Title

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Understanding Zero Emission Truck (ZET) Manufacturing and Battery Supply Chains

Aditya Ramji, Jameel Jamhar

Why ZET supply chains?

As governments look to accelerate vehicle electrification, there has been a significant focus on EV supply chains with the clean transportation transition also being seen as an industrial development strategy by many countries[1]. This requires an in-depth understanding of EV market sales, production, vehicle exports and imports, battery chemistry choices and cell production to better inform ZEV policy. There has been a lot of focus on understanding EV supply chains and global trade through the lens of light duty vehicles[2]. For any country to fully understand the market dynamics of vehicle electrification, it is imperative to assess the transition across all relevant vehicle segments.

Zero emission trucks have picked up pace across both developed and developing country markets, driven by a combination of regulation, early market movers and industrial strategy[3]. While the current ZET market is still nascent, with about 382,000 sales between 2023-2025 (Q3), 70 GWh of battery capacity were delivered, an average of 310 kWh per heavy-duty and 135 kwh per medium-duty truck. While this does not compare in scale to the LDV EV market which deployed 2,247 GWh in the same period, ZETs have battery packs 3-5X that of LDVs (200-400 kWh vs 50-100 kWh). Ensuring a robust ZET market can substantially and rapidly scale battery demand and help countries leverage industrial policy benefits sooner and in a more integrated manner.

This brief carries a unique assessment of global ZET sales including regional deep dives for China, Europe and the United States, emerging battery chemistries & sizes, and battery supplier – EV OEM relationships – providing a first-of-its-kind insight into ZET market trends and the implications of OEM choices on supply-chain concentration and diversification[4].

Global ZET Market Trends

Between 2023 – 2025 (Q3), global medium and heavy duty zero emission truck sales totaled about 382,000 units **(Figure 1)**, with China accounting for 94% of heavy duty and about 15% of medium duty ZET sales. The U.S. made up ~55% of medium-duty ZET sales.

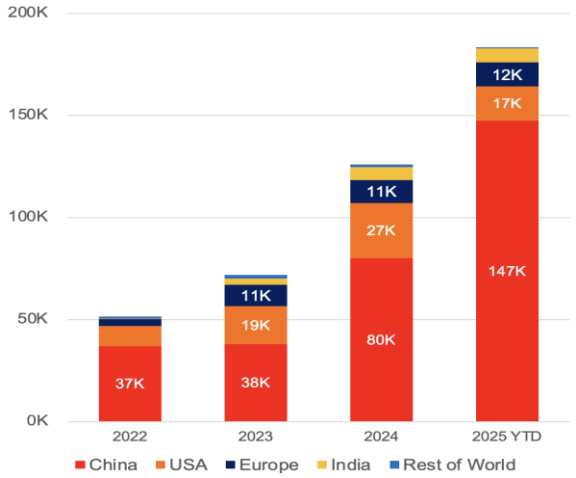

Figure 1: Global ZET Sales by major countries (2022-2025 Sep)

The most interesting trend is India's emergence in zero-emission trucks: medium- and heavy-duty sales are rising rapidly, and so far this year India has sold more electric heavy trucks than the U.S. this year.

Chinese ZET hypergrowth

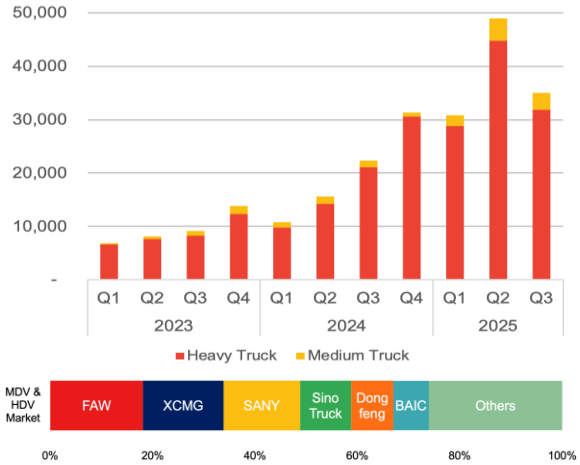

Figure 2: Chinese ZET quarterly sales (Jan 2023-Sep 2025) and OEM market shares 2025

China's ZET MHDV sales reached 114,800 units in 2025 (Jan-Sep), growing 43% above the full-year 2024 sales (80,021). 92% of 2025 sales were heavy trucks **(Figure 2)**.

Market leadership in China is distributed (FAW 18.1%, XCMG 15.8%, SANY 14.9%, CNHTC 10%) indicating robust competition. Notably, construction and heavy-equipment companies (non-traditional truck makers) such as XCMG and SANY have moved into heavy ZETs.

Concentrated Momentum in Europe

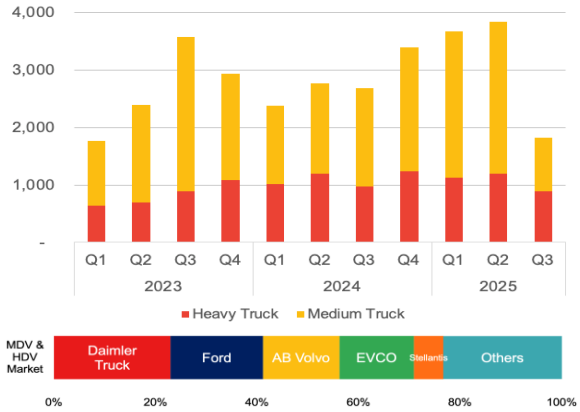

Figure 3: European ZET quarterly sales (Jan 2023-Sep 2025) and OEM market shares 2025

Europe's ZET HDV market continues to grow. After 11,240 units sold in 2024 (+5.4% YoY), 2025 (Q1-Q3) has already reached ~9,330 units, a 19% Y-o-Y growth **(Figure 3)**.

Daimler and Volvo remain key players, with Ford being the largest American OEM selling electric medium-duty trucks. EVCO (IVECO's EV brand) has also emerged as a key player.

10 European countries account for ~92% of 2025 YTD sales, concentrated in Western Europe. Germany is the anchor (~3000 units; 25% share), followed by the UK, while the Netherlands has surged to third (~1,500 units), already 110% growth over its 2024 full-year sales. France and Sweden constitute the remaining of the top 5 ZET markets in Europe.

Market Shock in the United States

U.S. ZET sales totaled 15,075 units in 2025 (Q1-Q3), driven by medium duty ZET sales. Heavy-duty ZET sales saw a Y-o-Y decline of 80% in 2025 (Q1-Q3), with only 200 units sold **(Figure 4)**. While there have been many commitments for heavy ZET deliveries in the U.S., actual sales have not yet translated[5].

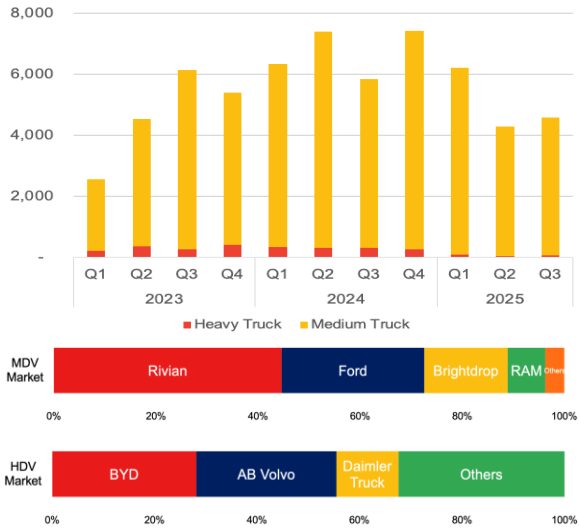

Figure 4: U.S. ZET quarterly sales (Jan 2023-Sep 2025) and MDV and HDV OEM market shares 2025

In 2025 (Q1–Q3), the medium-duty ZET market was concentrated: Rivian (~45%), Ford (~28%), and BrightDrop (~16%) together accounted for

~89% of zero emission MDV sales. The small volume heavy-duty ZET segment is led by BYD (~28%) and Volvo (~27%), which together control over half of US HDV ZET sales.

While the U.S. has blocked Chinese EV sales in the LDV segment, it is important to note the entry of BYD into the U.S. ZET market through direct imports.

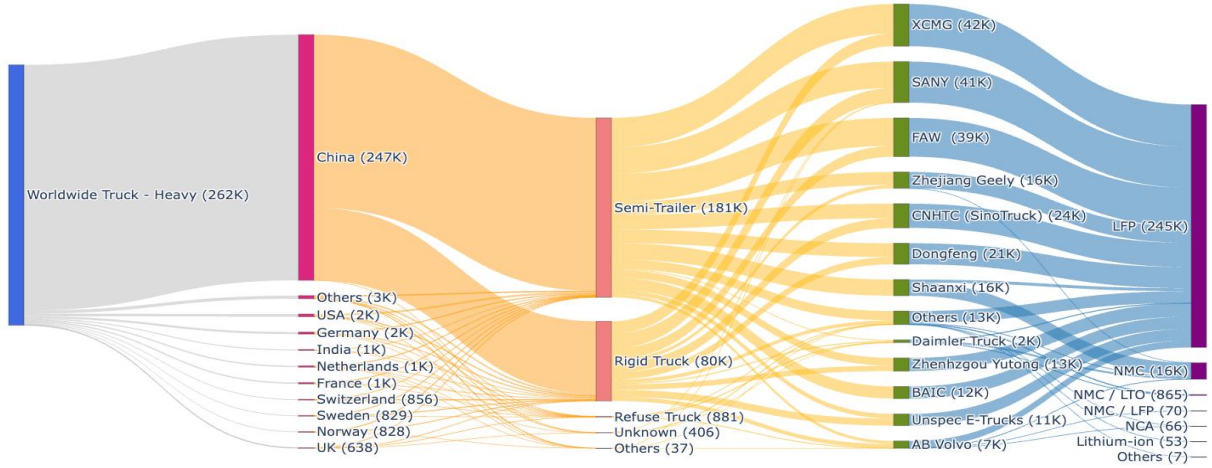

Figure 5: Global Heavy-Duty ZET sales by country of deployment, truck type, OEM and battery chemistry choices (2023 – 2025 September)

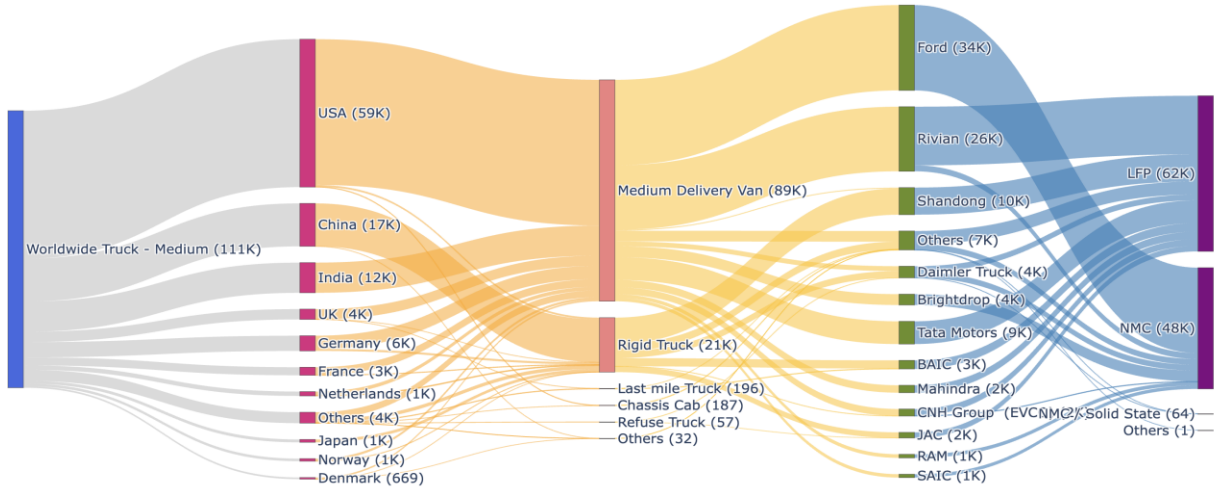

Figure 6: Global Medium Duty ZET sales by country of deployment, truck type, OEM and battery chemistry choices (2023 – 2025 September)

ZET Battery Sizes and Chemistries

In case of heavy-duty ZETs **(Figure 5)**, over 2/3rd sales were semi-trailers and 30% were rigid trucks, with LFP being the dominant chemistry (93%). For medium -duty ZETs **(Figure 6)**, the sales were more distributed, with U.S. (59%), China (15%), India (11%), Germany (5%), the UK and France (3% each). 56% of sales had LFP batteries while 43% were using NMC chemistries.

For heavy-duty ZETs, battery packs are consistently large: in the U.S. they average ~370–430 kWh (with LFP packs slightly larger than NMC); most major European markets cluster in the ~300–380 kWh range; while, Chinese HDVs run relatively smaller packs at ~210 kWh, reflecting deployment in shorter-range urban duty cycles.

On cell chemistry choices, LFP cells are used in over 90% of HDV ZET sales, with only a small share of NMC (and NMC/LTO) for niche applications in the U.S. and key European markets.

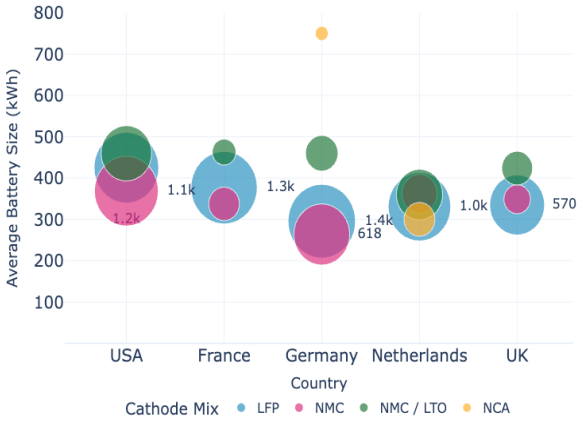

Figure 7: Heavy-duty ZET battery sizes and chemistries in the U.S. and Europe (2023-25)

In case of medium-duty ZETs, these are generally smaller battery packs (80–200 kWh) with regional differences. In the U.S. and Netherlands, LFP models use larger packs on average (USA: ~165 kWh vs 145 kWh for NMC; Netherlands: ~180 kWh vs ~97 kWh). In contrast, markets with high share of NMC chemistries like France and the UK use smaller packs**.** LFP is a slim global majority (~56%)**,** mainly because China is 100% LFP and the Netherlands is LFP-leading (58%). But most major Western markets are NMC-dominant — the USA (56% NMC), France (86% NMC), Germany (63% NMC), and the UK (79% NMC).

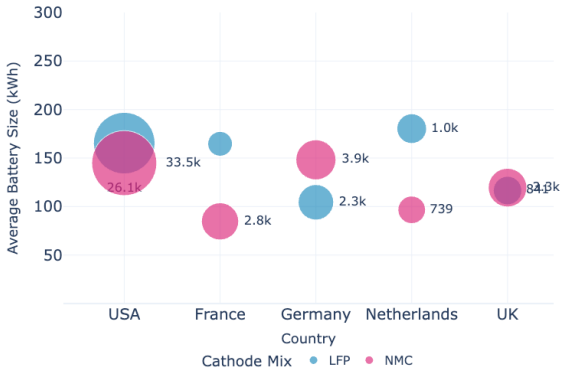

Figure 8: Medium-duty ZET battery sizes and chemistries in U.S. and Europe (2023-25)

While LFP is dominant among trucks in the U.S., it has limited domestic cell manufacturing capacity for LFP chemistries (mostly controlled by China). In Europe, OEMs have been more intentional using NMC for medium-duty ZETs in Europe, diversifying their chemistries and dependencies.

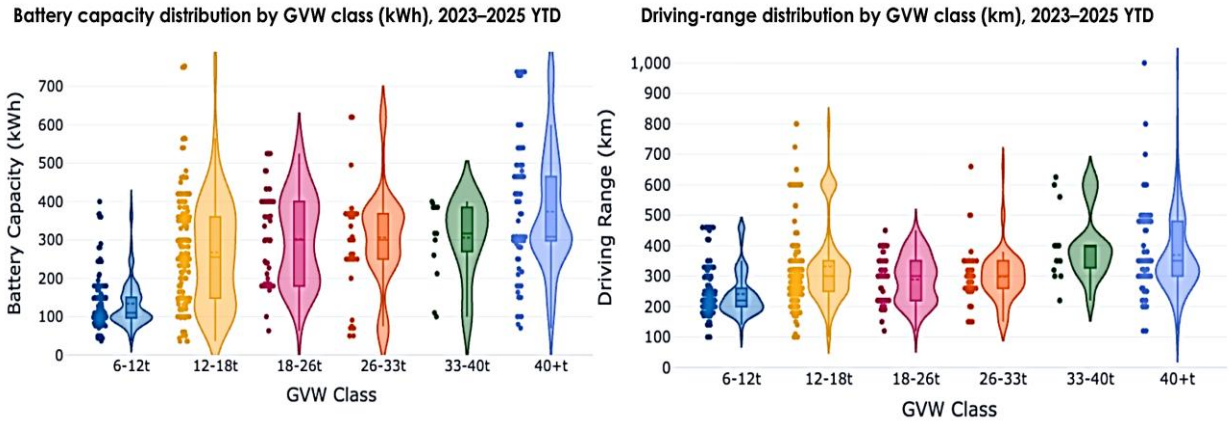

Figure 9: Battery size and corresponding range for ZETs by weight classes (2023-25)

How far does your ZET travel?

For OEMs, battery chemistry and size choices are inextricably linked to performance requirements, safety and segment economics. As seen in **Figure 9**, Average battery pack sizes scale with weight, ranging from 133 kWh (6–12T) to 266 kWh (12–18T) and reaching ~372 kWh (>40T). LFP dominates where cost and cycle-life are critical, capturing 98% of the high-volume 12–18T segment and 96% of the >40T segment. Conversely, NMC leads in the mid-to-heavy 26–40T segments, where higher energy density helps mitigate payload trade-offs.

Correspondingly, average driving range increases with weight classes (GVW), rising from ~242 km (6–12T) to ~333 km (12–18T) and plateauing between 370–392 km for the heaviest classes (>33T). Within the same class, semi-trailers outrun rigid trucks (e.g., 33–40T Semis average 431 km vs. rigid averaging 307 km in range), with a fleet-wide median range of 300 km. The 12–18T segment constitutes 65% of sales, yet the ranges in this segment span 100–800 km reflecting highly diverse duty cycles and platform strategies (urban vs. regional).

Who supplies your batteries?

Supply chain dependency must be assessed at two levels to begin with: (i) who is the manufacturer of the vehicle; (ii) who is the battery or cell supplier?

Even if the vehicle is made within domestic jurisdictions as countries would like, a key part of the ZET which is the battery is still being imported, either due to deficits in domestic production or lack of domestic suppliers for the choice of battery chemistry.

As seen in earlier sections, with the dominance of LFP batteries in ZETs, the dependence on Chinese cell suppliers for this chemistry will be high until ex-China production comes online. In another case, with BYD entering the U.S. ZET market, and remaining competitive even with tariffs, it is changing market dynamics, creating strong Chinese dependencies for the U.S. ZET ecosystem.

In this section, we investigate the OEM-Battery Supplier relationships for ZETs in major markets: U.S., Europe, India and China. The battery-cell suppliers are categorized as Chinese (CHN), Japanese (JPN), South Korean (KOR), European (EU) and Others (unclassified with limited information).

Battery Supplier by Country of Sale

In India, 70-80% of all medium and heavy-duty ZETs sold depend on Chinese batteries. In Europe, medium-duty ZETs are primarily supplied by South Korean cell suppliers (~50%), followed by Chinese suppliers (~32%), whereas for heavy-duty ZETs, Chinese cell dependence is the least in Europe among any region, dominated by European and South Korean cell suppliers. In the U.S., the narrative is similar to Europe, with South Korean (50%) and Chinese (45%) suppliers among medium-duty trucks, and ~40% Chinese suppliers for heavy-duty trucks **(Figures 10-11).**

In the U.S., BYD and Daimler use 100% Chinese cells for their heavy-duty ZETs, while Rivian has 90% exposure to Chinese cells for their medium-duty ZETs **(Figure 12)**.

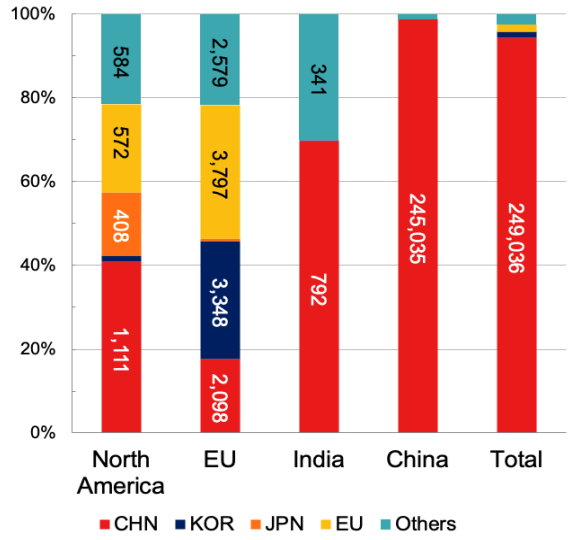

Figure 10: Battery suppliers for heavy-duty ZETs

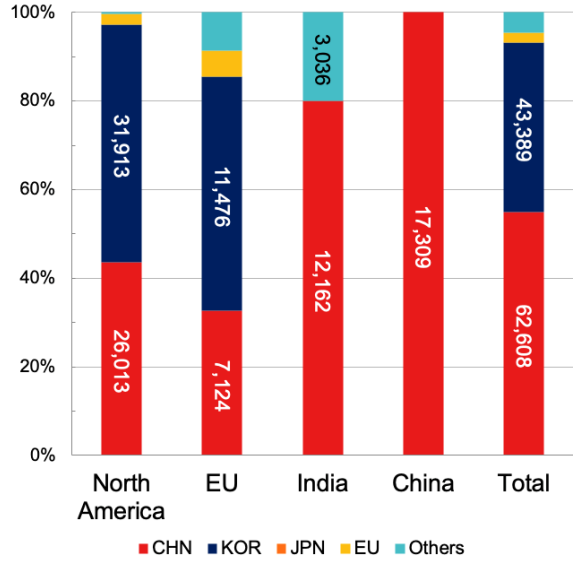

Figure 11: Battery suppliers for medium-duty ZETs

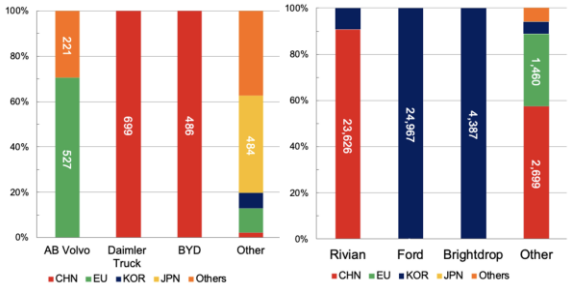

Figure 12: Battery suppliers for heavy (left) and medium (right) -duty ZETs in the U.S.

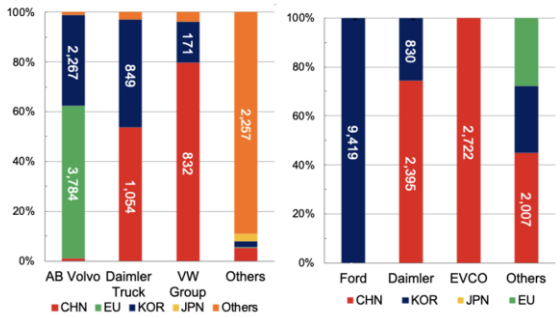

Figure 13: Battery suppliers for heavy (left) and medium (right) -duty ZETs in Europe

In Europe, except Ford, most leading medium-duty ZET manufacturers depend on Chinese cells, whereas, for heavy-duty ZETs, VW Group and Daimler Truck has high Chinese cell exposure, with Korean suppliers following closely **(Figure 13)**.

In India, BYD being the leading ZET heavy-duty player by volumes, sources Chinese cells. Medium-duty ZETs which are growing rapidly, have both the leading players, Tata Motors and Mahindra using Chinese cells. The high proportion of "Others" largely reflects newer market entrants with limited disclosure, though Chinese suppliers have consistently been the primary source for India's EV battery supply chain **(Figure 14)**.

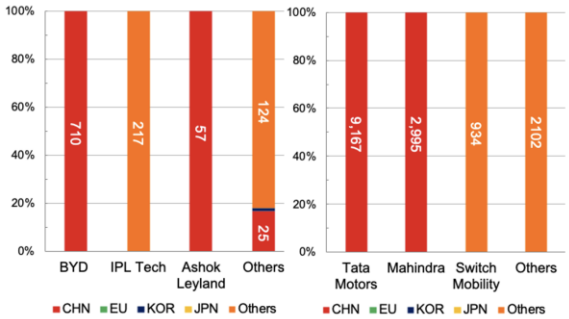

Figure 14: Battery suppliers for heavy (left) and medium (right) -duty ZETs in India

Policy Implications

First and foremost, providing policy certainty for ZET market growth can create a strong foundation for industrial strategy, as ZETs provide scale for both battery demand and for EV components, de-risking investment choices and increasing the likelihood of domestic manufacturing.

Second, as Chinese manufacturers rapidly scale ZETs, combined with their existing dominance in the LDV segment, their overall competitiveness and control on global supply chains will increase, posing a threat to other major automotive manufacturing regions such as the U.S., Europe and India.

Third, the emergence of construction and heavy-equipment companies turning into ZET manufacturers showcases the possibility of use-cases ready for deployment in other markets.

Fourth, battery chemistry choices are being made by OEMs not based on trade concerns but rather on performance and reliability for the customers in each market. For example, EU markets have chosen NMC chemistries for medium-duty trucks given their duty cycles and ability to cost optimize with smaller NMC battery packs delivering the required performance and range, compared to LFP domination in other markets.

Even with strong geopolitical headwinds on reducing Chinese dependence on EV supply chains, LFP chemistries and Chinese cell suppliers have emerged as dominant.

Fifth, a key question for policy makers will be to assess the trade-offs they are willing to make between rapidly growing ZET market demand and industrial competitiveness through protection by keeping Chinese suppliers out of their respective markets or finding suitable ways to cooperate. Further, the emerging play by BYD in U.S. ZETs also opens the question of Chinese market access. It brings to bear key questions around national and cyber security. One possible solution would be to consider allowing Chinese Joint Ventures strictly for battery-cell manufacturing, given the rapid demand for LFP chemistries and the significant R&D competitiveness of Chinese manufacturers for both LFP and emerging solid-state chemistries.

Both Europe and India are considering strategies wherein they will require Chinese EV and cell manufacturers to enter JVs with domestic firms and meet certain requirements for locally hired skilled workers at senior positions to ensure transfer of skills. Either way, restricting the Chinese from one market, while they continue to rapidly expand into other global markets allows them to build scale and competitiveness making others play constant catch-up.

Last but not the least, it is important to monitor global market developments, for example, emerging markets like India showing rapid growth in medium-duty ZET sales in 2025 might offer interesting opportunities for OEMs in different countries (especially between the U.S., Europe and India) to collaborate and secure new market access.

Policymakers must closely monitor both market adoption trends and supplier relationships to ensure that market demand and supply policies are closely aligned, delivering the scale necessary for industry to invest, enhance its competitiveness and remain financially viable while imposing constraints based on geopolitical considerations.

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This policy brief is part of an ongoing series on global EV market trends, vehicle production flows and battery supply chains under the Global Sustainable Transportation and Energy Materials (G-STEM) Initiative of the Global South Centre, Institute of Transportation Studies, University of California, Davis.