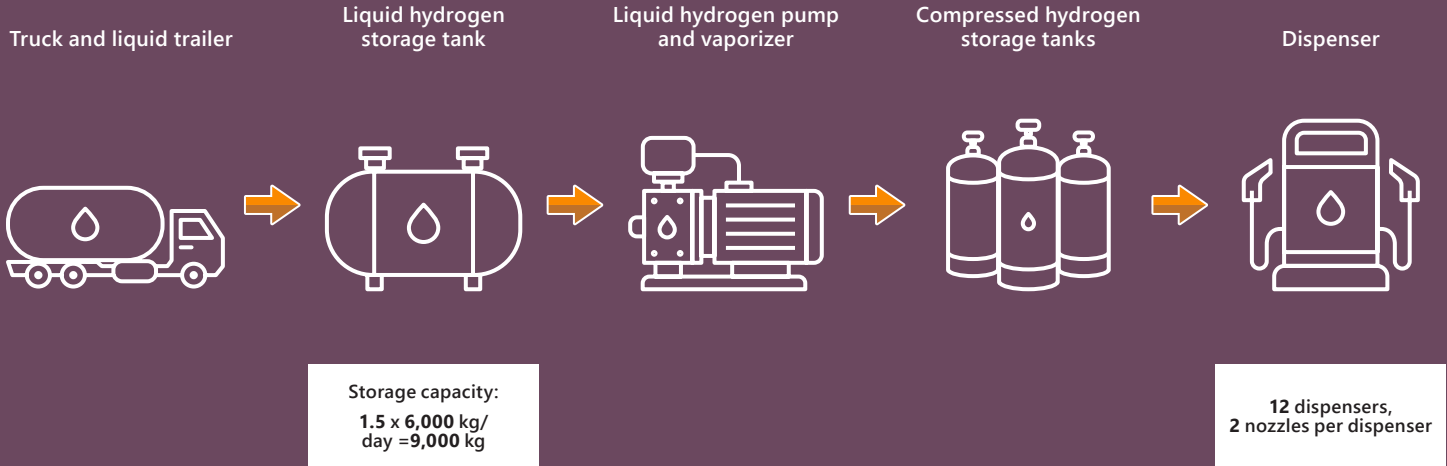
- | | |
|--|--|
| 0 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 1 Daily Mileage | 0 Load Capacity |
| 0 Existing Truck Parking | 5 Ability to Integrate DERs |
| 0 Scalability | 10 Proximity to Disadvantaged Communities |
| 9 Land Price | 1 Direct Benefit to Disadvantaged Communities |
| 0 Amenities | 10 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



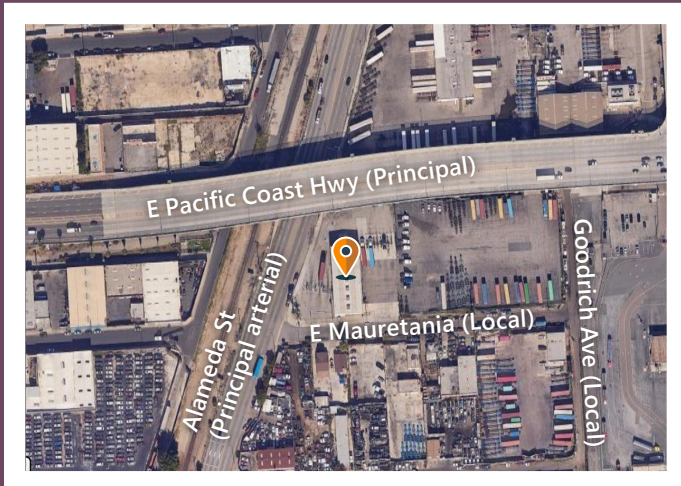
PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY

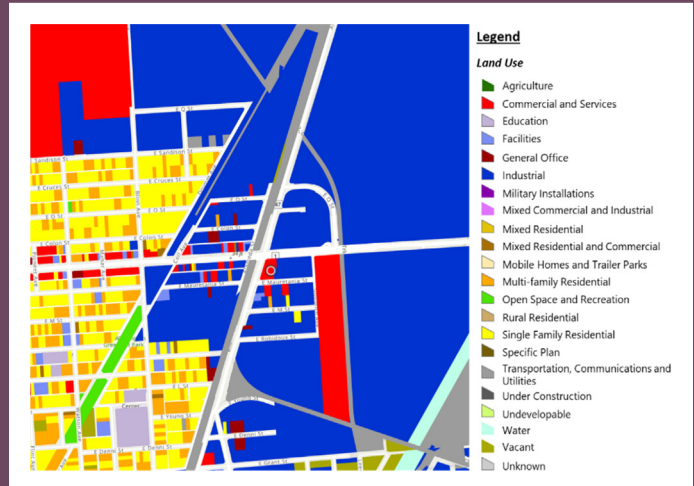


KEY CONSIDERATIONS

- > Since this is not an active truck stop, the facility could be designed as a dedicated hydrogen refueling hub, catering specifically to logistics companies and fleets that operate in the area. The nearby logistics company presents an additional opportunity to establish partnerships and potentially secure an initial user base, helping to drive regular utilization in addition to through traffic or incidental refueling.
- > The site is relatively close to hydrogen production facilities, potentially reducing transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site will likely attract more trucks once operational, clear entry and exit paths should still be planned to manage flow and prevent congestion, especially during peak logistics hours. Provisions for any queuing areas or designated refueling lanes could minimize potential traffic build-up.
- > Pull-in designs for trucks using hydrogen stations would be more appropriate, making efficient use of existing parking spaces without significant alterations and allowing trucks decouple their trailers and park to refuel.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 24 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.68%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution while minimizing the potential negative impact of becoming a 'truck magnet' within those communities.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost. Additionally, partnerships with local government or businesses in Long Beach could bolster the station's value as a sustainable infrastructure asset, potentially attracting subsidies or cost-sharing opportunities from stakeholders interested in reducing urban emissions.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

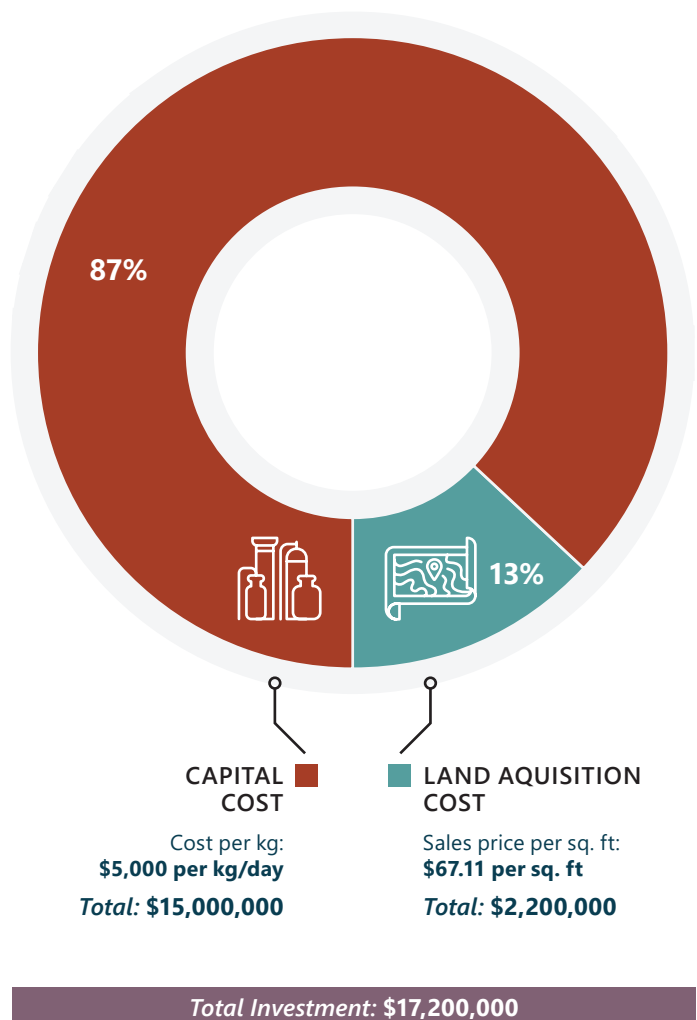
- > Has existing truck or fuel stop? **Yes**
- > Parcel size: **32,234 sq.ft**
- > Urban/rural: **Urban**
- > Property ownership: **Private**
- > Site land use: **Commercial and services**
- > Site primary neighboring land use(s): **Industrial, Commercial, Transportation, Residential, Facilities**
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity): up to **97 trucks**
- > Projected volume in the census tract (2040): **699 trips**

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **1.53**

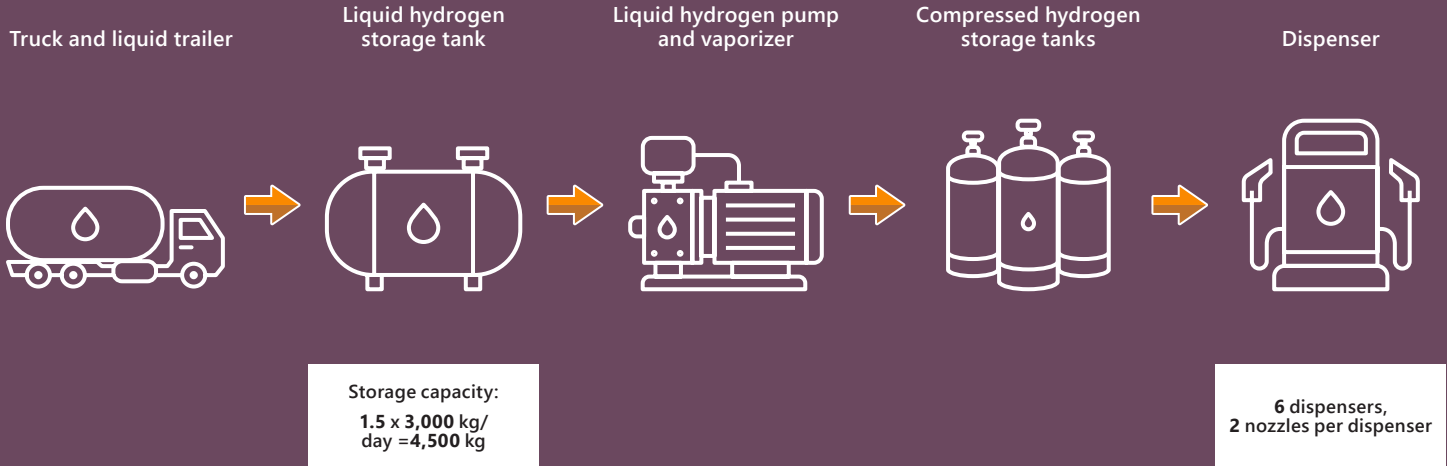
- | | |
|---------------------------------------|---|
| 0 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 0 Existing Truck Parking | 5 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 1 Direct Benefit to Disadvantaged Communities |
| 5 Amenities | 0 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



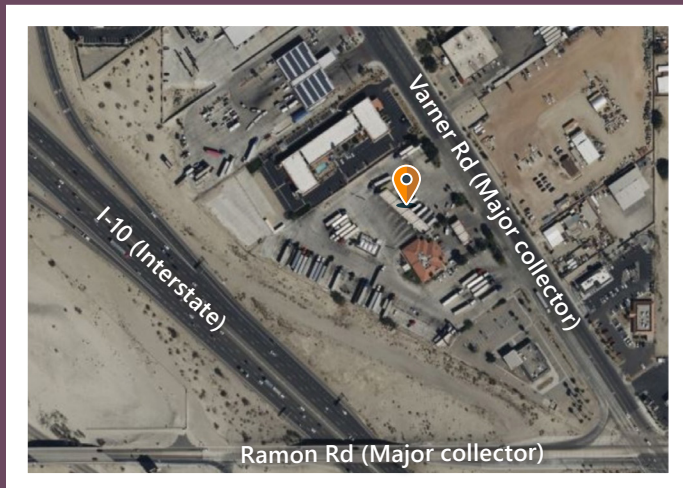
PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY

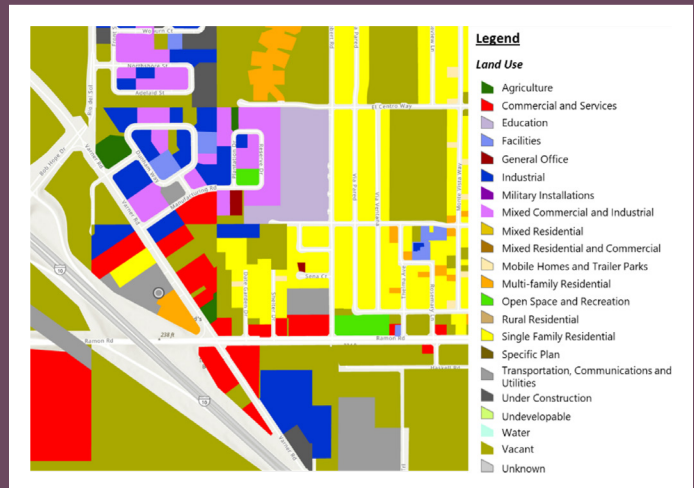


KEY CONSIDERATIONS

- > The presence of the existing fuel station and neighboring Port of Long Beach can be leveraged to attract drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The station's proximity to hydrogen production facilities is a key advantage, reducing transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is neighboring Port of Long Beach and industrial land uses, careful planning is needed to ensure smooth traffic flow in and out of the facility. A dedicated entrance for trucks can minimize congestion and reduce the risk of accidents with high volume of truck operations in the area.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes. Given the site's layout, pull-in designs could make more efficient use of existing parking spaces without limiting the capacity.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 12 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution and noise levels, promoting sustainability within the urban context.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

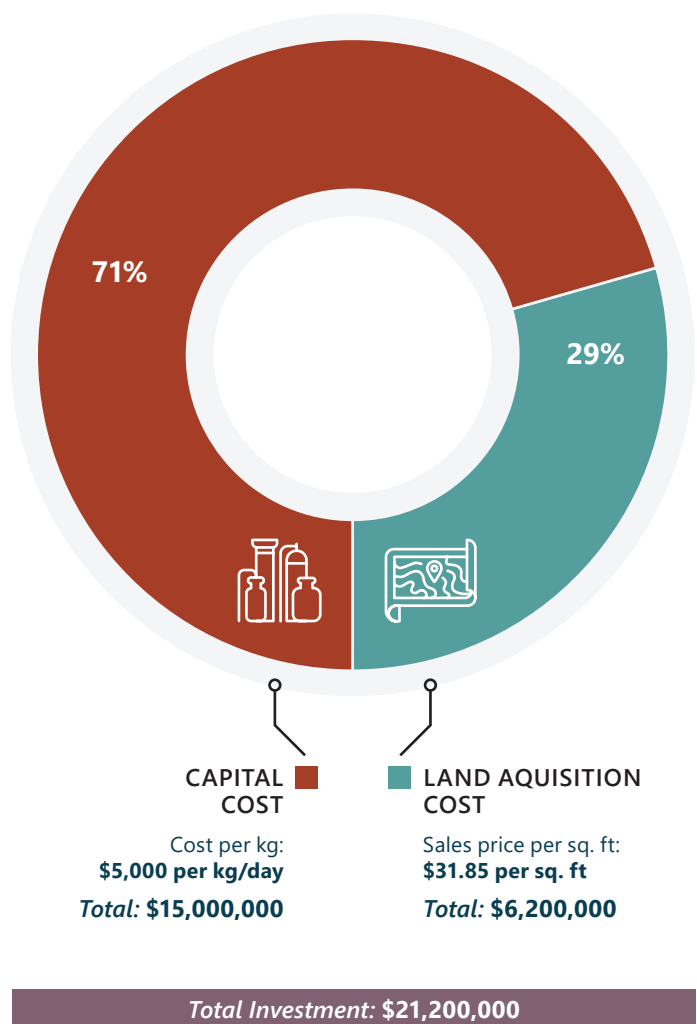
- > Has existing truck or fuel stop?
Yes
- > Parcel size:
196,020 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Transportation, Communication, and Utilities
- > Site primary neighboring land use(s):
Industrial, Commercial and services, Vacant, Industrial
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to **97 trucks**
- > Projected volume in the census tract (2040):
1,611 trips

SITE SUITABILITY SCORING (0-10)

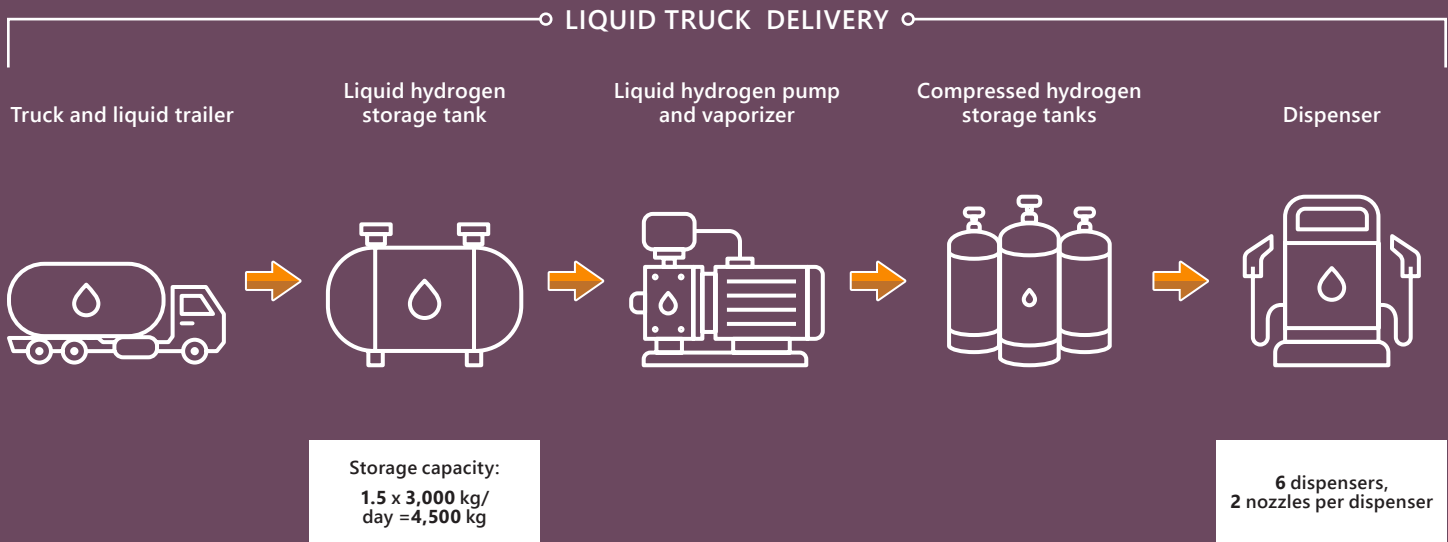
OVERALL SCORE: **2.61**

- | | |
|---|--|
| 1 Trip Volume (2040) | 10 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 5 Ability to Integrate DERs |
| 0 Scalability | 5 Proximity to Disadvantaged Communities |
| 10 Land Price | 0 Direct Benefit to Disadvantaged Communities |
| 10 Amenities | 0 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 0 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs

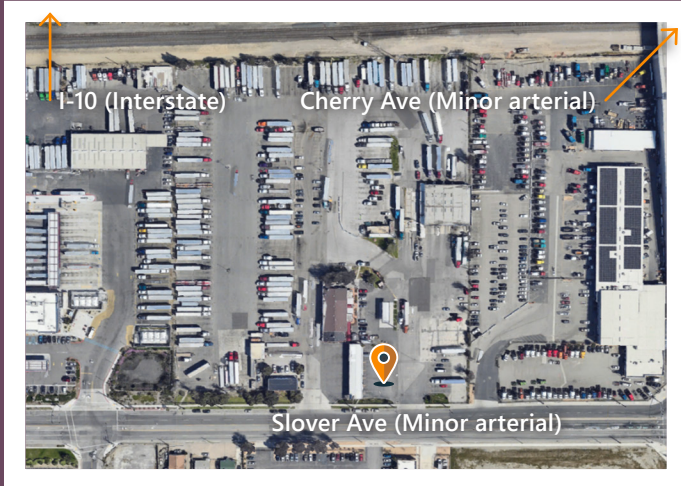


PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

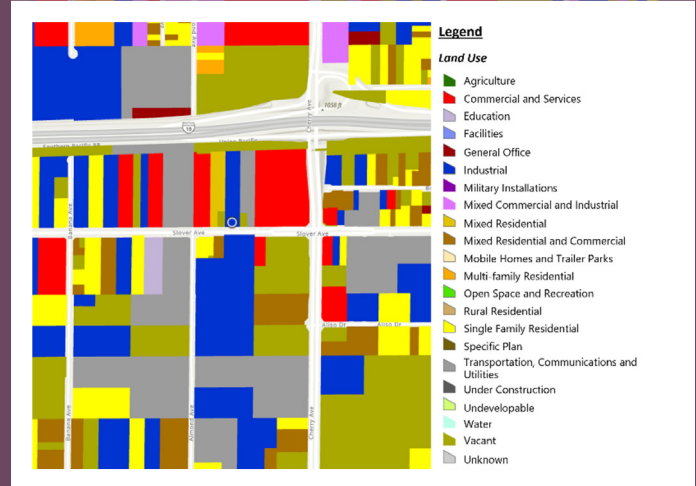


KEY CONSIDERATIONS

- > The presence of the existing Flying J Travel Center and related amenities, and being located near I-10 freeway can be leveraged to attract drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The absence of hydrogen production facilities nearby means that the site may need to rely on regular deliveries of liquid hydrogen, which can impact operational costs and supply chain reliability. Developers should consider establishing partnerships with hydrogen producers to secure long-term supply contracts, ensuring a steady and affordable hydrogen supply. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is neighboring commercial and residential land uses, careful planning is needed to ensure smooth traffic flow in and out of the facility. A dedicated entrance for trucks can minimize congestion and reduce the risk of accidents with neighboring residential traffic.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 12 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is not within a DAC but integrating zero emission truck operations can still contribute positively to reducing local air pollution and noise levels, promoting sustainability within the urban context.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

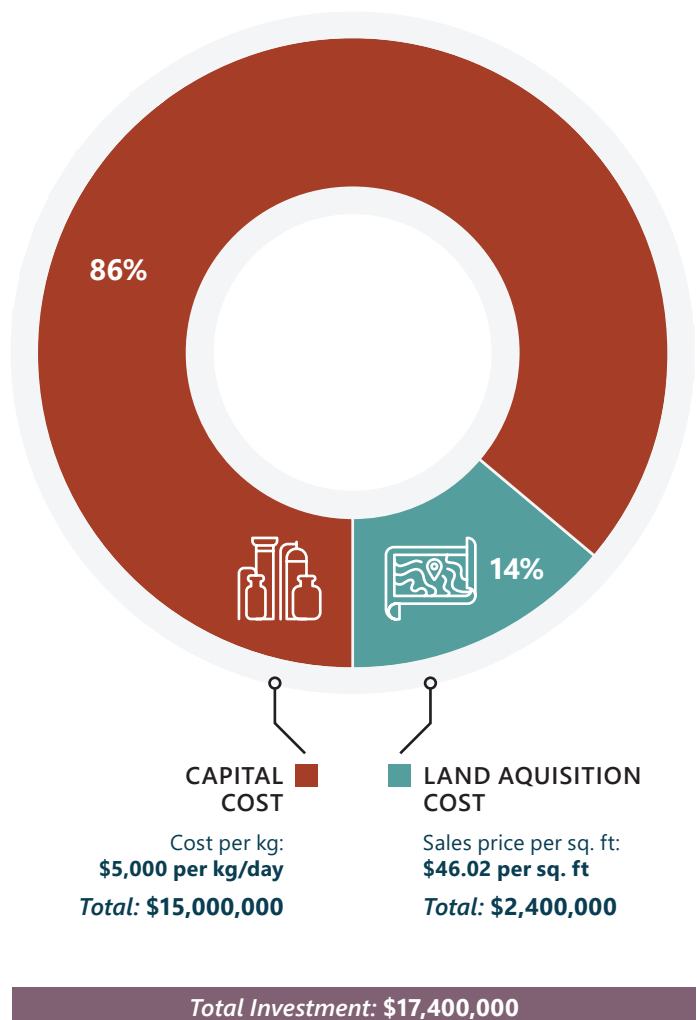
- > Has existing truck or fuel stop?
No
- > Parcel size:
128,938 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Industrial
- > Site primary neighboring land use(s):
Industrial, Commercial and services, Transportation, Communication and utilities
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to 97 trucks
- > Projected volume in the census tract (2040):
9,894 trips

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **3.26**

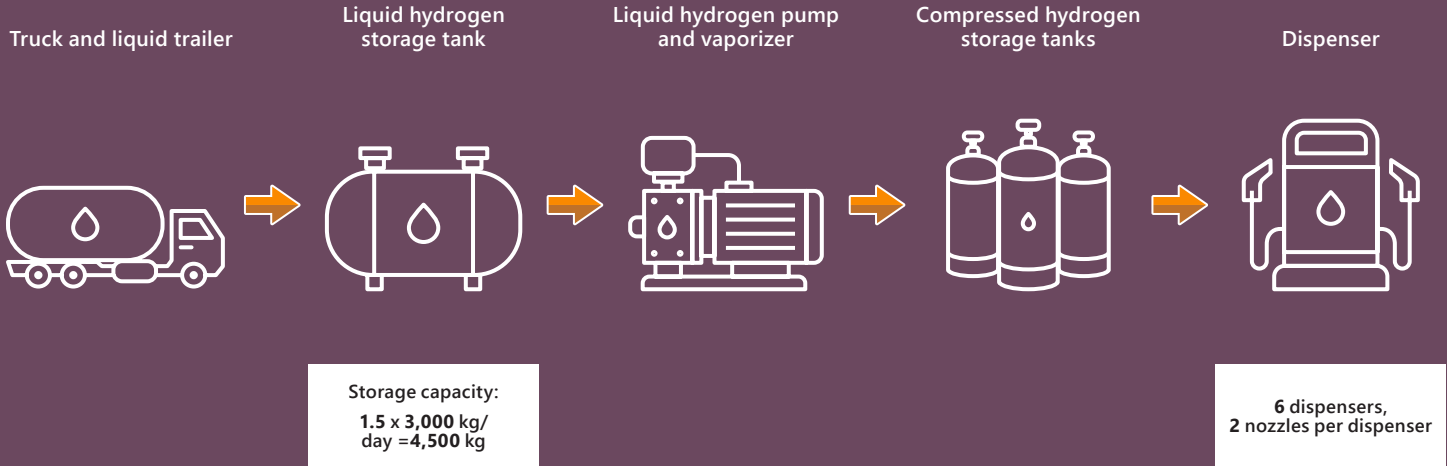
- | | |
|--|--|
| 5 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 4 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 5 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 2 Direct Benefit to Disadvantaged Communities |
| 5 Amenities | 10 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY

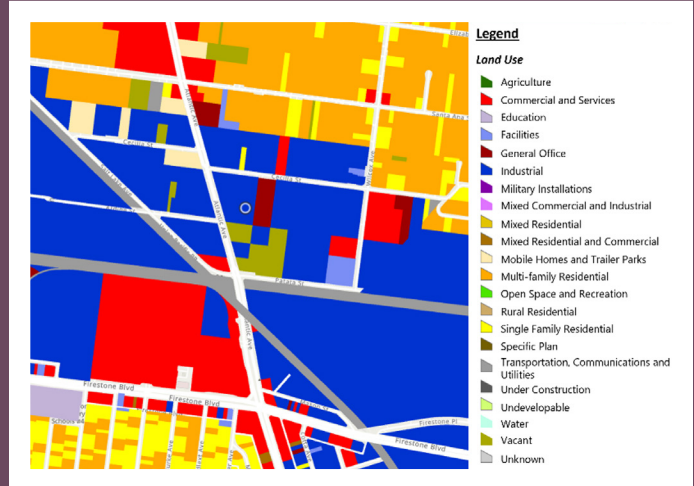


KEY CONSIDERATIONS

- > Located near I-10 and surrounded by a cluster of transportation-related facilities, this site could serve both long-haul trucks and local deliveries. The proximity to truck/fuel stops, and related amenities in nearby parcels can be leveraged to attract drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The station's proximity to a hydrogen production facility can reduce transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > To the right of the parcel lies Rush Truck Centers - Fontana, which features solar panels on its roof. This could provide an opportunity for collaboration on green initiatives, such as leveraging renewable energy sources to power the hydrogen refueling station or exploring shared resources to enhance operational efficiency.
- > The station's design should incorporate efficient traffic flow patterns to minimize potential congestion. This may include clear signage and dedicated lanes for refueling trucks to enhance safety and operational efficiency.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 12 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

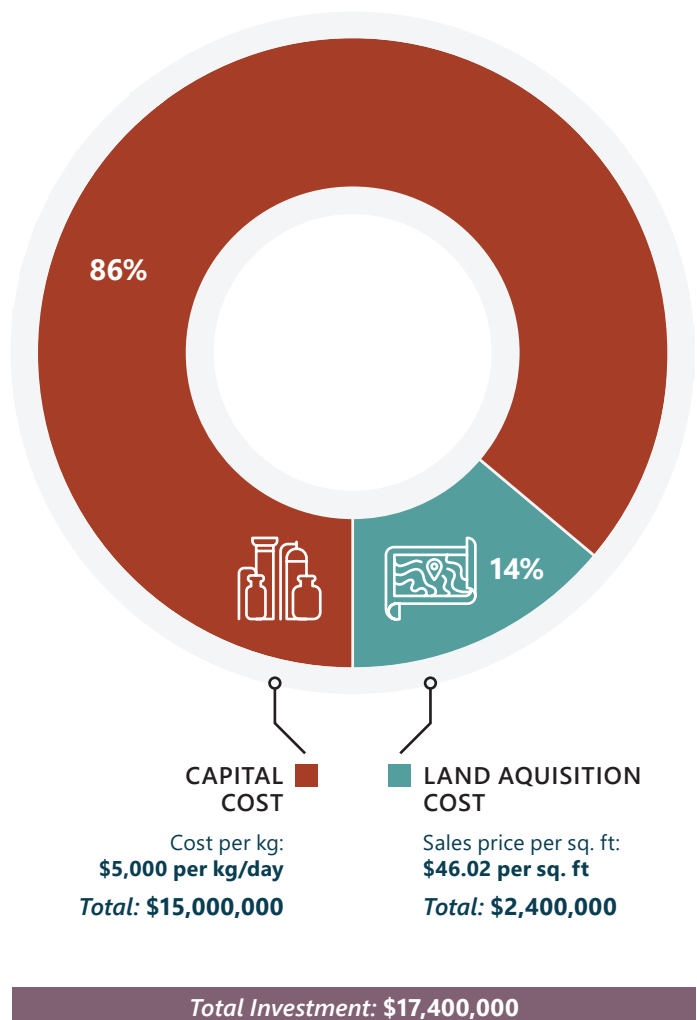
- > Has existing truck or fuel stop? **Yes**
- > Parcel size: **52,272 sq.ft**
- > Urban/rural: **Urban**
- > Property ownership: **Private**
- > Site land use: **Industrial**
- > Site primary neighboring land use(s): **Industrial, Commercial, Vacant, Residential, General office**
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity): up to **97 trucks**
- > Projected volume in the census tract (2040): **27 trips**

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **1.22**

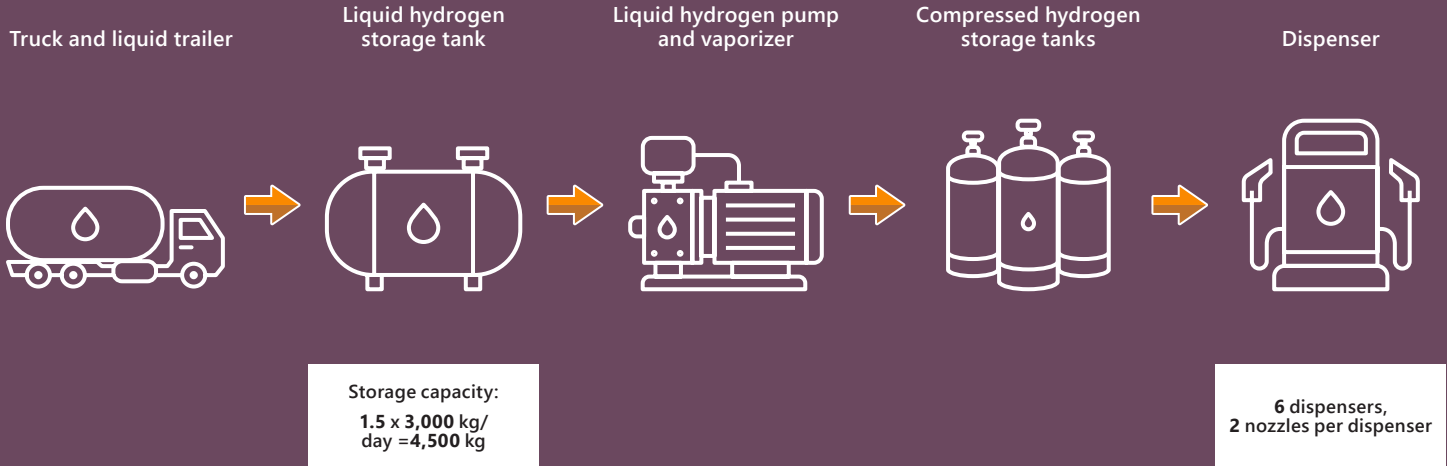
- | | |
|---------------------------------------|---|
| 0 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 0 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 0 Direct Benefit to Disadvantaged Communities |
| 5 Amenities | 0 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



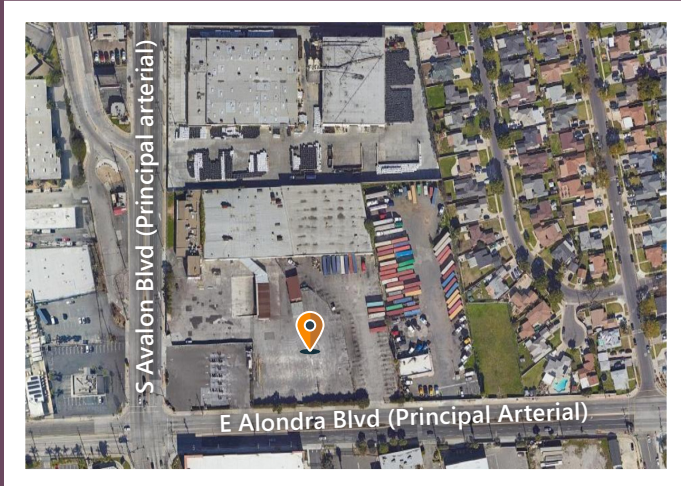
PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY

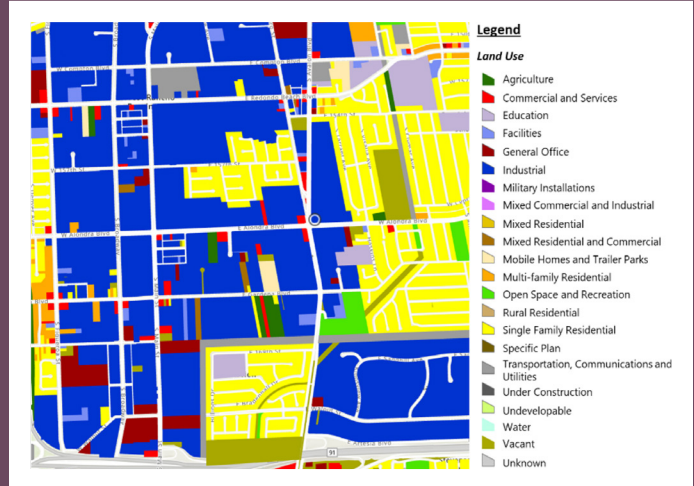


KEY CONSIDERATIONS

- > The presence of the existing Cudahy Fuel Stop and related amenities can be leveraged to attract drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The station's proximity to hydrogen production facilities is a key advantage, reducing transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is located in an industrial zone with neighboring commercial and residential land uses, careful planning is needed to ensure smooth traffic flow in and out of the facility. A dedicated entrance for trucks can minimize congestion and reduce the risk of accidents with neighboring residential traffic.
- > Pull-in designs for trucks using hydrogen stations would be more appropriate to maximize space efficiency and allow trucks decouple their trailers and park to refuel.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 12 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.68%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

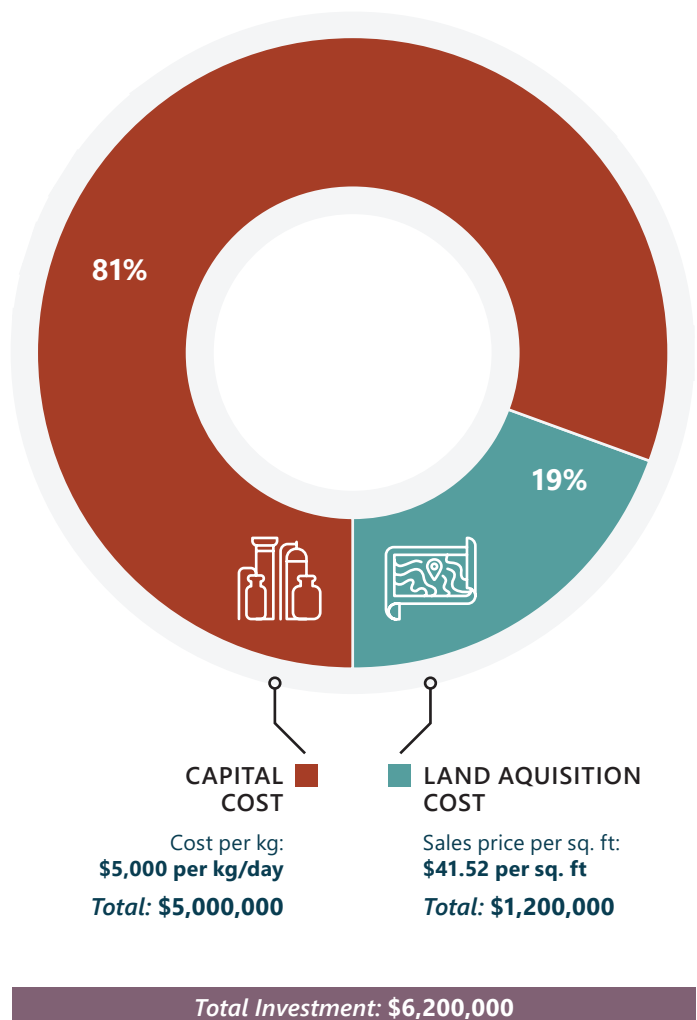
- > Has existing truck or fuel stop?
Yes
- > Parcel size:
25,265 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Industrial
- > Site primary neighboring land use(s):
Industrial, Residential, Commercial, Facilities
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to **32 trucks**
- > Projected volume in the census tract (2040):
324 trips

SITE SUITABILITY SCORING (0-10)

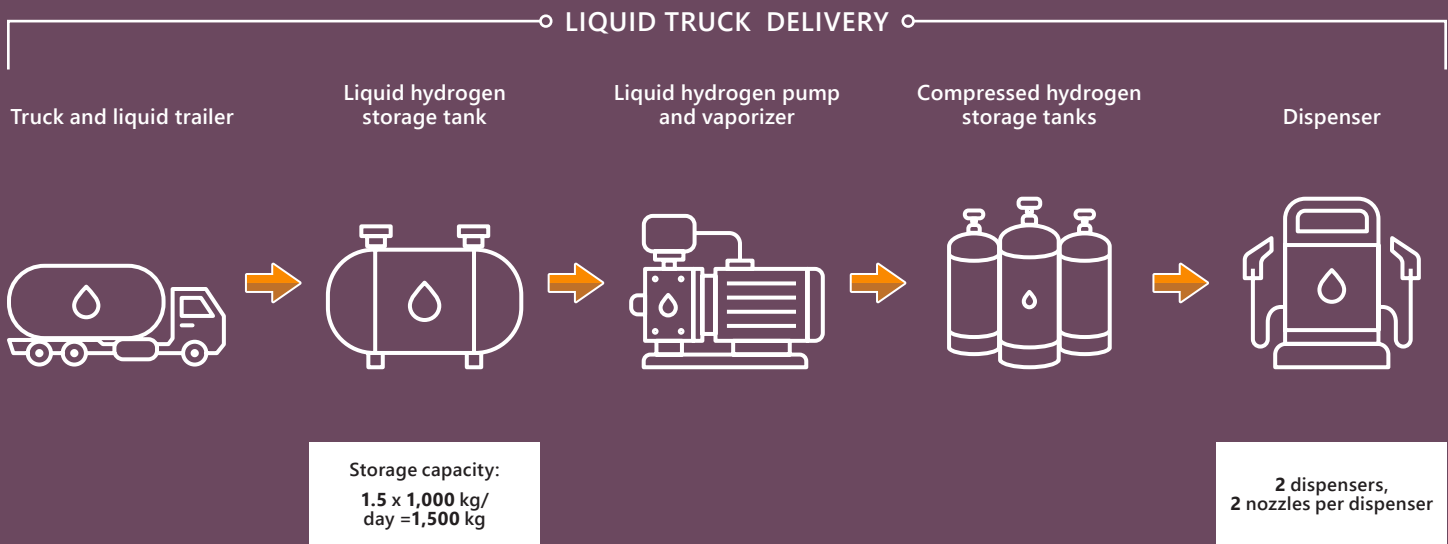
OVERALL SCORE: **2.13**

- | | |
|--|--|
| 0 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 10 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 0 Direct Benefit to Disadvantaged Communities |
| 5 Amenities | 0 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs

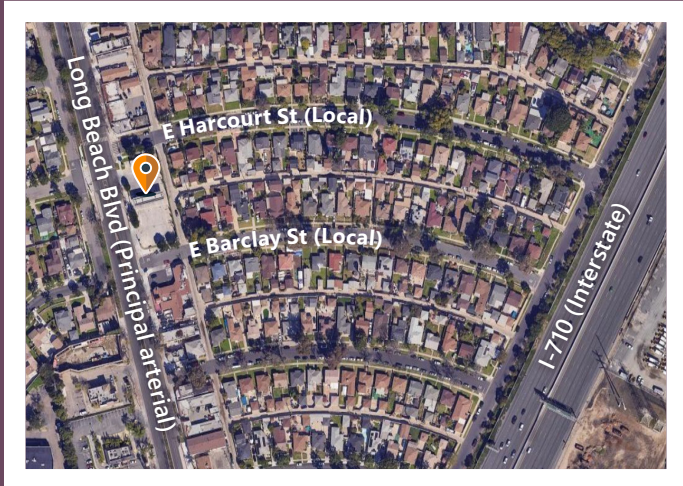


PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS



KEY CONSIDERATIONS

- > The presence of the existing truck parking and being accessible from two major highways of I-110 and CA-91 can be leveraged to attract drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams.
- > The station's proximity to hydrogen production facilities is a key advantage, reducing transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is located in an industrial zone with neighboring industrial and residential land uses, careful planning is needed to ensure smooth traffic flow in and out of the facility. A dedicated entrance for trucks can minimize congestion and reduce the risk of accidents with neighboring residential traffic.
- > Pull-through designs for trucks using hydrogen stations would be more appropriate avoiding the need for reversing.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 4 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

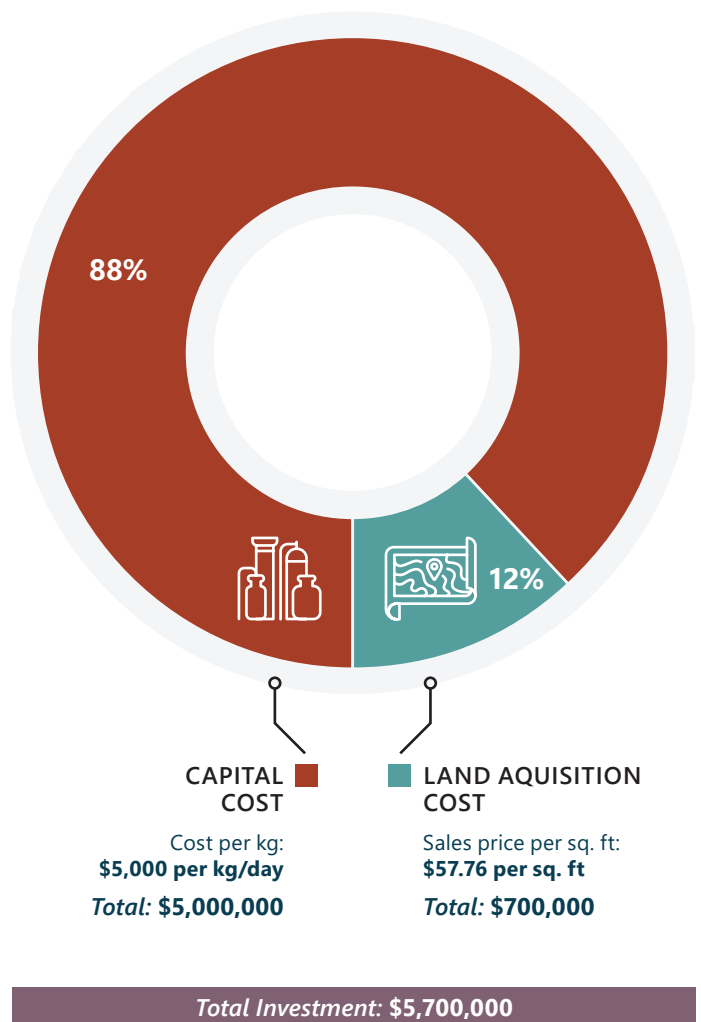
- > Has existing truck or fuel stop?
Yes
- > Parcel size:
12,632 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Residential, Commercial and services, Transportation, Industrial
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to **32 trucks**
- > Projected volume in the census tract (2040):
288 trips

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.13**

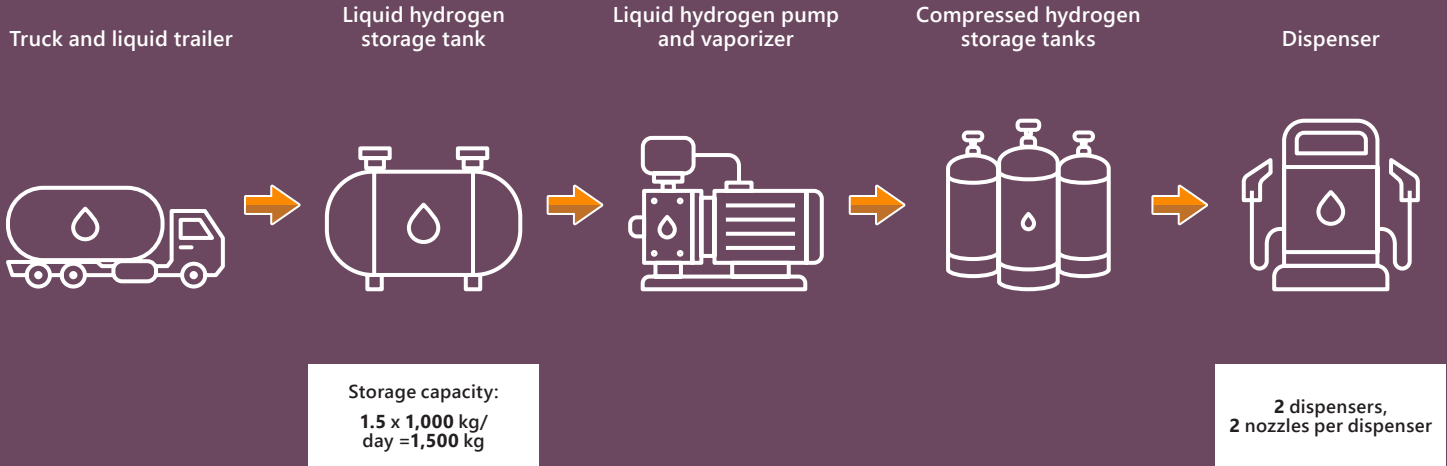
- | | |
|---------------------------------------|---|
| 0 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 0 Existing Truck Parking | 10 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 0 Direct Benefit to Disadvantaged Communities |
| 5 Amenities | 10 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



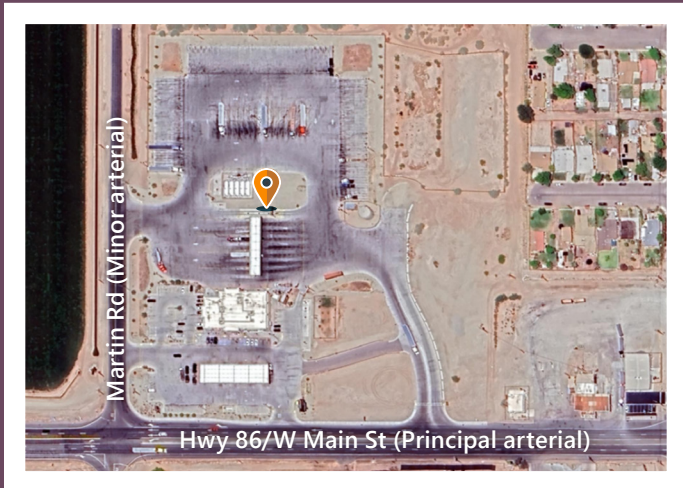
PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY



KEY CONSIDERATIONS

- > The presence of the existing fuel station and being located near I-10 can be leveraged to attract drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The station's relative proximity to hydrogen production facilities is a key advantage, reducing transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is neighboring commercial and residential land uses, careful planning is needed to ensure smooth traffic flow in and out of the facility. A dedicated entrance for trucks can minimize congestion and reduce the risk of accidents with neighboring residential traffic.
- > Pull-through designs for trucks using hydrogen stations would be more appropriate avoiding the need for reversing.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 4 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

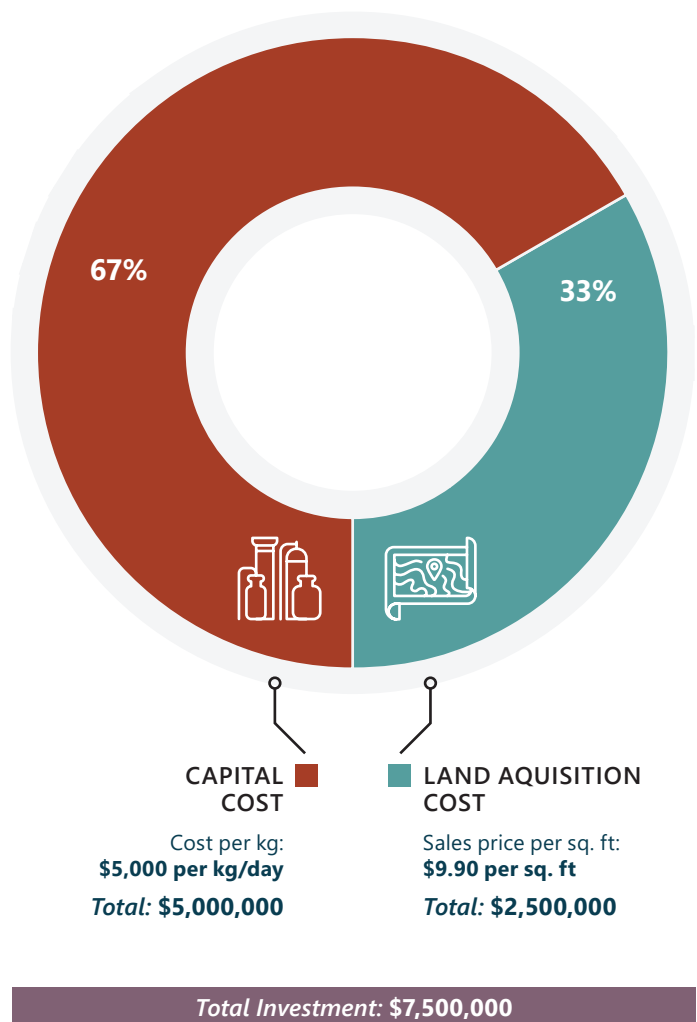
- > Has existing truck or fuel stop?
Yes
- > Parcel size:
248,292 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Industrial, Commercial and services, Agriculture, Vacant, Residential
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to 32 trucks
- > Projected volume in the census tract (2040):
705 trips

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.21**

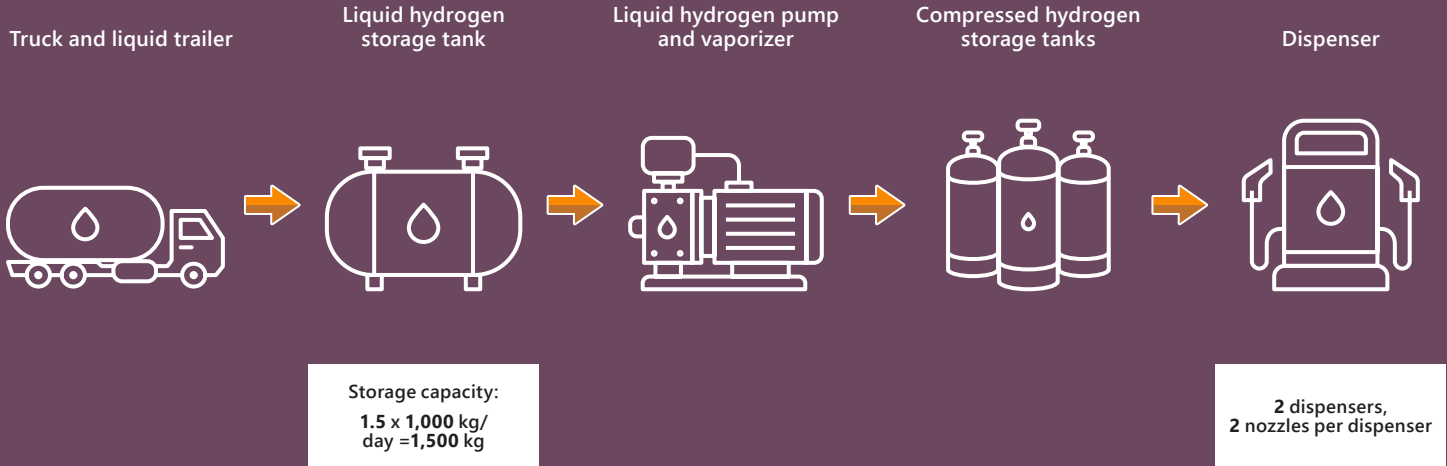
- | | |
|---|--|
| 0 Trip Volume (2040) | 10 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 5 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 10 Land Price | 0 Direct Benefit to Disadvantaged Communities |
| 10 Amenities | 10 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 0 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



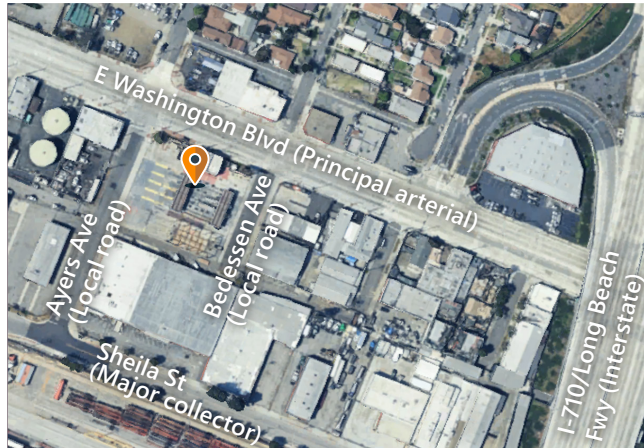
PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY

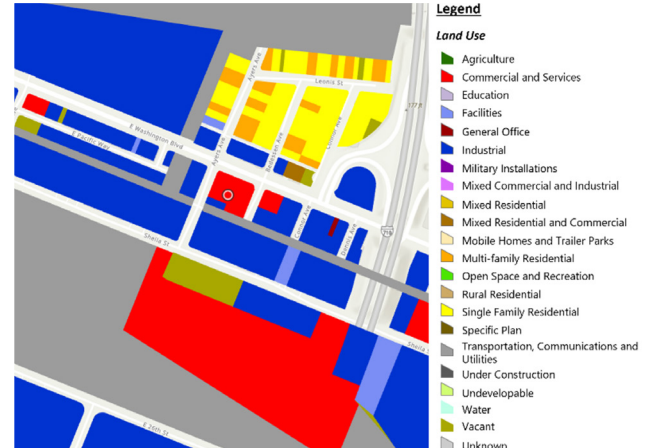


KEY CONSIDERATIONS

- > Positioned along Hwy 86, this site is ideal for servicing both long-haul trucks on interstate routes and shorter-haul vehicles operating within the urban and agricultural surroundings. The presence of the existing truck and fuel stop, and related amenities can be leveraged to attract drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The absence of hydrogen production facilities nearby means that the site may need to rely on regular deliveries of liquid hydrogen, which can impact operational costs and supply chain reliability. Developers should consider establishing partnerships with hydrogen producers to secure long-term supply contracts, ensuring a steady and affordable hydrogen supply. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is located in a commercial zone with neighboring commercial and residential land uses, careful planning is needed to maintain smooth traffic flow in and out of the facility.
- > The site can accommodate both pull-through and pull-in spots, offering flexibility for various vehicle sizes.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 2 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.67%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The presence of adjacent vacant land offers opportunities for future expansion of the hydrogen refueling station. This could involve increasing the number of dispensers or expanding hydrogen storage capacity to accommodate growing demand.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.



SITE AERIAL VIEW



SITE VICINITY LAND USE (2019)

FACILITY GENERAL CHARACTERISTICS

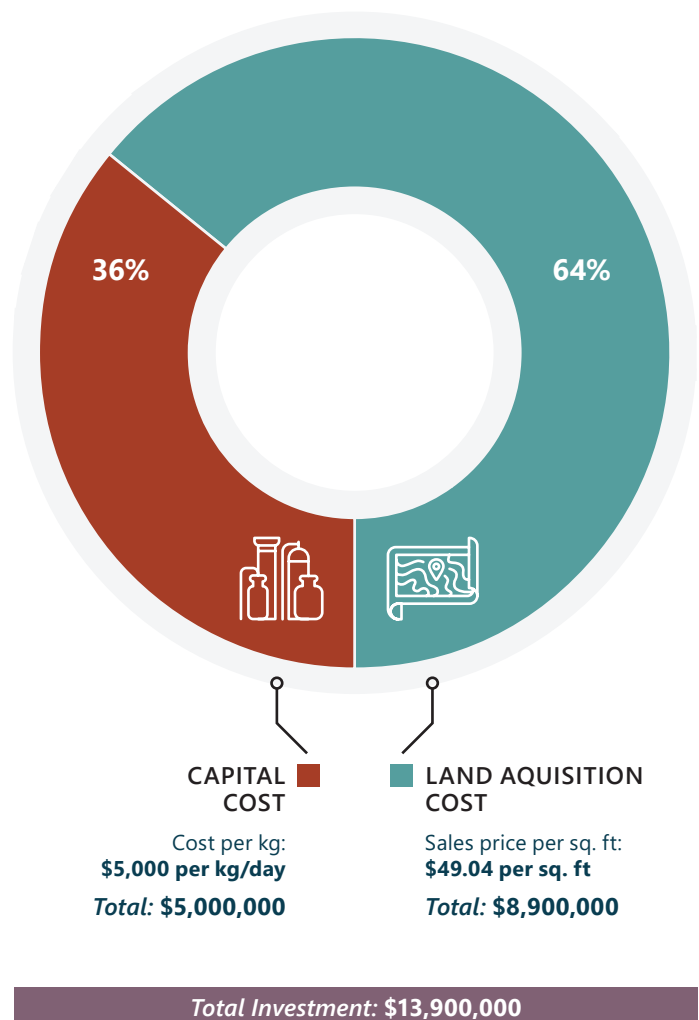
- > Has existing truck or fuel stop?
Yes
- > Parcel size:
180,774 sq.ft
- > Urban/rural:
Urban
- > Property ownership:
Private
- > Site land use:
Commercial and services
- > Site primary neighboring land use(s):
Industrial, Commercial and services, Vacant, Residential, Transportation, Communications and utility
- > Estimated number of trucks being served (assuming 31 kg vehicle tank capacity):
up to **32**
- > Projected volume in the census tract (2040):
798 trips

SITE SUITABILITY SCORING (0-10)

OVERALL SCORE: **2.29**

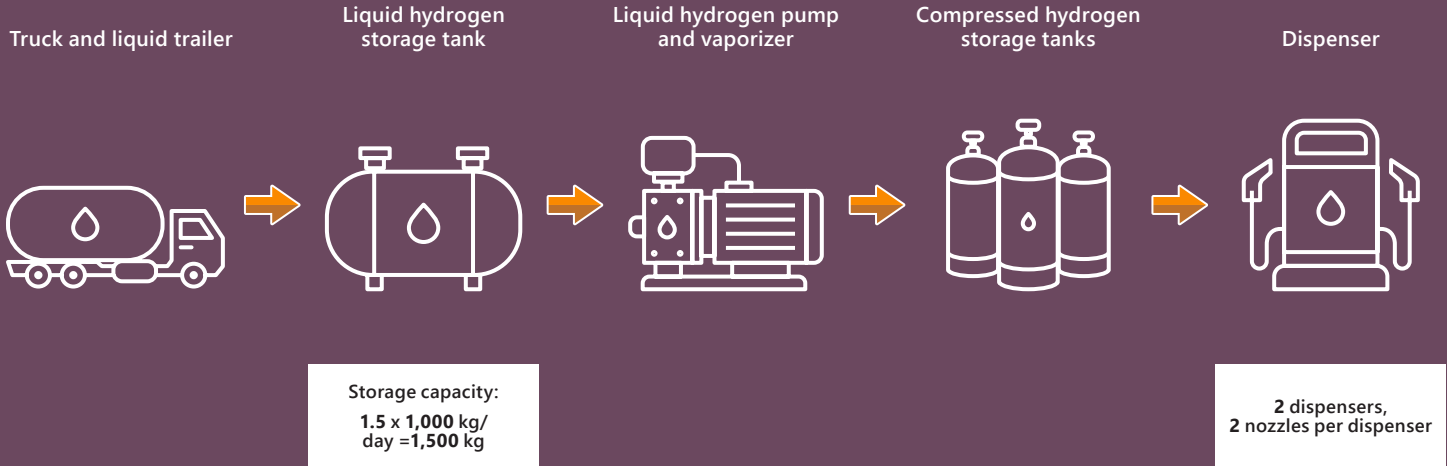
- | | |
|--|--|
| 0 Trip Volume (2040) | 0 Proximity to Other ZEV Infrastructure |
| 0 Daily Mileage | 0 Load Capacity |
| 10 Existing Truck Parking | 10 Ability to Integrate DERs |
| 0 Scalability | 0 Proximity to Disadvantaged Communities |
| 9 Land Price | 1 Direct Benefit to Disadvantaged Communities |
| 5 Amenities | 0 Flood Risk |
| 10 Access, Congestion, Safety | 0 Brownfields |
| 10 Proximity to Hydrogen Supply Chain | |

Hydrogen Infrastructure Key Costs



PROPOSED HYDROGEN INFRASTRUCTURE CHARACTERISTICS

LIQUID TRUCK DELIVERY



KEY CONSIDERATIONS

- > Located in an urban area surrounded by local roads, the facility may cater to trucks engaged in shorter delivery routes. The presence of an existing truck stop and related amenities can be leveraged to attract drivers already familiar with refueling at this location, enhancing initial customer adoption and leading to steady revenue streams. It also provides an opportunity to integrate both traditional and alternative fuel offerings, providing flexibility to operators who manage mixed fleets.
- > The station's proximity to hydrogen production facilities is a key advantage, reducing transportation costs and delivery times. Partnerships with the production facility could lead to price advantages for bulk hydrogen purchases, long-term supply contracts, or joint ventures. Additionally, the feasibility of on-site hydrogen production or mobile reformer units could be explored, leveraging the close proximity for supply resilience, especially if demand grows.
- > As the site is located in a commercial zone with neighboring industrial and residential land uses, careful planning is needed to ensure smooth traffic flow in and out of the facility. A dedicated entrance for trucks can minimize congestion and reduce the risk of accidents with neighboring residential traffic.
- > Pull-in designs for trucks using hydrogen stations would be more appropriate to maximize space efficiency and allow trucks decouple their trailers and park to refuel.
- > The hydrogen station design should accommodate regular delivery of liquid hydrogen, including specialized unloading areas that meet safety standards for cryogenic materials.
- > If the hydrogen storage is evenly distributed across all 4 nozzles, each nozzle can provide 250 kg/day. Assuming each nozzle dispenses hydrogen at 2 kg/min, it could operate continuously for approximately 2.08 hours/day at maximum flow, resulting in a utilization rate of about 8.68%. This lower utilization rate highlights potential for expansion in usage, allowing more vehicles to be refueled without reaching capacity limits.
- > The site is located within a DAC. While it helps transition existing truck traffic to zero emissions, benefiting DACs by reducing pollution and noise, it can also increase truck traffic within these communities. Mitigation involves community engagement to address concerns and robust traffic management to minimize congestion and safety risks.
- > The development of this site can create jobs both during the construction phase and ongoing operational roles, benefiting the local community.
- > Active engagement with state and federal agencies should be undertaken by developers to secure grants/incentives, which can offset significant portions of the project's cost.

SITE PRIORITIZATION TOOL

The site prioritization tool is designed to support the strategic planning and deployment of ZEV infrastructure, including EV charging stations and hydrogen refueling sites. Its main goal is to offer actionable insights to guide the near-term implementation of ZEV infrastructure across the Southern California region.

The tool is designed to help agencies understand local medium- and heavy-duty truck charging and refueling needs within the regional context. It also supports their efforts to secure federal and state grants by identifying optimal locations for EV charging and hydrogen refueling infrastructure. The siting prioritization tool is specifically designed to pinpoint sites where such infrastructure can be most effectively implemented, increasing the likelihood of grant success. Additionally, it serves as a valuable resource for developers and agencies, guiding them to suitable locations for ZEV infrastructure deployment in alignment with SCAG's ZETI regional blueprint.

While the tool is highly effective for strategic siting, it is not a one-size-fits-all solution and should be used alongside other planning and regulatory frameworks for comprehensive decision-making. The tool is primarily designed to assess sites based on currently available data and projections out to 2040 for certain travel-related data. Thus, changes in criteria such as land use, locations of existing ZEV stations or truck parking, and grid capacity could impact its accuracy for long-term planning. Additionally, the tool provides a high-level analysis and scoring of parcels, but it should not be used as a sole resource for final site selection. The tool may not account for more granular factors, such as site-specific infrastructure costs, building codes or local permitting processes, local policies or economic conditions which could affect the final suitability of a site. Local governments and developers will still need to conduct detailed feasibility studies, including site visits, community consultations, and technical evaluations to ensure the final sites meet all operational, regulatory, and community needs.

HOW DID WE DEVELOP THE TOOL?

The site prioritization tool was developed with its potential users in mind, we wanted to make sure that local agencies, private sector developers, and other stakeholders had an opportunity to help influence and shape the metrics used and how we weighted those metrics or criteria to score a parcel. The team worked with the ZETI TAC to develop the siting criteria and the baseline or initial weights on those selected criteria.

SITING CRITERIA

To properly site ZEV infrastructure, five broad groups of siting criteria are identified: utilization, land, equity, grid capacity and environmental conditions. The selection of the criteria was based on a comprehensive literature review and stakeholder input. To score each of the five criteria, datasets were selected to provide a quantitative representation of the parcels.

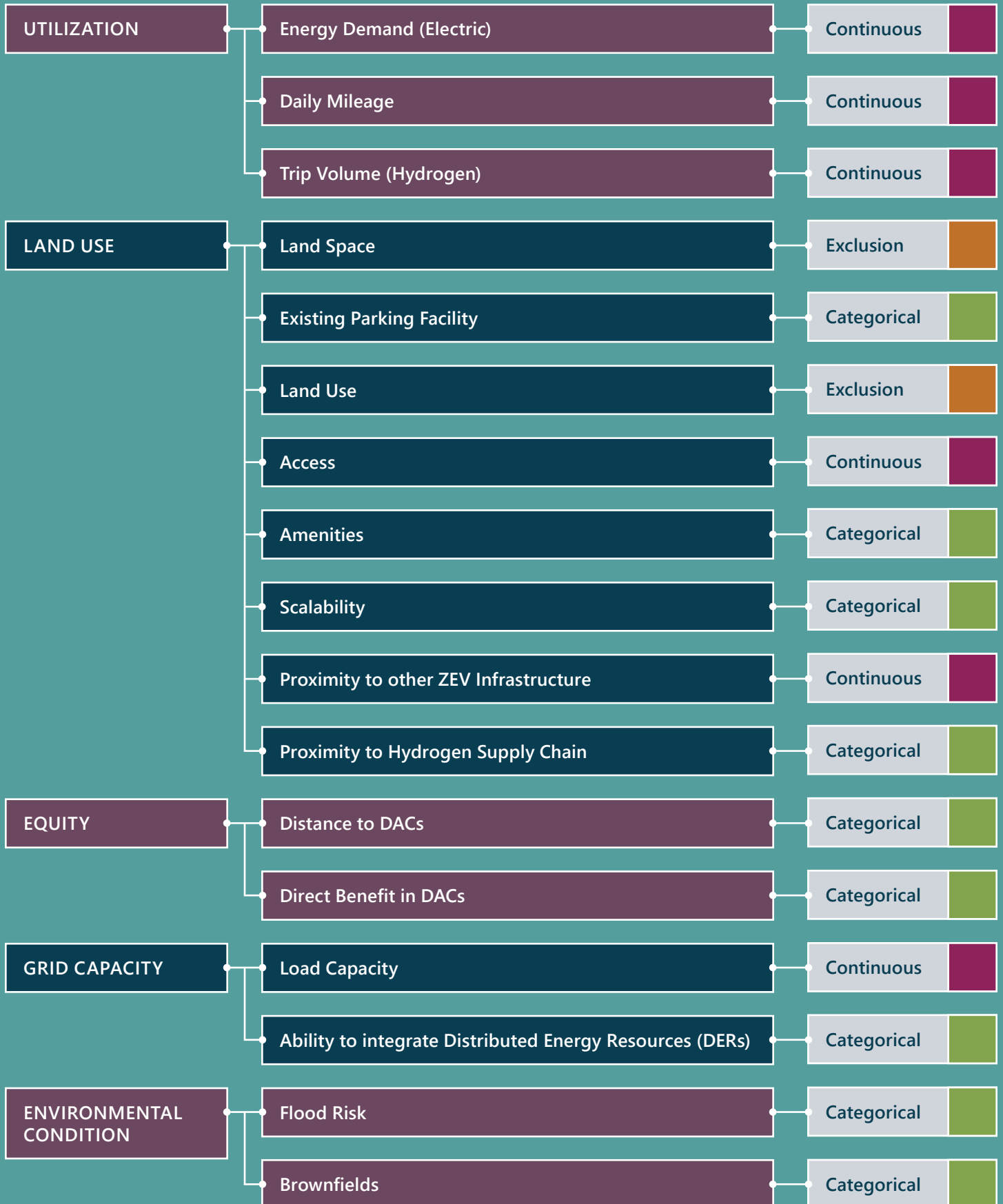
GENERAL APPROACH

The general approach to siting analysis for medium-/ heavy-duty ZEV infrastructure deployment primarily involves utilizing Geographic Information System (GIS) techniques. This approach involves the overlaying of various GIS layers to assess and score individual parcels of land within the SCAG region. By synthesizing layers that represent the siting criteria, the analysis evaluates the suitability of each parcel for developing ZEV infrastructure.

This siting analysis uses a multi-criteria decision analysis (MCDA) framework to evaluate potential sites. Each parcel or census tract is scored on a scale of 0 to 10 based on how well it meets specific criteria, with higher scores given to those that align closely with ideal conditions. The criteria are weighted according to their importance, and the final scores are calculated by combining the weighted scores for all criteria. The criteria, as illustrated on the following page, are categorized into three scoring groups:

1. **Continuous Criteria:** Continuous criteria allow for a spectrum of values within a given range, such as any decimal from 0 to 10. This type of criterion is ideal for quantitative measures that can vary incrementally and where such variations are meaningful. For instance, trip volume is a continuous criterion where the parcel or Census tract with the highest number of hydrogen trips would receive a perfect score of 10, with all other parcels scored relative to this benchmark. Depending on the nature of data and practical considerations, the continuous values of such criteria may also be categorized into specific ranges, and each range will be assigned a corresponding score.
2. **Categorical Criteria:** Categorical criteria in an MCDA are those that are evaluated by assigning a score based on predefined categories. Each category corresponds to a specific score, which is typically a whole number within a set range, such as 0, 5, or 10. This approach is useful for qualitative measures or when data is best grouped into distinct levels, such as low, medium, or high risk, with no need for more nuanced scoring between these levels. For example, a site with existing truck parking receives a score of 10.

ZEV INFRASTRUCTURE SITING CRITERIA

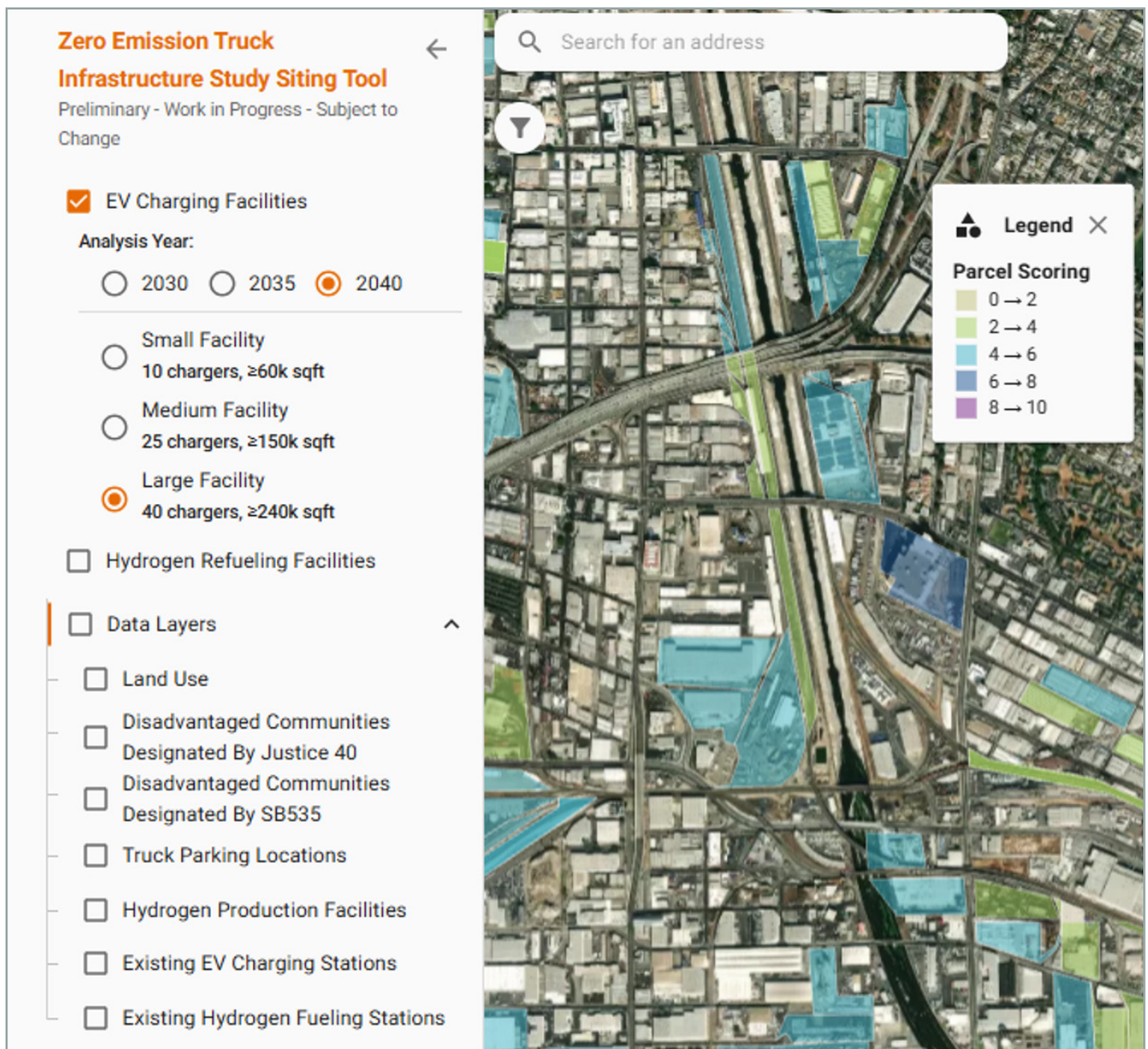


3. **Exclusionary Criteria:** Exclusionary criteria filter out parcels based on specific conditions to ensure only suitable sites are considered for ZEV infrastructure development. Parcels that do not meet these exclusionary criteria are excluded from consideration in the scoring process. An example of this is land size; if a parcel is smaller than the minimum requirement for developing a specific size of charging or fueling infrastructure, it is excluded from further analysis.

The details of all of the data used for this analysis can be found in Appendix E. In addition, to a comprehensive list and citations for all of the data used and detailed review of how the parcel scoring is conducted.

The Site Prioritization Tool works with the typologies developed for the site assessments as well as the future year scenarios, users are able to select those two parameters along with weighted criteria to see the scoring of various parcels (see Figure 55).

FIGURE 55 Example of Site Prioritization Tool - Parcel Scoring



PRIORITIZATION METHODOLOGY

The prioritization methodology for selecting parcels for ZEV infrastructure development unfolds in four structured steps, ensuring a comprehensive and systematic approach:

1. **Initial Screening for Exclusionary Criteria:** In the first step, parcels not meeting the minimum requirements, known as exclusionary criteria—insufficient land space or inappropriate land use—are excluded from further analysis. This screening ensures that only parcels with the fundamental suitability for ZEV infrastructure proceed to the scoring phase.
2. **Scoring Individual Criteria:** Next, all remaining parcels are evaluated and scored based on the specific subcriteria detailed previously. Each parcel is assigned a score ranging from 0 to 10 for each applicable subcriterion, following the parcel scoring methodology described earlier.
3. **Assigning Weights to Subcriteria:** Weights are allocated to each subcriterion within every criterion group. The weights across all subcriteria add up to 1 or 100 percent. These weights are determined through a stakeholder survey, forming a default scenario for the evaluation process. The results of the survey produce an average weight value across respondents for each subcriterion. For example, if for respondent A, the utilization category is weighted at 50 percent, with trip volume receiving 20 points and daily mileage receiving 30 points (out of a total of 50), and, if for respondent B, the utilization category is weighted at 60 percent, with trip volume receiving 25 points and daily mileage receiving 35 points (out of the total of 60): trip volume receives an average weight of 22.5 percent, and daily mileage receives an average weight of 32.5 percent across both respondents. The users of the tool are able to adjust these default weights based on their preferences.
4. **Calculating Weighted Sum Scores (Suitability Indices):** The scores within each criterion group (e.g., utilization, land) are then aggregated into a weighted sum score based on the predefined weights for each subcriterion within that group. The overall score is calculated by multiplying the weight of each subcriterion by its respective score and then summing up these values for each parcel.

SECTION ENDNOTES

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- 44 The San Diego Union Tribune. Fast EV Chargers Installed in Otay Mesa. <https://www.sandiegouniontribune.com/2023/03/27/fast-ev-chargers-installed-in-otay-mesa-at-busy-truck-stop/>
- 45 WattEV. Bakersfield Charging Depot. <https://polb.com/port-info/news-and-press/charging-station-to-power-electric-trucks-in-port-11-30-2023/>
- 46 The primary reference reported for the characteristics of these stations is the official website of the companies (e.g., WattEV) or the agencies (e.g. Port of Long Beach), which provides the most stable information. Additional details were sourced from news articles, which may not always be accessible due to their less permanent nature and are therefore not included as references.
- 47 Caltrans. (2022). California Statewide Truck Parking Study. <https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/freight-planning/plan-accordion/catrpkpgstdy-finalreport-a11y.pdf>
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- 49 Megawatt Truck Charging Hub in Ohio. <https://www.truckinginfo.com/10207881/megawatt-truck-charging-hub-opens-in-ohio>
- 50 While dual port charges are helpful efficient use of space; site constraints, types of operations, and supporting grid infrastructure could warrant the use of single port chargers in future site installations regardless of size.
- 51 Calstart. National Zero Emission Medium- and Heavy-Duty Infrastructure Map. <https://calstart.org/mhd-infrastructure-map/>
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7. NEXT STEPS

The SCAG ZETI Study serves as a guiding tool for public agencies, utilities, the private sector, and other stakeholders to help understand the challenges and future charging and fueling needs in developing a zero emission freight future that meets state regulations and goals. Achieving these goals and meeting regulations will take a collaborative, cooperative, and coordinated effort from all stakeholders to help create a cleaner, more sustainable future. As previous chapters of the study detailed locations of future charging and fueling needs for the SCAG region, this chapter will focus on overall strategies to help plan, fund, and install the zero emissions charging and fueling networks that will support the freight industry moving forward.

The recommendations below are focused on how we can address challenges highlighted in literature review, stakeholder engagement, and our analysis.

FUNDING

Funding is one of the most challenging issues facing the zero emissions freight future. The high cost of zero emissions trucks, infrastructure for charging and fueling, and the cost of land are all aspects that need to be considered. Below are a number of the actions to consider as we look to build the zero emissions network.

- Collaborate with SCAG and other agencies on grant funding opportunities. SCAG has technical resources that can assist with grant applications and can help coordinate regionally to support multiple applicants to ensure efficient use of staff time and resources.
- The high cost of land acquisition and lease rates may hinder EV charging and hydrogen fueling development, so considering low or no cost lease agreements with the private sector operator could help incentivize development or potentially act as part of the funding match for grant programs.
- Continue to explore public private partnerships for development of ZE sites. However, public agencies should carefully structure public-private agreements to ensure that timelines are adhered to, private funding is secured in advance and committed to the project, and sites are fully operational upon completion of the agreement period.
- Use the ZETI Study's future demand information to help prioritize investment in high demand areas, and consider future projected demand when reviewing grant applications to highlight needs.

- Provide education and technical support for smaller fleets to allow them better access and understand available grant funds. Outreach results indicated that smaller fleets did not know which funding programs could best support their purchase of ZE medium- and heavy-duty vehicles.
- Fund pilot projects that provide drivers/operators a chance to test the impacts and performance of ZE trucks. This will help them understand how it will impact their operation and may alleviate concerns of the unknown. This could include DER systems for locations without grid access or those facing challenges in bringing energy to site.
- Consider the use of the IBank in agency funding plans to speed up implementation of the public charging facilities. Agencies should also consider taking a more active role in building the charging facilities on state or federal land.
- Work together to advocate and incorporate initial operations funding to be included into grant programs to ensure supporting the ZE transition extends beyond simply completing a project.
- Work with funding agencies to build in performance measures that help move the industry forward and create an environment that rewards well-used and operated sites.
- Advocate for continued state and regional funding to support the ZE transition. With potential budget challenges, it is important that this remains a priority to meet state regulations and goals.

ELECTRIC GRID CAPACITY AND AVAILABILITY OF HYDROGEN

Grid capacity for electric charging and availability of hydrogen are major challenges for the transition to ZE freight. Grid capacity or available energy is one of the major components that EV installers and operators review as it impacts capital cost, timeline to establish operations, and operational costs. Hydrogen fueling is also impacted by its availability and means to provide hydrogen to fueling locations. Hydrogen is currently trucked to locations, but new practices, including pipelines will be needed to meet the future demand to make hydrogen a viable option for ZE trucks.

For EV installation, finding a site with existing capacity and needing minimal capital investment is ideal for more immediate cost recovery and will allow for a faster installation process with less infrastructure to install. For hydrogen, potential proximity to product sites or major holding facilities will be important to allow for efficient

trucking practices as well as the possibility to develop pipelines. Potential avenues to address some of the main concerns include:

- Transportation agencies and utilities need to coordinate plans to improve alignment between electric infrastructure and transportation/freight patterns. Transportation agencies and departments should look carefully at energy/utility plans to provide input to ensure that grid capital planning includes future EV charging needs.
- When developing future plans, coordinate with SCAG to reduce redundant analysis and expenditure. This will allow for future effort to focus on installation or site-specific studies instead of general planning.
- Transportation agencies and utilities should coordinate to help identify locations with high capacity and high demand. This could take the form of working groups, coordinated data sharing, or inviting each other to existing meetings or committees.
- Public agencies should coordinate with SCAG and other partner agencies to understand how public land and existing sites can be used to facilitate EV charger or hydrogen fueling. Developing on sites that are already designed for truck parking and fueling can potentially increase the speed of installation and reduce community impacts.
- Explore DER systems to support charging locations that are challenging to bring energy on-site or to supplement grid capacity.
- Work with state and local jurisdiction to facilitate the identification of locations and installation of hydrogen fueling or hydrogen development locations.
- Continue public education on hydrogen fueling technology will help alleviate the fear with of the technology, to increase potential locations for fueling infrastructure and support structures like holding tanks and pipelines.
- The hydrogen industry and public agencies need to coordinate to develop an approach for hydrogen pipelines. Defining key locations to support a network of fueling sites, as well as compression, liquefaction, storage will be needed to help provide the levels of hydrogen needed to meet future demand, if this will be a viable part of the ZE fueling future. Most local sites will not be able to support compression, liquefaction, and/or storage on-site.

- While battery electric vehicles will be key to a zero emissions future, there needs to be openness to alternative options as there may be truck markets and locations that are better suited for different technologies. Providing alternatives may make it easier to address grid capacity concerns in the near term.

PUBLIC VS PRIVATE DEPOTS

Both public and private depots are key to the overall transition to ZE freight fleet. The fleet survey revealed that larger fleets are somewhat likely or very likely to build EV charging on-site, while smaller fleets are uncertain or unlikely to do so. Additionally, our literature review and industry interviews illustrated the need to build public sites to support the industry as a whole. This is especially important for specific market segments such as long haul, drayage, and regional non-home operations, as these will be needed to facilitate the ZE transition.

While larger fleet and regional home operations will likely charge in private lots or “behind the fence”, they may need public charging due to unforeseen issues while operating. A robust network will also help reduce range concerns, which were highlighted as a major issue from the fleet survey.

- Government will need to be involved in the development of public charging stations to build the required number of stations considering the regulatory timeline, especially as private businesses are still trying to develop profitable and sustainable business models in this space.
- Increasing redundancy in the EV charging system, by building more charging sites will help alleviate range concerns. Though some interviews highlighted the need to consider not only where and the overall number, but to consider the power levels to allow for fast charging to minimize impacts to operations.
- Providing an accurate inventory and accessible map of all public and semi-public charging locations could help with some of the concerns on access/availability for drivers/operators.
- Government and industry stakeholders should coordinate on the future development of a charging and fueling network to help prioritize charging along known freight corridors and near warehousing sites.

TIMELINES

The industry stakeholders discussed at length the challenges related to timelines and expediting implementation, as well as the need for interim solutions until utilities can bring power to site. In addition to the challenges of aligning timelines for infrastructure, timelines for environmental review and other permits slow down the installation process and contribute to cost escalation. While the majority of the recommendations focus on government leadership and potential legislation or regulatory improvements, there is a significant role for private industry to work with government to help improve community engagement and provide information on future plans that may help agencies prepare for EV and hydrogen site installation.

- Continued support from government agencies like the CPUC to streamline approvals allowing for faster grid upgrades without offloading rate increases onto non-commercial or non-industrial customers. This needs to consider how local demand in Southern California is also driving the increased need for ZE vehicles, so those costs can be shared, to some degree, with the end customers of the transportation sector.
- To continue reducing barriers, additional support from the government in streamlining local permitting and the CPUC processes can help with the installation of EV charging infrastructure.
- Continue to work with legislators to enhance and extend the streamlined CEQA, minimizing the overall procedure for environmental documentation and associated studies for the development of EV charging and hydrogen fueling facilities.
- Consult with SCAG to obtain data and coordinate efforts that can potentially reduce planning timelines and consolidate efforts to maximize efficiency.
- Temporary and interim solutions are necessary to help address the lag in EV charging infrastructure installation when companies have trucks but no power on-site. Continued work on microgrids and other DER solutions should include funding pilot projects and research for innovative solutions.

EQUITY OF LOCATIONS

The community-based organizations, industry stakeholders, and public agencies discussed equity concerns for siting public charging depots. There were varying ideas about the potential benefits and impacts for existing truck fueling or parking sites in disadvantaged communities transitioning to ZE charging and fueling sites. The need to balance the locations, so that both the investments and impacts are shared by everyone, was emphasized. In addition, new legislation on warehousing and truck routes will impact where sites will be installed. The concerns about focused pollution (non-tailpipe pollution), blight, and potential safety challenges that freight vehicles present were highlighted during our engagement process and need to be addressed as the ZE transition continues. Potential avenues to address these main concerns include:

- Engage the communities early in the process. This can help address concerns and potentially ensure a faster but more equitable process with buy-in from community members and their leaders. Discuss the potential benefits while still being transparent about potential drawbacks.
- Develop local hire and capacity development programs in these communities, so that they reap the benefits of installing EV charging depots and hydrogen fueling sites.
- EV charging and hydrogen fueling installers, working with local agencies and installers, need to develop site beautification and safety plans to help address community needs and to reduce impacts.
- Ensure equity criteria in the decision-making process. This can be done at a local or regional or state level; this may manifest in funding criteria, environmental streamlining, or other development standards, but equity needs to be considered in the process.
- DACs cannot take on the full burden of the EV or hydrogen fueling network. With many of the existing truck parking sites and warehousing locations located in DACs, it is important that the overall network goes beyond these sites to ensure that there is a complete and redundant network and that we consider the number of future truck trips that will be induced in these communities.

As the ZETI Study highlights, there are significant challenges ahead, but there are solutions and a consolidated effort comprised of freight stakeholder that are heavily invested in seeing this ZE transition succeed. With California and the SCAG region playing such an integral role in freight locally, regionally, and nationally, it is fitting that we are on the vanguard of pushing innovation and equity in goods movement. It is hoped that the SCAG ZETI Study will be a tool to help guide and educate, but it is only actionable if all of us are invested and willing to collaborate to ensure a successful transition that bolsters the freight industry and encourages investment.

The SCAG ZETI Study is just one part of the effort SCAG is investing into ZE and regional freight planning. SCAG looks to play a significant role in supporting its regional partners in this ZE transition and helping facilitate the installation of charging and fueling sites. SCAG has invested heavily in building tools, datasets and information that can support those seeking to develop sites and hopes to be a resource to support coordinated efforts to secure regional funding. Together, as a region, we can develop a clean and equitable ZE freight future that can benefit communities locally and the industry moving forward.





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