Driving clean freight: Enabling India's transition to zero-emission trucking

Executive summary

India's ambitious goal of achieving net-zero carbon emissions by 2070 places the country's freight sector at the forefront of its climate strategy. As the lifeblood of economic activity, freight movement fuels India's rapid industrial growth and consumption patterns. Currently, road freight accounts for approximately 70% of all freight transported in India, underscoring the sector's prominence and critical influence on the country's economy and environment.

The freight and logistics sector itself contributes nearly 14% to India's gross domestic product (GDP), reflecting its role as a significant economic enabler and major employment provider. The heavy reliance on trucks stems from India's vast geography, the dispersed nature of industrial clusters, and the limited development of multimodal transport systems. Freight corridors comprising about 10,000 kilometers of national highways carry nearly half of all goods movement, reinforcing these routes as strategic arteries of commerce. However, this extensive movement brings with it severe climate and health challenges that demand urgent attention.

Although trucks constitute only about 3% of registered vehicles, they disproportionately contribute to pollution—accounting for 53% of particulate matter (PM) emissions and 34% of transport-sector CO_2 emissions. Without rapid adoption of cleaner technologies, emissions from freight trucks are projected to double by 2050. The environmental toll is compounded by dire public health consequences, as diesel exhaust—classified as a Group 1 carcinogen by the World Health Organization—exacerbates respiratory and cardiovascular diseases in millions, particularly in densely populated urban corridors. Economic losses from health impacts due to pollution are estimated to reach up to 8% of the national GDP, impeding progress toward key Sustainable Development Goals on health and sustainable cities.

Beyond health, the sector's voracious appetite for fuel is a critical economic vulnerability. Freight operations consume nearly a quarter of India's oil imports, translating into vast exposure to international price shocks and geopolitical risks that strain fiscal and trade balances. Projections suggest that, by 2050, the truck population could quintuple from around 4 million to 17 million vehicles, potentially doubling emissions and significantly increasing oil dependence. This trajectory risks locking India into a high-carbon, energy-insecure future unless decisive measures are undertaken to decarbonize freight.

India is not alone in facing these challenges. Leading economies across Europe, North America, and Asia are advancing aggressive policies and incentives to accelerate zero-emission trucking. Germany leads with purchase subsidies covering up to 80% of the added costs for zero-emission trucks and innovative CO_2-based road tolling to reward cleaner vehicles. The United Kingdom has invested significantly in electric and hydrogen truck pilots, alongside developing robust emissions reporting frameworks that enhance market confidence. California's pathbreaking mandate to phase out new sales of internal combustion trucks by 2036, backed by comprehensive subsidies and infrastructure development, sets a near-term global example. Notably, China has emerged as the world's largest electric truck market by leveraging targeted subsidies, toll reductions, and regulatory relaxations that enable cost parity with conventional trucks in key urban and port logistics sectors.

Drawing from these global exemplars and building on emerging domestic policies like the PM E-Drive and the National Green Hydrogen Mission, India is creating a strategic platform to enable large-scale freight decarbonization. However, realizing this vision requires coordinated efforts that address structural complexities such as the predominance of small fleet operators, financing gaps, uneven infrastructure buildout, and fragmented institutional mandates.

This report explores these dimensions, mapping the pathway for India's freight sector to transition to zero-emission trucks in alignment with economic growth, public health improvement, and climate resilience.

Attendees and contributors of the roundtable discussion

- NITI Aayog
- National Highways for Electric Vehicles
- Climate Group
- C40 Cities
- Indian Institute of Technology, Delhi
- Sun Mobility
- AFD: Agence Française de Développement
- International Council on Clean Transportation
- Volvo Eicher Commercial Vehicles Limited
- Rocky Mountain Institute
- FCDO: UK Foreign, Commonwealth and Development Office
- GIZ: Deutsche Gesellschaft für Internationale Zusammenarbeit

The role of freight in India's economy

The freight and logistics sector contributes ~14% to India's Gross Domestic Product (GDP), reflecting its role as both an enabler of industrial competitiveness and a major employment provider. The freight sector heavily relies on trucks, partly due to India's geography, partly due to the dispersed nature of its industrial hubs, and underinvestment in multimodal freight systems.

Transport corridors have become the backbone of this movement, with trucks travelling thousands of kilometers daily to meet consumer and industry demand. But even as trucks keep India's economy moving, their disproportionate environmental, health, and fiscal impacts raise an urgent case for accelerating decarbonization.

"India's freight system stands at an inflection point: trucking drives our economy but is also a significant emitter. The next few years will decide if this sector becomes a driver of clean growth and energy security, or a drag on climate and competitiveness."

– Speaker, ICF roundtable

Climate and public health dimensions

Trucks, though a minority within India's vehicle fleet, punch far above their weight in terms of emissions. Although light-duty vehicles (LDVs) are more numerous, nearly all freight movement is handled by medium— and heavy-duty trucks, which together account for 97% of tonne-kilometers Medium- and heavy-duty trucks (MDVs and HDVs) represent only 3% of registered vehicles in India, but account for 53% of the transport sector's PM emissions and 34% of transport-sector CO_2 emissions. Without a shift to cleaner vehicle technologies, freight-related emissions are expected to double by 2050, threatening climate goals and air quality.

This disproportionate pollution burden is especially evident around highways, logistics hubs and industrial corridors, where population density is high and exposure levels are acute. Diesel exhaust from freight trucks is a known Group 1 carcinogen, strongly linked to respiratory and cardiovascular diseases.
For vulnerable populations in cities, such exposure worsens asthma, reduces lung function, and increases the risk of premature mortality. The human cost is immense: India is home to 14 of the world's 20 most polluted cities, and freight contributes meaningfully to this health emergency.

The economic cost of such health impacts is equally severe. The World Bank estimates that air pollution imposes welfare losses equivalent to 8% of India's GDP through increased healthcare expenditure, lost working days, and reduced labor productivity. Freight-related emissions also undermine India's progress toward Sustainable Development Goals (SDGs) related to health, climate, and sustainable cities. Without urgent decarbonization, road freight risks becoming a bottleneck to both public health and equitable growth.

Economic vulnerability

Beyond health and environmental externalities, freight decarbonization is also an economic and energy security imperative. The trucking sector is a voracious consumer of imported fuel. Nearly a quarter of India's annual oil import bill, amounting to billions of dollars each year, is attributed to road freight usage. This dependence heightens India's exposure to global oil price fluctuations and geopolitical tensions, creating inflationary pressures that ripple across the economy.

As freight demand grows, so too will this vulnerability. Projections indicate that by 2050, the demand for freight could increase more than fivefold, from roughly 4 million vehicles currently to nearly 17 million. Such an expansion in diesel-based freight would escalate the country's oil import dependence, straining both foreign exchange reserves and fiscal balance sheets.

In a business-as-usual scenario, this trajectory is clearly unsustainable. Without interventions to reduce oil intensity and emissions, India risks locking itself into a high-carbon pathway that jeopardizes its net-zero by 2070 commitment, strains public health, and undermines energy resilience. Decarbonizing freight, therefore, is not merely a climate-aligned strategy, it is an economic survival strategy.

Global learnings

India's challenges are significant, but it is not alone. A wave of innovation and regulatory ambition is reshaping the HDV landscape globally. Several economies, responsible for a large share of global truck production and demand, have begun charting aggressive decarbonization pathways that India can draw lessons from and benchmark itself against.

Germany offers Zero-Emission Vehicle (ZEV) **purchase grants** for transport companies, providing up to €40,000 for Zero Emission Trucking (ZET), covering up to 80% of **additional investment costs** until 2023. The country is also implementing a CO_2-based road charging system, adding a **surcharge** to the existing toll system based on the vehicle's emissions class. Germany's extensive funding program for charging and refueling infrastructure shows how purchase subsidies and emissions-based tolling can help shift fleets toward cleaner technologies.

The United Kingdom has invested £200 million for battery-electric trucks (BETs) and hydrogen trucks, **advancing technology development** and reducing early adopter risks. The UK also leads in **developing streamlined emissions reporting and certification frameworks**, boosting investor and customer confidence in clean freight solutions.

California in the USA, stands out for regulatory ambition. It has mandated a **phase-out of new internal combustion engine** truck sales by 2036. This is backed by substantial **purchase subsidies** and major **public spending on charging and refueling networks.** The focus on compliance timelines provides clear signals for manufacturers, carriers, and infrastructure developers, setting ambitious but attainable decarbonization targets for the freight ecosystem.

China is the world's largest market for electric trucks, driven by **cost-targeted policies and massive incentives across LDV, MDV and HDV segments.** In 2023, over 330,000 commercial EVs were sold in China, with average monthly fuel cell truck sales exceeding 1,000. **City governments are promoting EV usage** with 35% of Shenzhen's delivery fleet converted to EV due to **purchase subsidies, tax exemptions, reduced**

tolls, and regulatory support for clean trucks. HDV electrification is accelerated by widespread DC fast charging and pilots of megawatt-class chargers (MCS), **with 50% of all heavy battery-electric trucks featuring swappable batteries in 2023.** Diesel truck market share has fallen from 60% in 2024 to below 50% in the first half of 2025

Despite smaller absolute volumes, **South Korea's** electric truck market is expanding rapidly through **coordinated government targets, corporate mandates, and major charging investments.** EV sales rose 48.4% year-on-year in 2025, accounting for 18.4% of all vehicle sales.

Key takeaways from the roundtable

ICF convened a roundtable of senior policymakers, industry leaders, and technical experts in August 2025 to deliberate on the successful transition to ZET in India. Discussions highlighted that this transition hinges on a systems-level approach **integrating technology innovation, financing innovation, and institutional collaboration.** Key themes and their associated challenges include:

1. Policy foundations for clean freight

India has begun laying the foundation for freight decarbonization through a mix of policies, pilot projects, and stakeholder initiatives listed below:

Exhibit 1. Key initiatives by the Indian government

Initiative	Launch date	Implementation agency	Objective
ZET Adoption in India and Its Impact on Emission and Energy Report	July 2025	Office of the Principal Scientific Adviser to the Government of India	Analyzes the growth and potential of India's Medium and Heavy-Duty Truck sector, provides projections on BET adoption, emission savings, savings in fuel and electricity demand.
India's Priority Corridors for Zero-Emission Trucking Study	May 2025	Office of the Principal Scientific Adviser to the Government of India	Identified 10 key highway segments as ZET corridors. Promotes ZET adoption based on traffic/infrastructure readiness.
PM E-Drive Scheme	October 2024	The Ministry of Heavy Industry	Accelerate the adoption of electric vehicles (EVs), establish charging infrastructure, and build a robust EV manufacturing ecosystem in the country.

Bharat ZET Advisory Document	August 2024	Office of the Principal Scientific Adviser to the Government of India	Outline policy recommendations across 5 areas (infrastructure, business/ financing, incentives, regulation, stakeholder initiatives); aim for 100% ZEV sales by 2050.
National Green Hydrogen Mission	January 2023	Ministry of New and Renewable Energy	Scale domestic green hydrogen production (target 5 MMTPA by 2030); pilot hydrogen usage in buses/trucks (37 vehicles, 9 refueling stations).
Fuel efficiency standards for HDV	Notified in 2018, re-notified in November 2022	Bureau of Energy Efficiency, Enforced by Ministry of Road Transport and Highways	Improve fuel efficiency, reduce fuel consumption and GHG emissions in HDVs.
Bharat Stage (BS) VI emission standards	Draft notified in February 2016; Implemented in April 2020	Ministry of Road Transport and Highways, Central Pollution Control Board	Limit air pollutants (PM, NOx, CO, HC) from all motor vehicles; improve fuel quality.
Corporate Average Fuel Efficiency (CAFE) standards	2017	Bureau of Energy Efficiency	Promotes cleaner, more efficient vehicle technologies and alternative fuels through fuel economy and emissions regulations that apply to the entire manufacturer's fleet.

It is evident that policy momentum is building but it needs deeper alignment. A unified national roadmap with freight-specific incentives and coordinated implementation across ministries is essential to accelerate adoption and scale impact.

2. Infrastructure challenge

India's freight movement is heavily concentrated on a relatively small portion of the national highway network. Approximately 10,000 kilometres of highways handle nearly 50 percent of all freight traffic, forming critical arteries for goods transportation across the country. This concentration allows targeted investment in ZET infrastructure such as megawatt-level electric chargers and green hydrogen refuelling to maximize impact and cost efficiency.

Yet, the challenge lies in utilization. Charging and refueling infrastructure must achieve 25–30% usage to be financially viable, but current demand remains far below this threshold. Fragmented ownership among small operators, limited adoption of ZEVs, and uncertainty about long-term technology choices suppress utilization rates. This creates a "chicken-and-egg" dilemma: operators hesitate to shift fleets without robust infrastructure,

while investors delay funding infrastructure due to weak demand signals. Low truck telematics adoption and lack of fleet coordination further aggravate infrastructure underuse, creating stranded assets and eroding investor confidence.

Breaking this cycle requires an integrated strategy that combines demand aggregation with shared-use models. Public–private partnerships that align risk-sharing between government, operators, and financiers will be essential to build high-capacity charging and refuelling infrastructure at scale.

3. Truck ownership cycles

A defining feature of India's trucking sector is the rapid turnover of vehicles, especially among small and mid-sized fleet owners in the unorganized segment. Most operators sell trucks within three to five years, often as warranties expire or new regulatory requirements emerge, driven by the financial pressure to recoup capital and manage maintenance costs efficiently.

This rapid fleet renewal pattern presents both challenges and opportunities for ZET adoption. On one hand, it creates significant pressure on fleet operators to minimize upfront costs and ensure rapid payback, rendering the current elevated purchase prices of ZEVs a formidable barrier. On the other hand, it provides predictable purchase cycles that could accelerate turnover if supported by financing instruments.

Addressing these dynamics is crucial for developing financing solutions that match operator cash flows and risk tolerance. Solutions must integrate small fleet operators, build financing mechanisms tailored to them, and address capacity challenges, which in turn can catalyse large-scale fleet electrification.

4. Financing innovations

The cost of ZEVs which can be 2.5 to 3.5 times that of diesel trucks, exacerbates financing challenges for SMEs that dominate the supply chain. While lifetime savings in fuel and maintenance are promising (potentially up to 46%), the initial capital requirement remains a formidable barrier. Operators are often unfamiliar with total cost of ownership calculations, increasing risk aversion and reliance on traditional diesel investments.

Key financial barriers include limited institutional credit access, lack of risk guarantees, and minimal experience with new models. Without efficient demand aggregation or blended finance platforms, smaller players struggle to negotiate better terms or benefit from economies of scale. Infrastructure investment also faces similar bottlenecks, with private financiers hesitant to fund projects without guaranteed utilization. This financing vacuum delays scale-up and reinforces the diesel lock-in across fleets. In addition, integrating ZET adoption with carbon credit revenues, concessional loans, and tailored subsidies remains underdeveloped in policy and practice.

A blended toolbox of financial instruments is needed. Pilots of these models should be incentivized, monitored, and scaled nationwide. Public policy has a catalytic role to play, by offering targeted subsidies, preferential loan terms, and risk guarantees, ensuring that innovative financing reaches unorganized operators.

5. Technology pathways for clean freight

India's freight system is heterogeneous, spanning short-haul deliveries, long-haul trucking, and specialized industrial logistics. Each segment requires a differentiated decarbonization strategy rather than a one-size-fits-all approach. Technology pathways must therefore be mapped against operational realities, payload requirements, and infrastructure availability, ensuring that adoption is both technologically feasible and economically viable:

- **Short-haul use cases:** Battery electric trucks (BETs) are the most viable technology option for short-haul routes typically covering 150–200 kilometers per day. These routes such as e-commerce deliveries,

port-to-warehouse transfers, and last-mile distribution are well-suited to centralized depot-based overnight charging. Advances in high-capacity battery packs, regenerative braking, and lightweight materials are further improving vehicle performance, while pilot projects in urban logistics hubs are already demonstrating operational feasibility. Emerging innovations, such as compact fuel cells for range extension, could expand BET competitiveness in peri-urban freight markets.

- **Heavy-duty, long-haul operations:** Long-distance trucks covering 300–600 kilometers daily with heavy payloads face significant barriers in adopting BETs, primarily due to limited range, slow charging cycles, and the near absence of megawatt-level charging stations. Hydrogen fuel cell electric vehicles (FCEVs) offer a promising alternative, with faster refueling, higher energy density, and suitability for energy-intensive routes. However, their commercial deployment depends on the rapid scaling of hydrogen production and refueling infrastructure, which remains embryonic in India. Battery-swapping models may partially bridge this gap, reducing downtime for long-haul fleets, but questions of standardization and capital costs persist.
- **Mining, construction, and industrial logistics:** Segments such as mining, construction, and heavy industrial transport involve high vehicle utilization within geographically constrained zones. Here, hydrogen FCEVs demonstrate advantages through quick refueling and durability under intensive duty cycles. In the near term, transitional fuels such as liquefied natural gas (LNG) and bio-CNG offer partial emissions reductions where electric or hydrogen technologies face barriers to scale. These alternatives can serve as bridging solutions while zero-emission technologies mature.

The central technological challenge lies in the lack of freight-oriented infrastructure. Most existing charging networks are designed for passenger EVs, with limited capacity for heavy-duty trucks. Dedicated megawatt chargers and hydrogen refueling stations are scarce and largely at the pilot stage. Daily runs of 300–600 kilometers with full payloads expose the inadequacy of current BET ranges and the operational bottleneck of long charging times.

Scaling clean freight technologies will therefore require synchronized progress across vehicles, infrastructure, and financing. Ultimately, success will depend not only on technological readiness but also on demonstrating long-term economic competitiveness and reliability across India's varied freight use cases.

6. Building the institutional ecosystem

Decarbonizing freight requires harmonized action across ministries, agencies, and market participants. The mandates of Road Transport and Highways (MoRTH), Power, Heavy Industry, and New and Renewable Energy ministries overlap, making institutional coordination vital. Inconsistent policies and fragmented incentives can create confusion, slow action, and waste investment.

Opportunity areas include cross-ministerial collaboration, alignment between central and state authorities, and representation of small fleet operators in policymaking. Currently, data and transparency gaps prevent effective planning and monitoring. Standards for vehicles, batteries, charging systems, and emissions measurement remain under development, creating uncertainty for investors. The result is a patchwork of initiatives with small impact at scale, despite growing policy intent.

The way forward lies in building robust coordination platforms that pool risk and direct capital to unorganized operators. By harmonizing efforts across technology, finance, and policy domains, India can create an enabling ecosystem that supports a comprehensive transition to zero-emission freight.

An action agenda for mainstreaming ZET in India

India stands at a pivotal moment. Decarbonizing the freight sector is not only a climate imperative, but also a socio-economic opportunity to create green jobs, strengthen energy resilience, and improve air quality. But there are still important questions to answer: Are current incentives strong enough to de-risk early adoption? How can policy clarity accelerate OEM investment and fleet operator buy-in? And what kind of coordination is needed across central and state governments?

The answers lie in an integrated action agenda, one that addresses the technological diversity of trucking applications, the financial barriers faced by operators, and the need for coherent institutional collaboration. Success depends on aligning appropriate ZET technologies with operational realities, unlocking innovative financing to overcome upfront cost challenges, and fostering seamless coordination among policymakers, industry, and financiers. Moving from pilots to full-scale transformation requires momentum on the following five fronts.

1. Design targeted incentives for market creation

Early adoption of zero-emission trucks requires stronger market signals. Globally, successful transitions have combined subsidies with regulatory mandates to create demand certainty. In India, a similar strategy is essential.

1A. Targeted incentives for fleet operators: Purchase subsidies or scrappage-linked incentives for MDVs and HDVs can lower the prohibitive upfront cost. Freight operators are highly cost-sensitive and will only shift if incentives visibly reduce payback time. These incentives should be designed to support both large fleets and micro, small, and medium enterprises (MSMEs).

1B. Expanding the Production-Linked Incentive (PLI) scheme: Current PLI schemes largely focus on passenger EVs and components such as advanced chemistry cells. Expanding coverage to include ZET-specific drivetrains, battery packs for heavy-duty applications, and hydrogen fuel cell systems would signal long-term policy commitment. This would also encourage domestic manufacturing, reducing reliance on imported technologies and strengthening India's industrial competitiveness.

1C. Mandating public procurement: Large-scale adoption can be kick-started by requiring public-sector logistics fleets to procure a minimum percentage of ZETs (examples include rail freight feeders, port operations, and food grain distribution). Government demand aggregation creates scale for manufacturers and also demonstrates operational feasibility to private operators.

2. Build freight-centric infrastructure corridors

Freight decarbonization demands dedicated, high-capacity infrastructure that meets the specific operational and technical requirements of clean truck technologies.

2A. Investments should **prioritize megawatt-level charging hubs** along priority freight corridors.

2B. Grid integration and land access: High-capacity charging for freight vehicles will place significant strain on distribution infrastructure. Proactive investment in substations, smart load management, and storage integration will be critical. States should simplify land leasing along highways for ZET infrastructure, drawing from renewable energy park models that successfully unlocked scale for solar power.

2C. Hydrogen pilots must be scaled into commercial ecosystems with clusters of refueling stations integrated into industrial hubs, mining belts, and ports. Lessons from Japan and South Korea show that coordinated rollout of vehicles and stations within defined zones is more effective than scattered pilots.

2D. Public–private partnerships shall be designed where land is leased at concessional rates, renewable

power purchase agreements are secured, and operators gain access to overnight depot charging.

3. De-risk early investments

For fleet operators, the transition to ZETs is primarily a financial decision. Without addressing cost barriers and credit access, adoption will stall.

3A. Blended finance structures: India can implement blended finance platforms where concessional capital from multilateral agencies is combined with commercial finance. These structures can offer first-loss guarantees or interest subvention to reduce lender risk. By pooling capital, they can unlock larger credit flows for ZET adoption at competitive rates.

3B. Fostering leasing and pay-per-use models: Instead of outright purchase, small operators could access trucks through leasing markets, battery-as-a-service (BaaS), or pay-per-kilometer schemes. To enable this, clear residual value frameworks and secondary markets for ZETs must be established.

3C. Demand aggregation platforms: MSMEs cannot individually negotiate favourable loan terms or service contracts. Demand aggregation through cooperatives, logistics clusters, or digital platforms can pool procurement, financing, and servicing, reducing unit costs and risk exposure.

3D. Carbon credit monetization: Emission reductions from ZET operations can generate carbon credits that add an additional revenue stream. Aggregating these credits through a national platform could further incentivize operators while aligning with global climate finance mechanisms.

4. Strengthen institutional coordination

4A. Establishing a **national freight decarbonization task force** co-chaired by MoRTH and MNRE, with representation from MoP, MHI, NITI Aayog, and state governments, can provide unified direction. This platform would be responsible for harmonizing incentives, setting adoption targets, and coordinating corridor-level planning.

4B. Freight flows do not stop at state boundaries, yet policies often do. **States must be supported to create enabling policies** such as land allocation, state EV subsidies, and electricity tariff rationalization that complement national measures.

4C. Inclusion of small fleet operators: Policy design often reflects the interests of large logistics players, sidelining MSMEs. Dedicated consultation forums and capacity-building programs for small fleet operators can ensure inclusivity and broader buy-in.

4D. Financing institution alignment: Development banks, commercial lenders, and NBFCs must be connected to policy goals through priority sector lending classifications or credit guarantee schemes.

5. Enhance data and R&D capacity

Reliable data and robust R&D are the bedrock of long-term freight decarbonization. Currently, gaps in data on fleet operations, fuel consumption, and emissions make planning and monitoring difficult.

5A. Establishing **measurement, reporting, and verification (MRV) systems** for freight emissions using digital telematics, smart meters, and blockchain-backed registries would improve transparency. Such systems could also underpin carbon credit generation and compliance frameworks.

5B. Indigenous technology development: India must invest in developing ZET technologies tailored to its conditions. Public-private research partnerships should focus on high-capacity batteries suited for hot climates, modular fuel cells, and cost-effective charging technologies.

5C. Academic-industry collaboration: Institutions such as IITs, NITs, and CSIR labs can be linked with OEMs and logistics companies to build applied

research programs. Dedicated freight technology centers could mirror the success of solar research institutions that helped bring down renewable energy costs in India.

5D. Global collaboration: India should actively participate in international freight decarbonization alliances, enabling technology transfer, harmonized standards, and joint R&D pilots. Collaboration with Asian peers such as China, Japan, and South Korea, which are investing heavily in ZETs, can accelerate learning.

Action agenda for mainstreaming ZET in India

1. Design targeted incentives for market creation

- **Targeted incentives for fleet operators** ⟶ Reduce payback time visibly
- **Expanding the Production-Linked Incentive (PLI) scheme** ⟶ ZET-specific drivetrains and packs
- **Mandating public procurement** ⟶ Government demand aggregation scale

2. Build freight centric infrastructure corridors

- **Megawatt-level charging hubs** ⟶ Priority freight corridor charging
- **Grid integration and land access** ⟶ Smart load management critical
- **Hydrogen pilots into ecosystems** ⟶ Defined zones more effective
- **Public–private partnerships** ⟶ Concessional land lease agreements

3. De-risk early investments

- **Blended finance structures** ⟶ First-loss guarantees reduce risk
- **Leasing and pay-per-use models** ⟶ Battery-as-a-service schemes
- **Demand aggregation platforms** ⟶ Pool procurement and servicing
- **Carbon credit monetization** ⟶ National platform carbon credits

4. Strengthen institutional coordination

- **National freight decarbonization task force** ⟶ Unified direction and planning
- **State-level policy support** ⟶ Electricity tariff rationalization
- **Inclusion of small fleet operators** ⟶ Dedicated consultation forums
- **Financing institution alignment** ⟶ Priority sector lending classifications

5. Enhance data and R&D capacity

- **Measurement, reporting, and verification systems** ⟶ Digital emissions registries
- **Indigenous technology development** ⟶ High-capacity batteries hot climates
- **Academic-industry collaboration** ⟶ Dedicated freight technology centers
- **Global collaboration** ⟶ International freight alliances participation

ICF in action

ICF is a global leader in clean transportation consulting, with over 50 years of experience supporting governments, development partners, and private sector clients in advancing sustainable mobility. In India and South Asia, ICF is actively shaping the freight decarbonization agenda through policy advisory, stakeholder engagement, and market development.

- ICF conducted a logistics energy and emissions audit for a growing agri-logistics startup, including a market assessment to map OEMs and operators offering clean transport technologies across short- and long-haul use cases.
- ICF supported a World Bank–backed study on heavy-duty vehicles (HDVs) in Bangladesh, focused on identifying policy-level interventions to transition toward cleaner fuels and alternative powertrains.
- ICF has conducted multiple market assessments for UK-based innovators to understand the current landscape and trends in electric mobility adoption across passenger and freight segments.
- ICF supported state and local governments in Shimla and Chandigarh to develop low-carbon mobility plans, including phased roadmaps for the adoption of electric vehicles across segments.
- ICF developed an EV Charging Roadmap for Guwahati city and the 220-km Guwahati–Kaziranga Highway, aligned with EV adoption scenarios and grid upgradation needs.
- ICF supported a World Bank–backed study on developing an EV policy and strategic adoption of electric buses in Kathmandu, Nepal.
- ICF has supported 20+ U.S. public agencies at the federal, state, and local levels, offering technical advisory on EV infrastructure planning and strategy.
- Since 2000, ICF has supported the U.S. Department of Energy (DOE) Vehicle Technologies Office with a variety of alternative fuels programs and efforts.

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