MANUFACTURING CAPACITY FOR HEAVY-DUTY ZERO-EMISSION VEHICLES IN THE UNITED STATES

Estimating the current and planned production capacity for heavy-duty zero-emission vehicles in the United States

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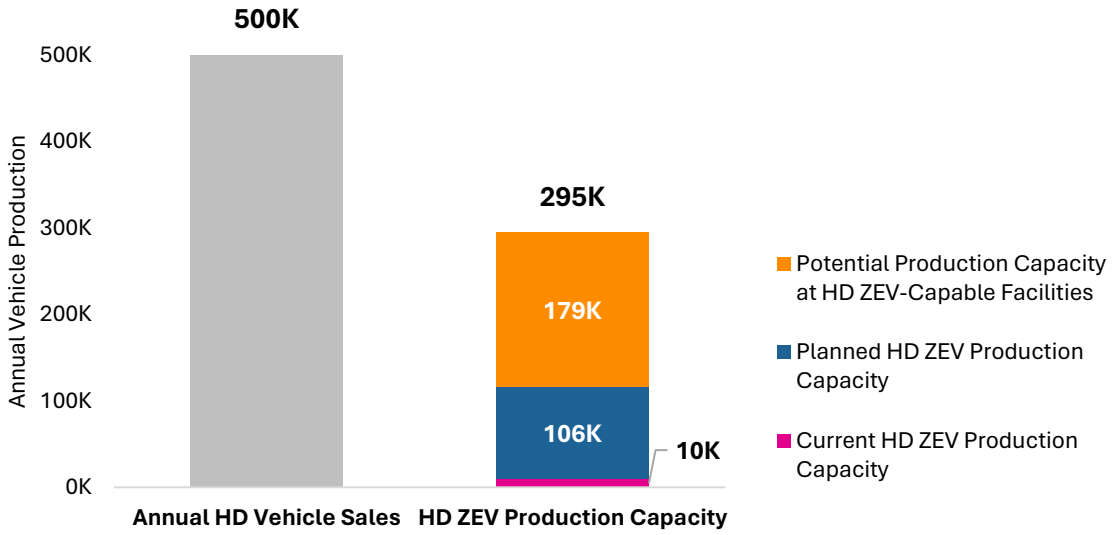
Executive Summary

Atlas Public Policy assessed the current and planned production capacity for class 4-8 heavy-duty (HD) zero-emission vehicles (ZEVs) based on publicly available information from vehicle manufacturers and news sources.

Atlas identified 43 HD vehicle manufacturing facilities across the United States, 37 of which can currently produce ZEVs. These 37 "ZEV-capable" facilities have a cumulative, estimated annual production capacity of 10,000 ZEVs and 179,000 ICE vehicles in 2023. Further, manufacturers have announced plans to invest nearly $6.5 billion in new HD ZEV production capacity, representing an additional planned capacity of 106,000 ZEVs per year.

Combined with current and planned capacity for ZEV production, converting all production of ICE vehicles at ZEV-capable facilities could yield an annual production capacity of over 295,000 HD ZEVs, which represents 59 percent of annual U.S. HD vehicle sales.

Figure 1: Annual HD vehicle sales and potential U.S. HD ZEV manufacturing capacity

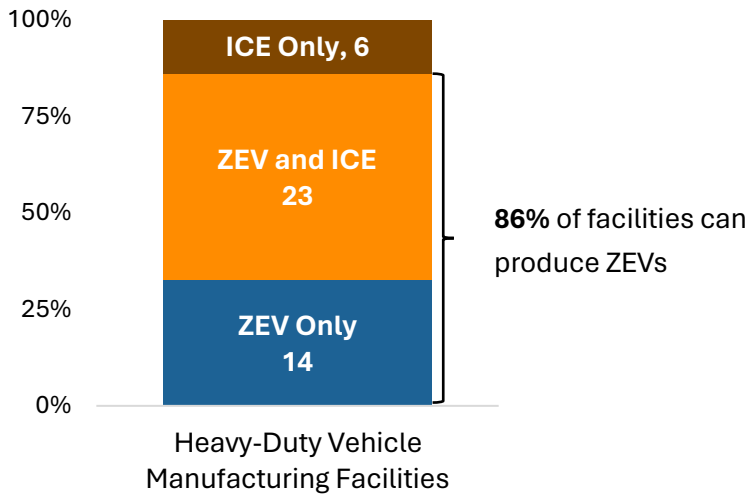


Atlas sourced current production capacity from manufacturer press releases and news coverage to estimate annual and planned production capacities of ICE and ZEV vehicles (see *Methodology*). Atlas sourced annual vehicle sales from the U.S. Environmental Protection Agency [1].

Current Production Capacity

Atlas identified 43 facilities across the United States currently producing heavy-duty (HD) class 4-8 trucks and buses. Collectively, these 43 facilities have an estimated annual production capacity of approximately 400,000 conventional internal combustion engine (ICE) vehicles and 10,000 zero-emission vehicles (ZEVs), not including ten facilities where data was unavailable. Eighty-six percent of all facilities are capable of producing ZEVs, and 14 facilities (33 percent) exclusively produce ZEVs, see Figure 2.

Figure 2: Heavy-Duty Manufacturing Facilities by Type of Vehicles Produced



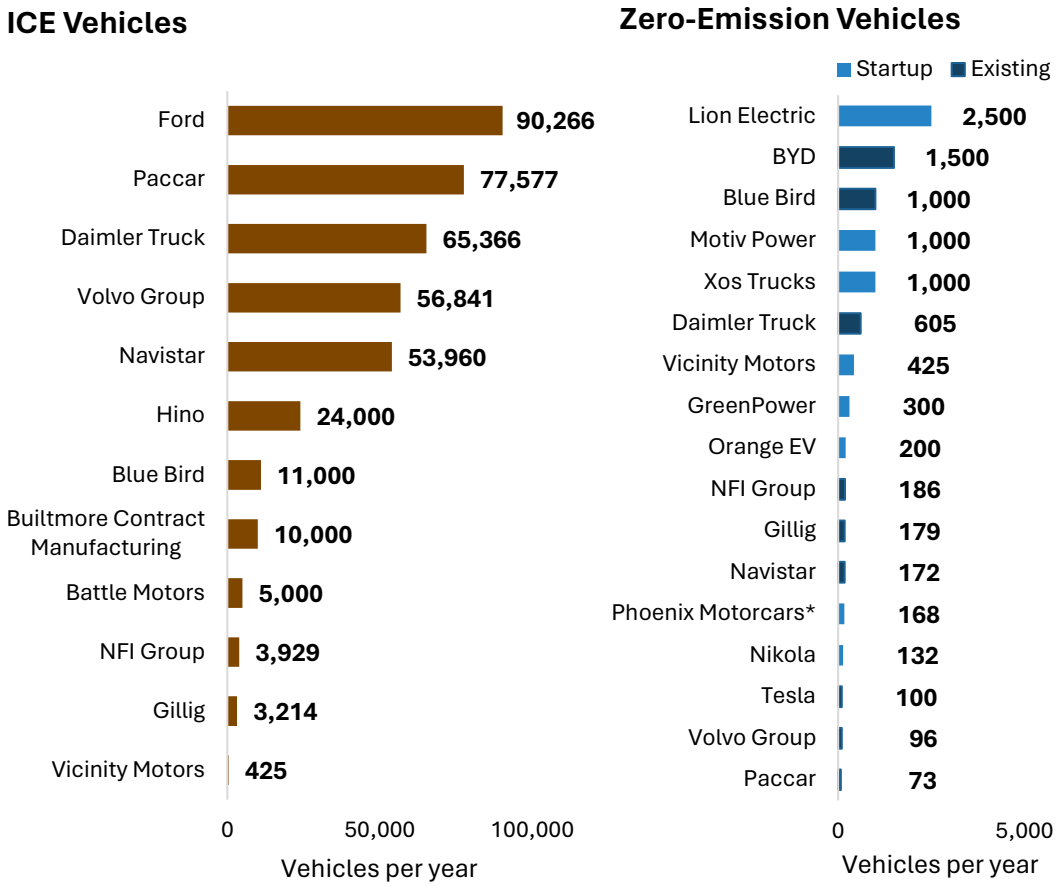
This figure depicts the 43 facilities identified that produce heavy-duty vehicles in the United States broken down by the type of vehicles produced at that facility.

Ford leads the way with an estimated annual production capacity of 90,000 HD vehicles. While Ford does not currently offer any ZEVs in the class 4-8 range, the company has committed to invest more than $50 billion in the transition to EVs including $1.5 billion to launch an all-new commercial EV at its Ohio Assembly Plant by mid-decade [2, 3].

Paccar, Daimler Truck, Volvo Group, and Navistar (TRATON Group) round out the top five, each with over 50,000 vehicles per year and collectively accounting for 60 percent of current ICE production capacity. All four of these leading manufacturers have begun to produce HD ZEVs at their existing manufacturing facilities with a collective current ZEV production capacity of nearly 1,000 units per year.

Lion Electric has the highest reported current ZEV production capacity at 2,500 vehicles per year followed by BYD with 1,500. Figure 3 shows the estimated annual production capacity for ICE and zero-emission vehicles by original equipment manufacturer (OEM) group for 33 facilities where public information was available.

Figure 3: Estimated U.S. Annual Production Capacity of Class 4-8 Vehicles by OEM Group



Atlas sourced production capacity from manufacturer press releases and news coverage for 33 facilities to estimate annual production capacities of ICE and ZEV vehicles by OEM groups. For 27 of these facilities, Atlas had to estimate annual production capacity based on partial information (see *Methodology*). Ten facilities did not make any information on production capacity available and are excluded from this chart.

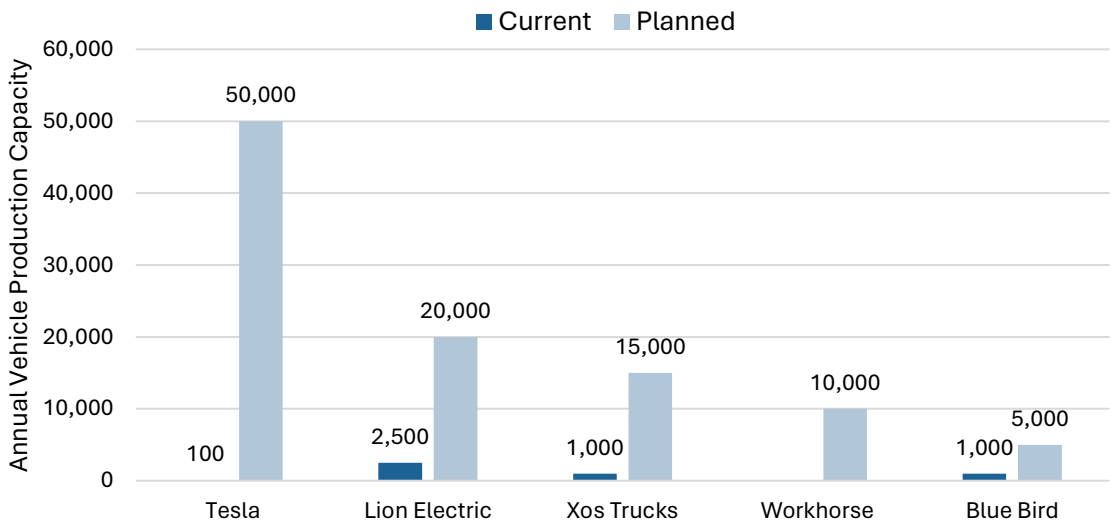
* Includes production capacity from Proterra's facility in Greenville, South Carolina which was purchased by Phoenix Motorcars on November 14. 2023 [4].

Planned Production Capacity

Manufacturers have announced plans to increase their combined annual production capacity by 106,000 units, bringing the total to 116,000 ZEVs, or 12 times the current production capacity. This expansion includes plans to increase ZEV production capacity across eight existing facilities and to bring 11 new ZEV-producing facilities online. In total, manufacturers have pledged over $6.5 billion towards this transition in the form of construction, expansion, and retooling of facilities to produce HD ZEVs.

Tesla leads the planned production ramp up, targeting an annual production capacity of 50,000 Tesla Semis at its Nevada gigafactory by the end of 2024, a significant increase from the 60 to 70 Semis it has produced as of October 2023 [5]. Three EV-only startups, Lion Electric, Xos Trucks, and Workhorse have also set ambitious targets. Though no timeline has been disclosed for their targets, each company is aiming to produce more than 10,000 units per year, up from 2,500 or fewer in 2023. Bluebird, a leading bus manufacturer, rounds out the top five with its plans to scale ZEV production from 1,000 units in 2023 to 5,000 at its manufacturing facility in Fort Valley, Georgia. In total, EV-only manufacturers account for 90 percent of publicly-announced, planned ZEV capacity. Figure 4 shows the current versus planned ZEV production capacity for the top five companies by planned ZEV capacity.

Figure 4: Current and Planned ZEV Production Capacity for Top 5 Companies by Planned Capacity



This figure depicts the current and planned ZEV production capacity of the top five companies by planned ZEV capacity. Planned capacity is based on company statements and may not be realized.

Historically, EV-only startup manufacturers have struggled to meet ambitious production targets and lack the access to capital of established manufacturers [6, 7, 8]. It remains to be seen if these manufacturers will be able to reach their production targets.

On the other hand, existing manufacturers are well positioned to recalibrate their facilities to ramp up production of ZEVs. For example, in 2019, Volvo Trucks announced plans to upgrade its New River Valley Plant in preparation to produce electric trucks [9]. At $400 million, the total cost of the upgrade was a fraction that of a new facility, and by early 2021, electric trucks were already rolling off the same production lines as Volvo's diesel vehicles [10]. The flexibility of these recalibrated facilities enables manufacturers to easily scale ZEV production to meet growing demand [11].

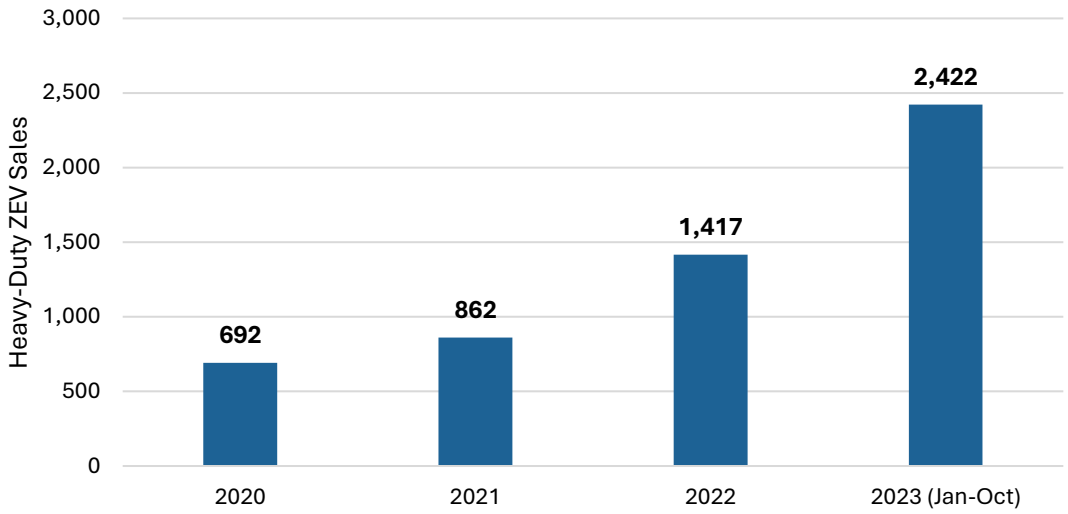
Other leading manufacturers have also taken steps in recent years to recalibrate facilities to flexibly produce both ZEVs and ICE vehicles. Since 2021, Paccar has added ZEV production lines at two of their three production facilities in the U.S. with an estimated collective capacity of over 40,000 trucks, Navistar opened a new manufacturing facility with an annual capacity of 13,000 trucks specifically dedicated to producing diesel and electric trucks side by side, and Daimler Truck launched series production of its flagship Freightliner eCascadia and eM2 at its plant in Portland, Oregon. On the bus side, all existing facilities from the nation's leading bus manufacturers including Gillig, New Flyer, IC Corporation, Thomas Built, and Blue Bird, can produce electric buses.

In total, if all the production capacity at facilities capable of producing both ICE and ZEV heavy-duty vehicles was dedicated exclusively to ZEVs, existing manufacturers could produce more than 175,000 HD ZEVs per year. Combined with planned capacity from EV-only manufacturers, this conversion could put U.S. production capacity at over 295,000 HD ZEVs per year, representing 59 percent of annual HD vehicles sales [1].

Growing Demand

While ZEV volumes are low today, the flexibility and scalable capacity of these recalibrated facilities will be critical for meeting the rising demand for HD ZEVs. After seeing a 64 percent increase in 2022, HD ZEV sales are on track to double in 2023 (see Figure 5). Further, according to the Environmental Defense Fund, U.S. fleets have already committed to deploy more than 15,000 HD ZEVs [12], more than five times the total projected sales for 2023. As the demand for HD ZEVs continues to accelerate, manufacturers with flexible assembly lines will be well positioned to ramp up production to fill their growing order books.

Figure 5. U.S. Heavy-Duty ZEV Sales by Year (2020 to Oct 2023)



This figure shows annual sales of class 4-8 zero-emission vehicles in the United States.

Source: Atlas EV Hub

Battery and Fuel Cell Supply

The supply chain, particularly of batteries and fuel cells, presents a significant potential barrier to scaling up HD ZEV manufacturing. Recently, startup and existing manufacturers alike have begun to establish supply chain agreements and in-house manufacturing to secure an adequate battery and fuel cell supply to lead the transition to zero-emission vehicles [13, 14, 15, 16].

Atlas identified 33 battery and fuel cell supply agreements across 28 HD ZEV manufacturers signed since 2018. While the details of these agreements are typically not made public, those that did disclose commitments totaled over $5.4 billion of investment and 27 gigawatt-hours (GWh) of battery supply.

Daimler Truck and Paccar led the way with their joint venture with Accelera by Cummins, announced in September 2023. The three-way partnership will invest $2 to $3 billion in a 21 GWh battery manufacturing facility to serve commercial vehicles, enough to supply approximately 70,000 HD ZEVs annually.[1] EVE Energy will serve as the technology partner with a 10

[1] Assumes 300 kWh per vehicle based on average of models currently offered by Daimler and Paccar.

percent ownership stake. Meanwhile, Volvo Truck continues to rely on a strategic partnership formed with Samsung SDI in 2019 to provide battery cells and modules for Volvo Group's electric trucks. The group has already opened its first dedicated battery plant in Ghent, Belgium to serve the European market. In November 2023, Volvo Group announced the purchase of Proterra's battery business for $210 million, including Proterra's multi-GWh EV battery factory in Greer, South Carolina [17].

Battery and fuel cell supply remains a top priority for HD ZEV manufacturers, and additional supply will likely need to be secured in order to meet emissions targets [18]. It is difficult to assess the adequacy of existing supply agreements given the confidential nature of these documents.

Looking Ahead

The transformation of the U.S. heavy-duty vehicle manufacturing industry is well underway with over 85 percent of HD manufacturing facilities already producing ZEVs and every leading manufacturer producing, or soon planning to produce, zero-emission models.

Manufacturers are positioning themselves for a zero-emission future through constructing new ZEV production facilities, recalibrating existing facilities to produce ZEVs alongside ICE vehicles, and establishing purchase agreements for battery and fuel cell supply. While production is still low today, these strategic investments are providing the capacity to significantly ramp up HD ZEV production capacity as demand grows.

The current production capacity combined with planned developments, and already-recalibrated facilities have put the HD vehicle manufacturing industry on course to meet nearly 60 percent of annual HD vehicle sales.

Methodology

Atlas identified facilities that produce HD vehicles using a combination of original research and data provided by the International Council on Clean Transportation. Atlas only included locations of final vehicle assembly, excluding parts, servicing, and subassembly centers. Atlas only included locations that predominantly produce class 4-8 vehicles; however, some facilities may also produce vehicles of class 3 and below. Where possible, Atlas only reports the investment and production capacity for class 4-8 vehicles.

Atlas sourced production capacity from manufacturer press releases and local news coverage. In many cases, Atlas had to estimate annual production capacity based on partial information including:

- For facilities that only provided a daily production capacity, Atlas assumed an operating schedule of 250 days per year[2];
- For facilities that provided milestones, for example, the date of the production of the 50,000th and 100,000th truck, Atlas divided the number of vehicles produced by the number of years between the two dates, assuming constant annual production capacity;
- For some facilities that serve as the sole production facility for the North American market, Atlas used total annual vehicle deliveries from manufacturer websites and financial filings to estimate the annual production capacity for that facility; and,
- For ZEV models that are only manufactured at one facility, Atlas used U.S. vehicle sales from S&P Global through October 2023 to estimate current annual ZEV production capacity.

Atlas excluded Lightning eMotors's current and planned estimated production capacity of 2,500 and 20,000 HD ZEVs, respectively, due to uncertainty around the future of the company's manufacturing facility after it went into receivership in December 2023 [19].

This analysis estimates the maximum potential production capacity of zero-emission HD vehicles based on publicly available information. All production numbers rely on public reporting from manufacturers which is difficult to verify with external sources and tends to be optimistic. Further, manufacturers may not realize planned production capacity and converting ICE production to ZEVs at existing facilities may require significant capital investments.

[2] 250 operational days per year is based on the approximate number of work days in a year as well as comparisons of daily and annual production capacity from BlueBird and SEA Electric.

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Appendix A: Data Sources

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Arrival to build its first U.S. electric vehicle Microfactory in York County, South Carolina

Battle Motors
Battle Motors in New Philadelphia completes $40M expansion project (timesreporter.com)

Blue Bird
Blue Bird Celebrates Grand Opening of Electric Vehicle Build-up Center (blue-bird.com)
Blue Bird Corporation - Blue Bird Increasing Production Capacity; Adding Second Shift & New Employees in 2016 (blue-bird.com)
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Builtmore Contract Manufacturing
100,000th Isuzu gasoline truck produced in Michigan – Diesel Progress
Gov. Whitmer Announces 680 New Jobs Created by The Shyft Group Expansion in Charlotte | Michigan Business

BYD
Press Release: BYD Produces 300th Bus in Lancaster; AVTA Nears 1 Million Emission-Free Miles – BYD USA
Press Release: BYD Continues U.S. Investment with New $5 million Warehouse Facility – BYD USA

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Cenntro building-out Jacksonville factory and showroom | Jax Daily Record
Cenntro Automotive chooses Jacksonville for first U.S. electric vehicle plant | Jax Daily Record
Cenntro Announces New Assembly Plant in Ontario, California | Cenntro Electric Group Limited (cenntroauto.com)

Daimler Truck
Daimler Truck North America | Daimler
DTNA's Mount Holly Manufacturing Plant Marks Production of 700,000th Truck | Daimler (daimlertruck.com)
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Detroit Custom Chassis
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GreenPower Announces Plans to Triple Production Capacity – Green Bus (greenpowermotor.com)
Charged Evs | GreenPower's new West Virginia factory could produce 600 electric school buses per year – Charged Evs
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Lightning eMotors Expands Manufacturing Facility to Meet Increasing Customer Demand – Lightning eMotors

Lion Electric
Lion Electric opens factory in Illinois | electrive.com

Motiv Power
Motiv Power Systems Introduces New Electric Truck Series – CleanTechnica
Motiv Power Systems Wins $8.1 Million and Opens Manufacturing Facility to Meet All-Electric Truck and Bus Demand (prnewswire.com)

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Mullen takes over Electric Last Mile Solutions | electrive.com

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Truck orders and deliveries | Volvo Group
Mack Trucks Produces 10,000th Mack® MD Series truck at Roanoke Valley Operations (RVO) | Mack Trucks
Volvo to acquire battery business from Proterra Inc. and Proterra Operating Company (volvogroup.com)

Workhorse
About Us | All Electric Vehicles | Workhorse

Xos Trucks
Plucky L.A. Startup Xos Plots A Multibillion-Dollar Future In Unsexy Electric Work Trucks (forbes.com)

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