INTO THE FAST LANE:

Investing in the Future of Zero Emission Trucking

ESG BY EDF: INVESTOR INSIGHTS FOR A LOW-CARBON WORLD

ESG By EDF is a suite of investor-oriented research products providing insights on transition issues in carbon-intensive sectors informed by EDF expertise in science, policy and industry.

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Image Credit: Freightliner

Highlights

- **Medium- and heavy-duty trucks are a major source of CO_2 and air pollution.** Over 30 million trucks on US roads generate 7% of US greenhouse gas emissions - more than aviation, maritime shipping and rail combined. Trucks also negatively impact human health, disproportionately affecting overburdened communities.

- **Eliminating truck-related climate pollution is critical to net zero pathways.** To achieve climate goals, companies that use road freight should take steps to eliminate truck-related emissions. By tackling this issue head on, companies can reduce transition risks and maximize the benefits from adopting zero emissions technologies.

- **Investors should call for faster action from carriers and shippers.** Many companies that own or use trucks have not set clear strategies and commitments around decarbonizing road freight. Investors should press them to do so.

- **Key asks.** Investors should ask all carriers and shippers to: 1) commit to zero emissions (ZE) trucking by 2040, 2) set interim ZE trucking goals, with application-specific targets; 3) commit to deploying ZE trucks to pollution-burdened communities first; and 4) advocate for clean transport policies at the state and federal levels. Companies should also disclose trucking-related emissions and progress toward ZE targets.

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Definitions

Truck OEM: A company that manufactures trucks.

Leasing operator: A company that purchases, procures and services trucks to customers like carriers or trucking companies.

Carrier: A company that provides transportation services, typically owning or leasing and operating transportation equipment. These companies provide trucks and transport goods an behalf of shippers.

Logistics operator: A company that provides physical logistics operations (such as warehousing, distribution and transportation) to meet a shipper's or carrier's needs.

Shipper: A company that is responsible for the movement of product that must be transported. Shippers use services from carriers, logistic operators or internal fleets to transport their goods to customers or move inventory.

Drayage: Short movement of goods between transit modes, most often from a port to a warehouse.

Zero emissions (ZE) vehicle: A vehicle producing zero tailpipe emissions: either a battery electric vehicle (BEV) or a hydrogen fuel cell electric vehicle (FCEV).

Medium and heavy duty (MHD) truck: A vehicle with a gross vehicle weight over 8,500 pounds; the category comprises Federal Highway Administration truck classes 2b – 8.

Executive summary

If global commerce had a mascot, it might be a truck. Trucks are ubiquitous - a critical means to get raw materials to manufacturers and finished goods to consumers. Equally familiar are the exhaust plumes that so often trail behind them.

Medium- and heavy-duty (MHD) trucks are a major source of air pollution, generating significant climate-warming emissions as well as particulates and other pollutants that are harmful to human health. The internal combustion engines (ICEs) in MHD trucks collectively generate 7% of US CO_2 emissions. Avoiding the worst impacts of climate change will require drastic reductions in the emissions produced by MHD trucks today.

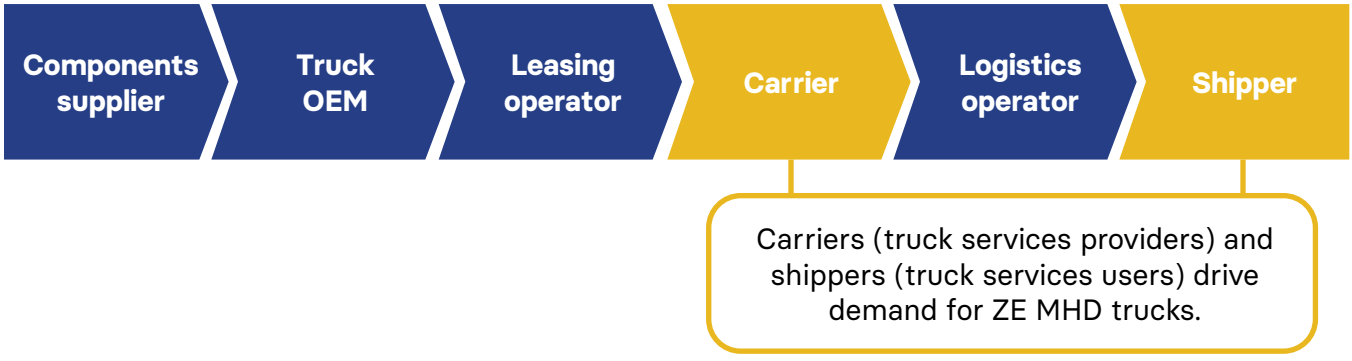
Pollution from trucks also causes major adverse health impacts. More than 20,000 people die prematurely every year in the U.S. due to pollution from highway vehicles, and the health impacts of commercial truck emissions are borne disproportionately by lower-income and minority communities. A recent EDF study estimated that transitioning to 100% zero emission (ZE) truck sales by 2040 would, within a decade, generate nearly $500 billion in health benefits and avoid more than 57,000 premature deaths in the U.S.

For companies, reducing trucking emissions not only reduces climate and health impacts, but also represents best practice from a risk management and governance perspective. Consumers and the general public are becoming increasingly engaged around supply chain emissions, and companies that fail to address the issue risk losing market share. For investors, assessing companies' adoption of and progress on ZE trucking goals is a means of identifying ESG leaders.

In light of the enormous business opportunities associated with ZE trucking, as well as the barriers that stand in the way of a rapid transition, companies throughout the transportation value chain should be developing trucking transition plans and publicly engaging on clean transport policy. Different players involved in trucking, illustrated in Figure 1, have different roles to play.

In this report we focus on the central role of carriers (trucking service providers) and shippers (trucking service users) in driving the transition to ZE trucking. As the primary operators and users of commercial trucks, these companies can have a major effect on the pace of the transition. By engaging with these companies, investors can help bring the transition to emission-free trucking "into the fast lane".

Figure 1:
Trucks corporate value chain



ZE technologies: increasingly ready

The availability of ZE technologies for MHD trucking has evolved rapidly over the past decade thanks to advances in systems such as vehicle batteries and charging infrastructure. A significant number of ZE MHD truck models are available now, and many more are expected to enter the market over the next 3 years. In many respects, these ZE trucks are superior to the ICE vehicles they replace – quieter, cleaner-operating, with better acceleration and requiring less maintenance. On a total cost of ownership (TCO) basis, some are price-competitive with ICE vehicles, particularly when government incentives are factored in. Most vehicle classes are projected to have cost-competitive ZE options available within a few years. Given the lead times required to integrate new vehicles into complex logistics systems, companies should take steps today to incorporate these new vehicles into their operations.

Due to the long-lived nature of transportation assets and infrastructure, actions taken now will have decades-long consequences for individual companies, the climate, and public health. Investors looking to manage ESG risks in their portfolio should address trucking and push companies to take a "pedal to the metal" approach to the ZE transport transition.

In this report, we provide information to help investors engage with carriers and shippers about fleet emissions. This includes recommended commitments and disclosures, opportunities and obstacles associated with ZE trucking and examples of ZE trucking deployments and commitments by leading carriers and shippers. In the appendices, we review U.S. federal and state policies related to ZE MHD trucks, as well as key institutions involved in trucking decarbonization.

The Ask: Key commitments and disclosures for carriers and shippers

The ZE trucking value chain includes distinct segments including truck makers and suppliers, electric utilities, and charging infrastructure providers. This report focuses on two segments that are particularly important in determining the pace of the transition to ZE trucking: the carriers that provide trucking services, and the shippers that contract for trucking services.

Carriers and shippers are instrumental to ZE trucking demand, and their needs will drive the business decisions of other stakeholders. Carriers, as the truck owners and operators, introduce ZE trucks into their fleets, install charging infrastructure, and adapt their operations to the features of the new vehicles. Demand from shippers, as the underlying users of trucking services, influences the pace at which carriers introduce ZE services. In addition, many shippers own their own private fleets and may transition those as well.

Investors can engage with both types of companies to encourage comprehensive decarbonization strategies and assess their progress in reducing trucking emissions. It is critical to begin integrating ZE trucks into fleets right away, both because companies will require time to adapt ZE trucking to their operational needs, and because assets introduced today will have multi-year climate and public health impacts.

Commitments

Investors should seek the following commitments from carriers and shippers:

1. **Commit to zero emission trucking by 2040.** This commitment should be part of a broader freight decarbonization strategy. Given the large emissions footprint of trucking and its direct impact on community health, as well as the fact that commercial solutions to decarbonize trucking exist today -- not yet the case for shipping and aviation -- it is important to be explicit about trucking goals. A number of leading shippers and carriers have made this commitment, including Walmart, PepsiCo, Colgate-Palmolive and FedEx, as noted in Chapter 6. More should so do.

2. **Set interim ZE trucking goals, with application-specific targets.** Achieving zero emissions road freight by 2040 requires taking action today. However differing operational needs and technological readiness across types of trucking means that some applications will be ready to transition to ZE vehicles sooner than others. Interim targets on the path to zero emissions trucking should reflect this. Carriers should plan to increase ZE vehicle deployments over time, and shippers should increase ZE usage over time. Below we recommend application-specific interim targets, reflecting the phased commercial availability of ZE vehicles for different use cases, on the path to zero emissions by 2040.

3. **Commit to deploying ZE trucks to pollution-burdened communities first.** Carriers and shippers should prioritize the launch of ZE trucks in areas that bear disproportionate burdens of pollution and associated health risks. To do this, companies should assess the impacts of trucking facilities that they operate or use -- such as distribution centers and warehouses – and the health and demographic profiles of neighboring communities.

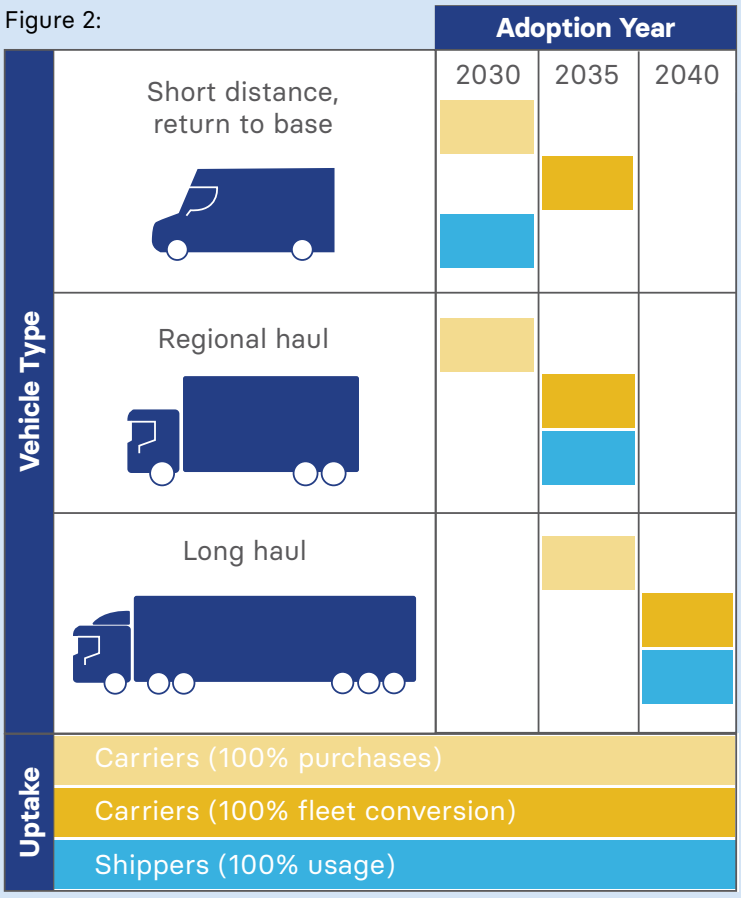
4. **Advocate for clean transport policies at the state and federal levels.** Sound policy is one of the most powerful tools to drive emissions reductions. Carriers and shippers should support policies that accelerate the transition to ZE trucking and align their lobbying with those goals.

Application-specific targets for carriers and shippers[1]

While some carriers and shippers may move faster in some operational areas, we recommend the following minimum time-based targets for carriers and shippers:

1. **Short distance, return-to-base operations.** Many segments that involve short duty cycles and overnight parking at a depot can be addressed by ZE vehicles that are currently available in the market. Carriers should begin purchasing these vehicles right away, while shippers should seek ZE trucking services in these segments. Examples include local delivery, refrigerated transportation, yard trucks and drayage.
   - Carriers: 100% ZE purchases by 2030, 100% ZE fleet by 2035
   - Shippers: 100% ZE usage by 2030
2. **Regional haul.** These segments involve longer distances and may not return to a depot each night, potentially requiring access to public charging infrastructure.
   - Carriers: 100% ZE purchases by 2030, 100% ZE fleet by 2035
   - Shippers: 100% ZE usage by 2035
3. **Long-haul.** Long haul is the most difficult segment to transition to zero emissions, due to the distances travelled and less predictable routes.
   - Carriers: 100% ZE purchases by 2035, 100% ZE fleet by 2040
   - Shippers: 100% ZE usage by 2040

Figure 2:



[1] Carrier targets apply to shipper private fleets.

Disclosures

Commitments to decarbonize trucking should be accompanied by disclosures, allowing investors and other stakeholders to evaluate progress towards those commitments. While some carriers disclose trucking emissions data, few provide concrete details on the deployment of ZE vehicles. Shippers generally provide limited or no details about the emissions footprint of third-party shipping. While sustainability accounting standards such as SASB require transportation companies to provide some data (Scope 1 emissions and fuel consumed), the standards do not generally require shippers to disclose their trucking or freight footprint.

Investors should seek the following disclosures:

1. **Carriers and shippers: trucking emissions.** This should include both emissions from a company's owned trucks (scope 1) and trucking services provided by third parties (scope 3). These disclosures should be part of a broader disclosure of transportation emissions, broken down by freight modes including road, air, rail and maritime shipping.
2. **Carriers:** Share of new truck purchases that are zero emission and share of miles travelled that are on ZE vehicles. Both items allow stakeholders to gauge progress towards implementing zero emissions goals.
3. **Shippers:** Share of trucking miles from third parties that are on ZE vehicles. Transportation management system platforms should be updated to provide this information. Disclosures on the way ZE goals are included in trucking procurement are also helpful.
4. **Carriers:** Share of ICE truck originations from facilities in pollution-burdened communities. A disproportionate share of ICE truck emissions come from activities during trip origination, and transitioning depots in overburdened communities to serve ZE vehicles can reduce the associated health impacts.
5. **Carriers and shippers:** Direct and indirect lobbying expenditures. Transparent lobbying disclosure enables accountability for corporate climate policy activities.

Questions to ask management about ZE trucking

When engaging with carriers and shippers on ZE trucking, the following questions can guide investors:

1. What is your strategy for reducing truck-related emissions?
2. What are your truck-related emissions targets, both overall and specific to applications?
3. How does your trucking strategy address the health and equity impacts of your logistics operations?
4. If you own trucks, have you acquired any ZE vehicles and what is your plan to acquire them?
5. For outsourced shipping, have you engaged with carriers to signal your commitment to ZE trucking services? Do you have providers that offer ZE trucking and have you used this offering?
6. For which segments have you tested ZE vehicles (i.e.: home delivery, drayage)?
7. Have you invested in charging infrastructure to support ZE trucks? What needs have you identified in discussions with charging providers and/or the relevant utilities?
8. What kinds of federal or state policies would be helpful in meeting your EV truck commitments or goals? Do you engage in policy advocacy to support ZE trucking?

The trucking transition imperative

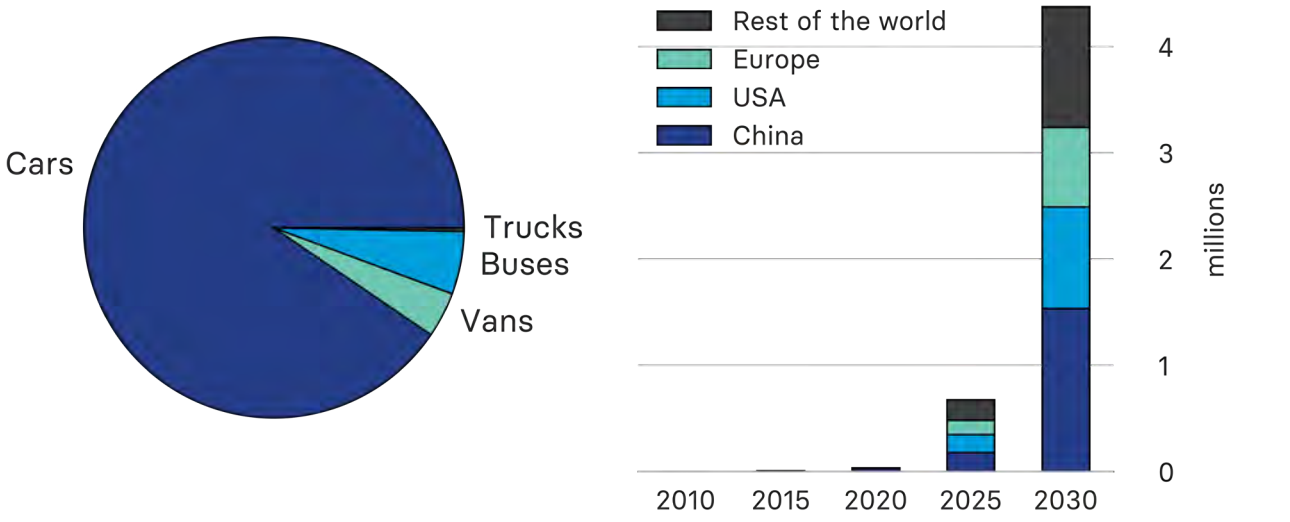
MHD truck market size

The U.S. MHD trucking fleet is estimated at around 30 million vehicles, ranging in size from vans to tractor trailers, compared with a global fleet of around 400 million vehicles. Over 8 million people work in trucking and warehousing in the US, including 3.5 million truck drivers. Trucks are associated with the generation of 5% of global GDP ($4.1 trillion), growing to 12% of global GDP ($9.6 trillion) if related logistics and services are included.

The transition to zero emissions trucks is just getting underway in the United States, which reported just 240 new ZE heavy truck registrations in 2020. Globally, just 0.2% of the MHD fleet is zero emission, according to the IEA, and most of these trucks are in China. Among heavy vehicles, only electric buses have made significant inroads, with a fleet of 600,000 units globally, 40% of the total bus fleet.

In its sustainable development scenario, the IEA projects a big increase in ZE trucks going forward, however, reaching 170k units in annual sales in the US in 2025 and nearly 1m units per year in 2030 (a 45% compound annual growth rate). It bears noting that the IEA has consistently underestimated the pace of sustainable technology adoption in the past.

Figure 3:
Electric vehicle mix (left), Electric truck stock by region (right)



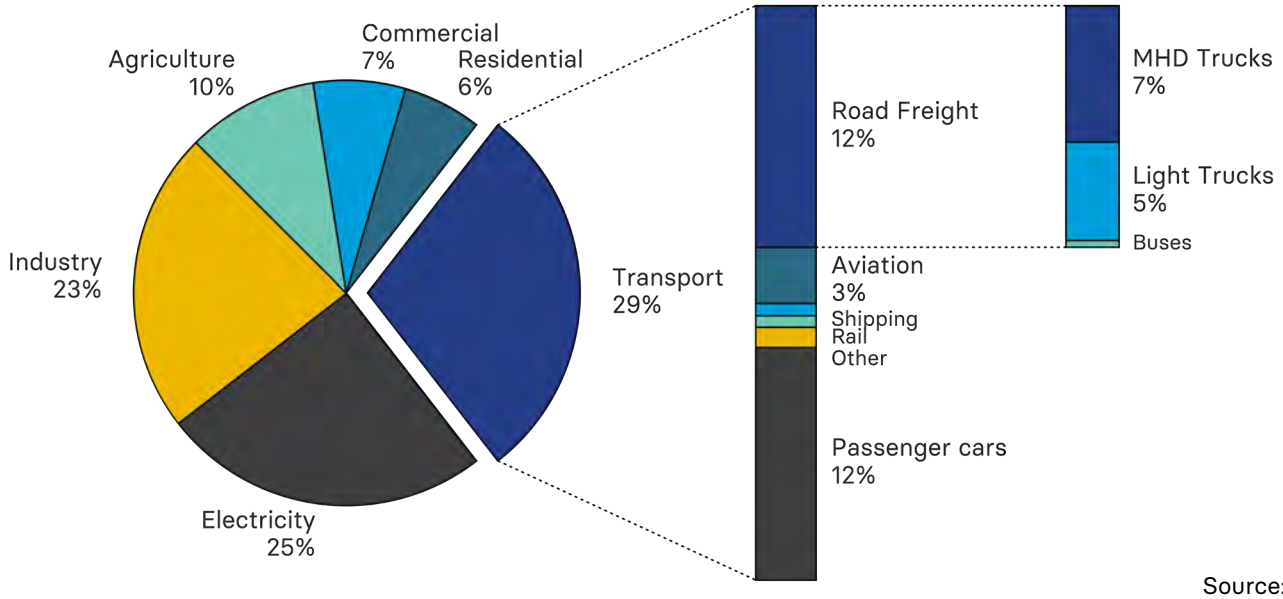
Source: OICA, IEA

Climate impact of trucking

Reducing truck emissions is crucial to limit climate change. In the United States, transportation generated 29% of global greenhouse gas (GHG) emissions in 2019, and road freight accounted for 12% of all emissions, of which slightly more than half (7%) was MHD trucks. This is more than the emissions of aviation, maritime shipping and rail combined (5%). In contrast with passenger cars, which have witnessed a surge in growth of zero emission vehicles, road freight has received less attention despite being a large emissions source.

Figure 4:

US GHG Emissions (2019)



Source: EPA

Addressing this issue in the United States is important because the country generates more road freight emissions than any other country (21% of the world total). In the US, road transport's share of total country emissions is one of the higher transport shares of the top emitters (among the top 10, only Brazil and Mexico are higher -- Figure 5).

Figure 5:

Road Freight Emissions

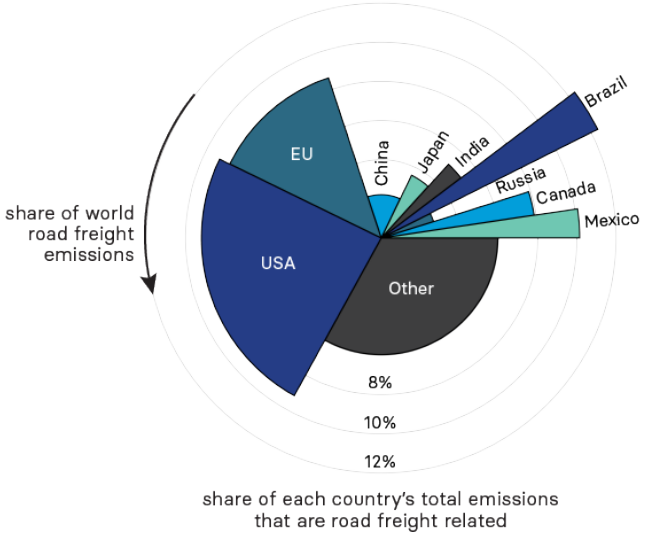
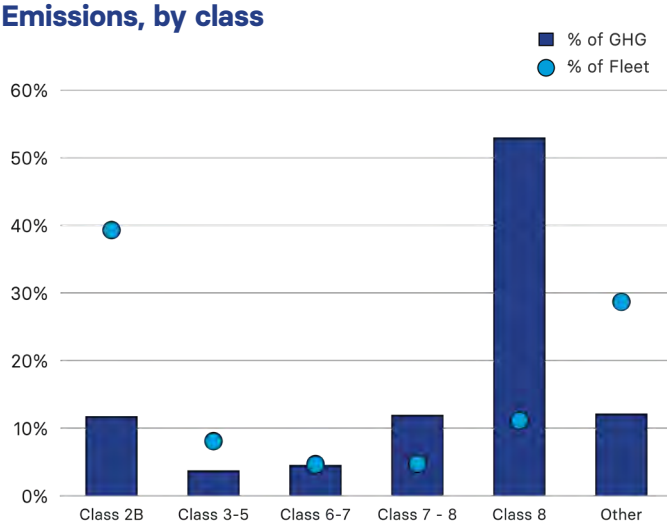


Figure 6:

MHD Share of Fleet and of GHG Emissions, by class



Source: MJ Bradley

The US trucking fleet is highly diverse, containing vehicles with a range of shapes, sizes and uses. The emissions footprint varies as well: the heaviest trucks – class 7-8[2] -- generate nearly two-thirds of the emissions of the MHD truck fleet, despite representing 15% of the number of vehicles.

[2] Consisting of long haul tractors, regional haul tractors and heavy box trucks.

Health impacts

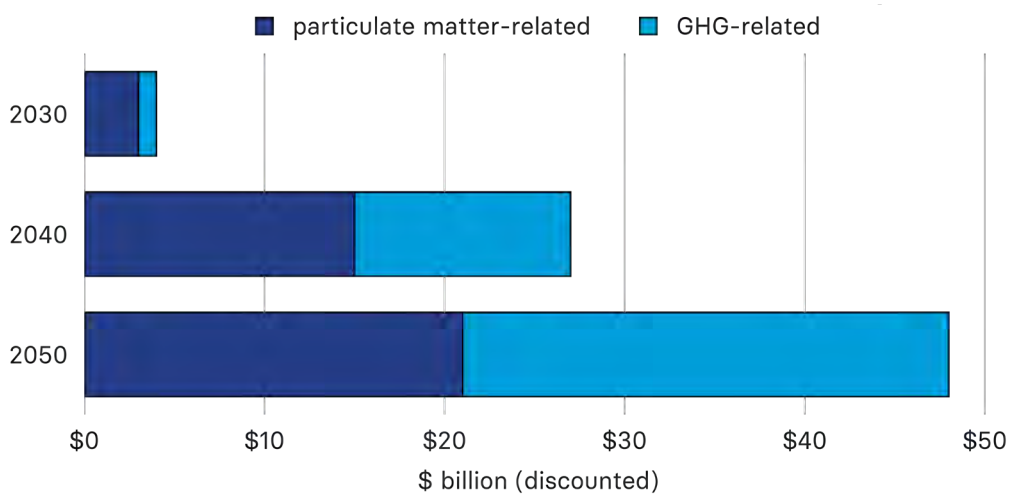
Truck pollution causes adverse health impacts to those who live close to highways, ports, freight depots and other concentrated emissions sources. More than 20,000 people die prematurely every year in the United States due to pollution from highway vehicles, and more are hospitalized for asthma, heart attacks or strokes, or missed work. Despite being only 4% of all registered vehicles, diesel vehicles are responsible for 60% of the air quality health impacts from vehicles.

An EDF study examined the potential health benefits of a transition to 100% zero emission truck sales by 2040, finding nearly $50 billion in health benefits per year by 2050, a cumulative impact of $485 billion, saving over 57,000 Americans from premature death through that time (Figure 7). Commercial diesel trucks take a heavy toll on neighborhoods along their routes, with studies finding more than a doubling in transportation-related air pollution on designated truck routes compared with freeways where trucks are prohibited.

Pollution sources are more likely to be sited near communities of color and low-income communities, and warehouses and distribution centers are no exception. Regardless of their state or income, African-Americans are exposed to 26% higher levels of soot from heavy-duty diesel trucks than the national average. This results in a three times increase in risk of death, compared to the national average.

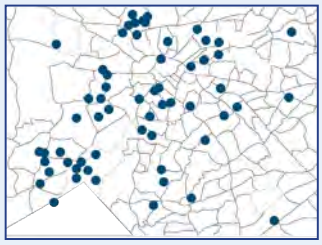
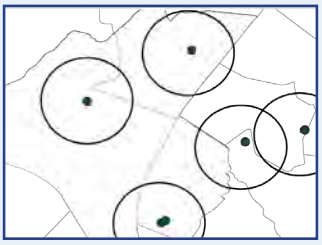
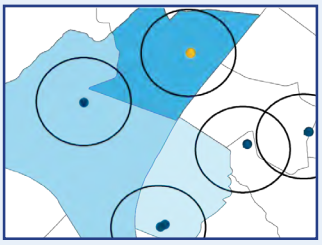
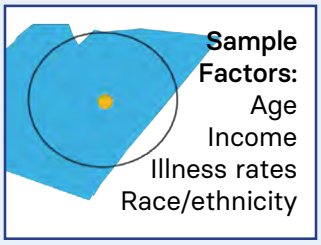
Truck depots that service diesel MHDs are an obvious target for conversion to zero emissions logistics. Truck turnarounds – also known as trip originations – are a count of how many truck trips begin at a given facility and are a useful proxy for the level of truck-related emissions generated there. Vehicle starts, especially cold starts, and vehicle idling both account for significant proportions of a truck's overall emissions profile and frequently occur with trip originations from depots. Trip originations from a particular facility can be overlaid with neighborhood demographic and other data to identify communities that are at risk for heightened health impacts. Truck facilities in such overburdened communities should be prioritized to serve ZE trucks.

Figure 7:
Health benefits to US from 100% new MHD sales by 2040



EDF developed Proximity Mapping, an approach that identifies demographic and health information of people living close to warehouse facilities in the United States, to visualize the proximity of low-wealth and minority communities to areas where trucks are concentrated. Application of the tool in Arizona found that people living near warehouses were 80% more likely to be Black than the Arizona population as a whole. Similarly in New Jersey, 80% of people living near warehouses live in a community identified as overburdened by pollution. Compared to state and national averages, some communities located near truck routes disproportionately suffer from health problems linked to truck pollution such as asthma, chronic heart disease, chronic obstructive pulmonary disease and stroke. The Proximity Mapping tool could be useful for corporate, government and community leaders to start integrating health and equity into ZE transportation planning decisions such as where to prioritize building truck charging infrastructure.

Figure 8:
Proximity Mapping: Targeting transportation policy for health and equity

1. Datasets: The starting point	**2. Buffers:** Identify close-in communities	**3. Impacts:** Map pollution burdens	**4. Qualitative Analysis:** Dive deeper
Map the study area with health & demographic data.	**Widen the lens to look at neighborhoods.**	**Estimate environmental stressors.**	**Prioritize facilities for action.**
• **High Truck-Traffic Facilities** (point location data) • **CDC PLACES** (health data) • **American Community Survey** (population data)	Map a ½-mile buffer around facility sites to reflect the nearby residents most affected by pollution.	EDF's **Proximity to Environmental Stressors Assessment Tool** estimates the health and demographic characteristics of neighbors near each facility.	Zoom in to prioritize facility improvements in places where neighbors have higher health burdens or demographic inequities.
			

ZE trucking 101: Technology, opportunities & obstacles

Not long ago, trucking was considered all-but-impossible to decarbonize; however rapid advances over the last two decades in areas such as lithium-ion batteries, charging infrastructure, and distributed energy resources have brought ZE trucking to the point of commercial readiness. In the United States, a growing number of ZE MHD truck models are available now, and many more are expected in the next three years. In several respects, these ZE trucks are superior to the internal combustion engines they are replacing – quieter, with faster acceleration and lower maintenance -- and they are widely expected to become price competitive with ICE trucks on a total cost of ownership (TCO) basis by the middle of the decade.

ZE pathways: battery electric versus hydrogen fuel cell

There are two primary ZE truck technologies today: battery electric vehicles (BEV) and hydrogen fuel cell electric vehicles (FCEV). Both use electric drivetrains, but BEVs use electrochemical batteries charged by electricity to store and deliver energy, while FCEVs use fuel cells to release energy from the chemical bonds of hydrogen.

Both technologies have their adherents, but BEVs have a considerable head start over FCEVs in the U.S. and most other countries, with higher availability of both vehicles and recharging/refueling infrastructure. The total cost of ownership also favors BEVs, which is a more efficient ZE technology, with "wall to wheel" losses of 15% compared with losses of 65% for FCEVs fueled with green hydrogen. Questions about the lifecycle emissions of hydrogen as well as the lack of hydrogen transportation and storage infrastructure add to uncertainty about hydrogen's future as a transportation fuel.

Thanks to hydrogen's greater energy density (around 10 times more watt-hours of output than lithium-ion batteries, per unit of weight), FCEVs enable longer driving ranges than BEVs, which could be critical in applications such as long-haul trucking. However, BEVs are seeing improvements in battery energy density that could close this gap. The buildout of public charging networks for trucks could also make BEV long haul trucking feasible. Ultimately, the relative roles of these two technologies in the ZE transition remains unclear.

Charging infrastructure

BEVs need to be charged with electricity to operate. Ensuring these vehicles maintain sufficient charge to meet operator needs is one of the key challenges associated with the transition. In the U.S., major investments in public charging infrastructure are under way at the state and federal levels, and the November 2021 Infrastructure Investment and Jobs Act includes significant new funding for EV charging infrastructure (see Appendix 1).

The majority of MHD trucks drive moderate distances during the day and operate as "return to base" vehicles, returning to a depot at night. For these trucks, operators will generally need to provide charging infrastructure on site, including the charging station itself (see Figure 9) and the electrical infrastructure to connect to the utility.

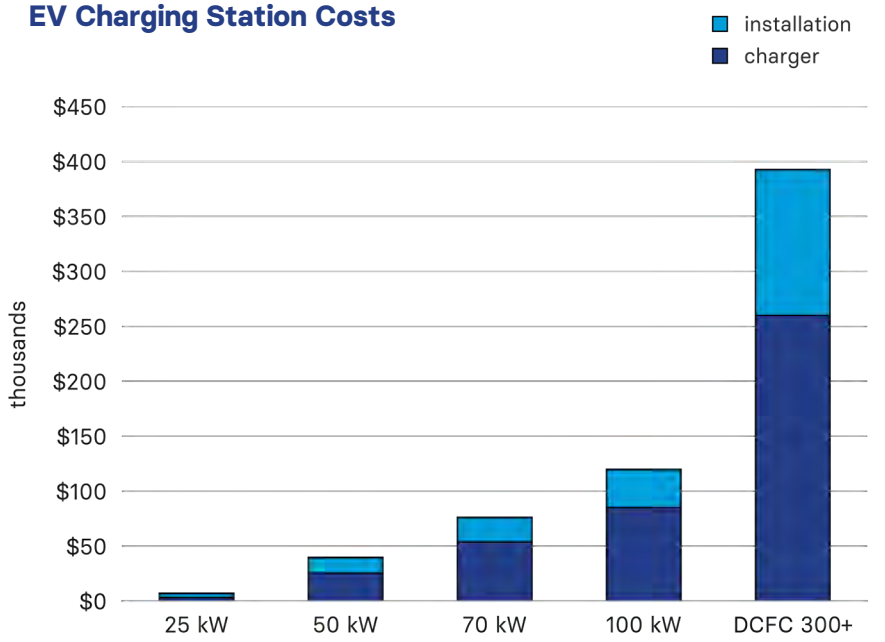
Figure 9:
MHD truck charging

Charging electric MHD trucks requires high-voltage power connections and specialized equipment, and establishing capacity for fleet charging requires close coordination with the electricity provider.

Charging infrastructure costs vary widely, depending both on the power rating of the charger and specific features of the site. Today, average costs range from $40k to purchase and install a 50 kw charger to nearly $400k for a 300+ kW charger.

Charging infrastructure investments require operators to make strategic decisions about the number and type of stations to build, which will affect both the cost of the system and the constraints it puts on trucking operations. A 50 kW charger could be adequate to charge a 500 kWh truck battery fully in 10 hours, providing 250 miles of range. However some applications may require a faster charge and costlier equipment.

Figure 10:
EV Charging Station Costs



Source: IEA

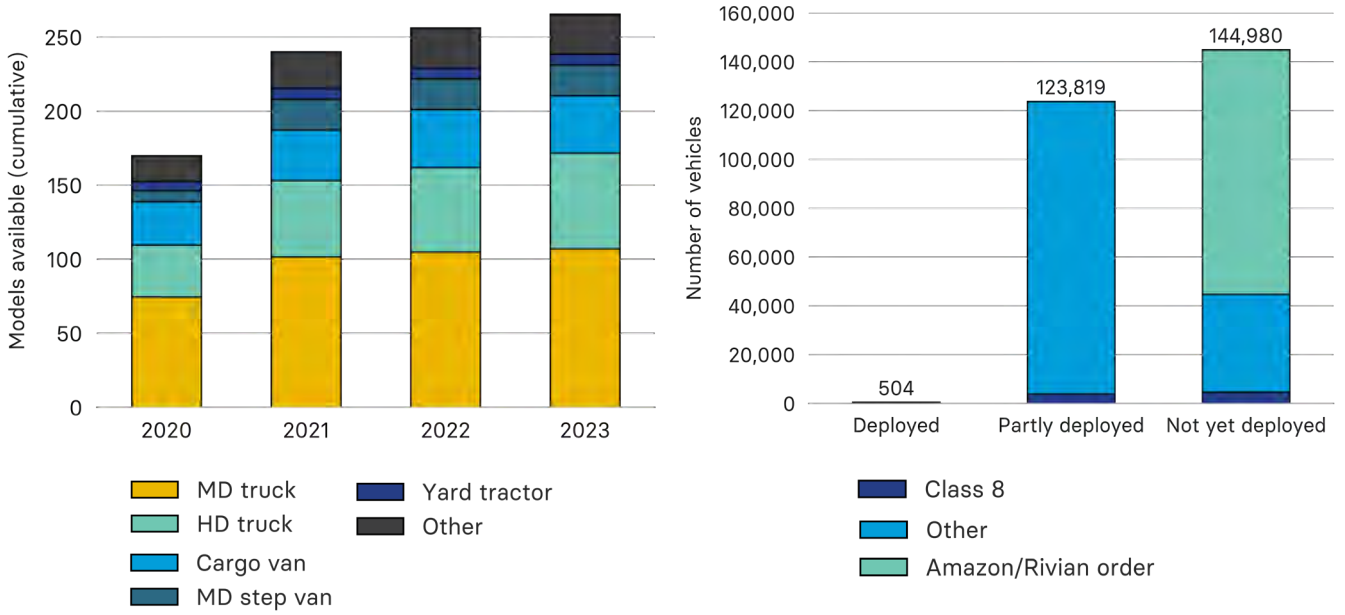
Availability of EV trucks is on the rise

Until now, a major barrier to fleet transition has been a lack of available ZE truck models. This is starting to change as manufacturers introduce new models and raise capacity. Although supply does not yet meet demand for vehicles, a range of OEMs are making investments – primarily in BEVs -- that are likely to cause a large increase in availability over the next three years. As production rises, now is the time for carriers and shippers to prepare for the transition by developing their ZE strategy, planning charging infrastructure, and placing ZE vehicle orders.

In the United States, there are over 30 OEMs that offer at least one ZE model for sale commercially. An additional 9 manufacturers, including 5 major global brands, have announced they will begin production of ZE models between 2022 and 2025 according to MJ Bradley. Based on existing manufacturer announcements, there will be multiple companies selling ZE trucks in virtually all MHD market applications by 2025, including 58% of the major OEMs. Companies like Lightning Systems and Motiv also offer options to retrofit existing Class 2-6 vehicles from leading manufacturers into plug-in BEVs.

EDF's Electric Fleet Deployment & Commitment List tracks announcements of ZE truck and bus deployments from carriers, shippers with private fleets, and governments. 162 individual announcements indicate that while only 504 ZE MHD vehicles have been deployed commercially in the U.S. to date, 23,819 are in the process of deployment, and announced plans reflect an additional 120,657 ZE MHD truck deployments. A large share of the latter category is made up of Amazon's commitment to order 100,000 delivery vans from Rivian, first announced in September 2019. Overall, 60 different MHD vehicle models are mentioned as either deployed or on order, from OEMs including Arrival, Battle Motors, CityFreighter, Cummins, Dana, Environtech, Ford, Freightliner, GM, GreenPower Motor, Hyundai, Kalmar Ottawa, Lightning Electric, Lion Electric, Mitsubishi, Motiv, Navistar, Nikola, OrangeEV, Peterbuilt, Phoenix Motorcars, Rivian, SEA, Tesla, Toyota, TransPower, Udelv, UES, US Hybrid, Workhorse and Xos.

Figure 11:
ZEV model availability (left), ZE deployments tracked by EDF (right)



Source: ZETI Tool, EDF

Other sources show a similar picture of rising availability: the SDGE 2021 Electric Vehicle Availability Guide lists 65 MHD BEV models as currently in production or pre-production, including 18 HD trucks, 6 yard tractors, 41 MD trucks, and 34 buses. Another model availability tracker, the Zero Emission Technology Inventory (ZETI) tool, shows an even broader array of models.

Affordability and total cost of ownership

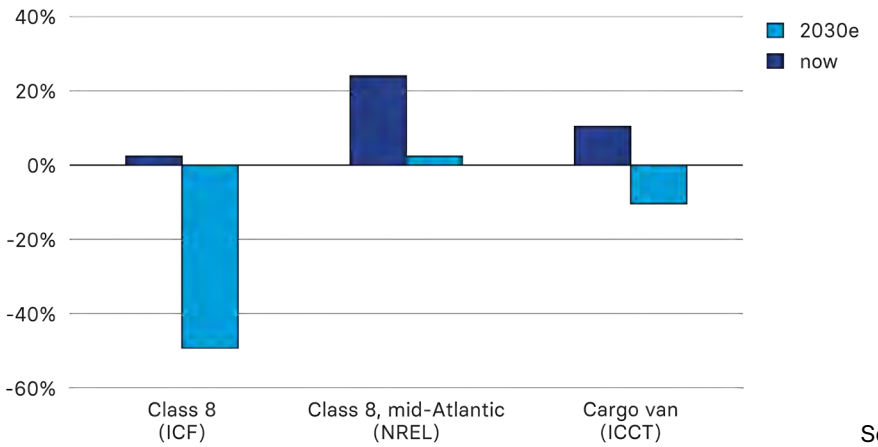
Although ZE MHD trucks tend to carry a higher purchase price than ICE trucks, this does not necessarily mean they are more expensive to own over their lifetime. The economics of truck ownership depends on a range of factors including the price of fuel, maintenance, insurance and financing costs – as well as, for electric vehicles, the costs of installing and maintaining charging infrastructure. A total cost of ownership (TCO) framework accounts for all such costs, usually expressed in terms of $ per mile driven over the operating life of the vehicle.

A range of TCO models have been developed to assess these costs, including by NREL, ICF, ICCT and CALSTART. EDF has also developed its own Excel-based TCO tool (available upon request) comparing BEV with ICE vehicles. All such models require assumptions about factors that are subject to considerable uncertainty, including:

- Future costs of diesel fuel and electricity
- Charging infrastructure costs
- Expected annual miles driven
- Difference between diesel and BEV operations and maintenance costs
- Expected life of a BEV truck and resale value at the end of life
- Pace of decline of up front BEV costs, including key components such as batteries
- Government, utility and other incentives

While different TCO models tend to give differing conclusions as to the relative attractiveness of BEVs compared with diesel trucks today, all TCOs tend to show BEVs becoming more attractive over time as the OEMs scale up and purchase prices come down. Figure 12 compares the output of 3 TCOs, for class 8 trailers (ICF and NREL) and cargo vans (ICCT). Under all 3 models, BEVs shift from being either at parity or more expensive today to being at parity or considerably cheaper in 2030, depending on the model used.

Figure 12:
TCO Comparisons, EV versus diesel



Source: NREL, ICF, ICCT

Non-financial costs of the transition

TCO models do not necessarily capture the full range of barriers associated with transitioning to a zero-emission fleet. These factors include changes to business practices, the need for new permits, uncertainty over residual truck values, changes to procurement, and management capacity to oversee the transition. As discussed in an EDF report on financing the trucking transition, these "soft costs" may be a barrier to transitioning a fleet even if other costs measured in the TCO are surmountable (see Figure 13). Such barriers further support EDF's view that shippers and carriers should take steps now towards implementation of a ZE transition plan, to address such factors that will take time to overcome.

Figure 13:
Total Cost of Electrification

TOTAL COST OF ELECTRIFICATION

HARD COSTS

Investment in new assets and fixed infrastructure

- High upfront vehicle capital cost
- High upfront and replacement battery costs
- Technical infrastructure costs, including chargers and system upgrades

SOFT COSTS

Activities and processes to switch to electric MHDVs

- Changes to business operations (including routes and schedules)
- Permitting and approvals
- Practicalities of switching to new maintenance logistics
- Knock-on effect of missed charging events

UNCERTAINTIES

Factors that make financing more expensive or electric MHDVs appear less cost-competitive

- Uncertain residual value of vehicles and batteries
- Uncertain future capital costs and total lifetime cost
- Uncertain battery technology performance and life
- Uncertain maintenance costs
- Uncertain fuel cost savings
- Uncertain evolution of incentives and policy standards

FRICTIONS

Limitations that increase the psychological or practical cost of switching

- Lack of capacity to plan and implement fleet switches to electric MHDVs
- Lack of capacity to use new financing approaches
- Inertia in procurement and contracting process

Are EV trucks ready for real-life use?

As zero emissions trucks are introduced into fleets, carriers and shippers will need to adapt to the ways in which these vehicles must be managed differently than ICE vehicles. In the case of BEVs, new constraints include range limitations and charging time.

For trucking segments involving shorter, predictable routes and overnight depot charging, the transition could be relatively straightforward. For long-haul truck routes involving hard-to-predict, multi-day journeys, operational changes are more significant. The average length of haul has declined over the past two decades, but even 600 miles is well over the range of most BEV trucks, suggesting that public charging will need to play a role.

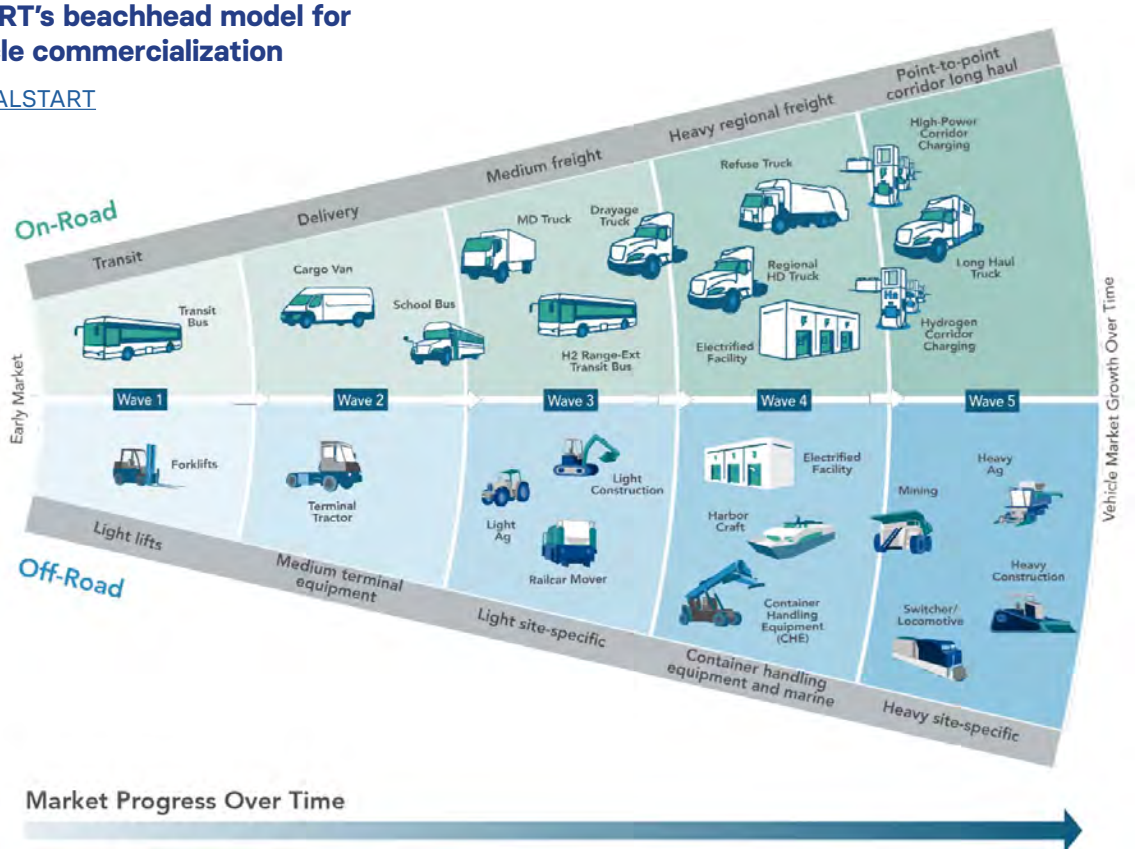
Public EV charging refers to EV charging stations that are available to all EV drivers and located in publicly accessible locations, such as commercial locations or along highway corridors. According to DOE's Alternative Fuels Data Center, there were nearly 7,000 individual DC fast chargers at public facilities in mid-2021, with fewer than 1000 of these being high power (>300 kW).

Several studies have assessed how running a trucking fleet might be affected by a transition to zero emissions vehicles. In September 2021, Run on Less – Electric monitored 13 BEV MHDVs performing normal fleet operations over a 3-week period (MD van, MD box truck, HD terminal tractor and HD regional haul tractor). The project sponsors said that all vehicles successfully completed their daily routes hauling real freight, showing that certain applications could be "operationally ready" to go electric. Another study[3] examined the impact that electrification might have on the operations of 2 carriers, NFI and Schneider, finding that the majority (88-93%) of trips that occurred over the period could have been undertaken successfully by an EV fleet with fast overnight charging, depending on the technology used.[4] Both findings suggest that introducing ZE trucks is technically feasible for many applications, once the necessary charging infrastructure is in place.

CALSTART, a national non-profit that works with business, fleets, and governments to implement clean transport solutions, breaks down the timeline for application-specific ZE vehicle commercialization based on usage and market size, as seen in Figure 14.

Figure 14:
CALSTART's beachhead model for ZE vehicle commercialization

Source: CALSTART



[3] California Heavy-Duty Fleet Electrification, March 2021 undertaken for Environmental Defense Fund by Gladstone, Neandros & Associates (GNA)

[4] Some of the scenarios assumed not yet commercially available technology (1000kWh battery back and 800kW DCFC power level). With available technology, 71% of trips would have been possible.

Analysis by both CALSTART[5] and MJ Bradley[6] identify applications such as delivery, drayage and medium freight as being more ready for ZE commercialization, based on factors including charging infrastructure requirements, range per charge compared to needs, availability of EV models and attractiveness of total cost of ownership.

Due to these varying stages of readiness, EDF recommends that company transition strategies be based on application-specific targets as described in Chapter 2. Understanding the readiness of ZE vehicles for different applications should be key to planning for the ZE transition by carriers and shippers.

[5] The Beachhead Model: Catalyzing Mass Market Opportunities for Zero Emission Commercial Vehicles, October 2020, CALSTART

[6] Medium- & Heavy-Duty Vehicles: Market structure, Environmental Impact, and EV Readiness, MJ Bradley, undertaken for Environmental Defense Fund

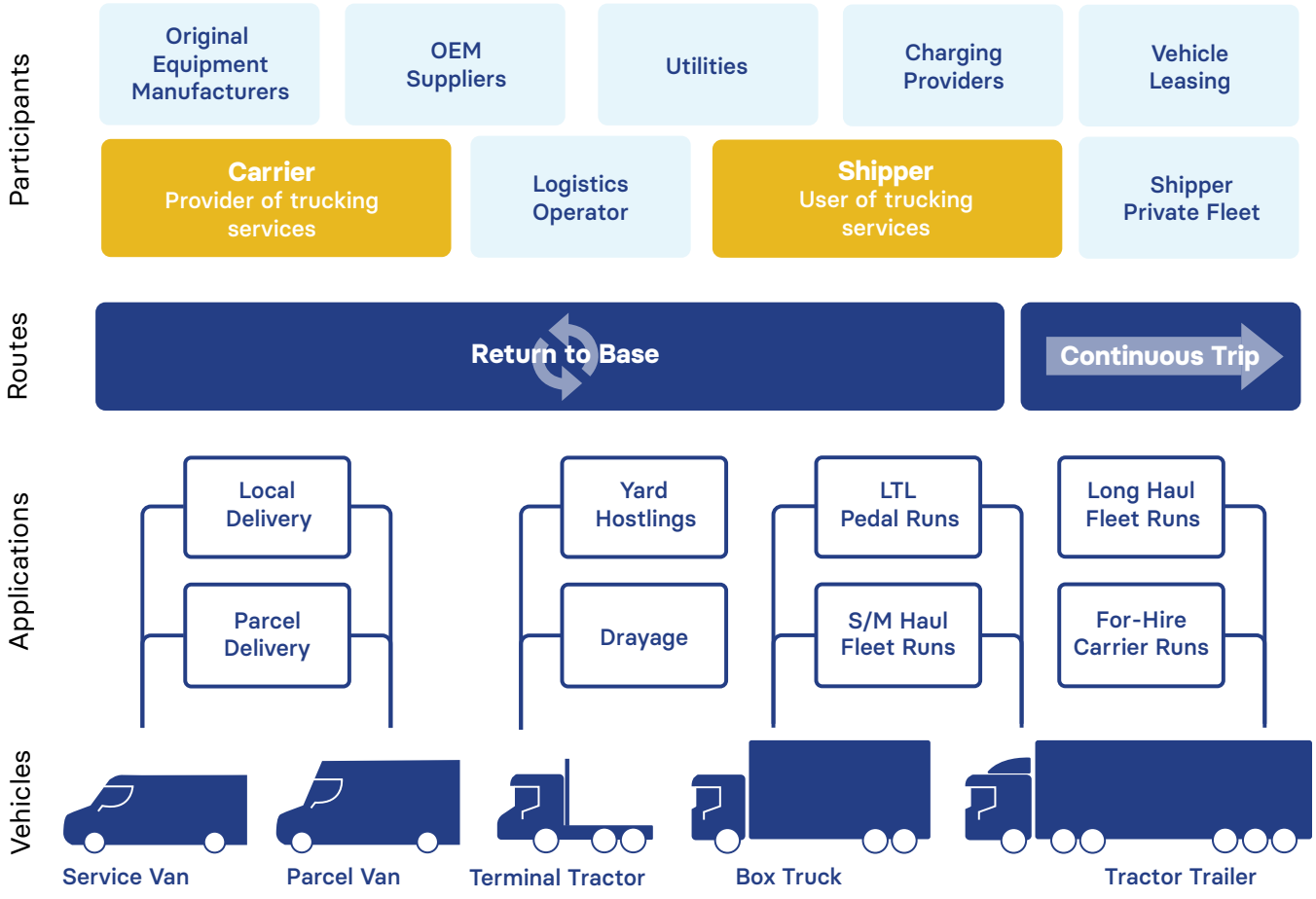
How early action by carriers and shippers can ease the ZE transition

Modern logistics networks are complex systems designed to move goods and services safely and rapidly at low cost. They involve many participants with distinct business interests and incentives. The transition to zero emissions will require change across logistics systems and introduce new participants such as utilities and charging providers, as indicated in Figure 15.

The complexity of the trucking ecosystem – and the institutional inertia captured in the "soft costs" described above – will slow the ZE transition. This makes it especially important for all entities that use trucks to develop ZE transition plans and make steady progress on them.

Advocating for supportive federal and state policies can shape government spending on clean transport and target it to where it will be most helpful. Taking early steps to plan for and pilot new ways of doing business will be crucial to begin organizational learning, reduce system-wide frictions, and enable the overall transition to take place at the necessary speed and scale.

Figure 15:
Key players in ZE Trucking



The benefits of early action

With new ZE truck models appearing on the market, the pace of deployment will depend largely on the response to these new vehicles from carriers and shippers. Big purchasing commitments and other demand signals will spur further OEM innovation and lead to more options becoming available, and the development and trial of vehicle financing and charging systems will bring refinement to these important system components. If, on the other hand, new ZE truck options are met with a wait-and-see approach from carriers and shippers, it will take longer to develop the robust ecosystem of ZE trucking participants that must ultimately emerge in order to reach a tipping point in the transition.

Aside from the broader benefits to the environment and public health, carriers and shippers can create benefits for their shareholders by showing leadership in the ZE transition:

1. **Get ahead of the competition.** Carriers and shippers that invest early in the transition will develop infrastructure and processes to integrate ZE trucking into their day-to-day business. This will put them in a better position than rivals who delay action and end up lagging in the transition.

2. **Enhance brand.** Carriers and shippers that adopt ZE delivery early have an opportunity to differentiate themselves via this climate leadership. Shippers are already showing a preference for carriers that provide ZE offerings.

3. **Support corporate sustainability goals.** Transportation is a significant contributor to the emissions footprint of many companies, and a shipping plan can be a central part of an overall net zero plan. For many shippers and carriers, achieving a target like reaching net-zero carbon emissions by 2050 will require a ZE trucking transition.

4. **Deepen relationships.** Although trucking services are often based on simple parameters of price, service, and volume, for certain shippers, carrier relationships with an emphasis on high levels of service is an important product differentiator. Emissions reduction provides another dimension of service for shippers to develop deeper relationships with carriers while enhancing their brand.

5. **Raise the industry bar.** Carriers and shippers that take a more proactive role in introducing and advocating for ZE capacity can inspire industry peers to pursue a similar strategy, raising the floor for the industry as a whole and reinforcing the value of leading companies' emphasis on emissions reductions.

Examples of ZE commitments and pilots by carriers and shippers

Many carriers and shippers have begun to introduce ZE MHD trucks, often in a limited pilot setting. These pilots allow companies to learn from using ZE trucks on the ground and often benefit from government incentives that cover a portion of the costs.

EDF's Electric Fleet Deployment & Commitment List tracks pilots and commitments by a range of carriers and shippers to decarbonize their US trucking footprint. Below we highlight some of the announcements that have been made around trucks. Most commitments have been made by carriers and shippers with private fleets; few shippers have made explicit commitments to transition their outsourced trucking footprint. Overall we see significant scope for all carriers and shippers to raise the ambition and specificity of their commitments.

Carrier commitments

- **FedEx** - In early 2021, Fedex announced plans to achieve carbon neutral operations globally by 2040, including electrification of the entire parcel pickup and delivery (PUD) fleet alongside investments in alternative fuels, efficiency and decarbonization of facilities. By 2025, 50% of FedEx Express global PUD vehicle purchases will be electric, rising to 100% of all purchases by 2030.
- **J.B. Hunt** - J.B. Hunt set a goal to reduce CO_2e per ton-mile (Scope 1) by 3% by 2025 and convert at least 25% of its day cab and straight truck fleet to an alternative power fuel source by 2035 — assuming operational, regulatory, and total cost of ownership (TCO) requirements are achieved.
- **Knight-Swift** - Reduce CO_2 emissions per mile by 5% by 2025 from 2019 baseline year. Reduce CO_2 emissions per mile by 50% by 2035.
- **Martin Brower** - Reduce carbon emissions by 40% by 2030, which includes investing in vehicles with the lowest carbon emissions as well as facility improvements and sourcing of renewable energy.
- **Ryder Supply Chain Solutions** - Ryder has set 2024 targets from a 2018 baseline of 10% for scope 1 (company-operated fleet); 30% for scope 2 (company-operated facilities), and 15% for scope 3 (downstream leased equipment).
- **Schneider** - A commitment to reduce carbon emissions by 7.5% per mile by 2025, reaching 60% percent per mile by 2035. The company has been piloting the use of an electric eCascadia truck by Freightliner in California for local and regional delivery and pick up.
- **Titan Freight** - The company has implemented a range of practices to decrease fuel consumption and CO_2 emissions, with the ultimate goal of being emissions free by 2030.
- **Total Transportation Services** - Goal is to operate a zero-emission fleet. The company is testing every ZE class 8 vehicle on the market.
- **U.S. Xpress Enterprises** - Xpress plans to reduce its carbon footprint 60% by the year 2035.

- **UPS Inc.** - By 2025: 40% alternative fuel in ground operations and 25% renewable electricity in facilities. By 2035: 50% reduction in CO_2 per package delivered for global small package compared with 2020, 100% renewable electricity in facilities and 30% sustainable aviation fuel. By 2050: carbon neutral across global operations.
- **Werner Enterprises** - Werner targets 55% lower carbon emissions by 2035. Announced testing of first electric-powered truck in January 2020 in partnership with Peterbilt, Meritor, and TransPower, operating in LA metro area.
- **XPO Logistics** - Reduce carbon emissions by 10% or more in North American logistics distribution centers by 2023.

Shipper commitments

- **Amazon** - Shipment Zero is Amazon's goal to deliver 50% of Amazon shipments with net-zero carbon by 2030. In 2019, Amazon ordered 100,000 custom electric delivery vehicles from Rivian—the largest order ever of electric delivery vehicles and rolled out the first of these vehicles in Los Angeles in February 2021. Amazon plans to have 10,000 Rivian vehicles on the road in 2022 and all 100,000 vehicles deployed by 2030.
- **Clorox** - Commitment to use rail vs truck when possible to minimize emissions (25% of the total mileage that Clorox ships). Over 60% of all trucks delivering Clorox products are SmartWay carriers.
- **Colgate-Palmolive** - Committed to become Net Zero Carbon across global operations by 2040. The company is engaged in efforts to support sustainable and efficient logistics such as: load optimization, zero empty miles, container utilization, and improving fuel efficiency, and distribution network optimization.
- **Molson Coors Beverage** - Goal to reduce absolute carbon emissions across operations by 50% and throughout value chain by 20% by 2025.
- **PepsiCo** - Committed to reduce absolute GHG emissions across direct operations (scope 1 and 2) by 75% and its indirect value chain (scope 3) by 40% by 2030, against a 2015 baseline. Goal of reaching net zero across operations by 2040.
- **Proctor & Gamble Co.** - Committed to reducing upstream finished product freight emissions intensity 50% by 2030 and grow rail shipping while increasing renewable fuels and energy sources for transportation.
- **Sysco** - The global foodservice distribution company has commited to electrifying 35% of its fleet by 2030 as part of a series of science-based emissions reduction targets including reduction of Scope 1 and 2 emissions by 27.5% by 2030, and ensuring that suppliers covering 67% of Sysco's Scope 3 emissions establish science-based targets by 2026.
- **Walmart** - Walmart has pledged to reach zero emissions from its entire vehicle and transportation network, including long-haul trucks in the US and Canada, by 2040. The company plans to accomplish this by a range of technologies including BEV, FCEV and renewable diesel. It recently signed an agreement to reserve 5,000 BEV delivery trucks and vans from BrightDrop, a division of General Motors. Walmart includes a transportation pillar within Project Gigaton, the company's initiative to engage suppliers in climate action aiming to avoid one billion metric tons of GHG from global value chain by 2030.

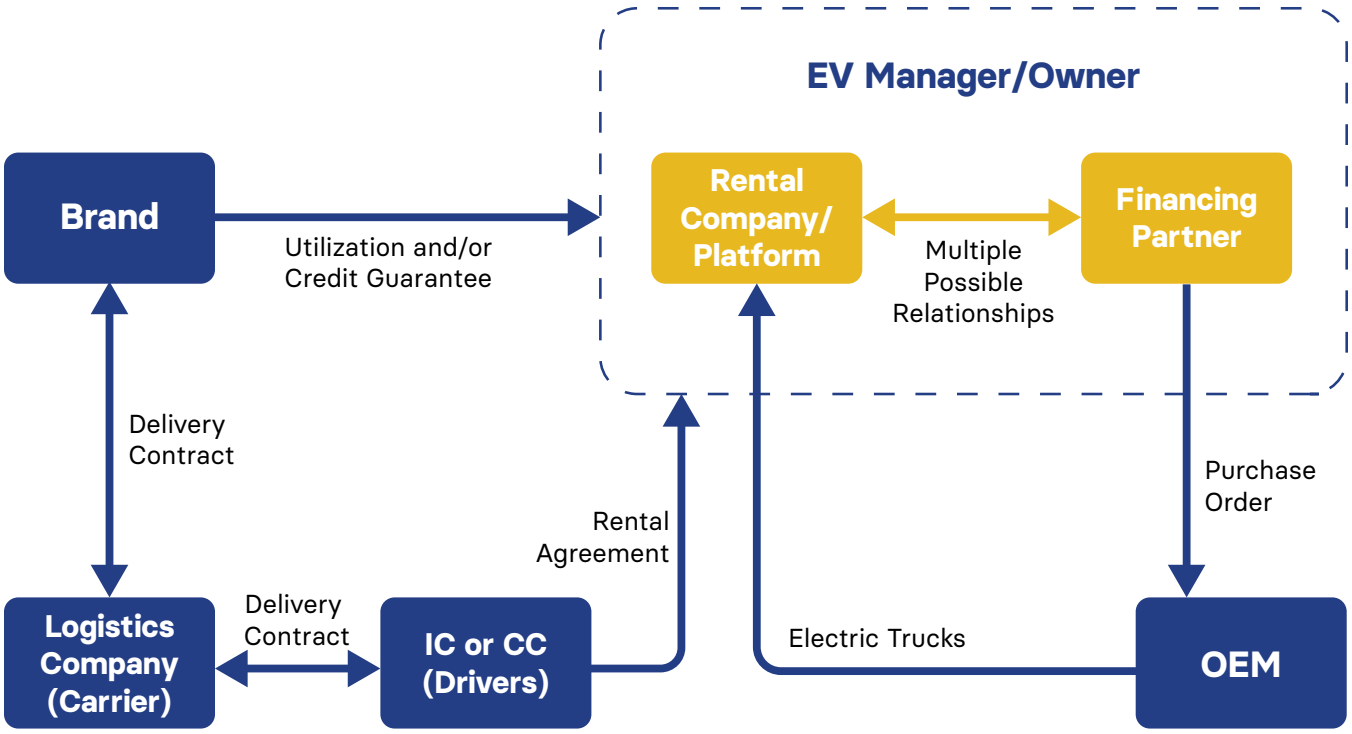
Selected carrier/shipper ZE pilots

As ZE truck supply scales up, one of the best way for carriers and shippers to develop and refine their transition plans is by implementing pilot programs involving deployment of zero emission trucks. This can involve acquiring ZE vehicles for a carrier or shipper's own fleet, or bringing in a third party provider of ZE trucking services. We note a few examples from the EDF Electric Fleet Deployment & Commitment List.

EV sponsorship model: IKEA

Electric vehicle sponsorship models allow companies to ensure a minimum amount of zero emissions freight without owning the trucks.[7] In one example of such an arrangement, illustrated in Figure 16, IKEA U.S. has partnered with Fluid Truck, an electric truck rental platform, to pilot an electric vehicle sponsorship model as a step towards its goal of providing 100% zero emissions home deliveries by 2025. Today, a fleet of several delivery trucks - Ford box truck chassis upfitted to BEVs by Lightning eMotors - carry IKEA products in the New York City market. Furthermore, IKEA will explore other markets towards its goal of providing 100% zero emissions home deliveries.

Figure 16:
EV Sponsorship Model



[7] EDF has described different approaches to structuring electric vehicle sponsorship models for last mile delivery, called ZED (zero emissions delivery) Zones.

Shipper-supported pilot: SunPower

Another deployment example is the collaboration between a shipper (SunPower Corp., the California-based solar technology and energy services provider), an OEM (Volvo Trucks North America), a carrier (Dependable Highway Express, or DHE) and a logistics service provider (Kuehne+Nagel). Under this collaboration, DHE transports SunPower's solar products using Volvo VNR Class 8 electric trucks from its facility in Ontario, California. There, the trucks are recharged a daily by renewable electricity generated by DHE's 2300 rooftop solar panels. Annually, the solar panels generate 1.3 GWh of renewable electricity, powering the Volvo VNR Electric fleet, the building, employee EV chargers, and battery-electric freight equipment. The arrangement is overseen by Kuehne+Nagel.

Appendix 1: ZE vehicle policy and regulation

While the electrification of transport will bring benefits over time, it also gives rise to up-front costs: more expensive vehicles, new charging infrastructure and the adjustment of logistics networks. Public policy can play a major role in accelerating the transition, with legislation and regulation at both the state and federal levels incentivizing vehicle electrification and charging infrastructure deployment. Investors can play a role in calling for such regulations directly and by encouraging portfolio companies to offer their support.

Policymakers are already moving in the right direction. In the U.S., states from California to New York have introduced regulations to begin making ZE vehicles more mainstream. These targets and underlying policies will create an opportunity for market development that will better enable companies to transition to ZE trucks.

Table 1:

Types of policy that affect the EV transition

Type of Policy	Description	Example
Supply oriented, volume-based		
1. Vehicle emissions standards	Time-bound emissions reduction benchmarks	Vehicle emission standards (for light- and medium/ heavy-duty) from the Environmental Protection Agency
2. Sales targets	Time-bound electric vehicle sales goals	New York Advanced Clean Trucks rule established electric vehicle sales mandates for manufacturers through 2035
3. Purchase targets	Time-bound electric vehicle deployment goals for fleets	California's forthcoming Advanced Clean Fleets rule would set percentage purchase requirements for commercial and government fleets.
Demand oriented, cost-based		
4. Point of sale discounts and rebates	Reduces cost of electric vehicles through post-purchase repayment	California's Heavy-Duty Vehicle Incentive program provides purchasers point-of-sale vouchers, for which dealers can submit for reimbursement
5. Tax incentives	Tax reduction for electric vehicles and charging infrastructure purchases	Federal 30(c) and (d) tax credit for charging stations and electric vehicles
6. Financing	Develop and design financial and non-financial supports to enable the transition to zero-emission MHD vehicles and unlock private investment	California Senate Bill 372, which establishes Medium- and Heavy-Duty Vehicle Fleet Purchasing Assistance Program
7. Spending	Direct public investment in electric vehicle manufacturing and charging infrastructure	Federal Advanced Technology Vehicle Manufacturing grants, state utility infrastructure programs (ratepayer-funded)

Federal policy landscape

The Infrastructure Investment and Jobs Act, which became law in November 2021 and had bipartisan support in both the Senate and House, included some important initial investments in zero-emission vehicles and charging infrastructure.

- $5 billion for low emission and electric school buses ($2.5 billion set aside specifically for electric school buses) through the EPA.
- $5.25 billion for state and local governments to purchase or lease zero-emission and low-emission transit buses through the Low-No Program.
- $2.5 billion for alternative fueling infrastructure that includes EV charging.
- $5 billion for a new National Electric Vehicle Formula Program for states to deploy electric vehicle charging infrastructure.
- $400 million for the reduction of truck emissions at ports. This provision also includes a study on how ports benefit from electrification, and the emerging technology needed to reduce truck emissions.
- $2.25 billion to fund the Port Infrastructure Development Program, which can be used to reduce or eliminate pollutants and greenhouse gas emissions, including vehicle electrification.
- $6 billion to expand the processing and manufacturing of advanced batteries, including for electric trucks.
- $7.5 billion for electric vehicle charging, helping states and local governments build a national network of electric vehicle charging stations.

As of January 1, the Build Back Better Act, having passed the House, also contains provisions to help advance ZE transportation:

Tax credits

- 45Y tax credit for commercial ZE vehicles, covering up to 30% of the cost of the vehicle.
- 30C Alternative Fuel Vehicle Refueling Property Credit extension to promote the installation of alternative fuel infrastructure.
- Expansion of 48C tax credit for electric vehicle manufacturing to include MHD vehicles.

Grant programs

- $5 billion for a Clean Heavy Duty Vehicles Program at the EPA to electrify class 6 and 7 vehicles.
- $9 billion for fleet electrification, with $6 billion for the United States Postal Service and $3 billion for the General Services Administration.
- $3.5 billion to purchase zero-emission port equipment through the EPA.
- $2 billion for electric vehicle charging infrastructure through the EPA's Greenhouse Gas Reduction Fund.
- $3.5 billion for Domestic Manufacturing Conversion Grants, promoting the production of plug-in electric hybrid, plug-in electric drive, and hydrogen fuel cell vehicles.

State policy leadership landscape

A handful of states are taking ambitious action on ZE trucking. In July 2020, for example, 15 states and the District of Columbia signed a joint memorandum of understanding agreeing to ensure that zero emissions vehicles account for 30% of new MHD truck sales by 2030 and 100% of new MHD truck sales by 2050.[8]

The following chart summarizes additional state policy measures, which can serve as an example for regulation in other jurisdictions. As more states introduce policies to accelerate zero emission transport, investors can combat regulatory risk by pushing portfolio companies to adapt proactively to emerging norms. Inaction could expose companies to financial penalties and litigation, jeopardizing returns for financial firms.

Table 2:

California

Policy	Summary	Anticipated Timeline
Financing: Senate Bill 372 (Leyva)	Financing tools and non-financial support for MHD ZE operators through a Vehicle Fleet Purchasing Assistance Program	SB 372 was signed by Governor Gavin Newsom on October 8, 2021.
Vehicle emissions standards: Indirect Source Rule (Rule 2305)	Requires warehouses greater than 100,000 square feet to directly reduce nitrogen oxide (NOx) and diesel particulate matter (PM) emissions, or to otherwise facilitate emission and exposure reductions of these pollutants in nearby communities.	The ISR has been adopted. Compliance obligations for warehouses larger than 250,000 sq ft started on Jan 1, 2022, phasing in smaller warehouses over time.
Spending: Utility infrastructure programs	California has approved over $700 million in utility infrastructure programs, including for medium- and heavy-duty vehicles. The CA Public Utilities Commission has also set out guidelines culminating in 10-year transportation electrification investment plans (TEPs).	The California Public Utility Commission is expecting to issue a series of decisions actualizing the transportation electrification framework. The first of these setting out near-term priorities for utility pre-TEP applications was issued in July 2021.

[8] Participating states are California, Connecticut, Colorado, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington.

Policy	Summary	Anticipated Timeline
Sales targets: Advanced Clean Trucks Rule	Sets out a sales mandate for manufacturers, setting out increasing targets, differentiated by vehicle class, through 2035.	Adopted by the California Air Resources Board (CARB) in June 2020 and filed as a formal regulation on March 15, 2021.
Purchase targets: Advanced Clean Fleets Rule	Sets targets for carriers to purchase ZE vehicles, including vehicle purchases by public agencies, carriers operating vans, trucks, and work vehicles, and drayage vehicles. Sets a 100% target for sales by manufacturers across all vehicle classes.	CARB issued its initial proposal in August and will formally consider the ACF in the summer of 2022, with a goal to adopt by the end of the year.
Vehicle emissions standards: Heavy-Duty Omnibus Rule	Designed to cut NOx to about 75% below current standards beginning in 2024 and 90 percent below current standards in 2027.	Adopted by CARB in August 2020.
Sales targets: Executive Order N-79-20	Establishes the following targets:100% of in-state sales of new passenger cars ZE by 2035; 100% of MHD vehicles ZE where feasible by 2045; 100% ZE drayage trucks by 2035; 100% ZE state off-road vehicles and equipment by 2035.	Signed on September 23, 2020.
Financing: Assembly Bill 841	Requires the PUC to approve rate-basing make-ready electric vehicle infrastructure on the utility side of the meter.	Passed into law in September 2020.

Table 3:

Illinois

Policy	Summary	Anticipated Timeline
Financing: Climate and Equitable Jobs Act	Requires utilities to file beneficial electrification plans designed to advance zero-emission vehicles of all types.	Signed into law in September 2021.

Table 4:

New Jersey

Policy	Summary	Anticipated Timeline
Spending: Board of Public Utilities straw proposal	Considers equitable deployment of medium- and heavy-duty vehicle infrastructure and rate reforms.	The BPU published the straw proposal in July 2021 and sought stakeholder comments through October 5, 2021.
Sales targets: Advanced Clean Trucks Rule	Sets out a sales mandate for manufacturers, differentiated by vehicle class, through 2035.	Adopted in December 2021.
Purchase targets: S 2252 (Plug-in Vehicle Law)	Requires that by December 31, 2020, NJ shall establish goals for MHDV electrification and infrastructure development. Sets out goals for NJ Transit: 10% of new bus purchases ZE by December 31, 2024, 50% by December 31, 2026, and 100% by December 31, 2032.	Signed into law by Governor Murphy in January 2020

Table 5:

New York

Policy	Summary	Anticipated Timeline
Sales targets: Advanced Clean Trucks Rule	Sets out a sales mandate for manufacturers, differentiated by vehicle class, through 2035.	Adopted by Department of Environmental Conservation in December 2021.
Sales targets: Assembly Bill 4302	Sets out sales targets for: 100% ZE light-duty vehicles by 2035 and MHDVs where feasible by 2045.	Signed into law by Gov. Hochul in August 2021.

Table 6:

Oregon

Policy	Summary	Anticipated Timeline
Sales targets: Advanced Clean Trucks Rule	Sets out a sales mandate for manufacturers, differentiated by vehicle class, through 2035.	Approved by the Oregon Environmental Quality Commission in December 2021.

Policy	Summary	Anticipated Timeline
Sales targets: Heavy Duty Omnibus Rule	Designed to cut NOx to about 75% below current standards beginning in 2024 and 90 percent below current standards in 2027.	Approved by the Oregon Environmental Quality Commission in December 2021.

Table 7:

Washington

Policy	Summary	Anticipated Timeline
Sales targets: Advanced Clean Trucks Rule	Sets out a sales mandate for manufacturers, differentiated by vehicle class, through 2035.	Adopted by Washington State Department of Ecology in December 2021.

Appendix 2: Disclosure frameworks and trucking

The leading sector-specific sustainability disclosure frameworks – the Sustainability Accounting Standards Board (part of the Value Reporting Foundation) and CDP – offer only limited recommendations for how companies that provide or use trucking services should report their trucking-related emissions.

SASB, in its Road Transportation sustainability accounting standard, recommends that carriers disclose their Scope 1 emissions, Scope 1 emissions reduction strategy, and total fuel consumed. This is a helpful start, although such information is insufficient for investors to assess a carrier's progress towards a ZE truck transition.

When it comes to shippers, however, SASB offers very little guidance on trucking or transportation. For one sector -- food retailers and distributors – the standard asks for disclosures on the fuel consumption of its fleets, but the standard does not ask companies to report the greenhouse gas emissions associated with trucking, nor to provide details of zero emissions vehicle usage. For other sectors – including truck-reliant sectors such as e-commerce, apparel, and specialty retailers – the standard omits any mention of trucking fleets or services, or transportation more broadly. This gap could lead investors to overlook truck-related greenhouse gas emissions, which could be significant.

CDP offers more comprehensive disclosure recommendations, asking companies to disclose a breakdown of emissions across their supply chains. Focusing on supply chain emissions helps guarantee that companies report emissions data not just from trucks they own but from trucks they contract using third party carriers. However in their reponses to CDP, most companies provide limited disclosure of this aspect of their business.

Moving forward, investors can improve the quality of trucking emissions data available to them by encouraging standard setters to include truck-related emissions in its disclosure recommendations for consumer goods companies and other major shippers.

Appendix 3: Key institutions in the trucking transition

Accelerating zero-emissions trucking will require coordination among stakeholders across the transportation ecosystem – from manufacturers to shippers to policymakers. Below are key institutions addressing zero-emissions transportation. These organizations can provide investors with guidance on emerging trends in trucking technology, regulation, and financing.

Advanced Clean Transportation Expo (ACT Expo): The Advanced Clean Transportation Expo is an annual conference showcasing new technologies and products in low-carbon trucking. The event draws over 4,000 attendees, including over 1,000 fleet operators. The 2022 expo will take place from May 9-12 in Long Beach, CA.

CALSTART: Founded in 1992, CALSTART is a nonprofit partnering with key industry stakeholders to advance clean transportation. CALSTART has more than 270 members, spanning governments, manufacturers, carriers, shippers, and academic institutions. The nonprofit concentrates on five workstreams: 1) demonstrate and develop new clean transportation technology, 2) assess business case for new technology, 3) oversee programs to accelerate purchase of clean technology, 4) support policy conducive to clean transportation deployment, and 5) help members achieve their business goals in clean transportation.

Climate Group EV100 Initiative (EV100): The EV100, overseen by the international nonprofit The Climate Group, brings together companies committed to electrifying their fleets and offering charging infrastructure to employees by 2030. The EV100 currently has 114 members representing 5 million vehicles. The initiative works with members to identify barriers to electrification and policy drivers to overcome existing obstacles. EV100 publishes an annual progress report and offers additional research on the business case for vehicle electrification. As of September 2021, EV100 members have already deployed approximately 170,000 electric vehicles.

Corporate Electric Vehicle Alliance: Managed by Ceres, the Corporate Electric Vehicle Alliance is a coalition of companies committed to the acceleration of vehicle electrification. By bringing companies together to support zero emissions vehicles, the alliance helps send a clear demand signal for greater variety of electric vehicles, affordable and available charging infrastructure, cost parity with diesel vehicles, and access to renewable energy.

Electric Vehicles Initiative (EVI): The Electric Vehicles Initiative, launched by the Clean Energy Ministerial and coordinated by the International Energy Agency, is a multi-government policy forum focused on the global adoption of electric vehicles. EVI consists of fifteen participating countries. In June 2017, EVI launched the EV 30@30 campaign to ensure that 30% of new vehicle sales by 2030 are electric. In May 2018, EVI launched the Global EV Pilot City Programme to share best practices in electric mobility and charging among cities. Through the Programme, EVI aims to mobilize 100 cities by 2023 to work together on electric transportation.

Global Commercial Vehicle Drive to Zero: The Global Commercial Drive to Zero program, managed by CALSTART, works with governments, manufacturers, fleet owners, utilities, and NGOs to make zero-emissions commercial vehicle technology financially viable in target markets by 2025 in hopes of achieving full market penetration by 2040. Drive to Zero uses the Beachhead Strategy, prioritizing market segments where zero-emissions technology is most likely to succeed first. The program offers its pledge partners a policy toolkit, an inventory and analysis of zero-emissions technology, and a total cost of ownership estimator.

International Council on Clean Transportation (ICCT): The International Council on Clean Transportation is a nonprofit providing research and analysis on low-carbon transport to environmental regulators. ICCT works in the United States, Europe, Latin America, China, and India. The organization has a dedicated heavy-duty vehicles research program, which offers webinars, white papers, and blogs on emission reduction opportunities in the trucking industry. For example, in September 2021, the program published a study on "Infrastructure to support a 100% zero-emission tractor-trailer fleet in the United States by 2040."

International Transport Forum (ITF): A subsidiary of the Organisation for Economic Cooperation and Development, the International Transport Forum serves as a think tank for transportation policy. ITF publishes research on electrification trends, organizes expert roundtable discussions on freight and logistics, and convenes an annual summit of transportation ministers representing 63 member countries. ITF's 2021 summit addressed transportation innovation for sustainable development.

National Renewable Energy Laboratory (NREL): The National Renewable Energy Laboratory, sponsored by the Department of Energy and funded by the federal government, advances research on clean technology and the energy transition. NREL has a transportation and mobility research department that explores emissions reduction technologies for commercial vehicles and electric vehicle grid integration, among other topics. The transportation department also offers data-driven analytical tools to help industry stakeholders assess new decarbonization strategies. The Drive-Cycle Rapid Investigation, Visualization, and Evaluation Analysis Tool, for example, helps fleet managers determine the payback periods of new zero-emissions transportation technologies.

North American Council for Freight Efficiency (NACFE): The North American Council for Freight Efficiency is an industry group supported by the Rocky Mountain Institute that communicates the benefits and challenges associated with environmentally friendly technologies and services in freight. NACFE offers confidence ratings of different fuel efficiency measures and guidance on emerging technologies. NACFE also organizes Run on Less efficiency demonstrations to disseminate fuel reduction strategies to industry partners. In September 2021, NACFE convened Run on Less – Electric, a three week showcase of electric trucks already available for deployment. These demonstrations built on NACFE's 2021 Electric Truck Bootcamp, a ten-part educational webinar series geared towards fleet managers, utility planners, and policymakers.

Smart Freight Centre (SFC): Established in 2013, SFC is an international non-profit organization focused on reducing greenhouse gas emissions from freight transportation. Its goal is to guide the global logistics industry in tracking and reducing its greenhouse gas emissions by one billion tonnes by 2030 and to reach zero emissions by 2050 or earlier.

SmartWay: SmartWay is a program from the Environmental Protection Agency helping companies track, document, and share information on fuel use and freight emissions across their supply chains. Using SmartWay data, corporations can identify efficient freight carriers, reducing emissions supply-chain wide. Over 4,000 companies have registered for the SmartWay program to measure supply chain emissions, benchmark performance, report results, and ultimately improve transportation efficiency.

Zero Emission Transportation Association (ZETA): The Zero Emission Transportation Association is an industry-backed coalition advocating for 100% electric vehicles sales by 2030. ZETA lobbies elected officials on policies and legislation to accelerate zero emissions transportation. The association divides its advocacy into six policy pillars: 1) performance and emissions standards, 2) domestic manufacturing, 3) light-duty EV consumer adoption, 4) medium- and heavy-duty electrification, 5) national charging, and 6) federal leadership.

Further EDF resources on trucking transition

Reports

The Green Freight Handbook, EDF, February 2019

Medium and Heavy Duty Zero Emissions Vehicle Supply Chain Analysis, EDF June 2021

Clean Trucks, Clean Air, American Jobs, EDF, March 2021

Accelerating Zero-Emissions Delivery: An innovative approach to transforming the last mile, EDF, 2021

Financing the Transition: Unlocking Capital to Electrify Truck and Bus Fleets, DF, MJ Bradley and Vivid Economics, November 2020

California Heavy-Duty Fleet Electrification, Gladstein, Neandross & Associates, with support of EDF, 2021

Blogs

Smart charging should be integral part of a national EV charging network

Walmart and Pepsi push for policy action on zero-emission trucking

After banner EV commitments at COP26, it's time for U.S. to lead

EDF analysis finds American fleets are embracing electric trucks

4 things every utility, fleet and energy regulator should know about heavy-duty truck charging

DOE's SuperTruck 3 can help us reach a zero-emission future – if we have the right clean truck standards too