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What's the Latest CASE for Commercial Vehicles?

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Summary

Commercial vehicles are a significant source of greenhouse gas emissions. Therefore, regulations are in place that are globally incentivizing manufacturers to move to alternative power sources for vehicles ranging in size from fleets of cars to large mining vehicles. New entrants are partnering with end user fleets as well as incumbent Tier-1 vehicle OEMs and Tier-2 parts manufacturers. CASE is an acronym for Connected Autonomous Safe Electric. This paper and presentation highlights some of the progress made to date, partnerships known to exist, the challenges remaining, and projections for the next decade.

Keywords: Commercial, Market Development, Heavy-Duty, Medium-Duty, Electric Vehicle (EV)

1 Overview

Commercial vehicles vary considerably. At the heaviest end are mining trucks, heavy-haul specialty vehicles, and over the road tractor-trailer combination vehicles. At the lighter end of the spectrum are delivery vans, shuttles, and passenger cars for hire. Even lighter now are electric and autonomous vehicles for delivery on campuses and in residential areas for pizza and package delivery. Excluded for this paper are other forms of freight handling such as drones, airplanes, ships, and trains. Also excluded are large agricultural vehicles which share many aspects of operations and parts with on-highway vehicles. The Federal Highway Administration classifies vehicles according to Figure 1 [1]. Light-Duty generally refers to Classes 1-3, Medium-Duty to Classes 5-7, Heavy-Duty to Class 8, Specialized or Heavy-Haul to Classes 9-13. Figures 2-7 provide a recent photographic example of the different classes.

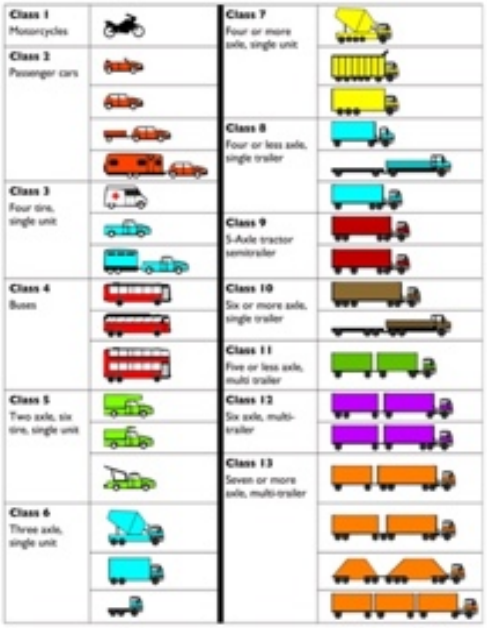

Figure 1:Federal HighWay Administration Vehicle Classification Chart [1]

Fig. 2-7 Current examples of electric vehicles in each class[2-7]

The variety of vehicles does not allow volumes to reach the passenger car levels of millions of units. For passenger cars, a production volume of 60,000 is considered too low to be sustainable and cause for cancelling a model. In the commercial vehicle market, volumes can be as low as 10 to 100 of a model. Volumes of 1,000 to 10,000 are possible, but often limited to buses and delivery vans. As such, this market depends much more heavily on development of platforms and designs that allow mixing and matching from different Tier-1 and Tier-2 suppliers.

For the major players, vertical integration with various “partners” and suppliers is common. Daimler Trucks, Volvo, Traton are likely to move in this direction, pressing their suppliers to provide unique solutions for them that are differentiated. Suppliers are already lining up with Dana, Meritor, ZF and others taking advantage of their long-term relationships with different vehicle OEMs. Those suppliers, in turn, are looking to their historical and new partners and suppliers at the Tier-2 level. Partner is a loose term in the industry. It can mean an exclusive arrangement for a limited time, an investment, or a contractual agreement to work together. Often, it is just a polite term for the normal OEM-Supplier relationship.

Horizontal integration is an alternative needed by the many smaller players in the industry. With volumes of just 10 to less than 1,000 units per year, they are not in a position to drive the Tier-1 and Tier-2 suppliers. Those same suppliers, pressed hard by the large vehicle OEMs, pursue the smaller OEMs with the plan of increased profit margins. Dana is a good example and they provided Figure 8 showing the scope of parts they can provide for a complete powertrain/drivetrain.

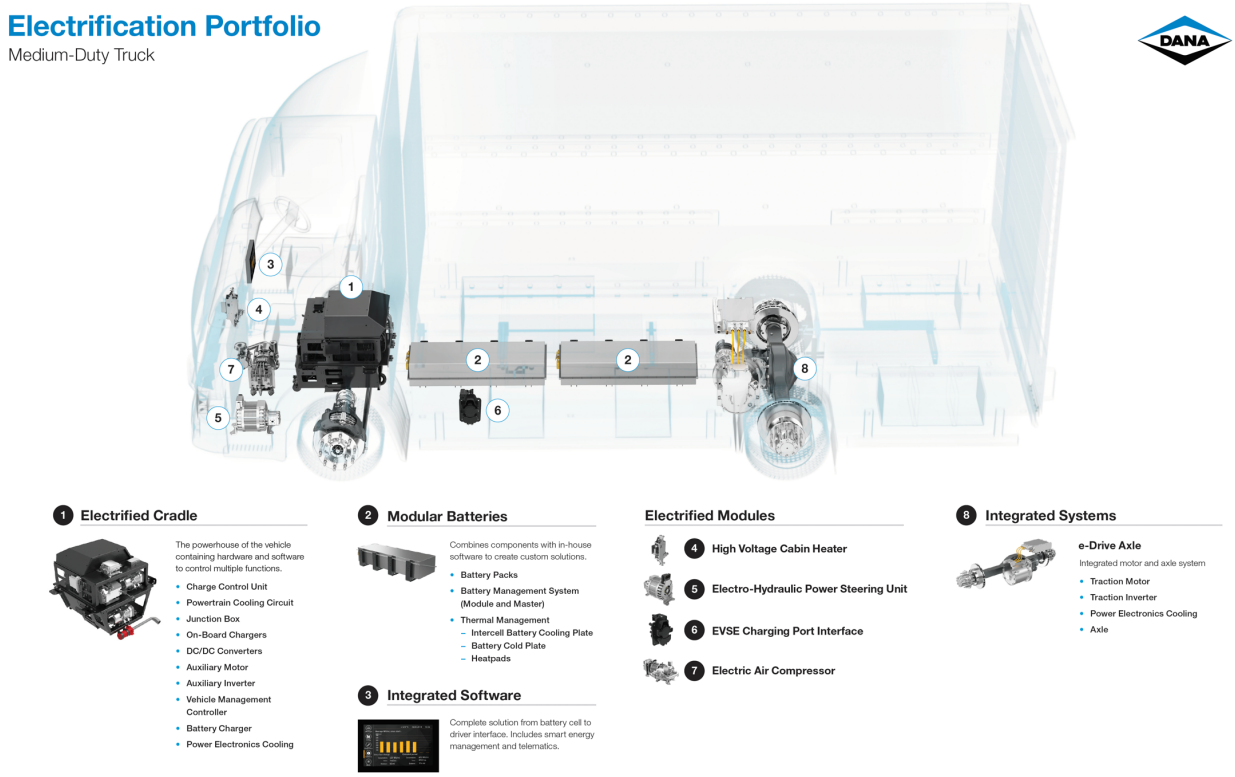

Figure 8 Dana Powertrain/Drivetrain Parts [8]

1.1 Global Standards, Regulations, Rules

The CASE (**C**onnected—**A**utonomous—**S**hared/**S**afe—**E**lectric) for commercial vehicles is important because they represent a major contributor to greenhouse gases around the world. The latest data for the USA is available at the EPA website https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions [9]. Global emission standards are tracked by Delphi Technologies and published regularly for both passenger cars and commercial vehicles at https://www.delphi.com/newsroom/press-release/delphi-technologies-releases-2019-2020-worldwide-emissions-standards-booklet [10].

These requirements drive the global vehicle OEMs and the tier-1 manufacturers to provide electric vehicle alternatives. The pace of investment and announcements has increased significantly even if introductions in volumes will lag behind those for light duty vehicles.

Acceptance of the Paris Climate Accord by all but the USA is driving countries to create goals, take legislative action, and develop regulations to improve CO2 emissions and levels in the atmosphere. This is further driving steps to eliminate production and outlaw operation of internal combustion engines. Figure 9 was published by Transport & Environment [11]. On February 4, it was reported in the news that the UK has advanced its 2040 requirement to 2035. While this is for passenger cars, similar pledges, goals, and laws are expected for commercial vehicles. CALSTART recently announced their Driver To Zero initiative and have published several tables providing information on policies and actions, primarily in the United States. http://toolkit.globaldrivetozero.org/policies-actions-incentives/ [12]. Various cities around the world with difficulty meeting clean air requirements have also taken action as shown in Figure 10 [13].

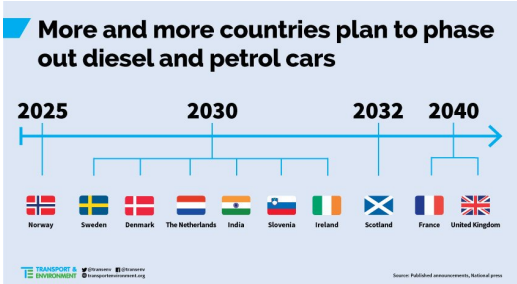

Figure 9 Global Plans to Eliminate Diesel and Petrol Cars [11]

Some cities listed have signed the Fossil Fuel Free Streets Declaration, committing to ban emitting vehicles by 2030,[25] but this does not necessarily have force of law in those jurisdictions.

City or Territory	Country	Ban announced	Ban commences	Scope	Selectivity
Amsterdam	Netherlands	2019	2030[26]	Gasoline or Diesel	All vehicles
Athens	Greece	2016	2025[27]	Diesel	All vehicles
Auckland	New Zealand	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
Balearic Islands	Spain	2018	2025–35[28]	Gasoline or Diesel	All vehicles
Barcelona		2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
Bristol	United Kingdom	2019	2021[29]	Diesel	All private vehicles (city center from 7 am to 3 pm)
British Columbia	Canada	2018	2025[30]	Gasoline or Diesel	All vehicles by 2040, 10% ZEVs by 2025
Brussels	Belgium	2018	2030[31]	Diesel	All vehicles
Cape Town	South Africa	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
Copenhagen	Denmark	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
Hainan	China	2018	2030[32]	Gasoline or Diesel	All vehicles
Heidelberg	Germany	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
London	United Kingdom	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
Los Angeles	United States	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
Madrid	Spain	2016	2025[27]	Diesel	All vehicles
Mexico City	Mexico	2016	2025[27]	Diesel	All vehicles
Milan	Italy	2017	2030[6]	Diesel	All diesel vehicles, electric buses by 2025
Oxford	United Kingdom	2017	2020–35[6]	Gasoline or Diesel	All vehicles (initially during daytime hours on six streets)[33][34]
Paris	France	2016	2025[27]	Diesel	All vehicles
Quito	Ecuador	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
Rome	Italy	2018	2024[35]	Diesel	All vehicles
Seattle	United States	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025
Vancouver	Canada	2017	2030[6]	Gasoline or Diesel	All vehicles, electric buses by 2025

Figure 10 Global City Clean Air Requirements [13]

1.2 Progress To Date

The largest concentrations of commercial electric vehicles is currently in buses. The emerging area is in delivery vans. Recently, some introductions have focused on reducing the weight of the vans to less than 10,000 pounds to make them capable of being legally driven without a commercial vehicle driver license. Figure 11 has two charts that provide a good overview of the annual sales and the installed base of buses today. It also provides projections for the different classes of vehicles through 2030 and beyond.

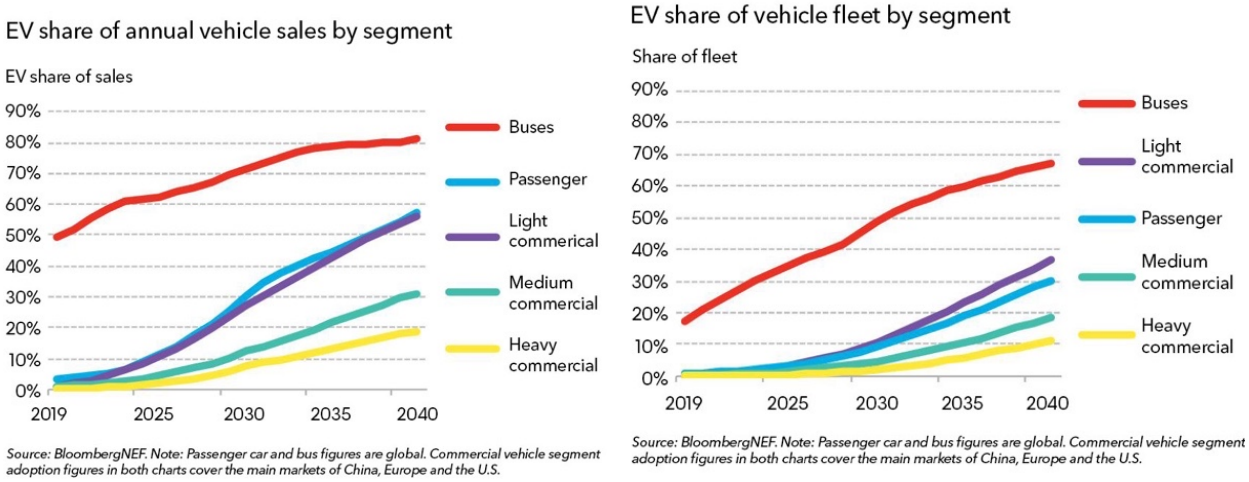

Figure 11 Current and Future Sales/Installed Base by Vehicle Type [14]

1.3 Commercial Vehicle Partnerships

In January of 2019, Reuters published information that 250 startups involved in vehicle electrification had attracted over $20 billion in venture capital [15]. Startups have accelerated in the last year with some coming out of stealth mode and investments have increased such as the $1.3 billion provided to Rivian by Ford, Amazon and Cox Automotive [16].

There are many players in various parts of the ecosystem for electric vehicles. It ranges from cloud services for tracking and remote maintenance, to charging infrastructure to vehicle miles travelled taxing methods to parts,

service, and aftermarket support. Most picture this in some layered approach with cloud services at the top and Tier-2 parts manufacturers at the bottom. Some show it going from left to right, as done in Figure 12.

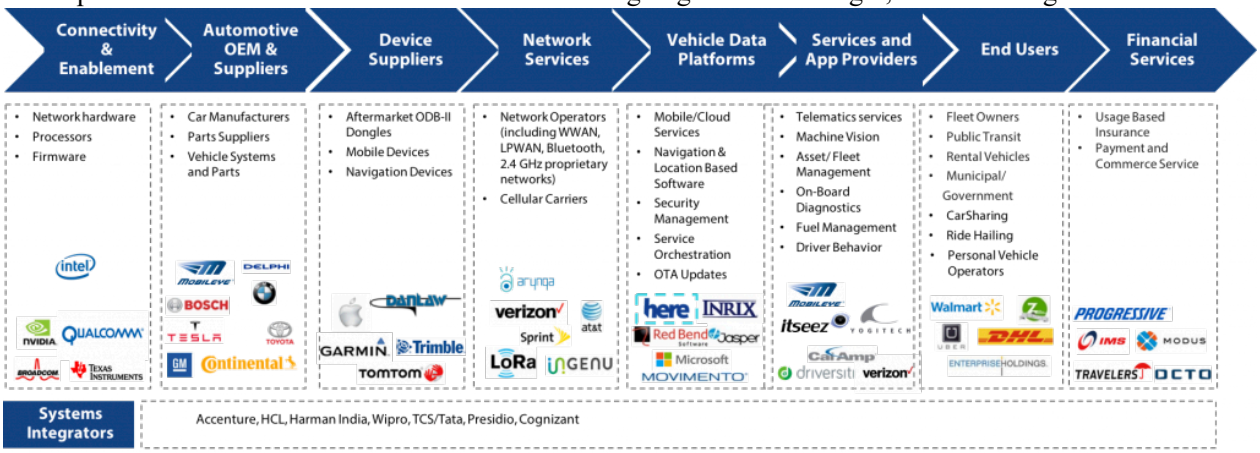

Figure 12 Example Supply Chain Companies [17]

CALSTART announced a new resource for the industry at the Green Truck Summit on March 3, 2020. Under their Drive To Zero initiative, they provide an interactive chart of applications, regions, and manufacturers.

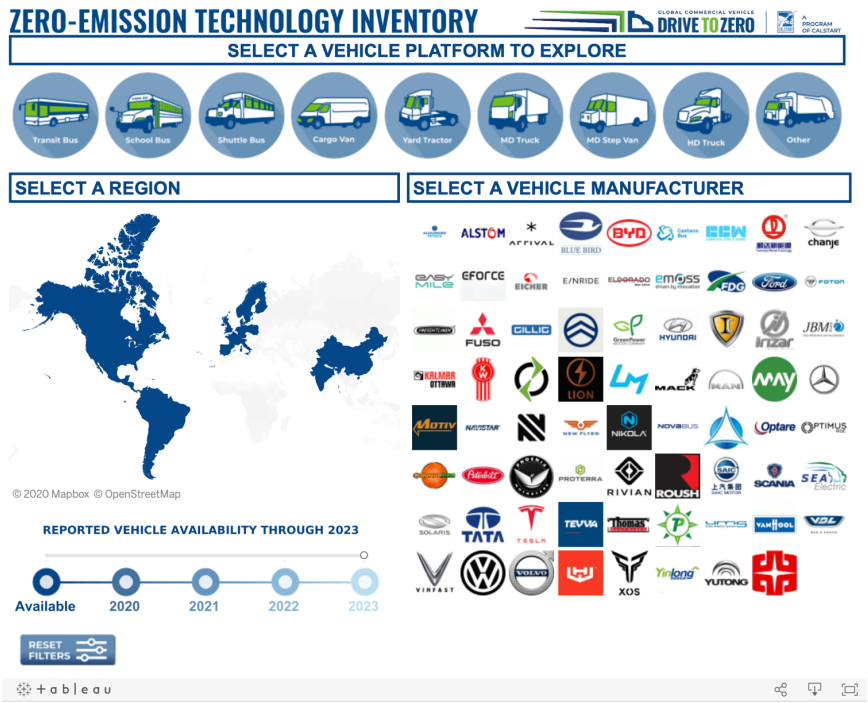

Figure 13 CALSTART Drive To Zero Inventory [18]

Suppliers and customers are so interconnected, it may take something like a point cloud network diagram to attempt to represent the many examples of public private partnerships (3Ps), ownership arrangements, strategic relationships. To provide an example of the relationships, consider a fleet customer (UPS), a vehicle OEM (Ford Motor Company), a Tier-1 supplier (Dana), and two aftermarket upfitters (Lightning Systems and MOTIV Power Systems).

UPS reported at the Green Truck Summit on March 3 that they currently have 8.457 alternatively fueled vehicles. The vast majority of those are CNG (5,173), Propane (1,175) and LNG (1,255) powered vehicles. They have HEV (622), EV (122), HHV (64) and EB (6) Electric Bikes. UPS has invested in and ordered

10,000 electric delivery vehicles from Arrival in the UK, is working with Waymo on autonomous van deliveries, is working with TuSimple and Peterbilt on autonomous heavy vehicle operations, is testing Gaussin electric autonomous yard tractors in Europe and received the first commercial drone license.

Ford Motor Company is a leader in light/medium duty trucks and vans. For years, their chassis has been used by upfitters to create all sorts of shuttle buses, work trucks, and delivery vans. Companies such as Lightning systems, SEA Electric and MOTIV, have been offering electric powertrain/drivetrain options as part of Ford's Qualified Vehicle Modifier program. As is typical in commercial vehicle markets, the aftermarket and upfitters establish a viable market in the early years. If successful in proving a market, the vehicle OEM then internalizes the development to decrease part costs, improve production efficiencies, give customers better factory warranties and access to financing. Thus, Ford announced in early March they will put into production an electric version of the Transit model available in 2022. They have already announced an electric F-150 pickup truck for possible 2021 production. Further, they have made a strategic investment of $500 million in Rivian, a company producing an electric chassis platform shown below. Ford has further announced a Lincoln brand SUV and a delivery van will be built on this platform. Ford is competing for the 186,000 USPS vehicle order. It is clear that Ford will now compete with some of its upfitters at the low end of the weight classifications.

Figure 14 Rivian Skateboard Chassis [19]

Dana is a classic Tier-1 supplier of parts to the truck industry. Coming from an early portfolio of transmissions, drivelines and axles, they have pivoted to becoming a nearly full line supplier of the parts needed for an electric powertrain/drivetrain. They have accomplished this with both internal development and a significant number of acquisitions in the last few years. They now offer motors, sensors, inverters, cooling packages, electronics, software, compressors. They combine this with system engineering capability so that they can offer components to the major vehicle OEMs and full system parts and support to the smaller OEMs such as Lion Electric and Phoenix Motor Cars.

Figure 15 is pictures are from presentation materials used by Lightning Systems and MOTIV Power Systems at the Green Truck Summit and Work Truck Show from March 3-5, 2020 showing the breadth of electric vehicles made from Ford chassis.

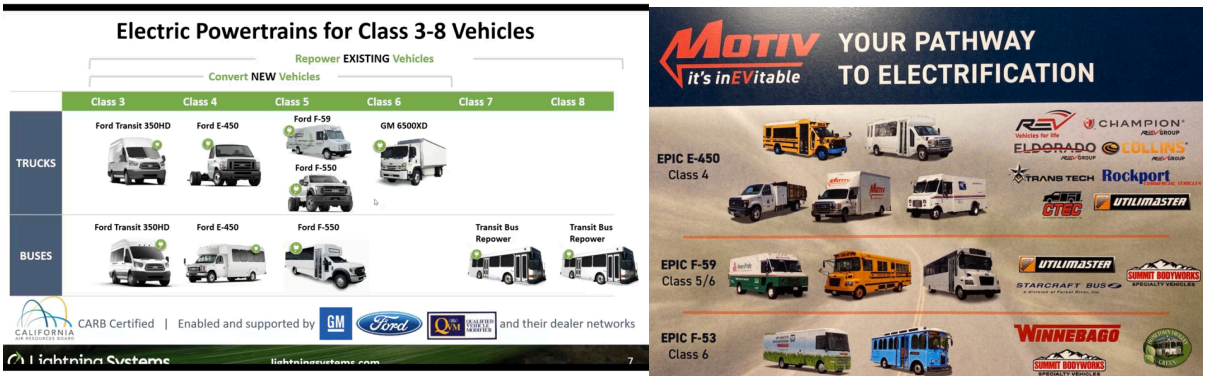

Figure 15 MOTIV and Lightning Ford chassis examples [20]

The EPIC (Electric Powered Intelligent Chassis) has been used for Utilimaster delivery vans, shuttle buses from the REV Group, trolleys, and school buses. It utilizes a motor from Dana and batteries from BMW. Both of these early stage developers of electric chassis will be impacted by FORD/Rivian taking some of the work internal. Since FORD/Rivian is concentrating on the F-150 and Transit models at the lower end of the weight spectrum, these suppliers will be able to continue building on the heavier chassis of the E-450, F-53, and F-59.

MOTIV (Figure 16) is an example of a company with a significantly complex supply chain and sales channel. The complexity and classification of companies reminds one of the taxonomy used in biology for classification purposes. For these purposes, this might be called the electronomy for electric commercial vehicles. Note that MOTIV is jumping past Ford to get its own battery system from BMW, a classic Vehicle OEM, not a Tier-1 supplier. The other major part suppliers are not shown. Also note that Ford provides its chassis to many upfitters that are in direct competition with MOTIV.

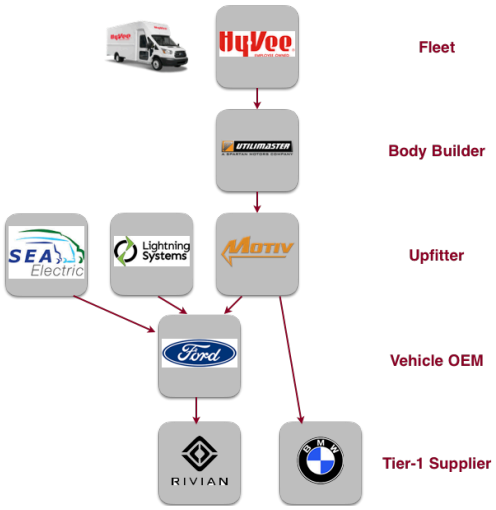

Figure 16 Electronomy Supply and Sales Channel Diagram for MOTIVE [21]

The example diagram (Figure 17) for UPS becomes much more complex quickly. Here, the relationships for the class 8 vehicle from TuSimple are shown with the recent start of a relationship with Arrival.

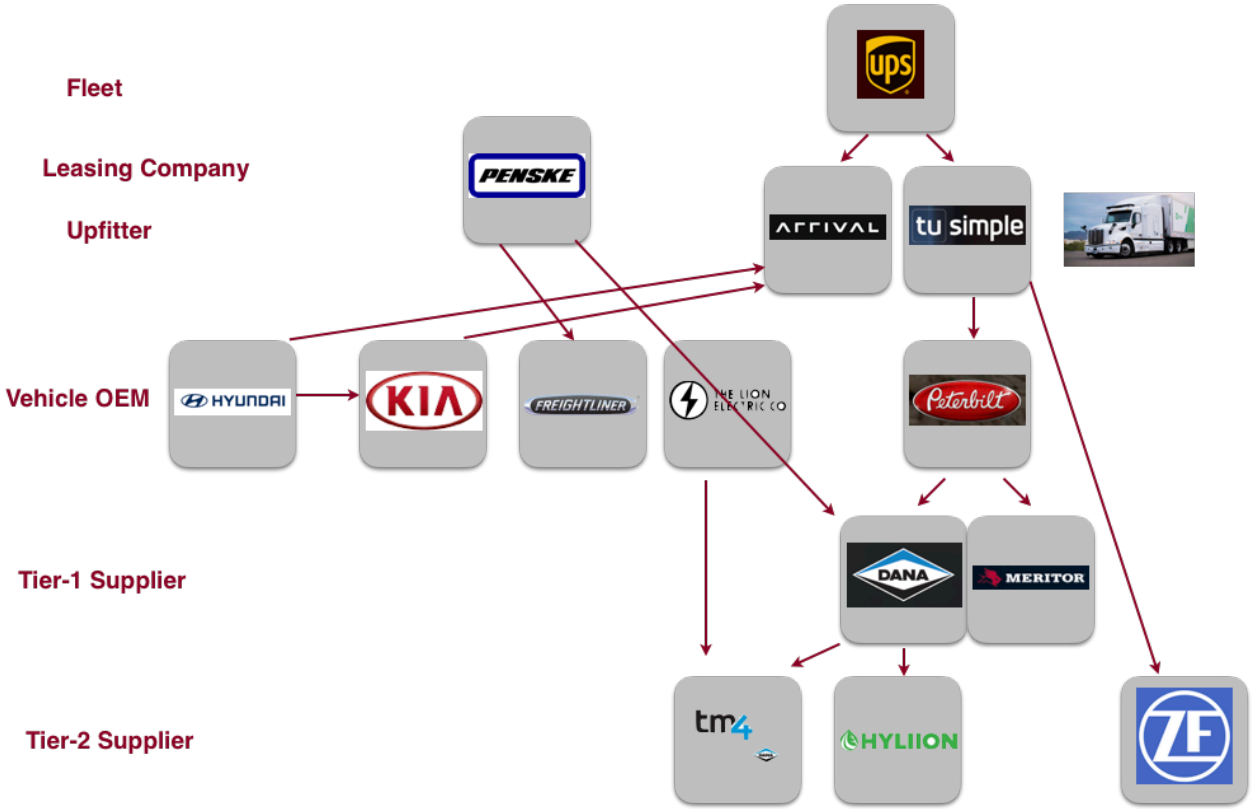

Figure 17 UPS Electronomy Supply and Sales Channel Diagram [22]

While early vehicles from TuSimple and Peterbilt use a powertrain/drivetrain from Meritor, Peterbilt recently announced the selection of Dana for future developments [23].

1.4 Challenges Remaining

UPS completed a study in 2018 [24] primarily for their own purposes, on the challenges of moving to electric vehicles. Purchase price and infrastructure were the biggest issues to overcome. Achieving cost parity remains the biggest challenge. Infrastructure is a big part of the cost for a fleet. Pacifc Gas & Electric (PG&E) used this slide at the Green Truck Summit and a recent webinar to help explain what infrastructure they would provide, where incentives exist, and what costs the fleet needs to assume.

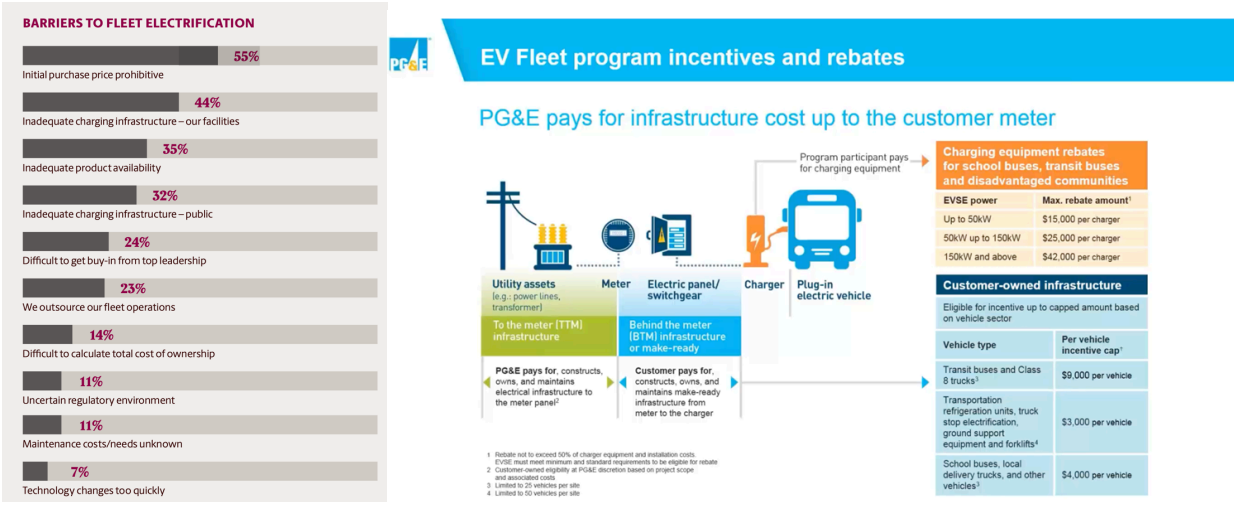

Figure 18 UPS Study of Electrificant Barriers and PGE Infrastructure Support [24, 25]

Since purchase price was the top reason from UPS, Figure 19 is from McKinsey and is illustrative of when cost parity will be achieved for different vehicle classes and applications.

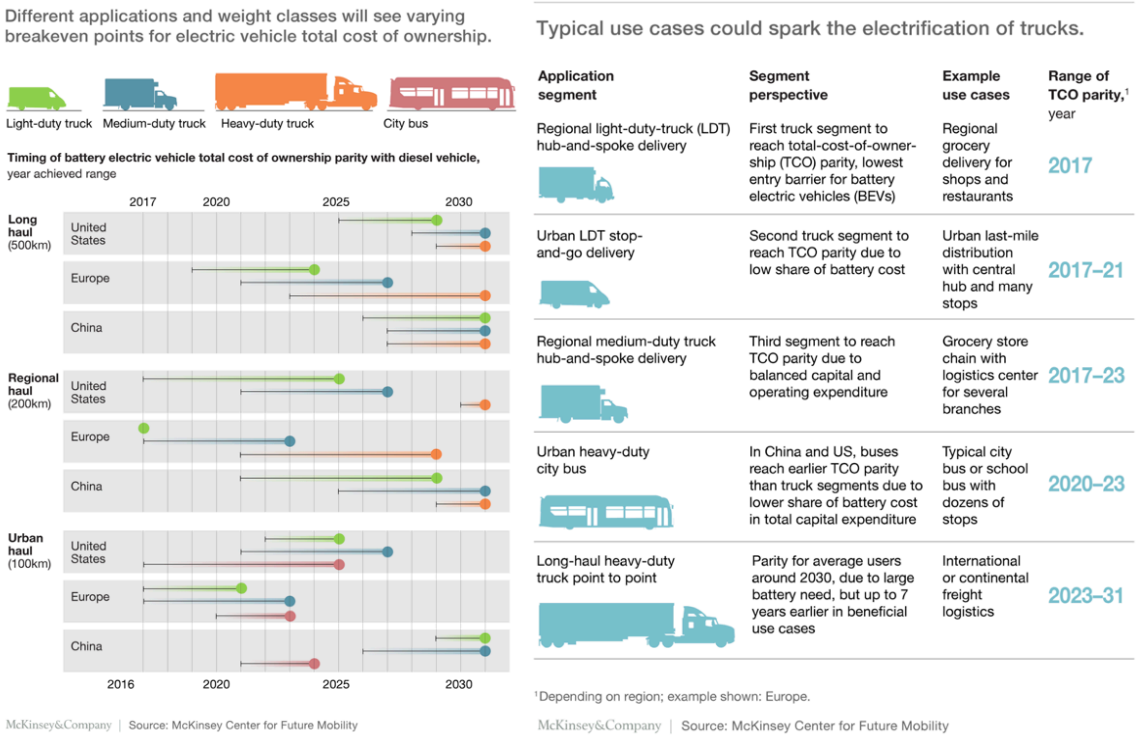

Figure 19 McKinsey Report on Cost Parity Date Estimate [26]

1.5 Projections for the Next Decade

Suppliers to the commercial vehicle industry have developed a new language for announcing milestones and accomplishments. It has become necessary to better define the word “production.” The North American Council for Freight Efficiency recently published a series of 4 reports on electric vehicles [27] and a report on the definition of production [28].

We can expect the increase in electric vehicles to advance more rapidly than the advance of autonomous vehicles. Both will require safety systems and wireless connections. As the internal combustion engine declines, autonomous vehicles can be expected to be built on the electric powertrains/drivetrains. Available incentives for electric vehicles, more easily controlled electric motors, reduced maintenance of electric vehicles with few parts will help to pay for the more expensive sensors and computers needed for autonomous control. As electric and autonomous combine, we can expect to talk about electronomous vehicles.

Figure 20 from McKinsey is a reasonable forecast for commercial electric vehicles.

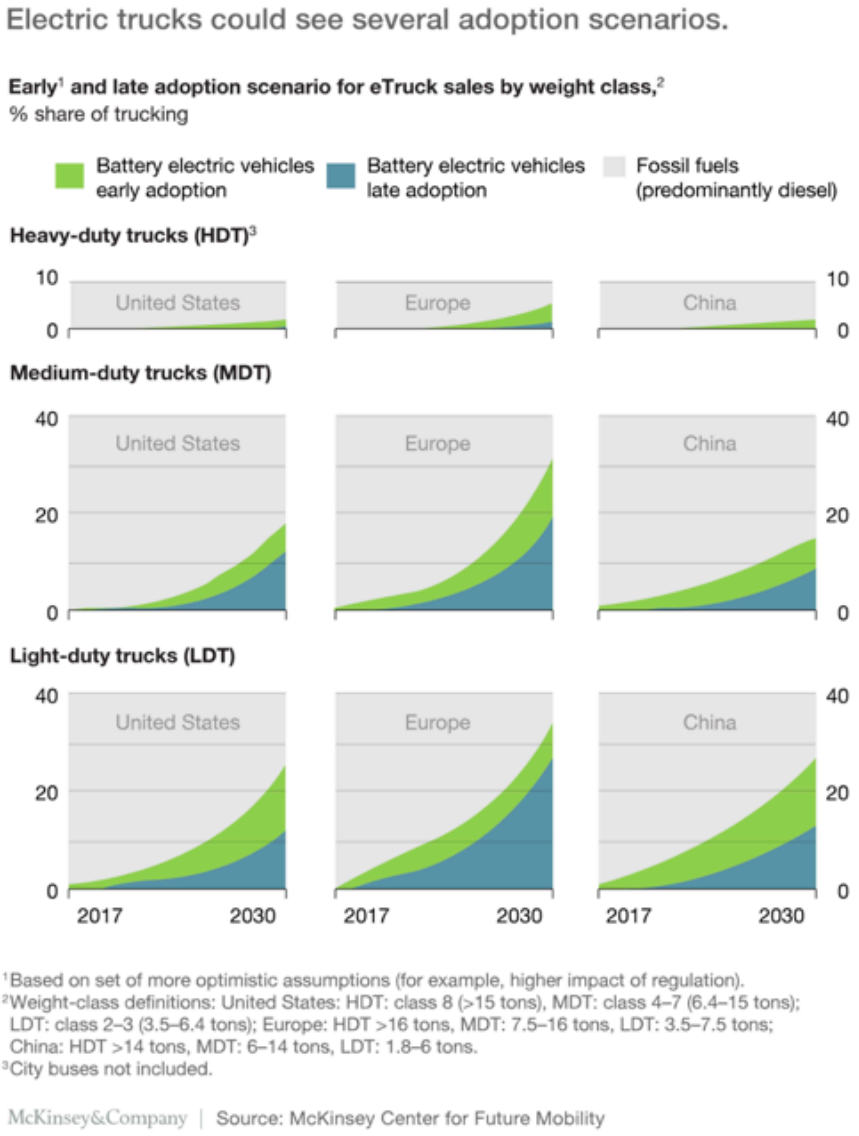

Figure 20 McKinsey Projection for Electric Commercial Vehicles by Region and Weight [29]

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