India's Road to Zero-emission Trucking

Tracking Early Electrification Efforts

Issue Brief | May 2025

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Climate Group is an international non-profit, launched in 2004, with offices in London, Amsterdam, Beijing, New Delhi, and New York. They have been in India since 2008 and have worked with **15 state governments, over 190 businesses** on driving climate action, fast. Climate Group's goal is a world of **net zero carbon emissions by 2050**, with greater prosperity for all. Together, Climate Group is helping to shift global markets and policies towards faster reductions in carbon emissions.

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India's Road to Zero-emission Trucking

Tracking Early Electrification Efforts

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70% of India's freight movement is handled by the trucking sector.

Image: CEEW

Foreword

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India stands at a pivotal moment in decarbonising the transport sector. As we pursue our ambitious climate goals of achieving net-zero emissions by 2070 and reducing emissions intensity by 45 per cent by 2030, the transformation of our freight sector presents both a significant challenge and an extraordinary opportunity. Medium—and heavy-duty trucks form the backbone of our nation's logistics infrastructure, facilitating the movement of goods that sustains our growing economy. While these vehicles represent only a small fraction of our total fleet, they generate a disproportionately high amount of on-road transport emissions.

The case studies presented in this report offer compelling evidence that electrifying our MHDT fleet is not a distant aspiration but an achievable reality. They further demonstrate that across diverse geographical regions and operational contexts, stakeholders are collaborating to overcome technical, infrastructural, and financial barriers. The findings regarding driver welfare and operational efficiency are particularly encouraging. The transition to e-MHDTs is not merely about changing powertrains—it represents a potential improvement in working conditions for millions of drivers who form the human core of our logistics sector. The recommendations outlined in this report provide a roadmap for all stakeholders—government agencies, manufacturers, fleet operators, and financial institutions—to align their efforts toward a common vision of zero-emission trucking in India.

The efforts of the Council on Energy, Environment and Water and the Climate Group in documenting the experiences of early e-truck adopters in India are appreciated. Their work provides valuable ground-level insights that align closely with NITI Aayog's vision and the objectives of the e-FAST (electric Freight Accelerator for Sustainable Transport) platform—fostering innovation, enabling stakeholder collaboration, and accelerating the transition to zero-emission trucks. Together, such efforts contribute meaningfully towards achieving India's net-zero ambitions and building a cleaner, more sustainable transport future.

As per our study, medium and heavy duty trucks sales in India are projected to grow steadily, with annual registration rising from 0.42 million units in 2024 to 0.77 million units in 2050.

Image: Pluc.TV

Key contributors

Council on Energy, Environment and Water

The **Council on Energy, Environment and Water (CEEW)** – a homegrown institution with headquarters in New Delhi – is among the **world's leading climate think tanks**. The Council is also often ranked among the **world's best managed and independent think tanks**. It uses data, integrated analysis, and strategic outreach to explain – and change – the use, reuse, and misuse of resources. It prides itself on the independence of its high-quality research and strives to **impact sustainable development at scale** in India and the Global South. In over 14 years of operation, CEEW has impacted over 400 million lives and engaged with over 20 state governments. Follow us on LinkedIn and X (formerly Twitter) for the latest updates.

CEEW co-led the research and writing of the sectoral overview of medium and heavy-duty trucks (mhdts) in India. CEEW facilitated stakeholder coordination to gather insights and data. It was responsible for writing and compiling the sections on the job estimation analysis, and the case studies of Kalyani Powertrain Ltd., BillionE Mobility, BluWheelz, and Transvolt, as well as the policy recommendations to support the adoption of electric MHDTs.

Climate Group

Climate Group is an international non-profit, launched in 2004, with offices in London, Amsterdam, Beijing, New Delhi, and New York. They have been in India since 2008 and have worked with 15 state governments, over 190 businesses on driving climate action, fast. Climate Group's goal is a world of **net zero carbon emissions by 2050**, with greater prosperity for all. They do this by forming powerful networks of business and government, unlocking the **power of collective action** and scale to move whole systems such as energy, transport, the built environment, industry and food to a cleaner future. Together, Climate Group is helping to shift global markets and policies towards faster reductions in carbon emissions.

Climate Group co-led the research and writing of the sectoral overview of MHDTs in India. The organisation leveraged its network to coordinate with stakeholders and was responsible for compiling and writing the case studies of SwitchLabs, JSW Cement, and BLR Logistics. Additionally, Climate Group reviewed and provided insights for the policy recommendations, drawing from its engagement with various platforms to support the adoption of electric MHDTs.

Acknowledgments

We extend our gratitude to the industry partners—Kalyani Powertrain Limited, BluWheelz, BillionE Mobility, Transvolt, SwitchLabs, JSW Cement, and BLR Logistiks—for their valuable contributions. Their support in providing information, data, and technical insights was instrumental in documenting the case studies. We also appreciate their assistance in connecting us with driver-partners, helping us better understand the e-transition from their perspectives.

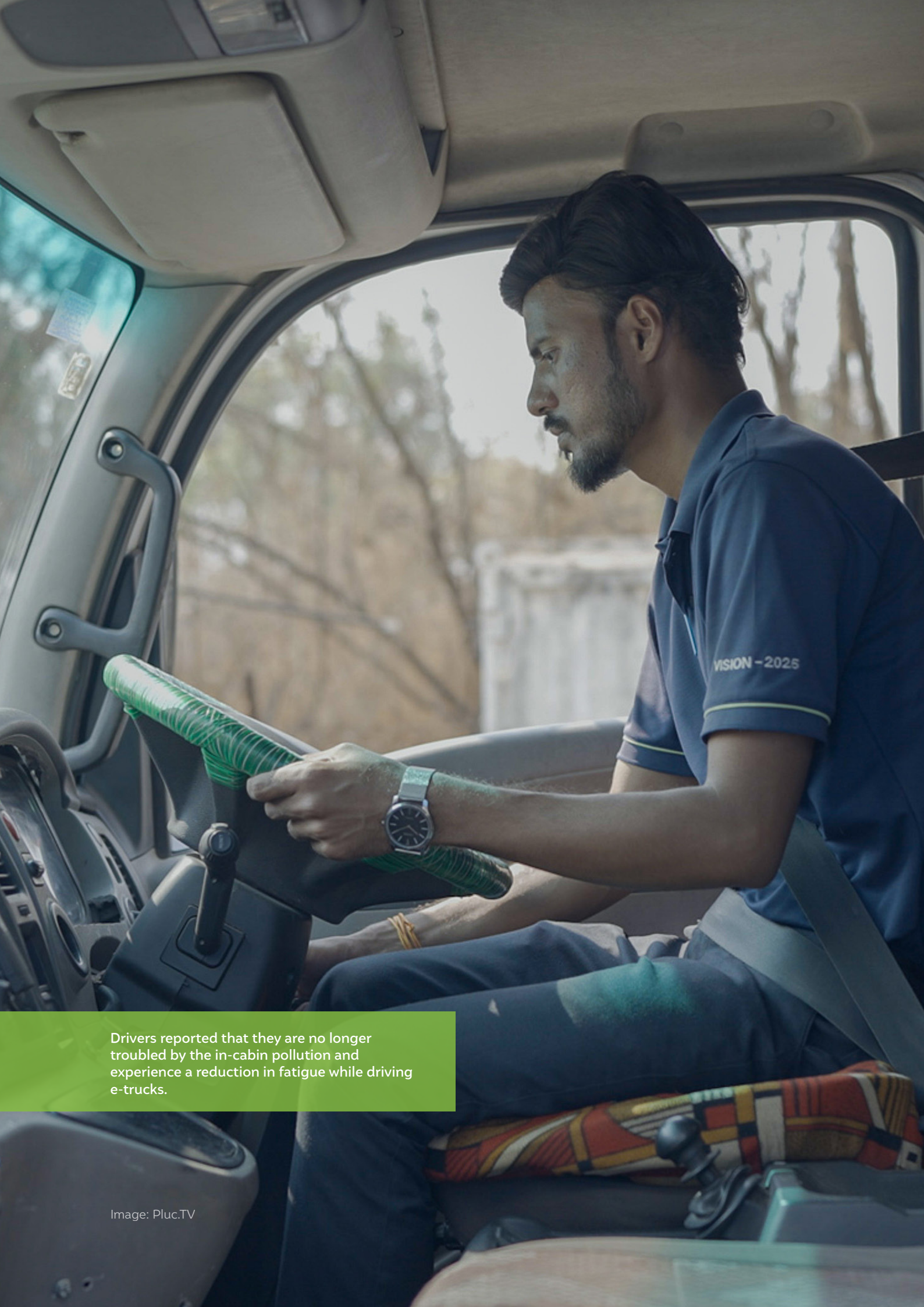
We would also like to acknowledge pManifold Business Solutions, the technical partner to Climate Group, on their 'Electrification of medium and heavy-duty trucks in India' programme. They have played a key role in generating market insights and highlighting key trends in preparing the background section of this report. This section offers an overview of the important characteristics of the MHDT segment in India.

Lastly, we would thank the reviewers and subject experts for their critical feedback and comments that have helped in refining this report.

Thank you all for your generosity and support in this endeavour.

The authors

Contents



Drivers reported that they are no longer troubled by the in-cabin pollution and experience a reduction in fatigue while driving e-trucks.

Image: Pluc.TV

Executive summary

With a fleet of around four million, India relies heavily on medium- and heavy-duty trucks (MHDTs)—especially diesel trucks—for road freight movement (NITI Aayog, RMI, and RMI India 2022). Despite constituting a small share of the total vehicle fleet, MHDTs account for approximately 35 per cent of on-road fuel consumption and around 45 per cent of total on-road transport sector emissions (Climate Group 2022). This disproportionately high contribution to ambient air pollution requires a transition to zero-emission trucks (ZETs). Among ZET technologies, electric and hydrogen-based, battery electric truck (e-truck) technology has matured globally and is being explored in various use cases in the Indian market.

The trucking sector will create approximately 30 million jobs by 2050

As India's MHDT fleet is projected to increase by approximately 2.6 times by 2050, it has the potential to exhibit global leadership in emission reduction by transitioning to e-trucks. This will create a large-scale impact aligned with its Nationally Determined Contribution (NDC) target of achieving a 45 per cent reduction in the emissions intensity of its gross domestic product (GDP) by 2030 and realising net zero by 2070 (NITI Aayog, RMI, and RMI India 2021). Along with these environmental benefits, electric MHDTs (e-MHDTs) also have the potential to enable socio-economic transformations, including public health improvements and occupational benefits.

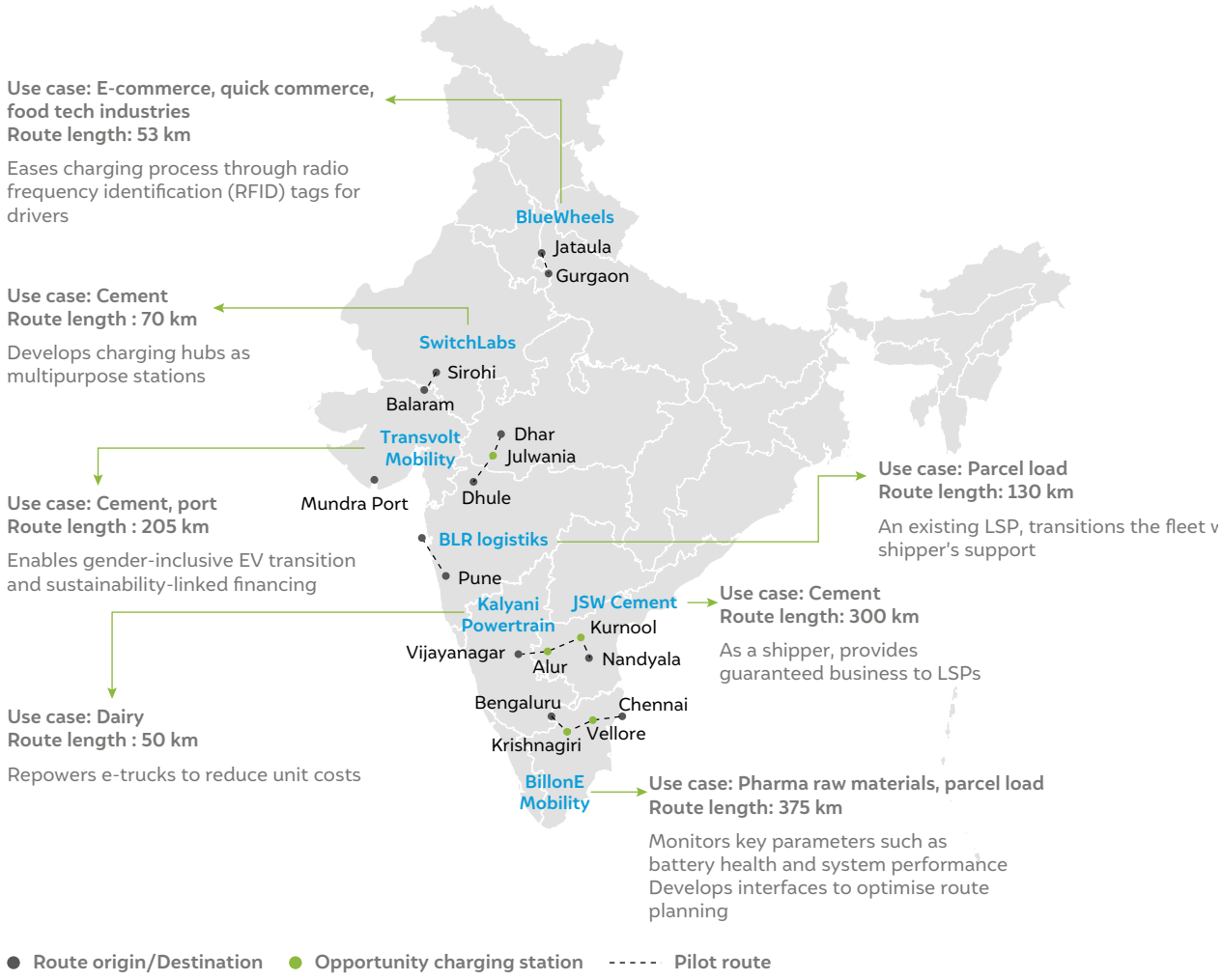
The e-MHDT transition is nascent in India, with stakeholders actively conducting pilots in different use cases. In this study, **we provide qualitative evidence from on-ground pilots, using seven recent case studies selected for their unique decentralised applications,** geographical spread across the country, and the ecosystem of stakeholders driving them (as illustrated in Figure ES1). We combine insights gained and lessons learnt from challenges during early transitions **through structured interviews with various strategic designations of different fleet operators, shippers, original equipment manufacturers(OEMs) and logistics service providers (LSPs)**. We also evaluate the impact of increased e-MHDT adoption on employment in the sector. Furthermore, to understand the occupational benefits of operating e-MHDTs, **we include the drivers' transition experiences through in-depth interviews**.

A. Key findings

- **The MHDT sector can drive job growth**: According to the Council on Energy, Environment and Water (CEEW)–Transportation Fuel Forecasting Model (TFFM), the **MHDT fleet is estimated to increase from around 3.9 million units in 2024 to around 10.2 million units in 2050**. We estimate that the trucking sector will **create approximately 30 million jobs by 2050**, impacting over 111 million individuals, including people working in the industry and their households. Of the estimated jobs, **around 1.2 million jobs will be in truck manufacturing, 13 million will be direct jobs (drivers, fleet operators, etc.), 9 million will be indirect jobs (after-sales, fuel station workers, etc.), and 7 million will be induced jobs (local businesses, rest stops, and hospitality services).** The e-MHDT segment will host around 20 per cent of the total trucking sector jobs.

- **e-MHDTs can enhance operational efficiency in the sector**: In each use case, engagement among key stakeholders in the ecosystem—such as fleet operators, charge point operators, and LSPs—emerges as the common factor driving the early transition. It has also fostered new businesses where stakeholders share risks through detailed contracts, exchange knowledge, and enhance peer learning through pilot initiatives. Hence, the logistics operations are data-driven, inclusive, and optimised to improve the overall efficiency in the sector.
- **e-MHDTs can reduce occupational stress and improve driver comfort**: Companies have demonstrated efforts to address the issues faced by MHDT drivers in this transition. Drivers have access to advanced vehicle technologies such as clutch-free systems and real-time AI driving assistance. Improved infrastructure, with amenities such as washrooms and rest stops synced with charging downtime are also provided. Drivers report overall job satisfaction, enhanced safety and comfort during long rides, and reduced fatigue and overall improvement in health.

Figure ES1 Various companies have adopted pilot e-MHDT applications with unique approaches



Source: Authors' compilation (CEEW)

B. Key recommendations

To foster a collaborative ecosystem in the trucking sector and accelerate the e-MHDT transition in India, it is crucial to implement supportive policies and regulations. Fleet operators are uniquely positioned to develop such partnerships, seek support from key players and share risks associated with early transitions. Table ES 1 lists some of the challenges and associated recommendations as key asks by fleet operators and LSPs from other stakeholders.

Table ES1 Recommendations for key stakeholders to drive the e-transition

Challenges	Recommendations
Financial The high upfront cost of e-trucks, lack of insurance options, and confidence in technology among financiers	**Ministry of Road Transport and Highways (MoRTH)**: Provide financial incentives with tax exemptions, toll waivers/green pass schemes, etc., to offset upfront costs **Financial institutions**: Develop innovative blended financial solutions to share risks and provide long-term loans
Infrastructural Concerns surrounding the scaling up and access to charging infrastructure with MHDT growth	**Ministry of Heavy Industries (MHI)**: Develop charging infrastructure on key freight corridors and upgrade existing freight infrastructure, such as logistics parks, special economic zones (SEZ), industrial units, etc.
Operational Restricted route flexibility and inefficient asset utilisation	**Fleet operators**: Provide data from initial pilots and experiential insights for vehicle R&D. Target key corridors to showcase the feasibility of use cases **Original equipment manufacturers (OEM)**: De-risk the vehicle through robust warranty clauses, reliable back-end solutions, and comprehensive after-sales support
Human resource Driver retention issues and limited human resources	**Ministry of Skill Development and Entrepreneurship**: Collaborate with training institutes and provide driver training on efficient driving techniques, charging procedures, safety protocols, and troubleshooting dashboard issues; help them develop the skills and confidence to use new technology

Source: Authors' analysis

The absence of a clutch in an e-truck eliminates the need to constantly engage one leg, significantly reducing the pain and discomfort that the drivers otherwise experience.

Image: Pluc.TV

1. Background

Of India's 4.6 billion tonnes of annual freight, 70 per cent is handled by the trucking sector (Arora et al. 2023). The trucking industry contributes significantly to the country's gross domestic product (GDP), creating over 21 million jobs, and supporting India's ambitious priorities – such as global competitiveness, job growth, and improving urban and rural livelihoods (Ranjan 2024; NITI Aayog, RMI, and RMI India 2021). With increasing population, growing e-commerce, and rising income levels, the cumulative freight volume is expected to grow fourfold, and the goods movement is expected to increase to 9.6 trillion tonne-km by 2050, increasing the demand for trucking services (NITI Aayog, RMI, and RMI India 2021; NITI Aayog, RMI, and RMI India 2022). The dominance of diesel trucks in India's MHDT fleet presents a challenge to the country's Nationally Determined Contribution (NDC) targets of 45 per cent reduction in the emissions intensity of its GDP by 2030 and Net Zero by 2070 (UNFCCC 2022).

MHDTs are responsible for approximately 35% of on-road fuel consumption and 45% of total on-road transport sector emissions

Currently, about 95 per cent of MHDTs used in road freight movement are diesel vehicles (NITI Aayog, RMI, and RMI India 2021). MHDTs are trucks that fall within the N2 and N3 classifications of the Ministry of Road Transport and Highways (MoRTH).[1] Although they comprise only 2 per cent of the total vehicles, they are responsible for approximately 35 per cent of on-road fuel consumption, 45 per cent of total on-road transport sector emissions (Patki et al. 2023; Climate Group 2022), and 53 per cent of particulate matter emissions (Krishnan, Kumar, and Sen 2024). In 2021, buses and trucks jointly contributed 70 per cent of nitrogen oxides (NO_x)to the emissions from India's road transportation sector (Arora et al. 2023). Global evidence shows that exposure to these pollutants can cause cardiovascular, metabolic, and respiratory diseases (Roychowdhury and Nasim 2016). Research also finds that in-cabin pollution causes detrimental health effects in drivers who spend long hours in their trucks, leading to asthma or respiratory infections and contributing to cardiovascular problems (Ortiz 2023). Thus, the trucking sector's disproportionate contribution to India's air pollution compared to their vehicle share as well as its impact on health requires India to reduce its dependence on diesel MHDTs.

Zero-emission trucks (ZETs) have the potential to lower emissions and improve air quality. They run on clean energy sources, such as electricity or hydrogen, instead of fossil fuels. Large-scale ZET adoption by 2050 could reduce the particulate matter and NOX pollution associated with trucking by nearly 40 per cent (Arora et al. 2023). ZETs can also prevent up to 3.8 cumulative gigatons of carbon emissions by 2050 Sinha and Teja 2022). Additionally, transitioning to ZETs offers socio-economic transformations, such as public health

1 The MoRTH classifies motor vehicles that carry goods into two categories: N2, with 3.5 T < gross vehicle weight (GVW) ≤ 12 T, and N3 with GVW > 12 T.

The light-duty truck (LDT), intermediate-duty truck (IDT), medium-duty truck (MDT), heavy-duty truck (HDT) and tractor–trailer (TT) categorisation is preferred in the industry, especially by the OEMs, for facilitating custom market strategy, product positioning, and pricing to maximise penetration while also catering to the diverse consumer and economic segments.

LDTs and IDTs cater to short-distance and urban transportation demands, providing fuel efficiency and ease of navigation in congested city environments. In contrast, MDTs and HDTs meet the requirements of long-haul transport and heavy cargo.

improvements, employment creation, and formalisation of the workforce through reskilling and upskilling (Krishnan, Kumar, and Sen 2024). Battery electric trucks (BETs) are emerging as the top choice among ZETs given that the development of the hydrogen ecosystem is in the nascent stages and there are challenges associated with green hydrogen use, such as its cost and availability (International Transport Forum 2024).

As the truck segment is set to grow over the next two decades, India has the opportunity to scale ZET use and achieve its Net Zero and development goals. Leveraging this opportunity requires policies to be formulated at both the national and sub-national levels, accompanied by efforts from the private sector to establish a robust ecosystem for the sustained adoption of ZETs. To identify the potential for such dedicated efforts, in the following section, we evaluate the existing structure of MHDT operations in India. We provide an overview of the market, examine the growth of the MHDT fleet in 2020–2024, and explore the policy landscape that can facilitate a transition to alternative fuel vehicles. For the scope of this study, we focus on BETs and map various policy efforts and early initiatives of private stakeholders to strengthen e-MHDT adoption.

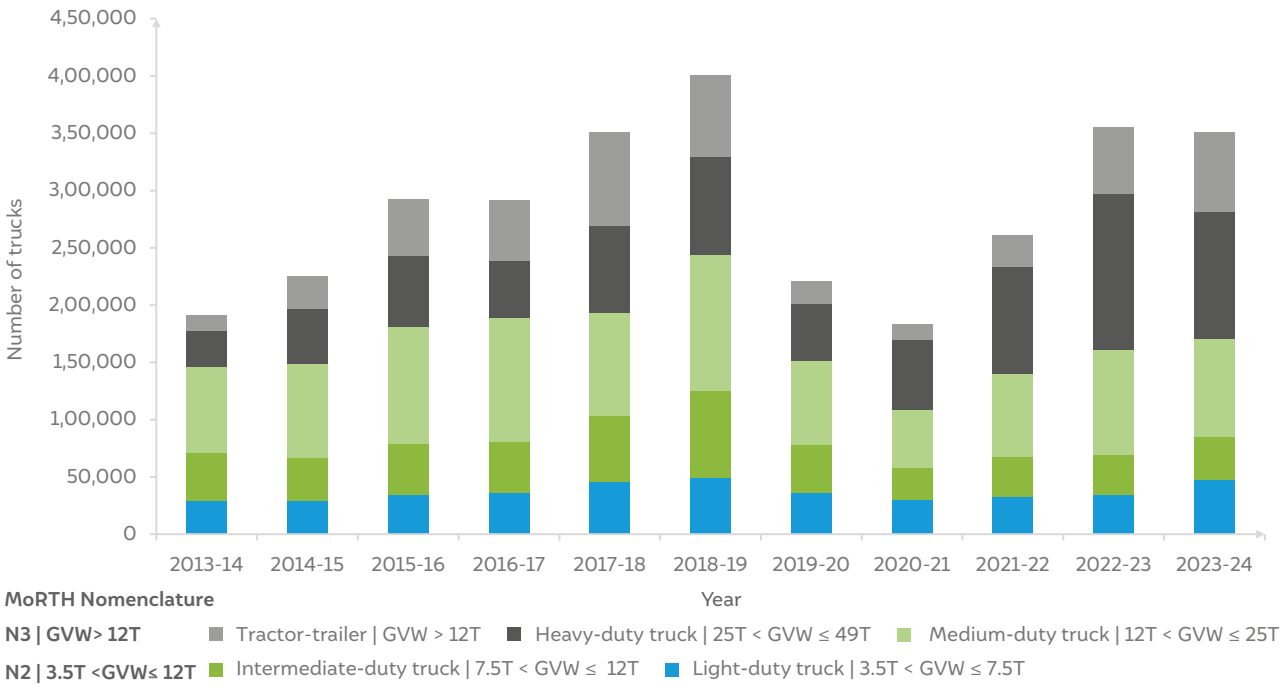
In 2024, diesel MHDTs constituted 96% of the overall MHDT sales

1.1 India's MHDT segment

India's road logistics fleet comprises about 4 million units of MHDTs ((NITI Aayog, RMI, and RMI India 2022). Ownership is highly dispersed, with approximately 59 per cent of the fleet managed by small and medium fleet operators (SFOs and MFOs) and most purchasers possessing no more than five trucks (CRISIL and MI&A 2024). Logistics service providers (LSPs) maintain an asset-light model and are dependent on third-party operators, with whom they coordinate through brokers, to meet their requirements (Krishnan, Kumar, and Sen 2024).

Brokers or agents play an integral role in ensuring that freight demand matches the fragmented supply in the sector. They connect LSPs to various MFOs and SFOs and help determine their reliability. Simultaneously, they facilitate contracts between SFOs and LSPs, as the former do not have enough access to funds and information to obtain contracts directly. This enables SFOs to access adequate load and fully utilise their assets.

Figure 1 Segment-wise sales of MHDTs in 2013–2024



Source: Authors' analysis (Climate Group)

Despite this fragmented nature of ownership and operations, the Indian truck industry is the sixth largest in the world. With increasing commercial activities and the emergence of new businesses and services demand for goods transportation across sectors is set to rise. Therefore, manufacturers are ramping up production to meet the increase in demand. In 2024 alone, India saw a sale of over 299,721 MHDTs (MoRTH 2024). Figure 1 provides an overview of the sales share of MHDTs in the past decade.

The sales of trucks in India witnessed steady growth from 2013–14 to 2018–19. In the next two years, annual truck sales experienced a decline, mainly due to COVID-19 pandemic. However, the market demonstrated a recovery in the fiscal year 2021–22. The upward trend in annual sales continues with a compounded annual growth rate (CAGR) of 28.4 per cent from 2021–22 to 2023–24, showcased in Table 1.

The dip in sales in 2019–20 can be partly attributed to a modification in the MoRTH's truck loading norms, which allow higher loading capacities per axle. This change was necessary to harmonise the axle load with international standards and resulted in increased gross vehicle weight (GVW) limits, for different categories of commercial vehicles (MoRTH 2018). This modification aimed to boost the goods-carrying capacity of the logistics sector by 20–25 per cent and lower logistics costs by about 2 per cent. Consequently, fleet owners took advantage of the additional loading capacity available, resulting in a reduced demand for trucks. In 2020–21, the effects of COVID-19, subsequent lockdowns, and post-GST rationalisation of sales processes caused an economic slowdown, which resulted in customers postponing the purchase of new trucks.

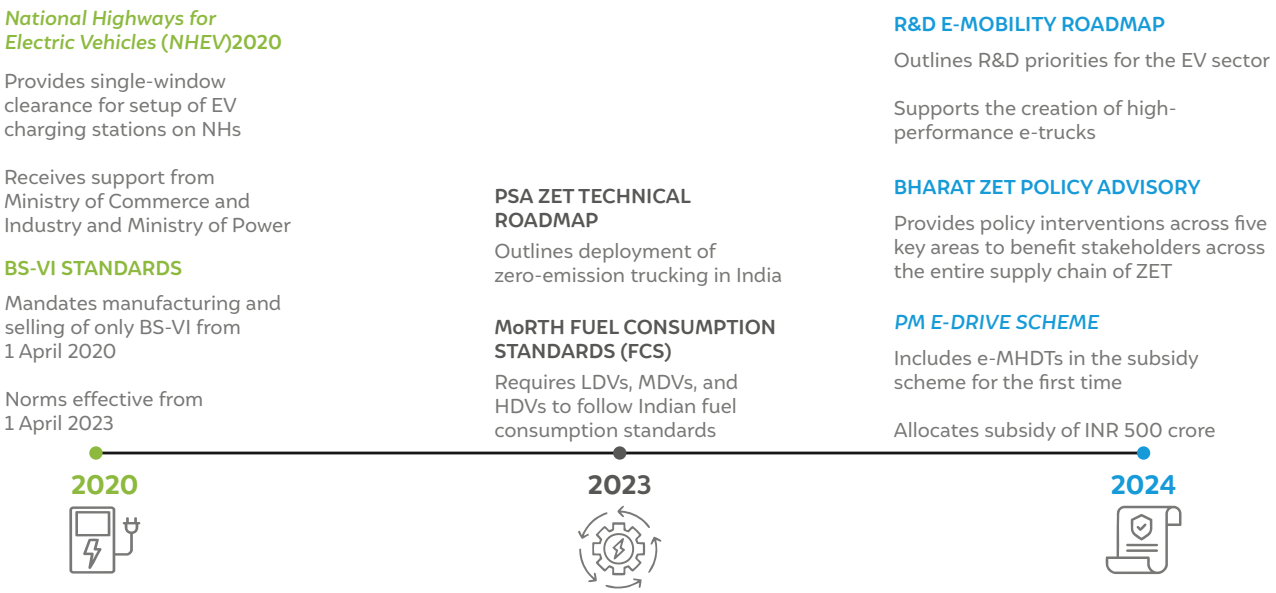
Table 1 Segment-wise growth rate of MHDTs

Truck segments	CAGR (2020–24)	CAGR (2013–19)	CAGR (2013–24)
Light-duty truck (rigid) | 3.5 T < GVW ≤ 7.5 T	16.6%	2.1%	4.9%
Intermediate-duty truck (rigid) | 7.5 T < GVW ≤ 12 T	10.2%	–0.1%	–1.0%
Medium-duty truck (rigid) | 12 T < GVW ≤ 25 T	19.1%	–0.2%	1.3%
Heavy-duty truck (rigid) | 25 T < GVW ≤ 49 T	22.1%	4.8%	13.5%
Tractor–trailer (across medium- and heavy-duty) | GVW > 12 T	70.7%	3.6%	17.5%
Total medium- and heavy-duty truck (rigid + tractor–trailer) | GVW > 12 T	28.4%	1.7%	8.2%

Source: Authors' analysis (Climate Group)

Presently, the market is experiencing an upward trend in annual truck sales, with diesel trucks holding the predominant share. In 2024, they constituted 96 per cent of overall registered MHDT sales. However, the growing emphasis on decarbonisation has resulted in efforts to reduce emissions within the trucking sector. Figure 2 details key government regulations and interventions to improve vehicle safety, emissions standards, and fuel efficiency.

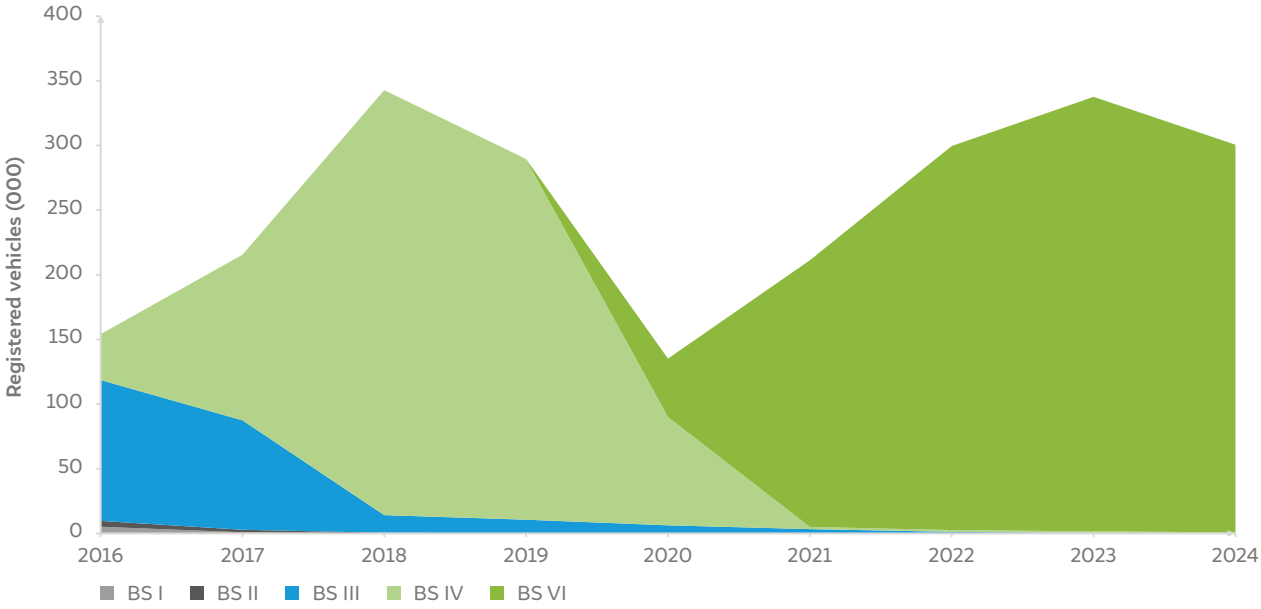
Figure 2 Key government regulations and interventions to decarbonise the MHDT segment



Source: Authors' compilation (Climate Group)

The changes made to the vehicle emission norms across 2016–2024 resulted in the phasing out of older standards and rapid adoption of Bharat Stage-VI (BS-VI) trucks. BS-I and BS-II MHDT registrations declined by nearly 100 per cent over these eight years. BS-III MHDTs dropped by 99.85 per cent, from 108,902 units in 2016 to 160 in 2024. BS-IV vehicles, which peaked at 328,514 units in 2018, fell to 641 units by 2024, with most of them having been phased out by 2023. In contrast, there was an explosive growth in BS-VI vehicles, from 30 units in 2016 to 299,813 units by 2024. Initial adoption gained traction by 2020 and rapid growth followed, solidifying the dominance of BS-VI units in the market. The trend line in Figure 3, represents the successful enforcement of stricter emission norms, with older standards phased out by 2023 and BS-VI adoption driven by regulatory policies and advancements in cleaner technologies.

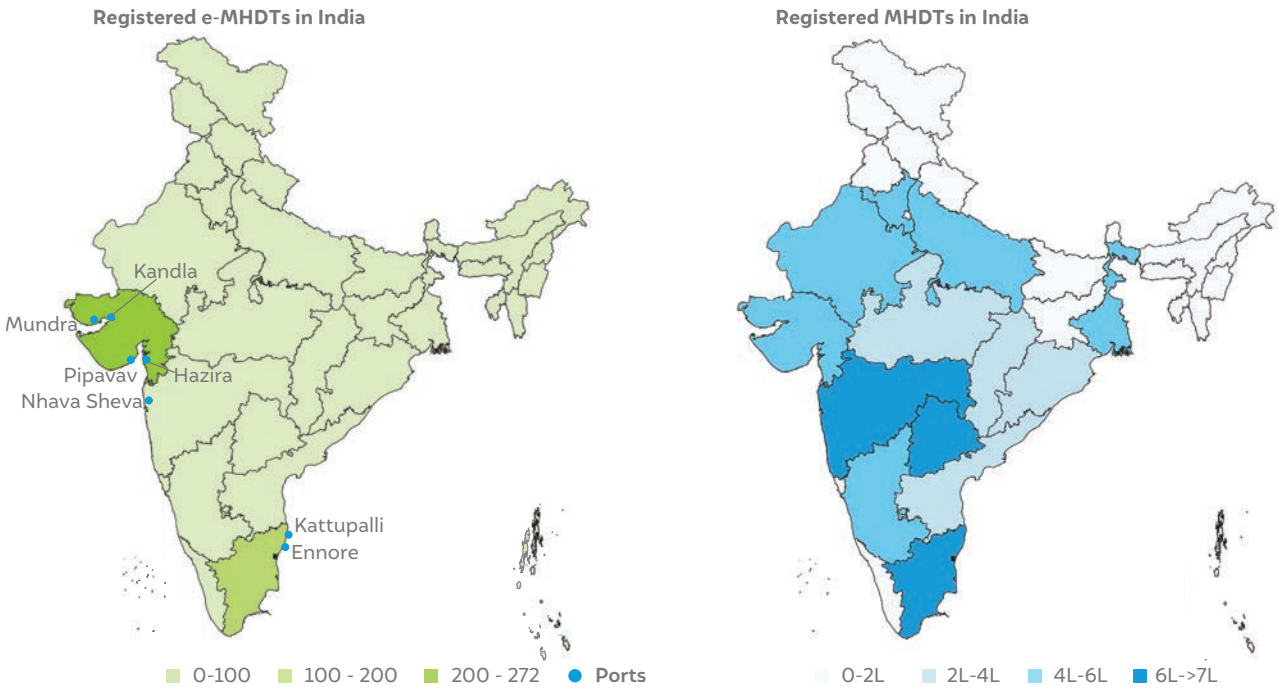
Figure 3 Due to strict emission norms, BS VI vehicles increased from 30 units in 2016 to 299,813 units by 2024



Source: Authors' analysis (CEEW)

Telangana leads in state-wise registration for diesel trucks, followed by Maharashtra (see Figure 4). Meanwhile, Gujarat has the highest number of registered e-MHDTs in the country, followed by Tamil Nadu. Port operations has emerged as the primary deployment use case for e-trucks so far. In Gujarat, the highest number of e-MHDTs, at 218 trucks, are registered with the Kacchh RTO, driven by freight and logistics activities at Kandla and Mundra ports. Also, 46 e-MHDTs are registered in the Surat RTO, as the Hazira Port here is the hub of freight and logistics operations.

Figure 4 MHDT (internal combustion engines and electric) presence across the Indian market



Source: Authors' analysis (CEEW)

1.2 Strengthening the ecosystem for e-MHDT adoption in India

There are several policy interventions and industry stakeholder efforts aiming to drive the initial uptake of e-trucks in India, as detailed in Table 2.

Table 2 Policy support for e-MHDT adoption

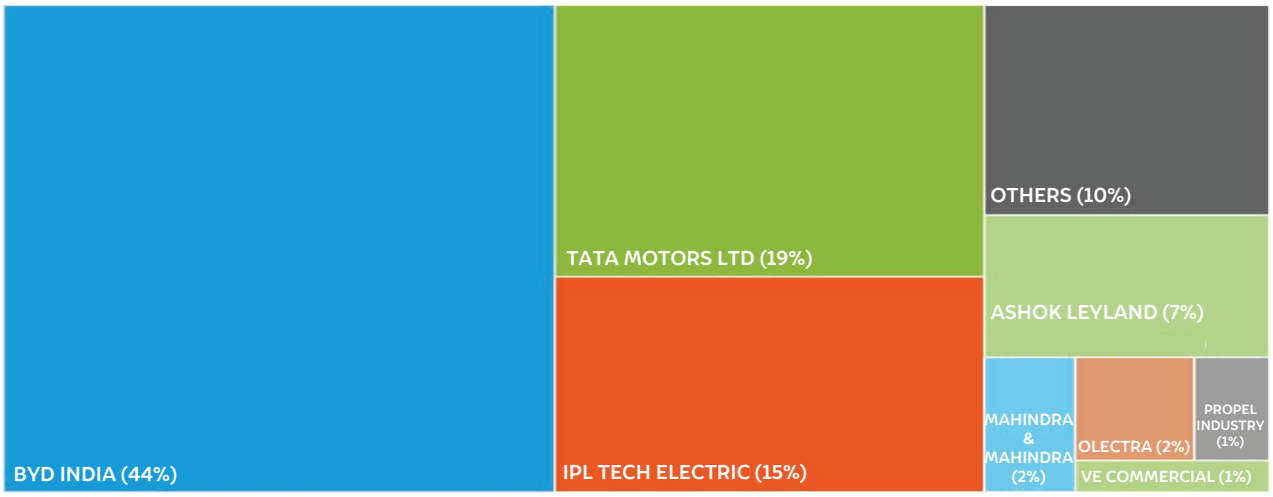
Guidelines and initiatives	Implementing agency	Key features
Electric Freight Accelerator for Sustainable Transport (E-FAST) (2022)	NITI Aayog and Zero Emission Vehicles Emerging Markets Initiative (ZEV-EMI)	• Strategic aggregation of demand for 7750 e-MHDTs by 2030 • National task force comprising regulators and industry experts • Development of scalable pilots (PIB 2023)
PSA Roadmap V1 (2023)	Office of the Principal Scientific Adviser	• Framework that identifies key technical areas for ZET implementation • Emphasis on the need for pilot projects to test and validate BETs and Fuel Cell Electric Trucks (FCETs) (Office of the Principal Scientific Adviser 2023)
PSA Roadmap V2 (2024)	Office of the Principal Scientific Adviser	• Addendum to the PSA Technical Roadmap V1 • Roadmap for the execution of technical actions for ZET implementation in India (Office of the Principal Scientific Adviser 2024)
E-mobility R&D Roadmap for India (2024)	Office of the Principal Scientific Adviser	• Outline of research projects aimed at developing high-performance e-trucks and their components • Emphasis on the importance of an extensive charging infrastructure in support of long-haul transport, including fast-charging solutions tailored for trucks (Office of the Principal Scientific Adviser 2024)
Bharat ZET Advisory (2024)	Office of the Principal Scientific Adviser	• Comprehensive guide detailing responsible agencies, stakeholders, impact assessments, and policy formulation methodologies • Acceleration of the adoption of ZETs in India through a strategic framework of 30 policy interventions organised into 5 categories: incentives, regulations, infrastructure, business and financing, and stakeholder-centric initiatives (Office of the Principal Scientific Adviser 2024)
***PM Electric Drive Revolution in Innovative Vehicle Enhancement* (*PM E-DRIVE*) (2024)**	Ministry of Heavy Industry	• Government-led push to accelerate e-truck adoption through a financial outlay of INR 500 crore (Ministry of Heavy Industries 2024)

Source: Authors' compilation (Climate Group)

Industry initiatives showcasing the performance of e-MHDTs

Existing companies, such as Ashok Leyland and Tata, and new players, such as BYD and IPL Tech Electric, are spearheading pilots to understand the potential of e-MHDTs as alternatives to existing diesel trucks. Figure 5 shows the share of OEMs that are actively involved with multiple fleet operators for e-MHDT demonstrations.

Figure 5 Early OEMs in the e-MHDT segment



Source: Authors' analysis (CEEW)

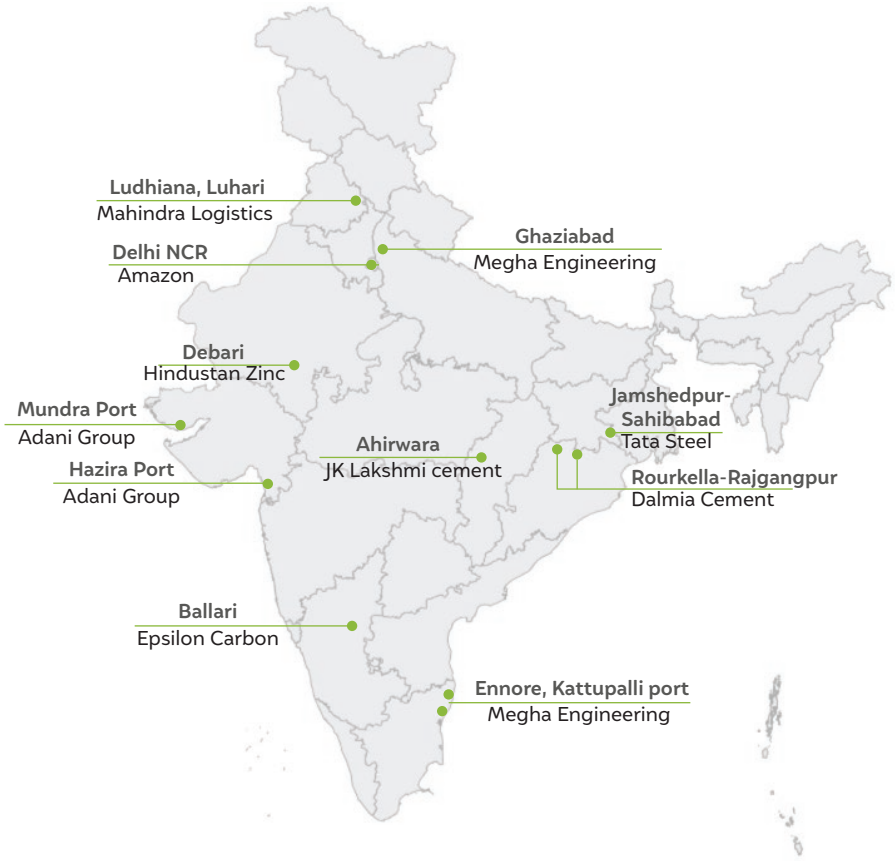
Various companies have undertaken pilot projects to explore the deployment of e-MHDTs in multiple use cases, such as cement, steel, and coal industries. Table 3 presents an overview of pilots or initiatives announced in the public domain, key industry players and their scale of transition. The Adani Group has deployed the largest fleet for port operations. Other companies, such as Flipkart, IKEA, and JSW Steel have also publicly committed to piloting e-trucks in their logistical fleets in India (Climate Group 2023). Chapter 3 covers similar use cases in detail and provides insights to guide other companies to integrate e-MHDT solutions in their operations.

Table 3 E-MHDT pilots collaboratively undertaken by OEMs and companies

Companies	Truck company	Key details of the pilot
Adani Group	BYD (Q1R)	In 2023, Adani Group announced 400 e-trucks for operation at the Ennore, Katupalli, Hazira, and Mundra ports (Hampel 2023).
Amazon	Volvo-Eicher	In 2023, Amazon announced plans to deploy 1,000 e-trucks across various payload categories for their delivery operations in partnership with Volvo-Eicher. The initial deployment of 50 trucks was slated to begin in major cities such as Delhi, Manesar, and Gurugram (Eicher 2023).
Dalmia Cement	IPLTech Electric	In 2021, the company announced that 22 trucks would transport raw materials from Rourkela to Rajgangpur for cement manufacturing (Dalmia Bharat 2024).
Hindustan Zinc	IPLTech Electric (Rhino 5536e)	In 2023, the company announced that 10 trucks would be deployed through Inland EV Green Services Pvt. Ltd., a logistics service provider, to transport concrete (Economic Times 2023).
Tata Steel	NA	In 2021, the company was to deploy 15 e-trucks at a Jamshedpur plant and 12 at a Sahibabad plant to transport finished steel between the plants and their stockyards (Tata Steel 2021).
Megha Engineering	Olectra Meghaetron	Megha Engineering deployed 55 e-trippers from Olectra Meghaetron (parent company of Olectra Green) (pManifold 2021).
JK Lakshmi Cement	IPLTech Electric (Rhino 5536e)	In 2023, the company deployed two e-trucks to transport cement bags from the manufacturing plant to the distribution hub (pManifold 2023).
Epsilon Carbon Pvt. Ltd.	IPLTech Electric	In 2024, the company deployed five e-trucks to transport coal tar (Energetica India 2024).
Mahindra Logistics (Consulting partner India Smart Grid Forum)	IPLTech Electric (Rhino 5536e)	In 2023, Mahindra Logistics announced plans to deploy e-trucks from its warehouse in Luhari, Haryana, to a warehouse in Ludhiana, Punjab (India Smart Grid Forum 2023).

Source: Authors' compilation (Climate Group)

Figure 6 E-MHDT pilot project locations and industry partners across India

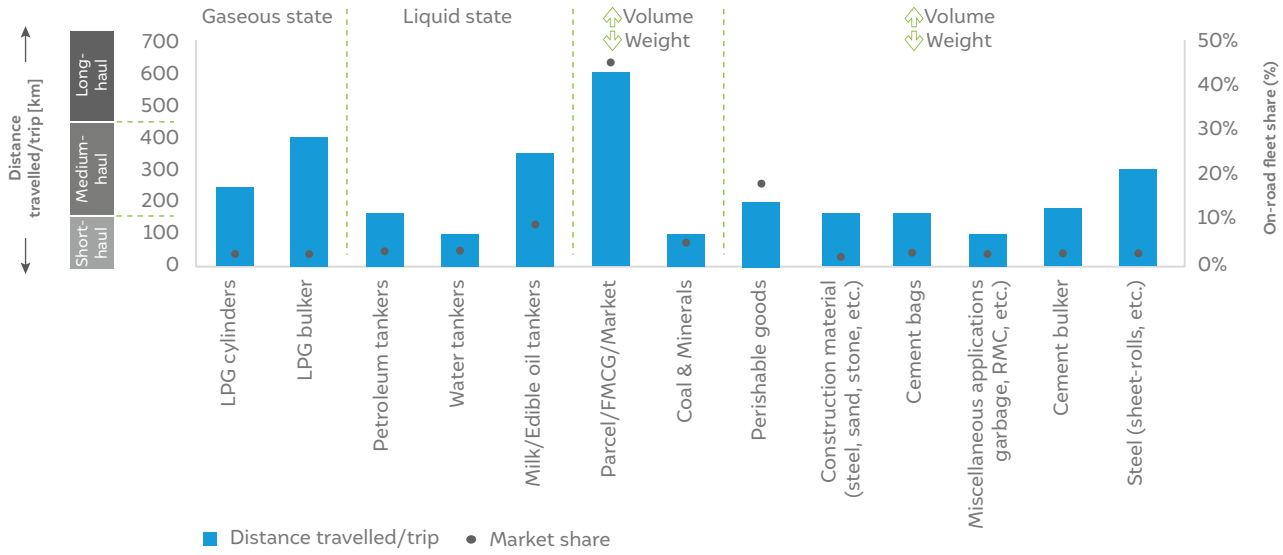


Source: Authors' compilation (CEEW)

1.3 Potential for e-MHDT application

MHDTs have a wide variety of applications in the Indian market. Figure 7 compares the use cases based on their market share and the distances travelled by MHDTs in these applications. Of the 13 broadly categorised applications, parcel/fast-moving consumer goods (FMCGs) load has the largest on-road truck fleet share (45 per cent), followed by perishable goods (18 per cent) and milk/edible oil tankers (9 per cent).

Figure 7 Predominant MHDTs use cases in India



Source: Climate Group. 2022. Early Market Outlook Report: Electrification of Medium and Heavy-Duty Trucks in India. 2022. New Delhi: pManifold, Climate Group.

Some of these use cases, such as dairy, cement bulker movement, slag transport, and port operations, have existing patterns and requirements that are suited for e-MHDT deployment. These use cases are also projected to continue growing, presenting an opportunity for increased e-MHDT penetration to achieve national electrification targets. Table 4 exhibits a general profile of the market characteristics of specific focus applications.

Table 4 Market characteristics and profile of focus applications for e-MHDTs

Applications	Market characteristics
Market load/FMCG and parcel load	• With the highest market share of on-road fleets and longer trip distances, e-MHDTs can target first-mile and last-mile operations. - The FMCG market is projected to grow from 211 billion USD in 2025 to 1178 billion USD in 2034. (Custom Market Insights 2025) • The e-commerce industry's market size in India went from 14 billion USD in 2014 to 123 billion USD in 2024, and it is forecast to reach 300 billion USD by 2030 (India Brand Equity Foundation 2024).
Perishables	• Relatively smaller on-road fleet share with shorter distances (nearly 190-200 km). • The global demand for agricultural outputs is forecasted to increase by 35–50% between 2012 and 2050 (FAO 2019). • Rapid development of cold chain infrastructure for longer shelf life of perishable goods and, as a result, output in the industry.
On-road tipper	• Used for construction activity on-site. • Relatively smaller truck market share characterised by minimal –to limited travel distances.

Applications	Market characteristics
Cement	• Bulkers and cement bags are mainly carried to shorter distances, but there may be instances of industry using them for longer distances. • In 2023, the market size of India's cement industry reached 3.96 billion tonnes and is expected to touch 5.99 billion tonnes by 2032, exhibiting a CAGR of 4.7% during 2024-32. • Cement consumption is expected to reach 450.78 million tonnes by the end of the financial year 2027. (Source: Indian Cement Industry, Top Cement Companies in India- IBEF, 2024)
Movement at ports	• Trucking at ports forms an essential component of Internal Transfer Vehicles (ITVs), as leased equipment at terminal ports. • Varying across ports, major terminals deploy between 30–110 ITVs (20 feet and 40 feet containers). There are 455 ITVs across JNPT, Mundra, Chennai, Cochin, and Visakhapatnam. • ITVs travel between 67–225 km per day, depending on terminal size and layout.

Source: Authors' compilation (Climate Group)

E-MHDTs can transport perishables and captive operations in cement manufacturing due to the limited operational distance (approximately 50 km), large number of trips, assured loads, and fixed routes with adequate charging infrastructure. Such use cases are also projected to continue growing in future, presenting an opportunity for increased e-MHDT penetration in the trucking sector to achieve national electrification targets. The market profile of various use cases provides a preliminary understanding of sectors that can kickstart e-MHDT penetration within the trucking sector.

There is a need for a detailed assessment of the characteristics that would render certain use cases suitable for increased e-MHDT penetration. Furthermore, the growing trucking sector is set to impact employment. Therefore, we need to examine how jobs will evolve with the greater penetration of e-MHDTs in the coming years. We undertook a combined assessment of the early e-MHDT initiatives in India and a jobs growth analysis for the next 25 years. This assessment provides fleet operators, shippers, LSPs, and OEMs, a holistic view of the e-MHDT transition's impact on employment and various strategies to drive the transition. The job assessment predicts the net impact on various job categories and provides a long-term vision, for the industry to prepare for job displacement and creation. The case studies provide insights into how stakeholders can implement unique business models, optimise the e-MHDT operations, and leverage use cases that exhibit suitability for increased e-MHDT penetration to enhance jobs growth.

We document seven early e-MHDT transition efforts by trucking companies and conduct a jobs-growth assessment to explore the following:

- The impact of increased e-MHDT penetration on employment in the trucking sector
- Use cases suitable for the successful deployment of e-MHDTs and unique strategies companies adopt to increase e-MHDT penetration
- Challenges in scaling e-MHDT applications in the trucking sector

The rest of this issue brief is organised as follows: Chapter 2 presents the findings from the job assessments; Chapter 3 presents the findings from each case study in distinct subsections; Chapter 4 discusses the challenges encountered by companies in their efforts to scale e-MHDT efforts and recommends policy actions for stakeholders to address these challenges; and Chapter 5 concludes the report.

2. Jobs potential of the growing trucking sector

Image: CEEW

Truck drivers sharing their experiences and challenges while driving diesel trucks.

India's MHDT segment plays a key role in supporting livelihoods and creating employment in areas such as end-to-end manufacturing, operations, maintenance, and after-sales service. The benefits of these jobs extend to the employees' family members and dependents – who likely manage household and other expenses – within the MHDT segment. Thus, the employment generated by MHDTs impacts individual and household income, livelihoods, and quality of life. Therefore, it requires a detailed assessment.

Past studies (Krishnan, Kumar and Sen 2024) assessing the employment generated by the MHDT segment in the Indian context are limited and mostly explore jobs in the operations area of the overall trucking sector. In our study, we add value to the existing literature by estimating jobs in manufacturing MHDTs, especially focusing on the electric vehicle (EV) value chain. We use the CEEW-TFFM to project the truck registrations and calculate the total MHDT stock in 2050. We then estimate manufacturing jobs in four areas – (1) suppliers, (2) OEMs, (3) ZET infrastructure, and (4) MHDT-related utilities – across the value chain and operations jobs across three categories – (1) direct, (2) indirect, and (3) induced. This detailed assessment will help identify and understand changes in employment opportunities as the sector evolves.

2.1 Estimating the growth of the MHDT segment in India

Zero emission trucks are projected to account for 35% of annual registrations in 2050

Our study draws on the CEEW–TFFM to estimate the annual sales of MHDTs and total MHDT stock in 2050. This model estimates the future energy demand in the road transportation sector, considering how the vehicle stock, total cost of ownership, infrastructure development, and policy scenarios will affect the transition to cleaner fuels using all the relevant factors that will potentially affect the transition, such as fuel pricing, infrastructure development, and vehicle cost. To arrive at the MHDT stock in 2050, we use historic vehicle registration trends obtained from the Vahan database. We then apply a Gompertz curve based on the GDP to this data to model population growth through 2050 in order to forecast MHDT sales during 2024–2050.

The annual MHDT registrations and vehicle stock obtained using the CEEW–TFFM are the basis for estimating jobs during the transition. Given that the Indian market is at a nascent stage in its transition to ZETs, we adopted the coefficients for manufacturing jobs from a mature market scenario – Europe. We took the components of manufacturing jobs from an existing study by the Boston Consulting Group Group and Transport & Environment on the European trucking market (BCG and T&E 2023). The coefficients for both internal combustion engines (ICEs) and EVs are explicitly derived from the European context, with the 2022 scenario dominated by ICE trucks and a projected complete transition to ZETs by 2035.

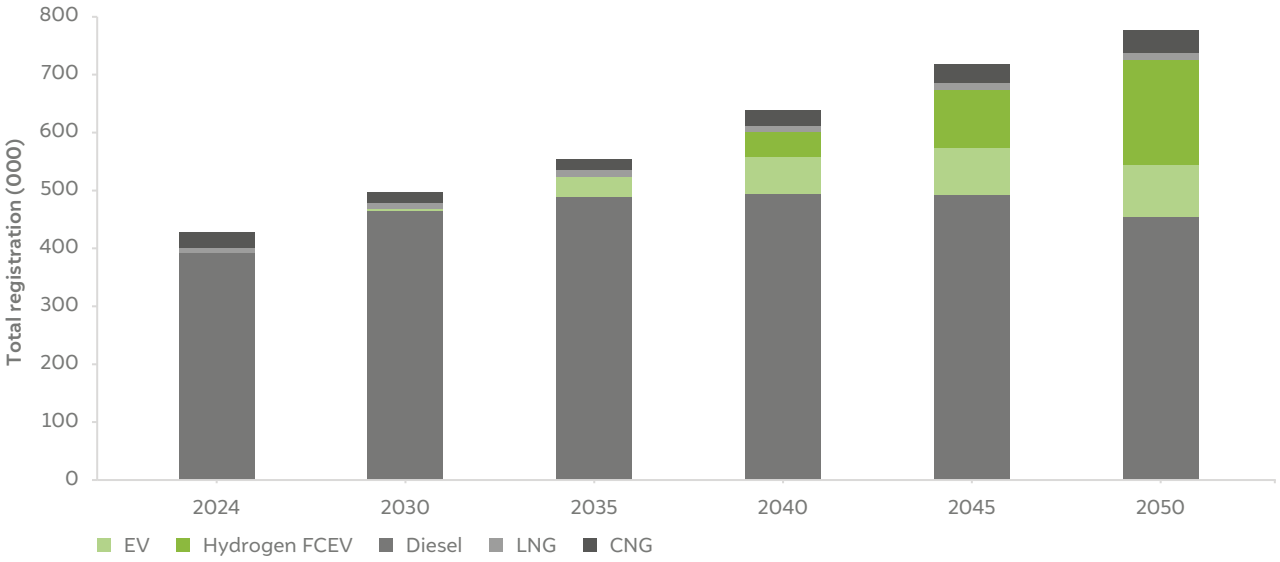
For suppliers, OEMs, and MHDT-related utilities, the job coefficient for EVs is reduced as compared to the ICE coefficients, while an additional job coefficient is added for ZET infrastructure. The ICE vehicles supplier coefficient stands at 0.68 while it is 0.60 for EVs. The coefficient for OEMs stands at 0.71 for ICE vehicles and 0.52 for EVs. For MHDT-related utilities of ICE vehicles, the coefficient is 0.25 and stands at 0.22 for EVs. Lastly, the coefficient for ZET infrastructure is 0.04 (BCG and T&E 2023). We assume that the job coefficients remain constant throughout the study period. We also assume that the job coefficients are the same for BET and hydrogen-based trucks within the ZET segment.

With the number of e-trucks deployed globally – mostly in China, the EU, and the US – being low, it is harder for sector experts to predict changes in job coefficients in the ZET transition. The coefficients for the operational jobs are adopted from the 2024 Climate Policy Initiative study (Krishnan, Kumar, and Sen 2024). These are considered the same for ICE vehicles and EVs, assuming that the existing operational jobs will transition with the necessary training and skill enhancement to accommodate new technologies. The coefficients for direct, indirect, and induced jobs are taken to be 1.31, 0.86, and 0.65, respectively (Krishnan, Kumar, and Sen 2024).

2.2 Estimated MHDT sales

As per our analysis, the MHDT sales in India for the period 2024–2050 are expected to show a steady increase, with annual registrations expected to rise from over 0.42 million units in 2024 to about 0.77 million units in 2050. However, diesel MHDTs are expected to remain dominant during this period because of their higher power output and the widespread availability of engines and fuel (Krishnan, Kumar, and Sen, 2024). Additionally, e-MHDT sales are limited by the high dependence on imports of powertrain and battery pack components (Krishnan, Kumar, and Sen 2024). Despite these limitations, ZETs are anticipated to grow from 221 units in 2024 to about 0.27 million units in 2050, accounting for 35 per cent of annual registrations in 2050. Although their current market share is smaller, the projected increase in their share is expected to bring with it a shift in jobs and employment. In the subsequent sections, we evaluate the changes in the employment landscape in the MHDT sector in the period 2024–2050.

Figure 8 Projected fuel-wise annual registration of MHDTs



Source: CEEW–TFFM (forthcoming, 2025)

2.3 MHDT jobs estimation: 2024–50

We estimate that over 30 million jobs will be created in the MHDT segment by 2050, with 6 million jobs created by e-MHDTs and 24 million jobs by ICE MHDTs in India. The next section describes and classifies these jobs as manufacturing and operations jobs. Based on the BCG Group and T&E study, we consider that MHDT manufacturing jobs include roles along the production value chain, focusing on four key areas:

Component suppliers

Roles related to the production of components, modules, and platforms, covering hardware, software, and licensing

OEM

Employment generated and supported by new vehicle production and sales, including capital equipment, consumables, labour and factory optimisation, IT, the sale of new vehicles, and marketing

ZEV infrastructure

An entirely new segment with roles created by the setting up of ZEV charging infrastructure

MHDT-related utilities

Roles related to supporting energy consumption, including hydrocarbon (diesel and gasoline) and electricity, to fuel MHDTs

Additionally, we also estimate operations jobs, which are classified into three categories adopted from the CPI study 2024:

Direct

Jobs directly tied to the operations of trucks, including truck drivers, assistants, fleet owners, and other company personnel

Indirect

Downstream indirect jobs, such as after-sales service and fuel stations

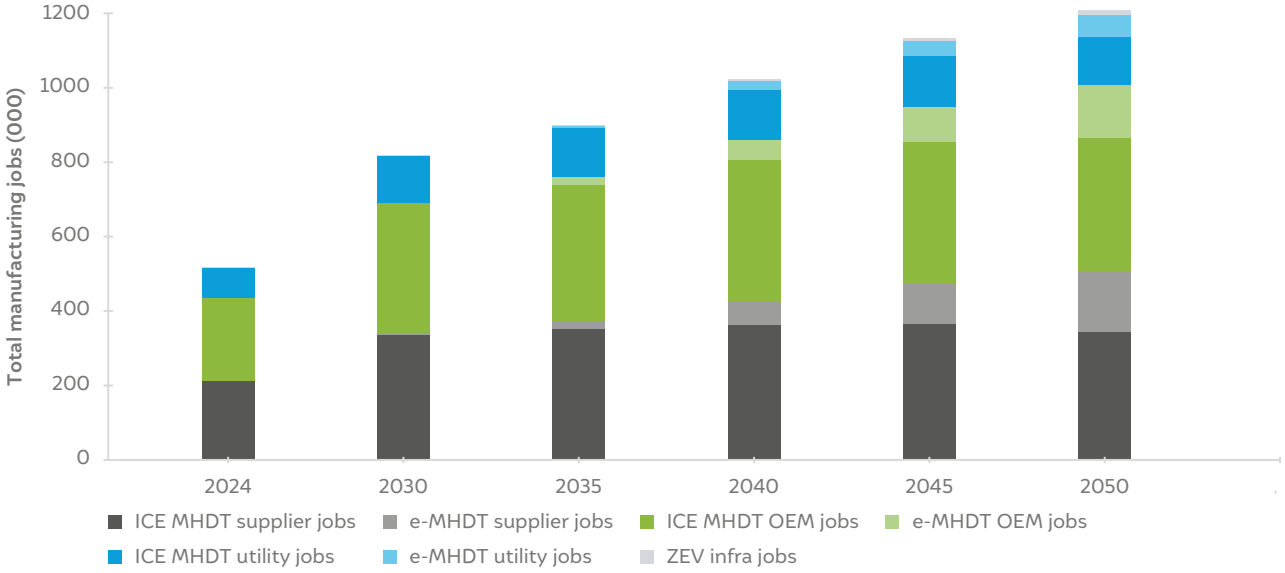
Induced

Employment that arises from economic activity around the trucking sector, such as jobs related to local businesses, rest stops, hotels, and so on which benefit from spending related to the trucking sector

Manufacturing jobs

As of 2024, around half a million manufacturing jobs were associated with the MHDT segment, with most of jobs attributable to ICE trucks and only 300 to e-MHDTs. The current market remains diesel-dominant as the industry tests the grounds for e-MHDT with initial pilots. However, by 2050, with the total manufacturing jobs increasing to 1.2 million, we might witness a rise in the share of e-MHDT jobs to 31 per cent. This increase in e-MHDT jobs is likely to be brought on by policies and a market that focus on reducing greenhouse gas emissions in the transportation sector through the use of alternative fuels.

Figure 9 The share of e-MHDT manufacturing jobs will increase to 31% by 2050 from less than 1% in 2024



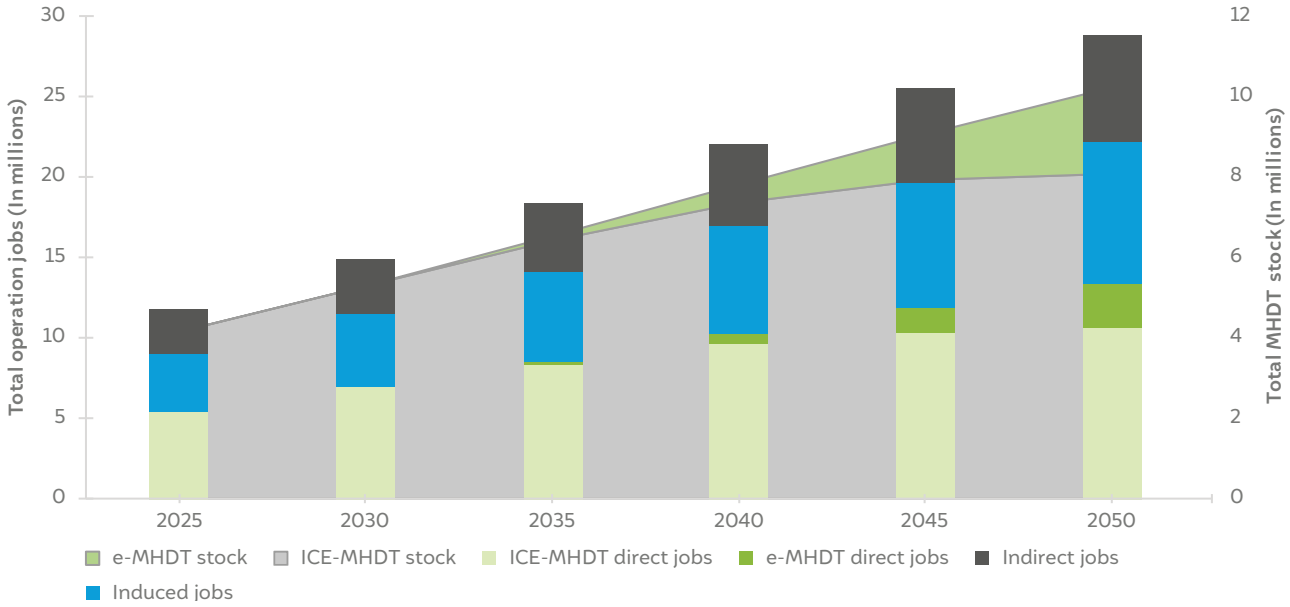
Source: Authors' analysis (CEEW)

According to our analysis, there will also be a shift from ICE MHDT jobs to e-MHDTs in three areas: suppliers of components, OEMs, and MHDT-related utilities. The employment generated by e-MHDTs is projected to increase from less than 1 per cent in 2024 across these three areas to 32 per cent, 28 per cent, and 31 per cent, respectively, by 2050. Green jobs will be created in the deployment of ZET infrastructure. By 2050, 12 thousands of green jobs directly linked to ZET infrastructure will be created.

Operations jobs

Operations jobs in the MHDT segment will also experience growth, as an increase in the stock of MHDTs in India will result in the rise of direct, indirect, and induced jobs. In 2024, 11 million operations jobs were linked to the MHDT segment, with less than 1 per cent of jobs affiliated to e-MHDTs. However, as the MHDT stock rises, associated jobs will also increase to 29 million by 2050. The increased penetration of e-trucks can result in a shift in the share of operations jobs, where ICE operations jobs will reduce from 99 per cent in 2024 to 79 per cent in 2050. Across direct, indirect, and induced operations jobs, the share of operations jobs associated with e-MHDTs is likely to rise from less than 1 per cent in 2024 to 21 per cent by 2050.

Figure 10 The share of e-MHDT operational jobs will increase from less than 1% in 2024 to 21% by 2050



Source: Authors' analysis (CEEW)

In our analysis, we find that growth in jobs is linked to the growth of the sector. In 2024, there were 11.6 million jobs in the MHDT segments, most of which were associated with ICE MHDT – due to the dominance of diesel MHDTs in India – and less than one per cent of the share of both manufacturing and operations jobs were associated with ZETs. By 2050, as the segment grows, we find that jobs associated with MHDTs will increase, with ZETs accounting for over 21 per cent of these jobs. For e-MHDTs to contribute more to employment, the EV penetration of e-trucks in India's MHDT segment needs to be expedited with the help of aggressive, target-based policies and regulations as well as expansion of EV infrastructure.

The projected growth in MHDTs has the potential to create over 30 million jobs. This will impact the lives of over 111 million individuals – those working in the industry as well as their households. However, realising these benefits requires active efforts by the MHDT industry; it also needs policy interventions to strengthen the e-MHDT ecosystem and address the skill gap that will ensue with a transition to e-MHDTs. In the subsequent chapters, we explore the early industry initiatives to transition to e-MHDTs across various use cases, highlight the challenges, and record the policy interventions required to support this transition.

Regular training and upskilling of the workforce, providing job benefits, and building quality infrastructure are crucial to creating attractive employment opportunities in the trucking sector.

Image: Climate Group

3. Understanding India's early e-MHDT initiatives

Various stakeholders have come together to implement pilot initiatives and test the ground for e-MHDTs across multiple use cases to drive decarbonisation efforts within the trucking sector. In this chapter, we look at seven unique case studies of e-truck pilots, which have been selected because they possess a diverse combination of factors suitable for early electrification efforts – such as geographical spread across the country, use case applications, and ecosystems of stakeholders leading them. We explore these initiatives through strategic interviews with several fleet operators, shippers, LSPs, and aggregators across India. In each case study, we highlight the unique approach taken to address a particular use and how different stakeholders are collaborating to make operations feasible. There is also a qualitative assessment of the drivers' perspectives on the e-transition.

3.1 Learning by doing: e-MHDT initiatives in India

The case studies we discuss below provide insights obtained from various companies' pilot programmes, including the unique interventions undertaken to facilitate the e-transition and the challenges encountered during these pilots. Building on the pilot's success, the companies plan to scale their businesses with e-MHDTs, making them the first set in India to transition.

Image: CEEW

E-truck being charged at the JSW cement facility in Nandyala, Andhra Pradesh.

Kalyani Powertrain

Repowering trucks to accelerate the e-truck transition

Image: Climate Group

Kalyani Powertrain drivers with their first repowered e-truck in the Chakan facility.

Kalyani Powertrain Limited (KPTL), a wholly owned subsidiary of Bharat Forge, was founded in April 2021 to drive the parent company's vision for sustainable development. Its electric mobility strategy offers various EV solutions across segments, including buses and trucks. Its solutions range from providing selected sub-systems to complete electric powertrains (Financial Express 2022).

KPTL's repowering business, where ICEs are converted to EVs, aims to electrify 5- to 8-year-old MHDTs in the tonnage segments of 7.4–14. There are 1.5–2 million trucks and buses that fit these criteria. For KPTL, this is an opportunity to work towards the country's zero carbon vision (Mohile 2024).

Currently, in the HDT segment, KPTL offers two repowering solutions – one for vehicles with a GVW of 12.9 T and a range of over 250 km and the other for those with a GVW of 18.5 T, with a range of over 225 km. They are also in the process of obtaining an Automotive Research Association of India (ARAI) certification for a third model – Tata 407 – which offers a range of more than 120 km. These trucks are co-created with shippers and LSPs to match their duty cycles across use cases. KPTL has repowered 14 trucks, tested dozens for tech readiness, and conducted numerous pilots across different use cases – such as freight, dairy, cement, and FMCG – with various customers. Their e-trucks have travelled a total distance of more than 324,000 km, saving over 65,000 litres of diesel and avoiding 174 tons of CO_2 emissions (Kalyani Powertrain 2020).

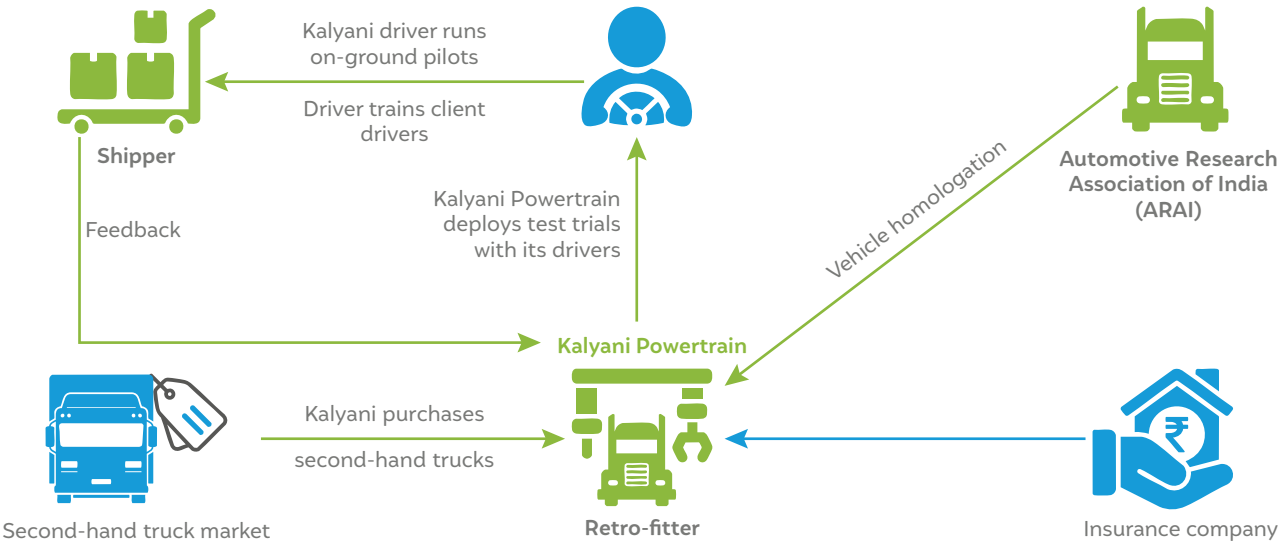
Pilot use case: Milk (perishable goods)

Route	Pune (intracity operations)
Route length	50 km
Fleet size, vehicle type	One 12.9-T repowered e-truck
Pilot timeline	Ongoing

In 2024, KPTL undertook a pilot with Chitale Bandhu to showcase the utility of repowered e-trucks when deployed in a proper use case. KPTL ran a repowered e-truck within Pune to transport milk containers from a collection centre to the Chitale Bandhu factory 50 km away. After unloading the containers, the trucks returned to the collection centre. Each e-truck undertook two such trips, one around 5:00–7:00 a.m. and another at 5:00–6:00 p.m.

An e-truck can travel up to 250 km on a single charge, and the two fixed trips provided adequate idle time to recharge during the day and night. For the pilot, KPTL arranged for the vehicle's charging, service, and maintenance. This pilot demonstrated the utility of a repowered e-truck when vehicle performance is matched with the duty cycle, thus generating trust in repowering technology, which has the potential to reduce the cost of EVs.

Figure 11 Stakeholder mapping of KPTL e-truck operations



Source: Authors' compilation (CEEW)

Company initiatives

From designing repowering kits to skilling drivers with the knowledge to operate repowered e-trucks effectively, KPTL undertakes several measures to ensure profitability across segments. In this section, we elaborate on the unique dimensions of KPTL's transition efforts.

- **Repowering to reduce costs**

KPTL aims to make affordable, quality e-trucks. The capital required to purchase e-trucks is high – around three times that required for ICE trucks. However, through the repowering model, KPTL can reduce costs and is working to lower them further to make them a competitive alternative to ICE trucks. KPTL is thereby addressing the high cost of e-trucks – one of the most pressing barriers to the e-transition.

- **Customised end-to-end solutions**

KPTL, through its strategic partnerships with banks and charge point operators (CPOs), provides their customers and LSPs with customised end-to-end solutions. They assess each customer's routes, payload and range requirements, and corresponding charging infrastructure. Based on this, they configure and build repowering kits and deploy vehicles on fleet routes to demonstrate their utility to the customers. KPTL has successfully proven the utility of its vehicles in five sectors – freight, FMCG, milk, cement, and industrial use.

- **Driver-led training programme and active driver engagement**

Once the repowered trucks are delivered to the customer, as part of the handover process, KPTL provides three to four days of training to the customer's drivers. This additional service is unique, since KPTL's in-house drivers lead the training efforts. A key focus of this training is on safety issues related to the new, unfamiliar aspects of the e-trucks. KPTL drivers also emphasise efficient charging practices, demonstrate the essential operation of the e-truck, brief drivers on the dashboard display and the meaning of various symbols, and assist them with different features.

- **End-to-end service provision**

KPTL takes steps to provide service support to its customers. KPTL drivers stated that two types of issues are generally encountered: mechanical issues and software challenges. While drivers are provided with skills to manage the former, KPTL handles issues related to the battery system or software. To ensure their speedy resolution, KPTL monitors the e-trucks in real time and provides any assistance the customer requires.

- **Charging infrastructure support**

Another unique support that KPTL provides is assistance with charging. It works collaboratively with CPOs to address issues related to a limited charging infrastructure network, thus easing customers' concerns regarding limited charging infrastructure.

Image: CEEW

A KPTL driver demonstrates the features of a repowered EV

Challenges encountered

The challenges to KPTL's sustained electrification efforts primarily involve charging infrastructure.

Drivers mentioned three major concerns:

- They have restricted access to truck-specific charging infrastructure at hotels and restaurants along highways. Additionally, infrastructure owners prevent trucks from using these chargers, allowing only cars, two-wheelers (2Ws), and three-wheelers (3Ws) to use them.
- Despite the presence of several CPOs in the market, there is no single app to detect the nearest station. Drivers have to install various applications and are required to maintain a minimum balance across all of them.
- Charging e-trucks is expensive. The cost varies from INR 18–23/kWh for vehicles, resulting in high business costs.

Due to these challenges, KPTL's efforts to scale operations are delayed. Therefore, a strategically planned charging network covering key stops, along with affordable rates, will significantly enhance truck electrification.

The way forward: scaling the pilot

KPTL has received investments of upwards of INR 300 crore and aims to sell 150 trucks by the end of 2025. It continues to focus on geographies and use cases where the utility of the repowered e-trucks has been proven. In the coming years, it aims to widen its network through demonstrations of more use cases and a reduction in acquisition costs.

BluWheelz

Electrifying logistics services through innovative business models

Image: CEEW

BluWheelz's staff and their first e-MHDT driver sharing their experiences of e-trucks

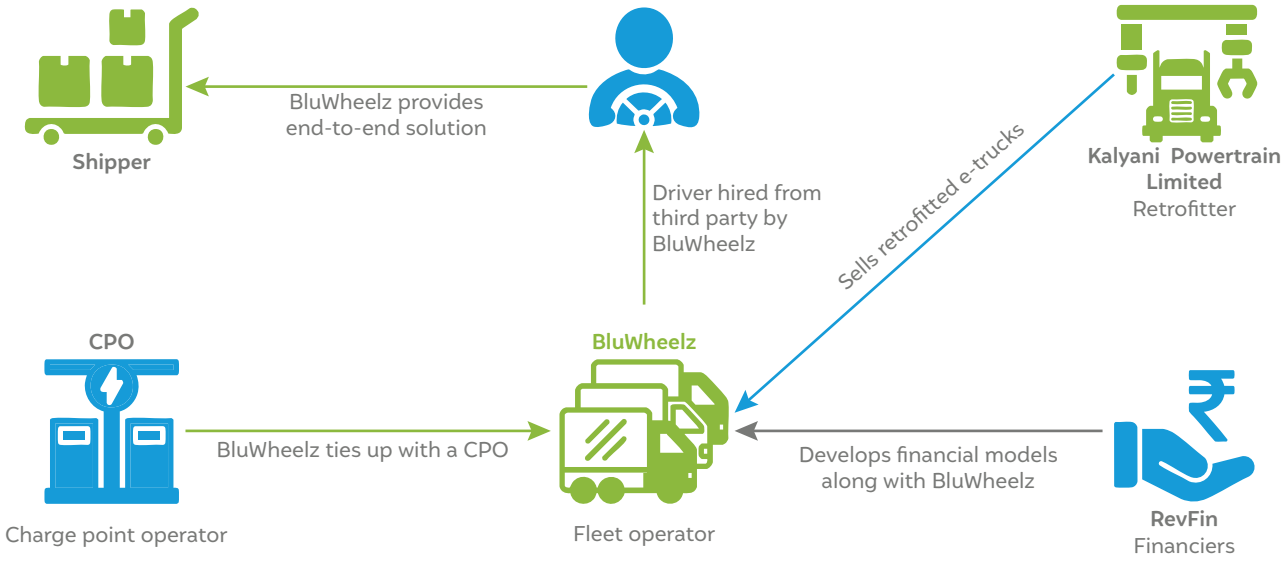
BluWheelz Mobility Services Private Limited is a delivery company which offers a platform for aggregating and operating EV fleets exclusively. It aims to revolutionise the logistics sector and sustainably meet the mobility needs of the e-commerce, FMCG, pharma, paint, quick commerce, and food tech industries. Since its incorporation in 2022, BluWheelz has rapidly grown and currently has a fleet of over 1,600 vehicles, operational in over 17 cities and catering to over 85 clients across sectors (ZeeBiz 2024). Its fleet consists of 2Ws, 3Ws, four-wheelers (4Ws), light commercial vehicles (LCVs), and e-MHDTs. They have successfully travelled over 62 million kilometres, transported 260 thousand tonnages, and abated 7,000 tonnes of carbon emissions. In the coming years, BluWheelz anticipates a burgeoning demand for urban logistics solutions and hopes to continue providing cleaner and more eco-efficient and innovative alternatives to existing logistics services.

Pilot use case: Perishable goods

Route	Jataula, Haryana, to Gurugram, Haryana
Route length	53 km
Charging infrastructure	Charging at the company's facility in Sonipat
Fleet size, vehicle type	1 KPTL repowered 22 ft 7-T truck
Pilot timeline	July 2024–August 2024

In 2024, along with an FMCG company and Kalyani Powertrain Limited (KPTL), BluWheelz initiated trials in Delhi-NCR to assess the feasibility of repowered e-trucks in urban logistics. In addition to providing the e-truck, KPTL trained the driver, made charging services available, and ensured that an engineer was present in the e-truck to address and resolve any potential technical issues during the pilot. The e-truck was deployed at the Sonipat facility, where it transported FMCGs from Jataula to Gurugram for a month. After assessments by the BluWheelz and KPTL teams, this route was selected to match the truck's performance with specific duty cycles. It was estimated that repowering can result in 24 per cent more TCO reduction as compared to e-trucks.

Figure 12 Stakeholder mapping of BluWheelz e-truck operations



Source: Authors' compilation (CEEW)

Company initiatives

- **One-stop solution for sustainable logistics services**

Currently, access to adequate charging infrastructure, limited e-truck options, and the absence of an e-truck service and maintenance network hinder companies from transitioning to e-trucks for their logistics requirements. BluWheelz, through collaborations and partnerships in the ecosystem, addresses these challenges and provides clients with a one-stop solution for adopting e-trucks. At present, BluWheelz has partnerships with key stakeholders, including e-truck OEMs such as Switch, Tata, Euler, Mahindra, Eicher, and KPTL; CPOs such as Statiq, Tata Power, Kazam, and Jio BP; and financiers such as RevFin and Alt Mobility. These partnerships enable them to procure e-trucks; match vehicles to duty cycles to ensure maximum utility; hire, train, and manage drivers; guarantee the availability of charging stations along routes; and arrange for after-sales services whenever necessary. Thus, BluWheelz ensures that its customers can transition to EV fleets with ease and also experience the same convenience that ICE vehicles offer.

- **Simplification of the charging process for drivers**

The entry of various CPOs supports the proliferation of charging infrastructure. However, drivers point out that using charging stations by different CPOs is cumbersome as for each CPO, drivers must maintain multiple applications and minimum balances in each of those applications. To address this, BluWheelz deploys specialised personnel to coordinate with drivers and manage the charging schedule and processes for the e-trucks. These personnel provide drivers with radio frequency identification (RFID) tags and manage the applications and payments. The drivers need to use the RFID tag to identify themselves at the charging stations and start charging, thus alleviating charging concerns.

BlueWheelz designated personnel issues RFID tags to drivers and handle charging applications and payments, easing charging concerns

- **Driver empowerment**

Truck drivers face several challenges due to the trucking sector's informal nature. As an aggregator, BluWheelz recognises the integral role of drivers in the ecosystem and aims to alleviate some of these challenges. It uses the EV transition to streamline operations and assist drivers in acquiring customers. Drivers who register on the BluWheelz platform are provided with assured earnings, reducing the uncertainty they otherwise face in their day-to-day operations.

BlueWheelz has also developed innovative business models to facilitate the purchase of EVs by existing ICE drivers, new drivers, fleet owners, or any individual. This is done through its franchise-cum-owner, rent-to-own, and driver-cum-owner programmes. Its partnerships with non-banking financial companies (NBFCs) enable drivers – especially those who have never owned a vehicle earlier– to access the finance to buy an EV. Its current business models facilitate the purchase of e2Ws, e3Ws, and e-LCVs; it is also designing similar financing models to support the purchase of e-HDTs. Thus, BluWheelz uses the EV transition to make drivers financially secure, and foster a sense of independence through vehicle ownership.

Challenges

- **High driver attrition**

The trucking industry experiences high attrition owing to low pay scales, adverse weather conditions, the risk of accidents, and lack of benefits at work. This poses two challenges for BluWheelz. First, they have to find replacement drivers and then adequately train them to drive e-trucks. This additional training has to be given before deploying the vehicle on-road. Second, BluWheelz builds financing models to increase the uptake of EVs and promote ownership by drivers. However, drivers find it difficult to commit to longer engagement periods, making it difficult to develop a viable model for driver-owned e-trucks.

- **High upfront cost of e-trucks**

Like other companies, Bluwheelz also faces the issue of high operating lease costs, with 19–20 per cent interest charged by NBFCs. However, through their franchise-cum-owner model, they have reduced interest to 13–14 per cent. Drivers who own trucks are quite hesitant to transition from their current ICE trucks to e-trucks. This is because they compare the costs of operating a new e-truck, where equated monthly instalments (EMIs) are high, with the current operational cost for a five- to six-year-old ICE truck after loan repayment. This comparison—skewed in favour of ICE trucks—is inaccurate, as it does not consider the costs incurred on the ICE truck during its initial years of operation. To address this issue, Bluwheelz has partnered with retrofitting companies, such as KPTL, EMOSS, and Virya-Indofast, to provide solutions to repower older ICE trucks to EVs – which will reduce the initial EMI cost.

The way forward: scaling the pilot

BluWheelz aims to become India's largest EV logistics company over the next two to three years. Continuing their efforts to provide clients with sustainable logistics services, they have partnered with the battery-swapping company SUNMobility; KPTL; and OEMs Eicher, Tata, Euler, Montra, Mahindra, and Virya for a diversity of e-trucks.

Image: Pluc.TV

BillionE Mobility's driver with the Ashok Leyland Boss 14T e-truck

BillionE

Facilitating the e-truck transition as a delivery and charging service provider

Image: Climate Group

Sanjeev Kulkarni, Chief Executive Officer at BillionE in Bengaluru, Karnataka, explaining how their asset ownership business model allows the flexibility to customise solutions.

The BillionE Group is an energy transition platform providing sustainable solutions across the energy and mobility sectors. They have a diverse portfolio spanning renewable energy, e-mobility, and EV charging infrastructure. With expertise in the power sector, BillionE Group established ChargeZone, a service platform and technology-driven EV charging infrastructure venture that provides comprehensive charging solutions. It specialises in serving business-to-business (B2B), business-to-consumer (B2C), and business-to-government (B2G) markets with dedicated and opportunity-based charging using the smart grid network. On identifying the need for emission reduction in the mobility sector, especially in the bus and truck segments, BillionE expanded to e-mobility as a service, offering mid-mile and long-haul transportation services for goods and passengers. This initiative also enhanced the utilisation of its charging stations. BillionE Mobility, along with ChargeZone, provides a unique value proposition to its customers, delivering integrated logistical services solutions along with charging infrastructure.

Pilot use case: Pharma raw materials

Route	Chennai to Bengaluru
Route length	375 km
Charging infrastructure	Two opportunities for charging at Vellore, Tamil Nadu, and Krishnagiri, Tamil Nadu
Fleet size, vehicle type	One Ashok Leyland Boss 14T
Pilot timeline	August 2024–present

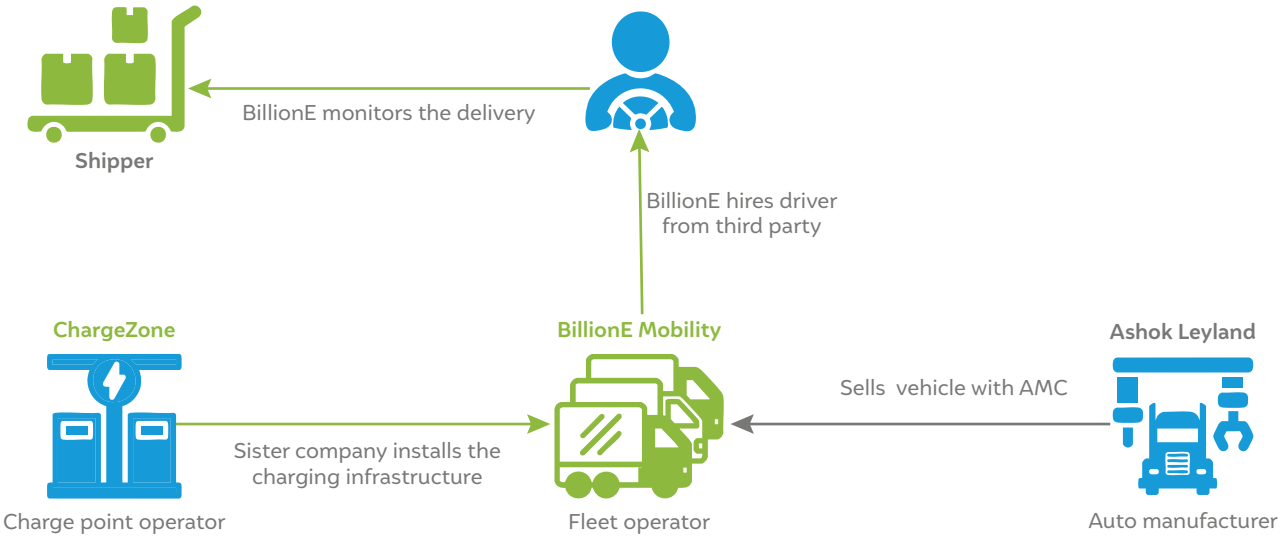
BillionE is piloting the Ashok Leyland Boss 14T EV for mid-mile transportation services for MDTs. The pilot, active since August 2024, has been transporting pharmaceutical raw materials in close-body trucks from Chennai port to Bengaluru as a one-way load.

The opportunity charging stations planned for on the way charging, are strategically planned so that the truck loads the consignment at Chennai port, tops up the charging at the opportunity charger at Vellore station, and fully charges the vehicle at Krishnagiri station. The charging intervals are aligned with the entry restrictions in the city limits to prevent delivery delays.

During the pilot, we observed that the range of the vehicle varied with topography and under loaded/unloaded conditions. For instance, while going from Bengaluru to Chennai, the truck travelled a distance of 300 km on a single charge, as the route followed a downhill slope and the vehicle was unloaded. However, when returning from Chennai to Bengaluru, the range of the e-truck on a single charge was reduced to 220–230 km. This is attributable to the load and the ghat area, where the e-truck had to travel along an uphill gradient. BillionE ascertained that as per the pilot, the observed energy consumption for a 14-T Ashok Leyland truck has been 0.75 kWh/km.

BillionE's asset ownership business model allows for the flexibility to customise solutions according to customer needs. It leverages data from pilots to make its operations more digitally advanced, enhancing the safety, reliability, and traceability of delivery services. Its in-house internet of things (IOT)-based technology platform helps optimise battery usage and fleet management, ensuring efficient delivery systems and energy usage.

Figure 13 Stakeholder mapping of BillionE Mobility's e-truck operations



Source: Authors' compilation (CEEW)

Company initiatives

BillionE uses digital integration and data management to provide customer-centric solutions. In this section, we discuss BillionE's efforts to develop scalable solutions for the broader utilisation of e-MHDTs.

- **Leveraging technology and data to enhance operations**

BillionE is leveraging the MHDT transition to improve the operational efficiency of vehicles with the help of technology- and data-driven strategies. Using data as a tool, it monitors key parameters, such as battery health and system performance, to improve overall fleet efficiency.

BilionE also analyses drivers' behaviour patterns and provides targeted training to improve their driving skills and enhance operational efficiency. The back-end communication system offers drivers AI- and machine learning (ML)-based real-time prompts on acceleration or harsh braking incidents to improve the vehicle's performance. Additionally, BillionE shares drivers' feedback on battery state of charge, regeneration levels, and other operational details with OEMs to refine the vehicle design and improve its overall performance.

- **Exploring new business use cases for the e-MHDT transition**

To accelerate the adoption of e-trucks, BillionE is exploring innovative solutions for new use cases in consultation with OEMs. The aim is to identify implementable use cases where the operational efficiency aligns with the ZET goals, making a viable business case for a transition to e-MHDTs. One such initiative includes designing a refrigerated truck with electrically operated refrigeration systems tailored to cold-chain logistics. Similar innovations that provide tailored solutions aligned with sustainability goals, while expanding the range of operations across sectors, could be explored.

- **'Smart route' planning to optimise operations**

Data insights about routes, topography, charging infrastructure, and vehicle-specific requirements can help drivers and operators plan operational routes to minimise energy consumption and reduce travel time. BillionE is actively engaging with map engine service providers to plan e-truck-suitable paths with information about the topography, charging infrastructure, and other details required for route pre-planning. It also plans to optimise operations with green-route planning, where vehicle routes are planned based on the load and topography to improve overall vehicle efficiency.

- **Technology-based services to improve overall experience**

ChargeZone operates on the Charge Cloud platform and provides customers with route information and real-time updates on the status of charging infrastructure. This enables the drivers to plan their charging halts effectively and avoid last-minute disruptions that would affect their delivery times.

Image: CEEW

Sohail, a BillionE driver, at ChargeZone facility in Krishnagiri, Tamil Nadu talking about how driving an e-truck on ghat roads takes less effort as compared to an ICE truck.

"Diesel is outdated, and this is the new world. It was a new experience, and this is the future"
- e-truck driver from BillionE

Challenges encountered

- **Limited route flexibility and vehicle range restrictions**

E-MHDTs have the disadvantage of restricted route flexibility when compared to ICE vehicles. They require prior route planning, which needs to be based on the charging infrastructure available, to ensure cost-effective deliveries. The fleet operator must also plug in the right vehicle size with the proper use case to optimise operations and make a business case for any service. Additionally, while planning for new routes, early coordination with OEMs is required to check the feasibility of maintenance services at the desired location. During operations, vehicle performance needs to be closely monitored, since the range varies based on the topography of the route and whether the truck is loaded or unloaded. In its pilot, BillionE strategically planned the routes to address the range differences and offered several opportunity charging stations along the route considering the topographical changes.

- **Suboptimal asset utilisation**

In the early stages of the e-transition, the asset utilisation of the vehicle and the charging infrastructure were challenging for the company. Restrictions in route flexibility and the lack of return loads on some routes increased the fleet operator's financial risk and the e-truck's capital cost burden. This is a crucial advantage that the ICE trucks have over e-MHDTs. Until charging infrastructure is scaled along major routes and the demand for e-MHDTs increases, asset utilisation will continue to be a challenge.

BillionE, as both a fleet operator and charging point operator, demonstrates multiple business use cases for the e-MHDT transition within the industry and the expansion of its fleet. By installing charging points along high-demand routes, it aims to optimise the utilisation of the charging infrastructure and expand delivery operations so that e-trucks can carry full loads in both directions, unlike the pilot, where load was carried only on the Chennai port to Bangalore leg.

Considering drivers' crucial role in the sector, BillionE is working to improve their quality of life, through e-transition

- **Shortage of skilled drivers**

Since drivers are responsible for the vehicles and the high-value items they transport across cities, the LSP needs verified and reliable drivers. Currently, the logistics sector is facing a shortage of drivers, and it is difficult to find licensed MHDT drivers, particularly those who are well versed in the new technology and systems in e-MHDTs.

BillionE recognises the key role of drivers in the e-MHDT transition and is making efforts to bring about a change in their quality of life. While planning for charging infrastructure and site selection, they consider the availability of restaurants, toilets, and pit stops to leverage the time used for charging as a rest stop for the drivers. They aim to enhance the overall job satisfaction of drivers, improve their experiences with the new vehicle technology, and create attractive job opportunities for them.

- **Financial barriers**

Another challenge faced by fleet operators is raising money from lenders. The financing ecosystem for e-MHDTs works on high premiums and interest rates, and lenders seek long-term contracts. Shippers' lack of confidence in the present EV ecosystem and the lack of transition mandates prevent fleet operators from committing to long-term contracts. Hence, with no mandates for shippers and lenders, the operators face challenges accessing the high upfront capital investment required to scale operations.

The way forward

BillionE is working to make the EV ecosystem more efficient through partnerships with stakeholders. They are showcasing business cases for e-MHDTs and expanding charging infrastructure network. It has placed an order for 180 Ashok Leyland e-trucks to scale its operations. These trucks are a combination of 14-T, 19-T, and 55-T vehicles. Additionally, through ChargeZone, the BillionE group aims to cover 20,000 km of road network by the end of 2025 and expand to 50,000 km on Indian highways by 2026 to support the e-transition.

Transvolt

Targeting a captive use case for the e-MHDT transition

Image: Climate Group

Siddesh Rai, Head of Business Development at Transvolt explaining the importance of detailed contracting in e-truck transition.

Transvolt is an OEM-agnostic EV platform for large commercial fleets, including trucks and buses. In the MHDT segment, Transvolt as an aggregator aims to reduce carbon emissions and promote cleaner, more efficient logistical operations through innovative mobility solutions. It provides end-to-end logistics solutions to companies and shippers by matching the right kind of vehicle with the most viable use case. Transvolt's business model is centred on use cases where shippers use trucks for captive movement across industries, including cement, steel, port, textile, and chemicals.

Transvolt facilitates the transition to e-MHDTs by undertaking an in-depth evaluation of the operational efficiency of a use case and demonstrating the benefits through pilots. They assess several factors, such as fleet size, route efficiency, and delivery timelines. Additionally, it reviews infrastructural requirements, including the quality of power supply, tariffs, and payloads, while planning for the operations. This is followed by pilot demonstrations, where it validates operational feasibility and efficiency through data analytics before scaling up e-MHDT operations.

In the e-HDT segment, Transvolt has successfully implemented solutions for sectors such as construction, ports, and steel in captive movement operations. They follow a comprehensive project finance model, providing all services from deploying the right vehicle for the particular use case to setting up the necessary infrastructure required to support the delivery system.

Pilot 1 use case: Construction

Route	Dhar, Madhya Pradesh, to Dhule, Maharashtra
Route length	205 km
Charging infrastructure	Chargers at both ends Opportunity charging at Julwania, Madhya Pradesh (100 km from Dhar)
Fleet size, vehicle type	5 × IPLT Rhino 5536 55T
Pilot timeline	August 2024–present

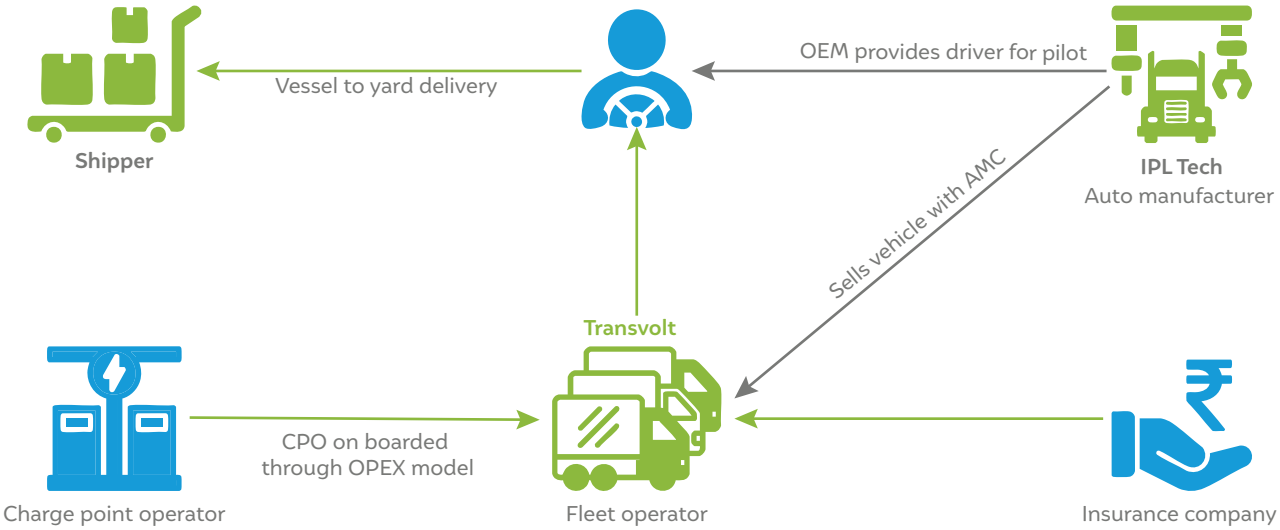
In August 2024, a cement manufacturing company hired Transvolt to optimise its logistics operation by deploying e-trucks. Transvolt used data-based approaches, reviewed the schedules, and monitored the trip timing and fleet availability to increase the number of monthly trips, hence moving more material in a day than ICE trucks. To further reduce the time for individual trips, they attempted coupling–decoupling of the fleet to maximise fleet utilisation. They also coordinated with OEMs to introduce battery swapping in the MHDT segment, reducing charging time and increasing trip frequency. Through trip optimisation and infrastructural improvements, Transvolt demonstrated that maximum output could be achieved from smaller fleet sizes, setting a compelling business case for the use of e-trucks in heavy-duty logistics.

Pilot 2 use case: Port operations

Route	Mundra Port, Gujarat
Route length	2–10 km
Charging infrastructure	In the port premises
Fleet size, vehicle type	One 55-ton trailer truck
Pilot timeline	August 2024–present

Transvolt selects routes with captive movements, as the movement between the origin and destination points and the in-between operations are under the aggregator's control. An application is in port logistics, where the targeted routes are for short-haul movement from the vessel to the yard and from the yard to the container freight station (CFS). Since the route from the CFS to the end customer is unpredictable and depends upon external factors, this movement has not been covered in the pilot.

Figure 14 Stakeholder mapping of Transvolt's e-truck operations



Source: Authors' compilation (CEEW)

Vessel to yard: The vessel to yard distance was around 1.5 km within the port complex. The short-haul movement within the complex provided the advantage of controlled movement and allowed for multiple trips within a day.

Yard to CFS: This route, with fixed distances of 5–10 km, provided the advantage of optimising trips and was ideal for EVs due to predictable loading and unloading conditions at both ends.

Company initiatives

- **Driver benefits and training**

The MHDT transition should address the industry's existing inequalities and informal nature by adopting a people-centric approach. Thus, Transvolt aims to improve the socio-economic status of its drivers with a commitment to inclusive transition. Recognising the pivotal role of drivers, Transvolt has elevated their professional identity by referring to them as 'pilots' while also ensuring a supportive work environment. This includes the integration of essential facilities, such as restrooms and washrooms, in the infrastructural design right from the project's onset.

Transvolt invests in comprehensive driver training programmes, including hard and soft skills. Initially, the OEMs train three or four drivers as coach drivers, who then train the other drivers. This promotes peer-to-peer learning and fosters mentorship within the driver community.

Furthermore, Transvolt is enhancing driver retention and motivation through a compensation structure that combines trip-based incentives with a stable salary. This not only boosts drivers' earning potential, but also drives performance, significantly benefitting overall operations.

- **Gender-inclusive transition**

Transvolt is driving efforts to make its e-MHDT operations gender inclusive and is committed to providing the necessary support. Transvolt and International Finance Corporation (IFC) – a member of the World Bank group – will be part of the India Gender Collaborative Project designed for more women participation in business operations and to strengthen gender-inclusive strategies.

Challenges

- **Securing financing and contracting for MHDT operations**

The risks associated with the MHDT sector, including hesitation in technology adoption, operational feasibility, and lack of adequate infrastructure, make securing finance difficult. This creates a financing gap for e-truck operations. Fleet operators require an assured tonnage commitment for a specific period before buying assets for e-truck operations. This kind of commitment will also promote confidence and encourage financiers to invest in the business.

The way forward

Transvolt, in collaboration with IFC, will implement a techno-commercial evaluation of EV projects covering a capex outlay of over USD 600 million across India. Transvolt is also exploring long-term financing structures to support EV projects covering the procurement, operation, and maintenance of around 8,000 EVs. The company is committed to expanding its pilot projects, aiming to own and deploy a fleet of 75 e-MHDVs specifically for transporting clinker in the cement industry by the end of March 2025.

As a facilitator, Transvolt advocates for more detailed contracts that outline all the operational nuances and risks associated with e-MHDT logistics services. Considering the sector's dynamic nature, which often demands price adjustments that cannot be predicted from the project's onset, clear escalation clauses and regular assessment must be included in the contracts from the initial stage. This will help address the necessary challenges and make amendments to ascertain assurances to all stakeholders.

SwitchLabs

Accelerating e-MHDT adoption through full-stack solutions

Image: Climate Group

SwitchLabs's drivers with their e-truck, operating for JK Lakshmi cement in Sirohi, Rajasthan.

"The truck runs extremely smoothly. I don't feel any exhaustion even after driving for 12 hours."
- e-truck driver from SwitchLabs

SwitchLabs, an EV start-up founded in 2022, is pioneering sustainable logistics solutions for Indian industries. By seamlessly integrating e-HDTs into supply chains, SwitchLabs helps businesses transition to cleaner operations. The company has deployed two 55-T e-trucks in Rajasthan, achieving over 50,000 km and demonstrating the viability of electric trucking for heavy-duty applications. It aims to deploy 100 e-trucks by March 2025.

Pilot use case: Cement raw materials

Route	Sirohi, Rajasthan, to Balaram, Gujarat
Route length	70 km one way (clinker load), 140 km round trip
Charging infrastructure	160 kW fast charger at the plant in Jaykaypuram, Sirohi, Rajasthan
Fleet size, vehicle type	One IPLT Rhino 5536 55T
Pilot timeline	July 2024–Till date

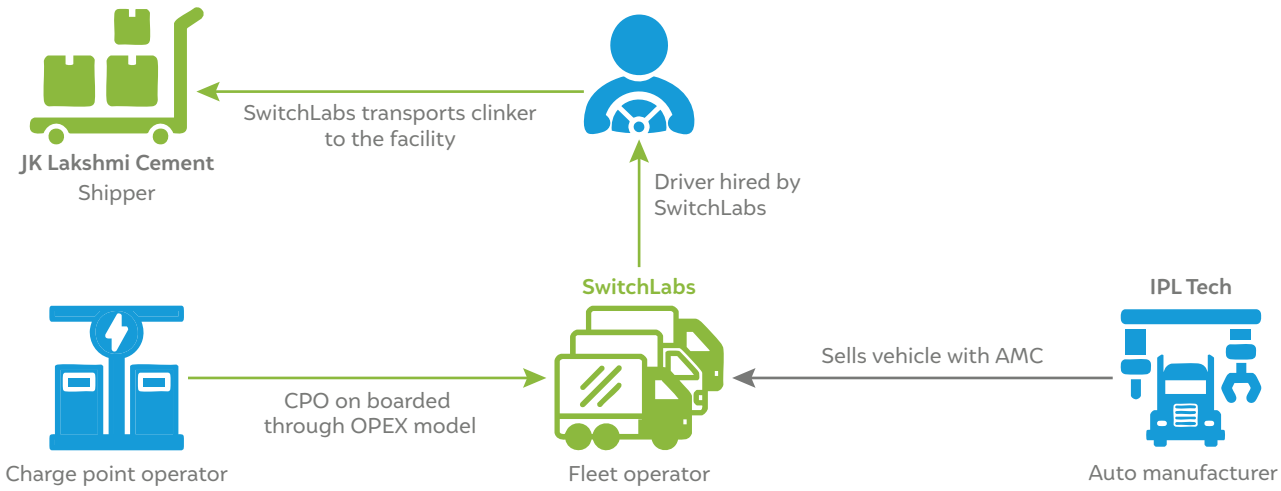
In 2024, SwitchLabs partnered with JK Lakshmi Cement to pilot e-HDT deployment in its supply chain. The pilot focused on transporting clinker from Sirohi, Rajasthan, to Balaram, Gujarat, a 140-km round trip. The pilot is financed through investments by the Foundation for Innovation and Technology Transfer, IIT Delhi, Clime Finance, and Finaqo (SwitchLabs 2024).

SwitchLabs initially deployed an IPLT Rhino 5536 truck with two drivers on this route – a 24-hour highway operation, averaging three round trips per day. A dedicated charging station with a 160-kW fast-charging point was established at JK Lakshmi's Jaykaypuram plant in Sirohi. The truck has a 258-kWh lithium iron phosphate (LFP) battery that charges from 20 per cent to 100 per cent in about 1.5 hours at this fast-charging point (Montra Electric 2025). However, during the pilot, amperage fluctuations caused variations in charging time throughout the day.

Each trip begins with charging the truck at Sirohi, followed by 10–15 minutes of loading. The truck then transports clinker downhill from Sirohi to Balaram and returns uphill without any load. This route profile allows for effective regenerative braking during the downhill descent, improving overall mileage and vehicle range.

Following the successful operation of the IPLT truck for over 100 days, Switchlabs is making consistent efforts towards deploying more trucks on the route. This pilot demonstrated the feasibility of electrifying heavy-duty transportation in hard-to-abate sectors such as cement.

Figure 15 Stakeholder mapping of SwitchLabs's e-truck operations



Source: Authors' compilation (Climate Group)

Company initiatives

- **Remodelling charging stations**

SwitchLabs plans to transform charging stations into comprehensive service hubs. To maximise the operational efficiency, these charging stations will have amenities, like restrooms and food, and facilities for truck cleaning and basic repairs, which can be availed during charging downtime.

- **Driver training and welfare**

Recognising the crucial role of drivers, SwitchLabs provides a comprehensive training programme. Currently, new drivers undergo a month-long on-the-job training under experienced drivers. To further enhance driver skills and safety, SwitchLabs is developing a certified training programme in collaboration with a leading skill council, covering topics like vehicle operation, maintenance, repair, and emergency response.

- **Full-stack solutions**

SwitchLabs has tailored comprehensive full-stack solutions to address the challenges of the e-transition. It partners with OEMs and CPOs to acquire assets directly and manage all aspects of the operations. This includes providing suitable e-HDTs, optimising routes for maximum efficiency, providing trained drivers, and establishing a robust charging infrastructure.

Challenges

- **High operational costs**

The principal challenge that Switchlabs faces in its effort to scale up pilots is the high cost of operation. While it has sound financial models to acquire the truck and its charger, other ongoing operational expenses remain a challenge. For multiple trips along the same route, the driver has to pay the toll multiple times, which significantly impacts the operational budgets.

Another issue is the reduced payload capacity in an e-truck. Because of the weight of the truck's battery pack, the available payload capacity is less than that of a diesel truck of similar size. This means fewer tonnes of clinker can be transported per trip, increasing the cost per tonne transported. Since the initial investment in procuring an electric truck is already high, any added expenditure makes these trucks even less economically viable compared to the traditional diesel alternative.

Finally, high interest rates on loans for e-trucks exacerbate operational expenses. The novel nature of the technology increases lenders' perceived risk, resulting in higher interest rates than those of diesel truck financing. This significantly increases repayment costs, directly impacting operational budgets.

The way forward

SwitchLabs plans to expand its operations into other hard-to-abate industries across western and southern India and deploy 20 additional trucks on the Sirohi–Balaram route by mid-2025. They also plan to upgrade their charging infrastructure, installing 240-kW fast chargers at the Jaykaypuram plant in Sirohi to reduce the overall charging time in the operation. To meet their sustainability goals, SwitchLabs plans to power charging stations with solar energy, leveraging open-access and fixed-rate power purchase agreements (PPAs) to reduce costs.

Image: CEEW

Founders of SwitchLabs explaining how they are transforming charging stations into comprehensive service hubs.

JSW Cement

Captive movement of e-trucks for business operations

Image: CEEW

An truck driver with an e-truck at the JSW cement facility in Nandyala, Andhra Pradesh

JSW Cement is a subsidiary of the JSW group, an Indian cement manufacturing company with trucking operations across the country. JSW Cement controls a fleet of close to 1,300 MHDTs across seven plants and uses a combination of captive and vendor-run movement to move raw materials, finished cement, and by-products.

JSW Cement aims to electrify 100 per cent of its fleet through its EV100 commitment. They have committed to transition their vehicle fleets to electric by 2030. JSW Cement's transition to e-trucks is unique as the company deploys and operates company owned e-trucks to meet its mid-mile operations without any reliance on external agencies.

Pilot use case: Cement

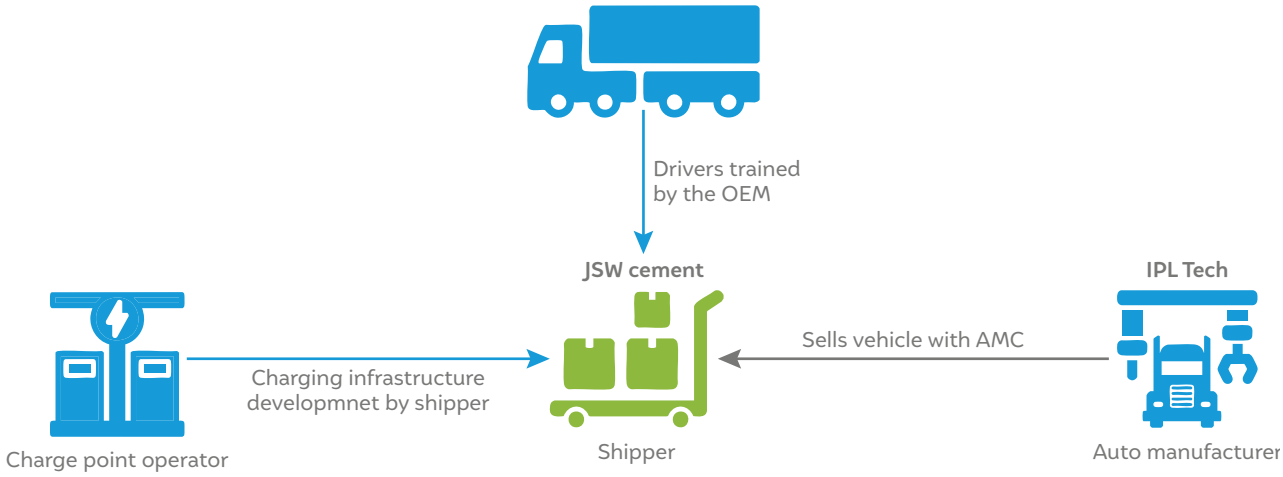
Route	Nandyal, Andhra Pradesh, to Vijayanagara, Karnataka
Route length	300 km
Charging infrastructure	Owned and operated by JSW Cement; four locations for 110-kWh chargers Nandyala, Andhra Pradesh Kurnool, Andhra Pradesh Alur, Andhra Pradesh Vijayanagara, Karnataka
Fleet size, vehicle type	5 × IPLT Rhino 5536 55T
Pilot timeline	November 2023–present

A total of 320 trucks move on this route, demonstrating a good volume within this use case. As part of this pilot, JSW Cement has deployed five e-trucks; the other trucks plying are ICE trucks. JSW's regional transporters operate the existing fleet of ICE trucks, whereas the e-trucks for the pilot are owned and operated by the company itself. These trucks transport clinker on the onward trip and slag on the return trip between two JSW Cement plants in South India – Nandyal in Andhra Pradesh and Vijayanagara in Karnataka.

The e-trucks cover a distance of approximately 600 km on a round trip, taking about 55 hours. The onward trip begins at Nandyal and ends at the Vijayanagara plant, with charging at stations set up in Kurnool (close to 90 km from Nandyal) and Alur in Andhra Pradesh (100 km from Kurnool). These charging stations were set up by JSW Cement as part of this pilot. The chargers have a capacity of 110 kWh and are supplied to JSW by the truck manufacturer. JSW monitor all the trucks and charging stations to maintain efficiency.

Owing to the long route of operations and assured loads in this pilot, JSW Cement's e-trucks experience substantially lower operational expenditures than their ICE counterparts on the same route. Five to six months after the pilot's initiation, JSW Cement saved about INR 100 per tonne in operational costs from its diesel truck usage. On the pilot route, the e-trucks undertake 11–12 trips per month. The five e-trucks deployed run a cumulative 7,200 km every month, avoiding close to 150 tonnes of carbon emissions.

Figure 16 Stakeholder mapping of JSW Cement operations



Source: Authors' compilation (Climate Group)

Company initiatives

JSW Cement's e-MHDT effort is the first within the group and one of the first initiatives in the cement industry.

- **Assured load on both legs of the trip**

The cement use case is a unique opportunity, as the trucks carry clinker one way and an assured load of slag on the return trip. Thus, the trucks are utilised to carry loads on both legs of the trip. The company also benefits from the load from the steel plant at Vijayanagar. This has made the volume of operations feasible, and there is a possibility that more of the load movement in this industry could be accomplished with e-trucks

- **Steady business for LSPs**

JSW Cement is seeking partnerships with various LSPs to scale its e-truck initiatives. To facilitate this, it intends to provide LSPs with an assurance of steady business for a specified period. However, it faces a challenge: lending for e-trucks is available to the transporters at a high interest rate, and only a limited number of LSPs can provide services at rates that are competitive with those of ICE trucks. The company's operations might also find it challenging to manage fragmented adoption by smaller transporters.

- **Reliable and accessible charging infrastructure**

JSW Cement established adequate charging infrastructure to ensure smooth and sustained operations. Before the trucks were deployed, it conducted a scouting exercise and set up charging points along the route, passing through rural stretches across two states. After the pilot's initiation, ground operations found that electricity supply at specific locations was unreliable. To address this issue, additional charging points were added. Both the charging points were set up in the same state, easing the time and effort that went into obtaining electrical connections from government entities.

JSW Cement aims to electrify 100% of its fleet through its EV100 commitment

Challenges

- **Recruiting and retaining drivers**

JSW initially approached existing diesel truck drivers for e-trucks. However, few expressed interest despite the offer of a relatively higher salary. Additionally, during the pilot, the company changed three sets of drivers for the five e-trucks in seven to eight months. This poses a challenge to the continuity of the pilot, as additional time is spent training new drivers. Since material transportation is not the company's primary expertise, more resources than expected are redirected to complete a task.

- **Issues related to vehicle breakdowns**

Over the course of the pilot, the e-trucks have experienced two breakdowns. One truck was involved in an accident, while another had a maintenance and repair issue. The OEM is responsible for repairs, and it takes some time to fix issues, which hinders the company's operations. As a result, the company maintains a stock of OEM-recommended list spare parts, and the OEM has a local team of technicians supporting the company's operations.

The way forward

JSW Steel is a founding member of Climate Group's global EV100+ initiative. As part of this initiative, they are taking steps to 'green' their logistics at scale. On the pilot route, the company intends to transition 100 per cent of its fleet for transporting slag and clinker and will take the decision to own soon. The induction of additional e-trucks on this route is set to start from December 2025; deployment will continue until all the ICE trucks on this route are replaced. For this, the company is looking to partner with vendors who can develop parking lots and charging infrastructure along the truck route. It is open to traditional charging systems as well as battery swapping.

As it plans to extend the use case of e-trucks to cement bulkers, JSW Cement is creating another pilot with 14- to 18-wheel vehicles. They are expanding their e-truck operations to different geographies—such as Maharashtra—where they plan on operating e-trucks with a carrying capacity of 10–12 T from Dolvi in Raigarh district to Mumbai.

For their future electrification efforts, JSW Cement is looking at two operating models: one in which they directly buy trucks and deploy them, and another in which a transporter – such as a partner LSP – buys and deploys the trucks with some guarantee of continued business from the company.

BLR Logistiks
Adoption of e-trucks by an established LSP

Image: Climate Group

BLR Logistiks officials highlighting the challenges faced during their e-truck pilot at their Navi Mumbai facility.

BLR Logistiks is a third-party logistics company offering warehousing, custom clearance, transport services, and integrated solutions to shippers. The company owns over 600 vehicles and has more than 3,000 attached vehicles and 21 warehouses across India. In 2023, BLR launched its Zero Carbon Project 2035 commitmenting to net zero by 2035.

Pilot use case: Parcel load

Route	Mumbai to Chakan (Pune)
Route length	130 km one way
Charging infrastructure	Charging set up near terminals (Dighode near Mumbai and Chakan near Pune) Paid charger located midway to fill gaps in current requirement; opportunity charging at public stations if required
Fleet size, vehicle type	One IPLT Rhino 5536 55T
Pilot timeline	October 2024–present

In August 2024, BLR Logistiks conducted a trial in collaboration with IKEA, a member of the EV100+ campaign. Along with IPLTech, they deployed an unloaded 55-T e-truck on a 130-km route from Mumbai to Chakan (Pune) to assess the viability of e-truck operations in the e-commerce sector. The truck had a 160-kWh battery which requires 90 minutes to fully charge. The truck ran for a day; at the end, its discharge of the unloaded truck was 80 per cent. After this initial trial, the company held deliberations with its stakeholders and initiated a longer-term pilot as part of the e-transition. The longer-term pilot became a pilot programme from October 2024.

Pilot programme

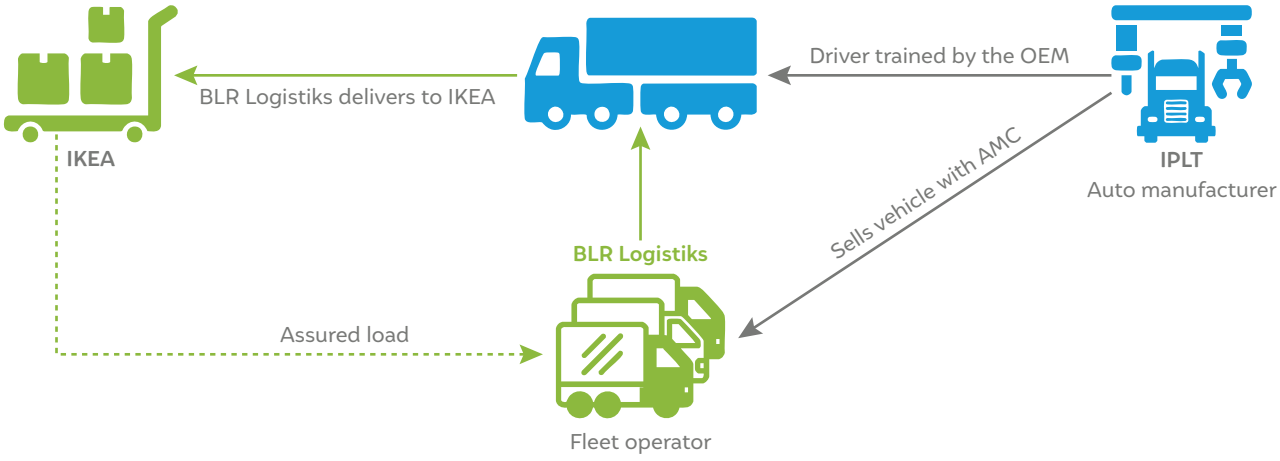
This route for the pilot programme from Pune to Mumbai was based on Ikea's confirmed load for e-truck operations. The route falls within a ghat section with a slope terrain. On its uphill journey from Mumbai to Pune, the truck transports a full load of 20–25 T; the load on its downhill return trip is reduced to 12–15 T. One charging point is located at Dighode in Raigarh district, Maharashtra, which is near a BLR Logistiks warehouse around 8–10 km away from the Mumbai loading point. The fully loaded truck is charged here. Another charging point is set up at the warehouse at Chakan, near Pune, to charge the truck before its return trip.

Soon after the pilot started in October 2024, BLR recognised the requirement to charge the e-truck en route, as it faced difficulties completing the trip. It is working with an OEM on paid basis to set up an exclusive charging station at Khalapur, which falls about midway along the route, 60–70 km from Mumbai. BLR is working with the OEM to set up a few more charging stations at this location.

In the event of a breakdown, the OEM is prepared to provide maintenance services at the loading/unloading stops or charging stations. The operational details are collected through the engine telematics within the vehicle. So far, there have not been any vehicle breakdowns.

The e-trucks in this pilot now undertake five to six trips per week; a round trip takes close to 15–16 hours per day. BLR's ICE trucks on this route undertake 8–10 trips per week, with a round trip taking 8–10 hours. However, due to assured loads, demand from the client, and a commitment to reducing emissions, BLR is working on running its e-truck operations.

Figure 17 Stakeholder mapping of BLR Logistiks operations



Source: Authors' compilation (Climate Group)

Company initiatives

Apart from the electrification of trucks, the company is exploring several other initiatives to make their operations cleaner and more sustainable. Client demand further drives this transition. In this section, we highlight BLR Logistiks's efforts to scale e-truck solutions within the logistics sector.

- **Health, safety, security, environment (HSSE) initiatives**

BLR's day-to-day operations include a dedicated wing of driver-centric HSSE initiatives to facilitate the e-transition. It conducts regular driver training across its warehouse for various aspects, such as technical operations, data reporting, and health updates. It also mandates halts of around 30–45 minutes after every 3–4 hours of driving.

- **Operational data to improve efficiency**

BLR collects data from its moving fleets on kilometre covered, damages for maintenance, truck usage, and driver behaviour through electronic control units. This existing monitoring and data management system helps in the planning phase of the pilot, gauging how better driving management can increase the efficiency of the e-trucks. In the past, this system has supported testing and learning by highlighting necessary course correction or interventions, such as adding en route chargers to increase operational efficiency.

- **Managing load to achieve viability**

As a general practice and policy within BLR Logistics, the company operates only on full-tonne-load (FTL) and does not share partial loads with other companies or use cases on the same route. However, to drive their sustainability initiative while ensuring that their e-truck operations are commercially viable, the company coordinated with IKEA's sustainability and logistics teams. They have since assigned a variable but confirmed load. Thus, the LSP and the shipper worked collaboratively to create demand for e-trucks within IKEA's operations.

Challenges

BLR faced a few challenges in its early deployment of e-trucks through the initial trial and the longer- term pilot. They have identified some measures to tackle these challenges.

- **Longer trips**

Feedback from the e-truck drivers suggests that the trucks need to stop for charging for around four hours over the set travel time. This adds to the time drivers spend on the road and implies that e-truck trips are longer than those involving ICE trucks. The company is therefore also considering two drivers for each e-truck on the Mumbai–Pune route. This would require a fast-charging set-up that can allow a single full charge time of 1–1.5 hours.

- **e-truck efficiency**

We observed – in the same truck – a difference in efficiency from the initial trial, where the truck ran close to 120 km on a single charge. When fully loaded with 20–25 T, the charging loss was close to 80 per cent in an average running of 70-80 km by the truck. There was also a lack of confidence among drivers about the truck reaching the destination on time, especially with traffic. Therefore, for pilot run, the truck is running an average distance of 60–70 km after charge. The en route charging point is about midway along the route, 60–70 km from Mumbai. Even on a plain road, the charge reduces to 80 per cent within less than 100 km, while there is complete charging loss in a 120 km run. In an uphill scenario with traffic, such as that of BLR's pilot route, the e-truck performs with decreased efficiency. This is a concern that requires adequate charging infrastructure planning to meet the LSP's operational needs.

- **Managing high capital expenditure cost, including charging infrastructure**

The high capital cost poses a challenge. For the pilots, the company installed charging infrastructure and incurred costs on commissioning transformers modified to the desired voltage in coordination with the state. BLR suggests that the government needs to install more charging points to increase opportunity charging.

The way forward

BLR is looking to scale their transition to e-trucks. After setting up and optimising the trip and charging infrastructure on the Mumbai–Pune route, it plans to run four or five trucks on this route in the following months in conjunction with IPLTech. It has identified a few other routes for pilots, including Pune–Hyderabad and Vapi–Mumbai.

3.2 Perspectives of e-MHDT drivers

Across the e-MHDT initiatives documented, companies highlighted the critical role of drivers in the e-MHDT transition. To understand their experiences with e-MHDTs, we conducted in-depth interviews with around 12 e-MHDT drivers. We identified advantages beyond the techno-economic benefits of e-MHDTs.

Technological advancements in e-trucks improve driver safety by issuing real-time alarms if they fall asleep while driving

Ease of use

The drivers reported several aspects where the e-trucks perform better than their ICE counterparts. The absence of a clutch in an e-truck eliminates the need to constantly engage one leg, significantly reducing the pain and discomfort that they otherwise experience. When driving on hilly terrain or a slope, the drivers stated that with diesel trucks, they had to press the brakes continuously. However, e-trucks are equipped with a hill hold mode, which makes driving easier. They added that e-trucks move more smoothly and feel more stable in hilly areas than diesel trucks.

E-trucks do not heat up like diesel trucks. Earlier, they would have to stop for about an hour to cool down their diesel trucks since the engine would heat up. Now, they only stop once a day to charge their e-trucks and enjoy the break this gives them.

Health benefits

Drivers reported experiencing numerous health benefits since transitioning to e-trucks. Recounting their experience with diesel trucks, one driver stated that previously, when he drove along the Mumbai–Bengaluru corridor, the cabin filled with fumes, which irritated his eyes. Now, after driving a re-powered e-truck for five to six months, he is no longer troubled by the in-cabin pollution. Another driver added that the lack of engine heating in the e-truck is a source of relief while driving. Additional health benefits experienced by drivers include a reduction in fatigue and exhaustion. One driver noted that since switching to e-trucks, drivers feel fresher and can make time for themselves – for example to exercise – and spend more time with their children.

Safety

Another key benefit of e-trucks is safety, as drivers can take adequate breaks between long journeys. For instance, with ICE trucks, they would drive continuously for long durations, increasing their chances of feeling sleepy and having accidents. However, with e-trucks, the time required to charge the vehicles can be used by drivers to rest, making them more attentive on the roads subsequently. When planning charging infrastructure along routes, fleet operators ensure their proximity to restaurants and utility areas, allowing drivers to coordinate meal breaks with truck charging schedules.

Drivers also feel safer driving e-trucks because they are more likely to drive slower, at 60–70 km/h, to maintain the vehicle's charge for longer durations. This speed limit prevents the risk of accidents. The technological advancements in e-trucks also enhance driver safety, for example, by giving them real-time alarms if they sleep while driving.

4. Challenges, opportunities, and policy recommendations

Image: Pluc.TV

The early initiatives for e-MHDT adoption highlight strategic choices, innovative approaches, and benefits while revealing the various challenges encountered and lessons learnt in this process. Furthermore, continuous, targeted support by various stakeholders is vital for impactful scaling. In this chapter, we highlight the challenges to the e-transition, collated from the case studies, and elaborate on key recommendations to strengthen the ecosystem and fast-track e-MHDT adoption.

4.1 Challenges to the e-truck transition in India

The early deployment of e-trucks by various companies across different use cases and geographies has provided valuable insights. These experiences offer a crucial understanding of challenges and provide insights and guidance for future transitions.

Financial challenges

- **High upfront cost of e-trucks**

A principal challenge in electrification efforts is the high upfront cost of e-trucks, which is around two or three times the cost of ICE trucks. Decreased payload capacity from battery dead weight also leads to reduced revenue. For all segments of MHDTs, the companies owning the assets have been able to innovate financing models in partnership with banks or NBFCs to support the purchase of EVs. However, for e-trucks at this nascent stage, there is still no profitable, feasible business model in which financiers express confidence.

In order to mitigate nascent market risks, the financing ecosystem works on higher premiums and interest rates than for ICE trucks. Thus, fleet operators seek long-term contracts from shippers to lower interest rates and bring down loan payments. As shippers tend not to make long-term commitments, considering the limited life-cycle performance of new technology, investment in high-capital assets is a concern for fleet operators. Also, in the absence of transition mandates and the clients' lack of experience in the e-transition ecosystem, it is difficult to find financiers who can provide capital for financing e-trucks and the associated infrastructure.

Fleet operators seek long-term contracts from shippers to lower interest rates and bring down loan payments

- **Inadequate operational data and a lack of insurance options for e-MHDTs**

Early e-truck adopters face limited insurance options, while diesel trucks have a slew of options. Insurers consider electric variants of battery-operated trucks to be in the early stages of their development.

There is very limited operational data to accurately assess the average performance and risks associated with e-trucks. From an insurer's perspective, e-trucks are more expensive than diesel or CNG trucks, leading to higher insured declared values (IDVs). Insurance premiums are also higher because of higher electronics costs, non-standard battery designs, scanty battery performance data, and a notion of limited repairs and more replacements of components. For the owner, higher depreciation rates can reduce the IDV value – which is not favourable to them.

By making available data on battery diagnostics and overall performance – including battery deterioration and vehicle safety – leading OEMs, shippers, and LSPs can help stakeholders appreciate the financial and commercial risks of e-trucks. This will help financiers and insurers design specialised products that can financial safety.

Charging infrastructure–related challenges

- **Concerns surrounding access to charging infrastructure**

Drivers have restricted access to charging infrastructure at hotels and restaurants along highways. Several such infrastructure owners prioritise cars over trucks due to lack of space, which increases the waiting time for drivers. Additionally, while charging costs are significantly lower than the refuelling costs of ICE trucks, charging e-trucks is still expensive – which raises business costs. Dedicated depots and parking spaces on key freight corridors can reduce the waiting time for trucks and improve the overall operational efficiency.

Operational concerns

- **Restricted route flexibility**

E-truck charging requirement is estimated prior to the deployment of a pilot. Companies find that this can differ from the ground scenario and over time. After a certain period of running a pilot – particularly after a year – the performance of an e-truck's battery starts to decline. This needs companies to adjust the charging infrastructure for the pilot and increases their costs.

To ensure that operations are cost-effective, the deployment of e-trucks requires planning of routes and charging infrastructure. While planning new routes, OEMs must be informed at the planning stage, to check if they are prepared to provide any necessary after-sales support. As route planning depends on various external factors and route flexibility is limited, e-trucks cannot be deployed quickly or arbitrarily for new operations. Instead, fleet operators must choose the appropriate vehicle type for the specific use case to initiate operations.

- **Inefficient asset utilisation**

Asset utilisation poses a significant challenge for fleet operators and CPOs. Factors such as restricted route flexibility, limited range, prolonged charging times, and the absence of return loads on specific routes elevate the financial risks for fleet operators, further compounding the high capital cost burden of e-trucks. Moreover, with the low adoption rate of e-trucks, the existing charging infrastructure remains underutilised, which is a concern for CPOs. Until charging infrastructure is scaled up on significant freight routes and the demand for e-truck delivery increases, optimal asset utilisation will remain a persistent challenge for the industry.

Human resource concerns

- **Driver retention issues**

The trucking industry experiences high attrition because of low pay scales, adverse weather conditions, and lack of benefits at work. LSPs or companies that directly recruit drivers for pilots struggle to find replacements for e-truck drivers and must also ensure that newly onboarded drivers receive proper training to operate e-trucks. However, with a shortage of drivers in the logistics sector, it is difficult to find licensed HDT drivers who know how to operate e-trucks efficiently. As a result, companies have to arrange for training outside of the regularly planned sessions with the OEMs.

The MHDT sector supports a wide range of direct, indirect, and induced jobs, some of which will require upskilling, along with emerging new sectors, to meet the required technical skills. With already limited human resources in the sector, the e-transition will need to address skill gaps and make necessary arrangements to ensure a people-centric transition.

Behavioural biases

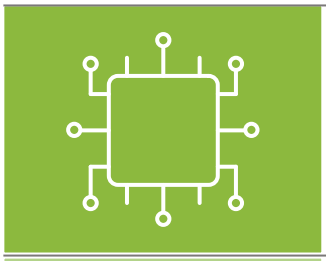
- **Driver hesitancy**

Drivers are more comfortable driving ICE trucks, as they are familiar with their vehicle design. They hesitate to transition to e-trucks since the technology is new and the drivers are required to change their driving habits. As they are unfamiliar with the vehicle, they experience doubts about its safety, convenience, and performance. Drivers often have to rely on external repair technicians for minor issues that they might have been able to handle themselves in a diesel truck. Since an e-truck's cabin seems lighter than that of an ICE truck, drivers fear that it will not safeguard them in case of an accident although this is not the case. Such erroneous perceptions and biases among truck drivers prevent them from supporting the deployment of e-trucks.

4.2 Key recommendations

A comprehensive review of the early transition case studies and the challenges they encountered indicates that the industry should foster a collaborative ecosystem among key industry stakeholders. Governments, OEMs, LSPs, charging operators, businesses, and financiers have the potential to build momentum for an inclusive transition in the sector. They can do this through risk sharing, knowledge exchange, and learning from early transitions among other measures.

Opportunities associated with EV transition

	**Drive innovation in technology** Research and development are paramount for advancing battery design, enhancing vehicle efficiency, reducing upfront costs, and adapting vehicles for diverse use cases. The industry should focus on innovative and contextual solutions tailored to the Indian MHDT market to reduce vehicle costs and make e-MHDTs a viable alternative to their ICE counterparts.
	**Develop robust infrastructure** Rapid infrastructure development is vital for adoption. Key freight corridors must fast-track strategically planned charging infrastructure. Existing infrastructure at logistics parks, industrial units, and ports should be upgraded for the EV transition.
	**Attract investments** Innovative financial mechanisms – such as blended financing – should be developed to accelerate e-truck adoption and ensure financial investments towards the e-transition. De-risking the sector through battery standards, life cycle management, residual value, first-loss default guarantees, and so on – while providing technical validation and ratings of e-trucks – can boost investor confidence and facilitate robust banking and insurance frameworks.
	**Ensure inclusive transition** The transition should address existing and potential challenges associated with the industry's workforce to ensure an inclusive transition. The e-transition can thus ensure quality working conditions for a more sustainable and equitable workforce within the sector. Regular training and upskilling of the workforce – including the drivers – and providing job benefits while building quality infrastructure are crucial to creating attractive employment opportunities.

Recommendations for different stakeholders to drive the transition

- **Fleet operators are uniquely positioned to foster partnerships within the ecosystem.** They can seize the opportunity of fleet electrification by providing integrated services using data-driven approaches to optimise networks and ensure more efficient fleet operations.
  - **Undertake targeted pilots to showcase feasibility**

    Fleet operators can deploy MHDTs for first- and last-mile logistics where movements are captive. They can also undertake targeted pilots with the help of incubators and philanthropies to showcase the feasibility of e-MHDTs before moving to large-scale operations. Identifying the vehicle that suits the particular use case is the key to optimising operations and building a strong case for transitioning to e-MHDTs.
  - **Develop data-based insights for the industry**

    With collaborative engagements, fleet operators can provide experiential insights and data – such as use cases, operational details, charging patterns, and driver behavioural insights – from initial pilots for vehicle R&D to improve vehicle design and align with operational needs.

- **Ensure a just transition for drivers**

  Fleet operators can play a crucial role in formalising the employment conditions for drivers. They can leverage the e-MHDT transition to formalise the sector and provide additional job benefits – such as health insurance or provident funds – along with necessary infrastructure at charging stops, including washrooms, rest areas, and eating joints. OEMs can play a key role in ensuring a just transition by training drivers in efficient driving techniques, charging procedures, safety protocols, and troubleshooting dashboard issues that may arise during e-truck operations.

  The operators need support and collaboration from other key players to share the risks associated with early transitions, get assured business, and develop cost parity with their diesel counterparts. They believe that different stakeholders can play key roles in the ecosystem:

- **Government to establish supply and demand-side mandates and invest in infrastructure development**
  - **Provide financial incentives**: To subsidise the investment cost, MoRTH should establish toll waivers and tax exemptions and remove registration and permit fees for the early stages of the e-transitions. Additionally, the Ministry can also consider introducing green pass schemes to tackle the high costs incurred by operators in their initial years. To build sector-wide confidence, blended financing models initiated by the government can help attract the investments required to accelerate the MHDTs' market growth and help early adopters demonstrate tangible benefits.
  - **Non-fiscal incentives to increase financial viability**: MoRTH can provide some non-fiscal incentives by increasing the GVW of e-trucks. This can be explored through initial pilots, which can allow operators to transport a higher capacity of cargo. Another measure that can make e-trucks more competitive is extending the vehicle's life from 15 to 20 years. This will allow e-MHDTs that are deemed fit through relevant certifications to be operated for a longer duration.
  - **Shared infrastructure on key corridors**: The government, along with other stakeholders, can focus on key freight corridors for infrastructure deployment. Identifying hotspots, such as logistics parks, SEZs, or industrial units, or developing e-depots along these corridors for charging infrastructure can provide economies of scale and ensure optimal asset utilisation. Businesses can also benefit from shared infrastructure, reducing the risks associated with infrastructure and operational efficiency.
  - **Develop partnerships**: Public–private partnerships can be formed to plan and provide the necessary financing and infrastructure, similar to fuel station set-up models. The government can focus on land provision at desired locations, such as toll plazas, and on incentivising associated infrastructure.
  - **Guidelines and standardisation for power infrastructure**: The Ministry of Power (MoP) should initiate the development of state-wide guidelines for standardised application procedures, upgrading, and setting up the infrastructure. Policies can focus on facilitating infrastructure upgradation, incentivising tariff rates, and integrating renewable energy sources to ensure improved power supply.

The operators need support and collaboration from other key players to share the risks associated with early transitions and get assured business

  - **Identify and develop a comprehensive skill matrix to upskill and train the workforce:** To address the workforce requirements for the e-transition, a skill matrix can help in the design of focused, government-led skill development programmes. The Ministry of Skill Development and Entrepreneurship should collaborate with sector-training councils – such as the Automotive Skill Development Council and the Skill Council for Green Jobs – to develop new programmes and integrate them with existing training programmes to fill the skill gap effectively. Additionally, dedicated funds need to be allocated to support a just transition and fulfil the evolving skill requirements of the sector.

- **OEMs to build confidence in the technology**
  - **De-risking the vehicle:** OEMs need to de-risk vehicle technology through more robust warranty clauses, reliable back-end solutions, and comprehensive after-sales support, which will incentivise early adopters. Investment in battery improvement technology to enhance unit economics and develop cost-effective vehicles at par with ICE vehicles will play a crucial role in adoption.

- **Financial institutions to design innovative financial models**
  - **Blended financing for e-trucks**: Financial institutions need to develop innovative blended financial solutions – including concessional debts, green bonds, viability gaps funding, and so on – through partnerships with the government, multilateral development banks, and development finance institutions. Tailored risk sharing and credit guarantee mechanisms are crucial for investors to absorb initial losses and encourage adoption among fleet operators. Technical validation and ratings can be included in the credit assessment processes to build confidence among financiers.

- **Civil Society Organisations (CSOs)/Academia to validate the technology through data and awareness raising among the community**
  - **Research and development**: E-truck technology is still in its nascent stage in India and requires more R&D for technological advancements and operational improvements. Researchers can use data-driven insights from early pilots to provide research-backed validations, foster innovation in the ecosystem, and create a positive narrative around technology acceptance.
  - **Awareness**: Awareness is necessary among the community – especially drivers – to help all players understand the technology and its benefits. With drivers and private operators as the target audience, these informational campaigns can focus on socio-economic and health benefits and address concerns about EV technology and driver experiences.

5. Conclusion

Image: Pluc.TV

Sohail, a BillionE driver, at ChargeZone facility in Krishnagiri, Tamil Nadu demonstrating the features of an e-truck.

In this brief, we document the early efforts by various private-sector trucking companies to deploy e-MHDTs across use cases. We shed light on the occupation scenario with increased e-MHDT deployment to understand the future benefits of such a transition. We also highlight the strategies adopted by various companies to transition to e-MHDTs and showcase the performance and effectiveness of these vehicles across use cases. This documentation provides key considerations for companies who wish to transition to e-MHDTs.

Transitioning the trucking sector presents an opportunity to achieve many environmental and developmental benefits ranging across emissions reduction, employment generation, livelihood improvement, and workforce formalisation through skilling programmes. However, arriving at these benefits requires consistent and collaborative efforts from all key ecosystem stakeholders.

Through R&D investments, industry partners can advance technology innovation to ensure that e-MHDTs cater to the growing demand for MHDT services. They can also collaborate with think tanks and CSOs to operate pilots and assess the suitability of e-MHDTs in different applications. Think tanks and CSOs can also facilitate campaigns to correct misconceptions and disseminate accurate information about the performance and utility of e-MHDTs, subsequently driving key policies. Through supportive policies and public–private partnerships, governments need to create adequate charging infrastructure to enable wider deployment of e-MHDTs. There is a need for concerted efforts by industry stakeholders, innovative business models and partnerships, and government incentives to boost investor confidence and facilitate robust banking and insurance frameworks to access the necessary financing to scale e-MHDT adoption. Lastly, as e-MHDT penetration increases, checks and balances must be in place to ensure that vulnerable stakeholders, such as informal workers, are not negatively impacted. Such measures can ensure that they can partake in the benefits of this transition by building their capacity through reskilling and upskilling programmes.

The partnerships-driven approach and unique strategies adopted by different companies to pilot e-MHDTs across various use cases provide a template for future companies that wish to undertake similar initiatives and trial e-MHDTs for their logistics needs. Furthermore, by addressing the challenges identified through the proposed strategies, key stakeholders can strengthen the ecosystem for a large-scale and inclusive e-MHDT transition.

Acronyms

BET	battery electric truck
CAGR	compounded annual growth rate
CFS	container freight station
CPO	charge point operator
CSO	civil society organisation
EV	electric vehicle
e-MHDT	electric medium- and heavy-duty truck
e-transition	electric transition
e-truck	electric truck
FMCG	fast-moving consumer goods
4Ws	four-wheelers
GDP	gross domestic product
GVW	gross vehicle weight
HDT	heavy-duty truck
ICE	internal combustion engine
IDT	intermediate-duty truck
IDV	insured declared value
ITV	internal transfer vehicles
KPTL	Kalyani Powertrain Limited
LCV	light commercial vehicles
LDT	light-duty truck
LSP	logistics service providers
MFO	medium fleet operator
MDT	medium-duty truck
MHDT	medium- and heavy-duty truck
MoP	Ministry of Power
MoRTH	Ministry of Road Transport and Highways
NDC	nationally determined contribution
NHEV	*National Highways for Electric Vehicles*
OEM	original equipment manufacturer
SFO	small fleet operator
SEZ	special economic zone
3Ws	three-wheelers
TFFM	Transportation Fuel Forecasting Model
TT	tractor-trailer
2Ws	two-wheelers
ZET	zero-emission truck

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