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Freight Industry Outreach Memo – Zero-Emission Truck Infrastructure Community Engagement Summary

Electric Truck Research and Utilization Center (eTRUC) Project (Task 3)

CALSTART

eTRUC

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eTRUC Project Managers
A. Rogers, EPRI
N. Fernandez, CALSTART

eTRUC Principal Investigators
W. Collins, EPRI
J. Tomic, CALSTART

EPRI
3420 Hillview Avenue, Palo Alto, California 94304-1338 USA
800.313.3774 ▪ 650.855.2121 ▪ askepri@epri.com ▪ www.epri.com

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The following organizations prepared this report:

EPRI
3420 Hillview Avenue
Palo Alto, CA 94304

Author
K. Lim

CALSTART
48 S Chester Ave
Pasadena, CA 91106

Authors
E. Hellier
T. Chi

Cambridge Systematics, Inc.
515 S. Figueroa Street, Suite 1975
Los Angeles, CA 90071

Author
S. Zneimer

Southern California Association of Governments (SCAG)
3403 Tenth Street #805
Riverside, CA 92501

Author
J. Raspa

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ABSTRACT

The Electric Truck Research and Utilization Center (eTRUC), California's premier research hub for electric technologies in truck applications, aims to accelerate the commercial adoption of the high-power, combined charging system (CCS) and megawatt (MW)-level technologies in heavy-duty (HD) drayage trucks.

This document is part of the eTRUC Task 3 - Fleet Charging Infrastructure Needs and Technology Maturity Assessment. The goal of this task is to engage stakeholders to collect detailed information on fleet operational needs and assess the market status of battery-electric vehicles (BEV) drayage trucks, high-power charging equipment, and supporting infrastructure. The goal of this Freight Industry Outreach Memo Industry (Subtask 3.2) is to assess regional and statewide fleet charging infrastructure needs. As part of task 3.2, a series of interviews, surveys, and focus groups were conducted with a wide variety of stakeholders ranging from fleet owners, warehouse operators, real estate developers, original equipment manufacturers (OEMs), community groups, public sector stakeholders, and quasi-public sector stakeholders, such as ports and utility companies, to gather information about heavy-duty truck transitions to zero-emission vehicles (ZEV) and associated infrastructure planning.

Aggregate statistics from fleet survey responses provide insight on the stages of planning for fleets, barriers to the transition, and resources available to the industry. Interview and focus group participants provide a more in-depth perspective on critical themes such as funding the ZEV transition, grid capacity, public versus private depot charging, timelines, and equity of locations.

This Industry Outreach Memo details the input received from stakeholders, highlights key themes, and provides recommendations for public charging infrastructure that will help provide a smoother transition to zero-emission trucks.

Keywords

Electric vehicles (EVs)
Medium- and heavy-duty vehicles (MDHD vehicles)
Zero-emission vehicles (ZEVs)
High-power charging
Megawatt charging system (MCS)
Electric vehicle supply equipment (EVSE)

ACRONYM/TERM LIST

Acronym/Term	Meaning
A	Amps
AC	Alternating Current
CBO	Community-Based Organization
CCS	Combined Charging System
CEC	California Energy Commission
CharIN	A global association involved in development of charging standards
DC	Direct Current
DCFC	Direct Current Fast Charger
DER	Distributed Energy Resources
EVSE	Electric Vehicle Supply Equipment
kW	Kilowatt
LV	Low Voltage (typically up to 600V)
MCS	Megawatt Charging System
MV	Medium Voltage (typically between 1000 and 35000 volts)
MW	Megawatt
SiC	Silicon Carbide based power electronics
V	Volts
VAC	Alternating current voltage
VDC	Direct current voltage
V2G	Vehicle-to-grid (electrical power specifically from vehicle to the grid)
VGI	Vehicle-grid-integration (bidirectional electrical power flow)

EXECUTIVE SUMMARY

California's Electric Truck Research and Utilization Center (eTRUC) is a stakeholder-driven consortium of industry, government, academia, and community partners committed to the development, advancement, and deployment of innovative heavy-duty (HD) high-power charging infrastructure along key freight corridors that promote the adoption of Class 7 and 8 battery electric zero-emission (ZE) trucks. This project is intended to support planning, research, design, and deployment of innovative high power public corridor charging strategies that will extend the range and increase the operational flexibility of heavy-duty battery electric trucks, beginning with an initial focus on drayage operations.

The goal of Task 3.2 is to assess regional and statewide fleet charging infrastructure needs. In this context, EPRI has contracted the Southern California Association of Governments (SCAG) to conduct freight transport industry outreach efforts.

Significant stakeholder engagement was conducted with fleet owners, warehouse operators, real estate developers, original equipment manufacturers (OEMs), community groups, public sector stakeholders (e.g., LA Metro, Caltrans, South Coast Air Quality Management District (AQMD)), and quasi-public sector stakeholders such as ports and utility companies. A variety of outreach methods, which included telephone surveys, focus groups, and one-on-one interviews, were employed to engage industry stakeholders. Throughout the effort, the study team worked hard to ensure that respondents felt candid about the issues and challenges they face. In exchange, summaries are provided at an aggregate level rather than identifying feedback from individual/specific stakeholders. In addition to this direct engagement of stakeholders, the project's Industry Technology Advisory Committee (ITAC) helps provide perspective and guidance throughout the project.

This Freight Industry Outreach Memo details the input received from stakeholders, highlights key themes, and provides recommendations for public charging infrastructure that will guide the eTRUC site deployment efforts. Below are a number of key highlights from the stakeholder engagement process:

- Engage communities early in the process of assessing the roadmap for public charging infrastructure. This will help address community concerns, but also potentially ensure a faster and more equitable process with buy-in from community members and their leaders.
- Education and technical support are critical for smaller fleets to allow them better access and understanding of available grant funds.
- The incongruous timeline between the purchase of an electric truck and charging infrastructure installation is a common barrier in fleet adoption of battery electric trucks.
- Higher-power charging is critical for public charging sites and megawatt-level charging should be prioritized in the development of these sites.

- Innovation programs that continue to fund scalable pilots is important. Continued work on microgrids and funding pilot projects for those solutions should be expanded, where possible.
- Public funding to subsidize charging infrastructure will remain critical to develop the electric truck industry.
- A regularly updated inventory and accessible map of public and semi-public charging locations could help with concerns about access/availability for drivers/operators.
- Creative temporary and interim public charging infrastructure options may be necessary to address early adopter challenges.

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1 STAKEHOLDER ENGAGEMENT APPROACH AND KEY THEMES

Project Background

CALSTART and EPRI are working with the Southern California Association of Governments (SCAG) to support the eTRUC Task 3 - Fleet Charging Infrastructure Needs and Technology Maturity Assessment. The goal of this task is to engage stakeholders to collect detailed information on fleet operational needs and assess the market status of BEV drayage trucks, high-power charging equipment, and supporting infrastructure. This is implemented through the Freight Transport Industry Outreach survey where key freight transport stakeholders (truck drivers, fleet operators, warehouse operators, industry associations) were engaged to gather information on freight transport behavior and its implications for charging hardware and infrastructure. This document will provide a summary of the survey, questionnaire, interview data and results, along with key themes and implications.

Stakeholder Engagement Outline

Freight industry outreach was conducted to gather information about zero-emission (ZE) Trucks and associated infrastructure planning from a wide-variety of stakeholders ranging from fleet owners, warehouse operators, real estate developers, original equipment manufacturers (OEMs), community groups, public sector stakeholders (e.g., LA Metro, Caltrans, South Coast Air Quality Management District (AQMD)), and quasi-public sector stakeholders such as ports and utility companies. Input from industry stakeholders will help build an understanding of the challenges and barriers to developing a regional and statewide charging infrastructure deployment plan as part of eTRUC.

A variety of outreach methods were employed to engage industry stakeholders, including telephone surveys, focus groups, and one-on-one interviews. In addition to this direct engagement of stakeholders, the eTRUC Industry Technology Advisory Committee (ITAC) helps provide perspective and guidance throughout the project. It is vital to the study that respondents felt free to be candid about the issues and challenges they face. To this end, the identities of individuals have been anonymized and key findings from the outreach efforts are aggregated in this report.

In total, over 100 surveys from truck fleets, three focus groups sessions, and eleven one-on-one interviews were conducted. Key themes emerging from these discussions are listed below.

Key Themes

The engagement effort identified several important barriers and challenges to achieving a full ZE trucking environment and the charging infrastructure that is needed to support a fleet that is in transition. Five key themes emerged in the discussions: Funding, Electric Grid Capacity, Public

vs Private Depots, Timelines, and Equity of Locations. Some of these themes emerged in the industry survey responses but were spoken about in more detail with examples and additional context during the focus groups and interviews.

Funding

- The cost related to the transition is high. The cost of ZE trucks can be more than double the price of existing diesel trucks.[1] Similarly, the installation and maintenance of the fueling/charging infrastructure is expensive. The industry is seeking grants and assistance from government funding to turbocharge the subsidization of electric trucks and the charging infrastructure.
- There are a number of funding programs and opportunities (federal, state, and regional) that currently exist. Additional education on funds and programs available to the trucking industry is needed, especially for smaller fleets.
- Industry members want to know who will pay for the infrastructure transition (managed charging, microgrids, mobile charging) needed in the fleet electrification process, separate from the truck and permanent charging infrastructure itself.

Electric Grid Capacity

- There are concerns regarding 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.
- It is unclear if locations that serve a large number of trucks today will have the space/capacity needed for deploying high-capacity charging infrastructure.

Public vs Private Depots

- It is clear that different charging infrastructure solutions are needed for different truck market segments. For instance, operators with return-and-home, or 'return-to-base' local operations that also have site ownership can deploy depot charging whereas small or single-owner fleets require public charging infrastructure to support their operations.
- Charging, especially for public sites, needs to be faster. Public sites may need megawatt charging or a fast-charging system. The stations should also be frequent so fleets have the flexibility to choose options that meet their service schedules and operations.
- For public charging, it is important to ensure that the surrounding land uses can support amenities for truck drivers.
- California Department of Transportation (Caltrans)-owned land or other existing government land may be a good starting point to Task 6 site prioritization efforts to reduce the burden of procuring and developing large real estate parcels.

[1] (Sharpe and Basma 2022)

Timelines

- There appear to be incongruent timelines in installing infrastructure and purchasing ZEVs. Trucking companies believe that they may be able to order Zero-Emission Trucks (ZET) but will then need to wait longer for charging equipment to be installed, missing out on months and potentially years of use of the ZET. Some participants pointed out that utilities work on a 12-to-36-month timeline to bring infrastructure on site, as opposed to the six to nine months to purchase the ZET.
- Concerns that existing regulation timelines are not realistic and that infrastructure/capacity assumptions may need closer examination due to existing challenges.
- Streamlining the local permitting and California Environmental Quality Act (CEQA)/environmental process can help improve the speed of installation.

Equity of Locations

- There are several planning considerations for installing EV charging stations. These include truck activity and utilization, existing infrastructure and potential for expansion, land use and zoning, environmental impacts, safety, and access to highways. Including truck drivers, operators, and the community in these discussions is important, as their needs and interests are not homogeneous.
- 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 of the charging stations need to be located by Ports, communities adjacent to highways and warehousing districts, especially those already identified as communities of concern, need to be part of the decision-making process.

More detailed summaries from the engagement process are described in the next three sections of the report.

2 INDUSTRY SURVEY AND RESULTS

The industry survey is intended to build an understanding of how fleets in California are currently operating, their familiarity with ZEV regulations and incentive programs, their plans for transitioning to a ZEV fleet, and their requirements for public charging infrastructure.

To find contacts for fleet operators of various operating scales, the survey team used multiple means to connect to fleet operators, including using the INFO USA, ZoomInfo, and a CA-VIUS database, in addition to information provided by SCAG and the ports. The survey was conducted by phone, with project team members administering the survey. As part of the survey approach, the team focused on reaching out to fleet operators of various sizes to reduce the potential for skewing the results.

The survey was conducted in a tense climate: with the state of California having passed new regulations on the timeline for transitioning medium- and heavy-duty trucks into a zero-emission paradigm,[2] it was challenging to get many fleet operators to respond to the survey in a calm and focused manner. Despite this obstacle, the survey team was able to get a 4.5 percent response rate. To help improve response rate and to garner more participants, incentives were offered. One hundred and three (103) firms responded to the survey over a 6-week duration.

The fleet survey provided several key findings to help us better understand the existing conditions and future plans for California trucking fleets. This section of the report will focus on the specific feedback from survey respondents and cover all of the questions asked to the fleets. In addition to reviewing the fleets' responses to questions, the project team looked deeper to see if there were any specific pieces of information to help make more detailed recommendations for varying fleet sizes or market segments to ensure we tailor our roadmap to best achieve the ZEV transition. Several key findings were discovered regarding the stages of planning for fleets, barriers to the transition, and resources available to the industry.

The industry survey provided some key findings for the ZEV transition:

- The top three (3) barriers to transitioning to a ZE truck were identified as: range limitations, vehicle purchasing cost, and grid readiness.
- For small fleets of 1-4 trucks, insufficient public charging infrastructure emerged as the top barrier, followed by the top three barriers for all operators.
- Large fleets are ahead on planning for the transition. The majority of fleets with less than 50 trucks are in the very beginning stages of planning for the transition. This is indicative that additional support will be crucial in helping smaller fleets in their transition towards ZEVs.
- Smaller fleets with less than 20 trucks were less likely to know the details of the Federal and State incentives.

[2] (California Air Resources Board 2023)

These important findings from the survey will help build the region's roadmap and target specific market segments to ensure all fleets can make the transition to ZE trucks within the regulatory timeframe. Details of the responses to each question and additional analysis focused on fleet size are below.

Of the industry stakeholders surveyed, approximately 86 percent had a fleet size of fewer than fifty vehicles (Figure 1). This generally mirrors national industry figures, with a majority of trucking companies operating a small fleet. Over half of respondents were in the transportation and warehousing industry, while approximately 17 percent were in construction (Figure 2).

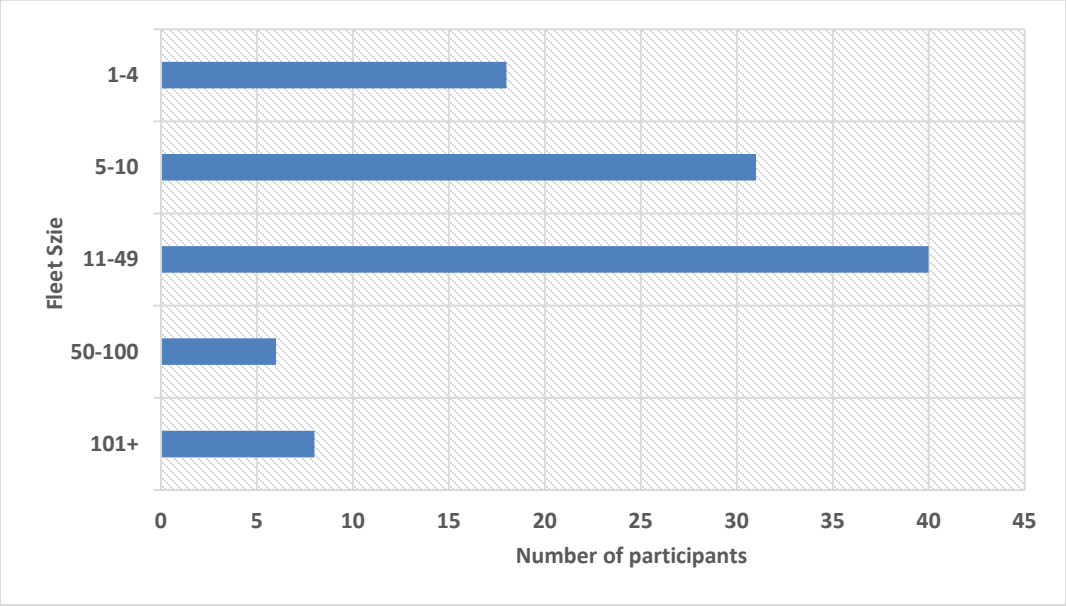

Figure 1. How many Class 3+ trucks (10,000 or more lbs.) are operating out of this location?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

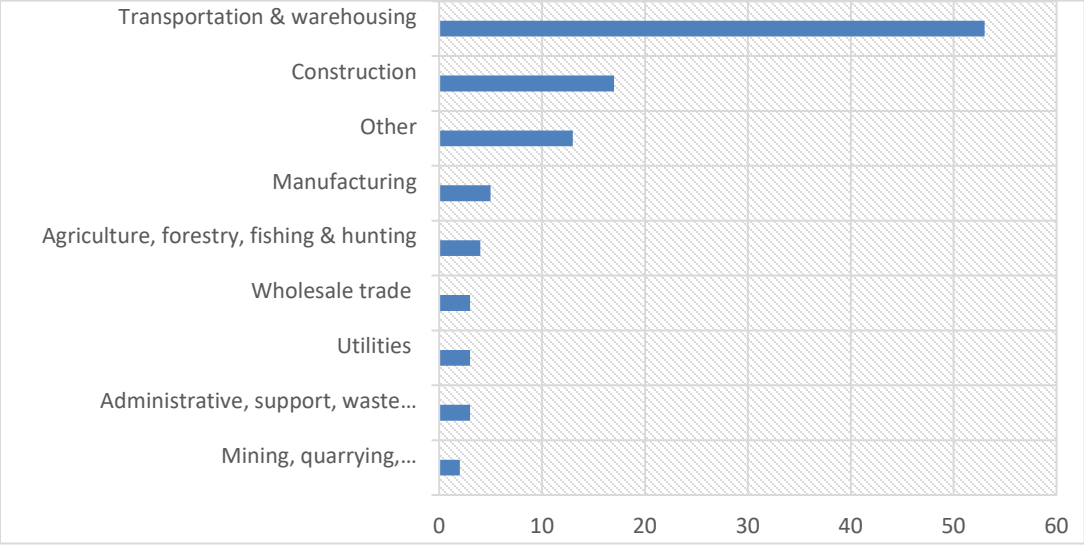

Figure 2. Which of the following best describes the industry for your organization?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

Figure 3 and Figure 4 show the travel patterns of these trucks. Approximately a third were destined for warehouses/distribution centers or ports, while about 10 percent typically journeyed to retail outlets, service businesses, manufacturing facilities, or truck terminals. Half of those surveyed travel primarily within Southern California and nearly a quarter of respondents travel within thirty miles of the yard/dispatch facility. With this percentage of survey respondents primarily located within Southern California, it is important to consider that there may be some bias to challenges to the region.

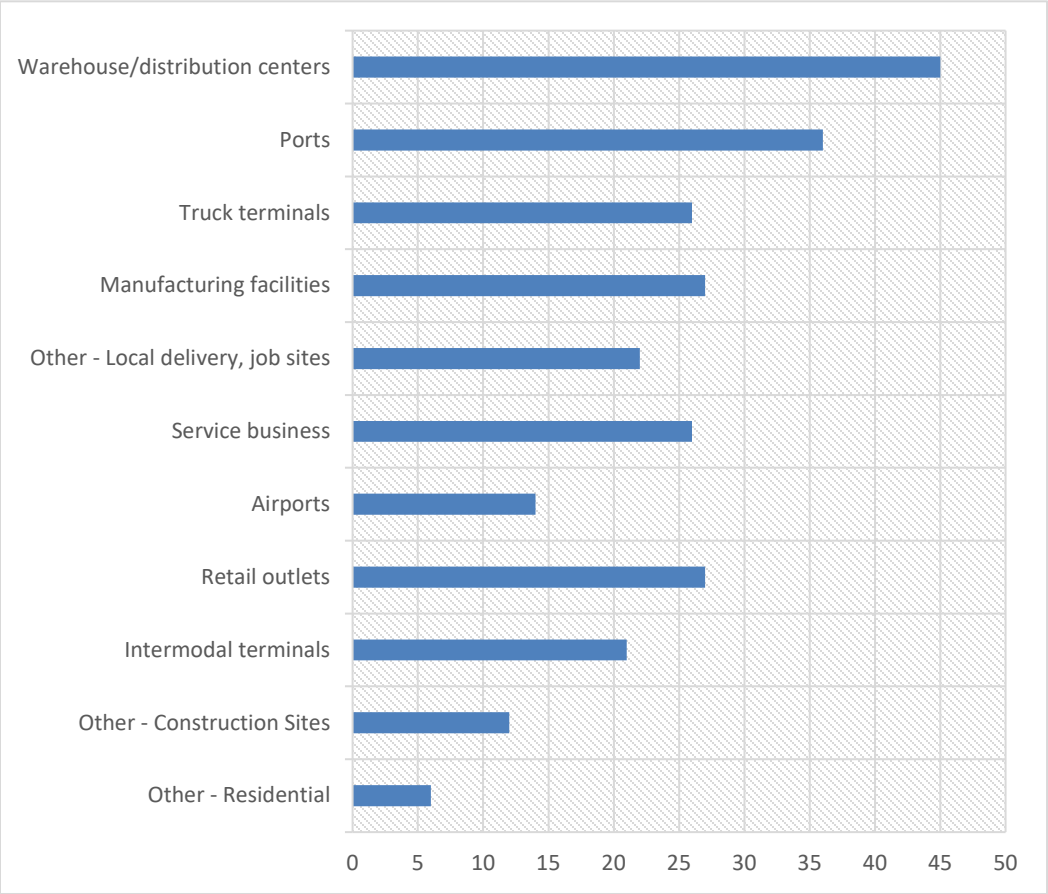

Figure 3. What are the most common types of destinations for these trucks?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

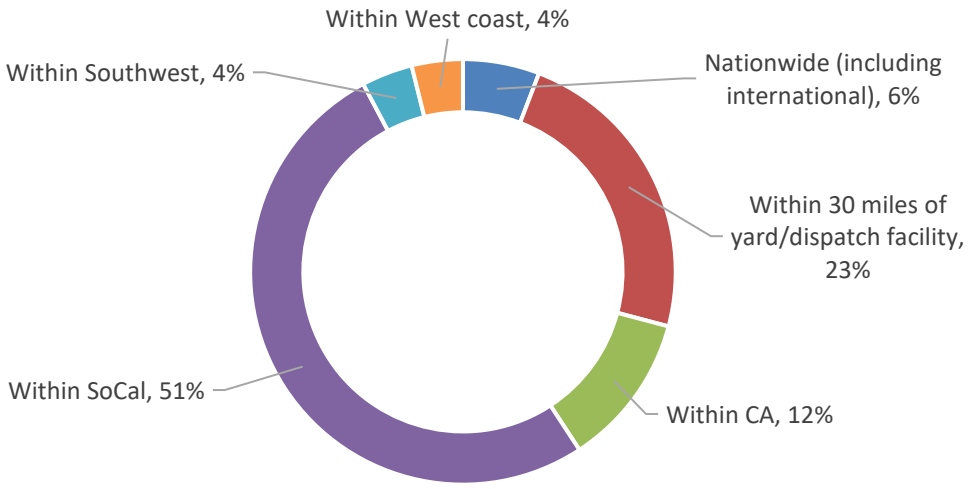

Figure 4. Which of the following best describes the primary travel area for these trucks?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

Figure 5 indicates that close to 60 percent of respondents average two to five stops per day, while nearly 20 percent make between 6 to 10 stops each day. Over half of respondents report an average daily mileage range between 50-99 miles or 100-199 miles (Figure 6).

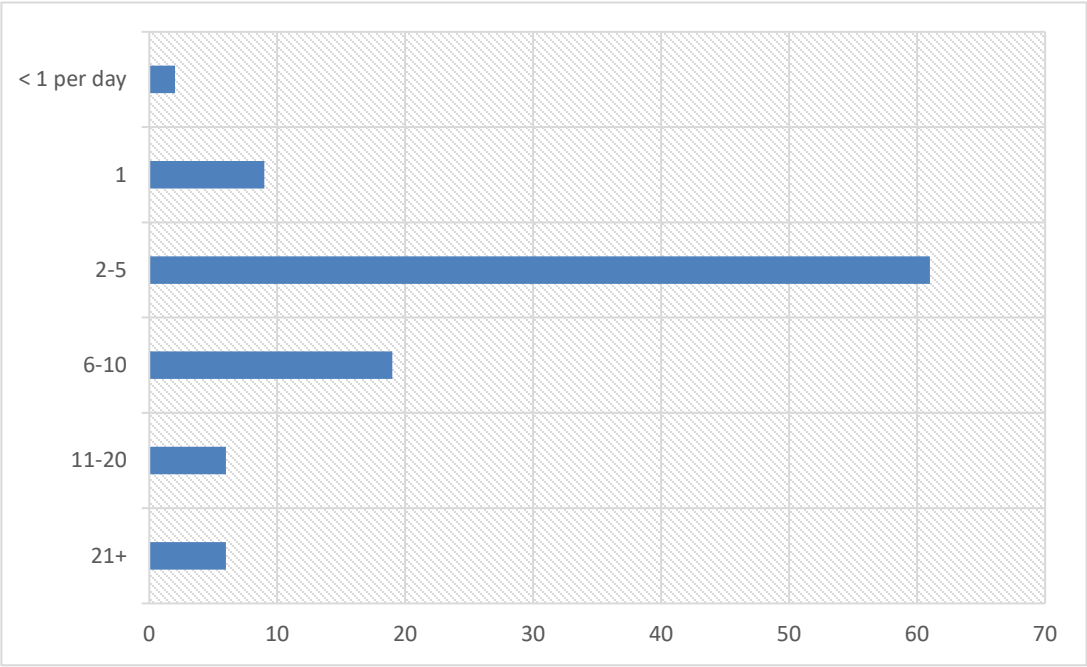

Figure 5. Which of the following best describes the average number of stops a truck makes per day?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

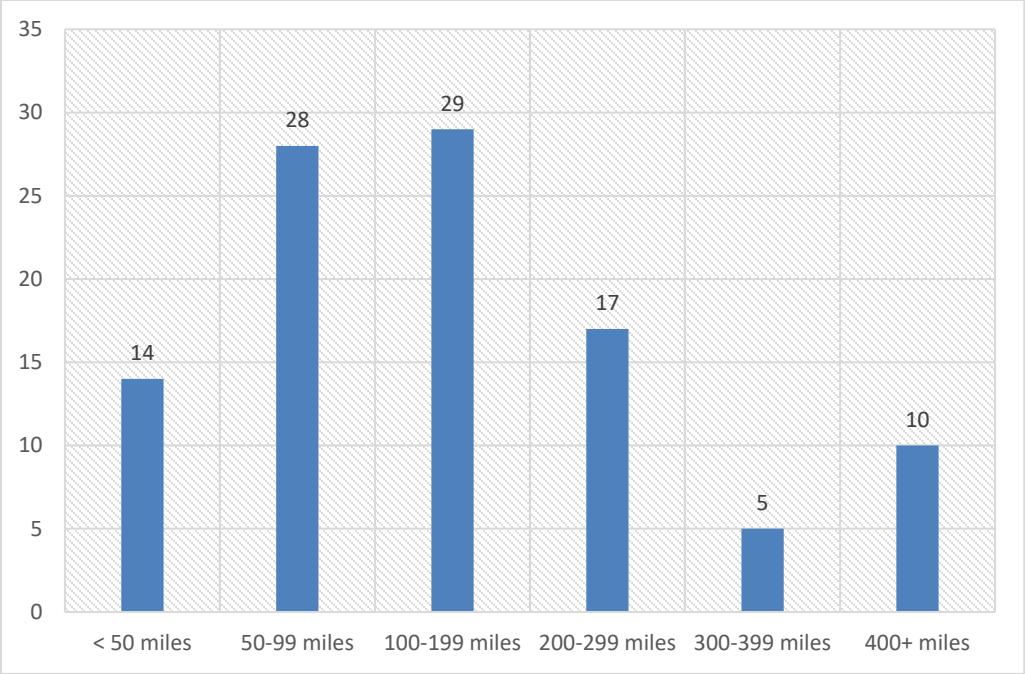

Figure 6. Which of the following best describes the average daily mileage for trucks in your fleet?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

One-third of respondents indicated they would replace their vehicles only at the end of economic life, while over 40 percent aim to begin their transition before 2030 (Figure 7). Approximately 20 percent of respondents stated they don't intend to make the switch, either due to impending retirement or plans to leave the state before the new laws are enforced.

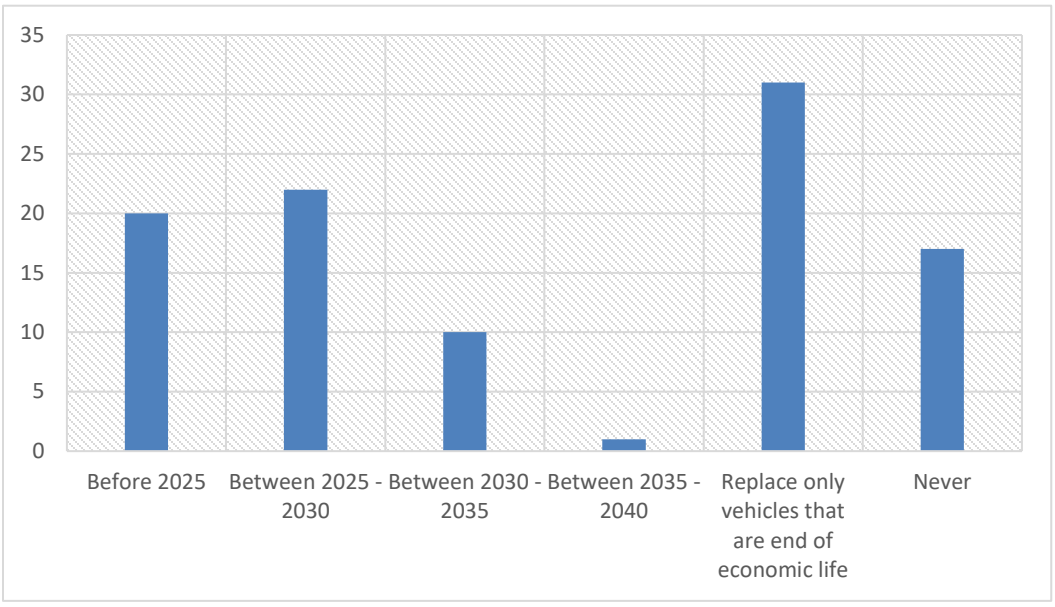

Figure 7. When are you likely to start transitioning your fleet to zero emission vehicles?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

Figure 8 shows the steps that some operators have taken to convert their fleet to ZET, while Figure 9 breaks down the results by fleet size. The majority of respondents said that they have not started planning for the transition to ZET. Some respondents have established a plan and budget, calculated the total cost of ownership, and set a target date for starting conversion, but only a few have begun implementing their plans.

When disaggregated by fleet size, the measures that organizations have taken to convert their fleet varied considerably. It is important to note that respondents can indicate that they have completed multiple measures listed. Of respondents who have not started planning for ZET, 58 percent had a fleet size under ten, while only three percent of respondents with fleet size over a hundred have not initiated any plans to convert their fleet. While the majority of fleets under 50 trucks have not started planning for transition; of those smaller fleets who have started planning, over 70 percent of respondents have established a plan, a budget, or calculated the total cost of ownership. Only those with fleet size of at least 20 trucks have contracted with a fleet electrification consultant, submitted a utility service request, applied for permits, started deployment, begun construction, and completed the project.

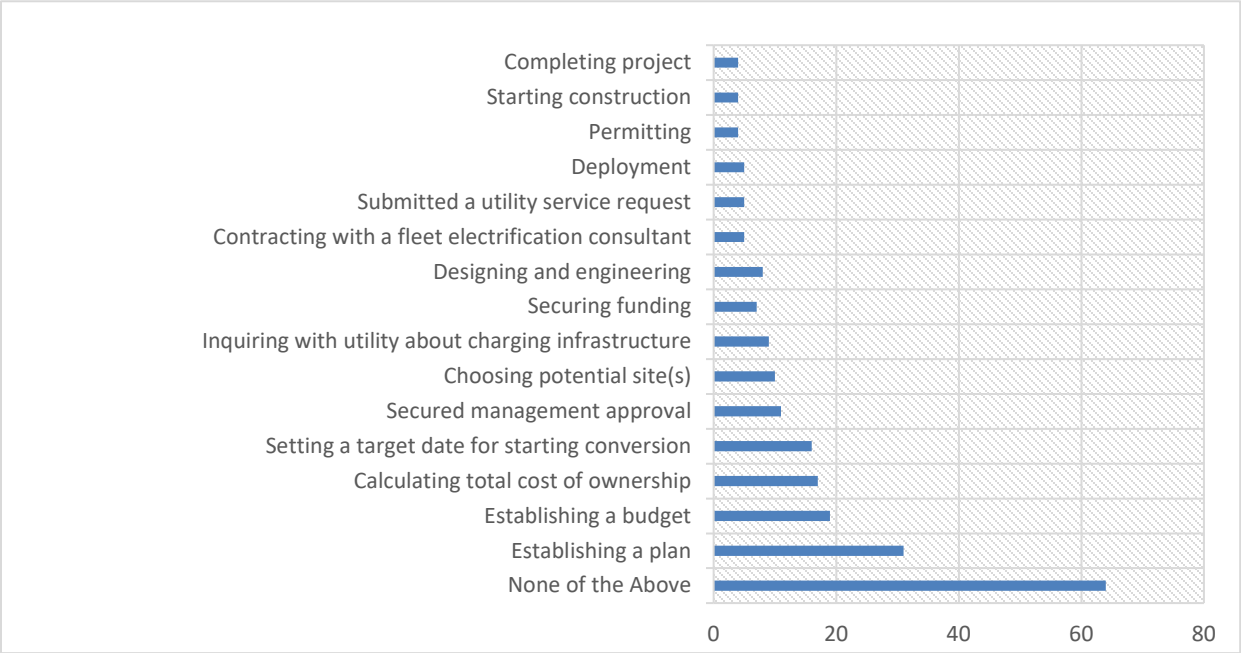

Figure 8. Which of the following, if any, has your organization done relative to converting your fleet to Zero Emission trucks?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

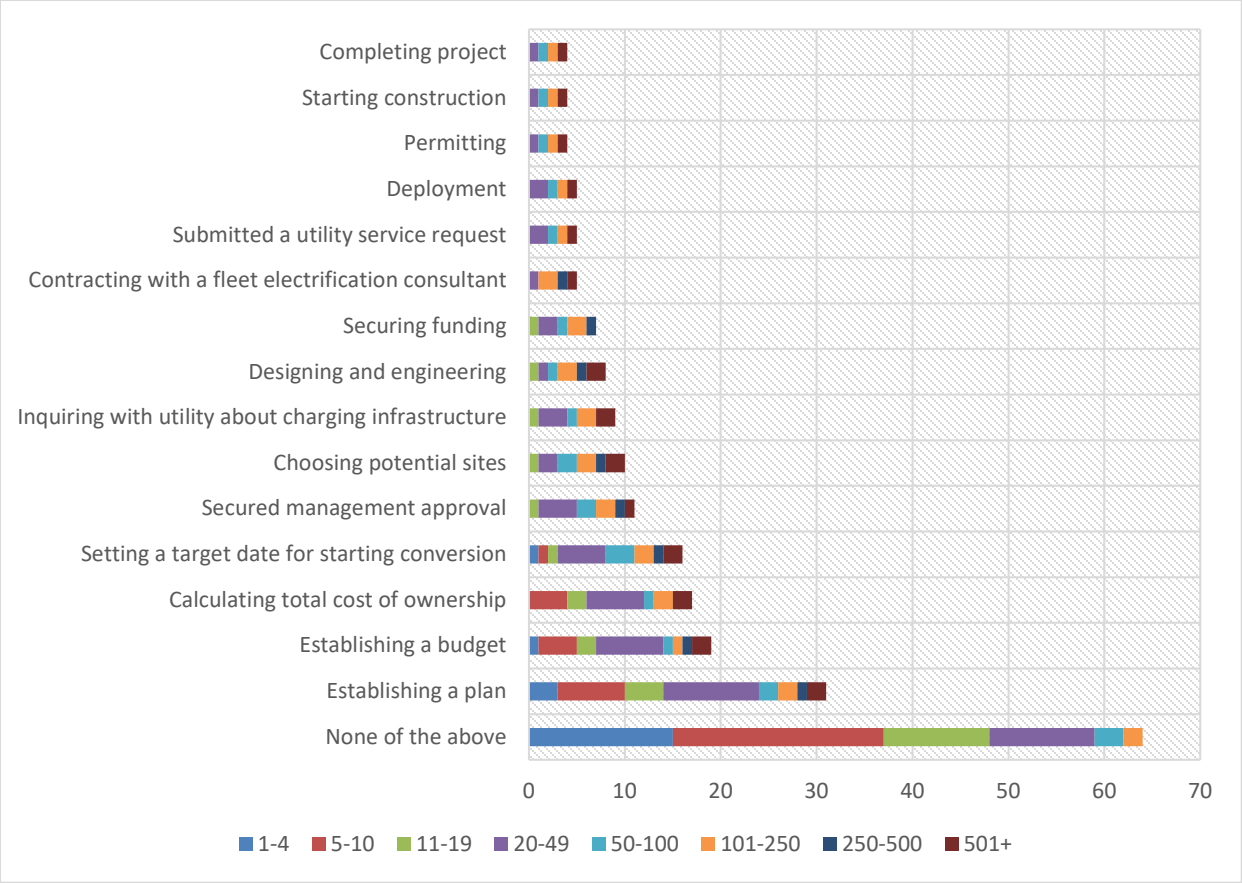

Figure 9. Organization efforts to convert the fleet to Zero Emission Trucks

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

While 40 percent of respondents have spoken to manufacturers about purchasing ZET, almost 80 percent of respondents have not initiated discussions with utility providers about electrification (Figure 10 and Figure 11). It is unclear if the lack of conversations with utility companies is due to limited contacts or understanding of who to work with at the utilities or if this has to do with the number of small fleets interviewed that will not be installing EV chargers at their site.

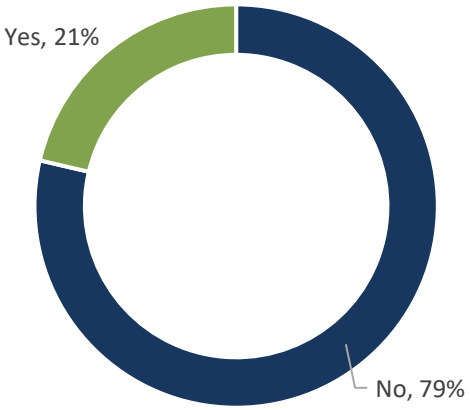

Figure 10. Have you had discussions with utilities about electrification?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

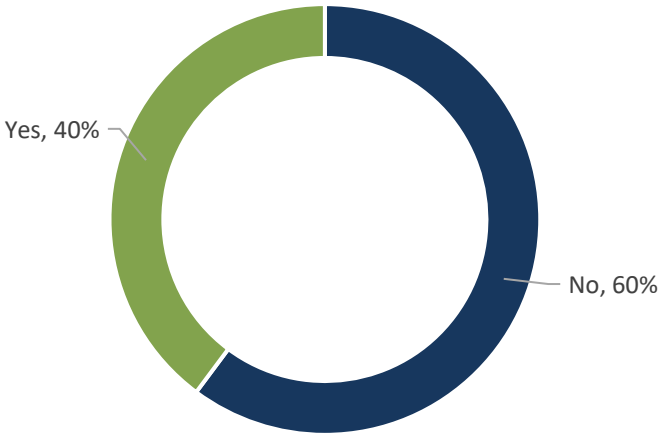

Figure 11. Have you had discussions with Zero Emission vehicle manufacturers to explore purchasing Zero Emission commercial vehicles?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

Figure 12 displays respondents' intentions regarding the development of charging infrastructure at their sites. 27 percent of respondents said they were very likely to develop electrical charging capabilities at their location. Respondent's opinions varied according to their fleet size. Over 70 percent of respondents with a fleet size under 10 indicated that they were uncertain while over 90 percent with a fleet size less than 50 said they were very unlikely to develop electrical charging capabilities on site. All respondents with a fleet size over one hundred were either somewhat likely or very likely to install electrical charging infrastructure on-site.

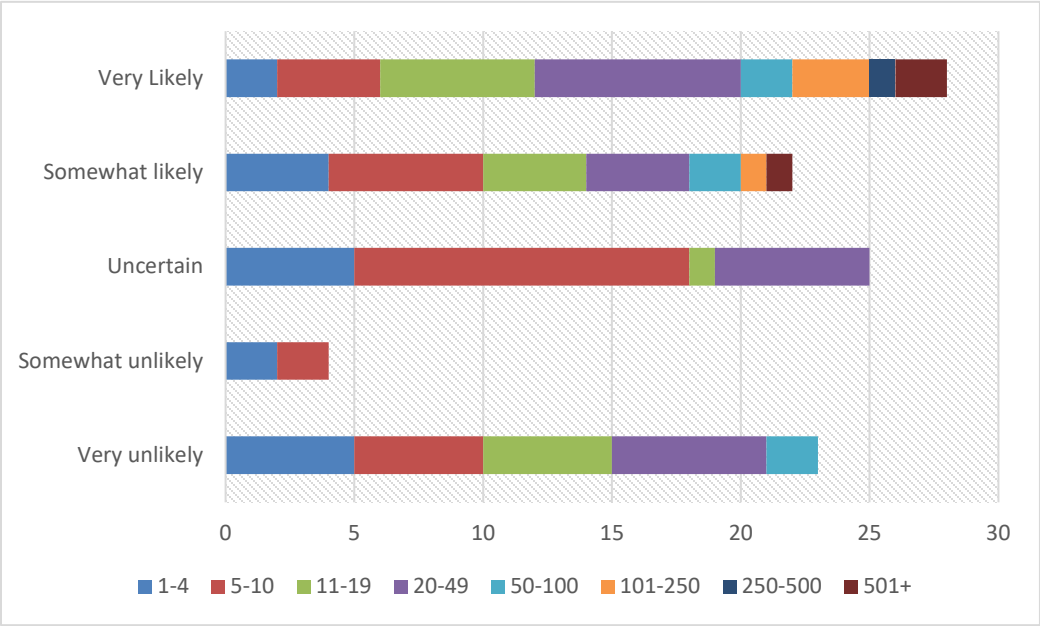

Figure 12. How likely is your organization to develop truck electrical charging infrastructure at your location?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

Respondents indicated several barriers to converting to zero emission trucks as shown in Figure 13 below. Range limitations and the vehicle purchase cost were the top barriers, followed by grid readiness and infrastructure cost. Only 8 percent of respondents identified maintenance concerns as a challenge to transitioning to ZET. When disaggregated by fleet size, around 60 percent of respondents with a fleet size under 20 have consistently identified cost, technology, and grid limitations as barriers to transitioning to ZET, compared to roughly ten percent of respondents with a fleet size of at least one hundred (Figure 14).

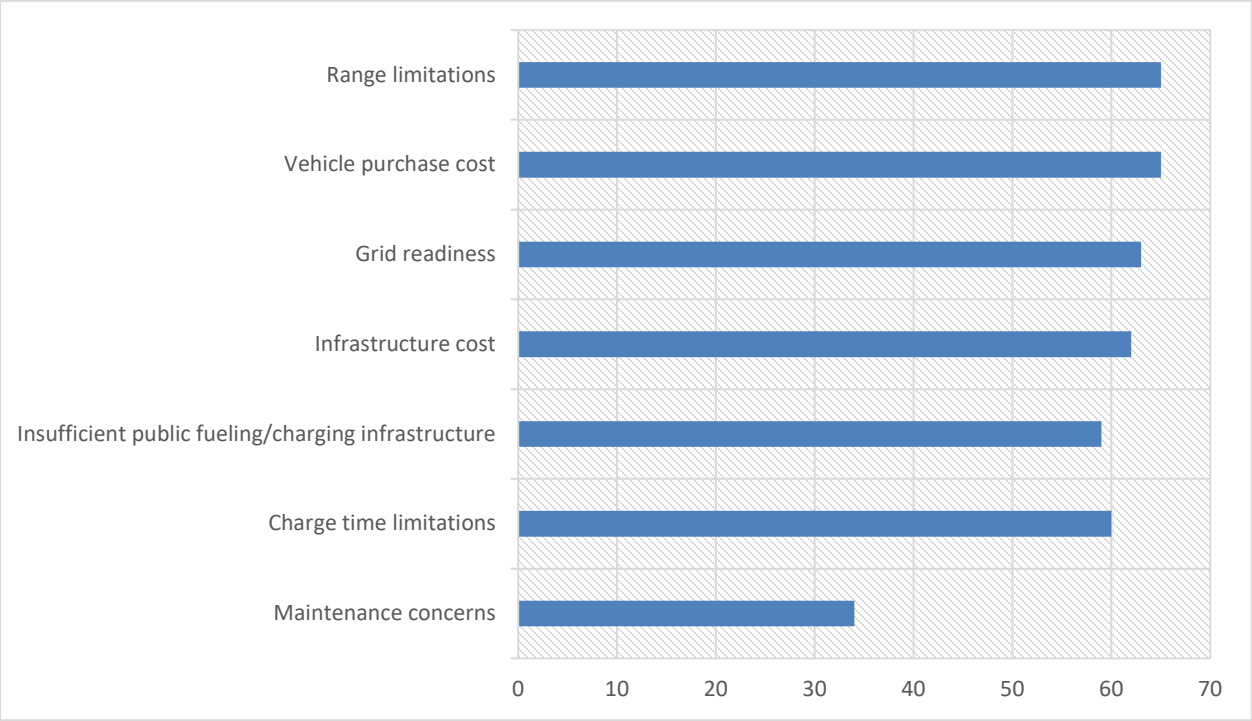

Figure 13. What are the barriers to converting to zero emission trucks?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

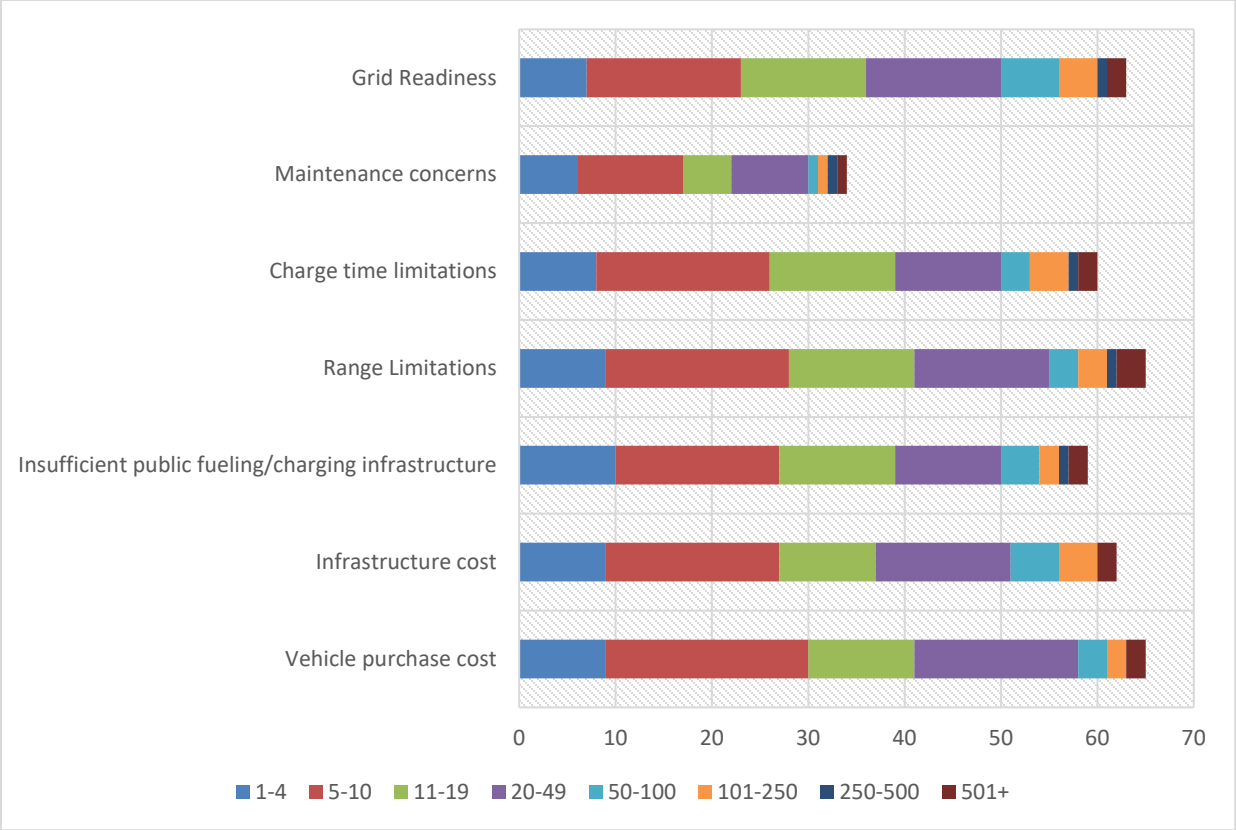

Figure 14. Barriers to converting to Zero Emission trucks

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

Figure 15 shows which zero-emission fuel technology organizations were most likely to pursue. 36 percent of respondents said they are considering electric trucks and around a third said they were still unsure.

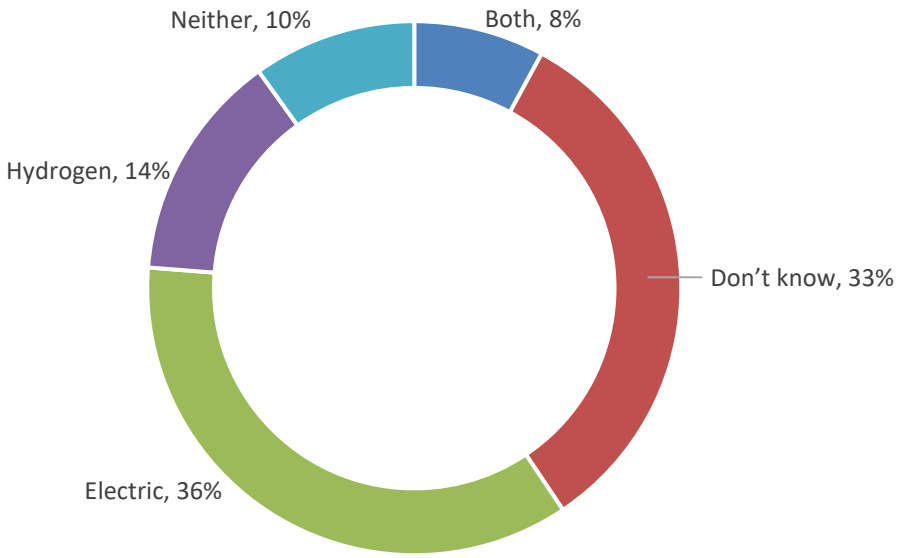

Figure 15. Which Zero Emission Fuel technology, electric or hydrogen, do you think you are more likely to pursue?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

Although the majority of respondents have heard of the state and federal incentives, over half of respondents were not familiar with the details (Figure 16 and Figure 17). Less than 15 percent of respondents said they have applied for government incentives, while almost 20 percent have not heard about them. This implies that more work needs to be done to educate consumers on incentives that are available to help them transition to zero-emission trucks.

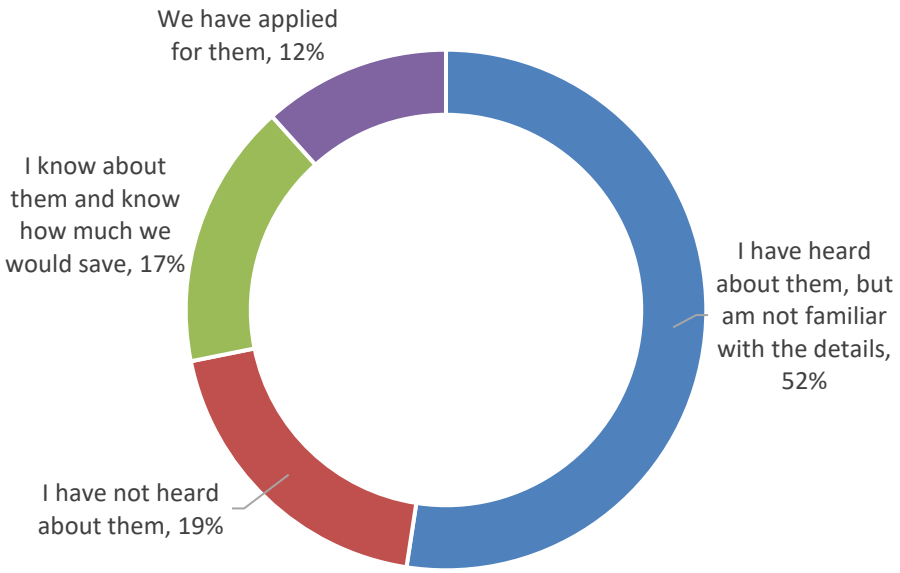

Figure 16. How would you rate your familiarity with California state incentives to support the purchase of Zero Emission commercial vehicles?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

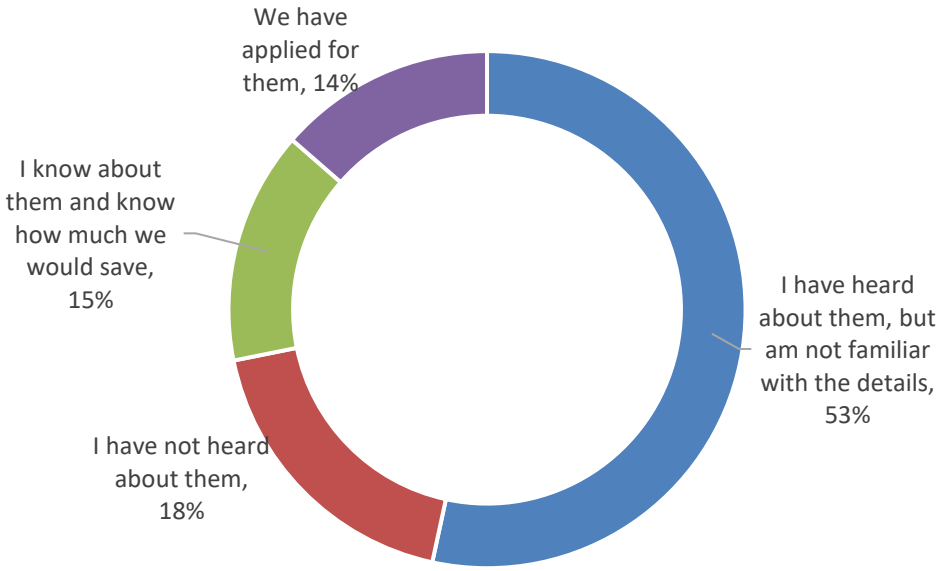

Figure 17. How would you rate your familiarity with Federal incentives to support the purchase of Zero Emission commercial vehicles?

Source: Results from 100+ Freight Industry Stakeholder Surveys, Cambridge Systematics.

3 FOCUS GROUPS

The focus groups were comprised of various perspectives including, but not limited to, academic research institutions, community-based organizations, regulatory agencies, transportation agencies, and utilities. Three focus group meetings were held on August 24, August 28, and August 31. The focus group meetings started with an overview of the project, followed by a review of the goals and objectives and the different phases of the study. The consultant team shared the outreach strategies for the study and described the role of the focus groups. The focus group discussions centered on three topic areas: public and private sector roles in electrification, location of EV truck charging sites, and the future of trucking. The focus group meetings were not recorded, and participants' comments were anonymized to ensure that they felt comfortable speaking freely. Key findings from these focus group meetings summarized by area are shown in Table 1.

Table 1. Key Findings from Focus Groups

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	• Grid capacity needs to be addressed, especially for peak hour usage.
Public vs Private Depots	• Public sites may need megawatt charging or a fast-charging system to fit charging needs so as to not disrupt operations and for the integration of the next generation of heavy-duty battery electric trucks with larger batteries and longer ranges. • For public charging, ensure that surrounding land uses can accommodate amenities for truck drivers. • Caltrans land may be a good starting point for public charging stations to support its development and 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.

Source: Results from Freight Industry Stakeholder Focus Groups, Cambridge Systematics.

The summary below provides additional information and context on the topics used to prompt discussion with the focus groups. All three focus groups were provided with the same topics to respond to.

Public and Private Sector Roles in Electrification

The participants across all three focus group discussions expressed both excitement and concern about the transition to a ZEV fleet. Several participants acknowledged the potential health benefits of reduced emissions, especially in disadvantaged communities. The shift to ZEVs would also help the region meet its federal air quality attainment goals. Despite these benefits, several participants shared the challenges they have experienced or are anticipating given the uncertainties about regulations, specifically Advanced Clean Fleets/Advanced Clean Trucks (ACF/ACT)[3] and the state's long-term plans for ZEV infrastructure.

Throughout the focus group meetings, participants identified advancing ZEV infrastructure as one of the biggest challenges facing the industry. The timing of installing ZEV infrastructure and delivering vehicles is mismatched, and several operators have experienced supply chain issues for EVCS equipment. Without additional investment in charging opportunities, operators are reluctant to purchase more ZEVs. However, without enough ZEVs on the road, operators will not see the need to create additional charging opportunities. One participant shared that a transit operator had to return their ZEVs because there were not enough charging opportunities. Participants were interested in whether the government's plans are scalable and if proper metrics are in place to ensure that the transition is economically viable for small and large operators. The industry would like to see agencies and regulators lay out a clear plan for meeting the infrastructure demand within the next few years.

The participants also shared their concern about the grid's capacity to support ZEV infrastructure while also meeting California's other "electric greening" initiatives. Utility providers are unable to rapidly increase power availability for entities that want to do on-site charging, especially during peak hours. A participant raised the need for the California Public Utilities Commission (CPUC) to collaborate with air districts that work closely with fleet owners and operators and the California Air Resources Board (CARB), to ensure that the inputs and assumptions used in their integrated energy report[4] consider the electrical needs from the mobile and stationary sectors. There was also concern over the shortage of skilled labor to install charging or grid infrastructure, as this type of workforce training can take several years.

Stakeholder Sentiments on the Shift to ZEVs

Educating both the logistics and local communities while creating clear requirements for siting charging stations and grid and transmission infrastructure is important. A decision tree documenting the criteria for siting these charging stations would be helpful to practitioners. In general, several communities, especially those near freight hubs, have expressed concerns

[3] (California Air Resources Board)

[4] (California Public Utilities Commission)

about the impacts of the ZEV fleet and infrastructure. There were questions about the impacts on local zoning, project labor agreements and the Biden Administration's Justice40 initiatives, maintenance responsibility for charging stations, and community involvement at the local job level.

> "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."
>
> *eTRUC focus group participant*

CARB is organizing regional outreach and education for fleets and single operators. The participants shared feedback they received during their community outreach activities. Through CARB's Assembly Bill 617 implementation, communities have relayed that they do not want trucks passing through their neighborhoods. Locating infrastructure in their communities will make them a magnet for truck traffic. Sensitivity is required so that siting will not change truck routes or increase traffic on truck routes through communities.

The Los Angeles Clean Tech Incubator (LACI) has helped lead an initiative to involve community members in conversations about charging station siting. 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, which could involve considering additional alternative locations during the charging site planning process**.**

Role of Government Agencies

Government support in the transition towards zero-emission trucks is crucial and must be equitable for both fleets and owner-operators. The California Air Resources Board (CARB) provides grant funding to help truck owners purchase ZEVs. The Port of Long Beach (POLB), through its Technology Advancement Program (TAP),[5] also provides incentives for fleet turnover. Since space within the Ports is limited, the majority of ZEV infrastructure needs to be located outside the port. POLB is looking at private partners to spearhead additional technological advancements, as they can only directly incentivize trucking companies. Participants noted that while more grants would be helpful in the transition to ZEVs, local cities and owner-operators have limited capacity to apply for these grants.

The government's role in streamlining permitting processes is also crucial. Since agencies have ownership of substantial right-of-way (ROW) and public streets, leveraging this could be a deciding factor in the speed of implementation. Agencies like Caltrans are exploring how their ROW can be used to support ZEV charging infrastructure. In addition, the federal and state

[5] (San Pedro Bay Ports 2023)

legislatures could support operators by streamlining project approvals and reducing delays by amending the CEQA and National Environmental Policy Act (NEPA).

A participant cautioned that diesel trucks will be similarly unsupported, recalling that when CARB outlawed model year 2010 or older trucks, there was not enough advance communication to vehicle owners on the upcoming change. This resulted in confusion among vehicle owners when they could not renew their registration. Broad education and targeted incentives need to be made available to help businesses, especially small businesses, transition to ZEVs.

Role of Utility Providers

The staff draft report for AB 2127 Electric Vehicle Charging Infrastructure Assessment[6] finds that 400 to 500 high power charging stations for trucks must be introduced per week until 2030 to support 155,000 medium- and heavy-duty plug-in electric vehicles.[7] However, participants raised several issues that could affect the adoption of ZEVs. Several participants noted that the timelines of utility providers and trucking companies are not well-aligned. Some participants pointed out that utilities work on a 12-to-36-month timeline to bring infrastructure on site, as opposed to the six to nine months to purchase ZEV trucks. To bridge the period between the ZEV truck purchase and the installation of charging infrastructure, utility providers should have a clear, public ten-year plan for grid upgrades so operators know when to purchase new vehicles. A participant indicated that while the California Public Utilities Commission (CPUC) plays a big role, their process is quite long, especially given that not all operators have fleets. This participant suggests looking at a corridor model for the siting infrastructure for independent operators who don't have a fleet and would be better served by public charging stations.

> "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."
>
> *eTRUC focus group participant*

Other participants noted that portable charging solutions are not ready for the market. Warehouses have to comply with new rules on installing chargers. There is more power availability for charging infrastructure in urban industrial areas and less in rural areas, partially due to a nationwide shortage of transformers affecting implementation timelines. It was noted that utilities need to focus more on renewable power sources, not just EV infrastructure.

Focus Group participants emphasized that while utility providers are doing what they can to get projects off the ground, they need to bridge technologies and portable temporary solutions to

[6] (California Energy Commission 2018)

[7] (Adam Davis 2023)

scale up quickly and meet demand. Although the government has offered incentives, utility providers shared that they cannot install new substations without knowing if they can recoup the costs through the CPUC's ratemaking proceedings. The government should partner with utility providers to move projects forward effectively and efficiently, streamline permitting, and to support infrastructure for the transition to ZEVs. Technology and software are critical to help the private sector switch over to ZEVs, as operators don't know if electric trucks can complete their current routes with ZEV ranges, causing them to delay their switch to ZEVs. If the CPUC and industry implemented software standardization for system integrations statewide, costs would be reduced, and ZEV utilization will increase.

Location of EV Truck Charging Sites

In identifying locations for EV charging infrastructure, it is important to consider the use case and determine what customers are looking for. Hearing from each community is important, as their needs and interests are not homogeneous. Drivers also need to be included in these dialogues. Some participants suggested looking at the data on truck activity.

Focus group participants –transportation agencies and CBOs in particular– highlighted that there are several planning considerations for installing EV charging stations. Independent truck owners typically park their trucks by their residence overnight, with another participant noting that many Class A trucks are registered at residential addresses. Operators who charge their trucks overnight should have access to safe parking spots available for long periods of time. Since smaller operators need to complete two pick-ups a day to maximize their investments in ZEVs, there is a need for fast charging solutions midday. Truck depot design should account for different needs including midday charges where access to amenities and trailer space is important, and overnight charges, where parking and transit connections are more critical considerations.

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. EV charging sites should be consistent with local land use plans and cognizant of nonconforming uses. Charging stations should not be located near residential neighborhoods or schools. Since many communities don't want heavy-duty vehicles in their neighborhoods, it is important to minimize the impacts of trucks driving through and parking in these neighborhoods.

> "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 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 occur."
>
> *eTRUC focus group participant*

Several participants suggested that EV charging stations should be located near manufacturing or logistics centers. One participant reiterated that industrial areas already have plenty of power and can service a lot of vehicles. Bringing charging stations to areas where trucks already park would reduce the need to redevelop lots. Another participant said that it would be useful to co-locate charging locations at gas stations. Capacity requirements, including both power capacity and trucks per acre to be served, scalability for storage and generation, and wireless charging should also be examined when evaluating potential locations.

Safety should be accounted for so truckers can park in areas that are well-lit with few conflict points and decent visibility. Truckers should have efficient access to highways and major arterials, as well as national, state, and local truck routes. A participant advised siting public charging stations along the State's top 6 freight corridors, as indicated in the SB 671 draft assessment.[8]

Participants pointed to several resources that have examined or can help determine potential locations of charging sites. San Diego Association of Governments' (SANDAG) Regional Medium-Duty and Heavy-Duty ZEV blueprint[9] considers site selection evaluation criteria such as utilization (volume of trucks, proximity to major routes, origin destination pairs, dwell times, freight capacity), land use (cost of land and zoning), equity (community concerns), infrastructure size (the potential for parking lot expansion), and environmental criteria. California State Transportation Agency (CALSTA) allocated funding for electrification projects and outlined state standards in the grant requirements. A POLB study identified five (5) existing lots that could potentially service truck charging and fueling infrastructure. Southern California Edison (SCE) and the Department of Water and Power (DPW) have maps of grid capacity which can be used to co-locate charging infrastructure, while Daimler has data on vehicle telematics.

Future of Trucking

Participants noted that there were two potential disruptors to the industry: telematics and autonomous vehicle technology. The advent of telematics connects the trucks with the greater vehicle-to-infrastructure (V2I) system and can produce useful data including recharging times, battery status, and driving patterns. Autonomous vehicle technology, which can be applied to trucking, has the potential to improve safety and support growth in the industry. A participant mentioned a company seeking grant money to move the containers away from the port for the last mile, which can reduce dwell times and idling. Citing the Hyperloop as an example, another participant cautioned that the world changes quickly and it is difficult to predict which technologies will be sustained for the long term in the transportation industry.

[8] (California Transportation Commission 2021)

[9] (San Diego Association of Governments 2023)

4 INTERVIEWS

As part of the engagement process for the Industry Outreach Memo, the consultant team conducted eleven (11) one-on-one interviews to gain additional perspective and understanding of the important barriers and challenges for zero-emission heavy-duty trucks. The interviews took place over two months starting in August and ending in September. In contrast to the focus groups, which brought together multiple industries to discuss a topic area from various perspectives, the interviews allowed one stakeholder to explain the key challenges their company is facing. These individuals brought a different perspective to the study, these were not the same fleets/fleet managers that took part in the survey but provided private industry perspective on what barriers are specifically challenging to them and others in the trucking industry as the industry transitions to ZETs. The team interviewed private sector industry stakeholders and agencies who are either involved in the design and/or implementation of ZET and/or charging infrastructure. These include industry representatives from trucking associations, OEMs, new-service providers (truck-as-a-service), and regional/national developers.

The interviews resulted in generating key themes, which largely paralleled those from the focus groups and reinforced the most prevalent issues and challenges for the transition to ZEV. In addition to the key themes, the interviewees provided information on specific topics that were important to understand fleet needs and the biggest challenges to the transition to ZEV. Below is a summary of each of those themes, followed by additional details about each topic.

Need for Public Charging

There is a need for a very large number of public, non-subscription charging sites suitable for in-service use by heavy-duty trucks, notably tractor-trailer combinations. Public charging sites must be available near clusters of truck origins and destinations, as well as along major short- and long-haul truck routes. Depot charging can meet only part of the requirement and is not likely to be feasible for small fleets or owner-operators. Freight origin and destination points such as marine terminals, rail terminals, distribution centers, or manufacturers cannot be expected to provide charging for visiting trucks.

Insufficient Utility Infrastructure

The major limiting factor in the development of charging infrastructure appears to be the ability of utilities to supply appropriate sites. Based on information received to date, there appears to be major shortfalls in total grid capacity, local substation capacity, and 480/1000v transmission lines to support Level 3 chargers. There is also reportedly a large backlog of SCE commitments to serve existing and planned developments in the broader Southern California region, which could take priority over truck charging sites.

Financial Burden

The cost of heavy-duty ZETs, notably replacements for conventional diesel tractors, is proving to be much higher than originally estimated by CARB or other agencies, and is a barrier to meeting CARB timelines, especially for drayage tractors. The cost of chargers, including local infrastructure and electrical service, is also extremely high and will limit the ability of motor carriers and other fleet operators to install and use depot charging. Grants and other sources are helpful but are not expected to meet the escalating need. The ability of the trucking industry to acquire ZETs and chargers on a timely or predictable basis is questionable.

Technical and Operational Uncertainty

Every aspect of ZET operation and charging is highly uncertain at this point. There is very limited experience with battery size and weight, range, charging rates, cost, etc., particularly for heavy-duty applications. There is thus no reliable basis to estimate the number of chargers needed, the charging times required, or the time and distance intervals between charging.

Table 2. Key Findings from Interviews

Theme Area	Key Finding
Funding	• Continued grant funding is needed for companies to make the transition to ZET. Small businesses face high costs for purchasing trucks and larger fleets and need assistance with funding of EV charging infrastructure. • Important to develop a path forward to funding the utility upgrades needed for the electrical grid.
Electric Grid Capacity	• 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. • 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 owners 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.

Table 2 (continued): Key Findings from Interviews

Theme Area	Key Finding
Timelines	• Incongruent timelines in installing infrastructure and purchasing ZEVs. The 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/Environmental Process 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 of the charging stations need to be located by the Ports, warehousing districts, and adjacent to highways, considering their impacts on communities, especially those already identified as communities of concern, needs to be part of the decision-making process.

Source: Results from Freight Industry Stakeholder Interviews, Cambridge Systematics.

Additional Details for Each Theme

Need for Public Charging

In all the interviews conducted, industry stakeholders mentioned a significant need for increased public charging in order to accommodate the increasing number of electric trucks. Many small fleets and owner-operators do not have operating bases, and many other fleets lease their property rather than owning it. These factors make it difficult to install charging infrastructure, especially when increased competing energy needs are considered.

Few existing motor carrier facilities (the industry nomenclature is “terminals” or “yards”) have on-site fueling. On-site fueling is typically available only at the very largest facilities, at those (such as marine terminals) whose vehicles operate only on-site, and at construction firms or other operators of off-road fleets. Commercial medium and heavy-duty trucks in local or regional use are fueled almost exclusively at “cardlock” fueling stations or consumer filling stations that can accommodate trucks.

There are multiple barriers to on-site or “depot” charging:

- *Charger cost:* A conventional filling station gas pump costs around $22,000 while Level 3 chargers range from $40,000 to $175,000. Installing 480v service can cost over $80,000. A gas pump can fuel an empty heavy-duty truck in around 5-15 minutes while even fast Level 3 chargers will take multiple hours.

- *Space*: Many motor carrier facilities are small, with most tractors parked elsewhere (frequently at drivers' homes).
- *Charging supervision:* Overnight charging would require someone to move tractors between chargers and parking spaces every few hours during the night.
- *Operating hours:* Many motor carriers have nighttime or multi-shift operations, narrowing the useable windows for depot charging.
- *Local electric infrastructure:* Very few locations have the 480v-1000v local feeder lines needed for Level 3 chargers.

For small fleets and owner-operators without an operating base, easy public charging is a necessity for operating EV fleets. At present, drayage operators without home base charging have very few options. Currently, the Port of Long Beach has a Clean Truck Center which allows free public charging, but it only includes two chargers, and there have been reliability issues with these chargers (one of them was down at the time of the stakeholder interviews, for example). There are very few other public charging options in the Port area (one in Wilmington was cited as one of the only other options), although the Port intends to require charging on new parcels. Some larger operators (4 Gen Logistics, for example) have their own chargers, but cannot be expected to make charging available to other operators.

With increasing public charging, land use is a major issue, as electric trucks can take a very long time to charge. During this time, the trucks are stationary for at least 30 minutes and possibly more than an hour, significantly increasing the amount of space taken up compared to the 5-15 minutes required for diesel refueling. This presents a major issue to the Port and to landowners in the Port area. Many stakeholders mentioned the importance of considering hydrogen as a zero-emission option in addition to electric batteries, as the infrastructure footprint and refueling time more closely resembles that of diesel. This strategy could help to reduce the overall increase in land use requirements for operating ZEV fleets.

> "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."
>
> *eTRUC focus group participant*

Public charging at drayage destinations for drayage and other local/regional trucking is also an issue that needs to be addressed. Stakeholders mentioned that many commonly seen range estimates for battery electric trucks are extremely optimistic. Operators rarely get this amount of range, especially if the truck has only a partial charge due to very long charging times. Stakeholders mentioned that waiting 60-90 minutes for a single charge is not realistic for most operators due to the loss of productivity, especially if this is on top of wait times at rail terminals or other transfer points. As such, there must also be sufficient public charging near inland origins and destinations. Currently, this charging infrastructure is basically non-existent. It is difficult for ports to do anything to create this infrastructure, as spending restrictions and legal issues can prohibit any Port spending outside of the immediate Port area. This contributes

significantly to issues with operating electric fleets, especially in Southern California compared to other areas where Ports have more influence over destination infrastructure.

Public charging must be configured for "through" charging (as is the case for current filling stations). It is impractical to separate tractors from trailers or chassis for charging.

> "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."
>
> *eTRUC focus group participant*

Interviewees mentioned the need for non-subscription public charging so anyone can use the sites, akin to existing fueling infrastructure. Truck-as-service arrangements and other developing options are not suitable for all operators.

Private facilities such as marine terminals, rail terminals, air cargo terminals, manufacturers, parcel sorting hubs, or distribution centers cannot be expected to offer charging for visiting trucks. Cost, space, and liability are all barriers. Moreover, the norm for semi-truck pickups and deliveries is "drop and pick" in which the driver spots the inbound unit and leaves with an outbound unit rather than waiting for freight handling. These operations would not allow time for charging.

Some business/logistics park developers have explored the feasibility of providing charging at a common location for tenants and visiting trucks. They have encountered institutional, cost, legal, and regulatory barriers. As noted below, interviewees stated that SCE cannot fulfill all its existing commitments for electrical supply to new facilities and questioned the near-term feasibility of an adequate Southern California charging network. Both developers and motor carrier organizations agreed that investing in costly Level 3 chargers and electrical service to leased facilities is unlikely to be viable due to uncertainty about long-term use. Some interviewees mentioned that providing commercial public charging is currently not viable.

Much of what the industry stakeholders mentioned corroborated and added to what was found in the literature review. Sources in the literature review mentioned an overall lack of public charging, with some trucking industry organizations and representatives describing public charging infrastructure as essentially non-existent. Problems with range issues and charging times were also mentioned in much of the literature found. Most operators cannot take 60-90 minutes to charge a truck, especially if this only results in 150 miles or less of range. Though range issues and problems with the reliability of range figures from manufacturers were mentioned in the literature, the industry stakeholders expanded significantly upon this, suggesting that many published range figures were not reliable at all in practice. Most stakeholders also mentioned the importance of alternative fuels as the infrastructure and refueling times are similar to diesel). This was touched upon in literature but was often not given as much attention as battery electric was the focus in much of this literature, so this may be an important point for the project team to consider going forward.

Insufficient Utility Infrastructure

Another major issue brought up by the industry stakeholders is the perceived inability of local Southern California utility companies, specifically SCE and the Los Angeles Department of Water and Power (LADWP), to provide sufficient power for charging. Solar panels for an operator base that allow for solar powered charging have also been difficult to construct and implement.

> "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."
>
> *eTRUC focus group participant*

One stakeholder estimated that, for one-to-one diesel to electric truck replacement by 2025, over 100 megawatts of additional power capacity would be needed in the area and stated that "…this is essentially impossible." In fact, most stakeholders mentioned that they are already having significant issues with getting enough power capacity simply for small numbers of additional chargers, and that wait times for the additional capacity often make it impossible to comply with the 2025 drayage regulations. SCE, for example, has reportedly estimated 4-6 year wait times for additional capacity, which means it will be well after 2025 before a significant number of new chargers can be installed. One stakeholder stated current estimates suggest new capacity requested now will not be available until 2030. The interviews show there is mixed feedback on the success and flexibility of some utility providers like LADWP; some stakeholders have found them flexible and good to work with while others stated they had long wait times for LADWP capacity, significantly restricting the ability of all involved to add charging capacity for ZET trucks. Reasons for this vary, but stakeholders mentioned that utilities often do not have significant excess capacity due to regulators not wanting them to overspend, and that approval time for grid enhancement is a major issue. Costs for this additional capacity can also be prohibitive for many operators, as connect fees for significant 480v charging can run into hundreds of thousands of dollars.

Though rooftop solar power could potentially reduce some of the need for power from these independent utilities, it has also proven difficult to increase solar capacity. Limited rooftop space creates a problem for overall capacity. While distribution centers are larger buildings, motor carrier terminals are not. Most operating bases are also leased instead of owned, which means operators themselves cannot simply install solar capacity (assuming they could afford it to begin with). In addition, many property owners are reluctant to add solar capacity, as they often do not know how long their current tenants will be leasing. Tenants' power capacity needs can also vary significantly, and if tenants change, this could present a problem for property owners, as it would likely be prohibitively difficult and expensive for them to adjust solar capacity to each tenant's needs.

Interviewees cited a scale issue: it may be relatively easy to install a few chargers for a demonstration, but installing and powering the hundreds and even thousands of chargers required is an entirely different matter.

This issue, which especially affects Southern California and the SCAG region, was not as well-covered in available literature. Many regulatory agencies and a significant amount of the published literature seems to have largely neglected this issue, though charger costs are covered more in the literature.

> "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."
>
> *eTRUC focus group participant*

These observations imply that significant near-term charging capacity can only be located where electrical grid and distribution capacity are already available or easily added.

Interviewees also discussed that some of the reasons for lack of infrastructure has to do with issues with CEQA and permitting. The process is long and while legislation is moving forward, the issues with CEQA, CPUC, and local permitting is delaying and potentially derailing the installation of depot charging and can be an issue for subscription-based charging depots. Interviewees did express hope that streamlined regulations and public charging depots that partner with local government may help the issue.

Financial Burden

Although significant literature in the review mentioned significantly higher up-front costs for electric versus diesel trucks, stakeholders mostly reported that these up-front costs are even higher than many of these estimates, or at least reflect the highest cost estimates rather than the more conservative.

It has not been possible to obtain accurate cost estimates on the total price of ZETs from the literature. Although some estimates from manufacturers and other literature sources put the costs at under $200,000, stakeholders largely stated that these numbers are significantly lower than the true cost and are not accurate. One stakeholder stated that the up-front cost is a minimum of $350,000-$400,000, is likely to be close to $500,000, and that grants only help minimally offset the high costs. This is consistent with higher estimates of the cost of ZETs found in the literature review. Some literature suggested that the Port of Oakland had paid around this amount per-truck when purchased as part of a significant ZET order. Literature that analyzes actual numbers paid for these trucks and stakeholders seem to agree that this is closer to an accurate number, suggesting that manufacturer estimates (especially those from Tesla) are widely inaccurate. Although grants could lower costs somewhat, many estimates of the cost with grants still come to at least $250,000, putting the cost of a ZET significantly higher than a diesel truck, especially if bought used (used trucks can cost as little as $50,000-$75,000). Since ZETs are not yet widely available on the used market (and likely will not be for some time), this increased cost could be prohibitive for many operators. These estimates do not include the cost of adding chargers, which can also be significant.

The capital, installation, and maintenance costs of Level 3 chargers are high, and as noted above, small fleets and owner-operators with a single truck will probably not be able to justify, afford, or finance them.

> "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."
>
> *eTRUC focus group participant*

Accessing grants for additional chargers (and trucks) can be more difficult than many regulators assume due partly to utility delays, adding to the financial burden. One stakeholder mentioned that many Environmental Protection Agency (EPA) grants, for example, have a completely unrealistic timeline of mid-2027 for utility deadlines. This means that if any additional utility infrastructure is needed, it is impossible to even apply for the grants as the requirements simply cannot be met due to existing utility delays. In many cases, grant funding for certain projects also becomes inaccessible if it becomes a legal requirement to complete the project. As such, CARB regulations regularly cite funding programs that many stakeholders stated CARB is aware cannot be accessed. Stakeholders and literature from the trucking industry both strongly suggest that CARB has knowingly passed unrealistic regulations and used incorrect numbers, placing it in opposition to the industry and creating hostility towards new regulations.

Interviewees linked the cost burden to competitiveness. The motor carrier industry is highly competitive, and shippers are very sensitive to costs. Even with grants, a motor carrier with the higher capital cost burden of electric trucks, and perhaps chargers, will have a higher cost structure than a motor carrier operating conventional trucks. Most comparisons of the total cost of ownership (TCO) indicate that ZETs are more economical in the long run, but that several years are required to recover the higher capital costs. The capital costs are a barrier to ZET purchase, but an even greater barrier to charger purchase and installation. Based on comments from interviewees, ZET operators may be at a competitive disadvantage in the near term. Small operators may lose flexibility in operations as they adapt some of their operations to adjust for ZET ranges and potential limited access to charging facilities. Larger fleets may take portions of that market share, or some cargo could shift to other markets where costs are lower for operators.

Interviewees provided ideas for potential funding to help small businesses purchase trucks and help develop publicly 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 ZET trucks. They mentioned that other programs are out there, and it would be good to continue the use of them but try to keep the programs consistent, so they are well known to the industry.

Technical and Operational Uncertainty

- In addition to uncertainty over costs, none of the major technical or operational factors involved in conversion from diesel to electric or hydrogen are as of yet known with any precision.
- *Battery capacity:* There is no standard for ZET battery capacity, and different manufacturers are pursuing different paths. Existing studies and models make different assumptions, leading to uncertainty about which technology is a good fit for different fleet types or market segments.
- *Range:* Neither battery size or electrical power consumption per mile or hour are known with any confidence. Interviewees and the literature both report wide-ranging estimates and experiences; in most cases, in-use ranges turn out to be shorter than claimed ranges from OEMs or studies. Models and studies also use different estimates and assumptions.
- *Charging rates:* Estimated and claimed Level 3 charging rates vary. Moreover, existing chargers taper off the charging rate as the battery nears capacity, extending the charging time for a full battery and maximum driving range.
- *Charging locations and availability*: Several contacts suggested that this study should have been done five years ago, as the lack of chargers and the uncertainty regarding their availability is the largest hurdle to electric vehicle deployment.

Many stakeholders also mentioned significant reliability issues with charging infrastructure, often with little to no response or assistance from manufacturers. This is an issue largely neglected in literature, which rarely mentioned practical reliability issues with the technology. Many estimates of necessary infrastructure and many resources about it seem to assume that it will all be reliable and always functional, whereas stakeholders have stated that this is often not the case in real-world use of the technology.

> "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."
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> *eTRUC focus group participant*

Stakeholders have mentioned regular reliability issues with existing public chargers at the Port of Long Beach. At times, significant numbers of chargers are inoperable, suggesting there still needs to be significant review of the use and success of their installation. Early installation or early technology can have maintenance challenges and may need to be upgraded over time as new and improved technology is available.

Reliability of infrastructure for ZETs in general remains a major concern for stakeholders across manufacturers, existing public chargers already have significant reliability issues,[10] and other manufacturers are still in very early stages of development and may have issues as well. And statistics from manufacturers regarding range, charging times, reliability, and other issues often differ from experience for existing ZET, many stakeholders significantly question the overall reliability of almost every aspect of this technology.

[10] (National Renewable Energy Laboratory 2023)

5 TAKEAWAYS AND IMPLICATIONS FOR ETRUC

The stakeholder engagement provided important information that contextualized the current landscape of the trucking industry, deepened understanding of the challenges the industry is facing to accomplish the transition to zero-emission vehicles and highlighted important elements of site selection considerations and development that will help inform eTRUC's Task 6 deployment planning efforts.

The barriers and issues highlighted by participants illustrate the significant task ahead. Private industry, government agencies, and utility providers will have to work together to achieve collective goals. The section below focuses on potential ways to mitigate the key concerns raised during the interviews and focus groups:

Funding

The fleet survey and industry stakeholders focused on the cost of the overall transition as well as the burden for smaller fleets and owner operators. Potential avenues to address some of the main concerns include:

- Provide education and technical support for smaller fleets to allow them better access and to understand available grant funds.

  The eTRUC Industry Partner Presentations, an educational webinar series hosted quarterly, can provide a platform to inform smaller fleets.
- Fund pilot projects that provide drivers/operators a chance to test the impacts and performance of ZET. This will help them understand how it will impact their operation and may alleviate concerns of the unknown.

  The Advanced Transportation Research Center, MHX, and TA pilot sites will provide a physical space to this purpose.
- 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.

  Task 6 will explore implementation processes in more detail through the Regional Site-Level Analysis Technical Report (Task 6.1).
- Continue to fund innovation programs and look for existing pilots that can be scaled.

Electric Grid Capacity

The industry stakeholders focused on the need to locate electrical grid capacity in the best location to support trucking and not to force trucking to make major changes to operations for the transition. Potential avenues to address some of the main concerns include:

- Focused leadership from utilities and transportation is needed to increase collaboration to collocate public charging infrastructure that better matches transportation patterns. Similarly, understanding energy/utility plans to design infrastructure needs is important.

  In this regard, Task 6 will focus on analyzing existing and forecasted freight transportation industry needs for the ZEV transitions through the HEVI-LOAD model assessing charging needs, grid capacity, and travel patterns.

Public vs Private Depots

The industry stakeholder meetings discussed the need for both public and private depots. The fleet survey highlighted that larger fleets are somewhat likely or very likely to build EV charging onsite but smaller fleets are unsure or will not build on site. In addition, range concerns are a major issue from the fleet survey. Potential avenues to address the main concerns include:

- Government will need to be involved in the development of public charging stations to build the necessary number of stations considering the timeline of regulations, especially as private businesses are still trying to develop sustainable business models in this space.

  The Task 6 Regional and Statewide site deployment plans will provide details on the infrastructure charging needs at each proposed station location detailing the charge load and number of chargers needed to meet forecasted HDZET charging demands.
- Providing more redundancy in the EV charging system may alleviate some of the range concerns but only if the charging is fast enough to not impact 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.

  Heatmap 1.0 will detail existing, proposed, and planned public and private heavy-duty truck charging stations in California to this effect.
- Government and industry stakeholders should agree on standards to ensure charging networks work with various trucks and chargers.

Timelines

The industry stakeholders discussed at length the challenges of timelines and expediting implementation as well as the need for interim solutions until utilities can bring power to the site. Potential avenues to address the main concerns include:

- Continued government leadership to make this a priority for all parties involved, aligning, and potentially speeding up grid capacity and utilities installation to ensure that the state can power all the ZE vehicles.

  eTRUC is a consortium of industry stakeholders, including government agencies and utilities that will continue to be engaged in Advisory Committees.

- To continue to reduce the barriers, additional support from the government in streamlining local permitting and the CPUC processes can help with the installation of EV charging infrastructure.

  Task 6 will explore implementation processes and timelines in more detail through the Regional Site-Level Analysis Technical Report (Task 6.1).
- Continue to work with legislation to develop a CEQA process that minimizes the overall procedure for environmental documentation and associated studies for the development of EV charging facilities.
- Temporary and interim options are necessary to address the lag in EV charging infrastructure. Continued work on microgrids and funding pilot projects for those solutions should be expanded if possible.

Equity of Locations

The industry stakeholders discussed equity concerns for siting public charging depots and trying to balance the need for EV charging stations and locating charging stations in disadvantaged communities because it's easier or convenient. Potential avenues to address 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.

  This is being taken into account through the eTRUC Workforce Development Advisory Committee (WDAC).
- Ensure equity criteria in the decision-making process.

  As the eTRUC planning efforts continue, it is key that all parties work together to overcome funding and technological challenges and create a well-planned and sustainable future.

Reference

National Renewable Energy Laboratory. NREL Supports Efforts To Solve Drivers' Electric Vehicle Charging Experience Challenges. https://www.nrel.gov/news/program/2023/nrel-supports-efforts-to-solve-drivers-electric-vehicle-charging-experience-challenges.html. Accessed Oct 28, 2023.

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Program

Electric Transportation

3002029228

EPRI
3420 Hillview Avenue, Palo Alto, California 94304-1338 USA
800.313.3774 ▪ 650.855.2121 ▪ askepri@epri.com ▪ www.epri.com