WRI INDIA

CONFERENCE PROCEEDINGS

Accelerating Freight Electrification in India

A SUMMARY OF INDUSTRY INSIGHTS

December 13, 2022, February 16, May 3, and July 20, 2023 | New Delhi and Goa, India | Chandana K, Pravin Cherukuthota, Anshika Singh, Sharvari Patki, and Pawan Mulukutla

BACKGROUND

The global transportation sector is responsible for 25 percent of the world's energy consumption and 28 percent of greenhouse gas emissions, which are a major driver of climate change. In addition to greenhouse gases, the transport industry releases harmful substances like nitrogen oxides (NOx) into the air, leading to local air pollution. Freight vehicles, despite being less than 3 percent of the vehicular population, account for 64 percent of the nation's diesel consumption and contribute to 34 percent of road transport emissions. Transitioning to zero-emission trucking is crucial for addressing climate concerns and ensuring energy security.

As a recognition of these concerns, on September 7, 2022, **Electric Freight Accelerator for Sustainable Transport (e-FAST India)** – the first national electric freight platform – was launched, led by NITI Aayog and supported by WRI India. This platform aims to leverage co-creation opportunities that foster a conducive environment to accelerate road freight electrification. **Niti Samvaad,** a part of this initiative, is a deep-dive dialogue series with targeted stakeholder discussions curated to understand specific concerns regarding the decarbonization of the road freight sector.

The multi-faceted discussions explored aspects pertaining to the adoption of zero-emission trucks (ZETs), including operational challenges, technological feasibility, financial models, associated risks, business feasibility and viability, operationalization of pilot projects, and industry's concerns for the e-freight ecosystem. A series of these focused group discussions, in addition to bilateral stakeholder consultations, helped identify mechanisms to unlock the demand-supply deadlock by the demand signal of 7,750 e-trucks by 16 companies showcased at the **14th Clean Energy Ministerial on e-FAST**

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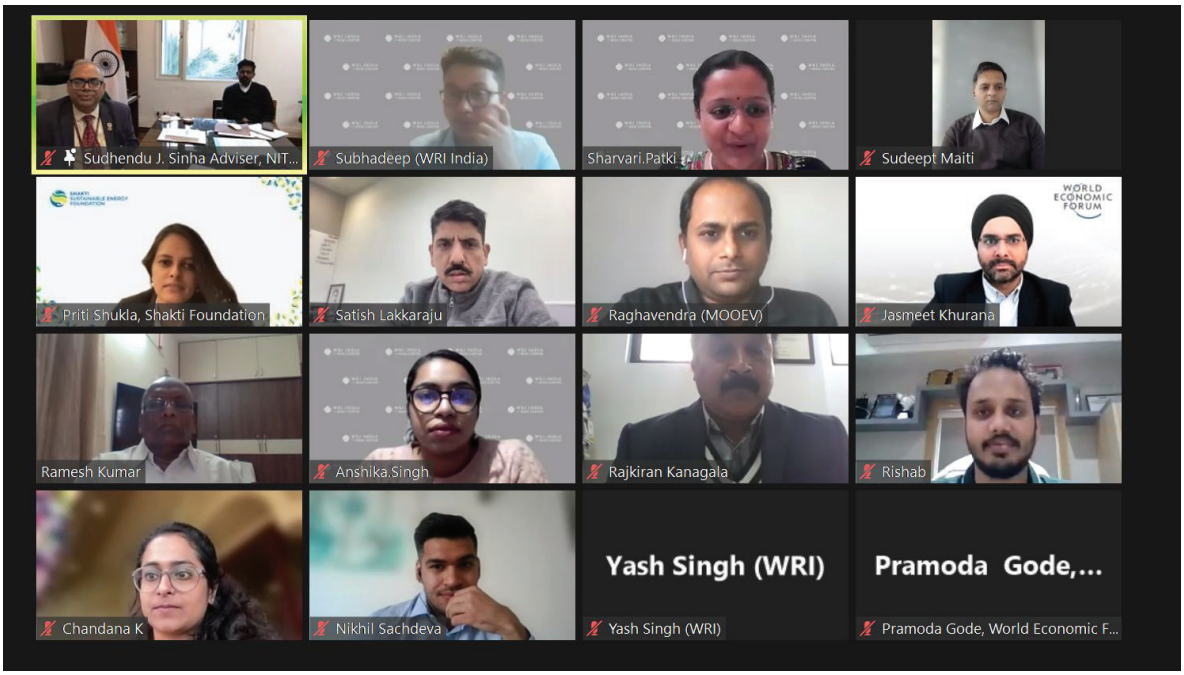
The content of these conference proceedings reflects the views of the conference participants and does not necessarily reflect the views of WRI India or other conference partners. These proceedings aim to faithfully reflect the conversations and content generated at the conference but for ease of readability some wording has been edited.

India: Driving Zero Freight Emissions held at Goa. The panel discussed learnings and challenges from global experiences, including California (USA) and the Netherlands. It drew parallels on vital levers that can chart the course for ZET adoption in India.

The conference proceeding encapsulates insights gleaned from the three Niti Samvaad events focusing on logistics service providers (LSPs), original equipment manufacturers (OEMs), and producer companies (cement, steel, fast-moving consumer goods or FMCGs, etc.), and the side event at the 14th Clean Energy Ministerial (CEM). These discussions provided leading industry stakeholders and experts a platform to share their experiences and insights on decarbonizing road-based freight transportation in India.

1. The first focus group discussion (FGD) was held on December 13, 2022 with LSPs, aimed at understanding barriers within the freight electrification ecosystem, exploring potential solutions, stakeholders' roles, and future adoption pathways for India. Technological obsolescence due to the rapidly evolving EV landscape and lack of clarity on alternative fuels was a major risk flagged by the LSPs as the ZETs require significant capital costs for vehicle procurement and refueling stations. The subsequent FGD was conducted with OEMs to understand zero-emission fuel explorations in their manufacturing, for ease of product identification.

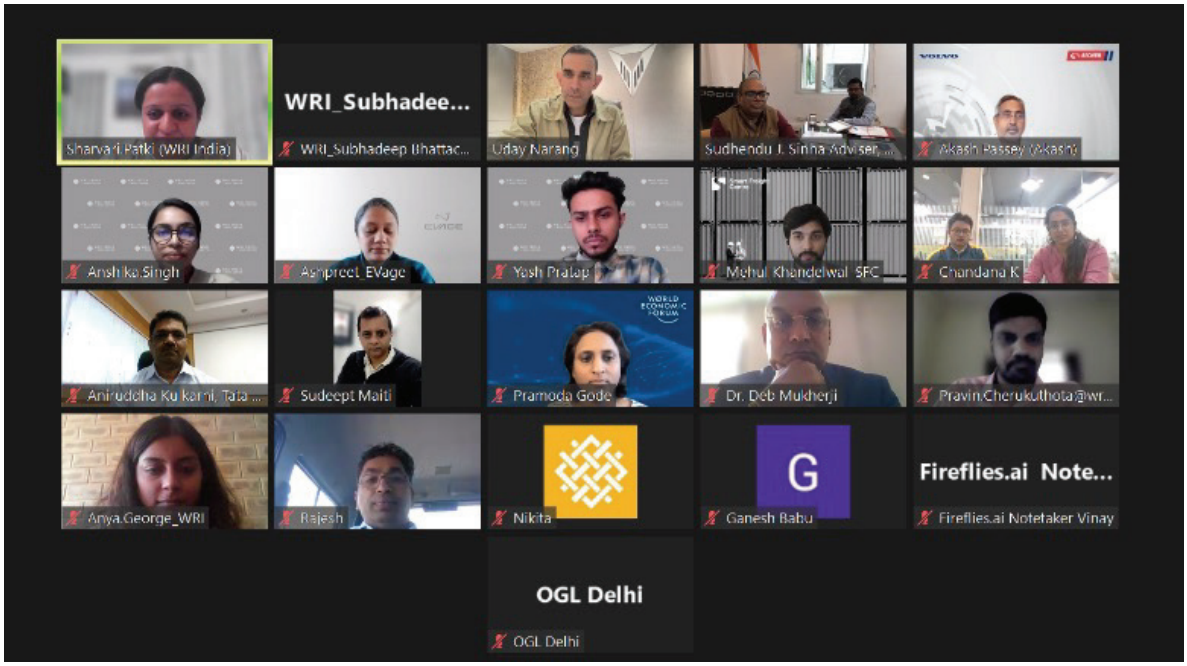
FIGURE 1 | Exploring barriers to adoption of zero-emission trucks at NITI Samvaad for logistics service providers (LSPs)



Source: WRI India

2. The second FGD on February 16, 2023 focused on OEMs' role in increasing the adoption of e-freight vehicles and the support required to boost confidence for a pilot project.

FIGURE 2 | Understanding challenges in manufacturing zero-emission trucks, at NITI Samvaad for original equipment manufacturers (OEMs)



Source: WRI India

3. With industry outreach in the advanced stages followed by discussions on pilot projects, the Leaders' Dialogue – Shipper Roundtable' on May 3, 2023 explored the role of producer companies to increase uptake of ZETs in India through successful implementation of scalable pilot projects, identification of innovative business models, and financing mechanisms to drive this transition and build an understanding of the operational use cases.

FIGURE 3 | Convening of industry stakeholders to accelerate fleet electrification at the Leaders' Dialogue – Shippers Roundtable in New Delhi

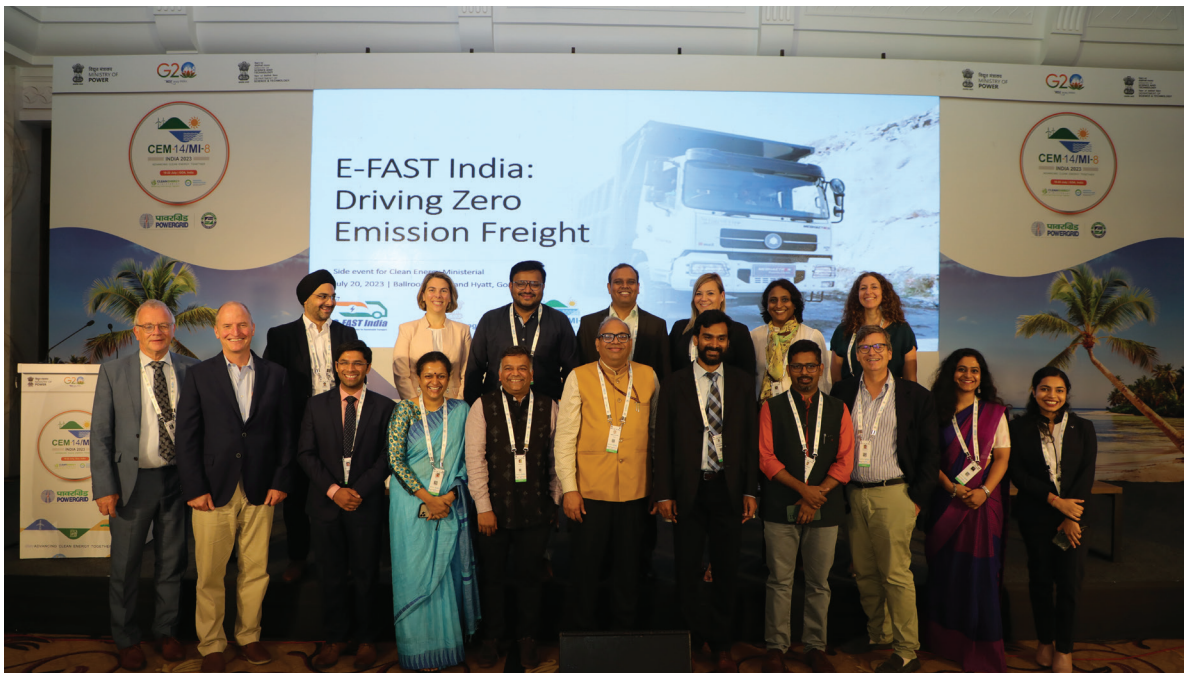
Source: WRI India

FIGURE 4 | Concluding of the Leaders' Dialogue – Shippers Roundtable in New Delhi

Source: WRI India

4. The side event at the 14th Clean Energy Ministerial on e-FAST India: Driving Zero Freight Emissions held at Goa on July 20, 2023 included three panel discussions to bring out specific suggestions on the policy, regulatory, and financial frameworks, and ways to foster collaborations for mitigating barriers on the adoption of ZETs. The session also showcased e-FAST video and launched the e-FAST website for mass awareness about the platform and the criticality of freight decarbonization.

FIGURE 5 | Organizing team at e-FAST India side event at 14th Clean Energy Ministerial in Goa



Source: CEM team

FIGURE 6 | Identifying a policy roadmap for zero-emission truck adoption in India at the e-FAST India side event at 14th Clean Energy Ministerial in Goa

Source: CEM team

Some key highlights and takeaways of the discussions :

- A clear **policy roadmap** is vital in identifying strategic levers and in achieving sustained and systematic growth of ZETs in India. Adopting an outside-in approach can shape robust and effective policies, drawing insights from global examples while tailoring solutions to cater to India's specific needs.
- **Pilot projects** serve as testing grounds, allowing stakeholders to innovate in technological, strategic, and financial models across geographies, segments, and sectors to assess the on-ground issues in ZET adoption. Implementation of scalable pilots across geographies, particularly in controlled environments and along high-intensity freight movement corridors, can bolster the confidence of truck operators to uptake ZETs and help in establishment of cleaner freight corridors. Various approaches to pilots can reap unique benefits.
- Policy levers can include **demand and supply incentives** for the manufacturing, purchasing, and research and development (R&D) of ZETs and for creating a resale market for ZETs to instill confidence among stakeholders. Performance-based incentives can help introduce e-trucks with international standards, strengthening future export potential.
- Additionally, once the incentives have been effectively applied, resulting in substantial enhancement in viability of e-trucks, a **combination of incentives and mandates** can become a potent force driving the expansion of ZETs within the sector. This approach can also assist in aligning the industry's future endeavors with India's domestic imperatives of achieving climate goals, strengthening energy security, and fostering a long-term vision for the sector.
- Finding suitable **financing mechanisms** is critical to moving the pilot to an advanced stage. Including trucks in central and state electrification incentives, priority sector lending, and interest rate subvention can help increase affordability among fleet owners.
- There is a need for **risk-sharing models** for the early adoption of ZETs, which needs to be supported by techno-commercial business case analysis. These can help in co-creating scalable opportunities across the value chain.

- **Charging infrastructure saturation** along green corridors/highways is identified as a critical lever to reduce range anxiety and enhance the preference for BETs. Leveraging the proposed wayside amenity land helps build a robust network of chargers, creating a conducive environment for ZET adoption. Installing fast chargers and alternative charging models such as battery as a service **(BaaS)** can also help reduce range anxiety.
- There is a need for **clarity on alternative fuel technologies** detailing a clear trajectory for adopting clean energy sources, such as hydrogen fuel cells and advanced battery technology, to ensure reduced emissions, higher energy efficiency, and a sustainable future for freight transportation.
- A greater emphasis on **localizing the supply chain** for manufacturing vehicles can help mitigate an OEM's vulnerability to supply chain risks.
- There is potential for **standardization** across three domains: the truck itself, the battery technology, and the charging infrastructure. While standardization is essential to ensure interoperability, safety, and a streamlined manufacturing process, it is vital to strike a balance that allows for innovation, as ZET technology is still evolving.
- Increase **awareness and capacity** building regarding ZET. Skill development and training are to be introduced at all stages, from manufacturing and battery handling to driver training, for efficient human resource utilization.
- India would require **cross-sectoral collaborations** on different fronts to evolve **innovative business models** to ensure the nascent ZET industry blooms. Mobilizing practical and resilient new-age business solutions independent of subsidies, such as subscription models and flexible terms of ownership, can reduce the barriers to ZET operations sustainably.
- **Digitization in trucks** can offer streamlined fleet management, real-time data insights, and predictive maintenance, enhancing operational efficiency and reducing costs.

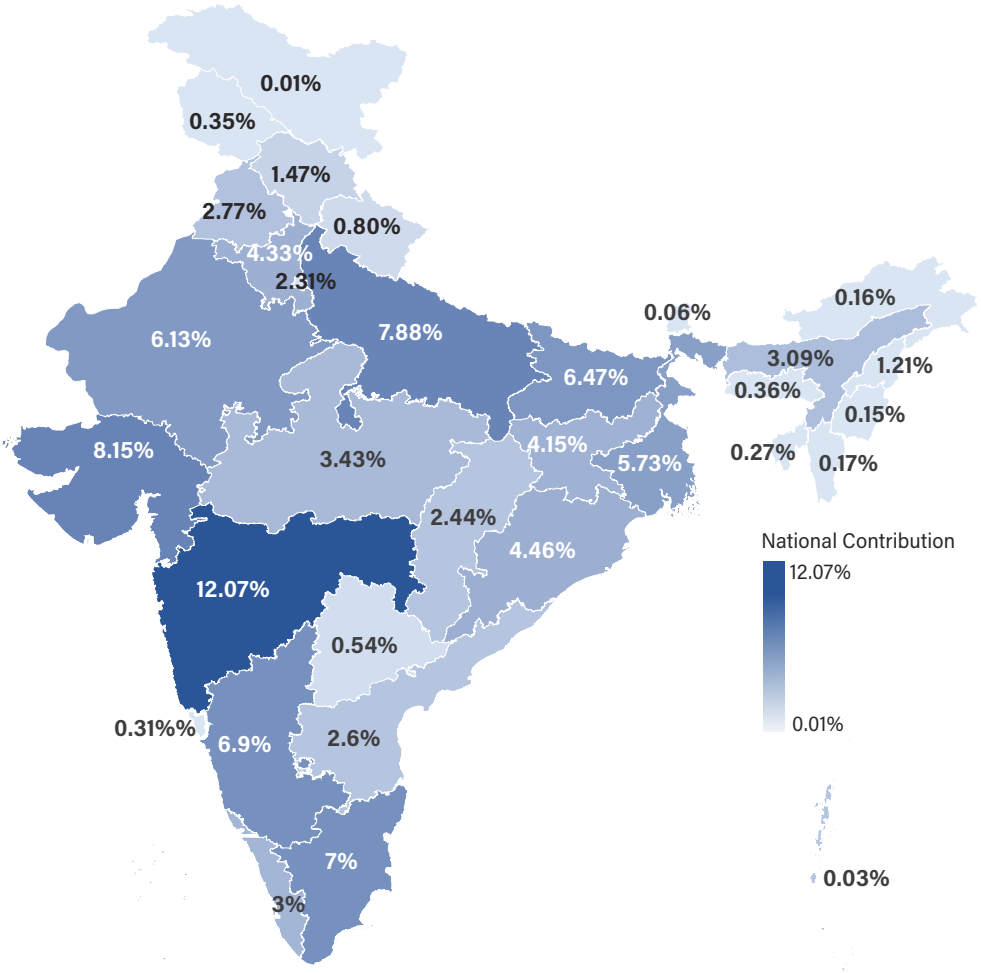
INTRODUCTION

The transport sector is completely dominated by fossil fuels (96% in 2021), mostly oil (93%). The 1.5°C compatible pathways requiring rapid electrification of the sector show the share of electricity in the total energy mix reaching 10–60 percent by 2030 and 44–89 percent by 2050 (Climate Action Tracker n.d.). About 71 percent of India's freight is carried by road transport (NITI Aayog and RMI 2021), with roughly one-third of the nation's diesel consumption being attributed to trucks (Economic Times 2017). India boasts to be the fourth largest trucking market globally, and it is projected to expand fourfold by 2050 (NITI Aayog and RMI 2022). This growth is reflected by a substantial increase in the registration of new vehicles, with a staggering 90 percent growth rate observed from 2007 to 2022, according to data from Vahan, the e-governance application portal related to vehicles, and the Road Transport Yearbooks of the Ministry of Road Transport and Highways (MoRTH).

Trucks are a crucial part of the value chain, playing a vital role in delivering raw materials, finished commodities, and recyclable materials. They also make a significant contribution to the country's economy. Notably, seven states in India witness more than 50 percent of all freight vehicle registrations. This concentration of registrations can be attributed to the clustering of logistics hubs and the presence of high-intensity road freight corridors, indicating the critical role of trucks in India's transport landscape.

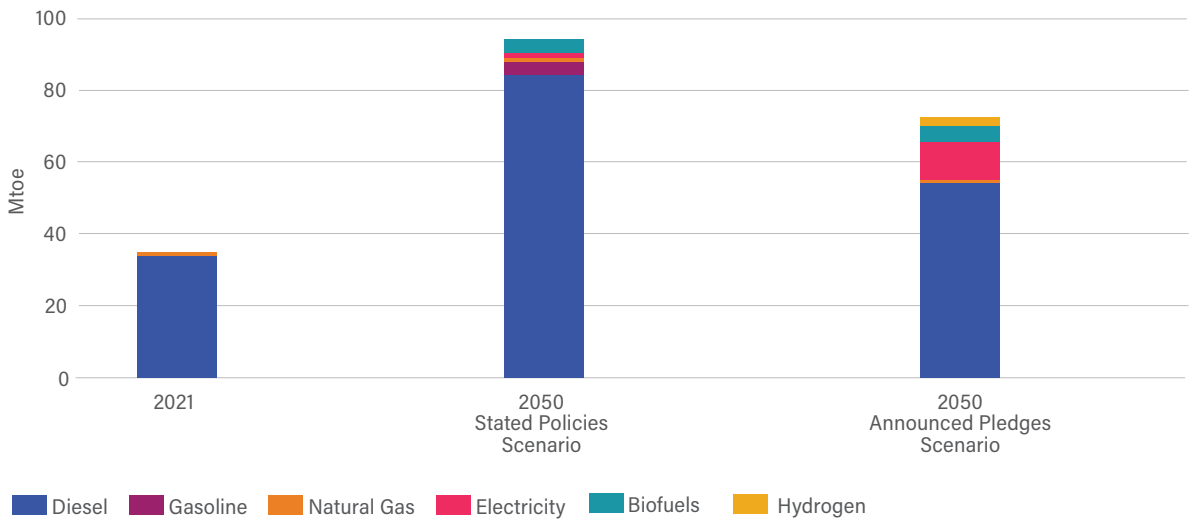
As road freight demand is estimated to be the second largest in the world in the coming decade (Raina 2023), it will be critical to ensure that new trucks contribute to a more sustainable transport system to align with the country's 2070 net zero goal. ZETs represent a cleaner and operationally cost-effective option for freight transport, and India can be a key player in the global transition to ZETs.

FIGURE 7 | Percentage of freight vehicles registered per state



Sources: Vaahan and MoRTH yearbooks | Visualization by WRI India

FIGURE 8 | Road transport fuel consumption of freight trucks in India in the stated policies scenario and the announced pledges scenario, 2021 and 2050



Source: Transitioning India's Road Transport Sector, IEA

Currently, the alternatives for automobiles encompass battery electric trucks (BETs), hydrogen internal combustion engine (H2ICE) vehicles, fuel cell electric vehicles (FCEVs), and other low-emission fuel technology vehicles. Given the operational feasibility, technology maturity, ease of handling, and most importantly – commercial viability, BETs have emerged to be a superior choice to other technologies. The projected Announced Pledges Scenario (APS) by International Energy Agency (IEA) indicates that additional efforts are needed to accelerate adoption of low/zero emission fuel trucks.

BETs, as of today, are more energy-efficient as they have fewer moving parts, leading to low maintenance costs; and they rely on simpler and more mature charging infrastructure than hydrogen fuel trucks. Although hydrogen-based trucks might be more suitable for long-haul operations, the applicability can be explored once the technology is ripe for the Indian trucking scenario.

E-FREIGHT LANDSCAPE IN INDIA

The Government of India (GOI) has set an ambitious electric vehicle (EV) sales target of 30 percent for private automobiles, 70 percent for commercial vehicles, and 80 percent for two-wheelers (2Ws) and three-wheelers (3Ws) by 2030 (PIB Delhi 2019). As one of the fastest-growing economies, India has an ambitious national agenda supported by the National Electric Mobility Mission Plan, reinforced by Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, and production-linked incentives (PLIs) for the automobile sector. These demand and supply side incentives, predominantly directed towards passenger vehicles, have spurred the introduction of a range of vehicles powered by electric technologies in the two-, three-, and four-wheeler segments and buses. The incentives have also given the start-up ecosystem a boost, leading to innovations in the automobile sector and the adoption of nearly 1.9 million EVs by the end of 2022. While EV adoption has increased for passenger mobility, the transition to EVs in medium- and heavy-duty trucking is yet to take off.

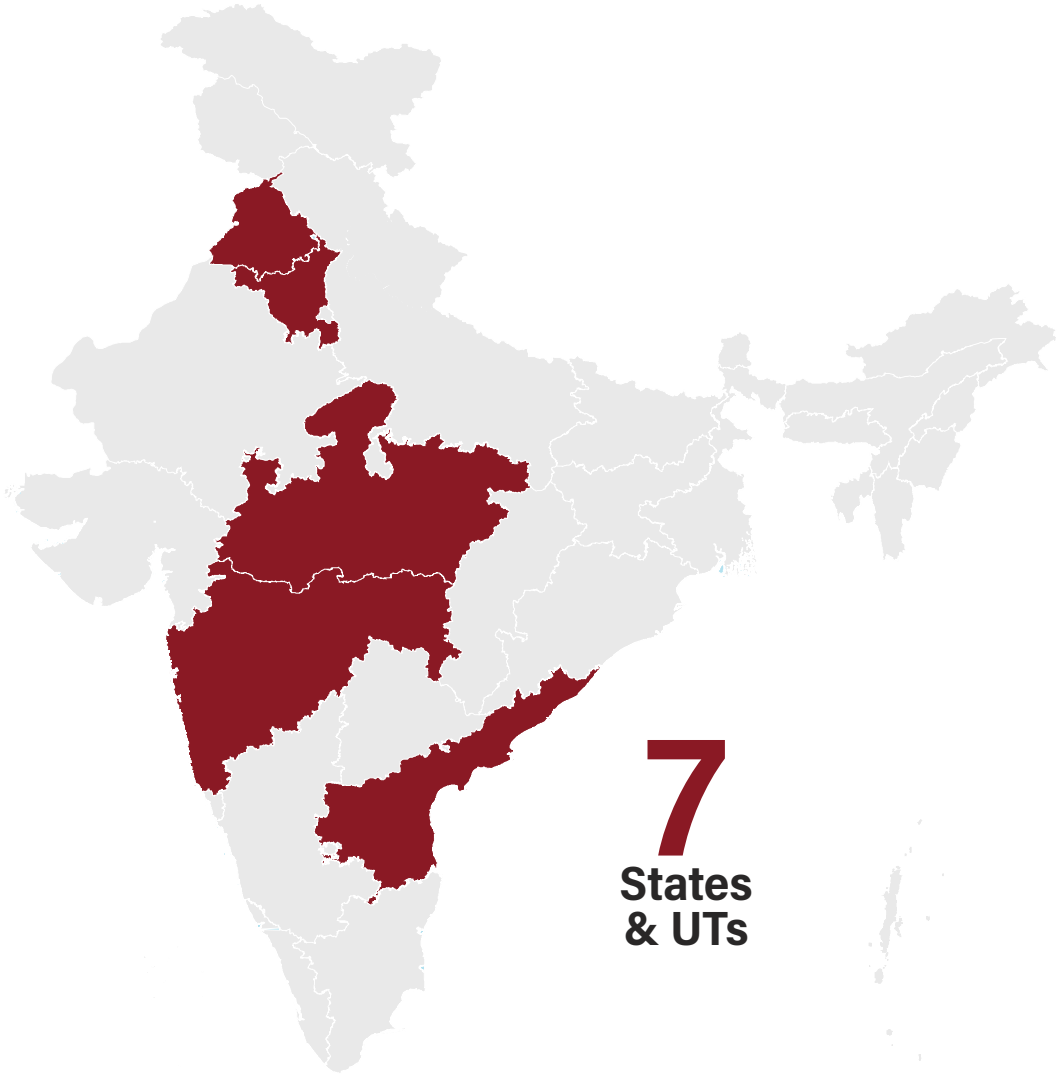
Point-of-sale incentives have helped reduce capex cost, bringing down the total cost of ownership (TCO). This has supported early adopters in the passenger vehicle segment. On the other hand, supply side policies such as PLI are attracting investments in EV technologies. Additional initiatives such as R&D efforts, capacity building, and tax exemptions have been provided to support early market development of electric passenger vehicles. Specifically for e-freight, road tax exemptions or registration fee waivers are the most prevalent subsidies offered by 17 states, according to state EV policies. Data indicate that 17 states demonstrate a strong commitment to establishing fast-charging infrastructure or battery-swapping stations along state and national highways. However, the transition to ZETs faces varying degrees of ambition across states:

- Andhra Pradesh, Uttar Pradesh, Assam, and Madhya Pradesh have committed to phasing out all fossil-fuel-based commercial fleets by 2030.
- Notably, Maharashtra, Punjab, Andhra Pradesh, Haryana, Madhya Pradesh, Andaman & Nicobar Islands, and Chandigarh have implemented policies specifically targeting the electrification of vehicles, such as garbage trucks, operated by a public authority.
- When it comes to subsidies for buying medium- and heavy-duty electric vehicles, Haryana is the only state that offers incentives for e-tractors.

FIGURE 9 | States offering fast charging or battery swapping at highways for electric freight vehicles

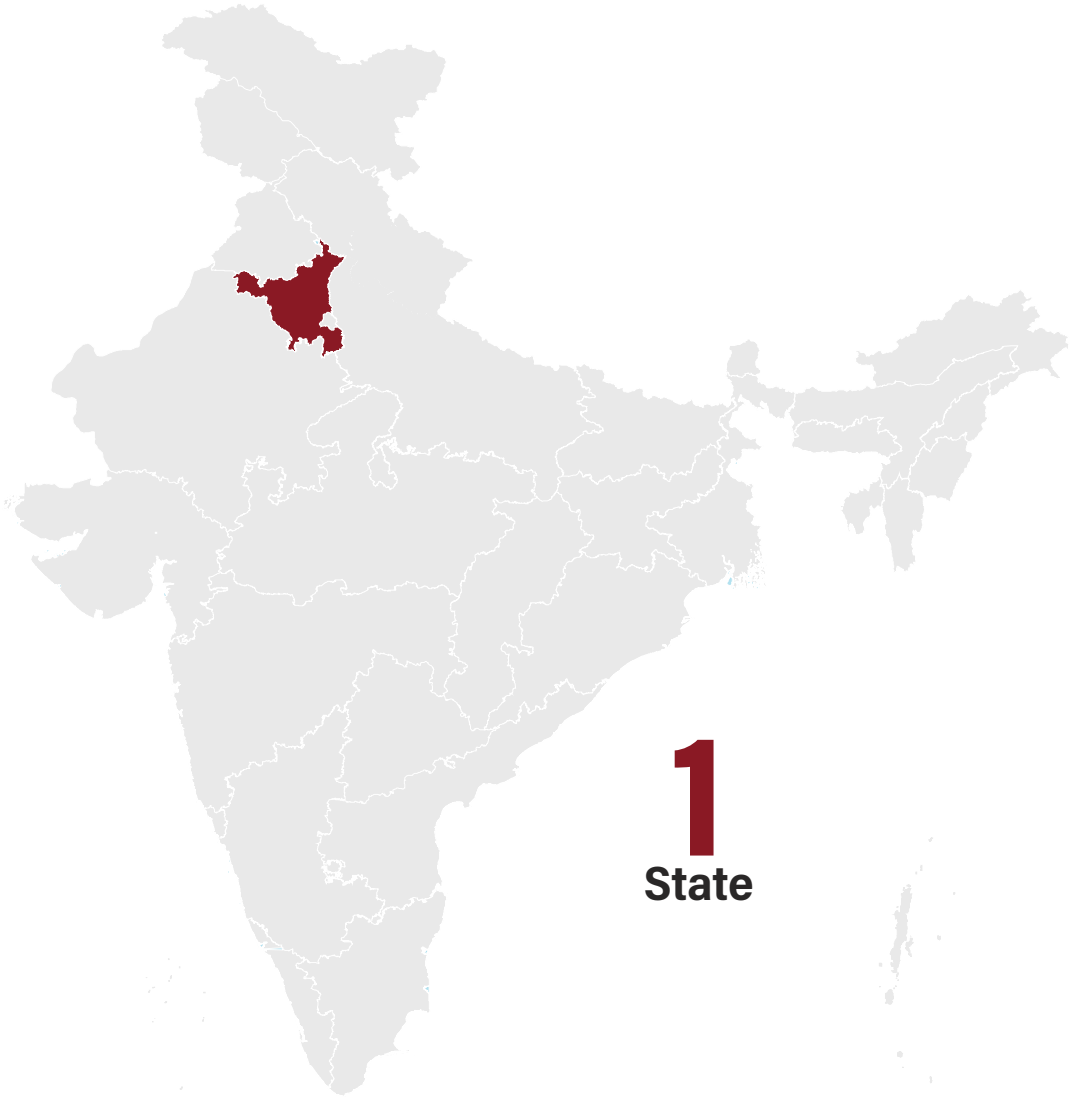
Sources: State EV Policies | Visualization by WRI India

FIGURE 10 | States & UTs implementing policies for public authority-operated freight vehicles



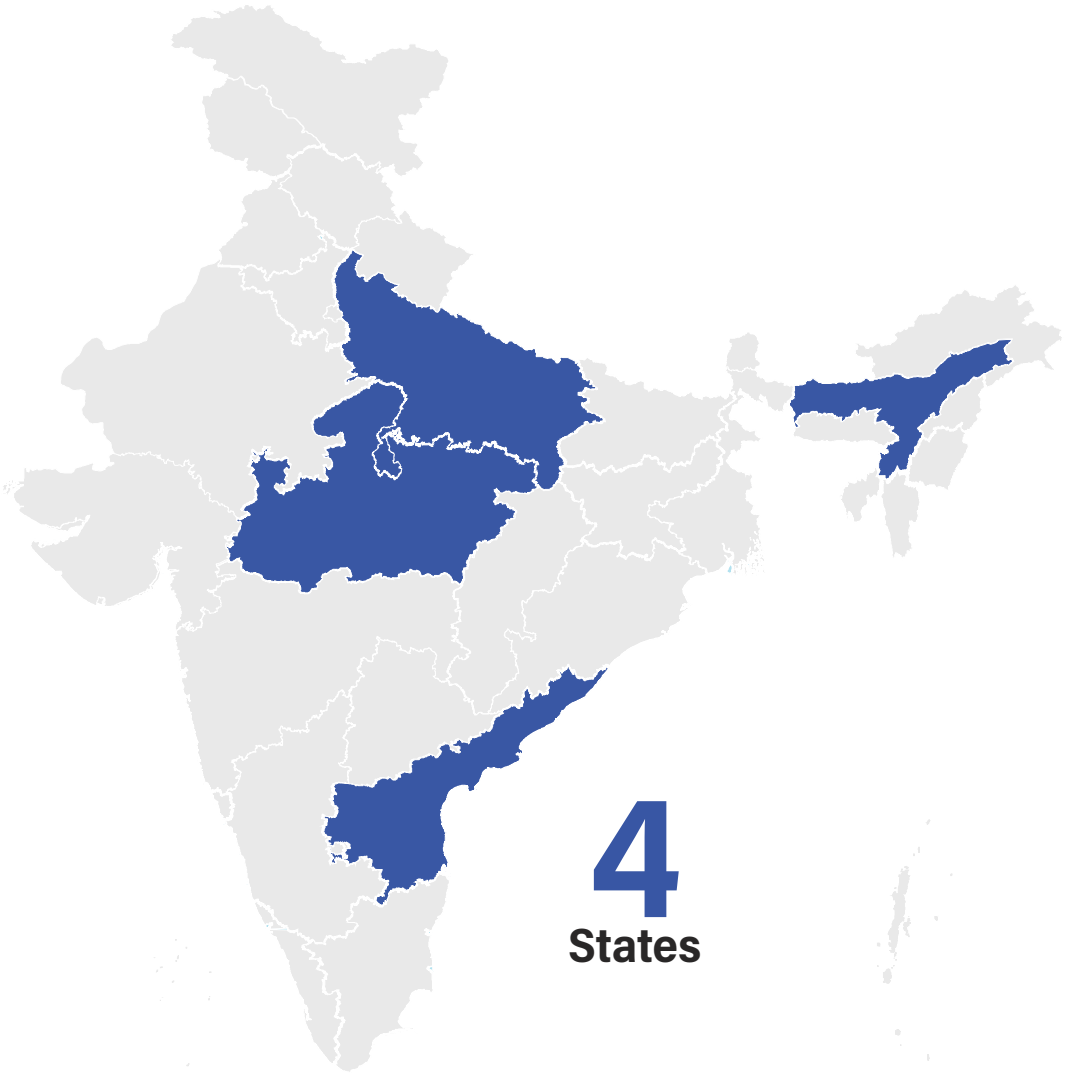
Sources: State EV Policies | Visualization by WRI India

FIGURE 11 | States that offer subsidies for electric medium & heavy-duty freight vehicles



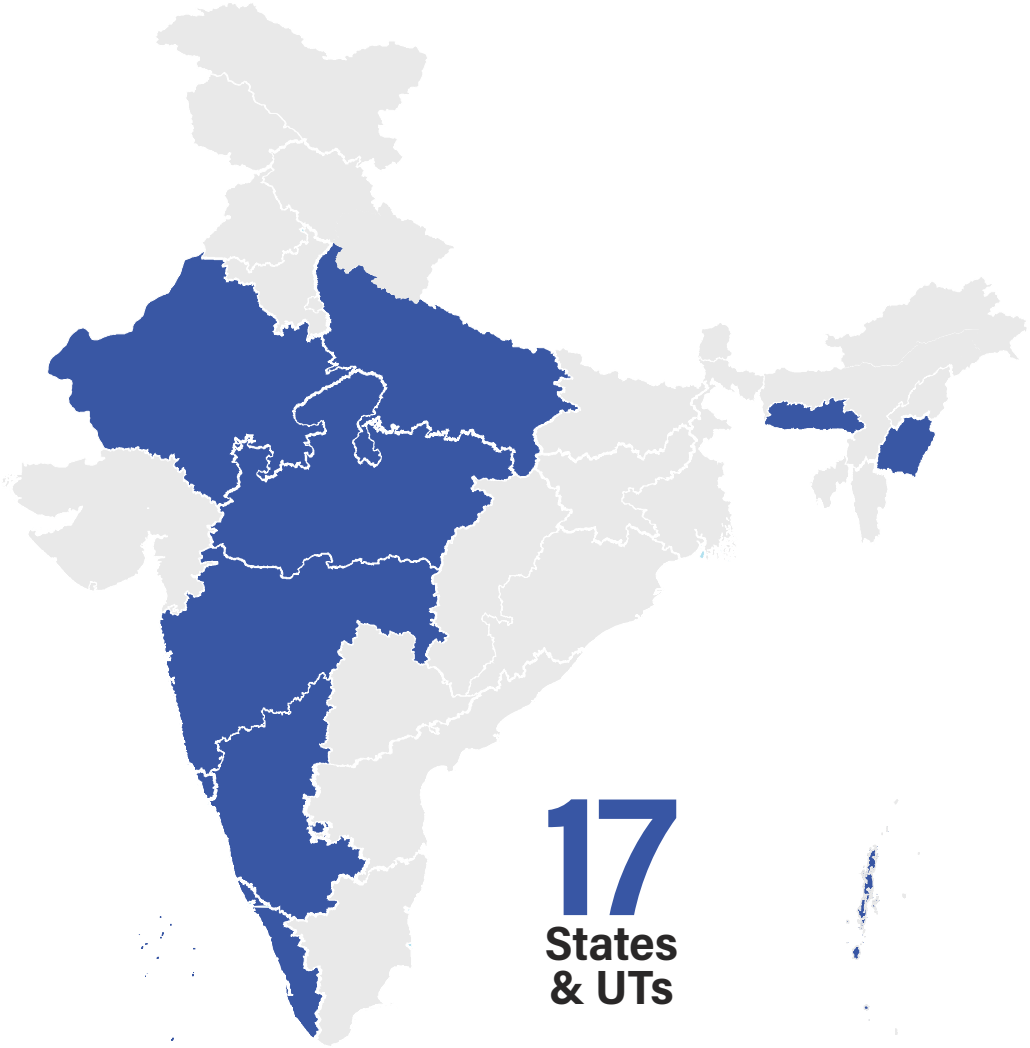
Sources: State EV Policies | Visualization by WRI India

FIGURE 12 | States committed to phasing out of all fossil-fuel-based commercial fleets by 2030



Sources: State EV Policies | Visualization by WRI India

FIGURE 13 | States and UTs offering road tax exemptions or registration fee waivers for electric freight vehicles



Sources: State EV Policies | Visualization by WRI India

While the policies are slowly shaping up to create a conducive environment for e-freight vehicles, key legacy vehicle manufacturers such as Tata Motors and Ashok Leyland are leading the path and have already committed to irreversible, sustainable mobility plans and net zero goals for commercial vehicles.

Collaborative efforts among various industry stakeholders, government agencies, and think tanks have generated immense momentum in the e-freight ecosystem, characterized by consensus-building and business case analysis. The efforts have also gained exceptional visibility. Moreover, additional e-truck pilot projects will be implemented across various sectors by Amazon, Apollo Tyres, Dalmia Cement, Flipkart, JSW Steel, Nestle, Shree Cement, Transport Corporation of India, and UltraTech, by 2025. These developments also expand the possibilities for strategic charging infrastructure deployment through geographical coupling. In addition to established players, start-ups in the commercial vehicle manufacturing sector are also catalyzing this transition, launching 'Make in India' products that range from 3W cargo vehicles to 55-ton trucks. These concerted efforts have ushered in the evolution of the e-freight ecosystem with OEMs launching ZETs, LSPs and shippers exploring viable business models, and financiers delving into risk-sharing mechanisms and financial feasibility models.

FIGURE 14 | E-freight vehicles launched – Light commercial vehicles (LCVs)

MANUFACTURER	MODEL	PAYLOAD (ton)	CAPACITY (kWh)	RANGE (km)
E-Trio	Retrofitter - Tata Ace	0.5	20	115
Tata Motors	Ace EV Cargo/ Tipper	0.6	21.3	154
Croyance Automotive	Electro J0.7	0.7	~12.3	150
EVAGE Ventures Pvt Ltd	FR8	0.9	21.6	100
Omega Seiki Mobility	MIKA 1.0	1	38.7	150 (with half load)
SWITCH Mobility	IeV3	1.2	-	120
SWITCH Mobility	IeV4	1.7	-	120

Source: WRI India

TABLE 15 | E-freight vehicles launched – Medium duty vehicles (MDVs)

MANUFACTURER	MODEL	PAYLOAD (ton)	CAPACITY (kWh)	RANGE (km)
Volvo Eicher	E Pro 2049	1.23	64.5	120-130
Electron EV	Amber	6.75	64	150
Volvo Eicher	E Pro 2055	1.4	64.5	120-130
Omega Seiki Mobility	MIKA 3.0	3	96.77	180

Source: WRI India

FIGURE 16 | E-freight vehicles launched – Heavy duty vehicles (HDVs)

MANUFACTURER	MODEL	PAYLOAD (ton)	CAPACITY (kWh)	RANGE (km)
Ashok Leyland	Boss EV	3 to 10	200 to 300	210 to 320
Olectra	Meghatron	11.5	350	150-200
IPLT	Rhino 5536	40	258.8	185
BYD	Q1R	GCVW: 40-75	255	Upto 200

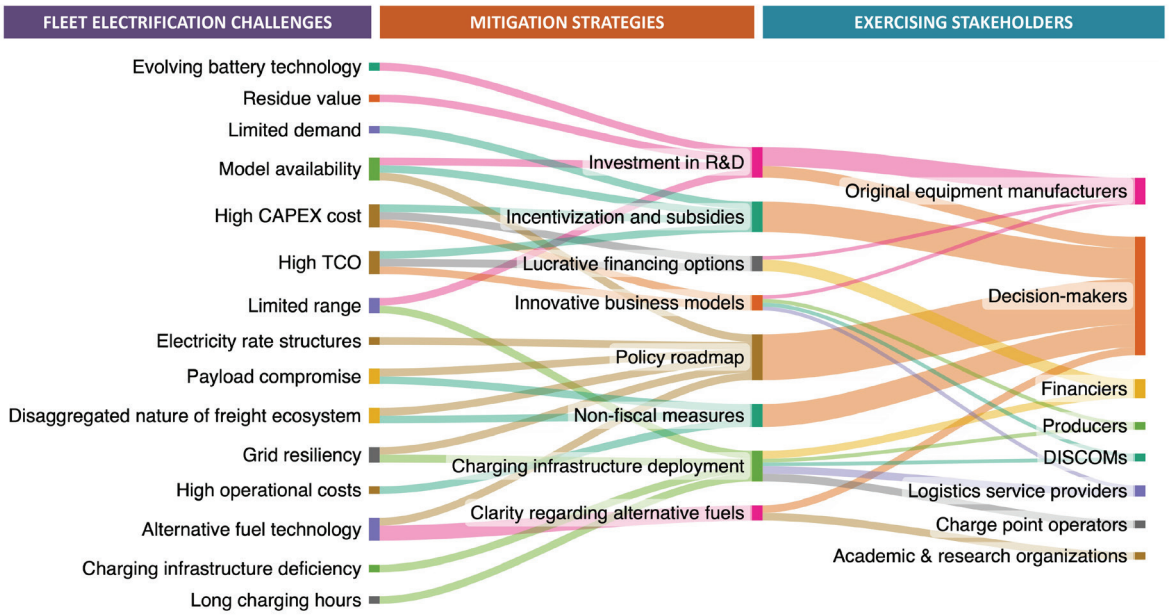
Source: WRI India

Although the e-freight ecosystem has gained substantial momentum in recent months, significant challenges persist in the adoption of e-freight vehicles.

BARRIERS TO THE ADOPTION OF BATTERY ELECTRIC TRUCKS (BETs) IN INDIA

Medium- and heavy-duty vehicles (MHDVs) require relatively more power due to their significant load capacity. This equates to a battery size of ~250-300kWh for 40 ton payload capacity vehicles, resulting in the cost of an e-truck being approximately 3–4 times that of a conventional diesel truck. Besides the high upfront costs, the limited availability of infrastructure, availability of limited models, and financial constraints are leading to the lack of an effective demand-supply cycle. This requires collaborative efforts between key stakeholders of the freight ecosystem to develop mitigation strategies to accelerate the adoption of BETs, as captured in Fig 17.

FIGURE 17 | Barriers to adoption of battery electric trucks (BETs) in India



Sources: Authors | Graphic: Sankeymatic

1. High upfront purchase cost

High purchase price of vehicles is perceived as one of the significant obstacles to freight electrification. Currently, electric medium-duty trucks (e-MDTs) cost twice as much, and electric heavy-duty trucks (e-HDTs) cost three times as much as their diesel counterparts. E-HDTs have a higher upfront cost difference due to their need for a larger battery pack as they travel longer distances and carry heavier loads. Batteries account for 40–70% of e-HDT purchasing price (NITI Aayog and RMI 2022). While batteries represent the highest cost in electric medium- and heavy-duty trucks (e-MHDTs), there are also cost challenges around other parts and components such as electric motors and system management devices. However, these additional challenges involving cost will likely be resolved as the economies of scale and manufacturing efficiencies improve with the industry's maturation.

2. Charging infrastructure technology and availability

For BETs to become viable options in replacing the current diesel variants, a sufficiently comprehensive charging network is required. Additionally, a high-powered charger is required to effectively charge a vehicle in an optimal time period, leading to substantial infrastructure and charging costs for BET operators. It's important to note that the charging needs for medium to long-haul trucks differ substantially from those of daytime delivery fleets, as the former must recharge swiftly at highway truck stops rather than relying on overnight charging. Technology is evolving to ensure compatibility with the maximum type of vehicles and making charging faster and hassle-free. However, fast charging also leads to major concerns over battery degradation. Studies have found that tropical climatic conditions (experienced in India) in conjunction with fast plug-in charging can accelerate the degradation of the battery, leading to a reduction in overall battery performance and increase in vehicle costs (Yuksel and Michalek 2015; Xie et al. 2020).

3. Evolutionary technology and availability of models

Limited model options in this segment have led many companies to continue their "business-as-usual" procurement and operation of diesel vehicles as they wait for the EV market to mature. The BET industry is currently in a chicken and egg position. Given the lack of regulatory pressure and as BETs are relatively new, fleet managers have been wary, leading to low demand. This limited demand in turn has led to a limited variety of BET models and choices. Lack of clarity on alternative fuel technologies has also led to uncertainties in their adoption.

4. Payload vs battery capacity

Unlike electric light commercial vehicles (e-LCVs) that usually operate over relatively short distances and from a centralized home base where they can be frequently recharged, e-MHDTs require a much larger battery pack. Although the large batteries can enable long-distance travel between charges, it can lead to compromised payload due to additional battery weight. The bigger the battery, the greater the cost and the weight. The greater the battery weight of the truck, the lower the carrying capacity or payload of the vehicle for goods movement.

KEY LESSONS AND ENTRY POINTS FOR ACTION

To fully realize and accelerate the opportunities in the adoption of BETs, substantial financial investments, institutional development, knowledge sharing, technology transfer, and capacity building will be required. These actions should achieve transformations that are technically and economically feasible within the foreseeable future.

Identifying actionable policy measures for supporting ecosystem

Although policies like FAME and PLIs have accelerated electric vehicle adoption in the passenger segments, the freight segment lags. Currently, EV policies of 17 states offer road tax exemptions and registration fee waivers for e-freight vehicles; some states have committed to phasing out fossil-fuel-based commercial vehicles (as indicated in fig 12). The Principal Scientific Advisor's office has outlined critical steps for electrifying freight transport in its report titled "Technical Roadmap for the Deployment of ZET in India". However, specific technology-agnostic policies on demand, supply, and charging infrastructure are essential to achieve sustained and systematic growth of ZETs in India. By adopting an outside-in approach, robust and effective policies can be shaped, drawing insights from global examples, while tailoring solutions to cater to India's specific needs. Furthermore, aligning stakeholder aspirations and expectations would enable the successful decarbonization of the trucking industry. These transformative policies act as catalysts for progress and enhance confidence in all stakeholders within the freight ecosystem, including industry, research organizations, think tanks, and other key players.

ENTRY POINTS FOR ACTION: Need for a policy roadmap has been identified as a critical lever to accelerate adoption of ZETs by introducing supply and demand side incentives. Furthermore, it can steer research and innovation towards energy efficient ZETs by identifying gaps, exploring alternative zero-emission technologies, updating existing regulations to accommodate zero-emission fuels, standardizing interoperable and fast charging solutions, devising financing mechanisms, and enabling circular economy initiatives. The roadmap can give clarity to industry regarding product cycle development and set clear targets to encourage industries to align their efforts with national decarbonization pathways.

Demand aggregation and proactive pilot projects to be taken up across geographies, segments, and sectors to assess on-ground issues

The nature of Indian trucking is markedly different from that of the rest of the world. Due to the evolutionary and informal nature of this sector, it is difficult to capture all the requirements for a significantly different option, such as the BETs, and their criticality only by testing the designs in tightly observed pilots. Moreover, given the varied nature of the geography, nature of cargo carried, road conditions, climate, driving patterns, loading patterns, vehicles used, and usage conditions across the country, it is crucial to conduct pilots in multiple corridors that cover all these variations. Large-scale pilot projects are required to gather the data, study the India-centric criteria, create evidence for scalability, and develop case-specific solutions. Proactive pilot projects need to be taken up across geographies, segments, and sectors to assess the on-ground issues. These need to start in controlled environments to showcase the technology maturity of BETs, while ensuring access to supporting infrastructure. Additionally, efforts to aggregate demand from various stakeholders can be crucial in quantifying industry commitment, creating economies of scale, driving down costs for BETs, and encouraging OEMs to develop and produce more models.

The demand signaled by the industry at the 14th CEM has been a significant step to increasing the momentum toward the uptake of e-trucks in India. With successful pilot projects deployed in the cement and steel industries, opportunities for scalability are being tested. Additionally, there has been an increase in the exploration of pilot projects by companies such as JSW Steel, Flipkart, and IKEA, with various scales of pilots planned by the end of 2024.

ENTRY POINTS FOR ACTION: To support the successful adoption of electric freight vehicles, stakeholders should collaborate to identify prospective demand for BETs and initiate pilot projects, taking India's diverse geographical and operational challenges into consideration. These pilot projects should focus on testing BETs in different regions, segments, and sectors, gathering essential data, and identifying solutions tailored to specific needs. The demand signal of 7,750 e-trucks is to be achieved by identifying opportunities for sectoral and geographical coupling. This can be enhanced by increasing the efficiency of charging infrastructure, route optimization, product identification, and stitching business solutions that are economically viable.

Enabling financing mechanisms and implementing suitable risk-sharing models are crucial for propelling pilots into more advanced stages

While battery electric trucks (BETs) have lower operating costs compared to diesel trucks, their high upfront costs and the need for new charging infrastructure can strain cash flows and reduce truck owners' net profits. Mitigating these effects can involve strategies like longer loan tenures and lower interest rates. Tailored financial models are essential to ensure success at the pilot as well as scaling-up phase. Given that more than 90 percent of such trucks are owned and operated by very small fleet owners who own 20 trucks or less, financial products become much more important for the rapid growth of e-trucks (Raghuram 2015). The cash flows and costs that are generated over the period of financing will require careful design and productizing.

Specific financial products are needed for pilot initiatives, including viability gap funding and first loss risk coverage for lenders, and also for the economic scaling-up phase. Furthermore, it is crucial to have risk-sharing mechanisms in place to encourage the early adoption of BETs, addressing uncertainties linked to the adoption of electric freight vehicles. A combination of fiscal, regulatory, and incentive-based approach is needed to ensure a rapid transition towards ZETs. Finding the right financing mechanisms is key for moving from the pilot phase to advanced stages of scalability. Inclusion of trucks in central and state electrification incentives, priority sector lending, and interest rate subvention need to be actively taken up to increase affordability among fleet owners.

ENTRY POINTS FOR ACTION: To bridge the financing gap and facilitate the transition to electric freight vehicles, policymakers and financial institutions should work together to create tailored financial products. These products can include viability gap funding for pilot projects; and innovative financing solutions to make BETs more affordable for small fleet owners and operators, along with risk sharing mechanisms like performance guarantees, extended warranties, and credit, insurance and warranty programs.

Ensuring clarity on alternative zero-emission fuels

With multiple alternative zero-emission fuels under research, raw material availability, ease of handling, safety aspects, and commercial viability of these fuels present a complex landscape with various challenges. Investments in research and development are critical to bringing these fuels to the market. Investments are also needed to study the life cycle emission analysis and long-term performance of the fuels. Evidence of research showcased through assessment of pilot projects can help build confidence in the ecosystem regarding alternative zero-emission fuels such as battery and hydrogen. Although low-emission fuels, such as liquified natural gas (LNG) can serve as transitional solutions, they require high infrastructure capital leading to infrastructure lock-ins. While hydrogen-powered trucks could be better suited for long-distance operations, their relevance can be considered when the technology becomes suitable for the Indian trucking context. BETs on the other hand are promising due to their comparatively advanced stage of applicability, and financial feasibility. Identifying the most promising avenues and taking the right steps forward in fuel development is crucial for achieving sustainable and environment-friendly road freight transportation.

In the evolving landscape of ZETs, stakeholders should engage in constructive discussions regarding alternative fuels and new technologies. While embracing innovation and diversity in technology, there's a need for developing minimalist standards that ensure compatibility, safety, and interoperability. These standards should be formulated through collaborative efforts involving vehicle OEMs, suppliers, regulators, and other relevant stakeholders.

ENTRY POINTS FOR ACTION: As the freight industry in India explores cleaner energy sources, it is imperative to develop a comprehensive alternative fuel roadmap that aligns with the evolving landscape of zero-emission freight vehicles. This roadmap should be a comprehensive and strategic guide, addressing several critical aspects that are pivotal to transitioning to cleaner and more sustainable freight transportation. To facilitate this transition, it is imperative to establish a clear and informed path that takes the diverse technologies and fuels into consideration. Such a roadmap can also expedite the commercialization of ZETs through enabling measures and incentives.

Skill development, capacity building, and localization of the supply chain

As India aims to transition to a cleaner freight sector, it becomes imperative to focus on equipping the workforce with the necessary knowledge and expertise while bolstering the domestic supply chain. This dual approach not only ensures a smoother transition but also strengthens India's position as a key player in the global shift towards cleaner transportation solutions. Being a major vehicle manufacturing country, India needs to leverage this opportunity to build the industrial base to localize the manufacturing of batteries, battery management systems, power trains, and other components. Localization of the supply chain for manufacturing vehicles locally mitigates vulnerability from supply chain risks and would help India become self-reliant by further encouraging research and development. During the pandemic, the central government announced a production-linked incentive (PLI) scheme for manufacturing advanced chemistry cells to support gigascale advanced cell manufacturing of up to 50 GWh. However, the scheme does not cover start-ups in the cell manufacturing space. Issues related to raw materials also need to be addressed as access to mined materials for batteries is a challenge, impacting battery cell localization in India.

In addition to localization of the supply chain, the role of skill development and capacity building in driving sustainable freight electrification is paramount. This encompasses a range of initiatives aimed at equipping stakeholders with the knowledge, expertise, and capabilities necessary to navigate the transition effectively.

ENTRY POINTS FOR ACTION: India, being a major vehicle-producing country, should leverage its manufacturing capabilities to localize the supply chain for BETs. This localization effort should encompass essential components such as batteries, battery management systems, powertrains, high capacity chargers, and other key elements. To facilitate this, policymakers should explore incentives and initiatives to support local manufacturing, reduce supply chain vulnerabilities, and promote research and development in the zero-emission freight sector.

Initiatives should be undertaken to enhance skill development at all stages of the e-freight ecosystem. This includes skill-building programs tailored for various stakeholders, from those involved in manufacturing and battery handling to drivers. By fostering a skilled workforce, the industry can optimize human resources, ensuring the efficient and safe transition to decarbonized road freight industry.

CONCLUSION

In conclusion, the widespread adoption of ZETs in India demands a holistic and a collaborative approach. Given the fragmented nature of the freight ecosystem, effective partnerships and concerted actions are fundamental. Deployment of pilot projects can help pinpoint on-ground challenges, paving way to identifying mechanisms for risk-sharing, consensus-building, technology advancement, and business case explorations, unlocking the demand-supply cycle. To align industry efforts with national decarbonization efforts, a meticulously crafted policy roadmap tailored to India's unique needs is indispensable. Additionally, deployment of robust charging infrastructure along identified freight-intensive corridors is vital to reduce range anxiety, bolstering the operational confidence of stakeholders. Equally vital is the need for skill development and capacity building, spanning various aspects from manufacturing processes to battery handling to comprehensive driver training. Powerful policy combinations such as incentivization coupled with supply-side mandates can streamline India's trajectory to achieve freight electrification. Moreover, the confidence imbibed by the industry can lead to enhancement in the availability of models. This multipronged approach aims to transform India's freight industry, and is also contingent to the decarbonization of India's transport sector, increasing overall energy security and environmental sustainability.

LIST OF PARTICIPANTS

NITI SAMVAAD 1 – LOGISTICS SERVICE PROVIDERS

Industry

Rajkiran Kanagala, Senior VP & Group Head - Emerging Business Units, Strategy & Business Development, TCI Express

Rishab Gandhi, Chief of Strategies, Raman Roadways

Satish Lakkaraju, Global Head Air Freight and Pharma, WIZ Freight

Raghavendra M, Co-Founder, MooEV

Nikhil Sachdeva, Director, Delhivery

Ramesh Kumar, Manager – Distribution and Logistics, Zydus Group

Policymakers

Sudhendu J Sinha, Adviser (Infrastructure Connectivity – Transport and Electric Mobility), NITI Aayog

Joseph Teja, Former Public Policy Analyst, NITI Aayog

Knowledge Partners

Jasmeet Khurana, Lead, Climate Technology, World Economic Forum

Pramoda Gode, Former Lead, Moving India, World Economic Forum

Priti Shukla, Programme Manager (Electric Mobility), Shakti Sustainable Energy Foundation

NITI SAMVAAD 3 – MANUFACUTURING/ PRODUCER COMPANIES

Industry

Deb Mukharjee, Senior Manager – Sourcing & Chartering, Tata Chemicals

Uday Narang, Founder & CEO, Omega Seiki Mobility

Akash Passey, Former President – CV, Volvo Eicher Commercial Vehicles

Rajesh Khanna, Head – MHCV Product Planning Group, Tata Motors

Anniruddha Kulkarni, VP – Commercial Vehicles, Tata Motors

Ashpreet Sethi, Former Head of Public Affairs, EVage

Policymakers

Sudhendu J Sinha, Adviser (Infrastructure Connectivity – Transport and Electric Mobility), NITI Aayog
Joseph Teja, Former Public Policy Analyst, NITI Aayog

Knowledge Partners

Pramoda Gode, Former Lead, Moving India, World Economic Forum

Mehul Khandelwal, Junior Technical Manager, SFC

LEADERS' DIALOGUE – SHIPPERS ROUNDTABLE

Industry

Mohan Gokani, Senior Manager – Sourcing & Chartering, Tata Chemicals

Sukanta Pandit, Head of Logistics – Road & Projects, Hindalco Industries

Kaustubh Prithwi Acharya, Project Implementation Manager, Ingka Group (IKEA)

Mukesh Suthar, Assistant General Manager & Head – Energy Management & Sustainability, Godrej & Boyce

Swetha Ramdas, Lead – Sustainability, Amazon India

Karthik Vijayan, Sustainable Transportation Lead, Amazon India

Ms Shubra Jain, Public Policy Manager, Amazon India

Akshima Khosla, Sustainable Transportation Manager, Amazon India

Aditya Rai, Program Manager, Amazon India

Sanjeev Agarwal, Sr. Vice President, Reliance Jio

Prashant Sharma, Manager, Dalmia Cement (Bharat) Limited

Amit Singh, Deputy General Manager, Dalmia Cement (Bharat) Limited

Saurabh Palsania, Former Executive Director, Dalmia Cement (Bharat) Limited

Satish Narang, Supply Chain Cluster Lead IBSL, Bayer CropScience

Suresh Pasricha, Lead– Customer Service and Distribution for India Operations, Bayer CropScience

Sanjeet Tiwari, National Transport Manager, Nestle

Prokash Roy, DGM – Chemical Logistics, TCIL

Rajkiran Kanagala, Senior VP & Group Head, Strategy & Business Development, TCIL

Jasmeet Khurana, Lead, Moving Emerging Markets, WEF

Saurabh Sood, Senior Transport Specialist, World Bank

Priti Shukla, Programme Manager (Electric Mobility), Shakti Sustainable Energy Foundation

Rishab Sethi, Programme Manager (Electric Mobility), Shakti Sustainable Energy Foundation

Narayankumar Sreekumar, Associate Director – Electric Mobility Program, Shakti Sustainable Energy Foundation

Shreya Verma, Program Manager, UN Global Compact Network India

Seerat Tajamul, Membership Officer, UN Global Compact Network India

Neeta Aggarwal, Programme Officer, UN Global Compact Network India

Deep Chandra Papnoi, Deputy Director, UN Global Compact Network India

Chandan Chaturvedi, Associate Director – Logistics, Distribution & Transportation (Africa, Middle East & South Asia), PepsiCo

Swati Dsouza, Program Head, India ZEV Centre, Institute of Transportation Studies, University of California, Davis

Vikash Mishra, Founder & CEO, MoEVing

Ajay Bhoj, National Logistics Manager, Royal Canin

Abhishek Ambike, Supply Chain Development Manager, Royal Canin

Kuldeep Rathore, Head of Ground and Rail – India, CEVA Logistics India

Dr Aditya Gupta, COO at Supply Chain Management Centre, IIM Bangalore

Fanny Westlund, Sustainability Leader, IKEA

Sacha Kersten, Senior Director Asia Pacific at Pfizer, Pfizer Asia Pacific

I V Rao, Distinguished Fellow, TERI

Sharif Qamar, Associate Director, TERI

Lisa Outtier, Head of CSR - Middle East, Indian Sub-Continent, Indian Ocean Islands, Southern & Eastern Africa, CMA CGM

Abhilekh Suryavanshi, South Asia Transportation and Logistics Lead, Cargill

Aishwarya Raman, Executive Director, OMI

Ashish Saraswat, Programme Manager – Transport (India), The Climate Group

Aviral Gupta, Manager (Business Development), Indure

Policymakers

Sudhendu J Sinha, Adviser (Infrastructure Connectivity – Transport and Electric Mobility), NITI Aayog

Sumeet Kumar Jarangal, Director, DPIIT

Knowledge Partners

Christoph Wolff, CEO, SFC

Mehul Khandelwal, Junior Technical Manager, SFC

Vijay Jaiswal, Director, SFC India

Jasmeet Khurana, Lead, Climate Technology, World Economic Forum

Saurabh Sood, Senior Transport Specialist, The World Bank

Ashish Saraswat, Programme Manager- Transport (India), Climate Group

Swati Dsouza, Former Program Head, India ZEV Centre, Institute of Transportation Studies, University of California, Davis

SIDE EVENT AT 14TH CLEAN ENERGY MINISTERIAL

Industry

Dr. Preeti Banzal, Adviser/Scientist 'G', Office of the PSA to GOI

Herman Sips, Ministry of Infrastructure and Water, Netherlands

Sydney Vergis, California Air Resources Board, USA

Koyel Kumar Mandal, Shakti Sustainable Energy Foundation

A Sundaresan, Head Alternative Technology, Ashok Leyland

Abhishek Dabas, CEO, Gentari Green Mobility India

Rajkiran Kanagala, President, Transport Corporation of India

Raju Goyal, President and Chief Technical Officer, Ultratech Cement

Rinika Grover, Head – Sustainability & CSR, Apollo Tyres

Saurabh Palsania, Joint President, Shree Cement

Vikas Adlakha, Head of Logistics, Hindustan Zinc

Shubhra Jain, Public Policy Manager, Amazon India

Anju Mary Kuruvilla, Director – Industry Affairs Communications & Sustainability, Danfoss

Anupam Badola, Deputy CSO, Dalmia Cement

Balbir Bhalla, Transportation – Hub Lead for SAR region, Nestle

Jitendra Kapoor, Head Surface Transport & Trucking – South Asia, MAERSK

Radhakrishna Gunti, Rhenus Logistics

Rajesh Khanna, Head – MHDV Design and Planning, TATA Motors

Policymakers

Sudhendu J Sinha, Adviser (Infrastructure Connectivity – Transport and Electric Mobility), NITI Aayog

Joseph Teja, Former Public Policy Analyst, NITI Aayog

Knowledge Partners

Atul Mudaliar, Head of Business Actions India, Climate Group

Christoph Wolff, CEO, SFC

Stephanie Kodish, Director-Drive to Zero, CALSTART

Pramoda Gode, Former Lead, Moving India, World Economic Forum

Urška Skrt, Manager, Mobility Decarbonization, WBCSD

FROM WRI INDIA

Madhav Pai, CEO

Pawan Mulukutla, Executive Program Director - Integrated Transport, Clean Air and Hydrogen

Sharvari Patki, Program Head – Electric Mobility

Sudeept Maiti, Former Associate Program Director

Vishal Ramprasad, Senior Program Manager - Transport

Chandana K, Program Associate - Freight

Anshika Singh, Program Associate, Electric Mobility

Pravin Cherukuthota, Program Associate, Electric Mobility

Nikita Gupta, Former Senior Program Associate- Communications

Anya George, Senior Program Associate- Communications

Yash Pratap Singh, Program Associate

Subhadeep Bhattacharjee, Former Senior Program Associate, Electric Mobility

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ABOUT THE AUTHORS

Chandana K, Program Associate – Freight, Sustainable Cities and Transport program, WRI India
Contact: Chandana.K@wri.org

Pravin Cherukuthota, Program Associate – Electric Mobility, Sustainable Cities and Transport program, WRI India
Contact: Pravin.Cherukuthota@wri.org

Anshika Singh, Program Associate – Electric Mobility, Sustainable Cities and Transport program, WRI India
Contact: Anshika.Singh@wri.org

Sharvari Patki, Program Head – Electric Mobility, Sustainable Cities and Transport program, WRI India
Contact: Sharvari.Patki@wri.org

Pawan Mulukutla, Executive Program Director – Integrated Transport, Clean Air and Hydrogen
Contact: Pawan.mulukutla@wri.org

ABOUT WRI INDIA

WRI India, an independent charity legally registered as the India Resources Trust, provides objective information and practical proposals to foster environmentally sound and socially equitable development. Our work focuses on building sustainable and liveable cities and working towards a low carbon economy. Through research, analysis, and recommendations, WRI India puts ideas into action to build transformative solutions to protect the earth, promote livelihoods, and enhance human well-being. We are inspired by and associated with World Resources Institute (WRI), a global research organization. Know more: www.wri-india.org

Our challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to inform government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

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1ST FLOOR, GODREJ & BOYCE
PREMISES, GASWORKS LANE,
LALBAUG, PAREL MUMBAI 400012,
INDIA WWW.WRI-INDIA.ORG