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Guidance
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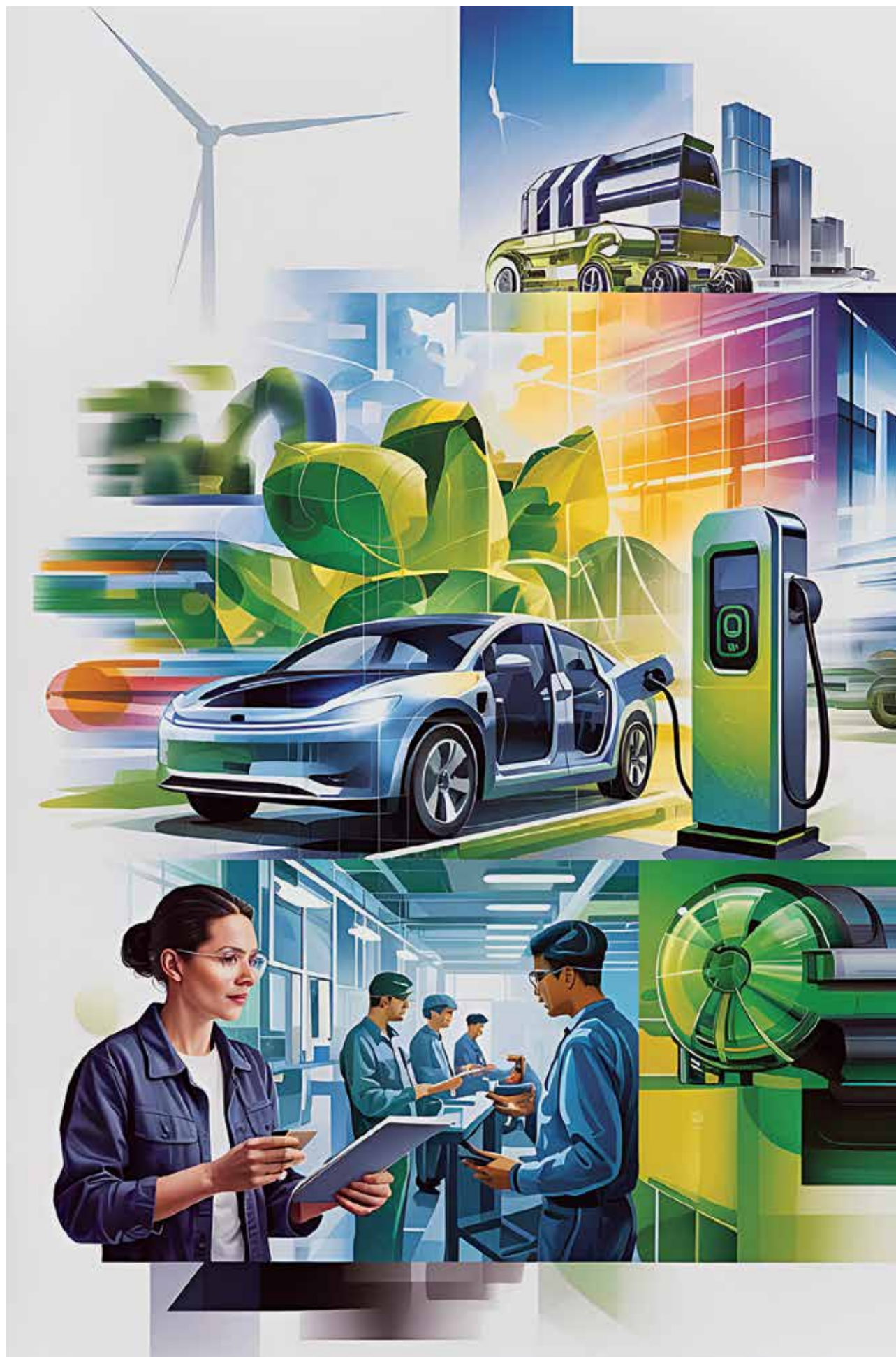
TAMIL NADU'S AUTOMOTIVE FUTURE





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P R E F A C E

TAMIL NADU IS at a defining juncture in its industrial and environmental journey. Traditionally known as the "Detroit of Asia" for its stronghold in automotive manufacturing, the state is now embarking on a transformative path—one that aligns long-term industrial growth with climate resilience and sustainability.

This report examines Tamil Nadu's evolution from a conventional manufacturing hub to a future-ready, low-carbon economy. The state's transition is not incidental; it is the product of sustained policy vision, strategic investments, and a consistent focus on human capital development. As India accelerates its national commitment to decarbonisation, Tamil Nadu is emerging as a frontrunner—through its proactive Electric Vehicle (EV) policy, renewable energy expansion, and creation of green industrial ecosystems.

The automotive sector remains central to this transformation. Tamil Nadu's position as a leading exporter of vehicles and components is being redefined through its growing capabilities in electric mobility and next-generation manufacturing. Realising this potential will require a robust policy framework, significant capital deployment, and—critically—a workforce that is

equipped to operate in an increasingly digital and multi-powertrain environment.

This report is informed by insights from a focused industry conclave held in March 2025, hosted together by State Planning Commission and Guidance Tamil Nadu. The gathering brought together key stakeholders across government, industry and technology, to discuss the future of powertrains and Tamil Nadu's leadership in shaping the transition. The dialogues reinforced the need for a diversified, inclusive, and scalable approach to sustainable mobility.

In tracing the state's multi-sectoral roadmap toward net zero—with a sharp lens on automotive and clean energy—we aim to spotlight how the convergence of policy, innovation, and infrastructure can drive systemic impact. At the same time, the report recognises the real challenges that lie ahead: infrastructure readiness, talent gaps, and the imperative for a just transition.

As India advances its net zero ambition, Tamil Nadu's integrated and pragmatic approach offers a replicable model for states and regions across the country. The transition to a sustainable future will not be driven by any single fuel, but by a multitude of technologies and platforms.



CHAPTER 1

AUTOMOTIVE MANUFACTURING

Global automobile manufacturing trends, key technology drivers, impactful policies and strategic shifts shaping the future of industrial production.

WITH GROWING ELECTRIFICATION, digitalisation, sustainability, and an ever-evolving consumer landscape, industrial production is adapting to meet the demands of next-generation mobility which has several tenets, including being sustainable and shared. As a result, manufacturing in the automotive ecosystem is undergoing a transformative overhaul, with component and vehicle manufacturers not only rethinking vehicle design and propulsion systems, but also fundamentally redefining the way vehicles are manufactured.

Hence, the automotive industry is being influenced by some key manufacturing and technology trends that are shaping the future of industrial production. The global transition from ICE to EVs is the most significant structural shift in the automotive industry in over a century, and EVs, with fewer moving parts, offer the opportunity to redesign manufacturing processes for greater simplicity and efficiency.

Modular EV platforms such as skateboard platforms allow for shared components across vehicle types, therefore, streamlining their assembly and tooling. Battery manufacturing and Gigafactory setups too are becoming critical to production ecosystems, necessitating close integration between OEMs and cell suppliers.

New EV entrants like Tesla have successfully demonstrated vertically-integrated models, thus, pushing legacy OEMs to rethink supply chains and in-house capabilities. EV-specific production lines also demand new skill sets and safety protocols, especially in battery handling, high-voltage systems, and thermal management systems. Therefore, it is critical for the Indian automotive industry to imbibe global best practices and ready a robust workforce, which is

well versed with the safety precautions necessary for the safe handling of high-voltage systems during development, manufacturing, as well as on the field.

Germany-headquartered testing, inspection, and certification agency, TUV SUD, recently inaugurated its e-mobility mobile training van, that would enable OEMs, suppliers, and dealerships in getting their manpower trained across the various modules of safe handling of high-voltage battery systems.

Deploying Industry 4.0 Tools

Furthermore, with the increasing transition towards futuristic propulsion technologies, the Industry 4.0 revolution, which is a highly-renowned efficiency enhancement tool in the manufacturing sector, is also introducing concepts such as cyber-physical systems, cloud computing, IoT, and big data analytics to automobile manufacturing.

What lies at the heart of this transformation is the digital twin - a real-time digital replica of a physical process, machine, or system. This digital replica allows for real-time monitoring and predictive maintenance, thus, reducing downtime, whereas with its simulation capabilities, companies can evaluate a production process before physically implementing it.

Advanced Industry 4.0 solutions, such as blockchain also enable enhanced traceability as well as quality assurance through digital records. Therefore, the implementation of these solutions promise a smart-factory, data-driven ecosystem. Some manufacturing footprints of global car giants, such as Mercedes-Benz and BMW deploy digital factory concepts that leverage latest technologies such as AI, machine learning and real-time analytics to optimise quality and productivity.

While robotics has long played a key role in



automotive production, the next-generation of robotics is being shaped by collaborative and AI-powered robots, especially in painting, welding, and assembly. The key future trends in robotics in the manufacturing domain include cobots working alongside humans to enhance precision and ergonomics, integration of AI and vision systems for quality inspection, and flexible manufacturing systems that can be easily reprogrammed based on demand fluctuations. As robots become more intelligent, mobile, and flexible, they work in tandem with humans to aid efficient and high-quality manufacturing on the shopfloor.

Furthermore, additive manufacturing or 3D printing is revolutionising prototyping and low-volume production of complex parts. With capabilities such as rapid tooling and jig creation, lightweight structures using lattice designs, and customised parts for niche brands, additive manufacturing is picking up pace in automotive manufacturing to efficiently produce low-volume batches. The technology also helps reduce the inventory and logistics costs in the field, usually associated with low-moving spare parts.

SDVs Driving Modern Manufacturing

As software-defined vehicles or SDVs begin to mark their foray in the automotive space, the manufacturing process too is transitioning to accommodate more software-centric workflows. For instance, just like an SDV, the over-the-air (OTA) update concept is becoming commonplace on the shopfloor, thereby bringing measures of flexibility and easy troubleshooting.

Increasing levels of software intervention as well as data logging on the shopfloor are also enhancing traceability, which is key for quality assurance, root-cause analyses of defects, and implementing kaizen or continuous improvement in the manufacturing process. Moreover, the conversion of information technology (IT) and operational technology (OT) aspects is enabling closed-loop feedback systems for bringing in real-time improvements and quality control.

Software, electronics, and a digital backbone of the shopfloor also brings an added layer of flexibility and agility in the modern times of uncertainty coming from various external factors that affect

demand. Therefore, a digital-native shopfloor with automated guided vehicles (AGVs), offers a flexible, and modular production centre that requires minimal downtime for changeovers.

Given the uncertainty, OEMs are also considering decentralised micro-factories that come with plug-and-play assembly modules, and align with the just-in-time (JIT) manufacturing and logistical approaches to reduce carbon footprints.

Role of AI in Quality Improvement

With significant advancements in the world of artificial intelligence (AI), modern technology is set to play a key role in enhancing product quality, yield, and overall equipment effectiveness. Several core competencies of AI, such as predictive analytics and demand forecasting, augur well for the automotive manufacturing ecosystem. While predictive analytics can notably aid resource efficiency by enabling machinery health monitoring, AI-based demand forecasting can offer supply chain optimisation.

With the industry's experience of grappling with chip shortage during the peak of Covid pandemic in 2020, the implementation of AI tools and block chain enable the digitisation of the supply chain, thereby ensuring real-time tracking and end-to-end visibility.

AI implementation can also drive efficiency by virtue of demand planning and bringing in innovative concepts such as an inventory-as-a-service model. Blockchain is also gaining traction to ensure transparency and traceability of high-value or safety-critical parts such as Li-ion cells or rare earth materials.

An additional benefit of implementing advanced manufacturing solutions is higher sustainability, which is no longer an optional add-on, but a core pillar of growth strategies across key automotive companies around the world. Government regulations as well as the need for circularity, are demanding cleaner, and more responsible production methods, and that is where concepts such as green factories using renewable energy like solar, hydro, and wind, are gaining prominence.

With water- and energy-efficient processes, waste segregation and zero discharge facilities attaining focal attention in manufacturing roadmaps of automotive companies, design for disassembly, and remanufacturing are getting embedded in early-stage vehicle design, thus, enabling circularity.

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The role of skilling is also paramount when it comes to operating highly automated and digitally-integrated manufacturing processes. As a result, while there is a pressing need to upskill the manpower, OEMs and Tier-1s are collaborating with technical institutes and governments to roll out large-scale reskilling programmes. Robotics operation and programming, data analytics and cybersecurity, as well as high-voltage safety and battery system handling are some of the key domains requiring advanced skilling initiatives.

Visionary Policies

With all these innovations in the manufacturing techniques, Tamil Nadu's consistent policy push is also giving a strong charge to the industry for achieving future growth. Long recognised for its industrial vibrancy and robust human capital, Tamil

Nadu is undergoing a remarkable economic transformation.

The state's evolution into a manufacturing hub is not accidental, but the result of sustained policy focus, infrastructure development, and strategic government initiatives.

A mix of pro-industry reforms, fiscal incentives, sector-specific policies, and institutional mechanisms has elevated Tamil Nadu's position on the national

and global investment map. One of the critical drivers behind Tamil Nadu's economic resurgence has been its consistent and stable governance, committed to inclusive and sustainable growth. Successive state governments have prioritized industrial development while maintaining social welfare, thereby creating a balanced model for economic advancement.

The state's Vision 2023 document aimed to make Tamil Nadu India's most prosperous and progressive state. This vision laid the groundwork for sectoral growth and infrastructure expansion, forming the basis for many subsequent reforms and initiatives. The Tamil Nadu Industrial Policy 2021, for instance, provides a comprehensive framework to attract investments and boost industrial development.

While the policy aims to attract investments worth Rs 10 lakh crore and create over 2 million jobs by 2025, it emphasises on sunrise sectors such as EV and electronics manufacturing, aerospace, defence, and renewable energy, among others. With its 'single-window 2.0' clearance mechanism across departments, the government aims to boost manufacturing-led investments in the state by offering



a conducive work environment.

Furthermore, Tamil Nadu's MSME Policy aims at enabling a plug-and-play infrastructure and establishment of common facilities through MSME parks, alongside offering subsidised capital investment assistance and marketing support. While it recognises the role of MSMEs in employment generation and exports, the state policy also looks at tailored skilling and technology upgradation support for smaller enterprises.

Future Mobility Solutions at Forefront

With over 40% automotive components manufacturing already being undertaken in the state, Tamil Nadu, has recognised future mobility as a

key sector for driving sustainable growth. As a result, the state has announced several incentive schemes for EV manufacturing, including a 20% capital subsidy on fixed assets for EV manufacturers setting up shop in the state.

Priority access for land in EV parks, fast-tracking of approvals, as well as exemptions on electricity tax, stamp duty, and registration fees for EV-related projects, are also some sops offered by the state under its dedicated EV Policy of 2023. Support for charging infrastructure and local component manufacturing has already put Tamil Nadu on the Indian map as the go-to state for EV manufacturing in the country.

Moreover, what goes along well with EVs is electronics manufacturing and the state's policy push

aims to make Tamil Nadu a leader in this domain by proposing dedicated electronics manufacturing clusters in Hosur, Sriperumbudur, and Coimbatore; offering fiscal incentives, ready infrastructure as well as skill training. With major ports such as Chennai, Ennore, and Thoothukudi, offering world-class infrastructure, the state has an export-led focus towards electronics manufacturing.

Furthermore, special economic zones or SEZs that offer state-of-the-art infrastructure, as well as tax benefits, enable the flourishing of a buzzing electronics industry in the state. With high-quality physical infrastructure being its backbone, several industrial corridors also provide a conducive environment for industrial activities in the state.

For instance, the Chennai-Bengaluru Industrial Corridor, and East Coast Economic Corridor are enhancing connectivity between ports and industrial clusters. Multi-modal logistics parks are also being developed to support cargo movement and reduce turnaround times. With fully online systems for labour, pollution, and building permits, Tamil Nadu has been consistently ranking among the top performers in DPIIT's ease of doing business rankings.

A well-developed educational system that fuels industry-led skilling through over 550 engineering colleges and 1,500 industrial training institutions, the state remains at the forefront of developing and manufacturing future mobility solutions that drive greater good for the society.



CHAPTER 2

AUTOMOTIVE MANUFACTURING IN INDIA AND TAMIL NADU

The automotive manufacturing landscape in India and Tamil Nadu, including current policies, workforce capabilities, export performance, investment trends and the overall economic impact of the automobile industry.

THE INDIAN AUTOMOTIVE industry stands as a critical pillar of the national economy, ranking among the world's largest automotive markets by both production and sales volume. Contributing significantly to India's Gross Domestic Product (GDP) (around 6-7%) and manufacturing GDP (approximately 40-49%), the sector is a major employment generator, supporting over 30 million jobs directly and indirectly. Recent years have witnessed robust domestic demand, particularly in Passenger Vehicles (PVs), although challenges remain in fully recovering sales volumes in the Two-Wheeler (2W) and Three-Wheeler (3W) segments to pre-pandemic peaks. Key trends shaping the industry include a strong push towards electrification, driven by government policies like the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme and Production Linked Incentive (PLI) schemes, alongside a focus on increasing localization ('Make in India') and meeting stringent emission norms (BS-VI).

Within this national landscape, the state of Tamil Nadu holds a preeminent position, often referred to as the "Detroit of Asia" or the "Automobile Capital of India". The state contributes disproportionately to India's automotive output, particularly in PVs, auto components, tyres, and crucially, in the burgeoning Electric Vehicle (EV) segment, where it manufactures a substantial share of vehicles sold nationally, especially EV two-wheelers. Tamil Nadu is also India's leading automotive exporter, leveraging its strategic location and well-developed port infrastructure.

The state's success is underpinned by a robust

ecosystem encompassing major domestic and international Original Equipment Manufacturers (OEMs), a dense network of component suppliers, significant R&D capabilities, and a large pool of skilled labor, including engineering talent. This established base is being actively leveraged to attract next-generation investments, particularly in EVs and advanced electronics, facilitated by proactive state-level policies (Tamil Nadu Industrial Policy 2021, EV Policy 2023, Semiconductor Policy 2024) that offer targeted incentives often exceeding central schemes. Recent major investments by Tata Motors, VinFast, Hyundai, and Ola Electric underscore Tamil Nadu's continued attractiveness.

However, both India and Tamil Nadu face challenges. Nationally, policy stability remains a concern, with the National Auto Policy still in draft form. A significant skills gap persists, particularly for the advanced technological requirements of EVs and modern manufacturing, despite numerous skilling initiatives at both central and state levels. Infrastructure bottlenecks and logistics costs also impact competitiveness. While Tamil Nadu benefits from a strong talent pool and infrastructure, its higher labor costs compared to some states and the concentration of industry around Chennai present potential vulnerabilities. The state's strategy appears focused on competing based on its comprehensive ecosystem and skilled workforce value rather than solely on cost, positioning itself strongly for the industry's high-tech future.



INDIA'S AUTO MANUFACTURING LANDSCAPE

Overview and Economic Significance

The Indian automotive industry is a cornerstone of the nation's economy, demonstrating significant scale and impact. As of 2023, India ranks as the world's third-largest automobile market by sales volume and the fourth-largest by production output (as per 2022 data). This prominence translates into substantial economic contributions. The sector accounts for approximately 6% to 7.1% of India's overall GDP and a remarkable 40% to 49% of its manufacturing GDP, highlighting its weight within the industrial landscape. The industry's overall turnover was estimated at around USD 151 billion in the financial year 2022-23 (FY23).

Beyond its direct economic output, the automotive industry is a massive employment engine. Estimates suggest it supports over 30 million direct and indirect jobs across the value chain, encompassing manufacturing, sales, service, and ancillary industries. Specific figures cited include 30.7 million jobs in 2019-20 and 32 million cited by ASDC, with projections under the Automotive Mission Plan 2026 aiming for an additional 65 million jobs. This vast employment footprint underscores the sector's socio-economic importance and explains the significant government focus on its health and growth. Policies supporting the automotive sector, therefore, are often viewed not just as industry-specific measures but as crucial components of broader national economic strategies aimed at boosting GDP, manufacturing output, and employment under initiatives like 'Make in India'.

Production Volumes and Market Size

India's automotive market is characterized by high production volumes, particularly dominated by the two-wheeler segment, followed by passenger vehicles. Total domestic production across all segments reached approximately 28-29 million units in FY24.

- **Passenger Vehicles (PVs):** This segment has shown remarkable resilience and growth. Domestic PV sales hit a record high of 3.89 million units in FY23, surpassing the previous peak set in FY19. Growth continued strongly into FY24, with sales reaching 4.27 million units. The momentum carried into the first quarter of FY25 (April-June 2024), where sales crossed the 1 million unit mark for the first time in a single quarter, totaling 1.026 million units, a 3% increase year-on-year (YoY). A significant trend within the PV segment is the consumer shift towards Utility Vehicles (UVs), which saw 16.8% growth in 2024 and accounted for 56% of PV production in FY24, while traditional passenger car sales declined.



- **Commercial Vehicles (CVs):** The CV segment experienced robust growth in FY23, reaching 9.62 lakh (0.96 million) units, the second-highest domestic sales ever. However, FY24 saw a slight contraction of 2.7%, with sales at 9.51 lakh units. Q1 FY25 showed a modest recovery, with sales increasing by 3.5% YoY to 2.24 lakh units. Within CVs, Medium and Heavy Commercial Vehicles (M&HCVs) faced declines in goods carriers but saw growth in passenger carriers, while Light Commercial Vehicles (LCVs) showed mixed results.
- **Two-Wheelers (2Ws):** As the largest segment by volume, India is the world's largest 2W market. Domestic sales reached 15.86 million units in FY23 and grew further to 19.54 million units in FY24. Despite this growth (16.9% in FY23, 14.5% in FY24), volumes remained below historical peaks, specifically below the levels seen in 2014-15. Q1

FY25 witnessed strong growth of 20.4% YoY, reaching nearly 5 million units, led by scooters (28.2% growth). The persistent lag in 2W domestic sales recovery compared to PVs, despite being the largest volume segment, suggests potential underlying economic stress or shifting consumer preferences affecting the lower end of the market more severely than the premium segments. This could stem from factors like rural economic health, financing availability, or a faster shift to alternatives in this price-sensitive category.

- **Three-Wheelers (3Ws):** India is also the world's largest producer of 3Ws. This segment saw a significant recovery, with domestic sales growing 87% in FY23 to 4.89 lakh units, and further increasing by 6.8% in FY24 to 7.28 lakh units. However, like 2Ws, these volumes were still below historical peaks (e.g., 2010-11 levels). Q1 FY25

marked the highest-ever Q1 sales for the segment at 1.65 lakh units, a 14.2% YoY growth.

In terms of market share in FY23, two-wheelers dominated with approximately 75.4%, followed by passenger vehicles at 17.7%. Despite being a top global market, India's vehicle penetration remains significantly low compared to developed and even some emerging nations, with only 26 cars per 1,000 people reported in FY24. This low penetration rate signifies substantial headroom for future growth, contingent upon factors like rising disposable incomes, sustained economic expansion, favorable financing options, and continued infrastructure development.

Key Production Hubs

India's automotive manufacturing capacity is concentrated in several key geographical clusters, creating regional ecosystems of OEMs, component suppliers, and supporting infrastructure. These clusters

offer efficiencies but also highlight the potential for regional disparities and vulnerabilities to localized disruptions, as seen during events like the COVID-19 pandemic or semiconductor shortages. The major hubs are:

- **Northern Cluster:** Centered around the National Capital Region (NCR), this cluster includes Gurugram, Manesar, and Kharkhoda in Haryana, which host Maruti Suzuki (India's largest car manufacturer) and Hero MotoCorp (a leading 2W manufacturer). Other locations include Lucknow and Greater Noida in Uttar Pradesh and the Haridwar-Pantnagar belt in Uttarakhand, hosting players like Tata Motors and Ashok Leyland. This cluster contributes significantly to national production, estimated around 30%.
- **Western Cluster:** This region, primarily focused around Maharashtra and Gujarat, accounts for a substantial share of the market (around 33% cited in 2010, with Maharashtra alone accounting for ~35% of auto output by value more recently). Key locations include the Pune-Chakan corridor, Aurangabad, and Nashik in Maharashtra, along with Sanand in Gujarat. Pune is a particularly dense hub, described as the largest in India with over 4,000 manufacturing and ancillary units. Major players in this cluster include Tata Motors, Mahindra & Mahindra, Bajaj Auto, Volkswagen Group (VW, Skoda, Audi), Mercedes-Benz, Stellantis (Fiat, Jeep), Force Motors, and formerly General Motors and Ford (though Ford discontinued manufacturing in Sanand).
- **Southern Cluster:** This is arguably the largest cluster, historically led by the Chennai region in Tamil Nadu, often dubbed the "Detroit of India/Asia". This cluster was estimated to have a 35% revenue share in 2010 and accounts for a large portion of India's auto exports. Key players include Hyundai, Renault-Nissan, BMW, Daimler, Ashok Leyland, TVS Motor, Royal Enfield, Caterpillar, and others. The cluster extends into Karnataka (Bengaluru region hosting Toyota, Volvo, Scania) and Andhra Pradesh (Sri City/Penukonda hosting Isuzu, Kia, Hero MotoCorp). Tamil Nadu is also seeing the emergence of new hubs like Krishnagiri (Ola Electric), Coimbatore, and Thoothukudi (VinFast).
- **Eastern Cluster:** This is a smaller cluster primarily centered around Jamshedpur in Jharkhand, largely

associated with Tata Motors' legacy operations. Kolkata in West Bengal also has some presence.

The concentration of activity in these clusters facilitates supply chain efficiencies and access to skilled labor but also means that economic shocks or policy changes can have disproportionately large impacts on these specific regions.

Major Manufacturers

India's automotive landscape features a mix of strong domestic companies and major international players across all vehicle segments.

Domestic OEMs: Key Indian manufacturers include:

- **Tata Motors:** A major player across PVs (including leadership in EVs like Nexon EV, Tigor EV) and CVs (market leader).
- **Mahindra & Mahindra (M&M):** Strong in UVs/SUVs and CVs, with a growing focus on EVs (e.g., XUV400, upcoming BE range).
- **Bajaj Auto:** A dominant force in motorcycles and three-wheelers, also entering the EV space with the Chetak scooter and electric 3Ws.
- **Hero MotoCorp:** India's largest two-wheeler manufacturer, primarily motorcycles, also venturing into EVs (Vida brand).
- **TVS Motor Company:** Significant player in scooters and motorcycles, with a strong EV presence (iQube scooter).
- **Ashok Leyland:** Major manufacturer of commercial vehicles (trucks, buses). Entering the EV bus market.
- **Royal Enfield:** Iconic motorcycle brand, strong in mid-size segment, based in Tamil Nadu.
- **Force Motors:** Produces CVs, UVs, and engines (including for BMW).
- **International OEMs:** Most global majors have established manufacturing operations in India:
- **Maruti Suzuki:** Market leader in PVs, subsidiary of Suzuki Motor Corp (Japan).
- **Hyundai Motor India:** Second largest PV player, significant exporter, major investments in TN including EVs.
- **Kia Motors:** Rapidly gained market share in PVs, part of Hyundai Motor Group.
- **Toyota Kirloskar Motor:** JV, strong in UVs and hybrids.
- **Honda Cars India:** Produces PVs. Honda Motorcycle & Scooter India is a major 2W player.
- **Renault-Nissan Alliance:** Joint manufacturing facility in TN, producing for domestic and export markets.

- **Volkswagen Group:** Includes VW, Skoda, Audi; manufacturing presence mainly in Maharashtra.
- **Mercedes-Benz:** Leading luxury car maker, investing in expansion.
- **BMW:** Luxury car manufacturing in TN.
- **Stellantis:** Produces Citroen vehicles in TN, also has engineering/R&D presence.
- **MG Motor India:** Subsidiary of SAIC Motor (China), offers PVs including popular EVs (ZS EV).
- **Volvo:** Presence in luxury cars and commercial vehicles (trucks, buses).
- **Isuzu Motors:** Manufacturing in Andhra Pradesh and Tamil Nadu.
- **Caterpillar:** Produces construction equipment/off-highway trucks in TN.
- **EV Specialists:** Besides established players entering the EV space, dedicated EV manufacturers are prominent:
- **Ola Electric:** Leading EV 2W player, major manufacturing in TN.
- **Ather Energy:** Premium EV scooter manufacturer, based in TN.
- **Hero Electric:** Large EV 2W manufacturer (separate from Hero MotoCorp).
- **Okinawa Autotech:** Significant player in EV 2Ws.
- **Ampere Vehicles (Greaves Electric Mobility):** Produces EV 2Ws, manufacturing in TN.

Electric Vehicle (EV) Segment

The electric vehicle segment represents a major growth frontier for the Indian automotive industry, driven by government incentives, environmental concerns, and evolving consumer preferences.

- **Growth Trajectory:** The EV market in India is projected to expand rapidly, with forecasts suggesting a Compound Annual Growth Rate (CAGR) of 49% between 2022 and 2030, or 36% until 2026. This translates into a potential market size exceeding USD 100 billion by 2030, with annual sales potentially crossing 10-17 million units by then. The total investment opportunity over the next decade is estimated at over USD 200 billion.
- **Market Penetration:** While growing fast, overall EV penetration remains relatively low. It reached 5.4% in FY24 and was reported at 6.6% by August 2024. This is significantly lower than markets like China (around 40%) and the USA (around 12.5%). However, the government aims for 30% EV sales share by 2030, with more ambitious targets in specific segments like 80% for 2Ws and 70% for CVs.
- **Segment Dominance:** Currently, the market is heavily skewed towards electric two-wheelers

(E2W) and three-wheelers (E3W), driven by lower upfront costs, operational savings, and specific use cases (last-mile delivery, shared mobility). E2W sales saw a 34% increase in Q3 FY24 vs Q2 FY24. Passenger car EV sales are growing (e.g., 49,800 units in 2022, 1.3% of total PV sales), but lag significantly behind E2W/E3W penetration.

- **Key Drivers:** Government subsidies (FAME, state policies), PLI schemes for vehicles and batteries, reduced GST rates (5% for EVs vs 28% for ICE), increasing environmental awareness, and rising fuel prices are major factors propelling EV adoption.
- **Challenges:** The primary hurdles include the high upfront cost of EVs compared to ICE vehicles, inadequate charging infrastructure (India's charging station to EV ratio of ~1:135 lags global norms of 1:6 to 1:20), range anxiety, and the need for a robust domestic supply chain, particularly for batteries. Government initiatives are actively working to address the charging infrastructure gap.

The significant gap between India's low overall vehicle penetration and its status as a top global producer suggests that future domestic growth, including for EVs, is heavily reliant on sustained economic development, rising incomes, and improved financing accessibility. This makes the industry's trajectory sensitive to broader macroeconomic conditions and policies, reinforcing the importance of exports as a potential buffer against domestic market fluctuations.

METRIC	VALUE (%)
Auto Component Production	~35%
Passenger Vehicle (4W) Prod.	~25-30%
Two-Wheeler (2W) Production	~36%
EV Production (Overall Sales)	~40%
EV 2W Manufacturing	~70%
Tyre Production	~40%
State Share of Mfg. GDP	~12%
Auto Exports (Overall)	30%
Vehicle Exports	45%
Passenger Vehicle Exports	60%
Motor Vehicle Exports	37% (FY24)
Auto Component Exports	32% (FY24)
State Share of National GDP	9.2% (FY24)

Note: Figures may vary slightly based on source and year.

TAMIL NADU: A PREMIER AUTOMOTIVE HUB

Tamil Nadu has earned a global reputation as a premier automotive manufacturing destination, frequently referred to as the "Detroit of Asia" or the "Automobile Capital of India". This status is built upon a long history of automotive manufacturing, dating back to the 1950s, and significantly accelerated by waves of investment from global OEMs starting in the 1990s. The Chennai metropolitan region, encompassing areas like Sriperumbudur, Oragadam, and Maraimalai Nagar, forms the core of this hub, hosting a dense concentration of vehicle manufacturers and component suppliers.

In recent years, the state's automotive landscape has expanded beyond Chennai. Krishnagiri has emerged as a significant center, particularly for EV two-wheeler manufacturing (hosting Ola Electric's Futurefactory). Coimbatore, with its strong engineering base, is another important cluster. Most recently, Thoothukudi is being developed as the state's fourth major auto cluster, anchored by VinFast's integrated EV manufacturing facility, leveraging its strategic port connectivity. This geographical expansion suggests a deliberate strategy to decentralize industrial growth and utilize specific locational advantages across the state.

Contribution to National Output

Tamil Nadu's contribution to India's overall automotive production and exports is substantial and disproportionately high compared to its size.

As the table illustrates, Tamil Nadu punches significantly above its weight in the automotive sector. Its dominance in EV manufacturing, particularly two-wheelers, highlights a successful strategic pivot towards future mobility technologies. The state's position as the leading exporter underscores its integration into global supply chains and the quality of its manufacturing output.

Key Manufacturers and Investments

Tamil Nadu hosts a diverse range of major automotive manufacturers, spanning domestic and international players across various segments. Key OEMs with significant operations include Hyundai, Renault-Nissan, BMW, Daimler (BharatBenz), Ashok Leyland, TVS Motor, Royal Enfield, Yamaha, Stellantis (Citroen manufacturing via PCA Automobiles), Caterpillar, TAFE Tractors, and Komatsu. Ford, a historical major investor, ceased manufacturing but is reportedly planning a comeback with an EV focus. The state is also a hub for specialized EV players like Ola Electric, Ather Energy, and Ampere Electric.

Recent years have seen a surge in major investment



commitments, particularly focused on EVs and capacity expansion, solidifying Tamil Nadu's position:

- **Tata Motors:** In a landmark move, Tata Motors is investing INR 9,000 crore (approx. USD 1.07 billion) to establish a new greenfield manufacturing facility in Panapakkam, Ranipet district. This state-of-the-art plant, will produce next-generation passenger vehicles and SUVs, explicitly including electric and luxury models for both Tata Motors and its subsidiary Jaguar Land Rover (JLR). Designed for an annual capacity of over 250,000 vehicles (to be reached progressively over 5-7 years), the facility emphasizes sustainability, aiming to run on 100% renewable energy. The project is expected to generate over 5,000 direct and indirect employment opportunities and involves significant skill-building initiatives.
- **VinFast:** Vietnamese EV manufacturer VinFast has committed USD 2 billion to establish an integrated EV manufacturing facility in Thoothukudi, with an initial phase investment of USD 500 million over five years. Construction began in February 2024 on a 400-acre site. The plant, nearing completion (90% reported in March 2025), is expected to commence operations around mid-2025. It will have an initial capacity of 50,000 units (CKD operations), scaling up to 150,000 units annually. The facility aims to produce mid-size electric SUVs (VF6, VF7 initially) for the domestic market and serve as an export hub for regions like West Asia and Africa, leveraging Thoothukudi's port access. The project is expected to create around 3,500 jobs.
- **Hyundai Motor India:** A long-standing investor in Tamil Nadu, Hyundai announced a significant 10-year investment plan (2023-2032) of INR 20,000 crore focused on EV manufacturing expansion, charging infrastructure, and skill development. In January 2024, an additional MoU for INR 6,180 crore was signed, specifically including the establishment of a 'Hydrogen Valley Innovation Hub' (INR 180 crore) in partnership with IIT-Madras to foster a hydrogen ecosystem. A key part of the EV plan is the construction of an EV battery pack assembly plant in Chennai with an investment of INR 7 billion (USD 84 million), targeting an annual capacity of 75,000 packs by 2025 to support localization and cost reduction.
- **Ola Electric:** The EV two-wheeler market leader operates the massive 'Ola Futurefactory' in Krishnagiri, Tamil Nadu, claimed to be the world's largest 2W factory. Ola is making substantial further investments in the state by setting up the 'Ola Gigafactory' in Pochampalli for in-house lithium-



ion cell manufacturing. The initial phase involves a USD 100 million investment, aiming for 1.5 GWh capacity initially, scaling to 5 GWh, with commercial production expected in 2025. This vertical integration aims to reduce reliance on imported cells (currently sourced from Korea/China) and improve costs.

These major investments highlight Tamil Nadu's success in attracting capital for both traditional and next-generation automotive manufacturing, driven by its established ecosystem and supportive policies.

Component Supplier Ecosystem

A critical element of Tamil Nadu's automotive strength is its deeply entrenched and extensive auto component supplier ecosystem. The state is home to a vast number of component manufacturers, with estimates ranging from over 400 firms according to the Automotive Component Manufacturers Association (ACMA) to over 1,500 factories producing auto and auto components cited by state sources. This includes over 100 major players, around 350 Tier I to Tier III suppliers, and

approximately 4,000 Small and Medium Enterprises (SMEs) in the Tier IV segment, heavily concentrated around Chennai.

This dense network allows Tamil Nadu to account for approximately 35% of India's total auto component production by value. Major domestic Tier 1 supplier groups like TVS Group and Rane Group have a strong base in the state, alongside global giants such as Bosch, Delphi-TVS, Visteon, Sundaram-Clayton (a leader in aluminum die-casting), and numerous others. The presence of these suppliers covers a wide spectrum of components, from engine and transmission parts, electricals and electronics, suspension and braking systems, to body parts and interiors.

The strength of this ecosystem enables a high degree of vehicle localization, estimated to be around 70-80%. This capability is a significant advantage for OEMs operating in the state, reducing supply chain complexities and costs. ACMA plays an active role in fostering this ecosystem, frequently organizing industry events and collaborations in Chennai. The state government is also reportedly working on a

specific policy to further support automotive MSMEs, focusing on demand creation, technology, R&D, and skills. This robust component base is a key factor attracting new investments, including those in the EV space, as manufacturers can leverage existing supply chains while developing new ones for EV-specific parts like batteries and motors.

Infrastructure and Logistics

Tamil Nadu's automotive prowess is significantly supported by its well-developed infrastructure and strategic logistical advantages.

- **Port Connectivity:** The state boasts a long coastline (1076 km) with multiple ports, crucial for its export-oriented automotive industry. The major ports of Chennai Port (ChPA), Kamarajar Port (KPL) at Ennore, and Kattupalli Port provide vital gateways for exporting finished vehicles and components to global markets. Chennai Port is one of India's largest and oldest major ports, while Kamarajar Port has developed significant Ro-Ro (Roll-on/Roll-off) capabilities specifically catering to automobile exports, boasting large parking yards and aiming to be a leading vehicle export hub. The emergence of Thoothukudi (V.O. Chidambaranar Port) as a hub, particularly for VinFast, further leverages port access in the southern part of the state.

- **Industrial Corridors and Parks:** Tamil Nadu has actively developed industrial infrastructure to support manufacturing. This includes numerous state-owned (SIPCOT, TIDCO, ELCOT) and private industrial parks, Special Economic Zones (SEZs -- Tamil Nadu has the highest number of operational SEZs in India), and Domestic Tariff Zones (DTZs). Major automotive clusters like Sriperumbudur, Oragadam, and Maraimalai Nagar are well-established industrial areas. The Chennai-Bengaluru Industrial Corridor (CBIC) further enhances connectivity and infrastructure along this key economic axis.

- **Road and Air Network:** The state possesses an extensive road network, including National and State Highways, ensuring good connectivity between manufacturing hubs, ports, and domestic markets. Tamil Nadu also has the highest number of international airports (4) in India (Chennai, Coimbatore, Madurai, Tiruchirappalli), along with

domestic airports, facilitating both passenger travel and air cargo movement. Chennai International Airport is a major cargo hub.

- **Power and Water:** While power availability has been a challenge historically, the state is actively working on ensuring reliable power and water supply for industrial regions, including initiatives like Tertiary Treatment Reverse Osmosis (TTRO) plants for industrial water supply near Chennai and Hosur. The new Tata Motors plant, for instance, plans to use 100% renewable energy.

This combination of logistical advantages -- particularly port access for exports -- and dedicated industrial infrastructure provides a compelling environment for automotive manufacturing and is a key element of Tamil Nadu's sustained leadership in the sector.

The state's ability to leverage this existing ecosystem while simultaneously attracting high-tech investments like EVs demonstrates a synergistic loop where infrastructure and industry reinforce each other, catalyzed by proactive state policies.

COMPARATIVE ANALYSIS

The policy landscape influencing the automotive industry in India involves initiatives from both

the Central Government and state governments, particularly proactive states like Tamil Nadu. Understanding the interplay and specific focus of these policies is crucial for assessing the operating environment.

Central Government Policies

The Central Government has implemented several key policies and schemes aimed at shaping the automotive sector's growth, promoting modernization, encouraging exports, and driving the transition towards cleaner mobility.

◆ National Automobile Policy (Draft 2018):

Although still in draft form and not formally adopted, this policy outlined a comprehensive vision. Its key proposals included establishing a long-term roadmap for emission standards beyond BS-VI (aiming for harmonization with global standards by 2028), rolling out Corporate Average Fuel Economy (CAFE) norms, adopting a composite taxation criterion based on vehicle length and CO2 emissions, harmonizing Indian standards with international WP-29 regulations, strengthening the

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skill development ecosystem via the Automotive Skills Development Council (ASDC), retaining R&D incentives, promoting indigenous R&D, fast-tracking the Bharat New Vehicle Safety Assessment Program (BNVSAP), and implementing measures to boost exports. The lack of formal adoption, however, has contributed to a degree of policy uncertainty noted by industry stakeholders.

- ◆ **FAME India Scheme:** This flagship scheme aims to promote the adoption and manufacturing of electric and hybrid vehicles.
- ◆ **FAME Phase II (April 2019 - March 2024, extended):** With an enhanced outlay of INR 11,500 crore, this phase focused primarily on subsidizing electric public and shared transport. It set targets to support 7,090 e-Buses, 5 lakh e-3Ws, 55,000 e-4W passenger cars, and 10 lakh e-2Ws through demand incentives. It also allocated funds (INR 800 crore initially) for setting up EV public charging stations (EVPCS), sanctioning over 7,400 stations through Oil Marketing Companies (OMCs) and others. By early 2025, the scheme had incentivized the sale of over 1.5 million EVs.
- ◆ **Post-FAME II Initiatives:** Recognizing the need for continued support, several schemes followed:
- ◆ **PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE):** Notified in September 2024, this two-year scheme has an outlay of INR 10,900 crore. It supports a broader range of EVs including e-Trucks and e-Ambulances, alongside e-2W, e-3W, e-Buses, charging stations, and upgrades for testing agencies. It also incorporates stricter compliance measures regarding localization (Phased Manufacturing Program - PMP) based on lessons from FAME II.
- ◆ **Electric Mobility Promotion Scheme (EMPS) 2024:** A short-term (4-month) scheme with INR 500 crore outlay launched in March 2024 to specifically support e-2W and e-3W segments.
- ◆ **PM e-Bus Sewa:** Notified in October 2024 with an outlay of INR 3,435 crore, this scheme aims to support the deployment of over 38,000 e-buses by providing a Payment Security Mechanism (PSM) to operators.
- ◆ **Production Linked Incentive (PLI) Schemes:** These schemes aim to boost domestic manufacturing, particularly in advanced technology areas.
- ◆ **PLI-Auto:** Approved in September 2021 with a budget of INR 25,938 crore over five years (FY23-FY27), this scheme incentivizes the domestic manufacturing of Advanced Automotive Technology (AAT) products, with a strong focus

on Battery Electric Vehicles (BEVs) and Hydrogen Fuel Cell Vehicles (HFCVs) and their components. It requires a minimum 50% Domestic Value Addition (DVA) and offers incentives ranging from 8% to 18% on determined sales of eligible products. 85 applicants (18 OEMs, 67 Component Companies) were approved. By December 2024, the scheme had attracted actual investments of INR 25,219 crore against a proposed INR 67,690 crore, and generated 38,186 jobs against a proposed 1.48 lakh. Incentive disbursements commenced in FY25.

- ◆ **PLI-ACC (Advanced Chemistry Cell):** Approved in May 2021 with an INR 18,100 crore outlay, this scheme targets the establishment of 50 GWh of domestic ACC battery manufacturing capacity, crucial for the EV ecosystem.

TAMIL NADU COMPLEMENTS CENTRAL POLICIES WITH ITS OWN SET OF TARGETED INITIATIVES TO LEVERAGE ITS STRENGTHS AND ATTRACT INVESTMENTS, ESPECIALLY IN HIGH-GROWTH AREAS SUCH AS EVs AND ELECTRONICS.

- ◆ **PLI for Large Scale Electronics Manufacturing:** Offers 4-6% incentives on incremental sales of mobile phones and specified electronic components, relevant to the increasing electronic content in vehicles.
- ◆ **Emission Norms (BS-VI):** India leapfrogged from BS-IV to the stringent BS-VI emission standards nationwide from April 1, 2020. This move aligned India with global standards like Euro VI and mandated significant reductions in pollutants like Sulphur (max 10 ppm in fuel), NOx, and Particulate Matter (PM). The transition required substantial industry investment (estimated INR 70,000 crore) for technological upgrades, including advanced exhaust after-treatment systems like Diesel Particulate Filters (DPF) and Selective Catalytic Reduction (SCR). BS-VI Phase 2 norms, incorporating Real Driving Emissions (RDE) monitoring, were implemented from April 2023. While crucial for air quality improvement, these norms led to increased vehicle costs.

Other Key Initiatives:

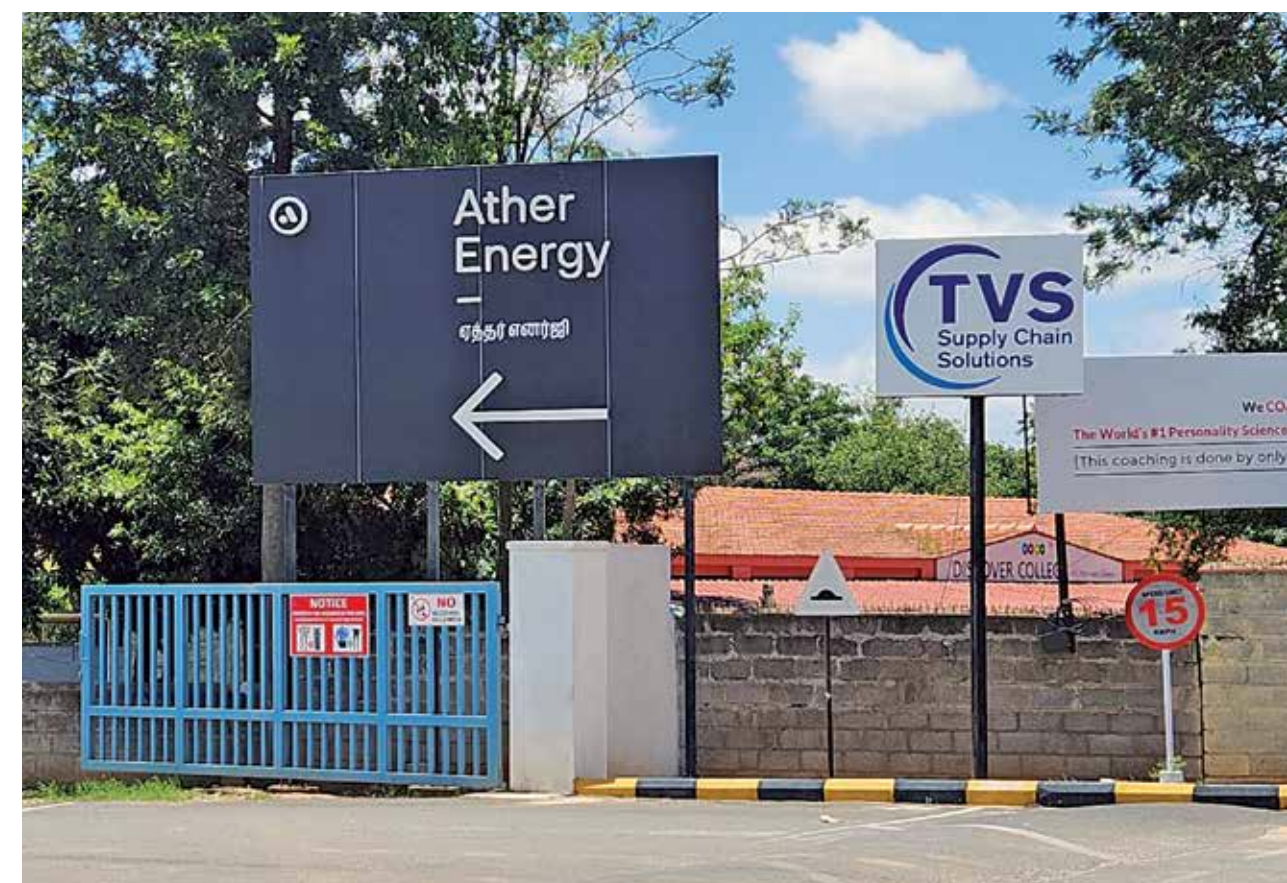
- **Automotive Mission Plan (AMP) 2016-2026:** A joint vision of the government and industry aiming to position India among the top three global automotive players in engineering, manufacturing,

and exports by 2026. It projected significant growth in industry value (to USD 260-300 Bn), GDP contribution (to >12%), and employment (65 Mn additional jobs).

- **NATRIP (National Automotive Testing and R&D Infrastructure Project):** A major initiative to create world-class automotive testing, validation, homologation, and R&D infrastructure across multiple centers in India (Manesar, Chennai, Pune, Indore, etc.).
- **Scheme for Promotion of Manufacturing of Electric Passenger Cars in India (SPMEPCI):** Notified March 2024, requires minimum investment (INR 4,150 Cr) and DVA targets (25% by year 3, 50% by year 5) to promote local EV car manufacturing.
- **FDI Policy:** Allows 100% FDI in the automotive sector under the automatic route, facilitating investment inflows.
- **Atmanirbhar Bharat Abhiyaan:** A broader self-reliant India initiative providing an overarching framework for promoting domestic manufacturing.

Tamil Nadu complements central policies with its own set of targeted initiatives designed to leverage its strengths and attract investment, particularly in high-growth and strategic areas like EVs and electronics.

- ◆ **Guidance Tamil Nadu:** This is the state's dedicated nodal agency responsible for investment promotion and single-window facilitation. Mandated under the TN Business Facilitation Act, it provides end-to-end support to investors, from initial inquiries and site selection to clearances and aftercare. Its active role has been evident in securing recent major automotive investments from companies like VinFast and Tata Motors. Guidance TN also plays a strategic role, such as declaring Thoothukudi as a new automotive hub.
- ◆ **Tamil Nadu Industrial Policy 2021:** This policy sets ambitious targets, including achieving a 15% annual growth rate in manufacturing, attracting INR 10 lakh crore (USD ~120 Bn) in investments, and creating 2 million employment opportunities between 2020 and 2025. It identifies Automobile & Auto Components and Electronic Hardware as key focus sectors. The policy offers a structured package of incentives for large projects, varying by investment size and location (categorized into A, B, C districts based on industrial development). Key fiscal incentives include:
- ◆ **SGST Reimbursement:** 100% reimbursement of State Goods and Services Tax (SGST) paid on final products manufactured and sold within the state for up to 15 years.



- ◆ **Capital Subsidies:** Options include a Fixed Capital Subsidy (up to 25% of Eligible Fixed Assets - EFA, disbursed over time) or a Flexible Capital Subsidy (up to 35-40% of EFA based on district category, disbursed over 2.5 times the investment period).
- ◆ **Turnover Based Subsidy:** Up to 2% of annual turnover for mega/ultra-mega projects creating significant employment (e.g., >2000 jobs) for 10 years.
- ◆ **Other Incentives:** Land cost subsidies (especially in less developed 'C' districts), training subsidies (INR 4000-6000 per worker/month for 6 months), electricity duty exemption (5 years), stamp duty exemptions/concessions, interest subvention (5% for 6 years, capped based on investment), and incentives for environmental protection, quality certification, and IP creation.
- ◆ **Tamil Nadu Electric Vehicle Policy 2023:** This policy, replacing the 2019 version, specifically targets the EV ecosystem. It aims to attract INR 50,000 crore (USD ~6 Bn) in EV investments and create 1.5 lakh jobs during the policy period. Key features include:
- ◆ **Manufacturing Incentives (EV Special Manufacturing Package):** Applicable for projects >INR 50 crore investment and >50 jobs. Offers choices like 100% SGST reimbursement (15 years), Capital Subsidy (15% in 10 installments), or Turnover Subsidy (up to 2% for 10 years). A special 20% capital subsidy is available for Advanced Chemistry Cell (ACC) battery manufacturing. R&D expenditure (including intangibles up to 20% of EFA) is included in EFA calculations. Also includes incentives like land cost subsidy, employment incentive (EPF reimbursement up to INR 48k/employee for 1 year), green industry incentive, quality certification, IP creation, interest subvention, and electricity/stamp duty exemptions.
- ◆ **Demand Side Incentives:** 100% road tax exemption and waiver of registration fees/charges for various EV categories (2W, private cars, 3W, transport vehicles, LGCs, buses) until December 31, 2025. Waiver on permit fees also included. Incentives for retrofitting ICE vehicles to EV are also mentioned.
- ◆ **Charging Infrastructure Support:** 25% capital subsidy on equipment/machinery for the first 200 public charging stations (up to INR 10 lakh for fast charging, INR 1 lakh for slow) and the first 50 private e-aggregator charging stations (up to INR 10 lakh). Similar 25% subsidy for the first 200 public battery swapping stations (up to INR 2 lakh). Concessional power tariffs and demand charge reductions for

charging stations are also provided.

- ◆ **Ecosystem Development:** Identifies pilot cities (Chennai, Coimbatore, Trichy, Madurai, Salem, Tirunelveli) for e-mobility solutions. Includes transition support via training subsidies for upskilling existing workforce for EV production lines. Aims for 30% electrification of state transport buses by 2030.
- ◆ **Tamil Nadu Semiconductor and Advanced Electronics Policy 2024:** Recognizing the increasing electronic content in vehicles (projected to rise from 20% to 40-50%) and the state's strength in electronics exports (targeting 40% of India's total by 2030), this policy is highly relevant to the automotive sector. Key features include:
- ◆ **Financial Support:** Offers up to 50% additional financial subsidy for semiconductor manufacturing projects selected under the central government's India Semiconductor Mission.
- ◆ **Payroll Subsidy:** Provides payroll reimbursement (30% in Year 1, 25% in Year 2, 20% in Year 3, capped at INR 20,000/employee/month) for eligible semiconductor design and R&D units that employ residents of Tamil Nadu, aiming to leverage and retain local talent.
- ◆ **R&D Incentives:** 50% reimbursement of expenditure incurred for IP creation (patents, copyrights, etc.) up to INR 1 crore.
- ◆ **Value Addition Requirement:** Incentives are linked to achieving a minimum unit-level value addition of over 20%, encouraging deeper manufacturing capabilities.
- ◆ **Other Relevant Policies:** The earlier Tamil Nadu Automobile and Auto Parts Policy 2014 laid the groundwork. A specific policy focused on supporting automotive MSMEs is also under development, aiming to address their unique needs in areas like finance, technology, and skills.

Comparative Assessment

Comparing the policy approaches reveals distinct roles and strategies:

- **Scope and Focus:** Central policies like FAME and PLI provide a national framework and significant financial impetus, particularly targeting the shift to EVs and advanced technologies across the country. They set the broad direction and minimum standards (like BS-VI). Tamil Nadu's policies, while aligned with national goals, are more granular and tailored to the state's specific strengths and ambitions. They offer a wider range of incentives (capital, turnover, SGST reimbursement, payroll, land cost) and often appear more generous or

Policy Area	Feature	Central Policy/Scheme (Examples)	Tamil Nadu Policy/Scheme (Examples)	Key Differences/Synergies
EV Manufacturing Incentive	Financial support for EV/Component Mfg.	PLI-Auto (8-18% on sales, AAT focus); PLI-ACC (Battery Mfg.); SPMEPCI (EV Cars)	TN EV Policy (Choice of 100% SGST reimbursement / 15% Capital Subsidy / up to 2% Turnover Subsidy; 20% ACC Subsidy)	TN offers multiple incentive options (Capital, Turnover, SGST) potentially more flexible/generous than central PLI sales linkage. TN has specific ACC subsidy. Both require DVA/Investment.
EV Demand Incentive	Subsidies for EV purchase	FAME II (ended Mar'24); EMPS 2024 (short-term 2W/3W); PM E-DRIVE (potential future support)	TN EV Policy (100% Road Tax Exemption, Registration Fee Waiver till Dec 2025)	Central focuses on direct purchase subsidies (now limited). TN focuses on waivers reducing on-road cost. Complementary effects.
Charging Infra Support	Financial aid for charging stations	FAME II (support for PCS via OMCs etc.); PM E-DRIVE	TN EV Policy (25% Capital Subsidy for Public/Private Charging/Swapping stations - capped; Concessional Power Tariff)	TN provides direct capital subsidy for station setup & operational cost reduction via power tariffs. Central support channeled differently (e.g., via OMCs).
Component Manufacturing	Incentives for Auto Components	PLI-Auto (8-13% on AAT component sales); PLI-Electronics	TN Industrial Policy (General incentives - Capital/Turnover/SGST); TN EV Policy (EV components); TN Semiconductor Policy (Advanced Electronics)	TN offers broader industrial policy incentives applicable to components, plus specific focus in EV/Electronics policies. PLI-Auto is specific to AAT.
R&D Support	Incentives for Research & Development	Draft National Auto Policy proposed R&D tax benefits; NATRIIP Infra	TN Industrial Policy (R&D Training, IP Creation, Quality Certification incentives); TN EV Policy (R&D included in EFA); TN Semiconductor Policy (Payroll Subsidy for Design/R&D)	TN policies offer more direct & diverse R&D incentives (payroll, IP cost reimbursement, inclusion in EFA). Central focus less explicit in current active schemes beyond infra.
Skill Development	Support for workforce training	ASDC initiatives; Skill India/PMKVY; NAPS	TN Industrial Policy (Training Subsidy); TN EV Policy (Transition Support/ Training Subsidy); TN Semiconductor Policy (Payroll Subsidy); TNSDC/ TN AutoSkills/Naan Mudhalvan programs	Both levels active. TN has dedicated state bodies (TNSDC, TN AutoSkills) and integrates training subsidies directly into industrial/EV policies. Central relies on SSCs/National schemes.
Land/Infrastructure Support	Facilitation for setting up facilities	National Industrial Corridors; EMC 2.0 Scheme (Electronics)	TN Industrial Policy (Land Cost Subsidy in C districts, Industrial Park development); Guidance TN facilitation	TN offers direct land cost subsidies in certain areas and dedicated agency support (Guidance TN). Central support more focused on large corridor/cluster projects.

flexible, aiming to create a compelling investment proposition within the national framework. The state's focus clearly extends beyond just manufacturing incentives to holistic ecosystem development, covering R&D, skills, charging infrastructure, and cluster development. This comprehensive approach likely enhances its attractiveness beyond simple fiscal benefits,

fostering a more sustainable competitive edge.

- **Synergy and Complexity:** State policies often build upon or complement central schemes. For instance, Tamil Nadu offers additional subsidies for semiconductor projects approved by the Centre. Investors can potentially benefit from both central (e.g., PLI) and state incentives. However, this multi-layered structure can also create complexity for



investors navigating the application and compliance processes for different schemes across different government levels. States with well-organized and proactive investment promotion agencies like Guidance Tamil Nadu may have an advantage in helping investors maximize benefits, potentially widening the gap with states lacking similar institutional capacity.

- **Policy Stability and Agility:** The draft status of the National Auto Policy creates a potential vacuum in long-term, stable national regulatory direction, forcing the industry to rely more on state-level policies for predictability, especially in rapidly evolving segments like EVs and electronics. Tamil Nadu has demonstrated agility by periodically revising its policies (e.g., EV Policy 2019 revised in 2023) and introducing new ones to capture emerging opportunities (e.g., Semiconductor Policy 2024). This responsiveness can be a significant advantage in attracting investment in dynamic sectors.
- **Implementation:** Central schemes like PLI utilize dedicated portals and Project Management Agencies (PMAs) like IFCI Ltd for implementation and monitoring. Tamil Nadu relies heavily on Guidance Tamil Nadu for single-window facilitation and investor handholding. The perceived

efficiency and supportiveness of these respective implementation mechanisms can influence investor experience and decisions.

In essence, while central policies set the stage and provide broad momentum, Tamil Nadu's targeted, comprehensive, and proactively managed policies appear to be a key differentiator, enabling it to carve out a leadership position, particularly in the crucial EV and advanced electronics segments of the automotive industry.

WORKFORCE CAPABILITIES ASSESSMENT

The availability, cost, and skill level of the workforce are critical factors influencing the competitiveness of the automotive manufacturing sector in both India and Tamil Nadu.

Overall Labor Pool & Costs

India possesses a vast labor pool, a demographic advantage for labor-intensive manufacturing. However, this large pool often suffers from a significant mismatch between available skills and industry requirements, posing a major challenge. The automotive sector alone is estimated to require around 35 million skilled workers, indicating a substantial demand.

Tamil Nadu stands out within India for its large industrial workforce. It ranks first nationally in the

number of factory workers, employing approximately 2.2 million people in factories, significantly more than other industrial states like Gujarat (1.6 million). In the fiscal year 2023-24, about 33.3% of Tamil Nadu's total workforce was engaged in industrial activities, split between manufacturing (around 16%) and construction (around 17%). This indicates a strong industrial orientation within the state's labor market.

Regarding labor costs, data suggests Tamil Nadu generally has higher wage levels compared to some other major manufacturing states, particularly in rural non-agricultural, agricultural, and construction segments when compared to Gujarat. The average wage/salary per worker in Tamil Nadu's manufacturing sector was recorded at INR 2.99 lakh in 2022-23, showing a consistent upward trend. However, manufacturing in Tamil Nadu, particularly in the SME sector, tends to be more labor-intensive compared to the more capital-intensive nature observed in states like Gujarat. While electricity costs in Tamil Nadu have been noted

as relatively high compared to some competitors, the state's overall competitiveness seems less reliant on achieving the absolute lowest labor cost. Instead, it appears to leverage its larger pool of available labor and potentially higher productivity. Data indicates rising net value added per person in Tamil Nadu's manufacturing sector, reaching INR 6.95 lakh in 2022-23, suggesting improvements in efficiency or technology adoption. This combination of a large workforce and rising productivity might offset higher wage levels for investors prioritizing scale and skill availability.

Skilled Labor & Engineering Talent

While India has a large number of graduates, including engineers, a critical skills gap persists, particularly in the competencies required for the modern automotive industry's shift towards electrification, connectivity, autonomous features, and advanced manufacturing (Industry 4.0). Skills in areas like battery management systems (BMS), EV algorithms, safety engineering, AI/ML, data analytics, software development, cybersecurity, and mechatronics are in high demand but short supply. The overall employability of graduates, while improving, remains a concern, although engineering (BE/BTech) graduates reportedly had a higher employability rate of around 71.5% in 2025. The automotive sector specifically faces a severe shortfall, estimated at a 35% gap between demand

and supply of skilled workers, significantly higher than the gap in the IT sector (11%). This suggests a potential misalignment between the skills imparted by the education system and the specific, rapidly evolving needs of the automotive industry.

Tamil Nadu is recognized for its strong emphasis on education and possesses a substantial pool of skilled and semi-skilled labor, particularly in engineering and technical fields. The state produces around 1.5 lakh engineering graduates annually, creating a deep talent pipeline. This availability of talent is frequently cited as a key reason for attracting major investments, including R&D centers and engineering hubs. India, in general,

is a significant hub for global engineering and R&D, accounting for 40% of the total global spend in this area, with automotive being a major component. The presence of tech hubs in cities like Chennai, Bengaluru (close proximity), Pune, and Hyderabad further supports the availability of specialized software and electronics talent crucial for modern automotive development. However, despite

the large number of graduates, the significant skill gap reported specifically for Tamil Nadu's auto sector underscores that quantity alone is insufficient; the relevance and quality of the skills are paramount.

Skill Development Initiatives

Recognizing the critical skills gap, numerous initiatives have been launched at both the national and state levels to train, retrain, and upskill the workforce for the automotive sector.

National Level:

- ◆ **Automotive Skills Development Council (ASDC):** Established as the first Sector Skill Council in India, ASDC is an industry-led body (supported by SIAM, ACMA, FADA) dedicated to setting occupational standards (Qualification Packs - QPs / National Occupational Standards - NOS) and promoting skill development in the automotive sector. It aims to skill and certify millions, having already certified over 3 lakh candidates through its network of over 1,500 training centers. ASDC develops standards for various job roles, including emerging areas like EVs and Industry 4.0 (robotics, IoT, AI, analytics). It collaborates extensively with industry partners (like Hero MotoCorp, Tata Motors, Uber) and academic institutions for training delivery, assessment, and certification, focusing on skilling, reskilling, and

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upskilling. Specific programs include EV technician courses and nanodegrees.

- ◆ **Other National Schemes:** The broader Skill India Mission, including the Pradhan Mantri Kaushal Vikas Yojana (PMKVY), provides funding and framework for industry-oriented training. The National Apprenticeship Promotion Scheme (NAPS) encourages practical, on-the-job training. The National Skill Development Corporation (NSDC) acts as a facilitator, funding partner, and standard-setter, working closely with SSCs like ASDC.

Tamil Nadu Level:

- ◆ **Tamil Nadu Skill Development Corporation (TNSDC):** As the state's nodal agency, TNSDC coordinates skill development activities, partnering with industries, training providers, and SSCs. It focuses on demand-based, placement-oriented training aligned with the National Skill Qualification Framework (NSQF). TNSDC runs various programs, including the prominent Naan Mudhalvan scheme.
- ◆ **TN Apex Skill Development Centre for Automobile (TN AutoSkills):** A joint venture between TNSDC and industry partners, TN AutoSkills is specifically focused on imparting high-end, technology-driven skills relevant to the modern automotive sector, including EV technology, automation, robotics, design, and mechatronics. It operates a state-of-the-art training center in Chennai and aims to skill/reskill/upskill a million people by 2032.
- ◆ **Naan Mudhalvan:** This ambitious scheme aims to make Tamil Nadu's youth job-ready and establish the state as a "skill capital". It collaborates directly with industries, such as the partnership with Stellantis for a Faculty Development Programme (FDP) focusing on emerging automotive technologies (EVs, connected vehicles) to enhance engineering curriculum relevance across colleges in the state.
- ◆ **MSME EV Skilling Program:** A collaboration between FaMe TN (Facilitating MSMEs of Tamil Nadu) and WRI India, this program provides practical, hands-on training specifically for MSMEs and workers in the EV supply chain, starting in the Coimbatore motor cluster and planned for expansion.
- ◆ **Policy-Integrated Support:** Tamil Nadu's Industrial Policy 2021 and EV Policy 2023 incorporate direct financial support for skilling, offering training subsidies for new hires and transition support (upskilling allowance/subsidy) for existing workers moving to EV lines. The Semiconductor Policy's

payroll subsidy further incentivizes hiring and retaining local R&D talent.

Addressing the Skills Gap

Despite the multitude of initiatives, bridging the significant skills gap remains a major undertaking. The challenge is not just quantitative but qualitative, requiring a workforce adept in new and rapidly evolving technologies. High employee turnover exacerbates the problem, alongside challenges like the cost of reskilling.

Effective solutions require a concerted, collaborative approach involving:

- **Industry-Academia Alignment:** Continuously updating educational curricula (from ITIs to engineering colleges) to match industry needs, incorporating practical training, internships, and apprenticeships. Initiatives like the Stellantis-Naan Mudhalvan FDP are steps in this direction.
- **Focus on Upskilling/Reskilling:** Given the technological shift, training the existing workforce is as crucial as training new entrants.
- **Leveraging Technology:** Using digital platforms, AI-powered learning, and AR/VR tools can help scale training initiatives, personalize learning, and reach a wider audience.
- **Standardization and Quality Assurance:** Ensuring that training programs meet industry standards (like NSQF) and lead to credible certifications is vital for ensuring employability and maintaining quality. ASDC's role in setting standards and assessment is key here.
- **Policy Support:** Continued government support through funding, incentives (like TN's training subsidies), and creating a conducive environment for skill development institutions and public-private partnerships is essential.

The sheer number of skilling initiatives at both national and state levels signifies strong awareness of the problem. However, their ultimate success will depend on effective coordination, robust quality control, and demonstrable outcomes in terms of bridging the specific skill gaps identified by the automotive industry, particularly in Tamil Nadu where the gap appears acute despite a large talent pool.

COMPARATIVE EXPORT PERFORMANCE

Automotive exports represent a significant aspect of India's manufacturing prowess and foreign exchange earnings, with Tamil Nadu playing a pivotal role in this domain.





India's Automotive Exports

India exports a substantial volume of vehicles and auto components globally.

Vehicle Exports:

- **Volumes:** Total vehicle exports reached 4.76 million units in FY23 but declined by 5.5% to 4.50 million units in FY24, impacted by monetary crises and economic slowdowns in key overseas markets. However, Q1 FY25 (April-June 2024) showed a strong recovery, with overall vehicle exports rising 15.5% YoY to 1.19 million units.
- **Segment Trends:** In FY24, PV exports saw marginal growth to 672,105 units, while CVs (65,816 units), 3Ws (299,977 units), and 2Ws (3.46 million units) all experienced declines compared to FY23. This followed a pattern in FY23 where PV exports grew 14.7%, but other segments contracted. The recovery in Q1 FY25 was broad-based, with PV exports surging 18.6-19% YoY to 180,483 units, and 2W exports growing 17% YoY to 923,148 units. This divergence suggests PV exports, often driven by global OEMs using India as a base, may be more resilient than 2W/3W/CV exports, which appear more sensitive to economic conditions in specific developing markets like Latin America and Africa.
- **Value:** Total automotive exports (vehicles + components) were valued at approximately USD

35.7 billion in FY23 and USD 35 billion in FY24. Vehicle exports alone were estimated at USD 4.3 billion in H1 FY24 (Apr-Sep 2023).

- **Auto Component Exports:** This segment has shown remarkable resilience and growth.
- **Value & Growth:** Component exports grew by 5.5% YoY in FY24 to reach USD 21.2 billion. This growth occurred despite challenges like the Red Sea crisis impacting logistics costs and timelines. The sector achieved a trade surplus of approximately USD 300 million in FY24, a positive shift from a deficit in FY23.
- **Targets:** The industry aims for ambitious export targets, ranging from USD 30 billion by 2026 to USD 80-100 billion by 2026-2030.
- **Key Components:** Dominant export categories include drive transmission & steering parts, engine components, body/chassis components, and suspension & braking systems.

Key Destinations:

- **Vehicles:** Major markets include South Africa, Saudi Arabia, Mexico, UAE, Chile, USA, Bangladesh, and countries in Latin America, Africa, and Southeast Asia.
- **Components:** North America is the largest market (32% share in FY24, primarily USA),

followed closely by Europe (33%, led by Germany, UK, Turkey, Italy), and Asia (24%, including Bangladesh, Thailand, UAE).

The growth in component exports, achieving a trade surplus even amidst logistical headwinds, suggests increasing global competitiveness and successful integration into global value chains. This trend, potentially fueled by factors like cost advantages, quality improvements, and global supply chain diversification strategies (e.g., "China+1"), might offer a more sustainable export growth path compared to finished vehicles, which are often subject to specific OEM strategies and demand fluctuations in destination markets.

Tamil Nadu is undeniably India's automotive export powerhouse due to various factors. The state consistently ranks first in automobile exports from India and is the third-largest exporting state overall across all merchandise categories. Tamil Nadu accounts for a very large share of India's automotive exports. Figures vary slightly across sources, but indicate contributions such as:

- 30% of India's total auto exports
- 45% of India's vehicle exports
- 60% of India's passenger vehicle exports

- 37% of India's motor vehicle exports (FY24)
- 32% of India's auto component exports (FY24)

This dominance highlights that Tamil Nadu's export performance heavily dictates India's overall standing in global automotive trade.

Growth Trends

Tamil Nadu's overall merchandise exports demonstrated resilience, growing 7.1% in FY24 to USD 43.6 billion, contrasting with the national decline and contractions seen in other top exporting states like Gujarat and Maharashtra. The state's share in national exports rose to nearly 10% in FY24. Specific automotive export growth from TN was reported at 25% YoY in the first half of calendar year 2024 by the Automotive Export Promotion Council (AEPC), suggesting strong momentum potentially outpacing the national recovery seen in Q1 FY25.

CHAPTER 3

TAMIL NADU'S \$1 TRILLION ECONOMIC VISION

*The Role of Tamil Nadu's Automotive Sector in
Realizing the \$1 Trillion Economy Vision*



TAMIL NADU IS aspiring to become a US\$ 1 trillion economy by 2030-31. For a state that is geographically advantaged and broad based, with a legacy in light and heavy manufacturing, high focus on human development and high level of women empowerment, this goal is a worthy dream. On the grounds there is clear a basis that these dreams are achievable based on the current scenario of the state.

As of 2024-25, Tamil Nadu's GDP is 2nd largest in India with an impressive growth of nearly 10%. The state also boasts of the largest number of industries in India, with leadership positions in labor participation in workforce, women participation in manufacturing sector, 22 of the top 100 engineering colleges are based in Tamilnadu among many other factors.

These factors have made Tamilnadu a strong manufacturing state with Kancheepuram, Chennai and Tiruvallur Districts (KCT), which is the main economic hub with multiple industries' driving growth including automobile and electronics. In addition to KCT there are four more development zones driving economic growth of the state with the formidable western region centered around Coimbatore and its adjoining districts with their textiles, foundry, pumps, auto components base along with their rich transition in car racing and vehicle customization legacy. The upcoming Electric vehicles (EV) hub of Hosur in Krishnagiri District built on a strong foundation of automotive industry, light engineering capabilities (unrecognized till now) has created a troika of in Tamilnadu for manufacturing and automobiles.

These three zones are ably supported by Madurai – Tiruchirappalli region developed on the legacy of TVS group and the upcoming hub of Thoothukudi – a bustling industrial, energy and port city. These 5 hubs spread across the state provide excellent physical infrastructure for the state's manufacturing industry to grow. In addition, with 3 seaports in Chennai and 1 in Thoothukudi the state is well prepared to be a key hub in global trade. Each of these zones are also well connected by air with access to international airports. The state has been endowed with geographical advantage as well as a strong legacy of economic growth with all regions in state benefitting.

Tamil Nadu's vision of becoming a \$1 trillion economy by 2030 is rooted in its aspiration to lead not just in industrial output, but also in economic inclusion, innovation, sustainability, and export competitiveness. As the most industrialized and urbanized state in India, Tamil Nadu has a foundational advantage — a robust manufacturing base, a strategic location, and a skilled workforce. However, reaching a \$1 trillion economic threshold requires a recalibration of its growth levers. Among these, the automotive sector stands out as both



a proven engine and a promising catalyst.

The automotive sector has traditionally been a cornerstone of Tamil Nadu's industrial development. Today, the state produces one out of every five cars made in India and contributes approximately 45% of India's automobile exports. The sector also plays a vital role in employment, technology diffusion, infrastructure development, and regional growth. With the global mobility landscape undergoing structural shifts driven by electrification, digitalization, and climate imperatives, Tamil Nadu's leadership in the automotive sector provides it with a strategic launchpad for broader economic transformation.

This transformation is not hypothetical; it is embedded in the state's policy blueprints, investment facilitation, logistics development, and skill initiatives. The Tamil Nadu Vision 2030 document outlines a cross-sectoral push that leverages industry clusters, sustainable infrastructure, digital governance, and innovation-led growth. Within this construct, the automotive sector, including electric vehicles (EVs), will not only contribute through direct manufacturing

output but also by triggering ecosystem-wide advancements in logistics, research and development, energy, and digital infrastructure

INDUSTRIAL MATURITY AND STRATEGIC POSITIONING

Tamil Nadu has decades of experience in nurturing industrial ecosystems. The state's industrial maturity is exemplified by its dense network of original equipment manufacturers (OEMs), tier-I and tier-II component suppliers, tool and die manufacturers, testing and homologation centres, and ports. The cities of Chennai, Hosur, Coimbatore, Trichy, and Madurai have all developed as interlinked hubs with a high degree of specialization and supply chain interdependence. This has enabled cost efficiencies, accelerated innovation cycles, and enhanced resilience in the face of global disruptions.

Strategic geography further strengthens the sector's export orientation. Tamil Nadu is home to three major ports and several minor ports, enabling the seamless movement of automotive products and raw

materials. The state's well-developed road and rail networks connect industrial hubs to domestic markets and logistics corridors, supporting just-in-time (JIT) manufacturing and large-scale exports.

The government's focus on creating plug-and-play infrastructure through the development of dedicated auto and EV parks in locations like Krishnagiri, Manallur, and Tuticorin underscores the emphasis on capital efficiency and speed-to-market. These parks are being planned with integrated facilities for design, testing, training, and logistics, enabling end-to-end manufacturing capabilities with minimal lead times.

FROM INTERNAL COMBUSTION TO ELECTRIC MOBILITY

While Tamil Nadu's historical strength lies in internal combustion engine (ICE) vehicles, the future is decisively electric. The state has already emerged as India's leading EV manufacturing hub, accounting for 70% of the nation's electric two-wheeler production. Key players such as Ola Electric, Ather Energy, Ampere Vehicles, and Simple Energy have established large-scale operations in the state. Tamil Nadu's proactive policy environment has been instrumental in facilitating this transition.

The Tamil Nadu Electric Vehicle Policy 2023 outlines a comprehensive framework to support the entire EV value chain. It provides fiscal and non-fiscal incentives for EV OEMs, component manufacturers, battery producers, and charging infrastructure developers. The policy also integrates demand-side measures, including tax waivers, registration fee exemptions, and support for EV adoption in public and commercial fleets. Importantly, it encourages the transition of ICE manufacturers towards EVs through re-skilling subsidies, R&D support, and policy flexibility.

This transition is both an economic and environmental imperative. By localizing the production of EVs and batteries, Tamil Nadu aims to reduce import dependence, promote circular economy models through battery recycling, and establish a leadership position in sustainable mobility. The creation of a green automotive economy contributes to the larger goal of climate-conscious growth and supports India's commitments under the Paris Agreement.

CLUSTERS AS ENGINES OF SCALE AND INNOVATION

Tamil Nadu's cluster-based approach to industrial development is at the heart of its automotive strategy. Clusters facilitate economies of scale, reduce transaction costs, and foster innovation through the co-location of firms, academia, and service providers. In the auto



sector, clusters serve as concentrated hubs of technical knowledge, tooling capabilities, and skilled labour.

The Chennai auto cluster, anchored by firms such as Hyundai, Ashok Leyland, Mahindra & Mahindra, Renault-Nissan, and Daimler, is a classic example. These OEMs have catalyzed the development of over 350 tier-I suppliers and hundreds of ancillary units within a 50-km radius. This agglomeration reduces supply chain complexity and ensures operational synergies across production, logistics, and warehousing.

New clusters in Krishnagiri, Manallur, and Tuticorin are being designed to support next-generation auto manufacturing, including EVs and EV components. These clusters are being equipped with R&D centres, training institutes, battery testing labs, and common facilities for prototyping and innovation. In Tuticorin, for instance, a proposed EV and auto component cluster will leverage port connectivity to support global exports.

The establishment of EV-focused clusters, in particular, supports the emergence of a resilient and self-sustaining EV value chain. By incentivizing local sourcing of

cathode materials, lithium-ion cells, power electronics, and battery packs, Tamil Nadu seeks to capture higher value addition within the state. The presence of Global Automotive Research Centre (GARC) and National Automotive Testing and R&D Infrastructure Project (NATRiP) facilities further enhance Tamil Nadu's capabilities in testing, validation, and homologation.

Export Orientation and Global Integration

Exports play a vital role in Tamil Nadu's economic strategy. As of FY22, the state accounted for nearly half of India's automobile exports. This orientation is driven by a mix of policy support, strategic geography, and private sector competitiveness. The government is keen on expanding this export base through focused interventions, including support for Free Trade Warehousing Zones (FTWZs), plug-and-play export units, and logistics optimization.

Tamil Nadu's ports — Chennai, Kamarajar (Ennore), and Tuticorin — are being equipped with dedicated roll-on/roll-off (RoRo) terminals and automotive handling facilities. These developments are

designed to reduce turnaround times and enhance cost competitiveness. The proposed Sagarmala projects are expected to further improve port connectivity and hinterland integration.

As global automotive OEMs look to diversify their supply chains beyond China and Southeast Asia, Tamil Nadu's proposition becomes even more compelling. The state's political stability, regulatory transparency, and investor support mechanisms position it as a preferred location for export-driven investments in auto and EV manufacturing.

In addition to finished vehicles, Tamil Nadu is also emerging as a key exporter of auto components. With over 35% of India's auto component exports originating from the state, there is a concerted push to develop high-value segments such as precision forgings, castings, engine management systems, and electric drivetrains. Policy incentives and testing support are being aligned to enable MSMEs to meet international quality and safety standards.

LOGISTICS INFRASTRUCTURE AS A COMPETITIVE ADVANTAGE

As Tamil Nadu accelerates towards its \$1 trillion economic goal, logistics and physical infrastructure will serve as foundational pillars that enable scale,

efficiency, and global connectivity. For the automotive sector, especially in its electric vehicle (EV) form, logistics infrastructure is not merely a cost factor—it is a strategic determinant of competitiveness. Tamil Nadu's forward-looking policies recognize this linkage and are driving massive investments into multimodal logistics ecosystems that align production zones with domestic markets and export gateways.

The development of Multimodal Logistics Parks (MMLPs) at locations such as Chennai, Madurai, Coimbatore, and Hosur is central to this strategy. These parks integrate road, rail, air, and sea transport, offering seamless intermodal freight movement. Each logistics hub is being equipped with automated warehousing, cold chains, bulk cargo handling facilities, and last-mile delivery nodes to ensure end-to-end visibility and cost control.

Port modernization initiatives under Sagarmala and state-led port policies are increasing cargo throughput and RoRo efficiency. At the same time, the Chennai-Kanyakumari Industrial Corridor (CKIC) and the Chennai-Bengaluru Industrial Corridor (CBIC) are being linked to logistics hubs, auto parks, and Special Economic Zones to minimize redundancy and optimize capital investments. Inland Container Depots (ICDs) and Dry Ports are being augmented to enable container

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stuffing and de-stuffing closer to manufacturing zones, thereby reducing port congestion and logistical delays.

The integration of digitized logistics platforms allows real-time tracking of inbound and outbound shipments, predictive route planning, and automated customs clearance. The Tamil Nadu Logistics Policy, in conjunction with the Tamil Nadu Warehousing Policy, aims to make the state one of India's top logistics performers by 2027.

BATTERY INNOVATION AND CIRCULAR MANUFACTURING

Battery technology lies at the heart of electric mobility. Tamil Nadu's strategic approach to batteries is not limited to assembly and integration—it encompasses the full lifecycle of batteries, from cell manufacturing to second-life applications and recycling. The EV policy outlines specific fiscal and regulatory support for giga-factories, cathode/anode material plants, battery management system (BMS) developers, and recycling units.

Localizing battery production offers multiple benefits: it reduces foreign exchange outflows, builds technological sovereignty, improves supply chain security, and creates high-value jobs in electrochemical engineering and automation. Tamil Nadu is currently facilitating land allocation and capital support for global battery manufacturers that wish to set up production in the state. In parallel, academic institutions are partnering with industries to drive innovation in cell chemistry, energy density optimization, and thermal management systems.

The state's circular economy model encourages battery reuse and materials recovery. Spent EV batteries are being repurposed into stationary storage units for renewable integration, telecom infrastructure, and backup power. End-of-life batteries are processed in recycling facilities to extract lithium, cobalt, and nickel—reducing the environmental footprint and creating a sustainable materials ecosystem. Tamil Nadu's ambition is to make battery circularity a competitive differentiator and a global best practice by 2030.

INDUSTRY 4.0: DRIVING DIGITAL AUTO MANUFACTURING

Tamil Nadu is pioneering the integration of Industry 4.0 tools into its manufacturing landscape. In the automotive and EV sectors, digitalization has moved beyond conceptual pilots into mainstream production. The state government, in collaboration with industry partners, is driving the adoption of advanced robotics, artificial intelligence, digital twins, IoT-enabled factory

floors, and cloud-based production management.

Smart factories in Hosur, Oragadam, and Chengalpattu are already deploying predictive maintenance systems, AI-enabled inspection tools, and real-time manufacturing analytics. These technologies reduce waste, improve productivity, enhance quality control, and create adaptive production lines suited for high-mix, low-volume demands typical in EV startups.

To further this agenda, Tamil Nadu has launched programs to create "AI-Ready Clusters" and digitized supply chains. The state is also exploring the use of blockchain for vehicle registration and certification, ensuring transparency in manufacturing and traceability in battery sourcing. These initiatives are aligned with the global movement toward responsible and ethical manufacturing.

SKILL DEVELOPMENT FOR THE AUTOMOTIVE FUTURE

Workforce development is both a strategic necessity and a social imperative for Tamil Nadu. With millions of jobs expected to be created in the automotive, EV, and battery ecosystems over the next decade, a multi-tiered approach to skill development is underway. Tamil Nadu Skill Development Corporation (TNSDC), in partnership with industrial bodies and academic institutions, is curating curricula in electric drivetrain assembly, power electronics, energy storage systems, and advanced diagnostics.

In line with the National Skills Qualification Framework (NSQF), polytechnics, ITIs, and engineering colleges are being equipped with simulators, testing rigs, and EV training kits. Skill Parks and Centres of Excellence (CoEs) are being established in Chennai, Coimbatore, Madurai, and Tirunelveli to provide hands-on training and certification programs.

The focus is not only on creating entry-level talent but also on reskilling existing automotive workers whose roles are being disrupted by the EV transition. Programs include EV technician certification, battery safety workshops, AI and data analytics for plant supervisors, and micro-courses in embedded systems for engineering graduates. These programs are tailored to the dynamic needs of startups, MSMEs, and global OEMs.

CREATING EV CITIES AND MOBILITY INNOVATION ZONES

Tamil Nadu is adopting a futuristic approach to urban mobility by developing Electric Vehicle Cities—municipal zones that are optimized for clean mobility, smart grid integration, and multimodal commuting. Chennai, Coimbatore, Salem, and Tiruchirappalli have been



identified as potential EV Cities where the entire urban transport ecosystem, including buses, autos, delivery fleets, and two-wheelers, will transition to electric within this decade.

To support this transformation, the state is investing in public charging infrastructure, battery swapping stations, electric bus depots, and vehicle-to-grid (V2G) pilot projects. Urban Local Bodies (ULBs) are being equipped with e-mobility readiness frameworks and GIS-based planning tools to map demand and optimize charging station placement.

Tamil Nadu is also setting up Mobility Innovation Zones—designated areas near academic hubs and industrial parks that act as regulatory sandboxes for emerging technologies such as autonomous vehicles, drone delivery systems, connected mobility platforms, and sustainable logistics models. These zones allow startups, OEMs, and R&D labs to test, iterate, and commercialize future mobility solutions within a supportive and compliant environment.

POLICY GOVERNANCE AND INVESTMENT FACILITATION

Tamil Nadu's success in the automotive and EV sectors is not accidental—it is the result of intentional, well-orchestrated governance. At the centre of this architecture lies the Government of Tamil Nadu's institutional framework for investment promotion and industrial regulation. The state has been consistently

ranked among the top performers in the Ease of Doing Business (EoDB) index, owing to digitized clearance systems, predictable incentive frameworks, and proactive investor engagement.

Key institutions like Guidance Tamil Nadu act as the nodal agency for foreign and domestic investors. Through single-window portals and investor concierge services, these agencies provide land identification, environment clearances, and access to fiscal incentives in a time-bound and transparent manner. Industrial policies are calibrated every 3–5 years to align with global market shifts and investor sentiment. The Tamil Nadu Industrial Policy 2021, Tamil Nadu Export Promotion Strategy, and the Tamil Nadu EV Policy 2023 are examples of such adaptive instruments.

To support the capital intensity of auto and EV investments, Tamil Nadu has established sector-specific industrial funds, blended finance instruments, and viability gap funding for EV infrastructure. The state also provides tax holidays, power subsidies, and performance-linked grants to anchor tenants in new industrial parks. Special incentives are designed for green manufacturing practices, R&D activities, and employment generation in backward districts. The institutionalization of real-time monitoring and performance audits ensures that policy intent is translated into execution. Investment MoUs are tracked, milestones are verified digitally, and mid-course corrections are undertaken in consultation with industry bodies. This agile model of governance has led to increased investor confidence and a robust pipeline of domestic and FDI projects across the automotive value chain.

INCLUSIVE GROWTH AND REGIONAL DEVELOPMENT

Achieving a \$1 trillion economy is as much about economic inclusion as it is about output expansion. Tamil Nadu's auto and EV strategy is deeply aligned with its regional development goals. The government has consciously moved away from a Chennai-centric growth model and is promoting Tier-2 and Tier-3 cities as industrial growth nodes. Locations like Thoothukudi, Hosur, Pudukottai, and Theni are being developed into industrial hubs with dedicated infrastructure for



mobility manufacturing and export-led clusters.

This decentralized industrialization ensures that employment opportunities, public investment, and income growth are distributed across geographies. By locating factories, training centres, and logistics hubs in rural and semi-urban areas, the state is promoting reverse migration and reducing pressure on metropolitan infrastructure.

Public-private partnerships are being forged with local colleges and training institutes to provide industry-relevant skills in these regions. The government is also investing in rural electrification, road upgrades, and digital connectivity to ensure that rural manufacturing units are integrated into national and global value chains. The EV ecosystem is seen as particularly conducive to regional development, since it allows for modular, decentralized manufacturing models suited to MSMEs and smaller urban centres.

ENVIRONMENTAL STEWARDSHIP AND NET-ZERO ALIGNMENT

Tamil Nadu's industrial policy is no longer just about production—it is about sustainability. The state has committed itself to a climate-compatible development trajectory, where economic growth goes hand-in-hand with emissions reduction, ecological stewardship, and sustainable resource use. The automotive and EV sectors are at the forefront of this transition.

More than 50% of the state's power already comes from renewable sources, making it one of the greenest industrial states in India. Automotive factories are being designed with net-zero readiness, including rooftop solar, rainwater harvesting, zero liquid discharge, and energy-efficient HVAC systems. Battery recycling, waste heat recovery, and circular economy frameworks are being integrated into manufacturing parks.

The EV policy mandates environmental compliance through green audits, life-cycle assessments (LCAs), and eco-labeling. Sustainable transport is also being promoted through policy incentives for electric buses, non-motorized transit, and low-emission logistics. The goal is to reduce per capita transport emissions and align mobility growth with India's Nationally Determined Contributions (NDCs).

Tamil Nadu is exploring green bonds, carbon credits, and ESG-linked investments to fund clean mobility infrastructure. The integration of ESG metrics into industrial policy and investor evaluations ensures that long-term value creation does not come at the cost of environmental degradation.

GLOBAL INVESTMENT STRATEGY AND TRADE CONNECTIVITY

Tamil Nadu's ascent to a \$1 trillion economy will be propelled not only by domestic dynamism but also by the strategic harnessing of global capital, markets, and

technologies. As global companies seek alternatives to traditional manufacturing geographies amid geopolitical realignments, Tamil Nadu is positioning itself as a resilient, transparent, and innovation-driven investment destination.

The state has already secured substantial foreign direct investment (FDI) in automotive and EV manufacturing from global leaders such as Renault-Nissan, Hyundai, Daimler, BMW, and Yamaha. These investments have helped develop world-class industrial infrastructure, world-leading export capabilities, and a stable base of high-skilled jobs. Tamil Nadu's auto exports already contribute nearly half of India's overall vehicle exports, and the trend is expected to intensify as the state captures a greater share of the global EV supply chain.

Tamil Nadu's engagement in bilateral trade and investment agreements through the Government of India—particularly those with the EU, UK, ASEAN, and the UAE—serves as a key enabler for deeper economic integration. These trade agreements will improve market access for Tamil Nadu-made vehicles, components, and battery technologies. The state is aligning its industrial policy framework to maximize these benefits by supporting export-oriented units (EOUs), establishing export facilitation zones, and incentivizing certification to international technical standards.

In anticipation of increased trade volumes, Tamil Nadu is expanding its port infrastructure and promoting the use of coastal and inland waterways. Dedicated automotive RoRo berths, smart container terminals, and automated customs clearance systems are being implemented in Chennai, Ennore, and Thoothukudi ports. These steps reduce time-to-export, lower freight costs, and improve India's competitiveness in the global auto value chain.

PUBLIC-PRIVATE INNOVATION ECOSYSTEMS

Innovation is the engine of long-term competitiveness, and Tamil Nadu has institutionalized this belief through a cross-cutting approach to R&D. The state is facilitating public-private research partnerships, incubating mobility startups, and enabling academic-industry collaboration to foster a vibrant ecosystem of innovation in automotive, battery, and mobility services.

The Tamil Nadu Innovation Initiative (TANII), StartupTN, and

the Tamil Nadu Research and Innovation Fund (TNRIF) are supporting early-stage ventures in areas such as battery technology, autonomous systems, EV software stacks, and mobility-as-a-service (MaaS) platforms. The government is incentivizing the co-location of R&D centres within industrial parks, with support for technology licensing, prototyping, patent filing, and commercialization.

Joint research labs involving premier institutions like IIT Madras, Anna University, and the Tamil Nadu Industrial Development Corporation (TIDCO) are tackling frontier challenges in lightweight materials, hydrogen fuel cells, next-gen battery chemistry, and vehicle-to-grid (V2G) communications. The vision is to transition Tamil Nadu from being a cost-efficient manufacturing hub to a knowledge-intensive innovation powerhouse in mobility technology.

The state is also encouraging global firms to establish captive innovation centres (CICs) and engineering centres of excellence (ECoEs) in Tamil Nadu. These facilities are being offered capital support, land benefits, and expedited approvals to encourage long-term anchoring of R&D capabilities. These efforts will help Tamil Nadu build intellectual capital and reduce dependence on imported innovation over time.

STARTUPS AND THE EV ENTREPRENEURSHIP ENGINE

The EV revolution in Tamil Nadu is being driven as much by agile startups as by legacy OEMs. The state is home to a new generation of electric mobility entrepreneurs who are building the future of two-wheelers, fleet electrification, battery swapping, and micro-mobility. Firms like Ather Energy, Ola Electric, and Simple Energy have placed Tamil Nadu on the map as a next-gen automotive innovation hub.

Recognizing this, the Tamil Nadu government has rolled out startup-specific incentives under its EV and Innovation policies. These include rental subsidies, interest-free working capital loans, and assistance with certification and IP protection. Shared testing and validation facilities are being made available at

subsidized rates through Centres of Excellence (CoEs) and FabLabs.

EV-focused incubators and accelerators are being set up in collaboration with universities and global accelerators. Startups in EV software, fleet analytics, mobility fintech, and charging services are being supported under Tamil Nadu's digital economy strategy. The ecosystem

TAMIL NADU IS A RISING HUB FOR ELECTRIC MOBILITY, DRIVEN BY STARTUPS LIKE ATHER ENERGY AND OLA ELECTRIC, ADVANCING FLEET ELECTRIFICATION, AND BATTERY SWAPPING.

is also receiving traction from ESG-focused investors and impact funds, eager to back climate-tech ventures operating in Tamil Nadu.

The EV startup ecosystem is not just creating new business models—it is democratizing industrialization by enabling small, tech-first teams to compete in large markets. This will be a vital ingredient in Tamil Nadu's inclusive growth model, offering scalable income and employment opportunities even outside traditional factory settings.

RISK MANAGEMENT, RESILIENCE, AND FUTURE UNCERTAINTIES

No development pathway is without volatility. Global macroeconomic risks, raw material dependencies, supply chain disruptions, technological shifts, and climate vulnerabilities all pose potential threats to the sustained growth of Tamil Nadu's automotive and EV sectors. To safeguard against these, the state is building institutional and policy resilience across key domains.

On the supply chain front, Tamil Nadu is investing in backward integration and supplier diversification. Local sourcing of critical materials, development of domestic cathode/anode industries, and partnerships in lithium resource diplomacy are being pursued to reduce over-reliance on imports. Component localization targets are being mainstreamed into incentive policies, and vendor parks are being encouraged to co-locate with OEMs to improve resilience.

Technology resilience is being built through skill upgrading, open innovation ecosystems, and modular manufacturing approaches that allow for rapid reconfiguration of production lines. The state is promoting agile regulation—regulatory sandboxes " for autonomous vehicles, pilot licensing for new EV tech, and fast-track approvals for low-volume innovation deployments.

From a climate risk perspective, Tamil Nadu is integrating green infrastructure, water conservation, and climate risk assessments into its industrial development model. This ensures that growth does not compromise long-term environmental stability. Contingency plans for energy supply, circular resource use, and industrial decarbonization are being incorporated into new industrial park planning.

From a market risk perspective, the state is de-risking its growth model by investing in both volume and value. While high-capacity manufacturing continues, the state is equally focused on building capabilities in software-defined vehicles, MaaS, and embedded electronics—sectors with high value addition and export potential.

MACROECONOMIC OUTLOOK AND STRATEGIC IMPERATIVES

Tamil Nadu's aspiration to become a \$1 trillion economy by 2030 requires a sustained compound annual growth rate (CAGR) of 13–14%, anchored in value-added manufacturing, services-led exports, and infrastructure modernization. Among the sectors expected to contribute significantly to this growth, the automotive industry—both in traditional and electric forms—stands out due to its multiplier effects across employment, exports, R&D, and skill development.

With its longstanding tradition in vehicle manufacturing, an early lead in EV production, and a proactive industrial policy framework, Tamil Nadu has positioned itself to capture a disproportionate share of India's automotive and mobility-driven GDP growth. As national and global demand for clean, connected, and autonomous vehicles accelerates, Tamil Nadu's ability to deliver speed, scale, and sophistication in manufacturing becomes a competitive differentiator.

The macroeconomic strategy hinges on five mutually reinforcing imperatives: increasing capital formation, deepening industrial linkages, enhancing human capital, transitioning to green growth, and leveraging digital infrastructure. The automotive sector contributes to each of these areas and thus plays a catalytic role in the broader economic transformation.

PROJECTIONS: AUTO AND EV SECTOR CONTRIBUTION BY 2030

By 2030, Tamil Nadu's automotive and EV sectors are expected to contribute upwards of \$150–\$170 billion to the state's Gross State Domestic Product (GSDP). This includes not only direct manufacturing value added by OEMs and component suppliers but also ancillary economic activities in logistics, energy, digital platforms, after-sales service, insurance, and fleet operations.

The sector is projected to employ more than 3 million people directly and indirectly, including in the formal and informal MSME segment. Women's participation in the mobility workforce is expected to cross 35%, owing to concerted policy interventions, workplace inclusivity measures, and expansion into semi-urban employment zones.

Tamil Nadu is poised to become the largest EV manufacturing hub in South Asia, with more than 40% of India's EV production capacity concentrated in the state. Battery manufacturing alone could attract investments worth Rs 1 lakh crore, supported by cell chemistry innovation, recycling, and second-life repurposing. Export revenues from auto and EV segments are forecast to exceed \$35 billion annually by 2030.

Component exports, software-defined vehicle platforms, and vehicle-integrated electronics will form a new frontier for value capture. Tamil Nadu's ability to provide both hardware excellence and software innovation will help it evolve from a contract manufacturer to an automotive solutions powerhouse.

ENVISIONING TAMIL NADU AS A GLOBAL MOBILITY LEADER

The future of mobility is defined by four technological megatrends—electrification, autonomy, connectivity, and shared mobility. Tamil Nadu's industrial policy framework, R&D orientation, and institutional architecture are aligned to embrace these trends and create competitive advantage.

The state envisions a future where urban transport systems are powered by locally produced electric buses, rural logistics networks run on modular EV fleets, and citizens use app-based electric mobility services for last-mile connectivity. At the same time, its export orientation will enable Tamil Nadu-made vehicles and components to power global transitions to clean mobility.

In this vision, the automotive sector is not just a producer of vehicles—it is a platform for energy storage, a vector for digital innovation, a laboratory for manufacturing excellence, and a catalyst for social transformation. It is a driver of climate action, a contributor to foreign exchange stability, and a source of dignified employment across demographics and geographies.

To support this global identity, Tamil Nadu will continue to forge cross-border partnerships, attract knowledge-intensive investments, and promote best-in-class infrastructure. Trade missions, technology scouting, academic collaborations, and diaspora engagement will all be leveraged to place Tamil Nadu at the forefront of global mobility conversations.

STRATEGIC ROADMAP TO 2030

The journey to a \$1 trillion economy is an exercise in long-term strategy, collaborative governance, and adaptive execution. For the automotive sector, Tamil Nadu has identified several focus areas that will serve as strategic pillars over the next five years:

1. **EV Leadership:** Scaling EV production through mega-factories, MSME supplier networks, and integrated charging infrastructure. Supporting demand-side adoption through fleet electrification, public transport upgrades, and two-wheeler conversions.
2. **Innovation and IP Creation:** Positioning Tamil Nadu as a hub for mobility innovation, from ADAS systems and digital twins to solid-state batteries and

connected vehicles. Promoting patents, technology licensing, and R&D investments.

3. **Logistics Optimization:** Enhancing port logistics, industrial corridors, and multimodal freight networks to reduce cost and improve just-in-time manufacturing. Operationalizing smart warehouses and auto export zones.
4. **Green Manufacturing:** Driving net-zero-ready industrial parks, clean energy integration, and circular economy frameworks. Promoting low-emission logistics, battery recycling, and energy-efficient factory design.
5. **Human Capital Transformation:** Upgrading the skill base for EVs, mechatronics, automation, and digital diagnostics. Building centres of excellence and vocational academies aligned with industry demand.
6. **Equitable Growth:** Ensuring inclusive participation by women, MSMEs, rural youth, and socially disadvantaged communities in the auto-EV supply chain. Supporting equitable industrial development through balanced regional investments.
7. **Digital Transition:** Embracing AI, cloud platforms, and predictive analytics in both factory automation and post-sales services. Supporting mobility startups, fleet management software, and EV payment solutions.
8. **Global Outreach:** Proactively engaging in global trade forums, technology platforms, and investor summits to enhance Tamil Nadu's visibility and integrate it into global value chains.

DRIVING INDIA'S ECONOMIC ENGINE

As Tamil Nadu steers its way toward becoming a \$1 trillion economy, the automotive and EV sectors will remain at the centre of its growth story—transforming factories into digital innovation labs, logistics corridors into green trade highways, and skilled youth into drivers of global innovation.

The mobility sector's contribution will not only be measured in units sold or GDP added—but in lives uplifted, pollution reduced, and futures reimaged. It will represent the successful convergence of infrastructure, capital, policy, and people in pursuit of a common vision: an economy that is fast, fair, and future-ready.

Tamil Nadu's playbook—rooted in resilient supply chains, forward-thinking policy, regional equity, and sustainable technology—serves as a national and global benchmark. It shows what is possible when ambition meets execution and tradition meets innovation.



CHAPTER 4

SKILLING FOR THE FUTURE

Skilling for the Future: Building a Future-Ready Workforce

AS THE GLOBAL automotive industry undergoes an accelerated transformation, driven by technological advancements, sustainability goals, and changing consumer expectations, the rise of EVs, connected and autonomous systems, and smart manufacturing is imperative. The sector is rapidly evolving from mechanical engineering-led operations to a multi-disciplinary, software-driven landscape.

Skilling a workforce in the era of Artificial Intelligence / Machine Level (AI/ML) and Robotics are as deep a challenge as it gets. In addition, Tamil Nadu faces an issue of stagnating population as well significant structural changes to its population. These elements of technological disruption and change in population structure need to be integrated into the skill development plan.

While this transformation offers immense opportunities, it also reveals significant skill gaps that need urgent attention to future-proof the workforce. The transition from ICE to EVs has created a pressing need for skills, particularly in the domains of battery design and battery management systems, battery chemistry and materials science, thermal management of high-voltage systems, electric drivetrain engineering, and lastly, charging infrastructure and energy management.

Skilling the workforce in Tamilnadu requires a multi-dimensional approach considering its unique population trajectory. A few elements of this approach include questions related to Skilling Women, Automation, human operators and their skill level, type of skills to develop, improving productivity through skill development, Skill attraction – both international and domestic, skill mindset around factors including quality consciousness and.

With the distinctive nature of EV-related technologies, traditional automotive engineers, who were trained in core ICE verticals, come across as lacking the adequate exposure to these areas of battery management and chemistry, thermal management of high-voltage systems, and electric drivetrain engineering, among others.

Furthermore, the scarcity of adequate training resources pertaining to these areas at key training institutions, itself exacerbate the situation, thus emanating a significant skills gap between the industry's demands and its readiness. As vehicles become smarter and more connected, embedded systems, software development, and cybersecurity too have become critical skill areas.

Therefore, automotive companies now require expertise in control systems and firmware programming like AUTOSAR, telematics and vehicle-to-everything (V2X) communication, human-machine interfaces (HMI) and infotainment systems, data analytics and AI for predictive maintenance, and cybersecurity for vehicle networks. This shift places computer science and electronics at the forefront of automotive engineering, an area traditionally dominated by mechanical and electrical disciplines.

The rapid adoption of EVs in India exposes a critical skill gap. EVs require specialised expertise in battery systems, power electronics, embedded software, modern assembly lines, and servicing – all areas where traditional automotive training falls short.

Demand for Industry 4.0 Skill Sets

The rise of smart factories and digital manufacturing ecosystems are also changing the way vehicles are produced. Hence, there is a clear demand for skill sets in domains such as robotics and automation, digital twins and simulations, additive manufacturing or 3D printing, as well as industrial IoT and sensor integration.

However, a significant portion of the current workforce is still trained in legacy manufacturing systems and lacks proficiency in digital tools and programming. With over 2 lakh skilled workers needed by 2030, we must align training with evolving industry needs. A strong industry-government partnership through co-created curriculum, practical, on-the-job training, and continuous upskilling will be key to building a future-ready workforce.

Sustainable product development, waste minimisation, and recycling too are becoming

extremely important, owing to regulatory pressures and environmental concerns. The required skills to undertake these aspects include lifecycle assessment (LCA) and sustainable design principles, knowledge of renewable materials and green manufacturing, and recycling technologies for batteries and vehicle components, among others.

The missing elements in the existing curriculum at engineering colleges that seldom cover these topics in depth, inhibits the industry's readiness in sustainability practices. There is a capacity challenge right now because academia does not seem to be up to speed with the innovations taking place in technology. Therefore, people coming out of engineering programmes are still very much focused on traditional models.

With a highly-intertwined supply chain and manufacturing ecosystem, there is a growing demand for an interdisciplinary and collaborative approach in the automotive industry. As a result, project management and communication skills, design-driven thinking and innovation methodologies, and business analytics and strategy planning are top skills required from a holistic perspective, when it comes to the transformation of the mobility landscape.

STRATEGY FOR A FUTURE-READY WORKFORCE

One of the root causes of the skill gap is the traditional curriculum in technical education, which demands a thorough revamp of the syllabus as well as training methodologies. Therefore, measures such as integrating EV-specific modules like battery management, power electronics, and hybrid systems, incorporating simulation tools such as MATLAB / Simulink and software programming into mainstream education, augur well for the sector to outline a realistic roadmap to transform the skill requirements.

Furthermore, providing hands-on experience through industry-backed labs focusing on EVs, autonomous systems, and smart manufacturing, could play a vital role in gearing the workforce for the future requirements of design, development, and manufacturing. As a result, nodal agencies of the likes of AICTE, UGC, as well as state technical boards must mandate curriculum updates and introduce certification tracks on emerging technologies.

As per the Automotive Skills Development Council (ASDC), with new and emerging technologies, the biggest challenge lies in the availability of competencies to impart training on a technology which is still under development. Despite that, there needs to be fundamental training courses that expose



students to these technologies so that once they join the workforce, they are aware about these futuristic solutions.

ASDC has created a modular programme for colleges to adopt as a fundamental course for various powertrain technologies, aimed at developing critical thinking skills when looking at a new technology. Certain apprenticeship-embedded degree programmes notified by the UGC also enable the industry to accommodate students who have interest in a new technology, and offer them a six-month apprenticeship. In recent times, there is also a provision of minor degree programmes, which was not a structured case in India earlier, allowing students to opt for a minor stream whilst doing a major specialisation in a core field, such as mechanical engineering.

Public-private partnership also promises a key role in enhancing future skills required by the industry, and as a result, automotive OEMs, Tier-1 suppliers, and startups must collaborate with government bodies like NSDC and ASDC to develop sector-specific skills framework aligned with evolving job profiles.

Furthermore, introduction of training programmes under government-initiated schemes like the PMKVY, with modern and modular content will give a fillip to skills enhancement in the automotive industry.

While organizations such as ASDC has been running a training module related to CNG from a field and service-technician perspective, there is an important application requirement in terms of engineering education itself. Higher education institutions as well as the industry must look at how to plug the gap.

Setting up of centres of excellence in partnership with academia as well as research institutions to impart cutting-edge training also holds promise in ensuring real-world exposure and alignment of training in accordance with the industry demands.

UPSKILLING THE EXISTING WORKFORCE

As technologies evolve, continuous learning becomes vital, and therefore, on-the-job training in domains such as EV systems, embedded software, and data analytics, is critical to augment the workforce and utilize it to its full potential. Furthermore, in-house academies or learning centres set up by companies can

run tailor-made programmes to suit the requirements of a specific organisation.

While skill audits and personalised learning can track the progress and readiness of the workforce towards the newer roles, a strong focus on practical training can be achieved through internships and live projects for students in real manufacturing or R&D environments, recognition of prior learning to allow traditional workers to gain certifications based on their skills, and undertaking apprenticeship-integrated programmes where students divide time between academic institutions and industry. Countries like Germany have successfully implemented such dual models, and India can adapt them through ITIs and polytechnics.

With the rapid transformation of the automotive industry, there is also a growing demand for Diversity, Equity, and Inclusion (DEI), which is emerging as a key focus area for companies operating in the sector. The key strategies to drive inclusivity and diversity in an organisation include measures such as scholarships and mentoring programmes for women in Science, Technology, Engineering, and Mathematics (STEM) roles, particularly related to EVs, AI, and design.

Providing a safe and inclusive workspace in factories as well as R&D centres, and undertaking leadership development programmes for women professionals to rise into decision-making roles, would play a critical role in enhancing diversity to broaden the talent pool, and driving future innovation.

NEED FOR A ROBUST POLICY PUSH

To encourage the industry to invest in skilling, there could be government-driven incentivisation schemes to push for upskilling of the human resource. Measures such as skill-linked incentives, or mandatory skill contribution funds could be explored to fund the public skilling infrastructure.

State governments could also integrate automotive skill development in their industrial policies by mapping the local skill supply-demand gaps, establishing mobility skill parks with simulation labs, and incubation centres, as well as supporting MSMEs in executing trainings through shared infrastructure and cluster-based training programmes.

Promoting faculty exchange programmes with foreign universities, and conducting joint research on topics such as EVs, ADAS, and circularity, could drive the future innovations required to transition towards a cleaner mobility ecosystem. Therefore, making a systemic action to close the widening skill gap in the transitioning automotive industry calls for a holistic strategy that encompasses curriculum reforms, industry collaboration, perpetual learning



mindset, inclusivity, as well as forward-looking policy frameworks. Hence, by investing in a future-ready workforce, India can not only support its domestic mobility transition but also position itself as a strategic player in the global automotive value chain. According to Lahiri, "An enabling policy push that facilitates the academia and industry to come together, will also drive the endeavour to bridge the skills gap around emerging powertrain technologies."

While the framework exists even today, to get it implemented, there needs to be a lot more collaboration between the industry and academia. However, there is a lot of concerted effort in recent times, and that augurs well for a robust workforce of the future.

SKILLING WOMEN

As per population projections by National Commission on Population, Ministry of Health & Family Welfare (MoHFW), Government of India gender ratio has turned in favor of women in Tamilnadu by 2020-21 with the ratio skew increasing over the next few years. It is imperative for Tamilnadu to design its policies to attract more women into the workforce as well as provide skilling to women to meet the needs of the automotive industry where shop floors are traditionally male oriented.

A gender specific skilling policy has become an absolute imperative for Tamilnadu to achieve its near term goal as well as continue to grow its economy.

AUTOMATION CONUNDRUM

MoHFW report also points that the general population of Tamilnadu will peak at around 7.8 crores by 2031 and from there on gradually witness decline. The birth rate in Tamilnadu has been determined at 1.7 which is significantly lower than the replacement rate of 2.1 births. Given the rapid changes during the past few years, it would not be a surprise that Tamilnadu is already witnessing a population decline. In addition, the population in the age group of 0-14 years will decline from 23.6% of the population in 2011 to about 15.6% of the population by 2031 while the population over 60+ is increasing from 10.6% to 20.8% by 2031. This sharp decline in the children population has serious implications for Tamil Nadu's economy both

from availability of human resources as well as consumption.

However, for the state population stability has coincided with rapid adoption of AI/ML and robotics. Tamilnadu can decide on processes where technology is best suited compared to human operators across all its functions. This would ensure that enough young and skilled people are deployed in jobs where human performance exceeds that of technology.

With life expectancy expected to be about 75 years, the grey economy can impose costs. Leveraging this grey economy as a strategy can help in freeing up the prime age group workforce to be deployed in high productive sectors. A well-defined strategy combined with proactive policies can help Tamilnadu address the issue of manpower availability. Automation and technology are likely to benefit Tamilnadu's demographic profile and leveraging them will help the state increase productivity.

MINDSET SHIFT

Skilling people should also include shifting their mindset. A few areas that require mindset change include a sense of quality consciousness and productivity improvement. It is well acknowledged that labor in other markets excel in these areas in comparison to India and Tamilnadu.

Skill Relocation - International and Domestic

Tamilnadu can also create an environment for skills from international markets to relocate to the state. The state can immensely benefit from the reverse brain drain provided a conducive environment is created for people with specific skillsets to return and contribute towards the economic growth of the state. It is also imperative for the state to recognize that it can leverage availability of labor in India that can drive the state's economy forward. These measures in addition to other areas of skill development can propel the state further in its economic journey.

A clear and well thought out strategy can help Tamilnadu clearly layout skill as well as reskilling requirements. Matching the skills required by industry is a constant endeavor of staying relevant. However, it is imperative that Tamilnadu go beyond industry skills but also focus on extending soft skill training to its workforce including communication skills, interpersonal skills, and etiquettes.

Developing Entrepreneurship in manufacturing will also help in maintaining and continuing its legacy.



CHAPTER 5

DRIVING TOWARDS NET ZERO

Decarbonising Tamil Nadu's Mobility

NET ZERO AS a concept has gained popularity and is a key policy pivot across the world. India has committed itself to net zero by 2070 while European nations have planned to achieve net zero a few decades earlier. Global warming and climate change poses significant challenges to economies and Tamilnadu with its long coastline and two of its major economic hubs being coast based on the impact of climate change needs to factor into its economic strategy.

Tamilnadu launched a state specific Climate Change Mission focusing on initiatives to manage climate change including working on District specific Climate Change Missions, creating carbon neutral hubs among other initiatives.

Mobility is one of the significant contributors to climate change and requires targeted initiatives to move towards sustainable transportation. The mobility initiatives need to work on multiple fronts including customized solutions based on local conditions, energy sources, policies, infrastructure and state as an enabler.

It was evident that the automotive capital of India-Tamil Nadu- has a role that will be crucial to achieve India's net-zero target by 2070. The state is a hub of original equipment manufacturers (OEMs) and many auto-component companies. Chennai's people show a phenomenal bent toward the adoption of new technologies. It shows that young minds are overtly keen to explore and innovate in the automobile sector, whether it's from sheer passion or the goal of making the state and country at large a sustainable place. This eagerness and voluntary participation is the reason why three out of four race circuits in India are found in Tamil Nadu.

Tamil Nadu leads the country in automobile exports and accounts for 35% of India's total auto component production. 40% of all electric vehicles sold in India are manufactured in the state, highlighting its key role in the nation's automotive and EV ecosystem.

To achieve the net-zero target, India is striving to switch to alternative energy solutions in automotive, agriculture, steel, power, aviation, and many other sectors. Experts point out that greenhouse gas tailpipe

emissions from road transport contribute the most to air pollution, depleting the ozone layer and further endangering the planet's health. They say vehicles emit 15-20% of the total greenhouse gases such as nitrogen oxide and carbon dioxide. This is evident in urban cities such as New Delhi, Mumbai, Bengaluru, and Chennai.

Tamil Nadu, home to millions – including automobile manufacturing and vehicle enthusiasts – holds a great responsibility to achieve the net-zero goal. The state is home to various OEMs such as Ashok Leyland, Tata Motors, Hyundai, TVS, Daimler, and soon-to-come VinFast. Moreover, it is also home to numerous automobile startups such as Raptee, which is working toward making electric vehicle adoption faster.

Tamil Nadu is aware of its duty. The state promises to achieve net-zero before 2070. Contributing 10% to India's manufacturing output and nearly 9% to the national GDP, this state plays a major role in driving the country's economic engine. Yet, it accounts for only 4% of the nation's total greenhouse gas emissions—a striking contrast that reflects its reliance on high value-added manufacturing and a strong services sector. This efficient economic structure positions the state to take the lead in decarbonization efforts. By 2050, the state aspires for 73% electric vehicles.

With the continued growth in the number of households, there is a rising demand for vehicles to support an increasingly mobile population, along with a greater need for industrial output to meet growing consumption demands. According to a 2020 report by the Ministry of Health and Family Welfare (MoHFW) on population projections, Tamil Nadu's population is expected to peak around 2032 and stabilize thereafter.

Interestingly, the state aspires to lower ICE vehicle use while gradually and efficiently shifting toward greener fuels. In a very practical approach, the state has urged OEMs to rigorously work on changing powertrain structures which are akin to the adoption of alternative fuels such as electricity, hydrogen, compressed biogas (CBG), liquefied natural gas (LNG), and ethanol.

Greenhouse gas emissions from the transport sector in Tamil Nadu nearly tripled between 2005 and 2019,



rising from 10 to 27 million tonnes of CO² equivalent. During this period, the transport sector's share of total energy-related emissions also grew significantly—from 12% to 19%.

A Council on Energy, Environment and Water (CEEW) report states that in 2019, out of the 19.7 lakh vehicles registered in the state, 87.7% were petrol-powered, followed by 10% running on diesel. Electric vehicles made up just 0.17% of the total, while hybrid and CNG vehicles together accounted for around 0.5%. Greenhouse gas emissions from the transport sector nearly tripled between 2005 and 2019 in the state, rising from 10 million tonnes to 27 million tonnes of carbon dioxide equivalent. During the same period, the transport sector's share of total energy sector emissions increased from 12% to 19%.

In recent years, new electric vehicle (EV) registrations have experienced a significant surge, with the number of EVs registered in 2023 being 26 times higher than in 2019. As a result, the share of new EV registrations rose to 5%, while the shares of petrol and diesel vehicle registrations dropped to 77% and 8.8%, respectively, in 2023.

CUSTOMIZED SOLUTIONS

The net zero journey needs to account for the differences of income and population density within the state. Districts like Coimbatore, Erode and Namakkal have high per capita income but have lower population density while Chennai has the highest population density per sq. km of 26,553 which is over 25 times of

the second highest density district of Kanyakumari. The table below provides the district wise population density and per capita income. Tamilnadu should develop customized solutions for districts or clusters of districts based on their geographic proximity. A one size fits all may not lead to the desired results to meet the Net Zero commitments as energy transition in mobility is likely to be expensive for consumers as well for the state as new infrastructure is required to be created. Tamilnadu per capita income is 3rd highest in India after Telangana and Karnataka which will help the state transition towards net zero.

TAMIL NADU'S EV POLICY

Tamil Nadu's Electric Vehicle (EV) Policy 2023 encourages both the manufacturing and adoption of EVs while also offering incentives to support the expansion of a strong charging infrastructure across the state. It aims to position Tamil Nadu as the leading hub for electric vehicle manufacturing in South-East Asia.

Its objectives include accelerating EV adoption, strengthening the state's EV ecosystem, and developing dedicated EV cities. The policy envisions attracting Rs 50,000 crore in investments, generating 1.5 lakh new jobs, and fostering a robust and sustainable EV industry across the state.

To enable a seamless transition to electric mobility, widespread deployment of both slow and fast chargers is essential. According to industry estimates, a single Bharat AC-001 charger can support approximately 125 two-wheelers and 30 three-wheelers. Likewise, one DC

DISTRICT	AREA (SQ KM)	TOTAL POPULATION (IN LAKHS), 2011	DENSITY PER SQ KM	PER CAPITA INCOME FY20
Chennai	175	46.47	26,553	Rs 3,29,113
Kanyakumari	1,684	18.70	1,111	Rs 2,43,438
Tiruvallur	3,394	37.28	1,098	Rs 3,64,337
Chengalpattu	2,945	25.56	868	NA
Madurai	3,710	30.38	819	Rs 2,13,868
Vellore	2,080	16.14	776	Rs 2,28,718
Coimbatore	4,732	34.58	731	Rs 3,38,643
Thanjavur	3,411	24.06	705	Rs 2,08,843
Kancheepuram	1,656	11.66	704	Rs 2,53,643
Cuddalore	3,703	26.06	704	Rs 1,88,818
Salem	5,237	34.82	665	Rs 1,90,026
Nagapattinam	2,569	16.16	629	NA
Tirupathur	1,793	11.12	620	NA
Tiruchirappalli	4,509	27.22	604	Rs 2,83,121
Villupuram	3,725	20.93	562	Rs 1,30,103
Ranipet	2,234	12.10	562	NA
Thiruvarur	2,274	12.64	556	Rs 1,07,731
Namakkal	3,420	17.27	505	Rs 3,37,025
Tenkasi	2,916	14.08	483	NA
Tirupur	5,187	24.79	478	Rs 2,42,950
Virudhunagar	4,241	19.42	458	Rs 2,58,415
Theni	2,868	12.46	434	Rs 1,67,151
Tirunelveli	3,842	16.65	433	Rs 1,98,353
Tiruvannamalai	6,188	24.65	398	Rs 1,36,389
Erode	5,760	22.52	391	Rs 3,57,116
Kallakuruchi	3,520	13.70	389	NA
Ariyalur	1,940	7.55	389	Rs 1,66,261
Thoothukudi	4,745	17.50	369	Rs 2,50,309
Krishnagiri	5,129	18.80	367	Rs 2,71,663
Karur	2,904	10.64	367	Rs 2,06,112
Dindigul	6,036	21.60	358	Rs 1,90,369
Pudukkottai	4,644	16.18	348	Rs 1,66,072
Dharmapuri	4,497	15.07	335	Rs 2,01,294
Ramanathapuram	4,104	13.53	330	Rs 1,59,774
Perambalur	1,756	5.65	322	Rs 1,07,731
Sivagangai	4,233	13.39	316	Rs 1,39,737
The Nilgiris	2,565	7.35	297	Rs 2,64,945
Tamil Nadu Total	1,30,058	721.47	555	Rs 2,36,783

fast charger using a Combined Charging System (CCS) can accommodate the charging needs of around 75 private and commercial four-wheelers.

The government has also declared six cities—Chennai, Coimbatore, Tiruchirappalli, Madurai, Salem, and Tirunelveli—as EV cities. In these cities, the Smart City Commissioner will be approached as the nodal officer to coordinate and drive EV adoption. This mission focuses on EVs to prepare a roadmap including electrification of auto rickshaws and buses within 10 years in a phased manner. The implementation program is designed to provide interventions on supporting taxi fleets and app-based transport aggregators in transitioning to an electric fleet.

The state has incentives for e-two wheelers, e-three wheelers, e-four wheelers, e-buses, battery swapping stations, and fast and slow charging stations ranging from Rs 30,000 to Rs 10,00,000.

The Tamil Nadu government's 2024-25 budget reflects its commitment to clean mobility, with plans to procure 500 electric buses as part of a total order of 3,000 new buses. However, to meet the 2050 target for a fully modernized and electric bus fleet, CEEW's report indicates that the state will need to procure approximately 2,000 buses each year between 2025 and 2050. This accounts for the retirement of aging buses reaching the end of their technical lifespan and the need for a steadily increasing share of electric buses over time.

OEMs OPEN TO NEW TECHNOLOGIES

While OEMs and tier 1s are working toward fuel-agnostic powertrains, they are also open to newer technologies. Price parity, consumer satisfaction, and lack of proper infrastructure are some factors restricting auto companies from questioning the methods. It is certainly a "chicken and egg" story for many. Changes in BS norms, CAFE norms, and new ways to push OEMs are sometimes challenging for companies. However, their goal is in sync with the government's vision. R&D and funding by both the union and state and the capability to accept failures are dire needs for achieving the net-zero target. According to various predictions, the world will not be only electric but will be a huge market for many different fuels.

Though adoption of electric three-wheelers and two-wheelers is gaining pace, passenger vehicles still struggle to earn consumers' trust, primarily for two reasons: lack of charging spaces and the initial cost of acquisition. Communication between consumers and OEMs can clear such doubts raised by consumers, while more incentives might push EV charging companies to set up more charging stations.

The Indian automotive sector is undergoing a transformative shift, driven by the global push towards sustainability. A consensus is emerging among industry leaders that the future will not be defined by a single technology but by multiple fuels adapted to regional contexts and customer acceptance. This multi-pathway approach to mobility includes hybrids, electric vehicles (EVs), hydrogen fuel cells, and LNG-powered options, each catering to unique market demands.

Hybrids, in particular, are gaining ground due to their practical, clean, and convenient nature. They represent a feasible green mobility solution for many consumers who seek environmentally friendly alternatives without compromising on convenience. However, the journey toward full electrification is complex and will be influenced heavily by infrastructure readiness and supportive policies.

Hydrogen fuel cells and LNG-powered vehicles are also being recognized as emerging technologies with potential. Yet, their success hinges on significant policy backing and infrastructure development. Despite the buzz around alternative fuels, diesel is expected to remain a dominant force in the Indian commercial vehicle segment until at least 2035. Its reliability and effectiveness continue to make it a preferred choice, especially for heavy-duty applications.

A GRADUAL SHIFT TO MULTIPLE FUELS

The transition to new energy vehicles involves long development cycles and substantial investment in core technologies. Without a strong focus on technological

innovation today, companies risk being unprepared when the market reaches a tipping point. Therefore, a strategic emphasis on research and development is essential to future-proof the industry.

EVs CREATE NEW OPPORTUNITIES IN SOFTWARE INTEGRATION, WHERE INDIA HAS A COMPETITIVE EDGE, ESPECIALLY IN AUTOMOTIVE SOFTWARE DEVELOPMENT, PAVING THE WAY FOR SIGNIFICANT EMPLOYMENT GROWTH.

In Tamil Nadu, this transition is being actively built rather than passively observed. The region is positioning itself as a hub not just for EV manufacturing but also for the broader innovation ecosystem. With its robust talent pool, the state is steering efforts beyond production into R&D and design.

The Indian consumer landscape further complicates the transition. Unique driving habits, diverse usage patterns, and varying levels of disposable income mean that global strategies cannot be replicated wholesale. Instead, India needs to develop its own benchmarks and solutions that cater to its specific needs.

Electric vehicles also present new opportunities in software integration, an area where India holds a competitive edge. The increased software content in EVs opens up substantial employment prospects, particularly in automotive software development,

offering India a chance to lead in this domain.

Finally, while internal combustion engines (ICE) are expected to phase out globally, India may continue producing them longer than most countries. Some believe that the last ICE vehicle in India will likely be manufactured in regions like Tamil Nadu, highlighting the complex and gradual nature of this transition.

India is taking significant strides toward achieving its net-zero emissions target by 2070, with sustainable fuels playing a pivotal role in this transition. While challenges such as high costs, supply constraints, and inadequate infrastructure remain, the automotive industry is actively exploring solutions to overcome them.

Recognizing the need to reduce diesel reliance without compromising industrial progress, Cummins India has introduced a strategic approach called HELM—High Efficiency, Low Emissions, and Multi-fuel. This strategy focuses on developing internal combustion engines capable of running on various fuels, including natural gas, diesel, and hydrogen. It reflects a broader industry move toward flexible, region-specific energy solutions that accommodate existing infrastructure while preparing for future sustainability goals.

CNG'S RISE IN INDIA'S FUEL MIX

A gradual transition remains the preferred approach for many automakers. Diesel still forms the core of most original equipment manufacturers' operations, serving as a dependable mainstay. However, battery electric vehicles are also emerging as an efficient route toward achieving zero emissions, given their immediate environmental benefits.

Compressed natural gas (CNG) is gaining prominence as a cleaner and more cost-effective alternative to diesel. In 2023, the National Biofuels Coordination Committee announced the phased blending of compressed biogas (CBG) with CNG for transportation and piped natural gas (PNG) for households. The initiative, set to begin in 2025-26, aims to reach a 5% blending rate by 2028-29. This shift is expected to reduce dependence on traditional fuels while lowering emissions.

Industry players have responded by scaling up CNG infrastructure. Greaves Cotton, for instance, ramped up production of CNG cylinders, citing rising diesel prices and evolving emission norms. The post-BS6 regulatory landscape has made diesel vehicles more complex and costly, accelerating CNG's market penetration, particularly in the three-wheeler segment. CNG has become increasingly attractive for its lower emissions, affordability, and compatibility with current fueling





networks. It is now poised to become the second-most preferred fuel for passenger vehicles, already accounting for 14% of total sales in the segment.

Electric vehicles, while offering zero emissions comparable to CNG, still face barriers such as higher initial costs and limited charging infrastructure. In this context, CNG vehicles present a practical alternative, especially in regions where EV adoption is hindered by infrastructure gaps. Major automakers like Maruti Suzuki are capitalizing on this shift, with one in every three cars sold by the company now being CNG-powered.

Hydrogen is emerging as another critical component in India's energy roadmap, especially as the country targets energy independence by 2047. Green hydrogen, produced via renewable-powered electrolysis or biomass gasification, offers a clean, emission-free fuel source. With a high reliance on imported crude oil, hydrogen presents an opportunity for India to reduce energy dependency and transform into an energy-exporting nation.

BIOFUELS PAVING THE WAY

To support this shift, the Indian government launched the National Green Hydrogen Mission in 2023. This initiative aims to produce at least 5 million metric tonnes of green hydrogen annually by 2030 and promote its use in commercial vehicles such as buses, trucks, and four-wheelers. The technology is

particularly promising for long-haul transportation, where hydrogen fuel cells offer faster refueling times compared to battery-electric options.

Companies like Bosch anticipate significant growth in hydrogen-based technologies, projecting that hydrogen internal combustion engine vehicles could capture 10–15% of the Indian truck market by 2030. The appeal lies in hydrogen engines' compatibility with existing vehicle components, requiring minimal modifications and benefiting from India's cost-effective manufacturing capabilities.

Nonetheless, the widespread adoption of hydrogen faces a familiar challenge: fuel availability versus vehicle readiness. Large-scale hydrogen production is essential to reduce costs and make the technology economically viable. This will require concerted efforts and investments from governments, energy providers, and key industry stakeholders. The transition is further complicated by the interdependence of infrastructure and vehicle deployment, with stakeholders hesitant to invest heavily without assured demand or supply.

Biofuels, particularly ethanol, are also integral to India's sustainability strategy. The country is on track to meet its target of blending 20% ethanol with petrol by October 2025. The government is urging automakers to integrate alternative fuels such as battery-electric, hydrogen, ethanol, and LNG into their offerings to curb emissions and reduce the import bill.

However, for biofuels to scale effectively, strong

regulatory frameworks and quality standards are essential. The lack of stringent regulations currently hampers commercial confidence in these fuels. While the production of E20 (20% ethanol blend) is progressing smoothly, the shift to E85 (85% ethanol) poses sustainability concerns, particularly if production remains heavily reliant on sugarcane. Diversifying raw materials and enhancing production efficiency will be key to expanding ethanol's role in India's energy mix.

India's path to zero-emission vehicles is being shaped by a blend of hydrogen, biofuels, CNG, and electric technologies. Each option has its strengths and challenges, and the transition will require a coordinated, multi-fuel strategy supported by robust policy, infrastructure development, and industry collaboration.

Many experts believe the net-zero target by 2070 is very much achievable, and Tamil Nadu's specialization in adapting to newer technologies will prove instrumental in taking India to greater heights in meeting sustainability goals.

ENERGY AGNOSTIC MOBILITY

Energy sources transformation in the mobility space is driven mainly by transition from fossil fuels to electric vehicles (EV) in passenger vehicles & 2 wheelers and compressed natural gas (CNG) for light trucks and 3 wheelers. Electrification is seen as the key driver of change with Government of India (GOI) policies favoring EV's over other options. However, GOI is also promoting hydrogen by creating a mission for use of hydrogen in mobility. Increasing the industry is also exploring usage of Liquefied Natural Gas (LNG) for heavy trucks.

On the passenger vehicles front the market leader is pushing for hybrids as a path towards full electrification of vehicles. Each technology comes at a cost to customer and infrastructure investment that require state support. It is recommended that Tamilnadu chooses an energy neutral path by balancing customer purchasing power with convenience and investment cost. The path towards net zero in mobility is expected to be a journey with intermediate steps with progressive achievement on emission reduction and should not be treated as a 0 or 1. The policies should reflect that consumer behavior is step change and realize that countries with per capita income 10-15 times more than Tamilnadu are also realizing that step change is a more sustainable path of net zero.

Energy Agnostic Taxation Policy

Tamilnadu should take the lead in developing policies that over a period ensure energy consumed by automobiles is taxed appropriately and are treated

on par to provide a level playing field. As energy transformation gathers pace in the automotive sector the state will feel pressure on its own revenues due to no tax on electricity and subsidized domestic electricity costs. The policy clarification will help the state provide a long-term view to its residents in deciding their choice.

The state can choose both tariff and non-tariff solutions to encourage consumer behavior through direct support while ensuring there is no distortion on taxation of energy sources.

ENERGY SOURCE TRANSFORMATION

With electrification of mobility, one of the key trends currently is important that energy sources are green. It is well accepted that achieving net zero should reflect the entire value from well to wheel instead of just measuring tail pipe emission. Tamilnadu has been in the forefront of energy source transformation, having built a strong network of windmills and hydroelectric sources of electricity over many decades. As per Central Electricity Authority, Ministry of Power, Government of India non fossil fuel-based capacity in electricity generation of Tamilnadu accounted for 64% in 2024-25. This means that two thirds of Tamilnadu electricity comes from renewable sources. By 2034-35 renewable energy and non-fossil fuel capacity in electricity generation will soar to over 77%, making the state a leader in renewable energy generation. The state is well prepared for an electrified future.

INFRASTRUCTURE DEVELOPMENT

Tamilnadu should actively develop infrastructure for various energy sources. The infrastructure development policy can also be developed based on the uniqueness of markets. For eg a policy for the Chennai district will need to account for the population density which may be replicable only in one or two cities in the state. A cluster-based approach to infrastructure development by factoring geographic uniqueness should help the state transition faster by providing programmatic solutions.

For highly urbanized districts cities are getting vertically developed. Making sure the integration of energy sources needs to be integrated with parking solutions, keeping safety, convenience, accessibility and demand in mind. Integrating public and green space requirements to enable public charging can provide greater customer access enabling faster adoption of non-fossil fuel-based mobility solutions. These solutions will help Tamilnadu achieve Net Zero ahead of the timelines



CHAPTER 6

CONCLUSION AND POLICY ROADMAP

The key recommendations and policies to position Tamil Nadu as a global leader in sustainable, inclusive, and future-ready mobility

WITH A LEGACY that dates back several decades, Tamil Nadu has emerged as a vital node in the global automotive supply chain. It is home to over 130 auto component manufacturers, global OEMs such as Hyundai, Renault-Nissan, and Daimler, and Indian legacy players including TVS Motor Company and Ashok Leyland. Now, Tamil Nadu is moving from being primarily a manufacturing hub to becoming an innovation engine for the future of mobility. The transformation is being driven by a strong policy ecosystem, a skilled workforce, and a sustained focus on inclusive industrial development.

As Dr. T.R.B. Rajaa, Tamil Nadu's Minister for Industries, Investment Promotions and Commerce, put it: "Tamil Nadu is rooted in metal and rising in code." This vision reflects the dual transformation underway — modernizing traditional industries while simultaneously emerging as a center for clean, connected, and software-led mobility solutions.

TAMIL NADU'S EV LEADERSHIP: A POLICY-DRIVEN TRANSFORMATION

At the Autocar Professional Future Powertrain Conclave, held in collaboration with Guidance Tamil Nadu, Arun Murugappan, Chairman of the Murugappa Group, made a powerful statement:

"We're not just witnessing the EV transition — we're building it here in Tamil Nadu." This sentiment captures the forward-thinking nature of the state's mobility journey — one that is being shaped not from the top down by the central government, but from the ground up by a state with clear policy intent and industrial capability. Tamil Nadu was among the first in India to release a dedicated EV policy back in 2016, a move that preceded EVs becoming a national priority. The state's revised EV Policy in 2023 builds on this legacy and sets a clear ambition: to transform Tamil Nadu into the preferred destination for electric vehicle manufacturing, services, and innovation.

Murugappan emphasized the strategic pillars of this transformation: early policy vision, advanced manufacturing infrastructure, and a willingness to partner with both legacy players and new-age EV startups. The state has already developed three EV-specific industrial parks and has plans to redevelop entire cities around electric vehicle ecosystems. The policy also targets investments worth Rs 50,000 crore and envisions a \$40 billion EV sector by 2030.

The Murugappa Group itself, a Chennai-based 125-year-old conglomerate, has become a leading example of this transformation. Through TI Clean Mobility and Tivolt Electric Vehicles, the group develops electric vehicles under the Montra Electric brand. In FY2024, the group earmarked Rs 500 crore for new facilities and R&D, inaugurated a dedicated e-SCV plant in Ponneri, Chennai, and announced a revenue target of \$1 billion by 2029 — aiming for a 15% share of the Indian EV market. Notably, three out of their four EV factories are located in Chennai, a testament to Tamil Nadu's proactive industrial policies.

POLICY ROADMAP

To cement Tamil Nadu's leadership in the global mobility transition, the following six-point policy roadmap is proposed:

ADVANCE R&D AND INNOVATION CAPACITY

Tamil Nadu must transition from being primarily a manufacturing hub to becoming a center for deep mobility innovation. This requires institutional and financial support for R&D, IP creation, and product development.

Recommendations:

- Establish a Tamil Nadu Mobility Innovation Fund to co-finance high-risk, high-reward R&D in key areas: battery technologies (LFP, solid-state), EV operating

systems, energy management software, hydrogen propulsion, and lightweight materials.

- Develop Mobility R&D Zones co-located with existing EV hubs (Chennai, Coimbatore, Hosur) with shared infrastructure like testing tracks, EMC labs, battery certification centers, and digital simulation environments.
- Forge academic-industry partnerships with institutions like IIT Madras, Anna University, and PSG Tech to promote translational research. Offer fellowships and startup grants to researchers building commercially viable IP.
- Encourage participation from startups and MSMEs by offering plug-and-play access to public R&D labs and prototyping equipment.

The recent inauguration of Montra Electric's e-SCV facility in Ponneri can be used as a blueprint for creating co-located innovation and production hubs across the state.

BUILD AND RETAIN SKILLED HUMAN CAPITAL

Tamil Nadu produces over 150,000 engineering graduates annually, but most are underutilized in core R&D or design functions. A future-ready workforce is key to sustaining mobility innovation.

Recommendations:

- Launch a Mobility Skills 2030 program, with courses in EV powertrains, battery tech, ADAS, AI/ML for mobility, embedded systems, and data-driven logistics.
- Partner with OEMs and global suppliers to create dual-training models combining academic learning with on-site apprenticeships.
- Provide funding for PhD programs and postdoctoral research in areas aligned with clean mobility.
- Incentivize reskilling programs for MSME workers and ICE vehicle technicians transitioning to EV maintenance and service roles.

TVS and Ola Electric can be tapped as anchor partners for establishing a Mobility Skills Academy with satellite centers across tier-II cities.

ENSURE INCLUSIVE AND EQUITABLE GROWTH

Economic growth from clean mobility must be inclusive — geographically and socially.

Recommendations:

- Prioritize job creation in backward districts, using mobility as a vehicle for regional development. Offer



location-based incentives for firms setting up in non-urban clusters.

- Provide differential subsidies to support electric buses, e-autos, and shared EV fleets in underserved areas.
- Design programs to enable women-led EV enterprises — e.g., e-rickshaw financing for SHGs, women-owned EV service stations.
- Create urban design schemes where new clean mobility investments are linked to affordable housing and skilling for the local population.

Use the redevelopment of EV cities (as envisioned in Tamil Nadu's EV policy) as pilots to create inclusive mobility zones with embedded workforce housing and transport links.

STRENGTHEN EV ECOSYSTEM INFRASTRUCTURE

For Tamil Nadu's EV ambitions to scale, supporting infrastructure must keep pace.

Recommendations:

- Accelerate the rollout of public charging stations, especially along highways, in industrial parks (IPAs), and urban mobility hubs.
- Provide land at concessional rates for battery swapping and charging facilities, especially for

commercial segments like last-mile delivery.

- Mandate EV readiness in building codes for new residential and commercial complexes.
- Encourage micro-grid and solar-powered charging stations in tier-II towns.

Murugappan emphasized the gap in charging infrastructure and proposed that IPAs offer land for charging stations — this should be operationalized through a policy-backed land bank and VGF model.

INTRODUCE SMART, ADAPTIVE INCENTIVES

Incentives must evolve beyond one-size-fits-all subsidies and align with real economic constraints.

Recommendations:

- Provide targeted time-bound incentives for commercial EVs, particularly e-trucks and e-SCVs, which face high upfront costs.
- Allow for dynamic subsidies based on vehicle class, usage intensity, and TCO (total cost of ownership) calculations.
- Reward OEMs and suppliers for localization milestones, job creation, and IP generation.
- Provide financial guarantees and low-interest credit for fleet electrification in logistics and public transport sectors.

Without government support, EV adoption in heavy CVs may not exceed 20% by 2030. Time-limited subsidies are essential to cross this inflection point.

INSTITUTIONALIZE POLICY CONTINUITY AND COLLABORATION

Mobility transformation requires sustained, coordinated action across sectors and timeframes.

Recommendations:

- Create a Mobility Innovation and Growth Council with representation from government, industry, academia, and civil society.
- Institutionalize policy continuity through bipartisan agreements and public reporting on key milestones.
- Launch a Mobility Data Commons, where anonymized data from vehicles, charging, and logistics networks can inform smarter urban planning and real-time transport policy.
- Collaborate with the Union government to expand the scope of FAME-like programs to include more segments and state-led pilot initiatives.

Tamil Nadu's ability to attract both legacy players and disruptors (Hyundai, TVS, Ola, Ather, Ampere) reflects strong ecosystem alignment — this must now be formalized through institutional architecture.

THE ROAD AHEAD

By leveraging its deep industrial roots, policy consistency, and growing innovation ecosystem, Tamil Nadu is poised to lead the global mobility transition — not just as a manufacturer, but as a designer, developer, and driver of the future of transport.

This transition will not be automatic. It will require bold policies, agile institutions, patient capital, and deep collaboration.

The next phase of growth for the state cannot come without establishing a state-wide EV Charging Infrastructure Masterplan, incentivizing private sector participation. The state can consider mandating EV-ready building codes in urban planning and housing developments. There is a dire need to position Tamil Nadu as the "Mobility Hardware Hub of Asia" with dedicated clusters for EVs, batteries, hydrogen fuel cells, and mobility components and provide capital subsidies, plug-and-play infrastructure, and green industrial parks for clean-tech startups and MSMEs.

Tamil Nadu's clean mobility story is about more than numbers — it's about people. As Minister Rajaa put it, "For us in Tamil Nadu, it's never about investment numbers. It's about jobs. It's about inclusive growth, about where those jobs are created and who benefits."

Tamil Nadu stands at a pivotal point in its industrial and environmental journey. Long known as the "Detroit of Asia" for its automotive strength, the state is now aligning industrial growth with climate resilience and sustainability.

This report explores Tamil Nadu's shift from traditional manufacturing to a low-carbon, future-ready economy—driven by policy vision, strategic investments, and human capital development. As India pushes toward decarbonisation, Tamil Nadu leads with its EV policy, renewable energy growth, and green industrial ecosystems.

Insights are drawn from a March 2025 industry conclave hosted by the State Planning Commission and Guidance Tamil Nadu, where stakeholders discussed powertrain transitions and sustainable mobility strategies. The dialogue underscored the need for a diversified, inclusive approach.

Tamil Nadu's integrated approach offers a scalable model as India moves toward net zero—a future shaped not by one solution, but by many technologies and platforms.



To know more
www.spc.tn.gov.in

Contact Us
+91 44 28545460

Write to us
tnspc.tn@nic.in