Electrifying Freight: Pathways to Accelerating the Transition

Electrification Coalition

Front Cover: Daimler, "E-FUSO Vision One", https://media.daimler.com/marsMediaSite/pic/en/30010495

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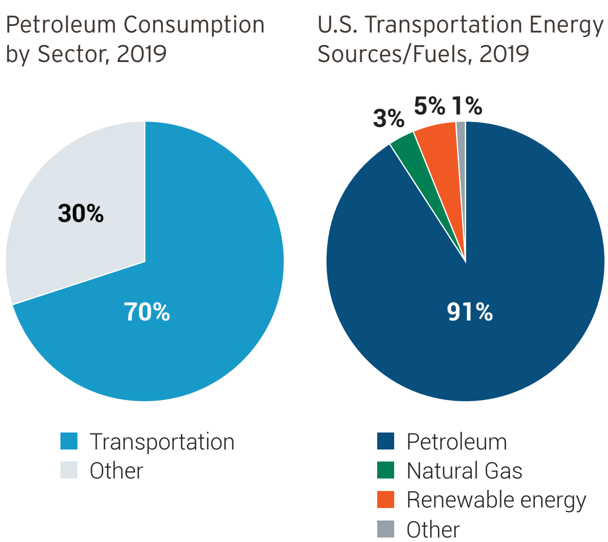
TABLE OF CONTENTS

Electrifying Freight:
Pathways to Accelerating the Transition

The United States has a historic opportunity to transition to an electrified freight transportation system and reap a host of national security, economic, and emissions benefits.

For over a century, America has been almost entirely reliant on petroleum-based fuels to move goods across its roadways.[1] In 2019, approximately 91% of America's transportation sector was dependent on oil, and transportation was responsible for 70% of all U.S. petroleum consumption (see Figure 1).[2]

FIGURE 1
U.S. TRANSPORTATION'S DEPENDENCE ON PETROLEUM



Source: U.S. Energy Information Administration, 2020, U.S. energy consumption by source and sector, 2019, https://www.eia.gov/totalenergy/data/monthly/pdf/flow/css_2019_energy.pdf.

Three out of four commercial trucks on the road today, and 98% of the largest, Class 8, trucks are powered by diesel.[3] This reliance creates significant energy and economic vulnerabilities, such as relying on oil from countries that manipulate supply, fix prices, and do not share our values. The US commercial transportation sector's reliance on oil adversely impacts the environment and public health as well, worsening air quality and respiratory diseases attributed to tailpipe emissions. These public health impacts disproportionately affect disadvantaged communities because of their proximity to major highways, rail yards, freight depots, and ports.[4] With e-commerce booming and the U.S. population expected to grow steadily,[5] the number of freight vehicles and total annual mileage of the freight sector are projected to increase dramatically over the next 30 years.[6] Meanwhile, the availability of cost-effective electrified freight vehicles is growing steadily but needs additional support to achieve widespread adoption. Recognizing the steep growth of road freight operations on the horizon, now is the time to accelerate the adoption of electrified freight.

Electrified freight vehicles offer many advantages over their diesel counterparts. The electricity they consume is domestically generated from a diverse set of energy resources, with a growing share of this electricity coming from cleaner and renewable resources. Also, electricity prices have historically been lower and more stable than diesel and gasoline prices.[7] While medium- and heavy-duty (MD/HD) vehicles represented only

1 This paper defines electrified freight as Class 3-8 road freight vehicles operating in urban delivery, port, regional, or long-haul operations.

2 U.S. Energy Information Administration, 2020, U.S. energy consumption by source and sector, 2019, https://www.eia.gov/totalenergy/data/monthly/pdf/flow/css_2019_energy.pdf.

3 *About Clean Diesel Trucking*. Diesel Technology Forum, www.dieselforum.org/about-clean-diesel/trucking.

4 American Lung Association, 2015, *American Lung Association Energy Policy Development: Transportation Background Document*, www.lung.org/getmedia/10333ba7-8f6f-472e-8392-1388cd5fd754/transportation-backgrounder.pdf.pdf.

5 Vespa, Jonathan, et al. U.S. Census Bureau, 2018, *Demographic Turning Points for the United States: Population Projections for 2020 to 2060* , www.census.gov/content/dam/Census/library/publications/2020/demo/p25-1144.pdf. Accessed 24 Sept. 2020

6 Hewlett Foundation, 2020, *Zero Emission Road Freight Strategy 2020-2025*, hewlett.org/wp-content/uploads/2020/04/Hewlett-Zero-Emission-Road-Freight-Strategy-2020-2025.pdf. Accessed 24 Sept. 2020.

7 U.S. Department of Energy, 2020, *Alternative Fuel Price Report*, afdc.energy.gov/fuels/prices.html.

6% of vehicles registered in 2018, they were responsible for over 26% of the U.S. transportation sector's fuel consumption[8] and 23% of the sector's greenhouse gas (GHG) emissions.[9] However, electric trucks emit zero tailpipe emissions, have a lower total cost of operation, and are starting to achieve total cost of ownership parity with diesel (see Figure 2).[10]

Electrification of the light-duty sector has been gaining momentum and is poised for significant market shift in the next decade due to a combination of driving forces, including: supportive public policies, investments in technology by manufacturers and government, significant advancements in battery technology, public and private interest in reducing oil consumption and tailpipe emissions, and growing consumer demand. While the electrification of freight vehicles is very promising, not every vehicle type may be presently suited for electrification. Meanwhile, medium- and heavy-duty electric trucks (MHDETs) have only recently begun to receive attention from the industry and policy makers. While some of the solutions from the light-duty sector can be adopted for use with MHDETs, the technology is quickly evolving. More importantly, the sector faces additional, unique barriers to achieve expanded production, sales, and demand.

Fortunately, the following examples of early leadership by public- and private-sector entities are helping to build momentum with MHDETs:

- **IKEA has set a goal to electrify all home delivery vehicles by 2025, starting with New York and Los Angeles;[11]**
- **PepsiCo/Frito-Lay is replacing diesel-powered freight equipment with electric assets at manufacturing and distribution sites across the country;**
- **Amazon has ordered 100,000 electric delivery vans from Rivian and plans to deploy all of them by 2030;[12]**
- **The California Air Resources Board (CARB) has approved the Advanced Clean Truck (ACT) Rule,[13] which pairs zero-emission manufacturer sales requirements with fleet operational reports that will guide suitable vehicle development. CARB also launched the**

8 US Department of Transportation/Federal Highway Administration, *Table VM-1 - Highway Statistics 2018 - Policy: Federal Highway Administration*, www.fhwa.dot.gov/policyinformation/statistics/2018/vm1.cfm.

9 Environmental Protection Agency – Office of Transportation and Air Quality, *Fast Facts: U.S. Transportation Sector Greenhouse Gase Emissions 1990-2018*, June 2020, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100ZK4P.pdf.

10 Hewlett Foundation, 2020, *Zero Emission Road Freight Strategy 2020-2025*, hewlett.org/wp-content/uploads/2020/04/Hewlett-Zero-Emission-Road-Freight-Strategy-2020-2025.pdf.

11 *Zero Emissions for Home Deliveries.* about.ikea.com/en/sustainability/becoming-climate-positive/zero-emissions-for-home-deliveries.

12 Lambert, Fred. "Closer Look at Rivian's Electric Delivery Van for Amazon." *Electrek*, 6 Feb. 2020, electrek.co/2020/02/06/rivian-amazon-electric-delivery-van-closer-look/.

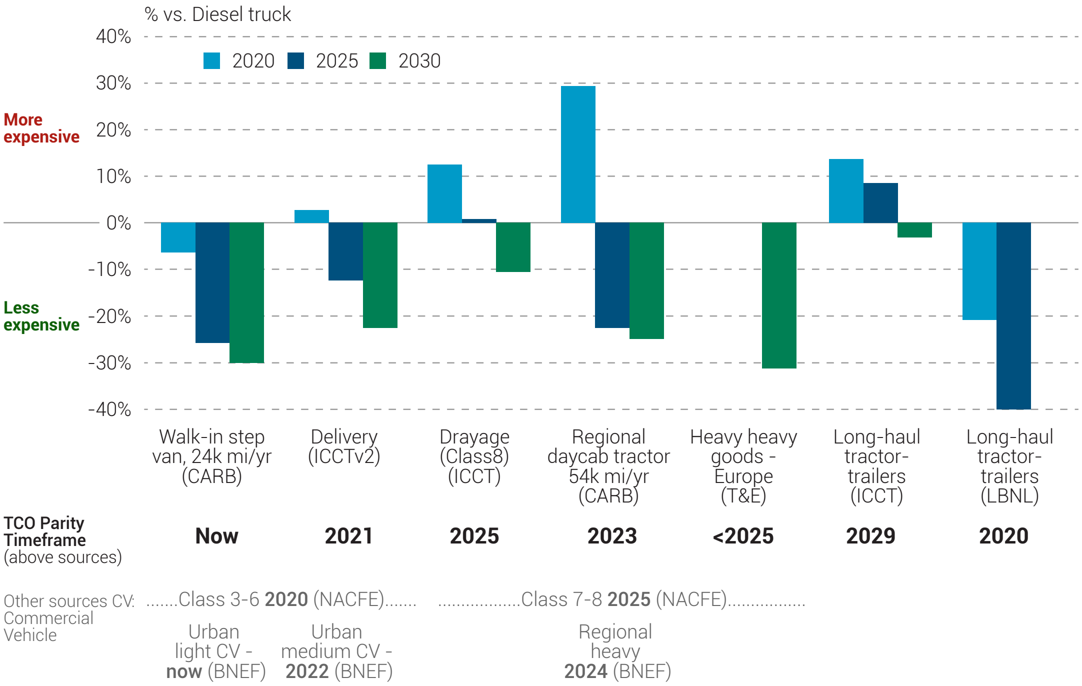
13 *California Air Resources Board - Advanced Clean Fleets.* ww2.arb.ca.gov/our-work/programs/ advanced-clean-fleets/about.

Benefits of Electric Trucks

- Electricity is **domestically generated from a diverse set of energy resources**, and a growing share comes from clean and renewable resources.
- Electricity prices are **cheaper and more stable than their fossil fuel counterparts**.
- Electric trucks **emit zero tailpipe emissions** and have **much lower total lifetime emissions** than diesel.
- Electric trucks have **lower total operational costs than diesel**, and are starting to achieve total cost of ownership parity with diesel vehicles.

Source: Arrival: Zero-Emission Mobility Solutions." Arrival, arrival.com/.

FIGURE 2
BATTERY ELECTRIC TRUCK TOTAL COST COMPARISON



Source: Hewlett Foundation, 2020, *Zero Emission Road Freight Strategy 2020-2025*, hewlett.org/wp-content/uploads/2020/04/Hewlett-Zero-Emission-Road-Freight-Strategy-2020-2025.pdf

Volvo LIGHTS heavy-duty electric truck pilot project in partnership with the South Coast Air Quality Management District, Volvo Trucks, and 14 other organizations to demonstrate the ability for heavy-duty, battery electric trucks and equipment to reliably move freight between two major ports and nearby warehouses with less noise emitted than their diesel counterparts and zero emissions;[14]

- **Northeast States for Coordinated Air Use Management (NESCAUM) has facilitated the agreement of 15 states and the District of Columbia to a Multi-State Medium- and Heavy-Duty Zero Emission Vehicle MOU (Memorandum of Understanding). Under the conditions of the MOU, which includes trucks as well as other vehicles, participating jurisdictions commit to strive to having 100% of all new medium- and heavy-duty vehicle sales be zero-emission vehicles by 2050 with an interim target of 30% zero-emission vehicle sales by 2030.[15]**

Despite these promising steps, much more action is needed to lay the foundation for a transformation of the freight sector to a future that is electric. Over the last six months, as part of a Freight Electrification Pilot Project, funded by the William and Flora Hewlett Foundation, the Electrification Coalition (EC) held conversations with various prominent MHDET providers, as well as representatives from large private fleets and logistics companies, public institutions, utilities, electric vehicle

14 "About Volvo LIGHTS." *Volvo LIGHTS*, California Climate Investments, 12 Feb. 2020, www.lightsproject.com/about/.

15 *Multi-State Medium- And Heavy-Duty Zero Emission Vehicle: Memorandum of Understanding.* NESCAUM: Multi-State Zero Emission Medium- and Heavy-Duty Vehicle Initiative, July 2020, https://www.nescaum.org/documents/multistate-truck-zev-governors-mou-20200714.pdf.

supply equipment (EVSE) providers, and non-governmental organizations (NGOs) to identify the most pressing challenges currently facing road freight electrification and examine possible solutions. The electrification of domestic road freight operations calls for a combination of policy measures, funding and financing mechanisms, and operational strategies to fully realize the range of benefits.

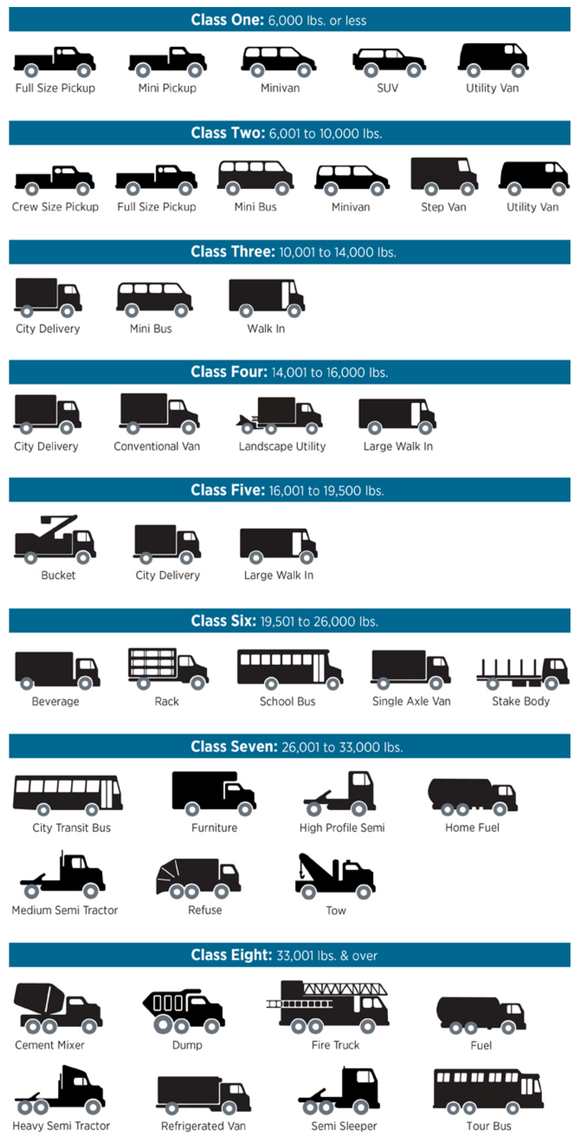
Furthermore, freight electrification stakeholders should consider how these solutions address equity concerns and how to ensure that the process for developing solutions includes equity voices and perspectives from the affected communities. Due to its operational footprint, freight electrification can play an important role in reducing toxic air pollution in metropolitan centers, along highway corridors, in freight depots, and in and around ports and provide critical benefits to low income communities and communities of color that live in those areas. While there are some nascent efforts, much more needs to be done to engage with, learn from, and incorporate the needs of underserved communities and communities of color on a local, regional, and national level. When planning and executing freight electrification projects, environmental justice groups and community advocacy organizations should be considered essential project partners. The EC will be taking a closer look at what freight electrification stakeholders are doing, or plan to do, to incorporate equity and inclusion into their business development models.

Progressive philanthropies in the space are also taking a close look at how they can incorporate equity into freight electrification efforts they support. The William and Flora Hewlett Foundation is actively addressing equity concerns through its freight electrification efforts. Recognizing the long-term negative impacts that diesel freight operations have created for disadvantaged communities, the Hewlett Foundation is fostering partnership and coalition building with frontline communities and environmental justice groups to include their voices and desires in the formation and implementation of zero-emission truck policies that will directly impact their communities.[16]

16 Hewlett Foundation, 2020, *Zero Emission Road Freight Strategy 2020-2025*, hewlett.org/wp-content/uploads/2020/04/Hewlett-Zero-Emission-Road-Freight-Strategy-2020-2025.pdf.

Based on our learnings from many conversations with freight stakeholders, and supported by our industry knowledge, we present our findings in this white paper to define and overcome real-world challenges to producing and deploying electrified freight vehicles and help freight electrification happen at scale across the country.

FIGURE 3
TYPES OF VEHICLES BY WEIGHT CLASS



Source: https://afdc.energy.gov/data/10381

1.0 Barriers to Freight Electrification

1. Higher Upfront Vehicle Costs and Associated Tariffs
2. Costly and Complex Charging Infrastructure Processes
3. Early Market & Limited Model Availability vs. Limited Fleet Demand
4. Entrenched Market Advantages of Diesel Trucks
5. Commercial and Industrial Electricity Rate Structures Not Aligned to MHDET Charging Needs
6. Lack of Verified Data - Total Cost of Ownership and Performance Specifications
7. Limited Availability of Certified Service Centers and Technicians
8. Concerns with Grid Resiliency
9. Antiquated Vehicle and Facility Ownership Structures

1.1 HIGHER UPFRONT VEHICLE COSTS AND ASSOCIATED TARIFFS

High vehicle purchase price is perceived as one of the largest barriers to freight electrification, as noted by the Hewlett Foundation Zero Emission Road Freight Strategy released earlier this year.[17] A 2018 research study released by UPS and GreenBiz also found that for most commercial fleets, the biggest barrier to electrification was the higher upfront cost associated with vehicles and charging infrastructure.[18]

Batteries are the most expensive component of an electric vehicle, but their prices are dropping.[19] Lithium-ion batteries prices decreased by approximately 87% from 2010 to 2019[20] and are projected to decline further over the following years, while energy density[21] and charging speed[22] are steadily increasing. Due to consistent technological advancements, Bloomberg New Energy Finance (BNEF) has predicted that medium-duty electric trucks will achieve upfront cost parity with internal combustion engine (ICE) vehicles around 2025 and heavy-duty electric trucks around 2030.[23] While batteries represent the largest cost to manufacturing MHDETs, there are also cost challenges around a variety of other parts and components such as electric motors and system management devices. However, these additional cost challenges are likely to be resolved as the economies of scale and manufacturing efficiencies improve with the industry's maturation.

17 Hewlett Foundation, 2020, *Zero Emission Road Freight Strategy 2020-2025*, hewlett.org/wp-content/uploads/2020/04/Hewlett-Zero-Emission-Road-Freight-Strategy-2020-2025.pdf. Accessed 24 Sept. 2020.

18 United Parcel Service of America, INC., 2018, *Curve Ahead: The Future of Commercial Fleet Electrification*, https://sustainability.ups.com/media/UPS_GreenBiz_Whitepaper_v2.pdf. Accessed 24 Sept. 2020.

19 Lutsey, Nic, and Michael Nicholas. The International Council on Clean Transportation, 2019, *Update on Electric Vehicle Costs in the United States through 2030*, theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf. Accessed 24 Sept. 2020.

20 Halvorson, Bengt. *Electric-Car Battery Prices Dropped 13% in 2019, Will Reach $100/Kwh in 2023*. 6 Dec. 2019, www.greencarreports.com/news/1126308_electric-car-battery-prices-dropped-13-in-2019-will-reach-100-kwh-in-2023.

21 Field, Kyle. *BloombergNEF: Lithium-Ion Battery Cell Densities Have Almost Tripled Since 2010*. 20 Feb. 2020, cleantechnica.com/2020/02/19/bloombergnef-lithium-ion-battery-cell-densities-have-almost-tripled-since-2010/.

22 Oberhaus, Daniel. *Charge a Car Battery in 5 Minutes? That's the Plan*. 30 Mar. 2020, www.wired.com/story/charge-a-car-battery-in-5-minutes-thats-the-plan/.

23 Hewlett Foundation, 2020, *Zero Emission Road Freight Strategy 2020-2025*, hewlett.org/wp-content/uploads/2020/04/Hewlett-Zero-Emission-Road-Freight-Strategy-2020-2025.pdf. Accessed 24 Sept. 2020.

A growing number of well-resourced and forward-thinking commercial fleets have begun recalibrating their operations and deploying initial MHDETs and charging infrastructure. Nonetheless, the near-term higher upfront costs associated with MHDETs are likely to remain a substantial barrier to fleets for the next five to 10 years. For many operators, these challenges can seem insurmountable. Small independent contractor and contract carrier fleets, for example, are often heavily invested in their diesel truck fleet and have neither the liquid capital nor the confirmed client demand to green-light significant investments in electric vehicles. In addition, most Class 8 heavy-duty truck sales are also subject to a 12% federal excise tax (FET). According to the Modernize the Truck Fleet (MTF) Coalition, the average FET adds $21,000 to the cost of new heavy-duty trucks and trailers.[24] The impact of this tax is even greater on MHDETs because of their higher upfront costs. The tax is a further impediment for fleets considering electrification.

1.2 COSTLY AND COMPLEX CHARGING INFRASTRUCTURE PROCESSES

When interviewed by the EC about challenges and concerns regarding charging infrastructure, more than 75% of private fleets interviewed confirmed that planning and installing EV infrastructure for MHDETs was one of the largest barriers.

Determining the necessary charging equipment to support a fleet of MHDETs is a decision influenced by a variety of factors, including the number of vehicles, type of vehicles, vehicle duty cycles, daily miles traveled, future fleet operations, and more. Level 1 charging is the slowest charging option and is not appropriate for charging commercial electric trucks. Level 2 charging is the next fastest charging option and utilizes 240V of electricity to charge a vehicle. Level 2 chargers vary in terms of energy output rate and cost, but typically cost a few hundred to a thousand dollars per port and can charge a vehicle at speeds anywhere from 7.2 kilowatts (kW) to upwards of 19 kW. For a Class 5 delivery van, such as the Chanje V8100 that has a 100 kilowatt-hour (kWh) battery and a driving efficiency of 1.5 miles per kWh, charging from 20% to 80% using a powerful Level 2 charger would take three to four hours. Level 2 chargers can be a suitable option for charging vehicles that have long dwell times, smaller batteries, and/or a centralized depot that facilitates opportunity charging throughout the day. DC fast charging (DCFC), the fastest charging level, can charge vehicles at rates of several hundred kW. DC fast chargers also vary in terms of energy output rate and price; a less expensive DCFC may charge at a speed of 72 kW and cost less than $20,000, whereas a more expensive DCFC may charge at speeds upwards of 500 kW and cost over $50,000. Assuming that a driver is using a 120 kW DCFC, charging a Class 8 Freightliner eCascadia with a 550-kWh battery and a driving efficiency of 0.45 miles per kWh from 20% to 80% would take 2.5-3.5 hours.[25] Figure 4 broadly summarizes when to consider using Level 2 vs. DCFC and expected charging rates for MHDETs.

Aside from selecting and purchasing the stations, deployment project teams must deal with the complexity and cost associated with siting, planning, commercial utility interconnection requirements, construction permitting, and final installation. Pacific Gas and Electric estimates a project will take nine to 13 months from initial plans to installation and activation,[26] Considerations such as site characteristics, available site power, and local grid capacity play a role in a project’s duration and cost.[27] In addition, project teams must consider software and maintenance factors when planning load management and equipment uptime assurance. Currently, establishing a network of charging stations to serve a fleet of commercial electric trucks is a much more complex than setting up a few diesel fueling stations and mapping out existing stations along shipping routes, and project costs are harder to estimate.

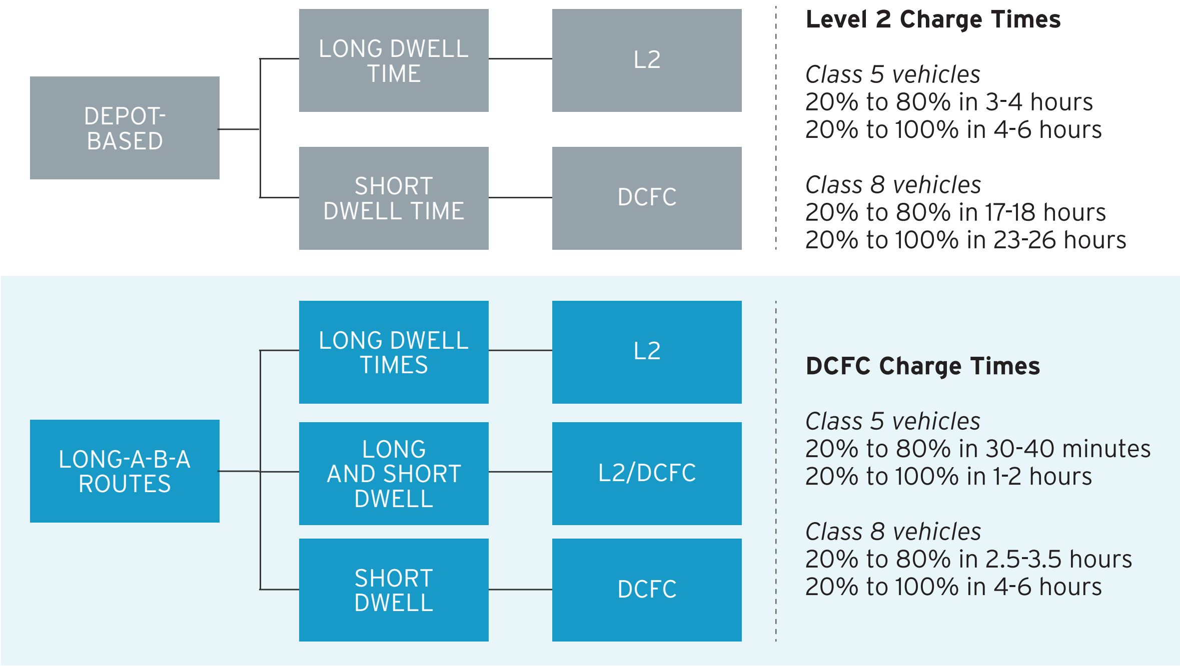
24 Pappas, Chris. Received by The US House of Representatives, Nancy Pelosi, James E. Clyburn, Steny Hoyer, Richard Neal, US House of Representatives, 20 July 2020, Washington, D.C. https://www.nada.org/workarea/DownloadAsset.aspx?id=21474861658.

25 North American Council for Freight Efficiency, 2019, *Amping Up: Charging Infrastructure for Electric Trucks*, nacfe.org/report-library/guidance-reports/#.

26 Pacific Gas & Electric - PG&E, 2019, *Take Charge: A Guidebook to Fleet Electrification and Infrastructure*, www.pge.com/pge_global/common/pdfs/solar-and-vehicles/your-options/clean-vehicles/charging-stations/ev-fleet-program/PGE_EV-Fleet-Guidebook.pdf.

27 United Parcel Service of America, INC., 2018, *Curve Ahead: The Future of Commercial Fleet Electrification*, sustainability.ups.com/media/UPS_GreenBiz_Whitepaper_v2.pdf. Accessed 24 Sept. 2020.

FIGURE 4
CHARGE TIME ESTIMATES FOR MD & HD VEHICLES



Charge times estimates were sourced from NACFE's "Amping Up: Charging Infrastructure for Electric Trucks" Guidance Report. Class 5 vehicle charge times assume vehicle is a Chanje V8100. Class 8 vehicle charge times assume vehicle is a Freightliner eCascadia.

Source: North American Council for Freight Efficiency, 2019, *Amping Up: Charging Infrastructure for Electric Trucks*, nacfe.org/report-library/guidance-reports/#.

Goals for a Future Electric Truck Industry

- Optimize performance, hauling capacity, range, weight, driving range
- Influence the build out of a nationwide infrastructure network
- Establish brand & model familiarity
- Establish a large used vehicle market
- Co-evolve with business operations to match design and development with market demands

1.3 EARLY MARKET & LIMITED MODEL AVAILABILITY VS. LIMITED FLEET DEMAND

Limited model options and unclear delivery dates have led a multitude of companies to continue their "business as usual" procurement and operation of diesel vehicles as they wait for the EV market to mature.

New technology, insufficient emissions regulations, lower diesel truck prices, and industry unfamiliarity have all contributed to limited fleet demand for MHDETs. Developing and scaling production of MHDETs is a complex process that requires significant investments of time and capital from vehicle providers. With the electrified freight vehicle market still in its infancy, compared to diesel trucks, there are a limited number of models available today and less inventory available for interested fleets to procure. These factors, in addition to insufficient emissions regulations, lower diesel truck sticker prices, and industry unfamiliarity have all contributed to limited fleet deployment and demand for MHDETs.

1.4 ENTRENCHED MARKET ADVANTAGES OF DIESEL TRUCKS

Diesel's century-long role in commercial transportation has facilitated long-term development and performance optimization of diesel-powered vehicles, supply chains, and service networks.

Diesel trucks have long dominated the trucking industry and the surrounding ecosystem. Building up a similar electric-focused industry to scale will take time to commercialize the technology and grow the broader network. Freight operations and supporting infrastructure across the country have been designed with diesel vehicles in mind. In addition, diesel's mature vehicle market has established a large market for used diesel vehicles that does not yet exist for MHDETs. Indeed the residual values of electric trucks are not yet clear.[28] Uncertainty around the resale value of trucks makes finance and lease structuring more difficult and can limit an operator's procurement options.

1.5 COMMERCIAL AND INDUSTRIAL ELECTRICITY RATE STRUCTURES NOT ALIGNED TO MHDET CHARGING NEEDS

Electricity charging costs in the U.S. are on average much lower than comparative diesel fueling costs.[29] However, the substantial electricity demand requirements coupled with limited down time to charge larger class vehicles can greatly reduce the financial savings of electricity over diesel if commercial and industrial rate structures are not adjusted.

Fixed electricity rates in most utility markets, and even some time varying rate systems with high peak pricing surcharges, are likely to be financially unsustainable for most commercial fleets operating MHDETs. These vehicles need to be able to charge at reasonably priced rates that meet their operational needs. Without more flexibility in rate structures and caps on demand charges, it may be financially challenging for fleet operators to consider electrifying their fleets. As such, to encourage market participants and drive greater levels of freight electrification, stakeholders are beginning to work with utilities and state commissions to consider alternative ratemaking options suitable for MHDETs at scale with rates that are intuitive and respond to changing market conditions.

28 North American Council for Freight Efficiency, *Electric Trucks: Where They Make Sense*, nacfe.org/emerging-technology/electric-trucks/#edd-free-download-modal. Accessed May 2018.

29 "Fuel Prices." Alternative Fuels Data Center: Fuel Prices, U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy's Vehicle Technologies Office, Oct. 2020, afdc.energy.gov/fuels/prices.html.

1.6 LACK OF VERIFIED DATA – TOTAL COST OF OWNERSHIP AND PERFORMANCE SPECIFICATIONS

Currently, it can be challenging for a fleet operator to accurately compare conventional diesel vehicles to electric alternatives due to a lack of available data on either operational costs or performance capabilities.

Fleet operators are often required to make procurement decisions based on two key factors. First, they need to minimize transportation costs by selecting the most efficient and reliable vehicles in their class. Second, they need to ensure operational requirements of the fleet can be met, if not exceeded, by the vehicles under consideration for acquisition. Determining whether a vehicle will meet these two key factors requires access to reliable total cost of ownership (TCO) data as well as performance specifications.

The limited availability of data on MHDETs is primarily due to two factors: 1) the limited numbers of vehicles currently being tested/operated by fleets; and 2) limited publicly available specifications and data on pre-production vehicles. Until more MHDETs go into production and are tested by actual fleet operators, it is likely that the availability of cost and operational performance data will be limited. However, the data availability challenge is likely to dissipate quickly as more vehicles go into production and are tested by fleets that have the capital and the organizational motivation to invest in a transition to electrification. The lessons learned by these fleet pioneers will allow additional fleets to more clearly understand the cost considerations and operational capabilities of MHDETs. Already, MHDET manufacturers and others are developing TCO tools to support purchase decisions.

1.7 LIMITED AVAILABILITY OF CERTIFIED SERVICE CENTERS AND TECHNICIANS

Without certified facilities and technicians located near the fleet operation, many fleet operators may be resistant to electrify their fleets until they can be assured that timely repairs can be made to their vehicles in order to protect against extended periods of downtime.

MD/HD fleets have very demanding operational requirements. Traditional diesel truck fleets are closely monitored to ensure optimal operational efficiency and minimal disruptions to fleet operations when a vehicle requires time-consuming repairs. A large network of highly capable and knowledgeable service centers and technicians has been developed to support large diesel vehicles in operation. While EVs tend to have much lower maintenance requirements and are less susceptible to many of the mechanical failures of their diesel competitors, MHDETs will require some maintenance over time. Some of the required maintenance and repairs for electric trucks will not require any special equipment or technical knowledge beyond what is already required for diesel-based vehicle platforms. However, in some cases, specialized technical equipment and technicians will be needed to repair and maintain these larger class vehicles, which are currently only available on a limited basis.

Addressing this challenge will require national and regional efforts to provide the necessary resources and training to ensure that third-party repair facilities are able to meet the needs of MHDETs. OEMs will likely have to play a major role in assisting and educating these service station networks and technicians to ensure they are able to meet the needs of freight electrification at scale.[30]

30 Borrás, Jo. "97% Of Auto Mechanics Can't Work on Electric Cars, New Report Concludes." *CleanTechnica*, 10 Dec. 2018, cleantechnica.com/2018/12/10/97-of-auto-mechanics-cant-work-on-electric-cars-new-report-concludes/.

1.8 CONCERNS WITH GRID RESILIENCY

As MD/HD fleets electrification becomes more common, there is concern that without significant investments in utility upgrades to current grid infrastructure, local grid networks may be pushed beyond their current distribution capacity, creating localized disruptions to services or a slowdown of fleet electrification efforts.

MHDETs, especially Class 8 vehicles, are expected to have very high electrical demand requirements. The average light-duty EV consumes between 0.25 and 0.35 kWh per mile, while the average Class 8 electric truck at full load consumes between 2 and 2.5 kWh per mile,[31] more than eight times the energy consumption per mile. As a result, even regional transportation vehicles that travel 150 miles per day will likely need to charge around 300kWh daily (based on 2kWh per mile estimate at full load).[32] In the early stages of MD/HD electrification of widely dispersed fleets, the increase in demand on the grid locally or as a whole is unlikely to put significant stress on electrical infrastructure. However, future widespread deployment of electrified trucks will represent large new demand for electricity. Evaluating the need for increasing grid distribution capacity is therefore essential to providing sufficient reliability to support a fully electrified freight transportation system. Without proactive evaluation and investment to support these potential grid and generation upgrades, the transition to electrified freight could see significant delays and infrastructure impediments.[33]

31 Loveday, Steven. "What is MPGe." U.S. News and World Report. https://cars.usnews.com/cars-trucks/what-is-mpge. July 5, 2018.

32 Park, Jim. "The Challenged of Migrating from Diesel to Electric." *Heavy Duty Trucking*. https://www.truckinginfo.com/342156/the-challenge-of-migrating-from-diesel-to-electric#:~:text=An%20electric%20Class%208%20truck,as%20the%20average%20American%20household. October9, 2019.

33 Engel, Hauke, et al. "The Potential Impact of Electric Vehicles on Global Energy Systems." *McKinsey & Company: Automotive and Assembly*, McKinsey & Company, 11 Jan. 2019, www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-potential-impact-of-electric-vehicles-on-global-energy-systems.

1.9 ANTIQUATED VEHICLE AND FACILITY OWNERSHIP STRUCTURES

The variety of MD/HD vehicle ownership structures provides significant flexibility to varying business structures that rely on MD/HD transportation services. While this has worked well for the conventional diesel-based trucking industry and services, it does create some ownership challenges for fleets that want to electrify their vehicles.

On the vehicle side, ownership is less of an issue. There are currently limited MHDETs that can be leased by fleet operators, but this is likely to change as more models become available and production is ramped up. The more significant challenge is around facility ownership and what to do about leased facilities that do not currently have the electrical infrastructure required for charging MHDETs. Many facility leasing agreements have specific limits or can outright prohibit major infrastructure upgrades by their tenants.

Additionally, even if permitted by the owner of the property to install upgraded electrical equipment, there is a lack of incentive for a tenant to spend the required funds unless the equipment and installations services the tenant pays for are either transferable (moveable from one facility to another) upon the termination of the lease or refundable (purchased at cost) by the facility owners. However, the market may resolve this issue over time as the demand grows for upgraded electrical equipment in truck depots.

A substantial number of depot owners may choose to upgrade their facilities' electrical equipment on their own in order to attract businesses that want to electrify their fleets. The added cost of installing electrical equipment could be, in some cases, primarily covered by utility make-ready programs and allow the facility owners to charge a higher lease rate to fleet tenants.

2.0 Overcoming Key Barriers

1. Public Sector Action Areas
2. Utility Action Areas
3. EV Supply Chain Action Areas
4. Corporate Action Areas
5. Collaborative Action Areas

Source: Daimler, "Fully electric medium duty truck eM2 for local distribution", https://media.daimler.com/marsMediaSite/pic/en/42193120

There are a range of actions that can help overcome barriers to the manufacturing, sales, and deployment of MHDETs. These include efforts from the public sector, utilities, the EV supply chain, businesses using freight services, and collaborations among those players. Efforts include a variety of policy measures, funding and financing mechanisms, and operational strategies that can help advance the production, variety, technology, affordability, and demand for MHDETs. Below is an overview of actions the freight ecosystem can take individually and collectively.

2.1 PUBLIC SECTOR ACTION AREAS

Freight electrification can be advanced through policy actions at the federal, state, and local levels using measures that increase affordability and access and address the soft costs associated with infrastructure development.

Vehicle Sales Targets and Goals

(Federal, State, & Local)

Governments at various levels are considering targets and goals around the sales of new EVs, through legislation, regulations, and executive orders to send a market signal and boost MHDET manufacturing and deployment efforts. At the state level, one approach being pursued in California by CARB is the ACT Rule which sets zero-emissions vehicle sales requirements (including hydrogen) for vehicle Classes 2b to 8.[34] CARB is also developing a medium- and heavy-duty zero-emissions fleet regulation that would initially focus on larger fleets with vehicles suitable for early electrification, their subhaulers, and large entities that hire them and mandate year-over-year electric truck deployments, as well as regular fleet and operational data reports that will help guide MHDET production and provision.[35] This regulation, if introduced, could serve as a complement to the ACT Rule and grow market demand alongside growing supply. Requirements like the ACT rule,

34 *California Air Resources Board - Advanced Clean Fleets.* ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet.

35 *California Air Resources Board - Advanced Clean Fleets.* ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/about.

or similar targets and goals, are best approached as part of a more comprehensive system of policies and incentives to support the transition and limit the risk of falling short of the targeted level. Moreover, implementation of the ACT rule will call for a federal waiver under the Clean Air Act.

Streamlined Permitting and Building Requirements for EV Charging Infrastructure

(Local Government & PUCs)

Currently, the process for developing and planning even a relatively small charging installation at a fleet facility can be onerous, complex, and time consuming for fleet operators to negotiate, and can vary greatly from one location to another depending on local regulations. State Public Utility Commissions (PUCs) can support the development of charging infrastructure by working with utilities to make the permitting process more transparent and less cumbersome. By reducing the number of permits that are required and allowing for a quicker approval processes, PUCs and utilities can work together to minimize the development timelines and site visits of inspectors without compromising safety or local regulations. Local governments can also facilitate charging infrastructure by empowering their planning departments to develop standardized permit applications, as well as review and inspection processes for installing charging stations.[36]

Vehicle and EV Charging Infrastructure Purchase Incentives

(Federal, State, & Local)

Purchase incentives for vehicles and EV charging infrastructure are a crucial part of the EV policy implementation approach. The Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) in California and the New York Truck Voucher Incentive Program (NYTVIP) are examples of vehicle incentives that offer a limited amount of "first come, first served" funding that makes the upfront costs of MHDET replacement vehicles comparable to, or even less than, diesel equivalents. The best incentive programs decouple scrappage requirements from procurement incentives, and instead put in place separate programs for each. There are many private companies, such as those that do not own their vehicles or mandate short vehicle replacement cycles and have relatively new vehicles in operation, that often cannot meet the scrappage requirements required to receive vehicle purchase incentives and are thereby ineligible. By having a stand-alone scrappage program and a stand-alone incentive program, fleets replacing old diesel vehicles with more efficient vehicles could benefit from both programs while fleets that cannot meet scrappage requirements are still incentivized to procure MHDETs.

State-based vehicle charging incentives are also important to implement in order to reduce the upfront cost of purchasing and installing expensive high-capacity charging equipment required to charge MHDETs during dwell times. For example, Colorado implemented the Charge Ahead program that provides substantial financial incentives for both Level 2 and DCFC EV charging systems to both public and private entities regardless of vehicle class.[37] Policymakers should take into consideration the input from a wide range of fleets in order to maximize benefits for many fleets with diverse operational profiles.

Clean Fuel Standards

(Federal and State)

Clean fuel standards are a market-based incentive program that reward lower emissions fuel sources with credits for being below government emission standards. Under such programs, electricity providers can sell credits to petroleum refiners and importers whose emissions levels are over the standard. Biofuels providers can also generate credits. Potential beneficiaries of clean fuel standards are commercial fleet operators that can earn revenue through becoming a regulated entity directly or through a partnership with a charging provider. The longest standing example is California's Low Carbon Fuel Standard (LCFS), which generates millions of dollars in credits each year (and hit a high of over $2 billion in transactions

36 O'Grady, Elaine, and Jesse Way. Northeast States for Coordinated Air Use Management, 2019, PREPARING OUR COMMUNITIES FOR ELECTRIC VEHICLES: FACILITATING DEPLOYMENT OF DC FAST CHARGERS.

37 Clean Air Fleets. "Charge Ahead Colorado." https://cleanairfleets.org/programs/charge-ahead-colorado.

in 2019).[38] Oregon has also established a Clean Fuels Program[39] and other states are exploring similar measures to accelerate the market directly and generate a source of revenue to make further investments.[40,41]

Emissions Cap and Invest Program to Cover Transportation Sector

(Federal and State)

An emissions cap and invest program can be used to send a market signal that supports cleaner transportation options and helps fund the transformation of the transportation sector. States can use these revenues to fund medium- and heavy-duty electrification projects. The Transportation and Climate Initiative (TCI) is a multi-state example of this effort being developed through a coalition of 13 states in the Northeast and Mid-Atlantic (CT, DE, DC, ME, MD, MA, NH, NJ, NY, PA, RI, VT, and VA). The TCI is focused on improving transportation, reducing carbon emissions from the transportation industry, and developing the clean energy economy. TCI aims to build on the region's successes in reducing emissions from the power supply sector through the Regional Greenhouse Gas Initiative (RGGI). This includes adding to or duplicating the RGGI's carbon-pricing, cap-and-invest program, and exploring the environmental justice and public health benefits from low-carbon transportation.[42]

Tax Exemptions

(Federal)

Reducing or removing the 12% federal excise tax (FET) on the sale of new Class 8 zero-emission trucks until they achieve retail cost parity with their diesel counterparts would help advance the electrification of freight vehicles in the near term. Because heavy-duty electric trucks today typically cost more than their diesel counterparts, the percentage-based FET placed upon their sale is even larger and further raises costs. With such a small number of electric trucks being sold today, and with MHDET retail prices largely projected to reach cost parity within this decade, the loss in tax revenue would be minimal.[43]

2.2 UTILITY ACTION AREAS

Electric utilities can support freight electrification through investments in charging infrastructure, developing long-term strategies for addressing the need for grid enhancements, and developing new rate structures that better align with the charging patterns of MHDETs while meeting the needs of the utility.

EV Charging Infrastructure Investment Programs

(Utilities and PUCs)

Utilities play a central role in supporting private MHDET charging infrastructure. Figure 5 shows the variety of potential ownership models for fleet infrastructure. The make-ready infrastructure arrangement is among the most common. It allows the utility to own all infrastructure up to the EV charger. These EVSE-funded support programs help reduce the cost of electrical upgrades that may be required to meet the electrical demand of MD/HD fleets, which can be in the multiple megawatt (MW) range. EV-Make Ready Programs for MD/HD fleets have been developed by California utilities such as Southern California Edison (SCE), Pacific Gas and Electric (PGE), and San Diego Gas and Electric, as well as Con Edison in New York and Xcel Energy in Colorado and Minnesota.

38 Figured calculated from CY2019 total volume and average price per credit. Monthly LCFS Credit Transfer Activity Report for December 2019. California Air Resources Board, 14 Jan. 2020, ww2.arb.ca.gov/search/site?keys=lcfs+december+2019.

39 "Clean Fuels Standard." Renew Oregon, Renew Oregon Action Fund, www.reneworegon.org/clean_fuels_standard.

40 Great Plains Institute, 2020, A Clean Fuels Policy for the Midwest, www.betterenergy.org/wp-content/uploads/2020/01/Clean-Fuels-Policy-for-the-Midwest.pdf.

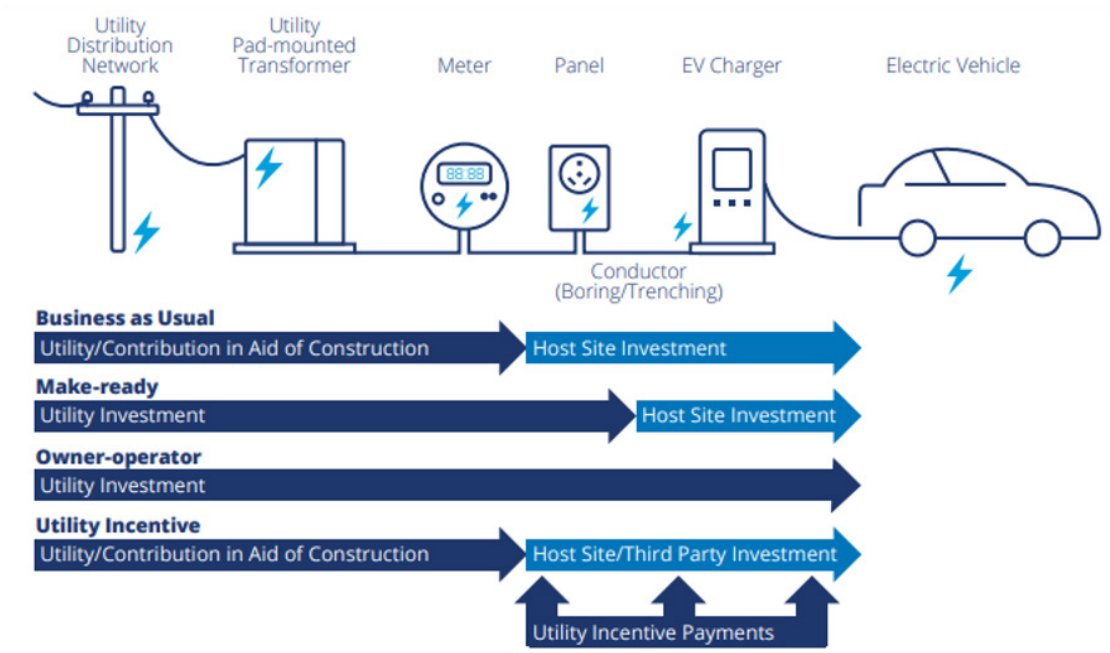
41 "Clean Energy Solutions for NY's Transportation Sector." Clean Fuels NY Coalition, Clean Fuels NY Coalition, www.cleanfuelsny.org/.

42 "Nine States and D.C. to Design Regional Approach to Cap Greenhouse Gas Pollution from Transportation." Nine States and D.C. to Design Regional Approach to Cap Greenhouse Gas Pollution from Transportation | Transportation and Climate Initiative, Transportation and Climate Initiative, 18 Dec. 2018, www.transportationandclimate.org/nine-states-and-dc-design-regional-approach-cap-greenhouse-gas-pollution-transportation.

43 Sharpe, Ben, et al. International Council on Clean Transportation, 2020, pp. 1–1, *Race to Zero: How Manufacturers Are Positioned for Zero-Emission Commercial Trucks and Buses in North America.*

FIGURE 5

MODELS OF UTILITY INVESTMENT IN EV CHARGING INFRASTRUCTURE[43]



Source: M.J. Bradley & Associates, 2019.

Evaluations of EV Energy Demand Growth Impacts and Investment in Grid Infrastructure

(Utilities and PUCs)

Utilities and transmission operators across the country are beginning to consider what an increase of electric vehicles on the road will mean for the grids they use and manage. For example, a large fleet depot using 150 kW DC fast chargers to simultaneously charge 65 Class 8 electric trucks could demand over 9 MW of power, and potentially more if they are using faster DC fast chargers. For context, that's comparable to the peak load demand of the Empire State Building.[44] As more and more commercial fleets demand electricity to charge their MHDETs, the influx in electricity load demand could, without improvements, put a significant strain on local electrical grids. Awareness of where new load growth is likely to occur along with proactive analyses of the growth and location of higher load demands on grid resources can provide essential insight into how best to cost-effectively upgrade grid infrastructure and avoid impediments to higher MHDET adoption rates.

By using a comprehensive assessment of MHDET growth projections within a utility's territory, utilities and others can prioritize the development of a long-term strategy for upgrading grid infrastructure. Given that grid upgrades can take multiple years to move through the regulatory and permitting process, planning ahead is key to ensuring sufficient grid and generation capacity to support MHDET deployment. Such efforts call for more coordinated undertakings among fleet operators, vehicle providers, utilities and infrastructure providers, and can benefit them and the EV ecosystem as a whole.[45] The North

44 Dixon, Darius. "Making the Big Apple Green Starts with the Empire State Building." *Scientific American*, Scientific American, 24 Aug. 2010, www.scientificamerican.com/article/making-big-apple-green/.

45 Walton, Robert. Electric Revolution: *As EV Demand Increases, Can Utilities and Cities Keep up?* 16 Oct. 2019, www.utilitydive.com/news/electric-revolution-as-ev-demand-increases-can-utilities-and-cities-keep/564585/.

Electrification Coalition

American Council for Freight Efficiency (NACFE) report *Amping Up: Charging Infrastructure for Electric Trucks* details best practices for planning and deploying charging infrastructure for a fleet of medium- or heavy-duty electric trucks.[46]

EV Friendly Rate Design

(Utilities)

Charging a fleet of MHDETs will significantly increase a site's peak electricity demand. Traditional commercial and industrial rate designs often include demand charges, added fees that are typically based on the maximum amount of power that a customer uses in any 15-minute interval during the month and can drive up charging costs significantly. Utilities can develop more EV friendly rate designs in a variety of ways to support EV charging while ensuring electricity system costs are covered, ideally through a combination of updated demand charges alongside updated time of use rates, as seen in the examples below.

Demand Charge Rebates

SCE and National Grid have developed demand charge rebates that phase out gradually over five years and recover all costs through fees based on the amount of electricity consumed. After the first five years, the rate gradually reincorporates demand charges at a lower level over the following five years. This system provides a time varying rate that incentivizes charging when demand on the grid is lower but does not work as well for all fleets, especially smaller fleet operators that may not be able to stagger charging times.[47]

Target – Medium to Large Fleets

Fixed Subscription Fee

PGE offers a commercial rate for EV charging that replaces demand charges with a fixed subscription fee based on charging capacity. This strategy helps to reduce costs, particularly for smaller fleets, and isn't temporary like SCE and National Grid's design. The subscription fee is coupled with a time-of-use rate that incentivizes charging when demand on the grid is lower.[48]

Target – All Fleet Sizes, More Advantageous to Medium and Large Fleets

Demand Charge Cap

Xcel Energy in Minnesota offers a commercial rate that caps the demand charge for customers that consume relatively little electricity overall and phases in demand charges for customers based on their total use of electricity. This provides a neutral solution that is available to all commercial customers but reduces the time-varying component that incentives charging when demand on the grid is lower.[49]

Target – All Fleet Sizes, More Advantageous to Small and Medium Fleets

2.3 EV SUPPLY CHAIN ACTION AREAS

Vehicle and component manufacturers can strengthen the freight electrification ecosystem by standardizing EV charging connectors, developing and guiding EV charging management software, addressing the reliance on a potentially unstable battery supply chain and ensuring that the workforce needed to service and maintain MHDETs is trained to meet the needs of the new technology.

Standardization of EV Charging Connectors

(EV Infrastructure Providers, Vehicle OEMs and Providers)

Standardization of charging connectors, particularly for lower capacity DCFC charging systems, will drive down charging system procurement costs for fleet operators by providing greater longevity for charging systems, In the near term, EVSE providers and vehicle OEM's need to continue working together to determine the optimal connectors for depot-based

46 North American Council for Freight Efficiency, 2019, *Amping Up: Charging Infrastructure for Electric Trucks*, nacfe.org/report-library/guidance-reports/#.

47 Houston, Samantha. Union of Concerned Scientists, 2019, *Electric Utility Investment in Truck and Bus Charging A Guide for Programs to Accelerate Electrification*, www.ucsusa.org/sites/default/files/attach/2019/04/Electric-Utility-Investment-Truck-Bus-Charging.pdf.

48 "Making Sense of Business EV Rate Plans." Business Electric Vehicle (EV) Rate Plans, Pacific Gas & Electric Company, www.pge.com/en_US/small-medium-business/energy-alternatives/clean-vehicles/ev-charge-network/electric-vehicle-rate-plans.page.

49 Houston, Samantha. Union of Concerned Scientists, 2019, *Electric Utility Investment in Truck and Bus Charging A Guide for Programs to Accelerate Electrification*, www.ucsusa.org/sites/default/files/attach/2019/04/Electric-Utility-Investment-Truck-Bus-Charging.pdf.

charging in order to drive down fleet capital expenses, increase vehicle acquisitions, and optimize fleet charging operations. Standardization of charging connectors will facilitate greater interoperability between vehicle classes and models that are currently available and soon to be produced. In the near future, as vehicle ranges improve to allow for longer-distance electrified freight operations, EVSE providers and vehicle OEMs will need to develop standards for both charging connectors and higher capacity DCFC systems to support a network of publicly available high capacity chargers in the MW range. Higher capacity chargers in the MW range will be required to support long distance freight operations using higher capacity battery systems.

Development and Guided Administration of EV Charging Management Software

(EV Infrastructure Providers)

Managed, networked EV charging management software is part of efficiently managing fleet operations and charging schedules for MHDET fleets. EV charging management software that can manage power consumption is able to simultaneously optimize charging schedules to fit fleet duty cycles and dwell time while also minimizing demand chargers and ensuring load demand does not exceed infrastructure capacity. Networking this software goes one step further by allowing complete oversight and tracking of fleet charging status down to the vehicle level and allows for easy changes to vehicle charging schedules. EV infrastructure providers need to play a key role in expanding the production and range of offerings for networked managed EV charging systems to bring down operational costs for fleet operators and ensure compatibility with a wide range of vehicle classes and operations. In addition to offering EV charging management software, EV infrastructure providers need to play a major role in explaining the operational and financial benefits of managed networked charging systems.

Safeguards Against Upstream Supply Challenges

(OEMs and Providers)

There are a variety of reasons why MHDET manufacturers should consider safeguarding their production against upstream supply chain volatility, such as import tariff fluctuations and potentially unstable resource availability. Cobalt, for example, is a key component in most lithium-ion batteries produced today and there are global concerns about unethical safety and labor standards associated with extraction. These, among other concerns, could create future disruptions in mineral prices or availability.[50] Some MHDET providers are taking a

50 "Top Tech Firms Sued over DR Congo Cobalt Mining Deaths." *BBC News*, BBC, 16 Dec. 2019, www.bbc.com/news/world-africa-50812616.

Source: The Lion Electric Co.

variety of proactive actions to buffer their operations from disruptions, such as diversifying their portfolio of battery suppliers or investing in research and development for in-house battery production. Tesla, for example, is looking to produce cobalt-free batteries to reduce costs and extricate problematic mining sites from their supply chain.[51] In an emerging and rapidly evolving market like commercial electric vehicles, vehicle providers should pay close attention to how they can safeguard their production from price volatility and/or disrupted availability of upstream materials.

Electrified Ecosystem — Certified Service Centers and Technicians

(OEMs)

Developing a nationwide and regional network of certified service centers and technicians is an essential element of ensuring a sustainable freight industry transition to MHDETs. There is already a highly developed ecosystem of service station facilities and trained technicians that are working in the conventional diesel truck sector. This network of facilities and technicians can be utilized through minimal retooling and retraining to support the electrified truck market. However, this is a bit of "chicken and egg" problem as these service centers and technicians are unlikely to retool and retrain until there is sufficient demand for those services, but without the availability of capable service centers and technicians many fleet operators will be reluctant to electrify their fleets. To resolve this issue, OEMs can play a leading role in providing funding and guidance to service centers and technicians required to retool or retrain their personnel. These new service capabilities have the potential to create a significant number of new technical positions and jobs in the vehicle service industry. Providing this support to develop a network of certified service centers and technicians will help to increase demand for OEM vehicles and provide the necessary level of service support that is required for an electrified trucking industry. State and local governments can help support these efforts through workforce training partnerships, including those involving community and technical colleges.

51 Calma, Justine. "Tesla to Make EV Battery Cathodes without Cobalt." *The Verge*, Vox Media, 22 Sept. 2020, www.theverge.com/2020/9/22/21451670/tesla-cobalt-free-cathodes-mining-battery-nickel-ev-cost.

2.4 CORPORATE ACTION AREAS

Companies that rely upon freight, through their own fleets or fleet operators, can advance electrification to help meet their sustainability and other goals by setting deployment goals, sponsoring pilot programs, aggregating purchases, and directing investments to build manufacturing capacity and scale.

EV Deployment Goals

(Private Fleets and Logistics Companies)

Large private fleets can spur vehicle development and production by establishing and publicly announcing EV deployment goals. By offering information on the vehicle types, duty cycles, and operational profiles of vehicles they desire to electrify, manufacturers and providers can focus their production and tailor products to align with demand. Companies can also influence policies that support their MHDET deployment efforts.

Pilot Programs

(Private Fleets and Logistics Companies)

Initial deployment of MHDETs in small batches can provide a fleet with important knowledge on which vehicles work best for different operational profiles. A fleet analysis that considers existing vehicle operations, location, local policies, and incentives can also help pinpoint which operations are most ideal for early MHDET deployment. Pilot programs also help with identifying early stage best practices that can be shared with freight stakeholders to encourage and guide future freight electrification deployments.

Aggregated Demand

(Private Fleets and Logistics Companies)

Fleets should consider aggregating their company-wide vehicle purchasing into larger batches in order to achieve economies of scale. Fleets can also consider coordinating their electrification efforts with the efforts of other fleets to further advance economies of scale and share best practices. The Climate Mayor's EV Purchasing Collaborative, co-operated by the EC, is an example of a platform that leverages the buying power of many fleets to reduce procurement costs. Through this program, the EC provides guidance and technical support to public fleets transitioning their fleets to EVs. Sourcewell establishes cooperative purchasing agreements for public fleet members and awards contracts to vehicle and charging station infrastructure vendors through a competitive solicitation process.[52]

Targeted Investments to Boost Economies of Scale

(Private Fleets and Logistics Companies)

The manufacturing of electric trucks and their components, including batteries, has not yet reached the point of reaping economies of scale which should lower prices and create consistent demand. To try and overcome this market barrier, some companies, such as DHL and Amazon, have accompanied purchase commitments with capital investments in vehicle providers to facilitate increased production and timely deployment.[53]

2.5 COLLABORATIVE ACTION AREAS

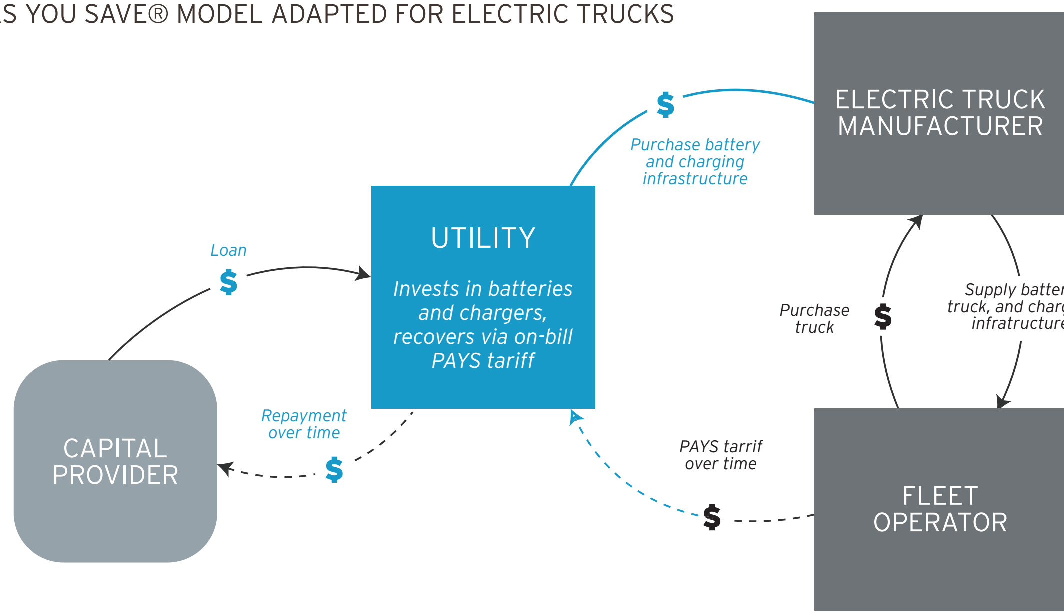
Various actors can work together to share knowledge, support financing programs, conduct outreach, and offer technical support.

Knowledge Sharing

(Vehicle OEMs/Providers, Private Fleets, Logistics Companies, Utilities, EV Infrastructure Providers, and NGOs)

States and localities are at different stages of adopting policies and funding directed towards stimulating MHDET development, production, and deployment. Under the California ACT Rule and the Multi-State Medium and Heavy-Duty Zero Emission

FIGURE 6
PAY AS YOU SAVE® MODEL ADAPTED FOR ELECTRIC TRUCKS



Source: PAYS® for Energy Efficiency, www.cleanenergyworks.org/clean-transit/

52 "How It Works: Cooperative Purchasing with Sourcewell." *Understanding How Cooperative Purchasing Contracts Work I Sourcewell*, Sourcewell, www.sourcewell-mn.gov/cooperative-purchasing/how-it-works.

53 Hewlett Foundation, 2020, *Zero Emission Road Freight Strategy 2020-2025*, hewlett.org/wp-content/uploads/2020/04/Hewlett-Zero-Emission-Road-Freight-Strategy-2020-2025.pdf. Accessed 24 Sept. 2020.

Vehicle MOU, states are currently partnering with industry and community stakeholders to develop a broad set of strategies to reduce emissions from heavy-duty vehicles. While every state has its own unique considerations and challenges, sharing learnings from these two processes and others can help other states learn what steps they can take and which mistakes to avoid. Public, private, and non-profit organizations can enhance state and local knowledge sharing by working together to publish reports and briefs outlining experienced or learned barriers and potential solutions.

Equipment Financing Systems

(Utilities, Vehicle OEMs/Providers, Private Fleets, Logistics Companies, EV Infrastructure Providers, and Financial Institutions)

Utilities can lead the creation of tariffed on-bill financing systems that will mitigate the upfront cost of MHDETs for purchasing fleets and promote greater demand and sales of vehicles. In one example, using a Pay As You Save® approach, a varying degree of the upfront costs for vehicle and/or infrastructure are covered by the utility and collected from the fleet over time through a monthly on-bill fee (see Figure 6).[54] Such a system can support procurement for both large and small fleets needing to mitigate upfront costs and shift capital expenditures (CAPEX) to operational expenditures (OPEX).

Coordinated Outreach

(Vehicle OEMs/Providers, EV Infrastructure Providers, Private Fleets, Logistics Companies, Utilities, and NGO's)

Freight electrification stakeholders can form or join outreach and information-exchange groups. Groups consisting of zero-emission vehicle (ZEV) supply chain companies and ones with a more diverse mixture of members can serve to connect vehicle providers with clients and project supporters, leverage aggregate demands to influence new supportive policy and incentives, and spread valuable information about industry and policy developments quickly and effectively. The National Zero-Emission Truck (ZET) Coalition, organized by CALSTART, is an example of a coalition that has united EV supply chain companies and shared federal policy and program ideas to stimulate the deployment and development of ZETs and support infrastructure expansion nationwide.[55]

Technical and Funding Support

(Vehicle OEMs/Providers, EV Infrastructure Providers, Private Fleets, Logistics Companies, Utilities, and NGO's)

Most private fleets need assistance in identifying opportunities for electrification, planning the process, and implementing deployment. In support for, and in response to, companies announcing EV deployment goals, stakeholders within the EV supply chain, non-profit, electrical transmission and distribution, and public sectors can work together to develop and offer private fleets insights into fleet adoption strategies and provide guidance, best practices, and funding to support deployment.

LOOKING AHEAD

Increasing the production and sales of MHDETs can help the country enhance energy and national security, the economy, and environmental and public health. It will entail a complex effort that calls for a diverse group of stakeholders to take action to overcome a wide range of barriers. As the EC and SAFE continue to execute our Freight Electrification Pilot Project and roll out our more comprehensive Freight Electrification Program, we will continue to gather insights into the market barriers to MHEDTs, which include procurement, deployment, and operational obstacles, as well as further identify how to integrate equity concerns. By overcoming these barriers through the public sector actions, utility upgrades and policy, EVSE supply chain growth, corporate actions, and collaboration outlined in this report and future reports, we can move more quickly towards an electrified freight transportation system.

54 Clean Energy Works. *PAYS® for Energy Efficiency*. www.cleanenergyworks.org/about-pays-for-ee/.

55 National Zero Emission Truck Coalition. *National Zero-Emission Truck Coalition Statement of Principles*, 2020.

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