A Futures Report By

OMI FOUNDATION

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EV-Ready Tamil Nadu:

Electrifying Freight With Wireless Charging

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October 2025

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Foreword

Sivarajah Ramanathan
Mission Director and
CEO, StartupTN

As the nodal agency supporting entrepreneurship and innovation in Tamil Nadu, StartupTN has consistently sought to nurture an ecosystem that empowers startups, fosters technological advancement, and drives sustainable industrial growth. In line with this mission, I am proud to present the study titled, ***'EV-Ready Tamil Nadu: Electrifying Freight with Wireless Charging'***, authored by **OMI Foundation**, and supported by **StartupTN**.

This report represents a shared vision for transforming Tamil Nadu's logistics and industrial sectors by pioneering the adoption of wireless charging systems for freight. This collaboration highlights the immense potential of wireless freight electrification to enhance operational efficiency, reduce emissions, and catalyse inclusive economic growth.

Tamil Nadu's freight corridors, industrial clusters, renewable energy capacity, and skilled workforce position the State uniquely to become India's first mover in next-generation freight electrification. Beyond the environmental and operational benefits, wireless charging systems offer opportunities for startups, SMEs, and innovators to develop solutions in retrofitting, digital platforms, energy management, and advanced logistics technologies.

The insights and recommendations in this report provide a practical roadmap for piloting, scaling, and mainstreaming wireless freight solutions in Tamil Nadu. StartupTN is committed to supporting this journey by fostering innovation, facilitating partnerships, and promoting entrepreneurship that can turn these technological opportunities into sustainable, large-scale impact.

This report is both a blueprint and a call to action for all stakeholders - startups, industry leaders, policymakers, and researchers - to collaborate in building a future-ready freight ecosystem.

Foreword

Ambassador (Retd.) Gautam Bambawale
Managing Trustee,
OMI Foundation

Harish Abichandani
First Trustee,
OMI Foundation

At OMI Foundation, we believe that the future of mobility must be shaped at the intersection of innovation, inclusion, and sustainability. Tamil Nadu has long exemplified this spirit: from pioneering renewable energy adoption to anchoring India's electric vehicle and electronics industries. Today, as the state advances toward becoming a USD 1 trillion economy, the decarbonisation of freight emerges as both an economic necessity and a climate imperative.

Freight is the backbone of Tamil Nadu's manufacturing and export competitiveness, but it is also a source of disproportionate fuel consumption, logistics costs, and emissions. Addressing this challenge requires boldness equal to the scale of the opportunity. **Wireless electric road systems (ERS)** represent such a frontier. No longer confined to research labs, these technologies are being deployed the world over. **Tamil Nadu is uniquely positioned to pioneer their adoption in India**, leveraging its freight-intensive corridors, renewable power base, and proven culture of industrial innovation.

This report, ***EV-Ready Tamil Nadu: Electrifying Freight with Wireless Charging***, authored by **OMI Foundation**, and supported by **StartupTN**, presents a comprehensive roadmap for how the state can move from concept to scale. It is the product of deep research, rigorous analysis, and a conviction that India's logistics transition must go beyond incremental solutions. The findings confirm that while challenges remain, the economic, environmental, and social benefits of wireless freight electrification are within reach - if we act decisively.

We offer this Futures Report as both a call to action and a framework for collaboration. The transition to clean freight cannot be achieved by the government alone. It demands coordinated leadership from policymakers, industry, utilities, startups, and research institutions. **Tamil Nadu has the opportunity to lead India as the nation's Wireless Freight Pioneer, setting standards that can ripple across the country, and inspire the Global South and the rest of the world.**

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Executive Summary

Tamil Nadu's freight sector lies at the intersection of its industrial growth, export competitiveness, and climate goals. Medium and heavy-duty trucks (M&HDTs) move the bulk of goods in the state but are responsible for ~35% of transport fuel consumption and ~45% of transport emissions. With freight demand projected to grow sharply alongside manufacturing and e-commerce expansion, electrifying freight is no longer optional; it is an **economic necessity** and a **climate imperative**.

Conventional charging solutions - plug-in stations and battery swapping - have proven insufficient for freight. They demand large land parcels, add downtime, and impose payload penalties from oversized batteries. **Wireless electric road systems (ERS) offer a transformative alternative.** Energy is transferred from coils embedded in the road to receivers installed on vehicles, allowing trucks to charge while stationary at depots or dynamically while in motion.

Figure 1: Dynamic induction electric charging for EVs piloted in Italy

Source: Stellantis, 2022

Why Wireless, Why Now: Unlocking Freight's Next Leap

1. **Efficiency:** Inductive ERS systems achieve ~91% efficiency; conductive alternatives up to 97%. Smaller onboard batteries reduce capital costs and protect payload capacity.
2. **Grid Management:** ERS distributes demand spatially and temporally, unlike fast-charging hubs. When paired with Tamil Nadu's renewable energy base, it delivers lifecycle emissions reductions.
3. **Economic Viability:** Despite high upfront costs, operational savings, higher utilisation, and falling battery prices make ERS viable within 7-10 years on high-volume corridors.
4. **Industrial Competitiveness:** By cutting downtime and logistics costs, Tamil Nadu's exporters gain resilience against compliance regimes like the EU's Carbon Border Adjustment Mechanism (CBAM).
5. **Socio-Economic Benefits:** Jobs in retrofitting, installation, and digital platforms; opportunities for startups in fleet optimisation and billing systems.

Figure 2: Wireless Charging: Coils under the asphalt safely transfer energy directly to EVs

Source: Stellantis, 2022

How We Built the Case: Evidence, Data, and Global Lessons

This Futures Report was conceptualised with four core objectives:

1. Establish the strategic case for freight electrification in Tamil Nadu.
2. Assess the scalability and impact of wireless charging on freight corridors.
3. Evaluate state readiness across infrastructure, grid capacity, retrofitting, and policy frameworks.
4. Recommend actionable pathways for deployment in Tamil Nadu's logistics ecosystem.

The methodology integrated global evidence with Tamil Nadu-specific analysis:

1. **Secondary Data Review:** Tamil Nadu EV Policy (2023), Logistics Policy (2023), and Economic Survey 2024-25; national baselines from NITI Aayog and RMI.
2. **Technology Assessment:** Insights from ICCT, ASPIRE, and ERTICO's FABRIC project, comparing ERS against plug-in and swapping.
3. **State Readiness Analysis:** VAHAN vehicle registration data to assess fleet composition; corridor suitability analysis (Chennai-Bengaluru, Chennai-Coimbatore, Manali-Ennore-CPRR); qualitative review of grid and renewable capacity.

What the Evidence Shows: Corridors, Costs, and Readiness

1. **Corridor Potential:** Chennai-Bengaluru and Chennai-Coimbatore corridors emerge as high-value pilots due to freight intensity, industrial clustering, and grid readiness; Manali-Ennore-CPRR offers a short, high-density urban-industrial loop for demonstration.
2. **Fleet Suitability:** N3A/B trucks (12-28 t) are the sweet spot for near-term retrofits; heavier N3C/D tractors (>28 t) will require new chassis and phased adoption.
3. **Grid Integration:** Tamil Nadu's renewable-rich grid can support ERS pilots, though substation upgrades and load-balancing will be required.
4. **Economic Case:** Fuel and maintenance savings can offset CapEx within 7-10 years; benefits grow with adoption. Battery price declines and carbon credit markets further improve viability.
5. **Socio-Economic Impact:** Corridor pilots can create hundreds of jobs, stimulate MSME participation, and anchor Tamil Nadu as a national hub for logistics-tech startups.

The Way Forward: Pilots, Policy, and Partnerships

1. **Pilot Corridor Development**
    a. Embed ERS in the under-construction Chennai Peripheral Ring Road (CPRR) to cut retrofit costs.
    b. Demonstrate dynamic charging on the Manali-Ennore-CPRR loop.
2. **Fleet Transition Strategy**
    a. Retrofit MDTs and HDTs (12-28 t) as first movers.
    b. Collaborate with OEMs (Ashok Leyland, Tata Motors, VECV, etc.) on ERS-ready designs.
3. **Infrastructure and Grid**
    a. Integrate ERS into NH44, NH48, NH544 corridors.
    b. Plan substation upgrades and renewable integration points.
    c. Develop tariff frameworks based on distance travelled or kWh consumed.
4. **Financing and Investment**
    a. Establish PPP-based SPVs for corridor pilots.
    b. Leverage state support with central schemes (PM E-DRIVE, MAHA EV Mission, DST funds).
    c. Attract FDI from global ERS providers to anchor India hubs in Tamil Nadu.

5. **Policy and Standards**
    a. Mainstream ERS into Tamil Nadu EV Policy, Logistics Policy, and Climate Action Plan.
    b. Develop standards for coils, communication protocols, and vehicle retrofits.
    c. Ensure safety protocols for ERS-ready trucks.
6. **Workforce and Startups**
    a. TNSDC to design training modules in retrofitting, ERS installation, and grid analytics.
    b. Prioritise women-centric skilling and rural participation.
    c. Launch startup challenge funds for billing systems, fleet optimisation, and V2I technologies.

The Payoff: Tamil Nadu as India's Wireless Freight Pioneer

By mainstreaming wireless freight electrification today, Tamil Nadu can:

- Reduce logistics costs, strengthen export competitiveness, and safeguard against global carbon trade barriers.
- Create thousands of high-quality jobs in advanced logistics, manufacturing, and digital innovation.
- Anchor high-value FDI and become a hub for ERS technology in India and beyond.
- Cement its role as **India's Wireless Freight Pioneer**, setting benchmarks for other states and positioning itself as a global knowledge hub for the logistics decarbonisation agenda of the Global South and the rest of the world.

1. Introduction

Freight is Tamil Nadu's growth engine, and its emissions hotspot. Medium and heavy-duty trucks (M&HDTs) move about 68% of India's road freight, with annual sales of over 3,20,000 vehicles, a figure expected to rise steadily through 2050 (McNamara & Shiledar, 2025). Tamil Nadu's ports, auto clusters, and e-commerce hubs make it one of India's most freight-intensive states, amplifying both the challenge and the opportunity of electrification. Decarbonising commercial fleets is not only an environmental imperative but also a strategic economic necessity for sustaining growth.

1.1. Freight Outside the EV transition

Despite Tamil Nadu's aggressive EV push, the focus has largely been on two- and three-wheelers and passenger vehicles, with companies like Ola Electric, Hyundai, and TVS leading the charge. Public charging infrastructure too has been concentrated in urban areas and built around static plug-in models. Freight fleets - responsible for 35% of transport fuel consumption and 45% of emissions - remain largely outside the transition (McNamara & Shiledar, 2025). **This dependence on fossil fuel imports locks India into a vulnerable position, while for an export-oriented state like Tamil Nadu, freight inefficiencies and downtime directly inflate logistics costs.** These inefficiencies are particularly concerning under new global compliance regimes such as the EU Carbon Border Adjustment Mechanism (CBAM), which penalises carbon-intensive supply chains.

Traditional charging options such as plug-ins and battery swapping have proven inadequate for freight. Their land and power demands are high, queuing delays are common, and they cannot provide the scale, payload tolerance, turnaround speed, or continuous operations that logistics operators require (OMI Foundation, 2025).

1.2. Wireless Charging as a Next-Generation Imperative

By contrast, **wireless electric road systems (ERS) represent a paradigm shift**. Global pilots in Sweden, Germany, France, and Israel among others demonstrate that ERS technologies are no longer speculative; they are deployable solutions. These systems embed pads within the road to transfer energy magnetically to receivers installed on vehicles. Trucks can charge wirelessly while stationary - during loading or unloading - or dynamically while moving along designated road segments. The advantages are clear: reduced downtime, higher vehicle utilisation, and smaller battery requirements, which lower upfront costs and improve efficiency.

Figure 3: Wireless Charging Deployment in Italy

Source: Stellantis, 2022; Electreon. (n.d.).

1.3. Why Tamil Nadu is uniquely positioned

Tamil Nadu is particularly well suited to pioneer ERS in India. The state combines **high-throughput freight corridors** (Chennai-Bengaluru, Chennai-Coimbatore, Manali-Ennore-CPRR[1] loop), **dense industrial and logistics clustering**, and a **rapidly growing renewable energy base**. It has a proven track record as an **"innovation-first" state**: from early renewable energy investments in the 1990s, to hosting some of **India's largest EV and electronics manufacturing facilities** today, to anchoring **world-class research** at IIT Madras's Centre of Excellence for Zero Emission Transport (CoE–ZET), among others.

These conditions create a natural testbed for next-generation freight technologies. Corridor-level pilots in Tamil Nadu can demonstrate the feasibility of wireless charging, build confidence among operators and investors, and position the state as a national and global leader in logistics decarbonisation.

1.4. The Case for Disruption

While wireless charging requires significant upfront investment, the long-term gains are substantial: lower operating costs through reduced fuel consumption and maintenance, resilience against volatile oil imports, and enhanced export competitiveness for India in general, and Tamil Nadu's industries in particular (ITS India Forum, OMI Foundation, NATRAX, 2025). For a state aspiring to become a USD 1 trillion economy, freight modernisation is not optional. Industrial growth, e-commerce expansion, and rising logistics demand require Tamil Nadu to disrupt its freight backbone - raising efficiency, enabling startups and new business models, and strengthening its position as India's innovation frontier.

[1] Chennai Peripheral Ring Road

2. Approach and Evidence Base: Wireless EV Charging in Tamil Nadu

2.1. Research Objectives

This Futures Report **examines the potential of wireless charging as a pathway to accelerate the electrification of Tamil Nadu's commercial freight sector**. The study was conceptualised around four objectives:

1. Establish the strategic case for freight electrification in Tamil Nadu.
2. Assess the scalability and impact of wireless charging along freight corridors.
3. Evaluate state readiness across infrastructure, grid capacity, retrofitting, and policy frameworks.
4. Recommend actionable pathways for deployment in Tamil Nadu's logistics ecosystem.

2.2. Research Methodology

To achieve these objectives, the **methodology integrates global evidence with Tamil Nadu-specific data across three interlinked layers of analysis**.

Secondary Data Review

Peer-reviewed literature, government policies, and industry reports formed the foundation of the study. Key state documents include the **Tamil Nadu Electric Vehicles Policy (2023)**, the **Tamil Nadu Logistics Policy and Integrated Logistics Plan (2023)**, and the **Tamil Nadu Economic Survey 2024-25 (Government of Tamil Nadu, 2023; 2025)**. These provide the policy backdrop for freight electrification.

At the national level, freight activity and emissions baselines were derived from **NITI Aayog and RMI's Fast Tracking Freight in India (2021)**, complemented by **recent analyses of India's zero-emission truck potential** (McNamara & Shiledar, 2025). Together, these sources contextualise Tamil Nadu's freight challenge within India's broader transition.

2.2.1. Technology and Feasibility Assessment

Insights on charging technologies were drawn from ICCT's Charging Solutions for Battery Electric Trucks (2022), the ASPIRE Research Center's corridor feasibility studies (Haddad et al., 2022), and the FABRIC project led by ERTICO (2018). Collectively, these studies demonstrate that high-volume, predictable truck corridors are most viable for early wireless deployment.

To benchmark against alternatives, existing literature was reviewed on plug-in charging, swapping, and stationary inductive solutions. This comparative analysis highlights the operational limits of incumbent models and the potential efficiency gains of dynamic wireless systems.

2.2.2. Tamil Nadu-Specific Readiness Analysis

Vehicle registration data from the **Ministry of Road Transport and Highways (MoRTH) VAHAN dashboard** was analysed to estimate the stock and composition of M&HDTs in Tamil Nadu. This enabled segmentation of candidate fleets for retrofitting and cost modelling. Findings were synthesised into comparative tables showing corridor suitability across ERS, plug-in, and swapping technologies.

A **qualitative review of the state's grid capacity, policy environment, and logistics patterns** further contextualised feasibility. In particular, the integration potential of **Tamil Nadu's renewable power base** was considered central to the long-term emissions benefits of freight electrification.

3. Tamil Nadu's Freight Economy: Growth, Policy, and Next Frontiers

3.1. Trade, Transport, and Growth Targets

Tamil Nadu has emerged as one of India's fastest-growing economies, achieving a record growth rate of **11.2% in 2024-25** (Ministry of Statistics and Programme Implementation, 2025). Growth has been anchored in trade (11.7%), manufacturing (8%), and construction (10.6%), all of which depend heavily on efficient commercial logistics (Government of Tamil Nadu, 2025).

The state is a leading hub for automobiles, textiles, leather, machinery, and electronics, and a top exporter of engineering goods, garments, and handloom products. For Tamil Nadu, both **cross-border exports** and **intra-state movement of goods** are critical.

Tamil Nadu's ambition to reach **USD 1 trillion GSDP by 2030** rests on expanding manufacturing to USD 250 billion and exports to USD 100 billion. Achieving this target requires a sharp reduction in logistics costs, which in India average around **13% of GDP**, compared to ~8% in OECD economies. Closing this gap would save Tamil Nadu billions annually and directly enhance its export competitiveness. This is a critical buffer against global compliance regimes such as the **EU Carbon Border Adjustment Mechanism (CBAM)**.

3.2. Logistics Infrastructure and Policy Framework

Tamil Nadu has **one of India's most extensive logistics ecosystems**:

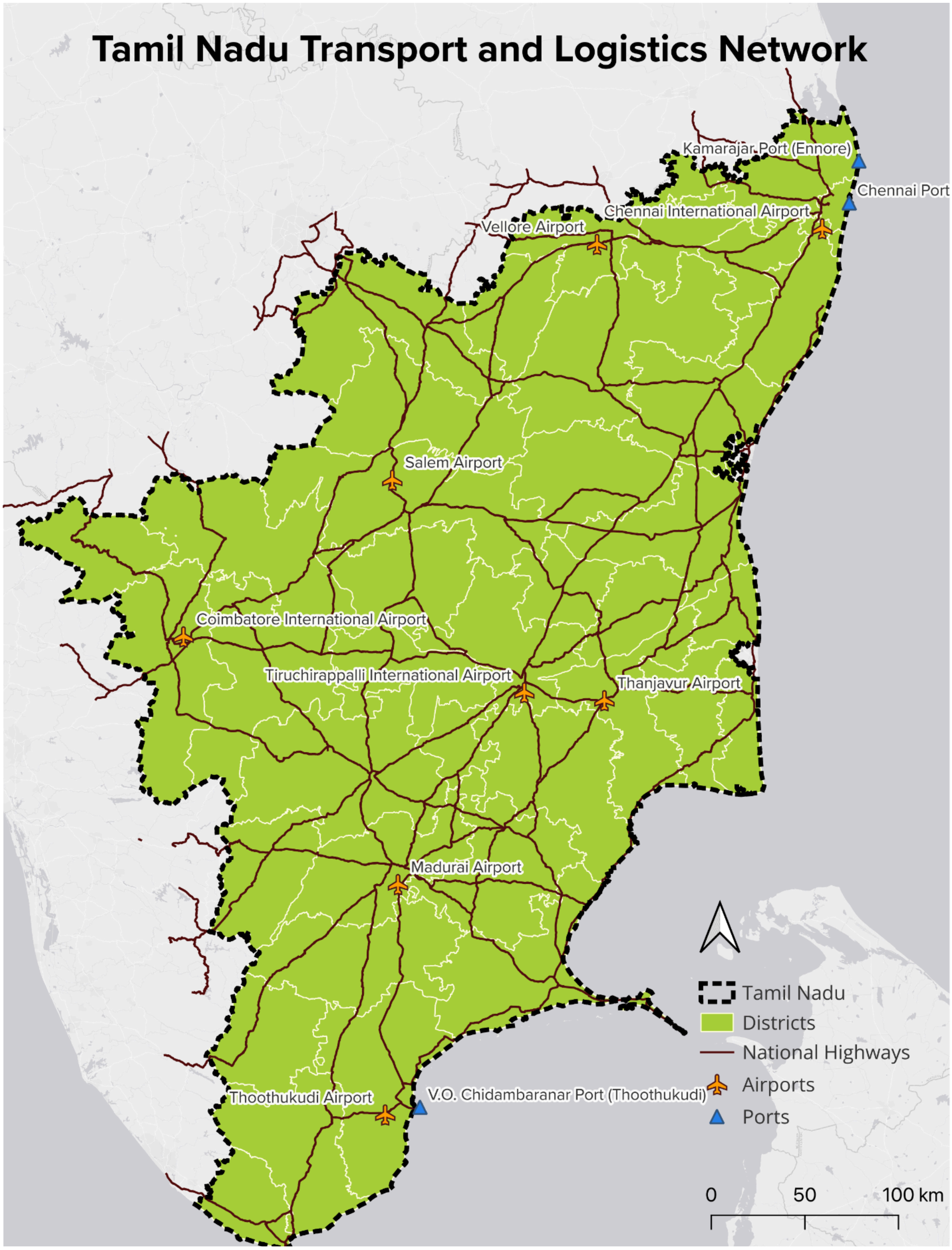
- ➢ A 2.5 lakh km road network,
- ➢ Three major ports: Chennai Port, the Kamarajar Port (Ennore), and the V.O. Chidambaranar Port (Thoothukudi),
- ➢ Four international, and additionally, three domestic airports, and
- ➢ Strong industrial and warehousing clusters.

Despite this multimodal footprint, **65% of freight still moves by road**, driving congestion and high transport costs. Tamil Nadu consistently ranks among the top five in India's **LEADS Index**, yet further efficiency gains are essential to sustain export-led growth.

Recognising this, the state launched the **Tamil Nadu Logistics Policy and Integrated Logistics Plan (2023)**, which identifies logistics as a critical enabler of industrial competitiveness. The policy emphasises resilience, sustainability, and new-age technologies. In parallel, the **Tamil Nadu Electric Vehicles Policy (2023)** offers incentives for commercial electrification, including purchase subsidies, fee waivers, and capital support for charging and swapping infrastructure.

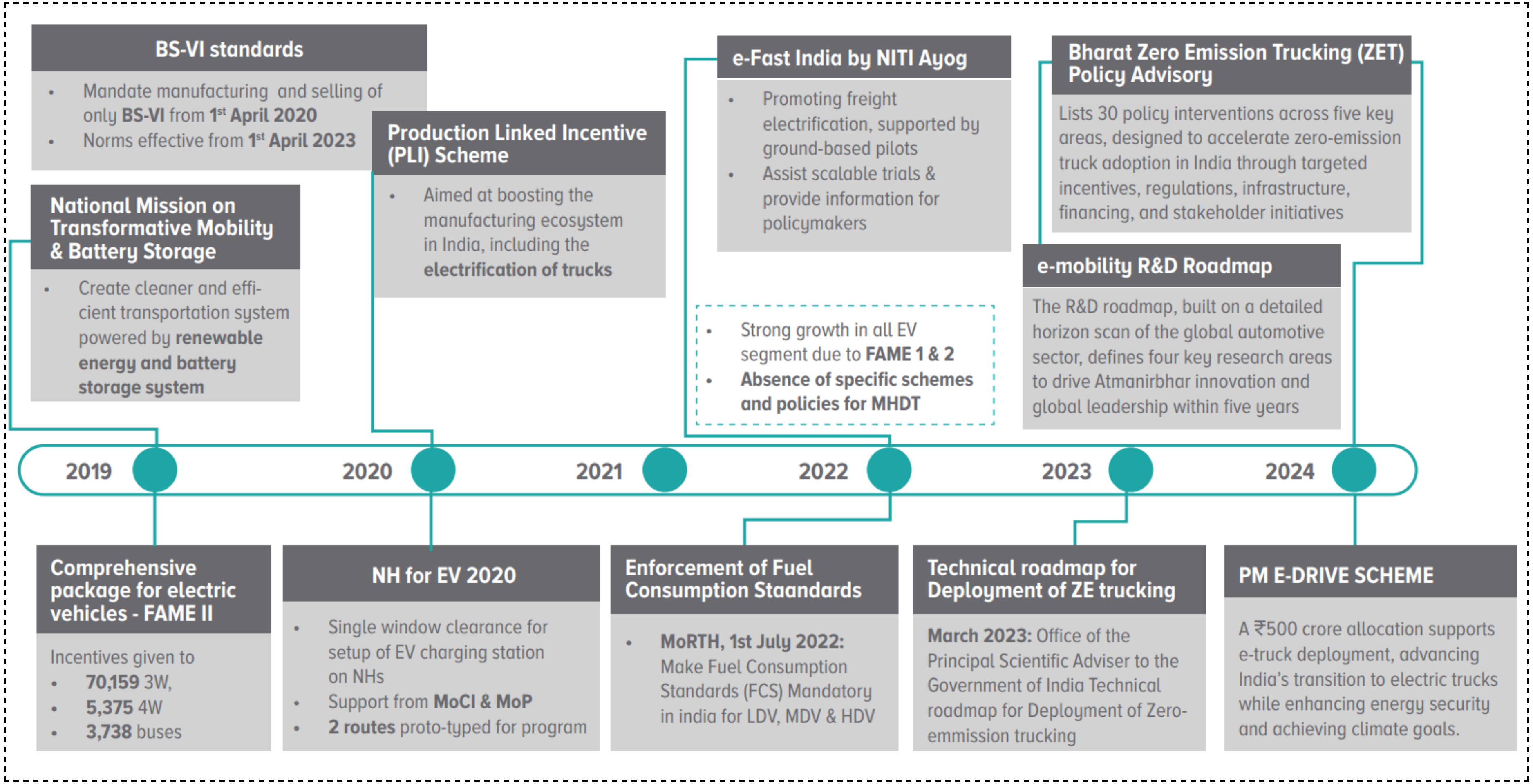
However, much of this policy thrust remains concentrated on passenger and light commercial vehicles. Heavy freight, the backbone of Tamil Nadu's logistics system, is still the next frontier. At the national level, complementary initiatives such as **PM E-DRIVE** (₹2,000 crore for EV charging and truck subsidies) and the **Logistics Efficiency Enhancement Program (LEEP)** (focused on multimodal logistics parks) provide additional levers for Tamil Nadu to accelerate freight decarbonisation.

Figure 4: Strategic logistic network of Tamil Nadu



Source: Authors; from multiple sources.

Figure 5: Tracking India's EV policies



Source: Authors; Adapted from SFC India, 2025.

3.3. Positioning Tamil Nadu for the Next Frontier

Tamil Nadu has repeatedly demonstrated its ability to leapfrog into new industries - from pioneering renewable energy investments in the 1990s to becoming India's EV manufacturing hub in the 2020s. Freight electrification, particularly through **Electric Road Systems (ERS)** in general, and **wireless charging**, in particular, represents the state's next leap.

Recent deployment of electric trucks along the **Chennai-Trichy corridor** signals early readiness for freight decarbonisation, creating a natural testbed for wireless pilots. Corridors such as **Chennai-Bengaluru**, **Chennai-Coimbatore**, and the **Manali-Ennore-CPRR loop** are already dense with industrial and logistics flows. They can be converted into "living laboratories" where **startups** develop **retrofit solutions, digital billing platforms, and AI-based fleet optimisation tools,** supported by Tamil Nadu's **research and incubation ecosystem** (IIT Madras CoE–ZET, CoEs in logistics, and innovation hubs).

By aligning its logistics ambitions with frontier technologies, Tamil Nadu can simultaneously:

- ➢ Reduce logistics costs and strengthen export competitiveness,
- ➢ Safeguard its industries under global decarbonisation regimes,
- ➢ Attract FDI in green logistics and infrastructure, and
- ➢ Generate high-quality jobs in EV retrofitting, infrastructure installation, and system integration.

In short, **freight electrification is not just a climate strategy; it is an industrial competitiveness strategy** that can cement Tamil Nadu's role as India's innovation frontier in logistics.

4. Wireless Charging: A Next-Generation Imperative for Tamil Nadu

While today's charging innovations have solved many challenges of early EV adoption, they remain rooted in **stationary plug-in models** that require downtime, land-intensive infrastructure, and large grid connections (OMI Foundation, 2025). For freight, these shortcomings are amplified: queuing delays, payload penalties from oversized batteries, and heavy land requirements near logistics hubs.

Wireless or inductive charging offers a transformative alternative. Here, energy transfers via magnetic fields between a pad embedded in the road and a receiver on the vehicle. In practice, trucks can "top up" while parked in a loading bay (static charging) or, more ambitiously, charge dynamically as they move along specially equipped road segments (dynamic charging).

4.1. Technical Explainer: How Wireless Charging Works

- ➢ **Static Wireless Charging**: Vehicles charge while stationary at depots, logistics parks, or port complexes. Inductive Power Transfer (IPT) systems can achieve **90-93% efficiency** when alignment is optimal, making them well suited for overnight or opportunity charging.
- ➢ **Dynamic Wireless Charging**: IPT modules embedded in the road surface allow in-motion charging. This reduces reliance on large batteries, optimises payload capacity, and supports continuous operations. However, dynamic systems require higher upfront investment and careful standardisation of coil design, communication protocols, and road durability.

ERS technologies overall deliver **energy transfer efficiencies of ~91%** for inductive systems and up to 97% for conductive alternatives. Importantly, by sending power directly to the traction motor, ERS can improve overall system efficiency by 10% or more compared to conventional battery-electric vehicles (ITS India Forum, OMI Foundation, and NATRAX, 2025).

4.2. Global Implementation: From Sweden to South Korea

Wireless charging is not futuristic; it is already being piloted worldwide. A few leading deployments are listed below, based on the comprehensive global analysis undertaken by ITS India Forum, OMI Foundation, and NATRAX (2025).

1. **Sweden - EVolution Road (Lund):** Tests dynamic charging for buses and light vehicles.
2. **France - CAYD Project (A10 Motorway):** Combining inductive wireless and conductive rail charging for long-haul freight.
3. **Germany - ELISA (A5 Autobahn):** Overhead ERS for hybrid freight trucks, showing how heavy-duty systems can integrate with existing highways.
4. **United States - Detroit Wireless Roadway:** First public inductive road charging project, developed by MDOT and Electreon.

5. **Israel - Tel Aviv University Project:** Demonstrated in-road wireless charging for electric buses.
6. **South Korea - OLEV (Gumi City):** One of the earliest inductive freight demonstrations, integrated into public bus operations.

These global pilots confirm the technical viability of both static and dynamic wireless charging across varied geographies - from dense urban roads to mountainous highways (ITS India Forum, OMI Foundation, and NATRAX, 2025).

4.3. Benefits for India and Tamil Nadu

For India, and particularly Tamil Nadu, wireless charging offers several strategic advantages (ITS India Forum, OMI Foundation, and NATRAX, 2025):

1. **Reduced Battery Size and Payload Protection:** Freight operations are often mass-limited. Smaller onboard batteries free up space and weight for cargo, directly improving operator profitability.
2. **Distributed Grid Load:** Unlike fast-charging hubs, ERS spreads demand spatially (every 2 km instead of every 40 km) and temporally, easing local grid stress. This is especially critical in industrial belts like **Chennai-Bengaluru** and **Coimbatore-Salem**.
3. **Lower Infrastructure Footprint:** Conventional depot charging could require tens of thousands of separate grid connections; an ERS network could achieve the same with a fraction; e.g.: The UK case study suggests as few as 64 connections for equivalent coverage.
4. **Energy Security:** Wireless systems reduce dependence on imported oil and heavy grid reinforcement, aligning with Tamil Nadu's renewable-rich power base.
5. **Industrial Competitiveness:** By cutting downtime and logistics costs, Tamil Nadu's exports - from textiles to electronics and semiconductors - gain resilience against compliance regimes like the EU's CBAM.

4.4. A Phased Approach for Tamil Nadu

Tamil Nadu could pursue a **complementary deployment strategy**:

- ➢ **Phase 1:** Static wireless charging at ports, logistics parks, and industrial hubs to build experience and confidence.
- ➢ **Phase 2:** Dynamic wireless corridors along high-throughput freight routes (e.g., Chennai-Bengaluru, Manali-Ennore-CPRR) to demonstrate long-haul viability.

This approach balances feasibility with ambition, allowing the state to progressively scale wireless charging while aligning with its **USD 1 trillion economy** and **green freight transition** goals.

5. From Concept to Scale: Roadmap for Tamil Nadu's Electric Freight Corridors Powered By Wireless Charging

Tamil Nadu's freight electrification strategy demonstrates the potential to bridge vision and execution, aligning corridor selection, fleet readiness, infrastructure deployment, grid integration, and economic validation to enable scalable policy and finance pathways. This chapter lays out a **phased roadmap** to take wireless charging for freight from concept to corridor pilots and statewide deployment - retaining a **technology-neutral** policy lens while detailing why and where **wireless (inductive) electric road systems (ERS)** are a catalytic option for medium- and heavy-duty trucks (M&HDTs).

5.1. Steps for Electrifying Freight Using Wireless Charging in Tamil Nadu

Building on the theoretical justification of why electrification, why freight, and why Tamil Nadu, this section sets out the process for piloting and scaling wireless charging deployment across Tamil Nadu's freight corridors.

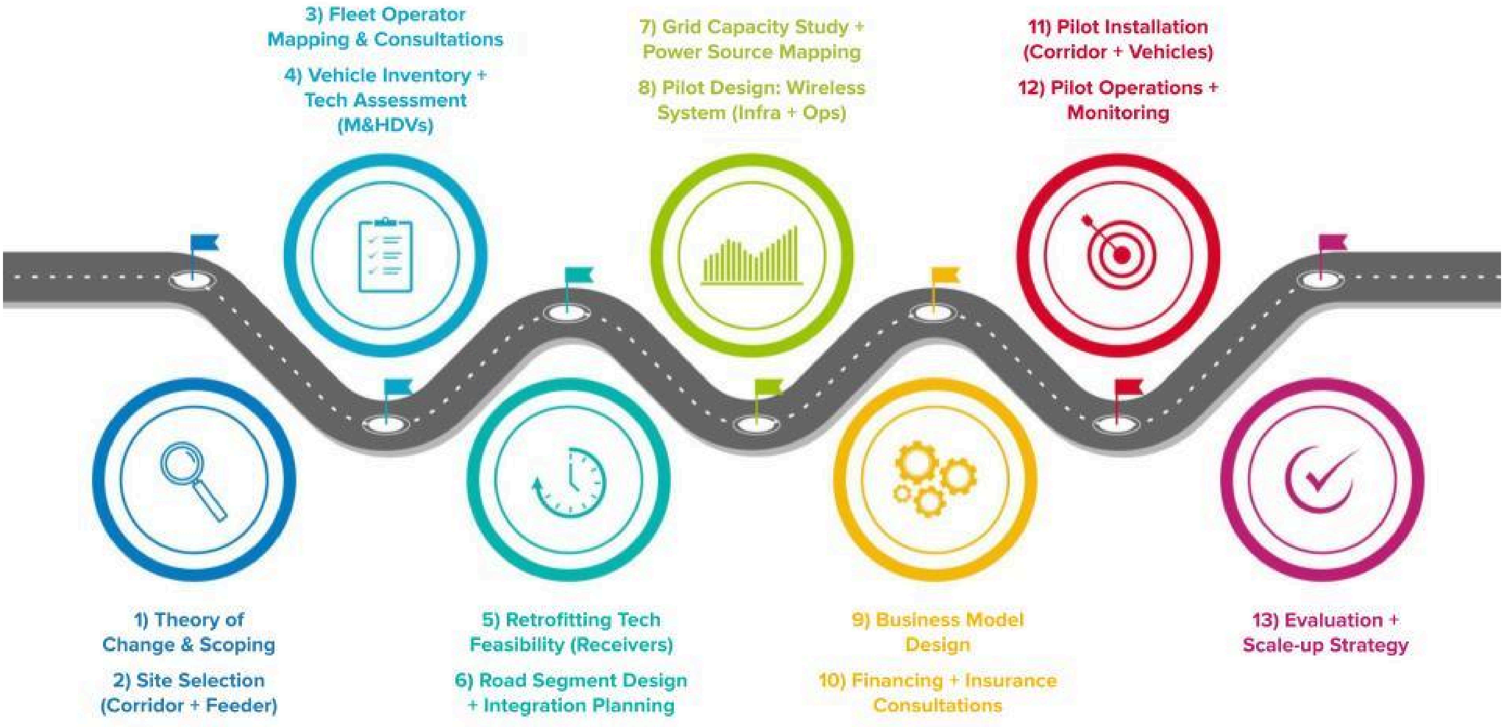
The first step is identifying a **viable freight corridor**. A suitable route must carry a high volume of freight traffic with consistent truck movement, preferably one that connects a logistics hub, dry port, or seaport. Once **site selection** is completed, the next step is **vehicle selection**, which involves determining which categories of trucks are most appropriate for the transition.

Following this, **vehicle retrofitting** becomes a critical enabler. Heavy-duty vehicles will need to be equipped with **transmission pads**, and decisions must be made on whether new chassis designs are required or existing models can be adapted. A retrofit programme led by startups can provide a disruptive model, positioning Tamil Nadu as the hub for scalable retrofitting solutions across India.

Once the vehicle requirements are clarified, the focus shifts to **infrastructure**. This involves installing **wireless technology** along selected road segments, calculating the optimal stretch length, identifying start and end points, planning installation, and evaluating cost implications. Parallel to infrastructure comes the integration of **power systems,** and the design of **transparent charging and payment mechanisms**.

Finally, a **long-term assessment** must establish whether wireless deployment delivers sustained **cost savings** for operators, users, the state, and the wider logistics ecosystem. Beyond cost, the **employment potential** is significant. The creation of **skilled jobs in EV manufacturing, retrofitting, maintenance, and digital platform development** can make wireless charging deployment not just a technological leap but also an economic development strategy.

Figure 6: Wireless Charging and Freight Electrification: Stepwise Roadmap



Source: Authors

5.2. Demand-Side Systems: Site Selection and Fleet Suitability

5.2.1. Site Selection: Corridor Prioritisation Logic

With the Logistics Efficiency Enhancement Program (LEEP) optimising freight movement by freight aggregation and multimodal logistic parks in development across the country, medium and heavy duty trucks have gained prominence. This transition to optimising logistics and aggregate planning **creates a window to test and pilot wireless charging technology in Tamil Nadu's busiest freight routes.** Inbound and outbound freight from these major hubs and multimodal logistics hubs offer measurable, predictable and feasible sites for pilots and as well to run these projects at scale. For Wireless charging , road-based freight corridors with heavy and medium-duty truck (H&MDTs) movement should be the target.

Identifying suitable corridors is a foundational step in wireless technology deployment, as corridors with **large, predictable flows of medium and heavy-duty trucks** are most likely to achieve high system utilisation and economic feasibility. Feasibility modeling by ASPIRE (Utah) concurs, showing cost-effectiveness hinges on **stable HDV corridor traffic** (ASPIRE Research Center, 2022). European feasibility studies such as FABRIC also underscore that **urban freight or public transit-heavy corridors are the most viable early deployment candidates** (ERTICO, 2018). ORNL's corridor-design work further shows how aligning **roadway power capacity, seasonal traffic loading, and base infrastructure on a corridor scale minimises vehicle TCO** (Sujan et al., 2024).

Table 1: Candidate Corridors for Wireless Charging Deployment in Tamil Nadu

Corridor Name	Stretch (km)	Freight Volume	Wireless Technology Suitability	Key Nodes / Clusters	Notes
Chennai - Bengaluru (NH48)	~350	Very High	High	Chennai & Ennore Ports, Sriperumbudur auto hub, Hosur manufacturing, Bengaluru warehousing	Strong industrial base, cross-border trade link, good grid access; moderate land constraints near urban sections
Chennai - Coimbatore (NH544/48)	~500	High	High	Chennai Port, Salem steel/ textiles, Erode agro-textiles, Coimbatore engineering	Long industrial belt; wireless charging could serve mid-long haul regional freight
Chennai - Thoothu-kudi (NH38)	~620	High	Moderate - High	Chennai & Thoothukudi ports, Tiruchirapalli, Madurai	Two-port connector; high export/ import volumes; certain stretches lower traffic density
Coimbatore - Hosur (NH544A/44)	~325	High	High	Coimbatore-Krishnagiri industries, Krishnagiri logistics, Bengaluru link	Regional distribution; partly overlaps with Chennai - Bengaluru
Madurai - Thoothukudi (NH38)	~150	Moderate	Moderate	Madurai logistics hub, Thoothukudi port	High-intensity port feeder; Suitable for medium to large-scale deployment
Manali - Ennore - CPRR Loop	~50	Very High	Very High (urban - industrial)	Manali petrochemical complex, Ennore Port, CPRR	Short urban loop, high chemical & container freight intensity; possible early demonstration route

Source: Authors

Based on freight volumes and logistics hubs, Tamil Nadu's **Chennai-Bengaluru** and **Chennai-Coimbatore** routes emerge as promising pilot candidates due to their freight intensity and strategic alignment with industrial clusters. These routes serve the state's major manufacturing, export, and logistics clusters, linking Chennai Port to Sriperumbudur, Hosur, and Bengaluru in the north, and to Salem, Erode, and Coimbatore in the west. In parallel, the **Manali-Ennore-CPRR loop** represents a unique early-stage demonstration opportunity. At just 50 km, this urban-industrial stretch serves petrochemical and container logistics and allows wireless charging to be embedded during CPRR's construction, making it an ideal testbed before scaling to longer corridors.

5.2.2. Fleet Suitability: Where To Start

Not all truck classes are equal candidates for early ERS deployment. Retrofit practicality, utilisation, and duty cycles matter. Evidence suggests **N3A/B (12-28 t) trucks** are the near-term sweet spot; **N3C/D tractors (>28 t)** can follow with engineered frames/ new chassis as standards mature (Nicolaides et al., 2018; Fresia et al., 2025).

Table 2: Truck Segments and Wireless Charging Feasibility Analysis[2]

GVW Range (t)	MoRTH Cat.	Seg-ment	Corridor Fleet Share Estimate (%)	Annual VKT/ corridor	Retro-fitability	Suitability for Wireless Pilot (Priority)	Barriers/ Enablers
> 3.5	N1/N1A	SCV	<10%	Low	-	No	Scattered ops
3.5-7.5	N2A	LDT	~15%	Medium	Uncertain	Low	Short haul; fragmented market
7.5-12	N2B	IDT	~10%	Medium	Possible	Medium	Some intercity use
12-18.5	**N3A**	**MDT**	**~25%**	**High**	**Easy (minor mods)**	**High**	**Key pilot target due to high fleet share**
18.5-28	**N3B**	**HDT**	**~25%**	**High**	**Frame mods**	**High**	**High utilisation, payback viable**
28-49	N3C	HDT	~13%	Very High	Advance mods	High	Pilot (phased); Container traffic, hardest to retrofit
30-55	N3D	HDT-TT	~8%	Very High	Major mods/ new chassis	Low	Tech risk; lowest initial focus

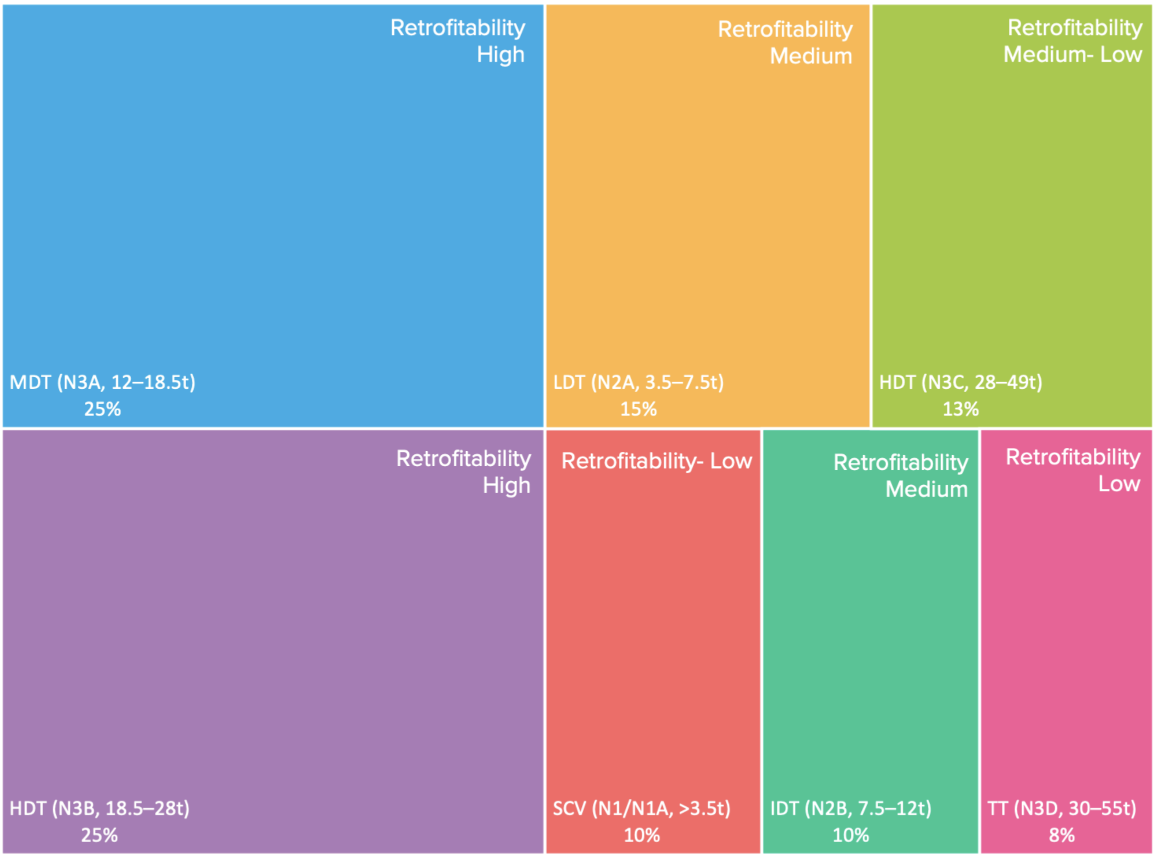
Source: Authors

Existing fleet assets can be equiped with wireless charging receivers. Design decisions will vary by truck class. The top manufacturers of medium and heavy-duty trucks (M&HDT) are Tata Motors, Ashok Leyland, VECV-Eicher, Mahindra & Mahindra, and SML Isuzu, accounting

[2] Glossary for Table 2: GVW (Gross Vehicle Weight), MoRTH (Ministry of Road Transport and Highways), Cat. (Category), SCV (Small Commercial Vehicle), LDT (Light-Duty Truck), IDT (Intermediate-Duty Truck), MDT (Medium-Duty Truck), HDT (Heavy-Duty Truck), TT (Tractor-Trailer), VKT (Vehicle Kilometres Travelled), mods (modifications).

for more than 95% of the market. Tata Motors and Ashok Leyland together consistently maintain a market coverage of more than 70% (SFC India, 2025). The key decision for them is: do we modify current chassis designs, or will certain tonnage classes require factory-built wireless charging-ready vehicles? For most N3A and N3B trucks, undercarriage space and frame strength allow for minor modifications, while heavier N3C/D tractors may require reinforced assemblies or new chassis frames. **The aim is to minimise capital outlay by retrofitting as much of the existing fleet as possible, while also stimulating new truck procurement.**

Figure 7: Truck Segments by Retrofit Feasibility -Treemap categorising truck segments (SCV, LDT, IDT, MDT, HDT, TT) by fleet share and retrofitability



Source: Authors

Figure 7 emphasises MDTs and HDTs are the most suitable for dynamic charging pilots.

5.3. Supply-Side Infrastructure: Vehicles, Roads, and Energy Systems

5.3.1. Vehicle Retrofitting: Integrating Wireless Receivers

What changes:

- ➢ Receiver coil, power electronics, thermal safeguards, underbody shielding; software/telemetry for alignment/control.
- ➢ For N3A/B trucks, undercarriage space and frame strength generally allow minor modifications;
- ➢ N3C/D tractors may require reinforced assemblies or new chassis in later phases (Nicolaides et al., 2018; Fresia et al., 2025).

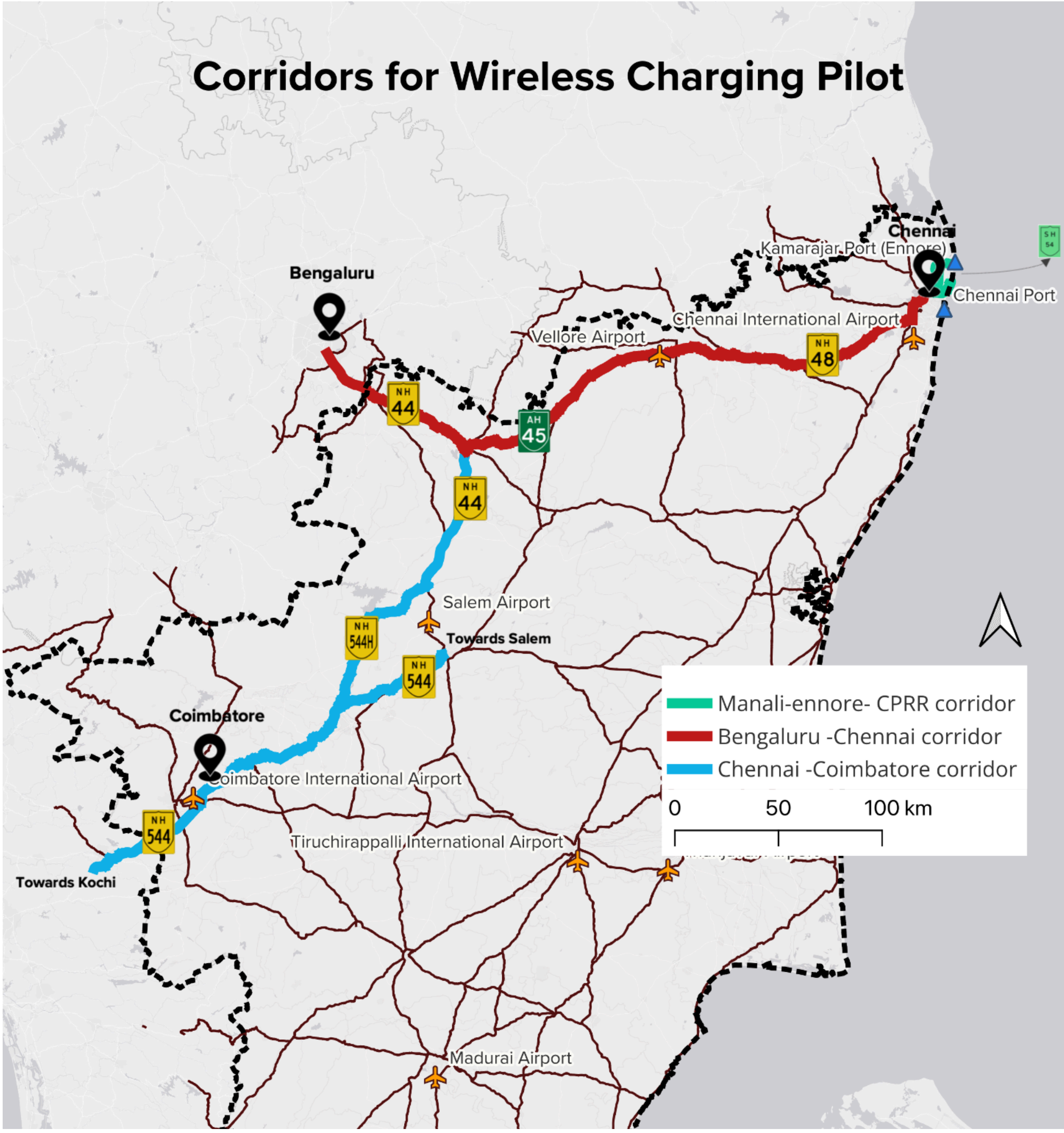
Execution model:

A **startup-led retrofitting ecosystem** could drive disruption by setting up scalable retrofit hubs across Tamil Nadu, with the potential to expand nationally. Such hubs in Sriperumbudur, Hosur, Coimbatore, Ennore, for instance, would not only accelerate EV adoption but also create significant **employment and entrepreneurship** in areas like EV servicing, retrofitting, digital fleet platforms, and charging operations. By linking clean mobility with job creation, Tamil Nadu can position itself as a leader in both technology innovation and livelihoods. This will help create and boost MSMEs as well as large enterprises.

5.3.2. Road Segment Integration, and Deployment

With the corridor chosen and the fleet retrofitted, the next step is **embedding the charging infrastructure into the selected road segments**. This requires determining segment lengths (e.g., 20-30 km pilot stretches), precise start and end points, integration with existing road geometry, and siting of roadside power electronics. The deployment strategy has to balance coverage with manageable investment during the pilot phase. This step must also consider phasing so that infrastructure comes online as fleet receivers are deployed.

Figure 8: Potential corridors for piloting wireless charging technology for freight transport



Source: Authors

Table 3: Corridor Features for Wireless Charging Pilots in Tamil Nadu[3]

Corridor	Road Segment	No. of Lanes	Authority	Median / Divider	Side Space / ROW	Key Feasibility Notes
Chennai - Bengaluru; Chennai - Coimbatore	NH44 (Krishnagiri - Salem)	4-6 lanes on most trunk sections	NHAI	Continuous median on upgraded stretches	Moderate to good in rural/ peri-urban stretches; constrained in towns	Long corridor linking industrial clusters; Good continuous stretches for installing wireless tech; Need to assess ROW at bypass nodes and urban approaches.
Chennai - Bengaluru	NH48 (Chennai - Sriperumbudur - Vellore)	4 lanes (Sriperumbudur - Walajah), 6 lanes (Koyambedu - Sriperumbudur, Walajah - Bengaluru)	NHAI	Central divider on expanded sections	Limited near Chennai urban fringe; improves outside metro	Excellent utilisation potential near Chennai - Ennore - Sriperumbudur logistics clusters; Urban sections face ROW constraints and traffic management challenges.
Chennai - Bengaluru	AH45 (Chennai - Nellore border)	4-6 lanes, with service lanes in busy sections	NHAI	Median on expanded stretches	Moderate ROW; constrained in urban nodes	Corridor with steady freight flows; Best suited where contiguous expanded carriageway exists.
Chennai - Coimbatore	NH544 (Chennai - Salem - Coimbatore)	4 lanes, partial 6 lanes (incl. Kuthiran tunnel)	NHAI	Median present	Moderate ROW in rural stretches; constrained in hilly/ urban approaches	Long industrial belt; strong candidate for mid-to-long haul wireless pilots. ROW verification needed in tunnels/ congested areas.

[3] Glossary for Table 3: ROW (Right of Way), NHAI (National Highways Authority of India), HMPD (Highways and Minor Ports Department), TNRDC (Tamil Nadu Road Development Company Ltd.), CPRR (Chennai Peripheral Ring Road).

Corridor	Road Segment	No. of Lanes	Authority	Median / Divider	Side Space / ROW	Key Feasibility Notes
Chennai - Coimbatore	NH544H (Thoppur - Erode)	2 lanes with paved shoulders; widening to 4 lanes	NHAI	Median on upgraded parts	Moderate, with tight stretches in towns	Functions as regional connector between NH544 and NH44. Useful as feeder/ secondary pilot corridor; Requires continuity and utility checks.
Ennore - Manali - CPRR loop	SH54 (Tiruvottiyur - Ponneri Road, north Chennai)	6 lanes	HMPD	Median/ divider present	Industrial corridor, ROW generally available	Links Ennore port-industrial belt; Heavy freight share (containers, chemicals); Strong near-port candidate for pilot demonstration.
Ennore - Manali - CPRR loop	CPRR (Chennai Peripheral Ring Road - Ennore port)	6 main lanes + 2 service lanes each side (up to 10 lanes)	TNRDC	Median/ divider planned	Wide ROW (greenfield alignment under construction)	Expected operational by 2026; High freight diversion potential; Ideal for future-ready wireless charging design during the construction stage.
Ennore - Manali - CPRR loop	Chennai - Ennore Expressway (Northern Port Access Road)	2 lanes	NHAI	Median present	Dense freight corridor, ROW constrained near habitations	Heaviest container and bulk freight flow in Chennai; Strong short urban-industrial wireless pilot opportunity; Needs traffic segregation and safety design.

Source: Authors

The road segment analysis shows that Tamil Nadu's national and state highways offer varying levels of suitability for wireless charging pilots depending on their physical and institutional characteristics.

- ➢ Corridors like NH44 and NH48, under the authority of NHAI, already operate as four- to six-lane highways with continuous medians and moderate ROW, making them strong candidates for regional-scale deployment despite localised constraints near urban nodes.
- ➢ NH544 and NH544H, also with NHAI, provide important industrial links, though sections under widening or with hilly terrain will require more detailed ROW assessments before deployment.
- ➢ Closer to Chennai, corridors such as SH54 (six-lane) and the Chennai-Ennore Expressway (twolane) provide, high-intensity freight movement under the state highways department and NHAI respectively, making them attractive near-term demonstration routes despite tighter ROW in urban-industrial stretches.
- ➢ The upcoming Chennai Peripheral Ring Road, managed by TNRDC, presents a unique opportunity to integrate wireless charging readiness during construction, with wide ROW and a planned six-plus-two lane cross-section.

Together, the combination of wide multi-lane availability, clear institutional authority, and manageable ROW constraints positions Tamil Nadu with a mix of near-term and long-term options for piloting and scaling wireless charging.

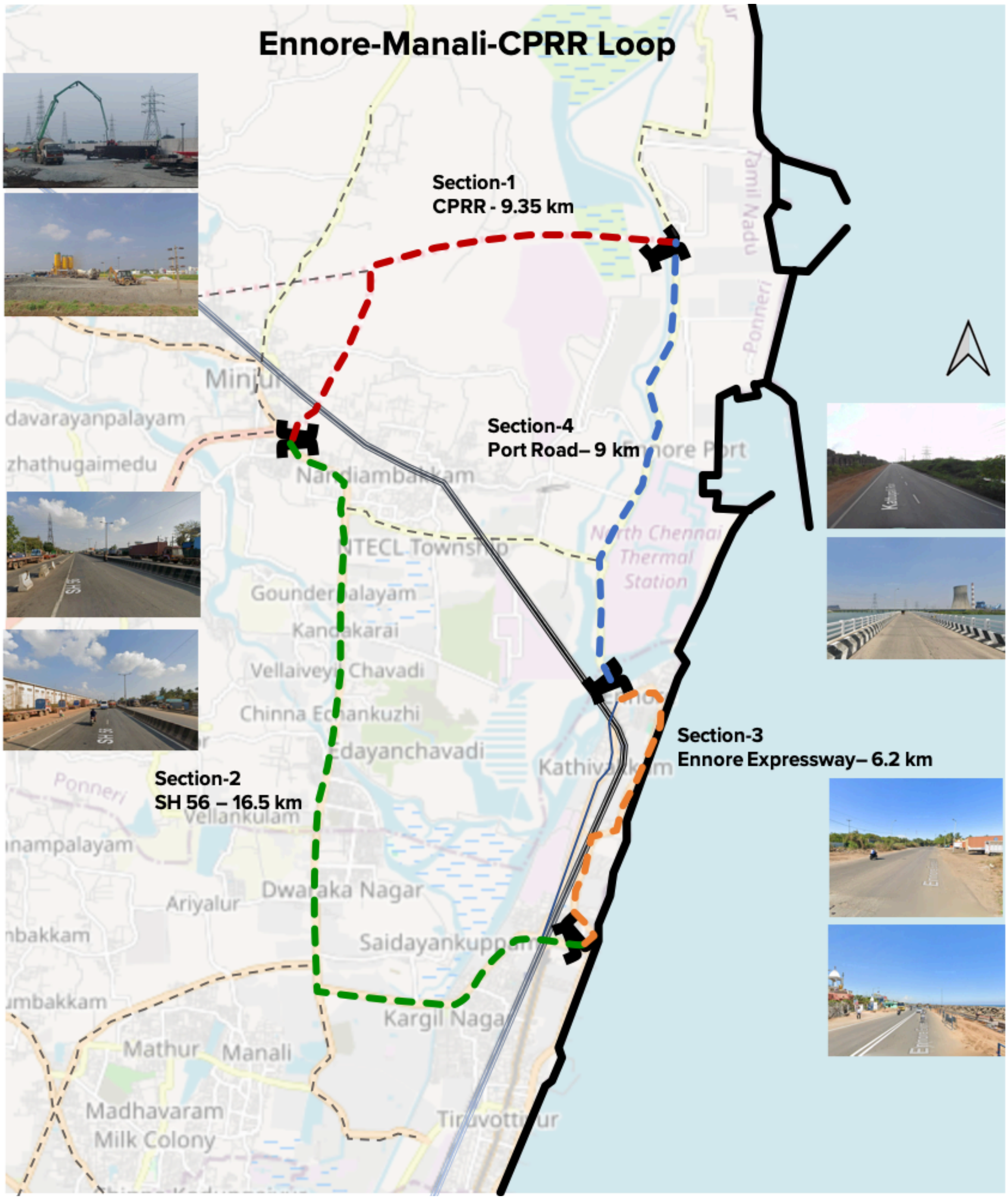
Ennore - Manali - CPRR Loop : A Strategic Freight Corridor for Wireless Charging Pilots

The Ennore - Manali - CPRR Loop connects some of Tamil Nadu's most critical industrial and logistics hubs, making it an ideal testbed for dynamic wireless charging. The loop covers:

1. **Section 1 - CPRR (9.35 km):** Part of the Chennai Peripheral Ring Road currently under construction, offering the opportunity to embed wireless charging infrastructure at the design stage for cost-effective deployment.
2. **Section 2 - SH 56 (16.5 km):** A high-density freight route connecting to major industrial areas, carrying significant truck volumes from refineries, petrochemical plants, and manufacturing clusters.
3. **Section 3 - Ennore Expressway (6.2 km):** A direct freight artery to Ennore Port, with steady heavy truck movement, ensuring high utilisation of any charging infrastructure deployed.
4. **Section 4 - Port Road (9 km):** Linking the port to Manali industrial complexes and logistics parks, this segment ensures that port-to-industry traffic can benefit from seamless charging opportunities.

The loop combines dense freight flows, under-construction segments that allow cost-efficient integration, and direct port connectivity. Together, these factors create a closed high-impact corridor where wireless charging can be piloted, monitored, and scaled with minimal disruption to the broader freight network.

Figure 9: Ennore - Manali - CPRR Loop : A Strategic Freight Corridor for Wireless Charging Pilots

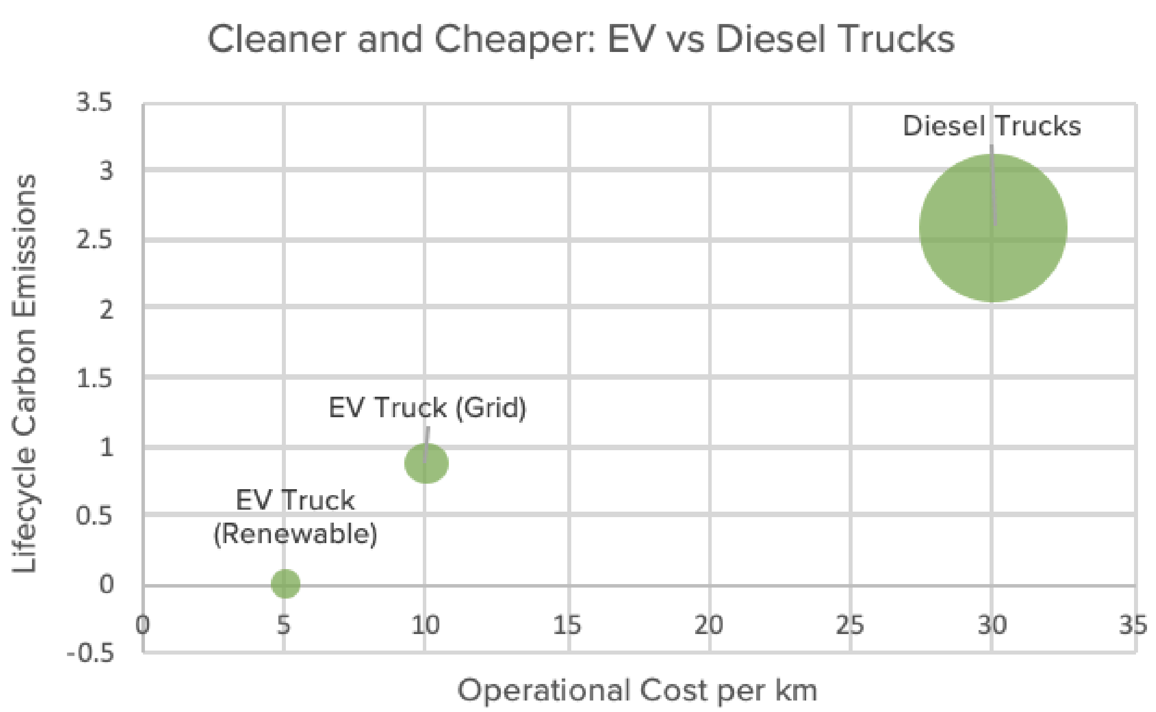


Source: Authors

5.3.3. Powering the System: Grid Integration and Load Management

The final technical link is powering the wireless charging and ensuring that its long-term economics work. As next steps, **grid integration plans** can identify nearby substations, capacity upgrades, renewable integration points, and load-balancing measures. **Tariff structures and charging models** - whether based on kWh consumed, distance travelled, or a blended access fee - can be designed to be commercially attractive while recouping infrastructure investment. Unless the grid integrated with the pilot is **powered by renewable energy or nuclear power plants**, the carbon emission saved in tailpipe emissions will be made up by the emissions in electricity generation. Lastly, **smart operations**, ranging from demand responsive time-of-day pricing to peak-shaving along corridors, will be essential for powering the wireless electric road system.

Figure 10: Lifecycle Cost and Emission Comparison: Diesel vs EV Freight Trucks (Grid) vs EV Freight Trucks (Renewable Energy)



Source: Authors

The bubble chart in figure 10 compares diesel trucks with grid-charged EVs, and renewable EVs, across operational cost, and lifecycle emissions. The analysis reveals renewable EVs are the cleanest and most cost-efficient long-term option.

5.4. Cost, Financing, and Scale-Up Strategy

5.4.1. Economic Viability: Where The Payback Comes From

The wirelessly charged freight proposition hinges on **fuel and maintenance savings**, **higher uptime**, and **smaller battery packs** offsetting corridor CapEx. On high-volume corridors, recovery within **7-10 years** for M&HDTs is plausible, improving as adoption rises. Macro cost trends strengthen the case: **battery pack prices have fallen ~90% since 2010** - from >USD 1,000/kWh to ~USD 130/kWh in 2023 - with further declines expected as manufacturing scales (IEA, 2023; BloombergNEF, 2023). Lower energy cost per km, reduced maintenance, and **emerging carbon markets** improve ROI.

Table 4: Cost-Benefit Viability of Wireless Technology Deployment

Component	Short-Term Viability	Medium-Term Viability	Long-Term Viability	Notes
CapEx (Road infra, retrofitting)	High cost	Medium (partial recovery)	Low (amortised)	Heavy upfront; recoups over years
OpEx (Maintenance, ops staff)	Medium	Medium	Medium-Low	Ongoing but predictable
Fuel Saving	Low (until uptake)	High	High	Gains increase with adoption rate
Cost saving by offsetting dependencies (imported diesel)	Low	Medium - High	High	Cuts import bill; improves energy security
Income generation (tariffs, contracts)	Low (pilot scale)	Medium - High	High	Scales with corridor expansion
Tailpipe emission reduction	Medium	High	High	Immediate on retrofits; expands with fleet
Lifecycle emission cuts	Medium	High	High	Linked to renewable power share

Source: Authors

5.4.2. Who Funds, Who Owns, Who Benefits

The following matrix shows at each stage who is responsible, who invests, who benefits, along with the viability profile. It makes clear that **utilities** have the **strongest long-term payback**, **road segments** require **patient capital** but yield **public benefits**, and **retrofits** are **commercially viable for fleets** within a few years.

Table 5: Institutional Responsibilities and Risk-Benefit Allocation

Stage/ Component	Responsible Entity	Who Owns Asset	Main Beneficiary	Payback Profile	Risk Level	Comments
Site Selection & Planning	Govt. (Logistics Dept.)	Govt.	State & Industry	High	Low	Planning
Road Segment Integration	Govt. / PPP SPV	Govt. / Concessionaire	Fleet operators, public	Medium - Low	Medium	Long-term infra asset
Vehicle Retrofitting	Fleet operators	Operators	Fleet operators, OEMs	Medium (3-5 yrs)	Medium	Driven by fuel/ Opex savings
Power Grid Upgrades	Utility (TANGEDCO)	Utility	State, Public	High	Low	Returns via electricity sales
Pilot Test Run	Govt. / PPP SPV	Shared	Govt., Operators	Medium	Medium	Critical for proof-of-concept
Scale-Up	PPP / Utility	PPP / Utility	All stakeholders	High (once scaled)	Medium - Low	Depends on traffic volumes

Source: Authors

5.5. Scale-Up: From Pilot to Statewide Network

5.5.1. Pilot Corridor Development: Manali-Ennore-CPRR Integration

The **Manali-Ennore Industrial Cluster and the Chennai Peripheral Ring Road (CPRR)** offer ideal conditions for piloting dynamic wireless charging. These corridors already host dense freight flows connecting ports, refineries, and logistics hubs. Since the CPRR is still under construction, **embedding wireless charging infrastructure at the design stage** will be more cost-effective and technically seamless, avoiding expensive retrofits later. A pilot here, supported by the Manali-Ennore Restoration and Rejuvenation Company (MERRC) and the Tamil Nadu Road Development Company Ltd. (TNRDC), would provide a **high-visibility, high-impact testbed** for demonstrating technology integration, cost feasibility, and operational performance.

Building on lessons from this initial demonstration, wireless deployment can be scaled in a phased manner across Tamil Nadu's strategic freight corridors.

- In the **medium term**, corridors such as **Chennai-Bengaluru (NH48)** and **Chennai-Coimbatore (NH544)** could be prioritised, given their **high freight volumes** and **concentration of industrial hubs**.

- ➢ In the **long term**, corridors like **Chennai-Thoothukudi**, and feeder connectors such as **NH544H** can be integrated, ensuring a state-wide network of wireless-enabled freight movement.

This **phased approach** would de-risk investments, allow progressive refinement of the technology, and align infrastructure build-out with fleet retrofitting and operator adoption timelines.

5.5.2. Policy Mainstreaming

1. **Tamil Nadu has already demonstrated strong leadership** in advancing **sustainable freight and logistics**, with initiatives such as the Manali-Ennore Restoration and Rejuvenation Council (MERRC) setting important precedents in pollution control, wetland and waterbody restoration, green projects, and community livelihood enhancement.
2. Building on this foundation, **a Manali-Ennore-CPRR wireless freight electrification pilot** could complement these ongoing efforts, aligning closely with the government's vision for green logistics, industrial growth, and carbon reduction. Integrating **wireless freight electrification within Tamil Nadu's EV Policy, Logistics Policy, and Climate Action Plan** would reinforce long term strategic priorities, supported by clear standards, fiscal incentives, and regulatory mechanisms.
3. **A phased, state led roadmap** could extend the pilot to other freight-intensive corridors, such as Chennai-Bengaluru, Chennai-Sriperumbudur, and Coimbatore-Salem by 2030. Linking corridor electrification with industrial clusters, port modernization, and sustainability objectives would provide policy certainty for technology providers, logistics operators, and financiers, while ensuring wireless charging is integrated into a coordinated, state led transition toward green logistics at scale.

5.6. Skills, Startups, Financing, and Inclusion

5.6.1. Workforce Skilling and Jobs

Wireless charging deployment can serve as a vehicle for **employment generation** and **skill upgrading**. The **Tamil Nadu Skill Development Corporation** can design training modules in EV retrofitting, wireless charging installation and maintenance, digital freight platforms, and grid-integration analytics. A full corridor-scale pilot could create hundreds of skilled jobs while establishing Tamil Nadu as a talent hub for advanced logistics and clean mobility.

Importantly, this effort can also **prioritise women-centric employment pathways**. Industrial training institutes, in partnership with freight and EV companies, could upskill rural and coastal women in areas such as EV retrofitting, charging operations, and digital logistics platforms, linking their livelihoods to stable jobs with dignified pay. This inclusive approach would not only meet labor demand but also strengthen the social impact case for wireless freight electrification.

5.6.2. Startup and Innovation Ecosystem

Tamil Nadu can **integrate wireless charging and green logistics** into its **Startup & Innovation Policy**, creating targeted pathways for local **entrepreneurs**. This can be achieved through **state-backed grants** to support proof-of-concept pilots and field trials, **accelerator programs** that connect startups with logistics majors, utilities, and OEMs, and **challenge funds** to drive innovation in areas such as retrofitting, fleet optimisation, and vehicle-to-infrastructure (V2I) communication systems. By embedding these measures, **Tamil Nadu** can position itself as the **national hub** for **logistics-tech** and **EV infrastructure startups**, complementing its strong manufacturing ecosystem and enhancing its leadership in clean mobility.

5.6.3. Financing and FDI Attraction

Tamil Nadu can pioneer a **blended finance model**, pooling state support, private logistics users, and technology providers through structured PPP frameworks for corridor pilots. The state can also actively leverage **union-level funding programmes** such as the **MAHA-EV Mission**, which supports electrification of freight and trucking, alongside **DST-backed innovation funds** for advanced charging and logistics technologies. Corridor pilots could also align with **national initiatives on industrial decarbonisation** and **clean logistics**, opening access to central support streams while easing fiscal pressures on the state.

At the same time, Tamil Nadu may invite **global wireless charging companies** to establish India hubs in the state, capitalising on its port-led industrial base, strong automotive ecosystem, and EV and electronics manufacturing incentives. This **dual strategy** of combining **PPP-led blended finance** with **FDI attraction** would accelerate knowledge transfer, build local supply chains, and position Tamil Nadu as a preferred destination for next-generation logistics and charging technologies.

6. Policy Levers for Scaling Wireless Freight Electrification in Tamil Nadu

Tamil Nadu's roadmap for wireless freight electrification is technically viable and economically promising. However, successful deployment depends on clear and timely policy signals. Without mainstreaming into the state's EV and logistics frameworks, wireless charging risks being seen as a "niche experiment." This chapter identifies five priority levers that can anchor wireless charging in Tamil Nadu's broader industrial and climate strategy.

6.1. Mainstreaming into State Policy Frameworks

Positioning wireless freight electrification within Tamil Nadu's established and emerging strategies offers strong alignment and implementation potential.

1. **EV Policy (2023):** Extend purchase subsidies to retrofitted M&HDTs; introduce corridor-level incentives for fleet operators adopting ERS-ready trucks.
2. **Logistics Policy (2023):** Add ERS corridors as a "next-generation logistics infrastructure" category, supported by PPP models.

3. **Climate Action Plan:** Align freight electrification with decarbonisation targets, leveraging wireless charging to reduce transport sector emissions by 2030.

6.2. Fiscal Incentives and Financing Support

Capital-intensive technologies require de-risking in their early stages. Tamil Nadu can:

1. Offer **capital subsidies or viability gap funding** for corridor pilots, especially where ERS is embedded in new highway construction (e.g., CPRR).
2. Provide **reduced electricity tariffs** for ERS charging, linked to renewable integration.
3. Enable **green bonds or blended finance pools**, where state funding leverages private capital.
4. Support **retrofit programmes** with tax rebates or low-interest credit lines for fleet operators.

6.3. Standards, Regulation, and Safety Codes

Policy has the opportunity to grow alongside technology development:

1. **Technical Standards:** Along with the Department of Science and Technology, and Bureau of Indian Standards, adopt/ adapt global norms for inductive coil design, communication protocols, and road reinforcement to ensure interoperability.
2. **Tariff Models:** Define transparent frameworks for ERS billing - whether per kWh consumed, per km travelled, or a hybrid approach.
3. **Safety Protocols:** Mandate safety testing for retrofitted trucks and ERS segments; integrate into MoRTH vehicle approval pathways.

6.4. Institutional Leadership and Coordination

ERS deployment requires coordinated action across multiple agencies. Tamil Nadu can:

1. Designate a **nodal agency** - such as the Logistics Department in partnership with TNRDC - to oversee pilots and scale-up.
2. Establish a **joint task force** including TANGEDCO, Highways Department, utilities, fleet operators, and OEMs.
3. Create a **pilot corridor SPV (Special Purpose Vehicle)** for shared ownership of assets and risks.

6.5. Data, Innovation, and Monitoring

As a first mover, Tamil Nadu's pilots can serve as national learning platforms:

1. Mandate **open data-sharing** (fleet utilisation, energy use, costs) from pilots to build evidence for replication.
2. Support **challenge grants** for startups and universities to analyse corridor performance.
3. Develop a **monitoring and evaluation framework** that tracks emissions, cost savings, and jobs created, ensuring transparency and accountability.

6.6. The Policy Payoff

Tamil Nadu has the opportunity to mainstream wireless freight within this decade by acting decisively. The advantages are evident:

1. Reduced logistics costs, strengthening export competitiveness.
2. Attraction of high-value FDI in advanced charging and EV infrastructure.
3. Job creation across retrofitting, installation, maintenance, and digital platforms.
4. Reinforcement of Tamil Nadu's identity as India's innovation frontier.

Conclusion: Tamil Nadu as India's Wireless Freight Pioneer

Tamil Nadu has always been a state that leads rather than follows. It pioneered renewable energy adoption decades before it was mainstream, and it built India's largest electric vehicle and electronics clusters in the 2020s. The opportunity before it today is no different. Wireless freight electrification represents the next leap, and Tamil Nadu is uniquely positioned to be India's first mover.

Becoming India's **Wireless Freight Pioneer** is about more than piloting a new charging technology. It is about reshaping the state's freight backbone into a platform for industrial competitiveness, clean growth, and technological leadership. Freight corridors like Chennai-Bengaluru, Chennai-Coimbatore, and the Manali-Ennore-CPRR loop can serve as the launchpads where India proves to itself and to the world that next-generation logistics can be clean, efficient, and globally competitive.

The prize is twofold. Domestically, Tamil Nadu can de-risk adoption for other Indian states, providing a tested model for corridor selection, fleet retrofitting, financing, and grid integration. Internationally, it can position itself as the **knowledge hub for wireless freight in the Global South**, shaping standards, attracting foreign investment, and exporting solutions born in Tamil Nadu to other emerging economies, and the rest of the world.

This is a strategic window of opportunity. If Tamil Nadu acts decisively - embedding ERS in its logistics strategy, mobilising finance, and building an innovation ecosystem around it - it can once again set the benchmark for India.

By embracing wireless freight today, Tamil Nadu can cement its place as **India's innovation frontier in logistics**, proving that clean mobility is not only about decarbonisation but about building the future of trade, industry, and growth.

References

Abrahamsson, K., Alakula, M., & Tongur, S. (2019). Vehicle and infrastructure requirements for electric road systems. *World Electric Vehicle Journal, 10*(1), 150–163.

Al-Hanahi, B., Ahmad, I., Habibi, D., & Masoum, M. A. S. (2021). Charging infrastructure for commercial electric vehicles: Challenges and future works. *IEEE Access, 9*, 123456–123470.

Busch, C. & Energy Innovation Policy & Technology LLC. (2024). *Fast-Falling Battery Prices Boost Economic Benefits Expected from Heavy-Duty Vehicle Electrification*. https://energyinnovation.org/wp-content/uploads/2024/02/Fast-Falling-Battery-Prices-Boost-Economic-Benefits-Expected-from-Heavy-Duty-Vehicle-Electrification.pdf

Business Standard. (2024, December 9). 58% potential EV buyers discouraged by range anxiety, says report. https://www.business-standard.com/industry/auto/58-potential-ev-buyers-discouraged-by-range-anxiety-says-report-124120900978_1.html

Chin, Q., & Chau, K. T. (2014). Overview of wireless charging technologies for electric vehicles. *Journal of Asian Electric Vehicles, 12*(2), 1679–1685. https://doi.org/10.4130/jaev.12.1679

Deshpande, S., Muthukumar, S., & Agarwal, A. (2023). Retrofitting for commercial EVs in India: Technical and economic constraints. *Renewable and Sustainable Energy Reviews, 184*, 113403. https://doi.org/10.1016/j.rser.2023.113403

Dhankhar, S., Pateer, S., Sandhu, V., & Kaur, H. (2024). Barriers to electric vehicle adoption in India: A comparative review and future growth prospects. *European Economics Letters, 14*, 2007–2015.

Electreon. (n.d.). *Lombardy, Italy Electric Road Case Study. https://electreon.com/projects/arena-of-the-future*

ERTICO. (2018, June 25). European feasibility studies explore on-road wireless charging solutions for future electric vehicles: FABRIC Project. https://erticonetwork.com/european-feasibility-studies-explore-on-road-wireless-charging-solutions-for-future-electric-vehicles/

Fresia, E., Frendo, F., Bernardini, G., & Andreasson, M. (2025). Demonstration of heavy-duty truck retrofitting for electric road system operation. *IEEE Access, 13*, 48755–48770.

Future Transport-News. (2022, November 17). Dynamic wireless EV charging to be deployed on a German autobahn. https://www.futuretransport-news.com/dynamic-wireless-ev-charging-to-be-deployed-on-a-german-autobahn/

Government of Tamil Nadu. (2018). *Highways and Minor Ports Department policy note, 2018–19*. Chennai: Government of Tamil Nadu. https://cms.tn.gov.in/cms_migrated/document/docfiles/hw_e_pn_2018_19.pdf

Government of Tamil Nadu. (2023). *Tamil Nadu Electric Vehicles Policy 2023*. Industries, Investment Promotion & Commerce Department. https://investingintamilnadu.com/DIGIGOV/StaticAttachment?AttachmentFileName=/pdf/poli_noti/TN_Electric_Vehicles_Policy_2023.pdf

Government of Tamil Nadu. (2023). *Tamil Nadu Logistics Policy and Integrated Logistics Plan 2023*. Chennai: Government of Tamil Nadu. https://tidco.com/wp-content/uploads/2021/08/Final_TN%20Logistics%20Policy%20&%20Integrated%20Logistics%20Plan.pdf

Government of Tamil Nadu. (2025). *Economic survey of Tamil Nadu 2024–25: Highlights*. Chennai: State Planning Commission. https://spc.tn.gov.in/wp-content/uploads/ES_TN-English.pdf

Haddad, D., Arellano, P., Bernicke, D., Castilho, M., et al. (2022). Economic feasibility of dynamic wireless power transfer lanes in Indiana freight corridors. *ASPIRE Research Center*. Utah State University. https://aspire.usu.edu

International Council on Clean Transportation (ICCT). (2021, September 13). Reducing India's road transport CO_2 emissions [Video]. YouTube. Reducing India's road transport CO_2 emissions [Video]

International Council on Clean Transportation (ICCT). (2022). Charging solutions for battery electric trucks. Washington, DC: ICCT.

International Council on Clean Transportation (ICCT). (2021). Decarbonising India's trucking sector: Pathways and policies. Washington, DC: ICCT.

International Energy Agency (IEA). (2023). *Global EV outlook 2023: Catching up with climate ambitions*. Paris: IEA. https://www.iea.org/reports/global-ev-outlook-2023

ITS India Forum, OMI Foundation, and NATRAX. (2025, September). *Charging Ahead: Global Insights and India's Roadmap for Electric Road Systems (ERS).*

Korakianitis, N. S., Nikolaos, N., Vokas, G. A., Ioannidis, G. Ch., & Kaminaris, S. D. (2025). Simulation-based evaluation of dynamic wireless charging systems for electric vehicles: Efficiency, limitations, and future directions. *AIMS Energy, 13*(3), 590–631. https://doi.org/10.3934/energy.2025023

McNamara, M., & Shiledar, S. (2025). *Zero-emission trucks in India: A game changer for clean mobility*. RMI. Zero-Emission Trucks in India: A Game Changer for Clean Mobility - RMI

Ministry of Statistics and Programme Implementation. (2025, August 1). *State-wise Gross State Domestic Product (GSDP) Growth Rates (in %) at Constant Prices (Base Year: 2011-12)*. MoSPI. https://www.mospi.gov.in/state-wise-gross-state-domestic-product-gsdp-growth-rates-constant-prices-base-year-2011-12

Nicolaides, D., Johansson, B., Tufvesson, F., & Tongur, S. (2018). Retrofitting heavy vehicles for dynamic charging on electric roads: Technical challenges and opportunities. *Energies, 11*(11), 3163.

NITI Aayog & RMI. (2021). *Fast tracking freight in India: A roadmap for clean and cost-effective goods transport*. New Delhi: NITI Aayog and Rocky Mountain Institute. FAST TRACKING FREIGHT IN INDIA

NITI Aayog & RMI. (2021). *Transforming trucking in India: Pathways to zero-emission truck deployment*. New Delhi: NITI Aayog and Rocky Mountain Institute. Transforming Trucking in India

OMI Foundation. (2025). *EV-Ready India: Unplugging Barriers with Wireless EV Charging*. OMI Foundation. https://olawebcdn.com/ola-institute/Unplugging_Barriers_with_Wireless_EV_Charging.pdf

Rajon Bernard, M., Tankou, A., Cui, H., & Ragon, P.-L. (2022). Charging solutions for battery electric trucks. Washington, DC: International Council on Clean Transportation.

RMI & Element-Arval Global Alliance (EAGA). (2024). *Global electrification report: Accelerating fleet decarbonization*. RMI & EAGA.

Schmidt, M., Staudt, P., & Weinhardt, C. (2021). Decision support and strategies for the electrification of commercial fleets. *Transportation Research Part A: Policy and Practice, 150*, 1–15.

Singh, A. R., Vishnuram, P., Alagarsamy, S., Bajaj, M., Blazek, V., Damaj, I., Rathore, R. S., Al-Wesabi, F. N., & Othman, K. M. (2024). Electric vehicle charging technologies, infrastructure expansion, grid integration strategies, and their role in promoting sustainable e-mobility. *Alexandria Engineering Journal, 105*, 300–330.

Stellantis. (2022). *"Arena del Futuro" Demonstrates Capability of Dynamic Inductive Recharging Technology for Electric Vehicles.* https://www.stellantis.com/en/news/press-releases/2022/june/arena-del-futuro-demonstrates-capability-of-dynamic-inductive-recharging-technology-for-electric-vehicles

Sujan, V. A., Siekmann, A. G., Tennille, S., & Tsybina, E. (2024). Designing dynamic wireless power transfer corridors for heavy duty battery electric commercial freight vehicles. *SAE International Journal of Advances and Current Practices in Mobility, 2023-01-0703.*

Zetkulic, A., & Abramczyk, M. (2024). How fleets can electrify light-duty commercial vehicles. *Rocky Mountain Institute (RMI).* https://rmi.org/how-fleets-can-electrify-light-duty-commercial-vehicles/

Zheng, Z., Zhang, A., & He, Z. (2024). Energy system modeling for dynamic wireless electric vehicle charging technologies. *Energy Reports, 10*, 200–215.

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About StartupTN

StartupTN, the nodal agency of the Government of Tamil Nadu for startups and innovation, works to position the state as a global innovation hub. Established under the Department of Micro, Small and Medium Enterprises (MSME), StartupTN fosters entrepreneurship by providing policy support, incubation facilities, seed funding, and access to markets and networks. With a focus on inclusivity, StartupTN supports women, rural, and social impact entrepreneurs alongside high-tech ventures. Through its sector-specific initiatives, global partnerships, and ecosystem-building programmes, StartupTN plays a pivotal role in transforming Tamil Nadu into one of India's most vibrant and diverse startup destinations.

About OMI Foundation Trust

OMI Foundation Trust is a new-age policy research and social innovation think tank operating at the intersection of mobility innovation, governance, and public good. Mobility is a cornerstone of inclusive growth providing the necessary medium and opportunities for every citizen to unlock their true potential. OMI Foundation endeavours to play a small but impactful role in ushering meaningful change as cities move towards sustainable, resilient, and equitable mobility systems, which meet the needs of not just today or tomorrow, but the day after.

OMI Foundation houses four interconnected centres that conduct cutting-edge evidence-based policy research on all things mobility:

1) The Centre for Technology Transitions is dedicated to transforming India's innovation ecosystem through a systems approach. It aims to position India as a global leader in ethical, inclusive, and sustainable technological innovation.

2) The Centre for Future Mobility supports the leapfrog of cities to a sustainable future anchored in the paradigms of active, shared, connected, clean, and AI-powered mobility.

3) The Centre for Clean Mobility catalyses the adoption of electric vehicles, future fuels, and renewable energy within the mobility ecosystem as a key climate strategy of cities.

4) The Centre for Inclusive Mobility promotes safe, accessible, reliable, and affordable mobility for all. It paves the road for the future of work and platform economy to fulfil the modern promise of labour.

About Futures Report

A "Futures Report" is a forward-looking, analytical report that explores emerging trends, transformative technologies, and future mobility scenarios through a combination of data-driven insights, strategic foresight, and policy analysis. Unlike traditional policy briefs or issue papers, the Futures Report anticipates and shapes future mobility developments, helping stakeholders prepare for and navigate upcoming disruptions.

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Arunima is an urban planner turned clean mobility advocate.

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Madhumitha is an emerging sustainable mobility leader. Holding an MA in Development Studies and a BA in Sociology, she applies a multidisciplinary approach to urban mobility, advocating for inclusive policies. At OMI Foundation, she leads initiatives promoting sustainable, accessible, and adaptable transport solutions, envisioning cities driven by active, shared, connected, electric/ green, and AI-powered mobility.

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An Oxford-trained student of sociology, she began her mobility sector journey as an entrepreneur and academic over a decade ago. A member of key policy committees at state, national, and global levels, she has received fellowships for AI-led transformations, including Salzburg Global and The Nippon Foundation fellowships. Under her leadership, OMI Foundation has developed pioneering policy tools, earning the organisation national and international recognition.

Suggested Citation

OMI Foundation. (2025, October). *EV-Ready Tamil Nadu: Electrifying Freight With Wireless Charging.*

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