INSIGHTS ON ELECTRIC TRUCKS FOR RETAILERS AND TRUCKING COMPANIES

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EXECUTIVE SUMMARY

The Center for Climate and Energy Solutions (C2ES) has partnered with the Retail Industry Leaders Association (RILA), Atlas Public Policy, and David Gardiner and Associates (DGA) to explore the landscape and outlook for electric trucks for freight movement.

This joint initiative assesses the market landscape, challenges, and opportunities for electric truck adoption among retailer shippers and their transportation partners. The initiative developed an independent total cost of ownership analysis, *Assessing Financial Barriers to Adoption of Medium- and Heavy-Duty Electric Vehicles* along with a publicly available total cost of ownership analysis tool, to help retailer-shippers better understand options available to them and their transportation providers.

As part of this collaboration, the project team interviewed an electric vehicle (EV) manufacturer and retail and trucking companies that have piloted electric vehicle trucks within their businesses to assess their perspective on the state of the industry. This brief summarizes issues that those companies see as important as they strategize about electrifying their fleets.

In general, companies are positive about the direction that electric trucks are taking. They recognize the environmental benefits of switching from diesel to electric, and some mention that employees enjoy test driving electric trucks. In the future, they envision their companies transitioning their fleets entirely, once national charging infrastructure is built out more, and the costs of electric trucks are reduced through technology maturity and deployment or expanded public policy. Specifically, the expansion of charging infrastructure and vehicle incentives were cited during several interviews as important elements needed before companies pursue deployment in earnest.

The retail and trucking companies interviewed for this brief recognized the environmental benefits of electric trucking and demonstrated a willingness to learn more. They also offered a few insights and strategies that other companies might consider as they plan to add electric trucks to their fleet. For example, start with adoption of electric yard trucks because they are not dependent on a nationwide network of charging infrastructure like shipping trucks are and only require an onsite 100-kilowatt charger.

Overall takeaways from interviews and research for this project include the following:

- The upfront costs for electric trucks remain a primary barrier to investment in electric trucks. However, financial incentives can reduce these upfront capital costs and models indicate that the total cost of ownership for an average electric truck can be lower than a diesel or natural gas equivalent with adequate incentives. In California, for example, several programs support EVs

including the low carbon fuel standard (LCFS) and the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) program.
    - One resource for finding incentives is the Alternative Fuels Data Center: https://afdc.energy.gov/laws.
    - Several retail and trucking companies interviewed suggested that operators of California fleets should strongly consider electrifying at least a portion of their fleets to take advantage of the financial incentives available.
- Electric heavy-duty vehicles have many tangible benefits, including several inherent health advantages. These include a much quieter ride than diesel trucks, making EVs less impactful on a driver's hearing, and no tailpipe emissions.
- As retail companies electrify their fleets, increased collaboration between a company's energy team and fleet management team will be required to maximize organization-wide efficiencies such as procurement and energy management. Without collaboration, costs could be much higher.[1]
- Vehicle maintenance is still a concern. Companies need technicians who are trained for electric trucks and savvy on new electronic software systems. One retail company highlighted how they were using EV manufacturers to provide maintenance and support but suggested there was also a need build out a third-party EV maintenance network nationwide.
- Communication between electric truck users and EV manufacturers is an important part of the process. One retail company who had conversations with EV manufacturers noted they were very receptive to feedback on usability and ergonomic design from companies who piloted EVs. This is a key aspect of the electric truck development process and can help with technology improvements and potentially accelerate the speed of deployment as manufacturers better understand what potential users want.[2]

INTRODUCTION

Since 2016, transportation has been the largest direct source of greenhouse gas emissions in the United States, accounting for 29 percent of total emissions.[3] After light-duty vehicles, medium- and heavy- duty trucks are the second-largest source of emissions from the sector with freight travel projected to increase almost 50 percent through 2050 under business-as-usual scenarios.[4]

However, businesses are not taking a passive role in reducing greenhouse gas emissions. Many retail actors are actively working to reduce emissions of carbon dioxide and other air pollutants through corporate social responsibility, sustainability, and emissions reduction programs. Several are also actively engaged with initiatives like the U.S. EPA SmartWay program and EV 100.[5,6,7] In addition to the climate benefits of reducing carbon dioxide, these efforts also have public health benefits associated with reducing other criteria air pollution in the local communities the trucks serve.

Within the medium- and heavy-duty vehicle space, companies and their logistics providers have an important role to play, some have made electric vehicle (EV) procurement announcements while others have already started integrating electric trucks into their fleets. In 2018, Walmart announced 30 pre-orders of the Tesla Semi in addition to its initial 2017 order of 15 trucks, making the company one of the largest holders of Tesla Semi reservations with a total of 45.[8] More recently in September 2019, Amazon announced an order of 100,000 electric delivery vans from EV company Rivian, to be delivered in 2021.[9] And in October 2019, Anheuser-Busch announced a plan to deploy 21 electric trucks from EV company BYD in California by end of 2019. Anheuser-Busch and BYD partnered with ENGIE Services to build out charging infrastructure at Anheuser-Busch's warehouse and distribution facilities.[10]

Because electric trucks are a relatively new technology, many retailers—especially those without the operational scale of Walmart or Amazon—lack access to independent analysis to help them make informed decisions about options to use electric trucks and EV charging infrastructure. Furthermore, many retailers employ a mix of private fleet trucks and outsourced trucking

services in their freight operations which can make fleet deployment more complicated for shippers.

To better understand how these business model variations can impact the expansion of the electric truck market, the state of the industry, and general outlook for electric trucks, C2ES, DGA, RILA, and Atlas Public Policy staff researched the issue. We interviewed parties involved in the electric truck market, including logistics and retail companies, as well as an EV manufacturer, to seek their input and understand their outlook on the future of electric trucks. We also included insights gleaned from the literature and participation in open forums where the subject was discussed.

GETTING STARTED

Companies who wish to electrify their fleets, or portions of a fleet, often need to assess where and how to begin the process. Two key questions are important starting points: 1) Which vehicles should be replaced for which uses? 2) How quickly should old vehicles be replaced?

VEHICLE USE OPTIONS

Factors that can make a fleet, or portions of a fleet, appropriate for electrification include:

- trucks that return each day to a facility
- a daily range that will allow sufficient time to recharge
- high annual mileage.[11]

Fleets that return to their own depot at the end of their daily routes can be more suitable for electrification, since they can recharge at their home base depot charging station rather than at public charging stations, where the cost to charge is only the price of electricity. At public facilities, costs include overhead and profit margin for the third-party charging provider.[12] Additionally, trucks that have a daily range with consistent mileage are also good early candidates for electrification, as they are often within the range of a single battery charge. More than 80 percent of all heavy-duty trucks in the United States travel less than 100 miles away from their home base on a daily basis, often on urban routes where they stop frequently.[13] Further, more than 75 percent of heavy-duty vehicles in the U.S. travel 30,000 miles in total each year, averaging out to approximately 120 miles per day. Trucks with such high utilization rates are good candidates for electrification because they can maximize fuel-cost savings to achieve a positive total cost of ownership, compared to their diesel counterparts, further discussed in this brief.[14] However, higher recharge times can also mean lower utilization. Use cases will vary by geography and incentive availability, and in one case described below, the availability of multiple incentive programs in California can be deciding factors in use case selection.

One company interviewed, for example, tested one type of electric trucks. Because they have a range of about 60 miles on a charge, the company chose to use them for delivering washers and dryers in neighborhoods and apartments. Another company looked at which hauling needs could be met with electric trucks and where the best incentives were available. Since its drayage trucks needed to go just 100 miles each day, it opted to invest in Freightliner's eCascadia trucks for its fleet in California where the financial incentives were the best. Due to the number of programs in California being available, as one company representative put it, "it was a no brainer."[15]

SPEED OF INTEGRATION

Beyond type of use, another key question regarding fleet electrification is: How fast and what is the ideal percentage of EVs in the existing fleet? In other words, how quickly will diesel trucks be phased out? This could depend on an array of factors, which may include a company's internal sustainability goals, external pressures, the availability of financial resources for replacements, access to charging infrastructure, maintenance capability, and regulations or incentives that promote the use of electric trucks.[16]

One carrier reported that it decided to be cautious in its integration plan by adding 10 electric trucks but only removing only five diesel trucks from the fleet. The carrier wanted to maintain a 2:1 ratio to test integration, due to current mileage range limitations on the EV pilot trucks. The carrier wanted to be cautious to ensure no

adverse impact on customer service that might result from charging delays or increased maintenance time. In the 2020 – 2021 production year, however, the company plans to adjust the ratio to 1:1. In three to four years, the company believes that electrification could be a key competitive advantage for it in the industry since it plans to have more charging infrastructure built out for its vehicles by that time. As companies transition their fleets and consider the appropriate pace of diesel truck replacement, they can make adjustments based on their customers' needs and deployment of charging infrastructure.

FACTORS AFFECTING THE COST-EFFECTIVENESS OF ELECTRIC TRUCKS

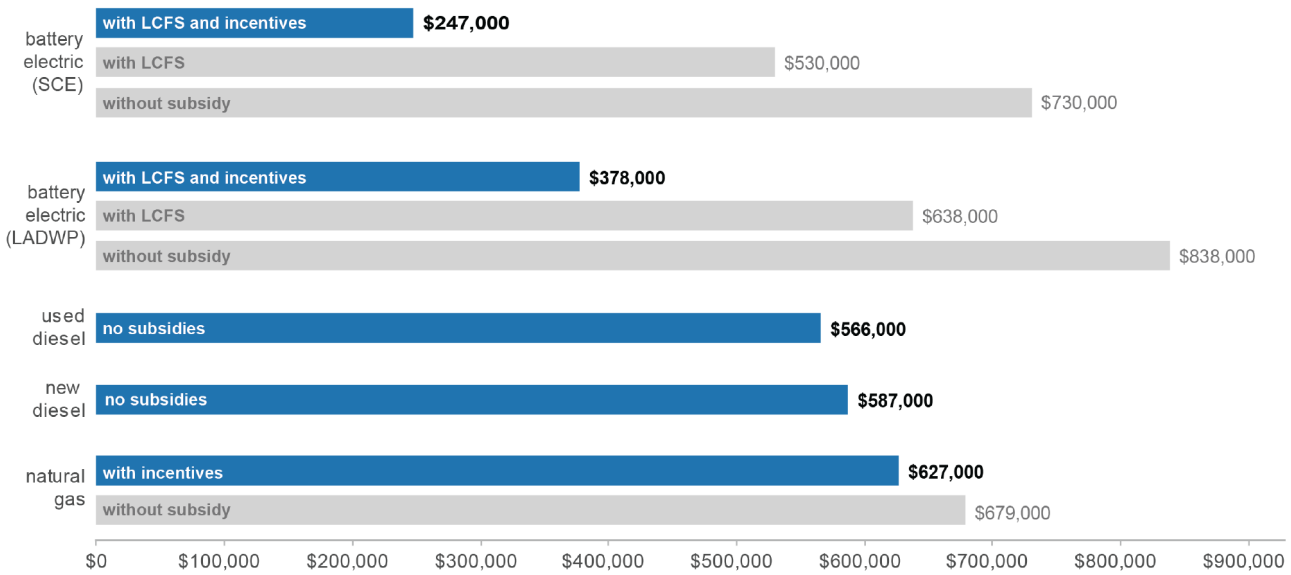
Upfront vehicle prices were highlighted in several interviews as a primary obstacle to increased deployment, though some research suggests that lifetime costs for the vehicle are often lower.[18] Nevertheless, potential owners of electric trucks need to consider the full cost of including them in their fleet, including upfront vehicle cost, available incentives, leasing versus owning, costs of charging infrastructure and charging strategy, fuel costs, maintenance, and staff.

VEHICLE COST

Presently, on average, upfront costs of medium- and heavy- duty EVs are typically twice that of their diesel counterparts. This is largely driven by battery costs. While battery costs have declined 80 percent between 2010 and 2017 as their technology has improved, they remain higher than those in diesel vehicles.[19] Industry analysts, however, believe the costs of batteries will continue to decline even as technology continues to improve in quality in the next 10 years. Experts expect battery prices will be cut in half in that time frame, which will further reduce the price of EVs, possibly by 2025.[20,21,22] This, in combination with increased air quality controls for diesel engines, will likely make these medium- and heavy-duty-EVs more cost competitive in the longer term.[23]

Globally, there are multiple electric truck manufactur-

FIGURE 1: Total Cost of Ownership for Average Drayage Truck



Note: Incentives include vehicle purchase incentives and charging infrastructure rebates where applicable.

Source: UCLA Luskin Center for Innovation.[17]

ers, including Chanje, Cummins, DAF, Daimler, Nikola, Tesla, Volvo, and Workhorse. Each has its own business model and is striving for competitive positioning. Tesla, which has a vertically integrated vehicle and battery business model, believes it has an advantage compared to EVs that require the purchase of battery packs or battery cells. Others, like Daimler, market their manufacturing expertise as part of their positioning. Competition in the market should increase innovation and reduce costs.[24] According to the North American Council for Freight Efficiency, the initial costs of electric trucks are expected to reach parity with diesel in class 3 through 6 vehicles by 2030, and after 2030 in classes 7 and 8 vehicles.[25]

AVAILABLE INCENTIVES

Even with higher vehicle costs, models indicate that the total cost of ownership for an average electric truck can be lower than a diesel or natural gas equivalent with adequate incentives. In California, for example, several programs support electric vehicles including the LCFS, and the HVIP program.

The LCFS is designed to reduce greenhouse gas emissions in the transportation sector. The program defines a set of low-carbon fuels, including electricity, that can generate LCFS credits.[26] Petroleum importers, refiners, and wholesalers with a carbon intensity higher than the standard must acquire these credits to be compliant with the program. Companies that operate electric trucks can generate and sell LCFS credits and receive significant revenue from the credit market.[27] **Figure 1** highlights how important this LCFS credit is to the total cost of ownership of an electric truck in California.[28]

Another example of a state financial incentive is California's HVIP, which is administered by the California Air Resources Board and CALSTART, a clean transportation non-profit, and is intended to increase the number of cleaner and more efficient trucks and busses in the state.[29] Any commercial user operating in California is eligible as long as the vehicle purchased is domiciled and operated for three years in California after a voucher is redeemed. Similarly, in New York State, there is a Truck Voucher Incentive Program (NYTVIP), administered by the New York State Energy Research and Development Authority (NYSERDA), which aims to remove older diesel engines and increase the number of cleaner technologies on roads.[30] The Texas Clean Fleet Program also offers incentives to operators of large fleets of light- or heavy-duty vehicles in Texas to replace their diesel-powered vehicles with alternative fuel or hybrid vehicles.[31]

Tax credits are also available for electric vehicles, in Utah and Colorado.[32,33] Companies considering EVs may wish to research and apply for incentives in the jurisdictions where they operate to see what they can specifically qualify for. The U.S. Department of Energy's Alternative Fuels Data Center is centralized resource that can be used to identify these incentives.[34]

Today, incentives are a major—if not the most—critical factor influencing a company's decision to electrify its vehicle fleet, because most of their impact on EVs' financial competitiveness comes while they're still new and comparatively expensive. According to one company interviewed, states and cities will need to offer incentives if they want significant deployment of zero-emission, heavy-duty transport in the next three years. Another company noted that the renewables electricity sector moved because of the various incentives offered and believes that longer-lasting incentives that can span over multiple years will be foundational for electric trucks as well. However, one barrier retailers face in accessing incentives is due to their outsourcing of delivery and transport to third parties, who might also outsource to other vendors. Companies that may initially qualify for incentives may not be able to pass them on to other parties, rendering the incentives no longer useful as a result.

LEASING VERSUS OWNING

There are a combination of factors that go into whether a company elects to lease or own a truck, regardless of whether it is diesel or electric, including resale value, payback period, and reliability.[35] The decision will vary for each company depending on its fleet size, anticipated duration of ownership and operation of its vehicles, financial standing, and financing options.[36] The issue of resale value poses a challenge to the industry since electric trucks are a comparatively new product and resale prices are relatively low.[37] While the diesel trucking industry has many years of data to calculate the residual value of diesel trucks, similar data does not exist for electric trucks.[38] To overcome this, one company currently piloting electric trucks said it had discussed the fair market value of the electric truck with its original EV manufacturer to compensate for the lack of available market information so it could appropriately calculate the residual value as it considers the decision about leasing or owning.

Another company theorized leasing may avoid a significant issue that has previously impacted natural-gas truck

adoption: sensitivity to diesel prices. In that case, diesel prices fell at the same time incentives for natural gas vehicles phased-out. The result was a significant decline in the resale price of natural gas trucks. In this case, leasing rather than owning would have avoided the negative cost impact. Another area of concern was regarding the pace of technological change and how it could be incorporated into leases. As batteries become more efficient and improve their quality, companies may want to replace older batteries even before their end of useful life. In this case, an electric truck may have separate leases for the battery and the truck itself. In general, rapid technological change makes it difficult to predict the resale value.[39]

CHARGING EQUIPMENT

Charging equipment is also important to the total cost of adding electric trucks to a fleet. Today there are many types of charging equipment, depending on the desired charging speed and level of power. Level 1 chargers use between 1.0 and 1.4 kW, and Level 2 chargers are between 3.6 to 19.2 kW, both using alternating current (AC) current. A Level 1 charger in an eight-hour period can provide about 40 miles of range. A Level 2 charger in the same eight-hour period would provide about 4 times more range, or more than 160 miles.

In contrast, Direct Current Fast Chargers (DCFC) consume between 20 and 350 kW and use direct current (DC) current. In one hour, they can often provide the same range achieved from eight hours on a Level 2 charger.[40] DC Fast Chargers may eventually become the industry standard because of their speed, even though they are substantially more expensive than Level 1 or 2 chargers. According to the U.S. Department of Energy, a Level 2 charger is in the range of $400 - $6,500, whereas a DCFC is in the range of $10,000 - $40,000 (not including installation) or utility upgrades.[41]

Added to the equipment costs are those associated with permitting, site plans, and possible electrical upgrades. Equipment and installation costs, however, are not the only consideration. Charging stations also have ongoing maintenance costs. Related to this is the indirect cost that can arise if a vehicle has to charge at a public charging station and is out of service for that time period. This can also be the case for fleet-owned charging stations if the company does not plan properly for vehicle charging.

Instead of owning the charging infrastructure, a company may also opt for simply using public charging stations. It allows a company to avoid the need to procure and build out charging infrastructure itself, even though the per-kWh fees will likely be higher than charging at the company's own depot. On the other hand, charging at a home base depot has the advantages of enabling charging to occur during EV downtime, when the vehicle is not running its normal routes, including at night when electricity rates might be lower.[42] In addition, depot charging allows a company the autonomy to select the number and type of charging stations it prefers to use for its fleet. Ultimately, charging costs will depend on the company's strategy, the number of EVs charging, the time of charging, the type of charging equipment, and the number of charges per day.[43]

One company interviewed was keenly focused on developing a charging infrastructure that would not negatively impact the local grid or their company's energy budget. Additionally, since the company's fleet is constantly being deployed, and there is not a lot of downtime for its trucks, the company's plan was to install only DC Fast Chargers. Concern about the grid is valid. For companies with large fleets who may charge simultaneously, there can be potentially adverse local and regional consequences on the power grid. Increased electricity demand for charging infrastructure during peak electricity usage times could strain the electric transmission and distribution system or require the electric utility to call additional generating units into service. As companies build out their charging infrastructure, it will require intimate coordination between the company and the local electric utility throughout the fleet electrification process so that potential power issues can be avoided.

Any operational change a company makes inherently comes with adoption costs. As one company noted, to include electric trucks in their fleet, identifying the right equipment, procuring it, and working with the electric utility, had an upfront cost which would be higher than simply buying more of the same type of diesel vehicle. With EVs, however, there is the ability to significantly reduce fuel costs in the long term, mitigating these additional upfront costs.

FUEL COSTS: DIESEL VERSUS ELECTRICITY PRICES

Historically, electricity prices have shown less volatility than diesel prices.[44] The unpredictability of diesel prices, and fuel costs more generally, can make budgeting for these costs more challenging. Electricity prices, in contrast, tend to be more stable and predictable. This is

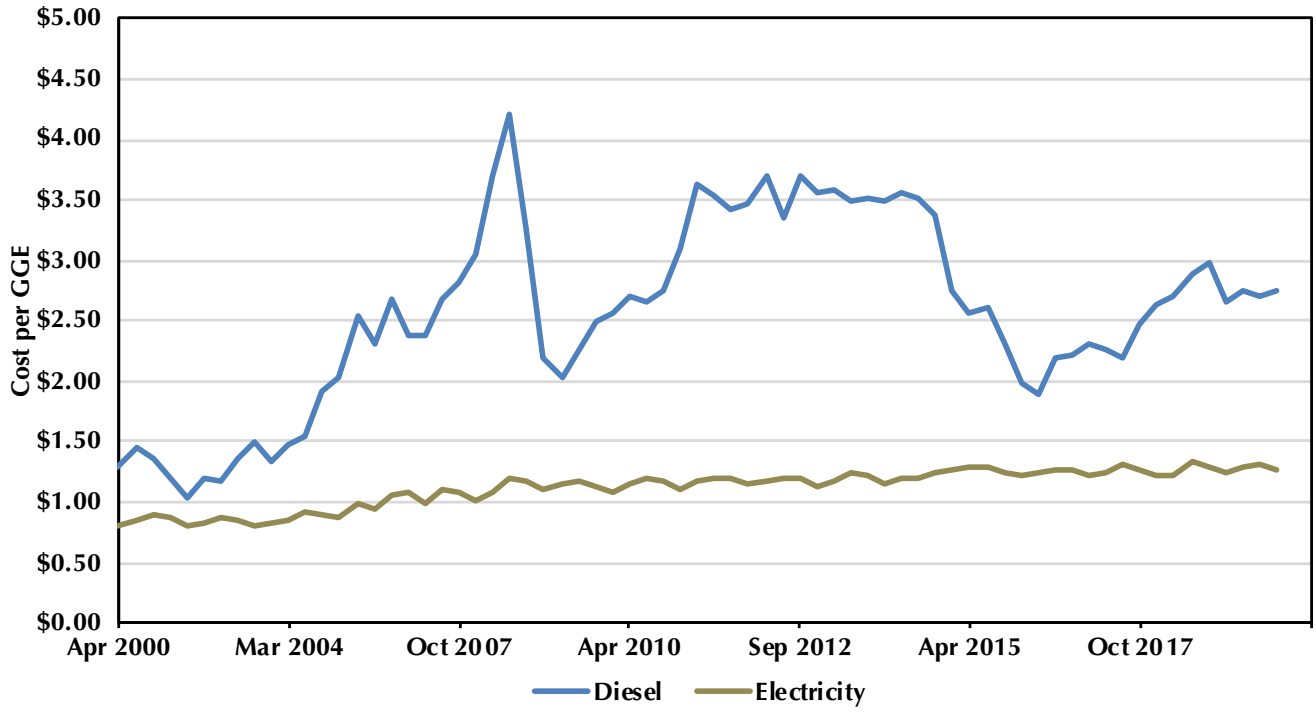
illustrated in **Figure 2** below, where diesel and electricity prices in the United States are compared in dollars per gasoline-gallon equivalents for the last 20 years.[45]

While average national retail prices of electricity are relatively stable, local retail prices will vary.[46] In addition, the electric utility include other charges in their rates besides the cost of electricity, including transmission and distribution costs and demand charges, which are charges based on times of highest electricity use in a given month. Demand charges are typically incorporated into commercial and industrial rates, intended for large buildings and industrial users that use electricity constantly.[47] They can often penalize customers who charge EVs since they draw a high volume electricity when plugged in, even if they are charging a time when the electricity rates are lower. Recently, however, Southern California Edison (SCE) and Pacific Gas and Electric (PG&E), two of the largest utilities in the United States, approved new commercial EV rates that ameliorate this demand charge problem. SCE's rates eliminate demand charges through 2024 and replace them with time-of-use rates that encourage customers to charge when renewable energy is more prevalent and costs are lower. The utility will phase demand charges back in after five years, when it forecasts more EVs will be on the road. Additional charging infrastructure will also be built, and more customers will be able to absorb the demand charges over more hours of charging.[48] Meanwhile, PG&E's new lower rates are permanent and include reduced rates for different types of charging customers, including medium- and heavy- duty vehicles. The new rates will enable more than 40 percent savings over the current rate structure such that users will pay roughly half the price they previously incurred with gas or diesel trucks, as seen in **Figure 3**.[49]

MAINTENANCE COSTS

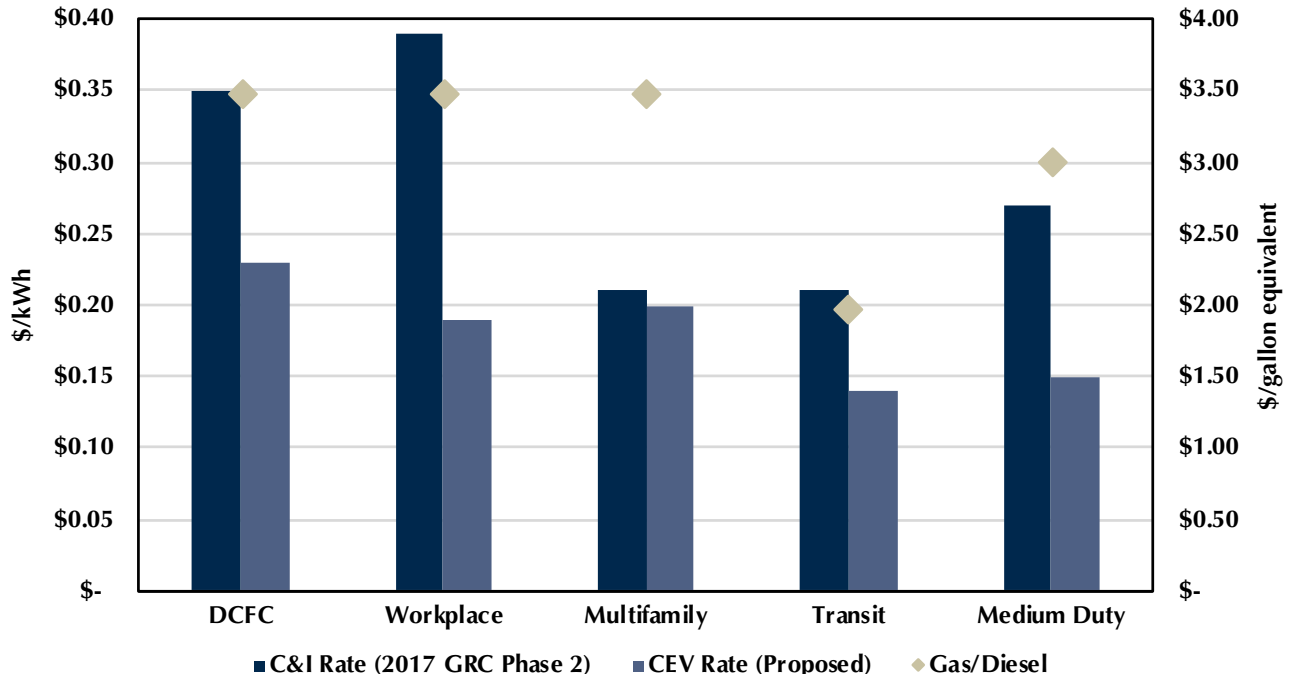
With electric trucks, maintenance costs differ drastically from diesel trucks because electric truck equipment wears significantly less. The cost for transmissions, belts, valves, and scrubbers is drastically reduced, since these parts are no longer needed. An EV manufacturer reported that regenerative braking is so effective, it can almost replace wheel brakes. Because of this, EV truck brake

Figure 2: Average Retail Fuel Prices in the United States



Source: U.S. Department of Energy

Figure 3: Estimated Average Rate Costs and Costs Per Gallon Equivalent



Source: Pacific Gas & Electric

pads can last up to 1 million miles, compared to 400,000 to 600,000 miles for the average diesel truck brake pad.[50,51] Compared to an average internal combustion engine vehicle, studies have shown the costs for maintenance and repair for an EV are much less over a vehicle's lifetime. These costs are estimated to fall between 18 to 45 percent on an annual basis.[52,53]

While EV maintenance costs are anticipated to be lower, finding services providers may be challenging. Not all service stations and third-party service providers have the needed expertise or equipment to work on EVs. To compensate for this, one company plans to rely exclusively on their EV manufacturer's dealer network to service its fleet. Another company said maintenance and support services are one of the first topics of discussion with EV manufacturers.

Companies also noted it is critical to know whether there will be any additional time required to order and receive EV parts, as delays would hinder their ability to return vehicles to normal flow of operations. As more EVs of all types are deployed, however, it is reasonable to expect that the availability of parts and the experience of third-party service providers will increase, and that a national network will develop to support the increasing number of EVs in the economy.

Firms that own electric trucks, however, may also need to provide additional training for their in-house servicing technicians. One company was concerned that while maintenance costs may be less overall with electric trucks, they may require additional equipment and different knowledge to maintain. For example, diesel trucks have at least 10 on-board computers, but electric trucks have more than 30. The equipment and costs of managing those electronics will likely be more focused on that component than it would be on a diesel engine. The company noted that it needed to have a reliable set of solutions available on-site. This includes knowledgeable technicians trained on software systems and available truck parts, including batteries, which are currently significantly more expensive for EVs than for diesel vehicles. This same company further explained that before it would completely replace its diesel fleet with EVs, it would need to have more confidence in development of a national network of maintenance experts and service

providers.

As this national network of third-party service providers evolves, companies like the ones interviewed for this brief will likely continue to rely on the vehicle manufacturers to provide much of the necessary service. Engaging with the manufacturers is also important for technology development. When one company was testing out electric trucks, it reported to the manufacturer that battery life was degrading faster than expected, and a battery was not holding a charge as long as it did in the beginning of its life. The company also had issues with air conditioning, finding there were not enough vents to cool the cabin. The company relayed this feedback to the EV manufacturer, who was very receptive to the comments. Notably, electric truck developers are already starting to design models for specific purposes, based on what users are telling them. This can help reduce the total cost of ownership and help EVs reach parity with diesel trucks sooner.[54]

OVERCOMING BARRIERS TO THE DEPLOYMENT OF ELECTRIC TRUCK FLEETS – A FIRST STEP

To overcome some of the concerns with electric trucks, one company recommended electric yard trucks (**Figure 4**) be used at site distribution centers as a good first step for integrating electric trucks into the company's business operations.[55] The electric yard trucks cost less than many other Class 8 heavy duty vehicles on the market, $200,000 – $285,000 before financial incentives are taken into account.[56] Because yard trucks stay on company property, they also do not require national EV charging infrastructure to be built out or direct-current EV chargers. The minimum charging capacity needed would be 80 to 100 kW. Yard trucks move trailers of goods around a company lot, so they can serve as a small-scale pilot for companies just beginning their electrification journey. A company that piloted electric yard trucks in both Kansas and California plans on continuing to use them in these locations, in addition to doing other types of pilots.

In general, this company reported that its drivers were satisfied with the level of power when driving the electric yard trucks. In addition, the EVs are much quieter than diesel engines, which the drivers liked. What's more, the elimination of diesel fumes is a bonus that the company thinks might help improve driver retention. Notably, health benefits from improved hearing and reduced diesel fume inhalation may also help reduce a company's healthcare costs and increase its profitability.

Figure 4: Example of an Electric Yard Truck, a Class 8 Heavy-Duty Vehicle

Source: Kalmar

OVERALL TAKEAWAYS

Overall takeaways from interviews and research for this project include the following:

- Electric trucks are still very costly, but incentives can reduce upfront costs and are one of the most important factors influencing whether a company in decides to electrify.
- California has a collection of incentive programs at the state and utility level that help significantly lower the total cost of ownership for electric trucks, including the LCFS and HVIP.
    - New York, Texas, Utah, Colorado also offer incentive programs, and companies are encouraged to look for incentives that their fleets might qualify for, possibly through local utilities.
- Several companies noted that operators of California fleets should strongly consider electrifying at least a portion of their fleets to take advantage of the financial incentives available.
- Electric heavy-duty vehicles have many tangible benefits, including several inherent health advantages. These include a much quieter ride than diesel trucks, making EVs less impactful on a driver's hearing, and no tailpipe emissions. It's also important to note the secondary overall health benefits of reduced emissions from electricity generation as the grid gets cleaner and more efficient EV motors.
- As retail companies electrify their fleets, a company's energy team should work with the fleet management team to maximize organization-wide efficiencies such as procurement and energy management. Without collaboration, costs could be much higher.[57]
- There are still some unknown variables around maintenance despite lower overall lifetime maintenance costs compared to diesel. One company interviewed planned to work with the EV manufacturer's dealer network on servicing for the vehicles, but companies will still need technicians who are trained for electric trucks and savvy on new electronic software systems.
- Communication between electric truck users and EV manufacturers is an important part of the electric truck development process. One retail company said EV manufacturers were very receptive to feedback on usability and ergonomic design from companies who piloted EVs. This is an important aspect of the development process and can help with technology improvements and potentially accelerate the speed of deployment as manufacturers better understand what potential users want.[58]

CONCLUSION

Companies starting to electrify their fleets need to consider their use cases and the speed at which they want to replace diesel trucks. While there are many cost drivers that go into determining an electric truck's total cost of ownership, companies are primarily concerned with the upfront cost of the vehicle, charging infrastructure, and maintenance. The concern about high upfront costs highlights the importance of financial incentives. Some recent studies have concluded that depending on the application and location of use, electric trucks can be cost competitive with diesel on a total cost of ownership basis.[59] This is largely due to state incentives and reduced fuel costs, where electricity was found to reduce fuel costs between 30 and 75 percent, depending on vehicle and fuel price assumptions.[60] Piloting companies reported that test drivers were pleased with the power that came from driving electric yard trucks, and all interviewees noted the health benefits that come from the quieter heavy-duty EVs and elimination of diesel fumes. Overall, companies interviewed were optimistic about the future of electric trucks.

The retail and trucking companies interviewed are interested in further evaluating the technology as it develops. Any organization looking to electrify will need an overarching customized electrification strategy and to execute it successfully. In addition, companies need to factor in lead time needed for planning, ordering, permitting, and installing charging infrastructure.

As companies electrify their trucking fleets, it will be critical for their energy team to collaborate with their fleet managers, which will already have existing relationships with their utilities or electricity providers. Traditionally, these staff have worked separately, but as electricity becomes a common fuel source for a company's buildings and vehicles, it is imperative that the teams collaborate.[61] They can strategize on short- and long-term fleet operations and how to optimize charging to minimize costs and maximize profitability, all while maintaining service to customers.

In addition to increased internal cooperation, companies will also need to have iterative conversations with their local electric utility, service providers, and other contractors as they electrify. Engagement with these stakeholders can facilitate a smoother transition by creating customized solutions that can potentially reduce risks and provide overall benefits to the company and the local distribution grid as well. Companies do not need to have all details planned out before initiating, but the key is beginning to have these conversations and engaging with the different parties. As the costs of batteries continue to decline and prices of electric trucks decrease, EV technology improvements will also occur. With the support of robust incentive programs, electric trucks can be a part of a retailer or carrier's electrified fleet solution.

Glossary of Terms

Drayage – Transporting cargo over a short distance, often between within a metropolitan area between ports, distribution centers, or other shipping hubs.

Regenerative braking – In an electric or hybrid vehicle, a means of reclaiming the kinetic energy during braking and storing it in the battery to be used later to power the vehicle.

Yard truck – Trucks used in short distances around freight terminals, ports, and warehouses. Also known as a terminal tractor or mule, they are classified as a heavy-duty vehicle (Class 7 or 8).

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ENDNOTES

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