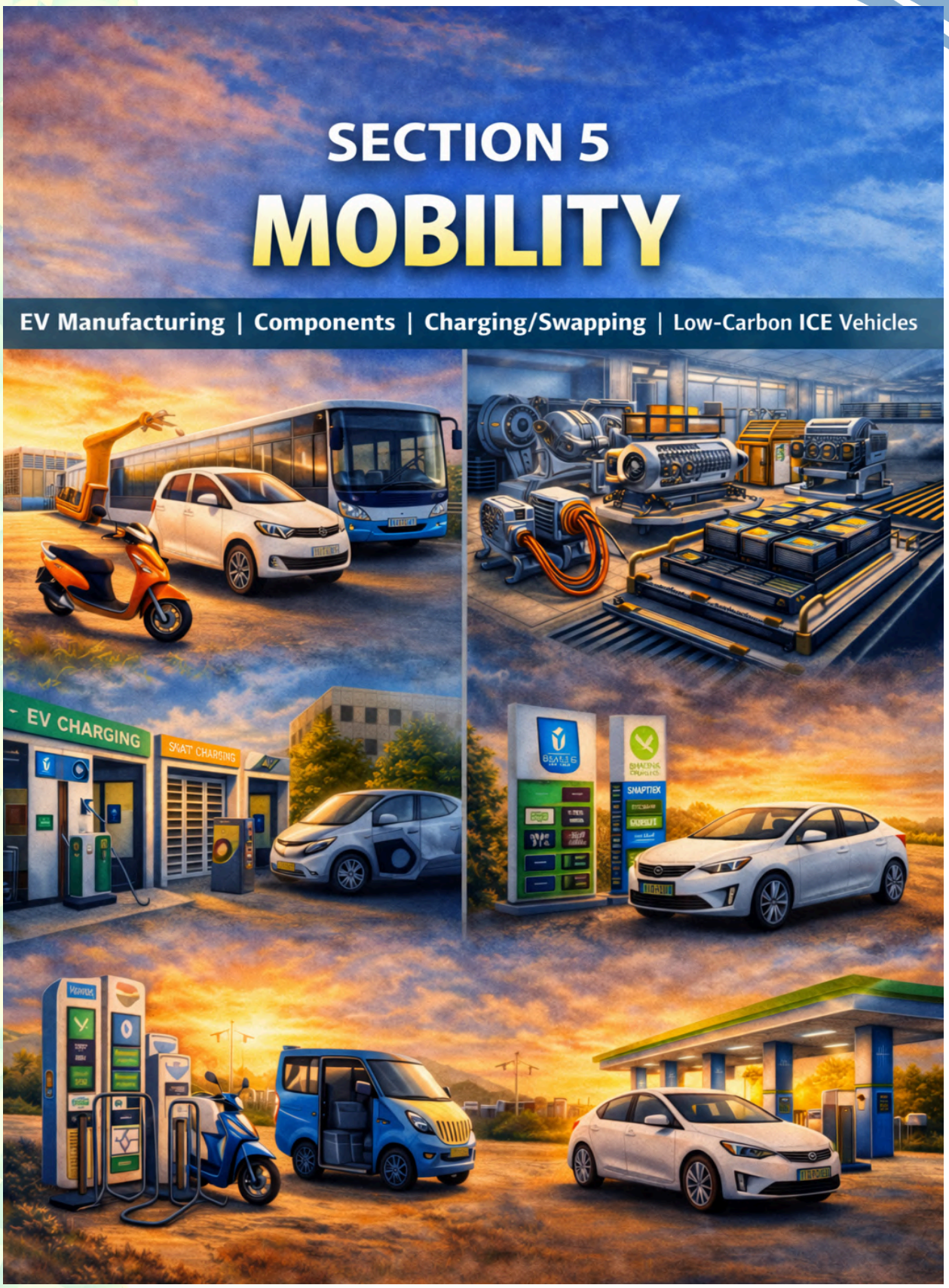

SECTION 5
MOBILITY
EV Manufacturing | Components | Charging/Swapping | Low-Carbon ICE Vehicles
EV CHARGING
SNAPTIEX

Section 5

Mobility

India's mobility transition is EV-led but pragmatic, balancing rapid electrification with low-carbon ICE solutions to ensure affordability, scale, and infrastructure readiness.

Market Scale & Momentum:
India is the world's largest EV market for 2-wheelers and 3-wheelers, with EV penetration of ~10–12% overall.

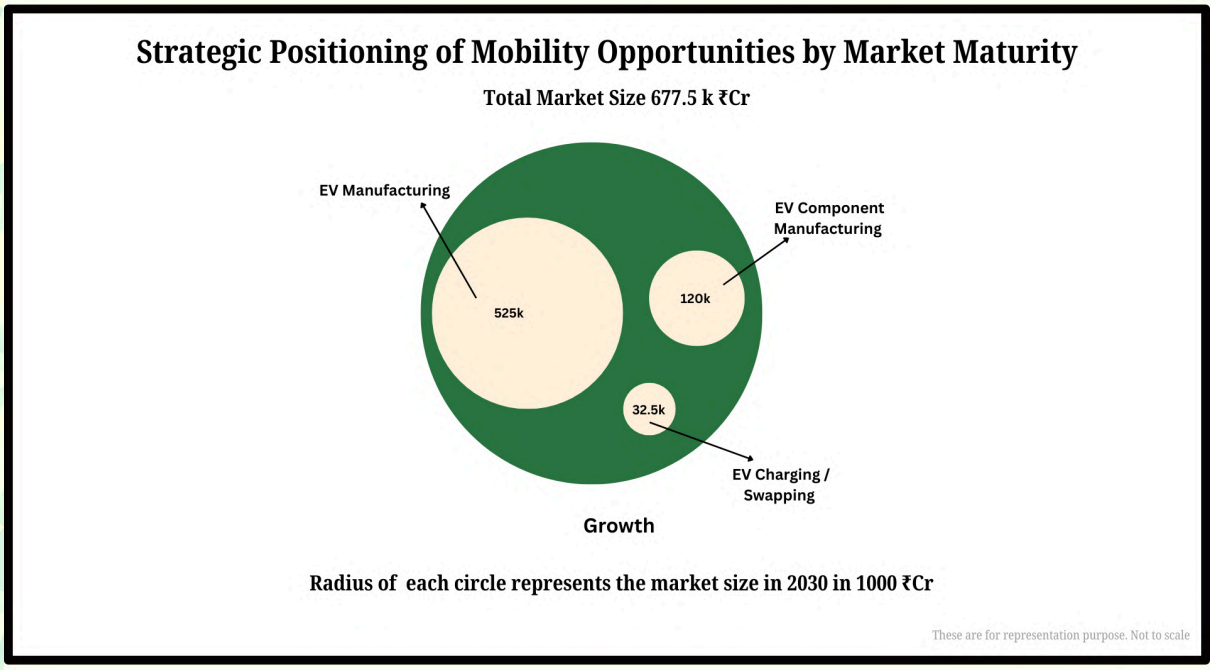
National targets aim for 30% EV sales by 2030 across vehicle segments.

Key Segments:

- **EV Manufacturing**: Strong domestic OEM presence across 2W, 3W, buses, and passenger cars
- **EV Components**: Motors, power electronics, BMS gaining rapid localisation
- **Charging & Swapping**: Fast rollout of public charging; swapping emerging for 2W/3W
- **Low-Carbon ICE**: Ethanol blending, flex-fuel, CNG/LNG as transition solutions

Growth Drivers:

- FAME-II & Auto PLI incentives
- Falling battery costs
- Urban air quality concerns
- Fleet electrification by e-commerce and logistics players



Strategic Trends:

- Electrification first in shared, fleet, and urban mobility
- Convergence of EVs, batteries, and renewable power
- Gradual decline of pure ICE, not abrupt replacement

Executive takeaway:

India's mobility decarbonisation will be driven by cost-effective EVs, supported by low-carbon fuels as a bridge—creating a large, multi-decade opportunity across manufacturing, infrastructure, and energy integration. For investors and corporates, the mobility sector provides opportunities at multiple stages, from high-growth EV and component manufacturing to scalable charging and swapping networks, as well as low-carbon-fuel platforms.

EV VALUE-CHAIN COMPONENTS

1 LI-ION BATTERY MANUFACTURING

Battery Materials and Components
Cell Manufacturing
Module Assembly

2 EV POWERTRAIN & VEHICLE COMPONENTS

E-motor
Controller
Inverter
Power electronics
Chargers

3 VEHICLE OEM MANUFACTURING

2W, 3W, Cars
Buses
Trucks
Fleet vehicles

4 CHARGING INFRASTRUCTURE

AC chargers
DC fast charging
Battery swapping
Software platforms

5 ENERGY ECOSYSTEM INTEGRATION

Renewable integration
V2G
Smart grid
Energy management

6 DOWNSTREAM SERVICES & DIGITAL LAYER

Fleet management
Leasing
Mobility-as-a-Service
Financing
Insurance

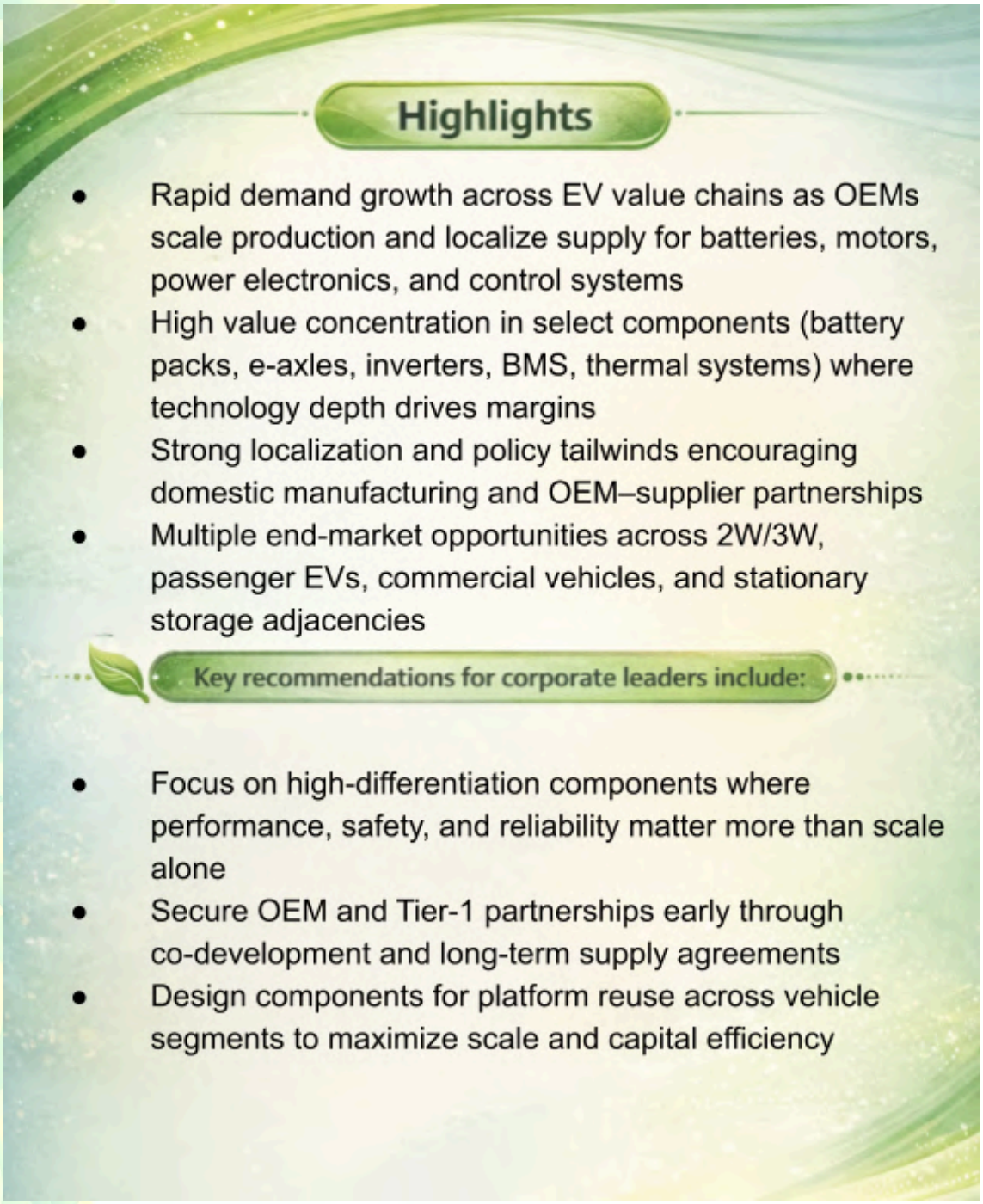
7 END-OF-LIFE & CIRCULAR ECONOMY

Battery second-life
Vehicle Component Recycling
Lithium recovery


AI MANUFACTURING INTELLIGENCE
PRODUCTION EFFICIENCY
98.7%
QUALITY INDEX
SYSTEM STATUS
OPTIMAL
POWER ELECTRONICS
E-DRIVES
INVERTERS & CONTROLLERS
SiC SEMICONDUCTORS
SiC
BATTERY INTELLIGENCE
98.2%
EST. RANGE
520 km
EV CONTROL
VEHICLE SYSTEMS DIAGNOSTICS
EV COMPONENT MANUFACTURING
POWER ELECTRONICS • E-DRIVES • INTELLIGENT MOBILITY SYSTEMS
PREPARED FOR CORPORATE LEADERS & CLIMATE-TECH STAKEHOLDERS

Mobility
EV Component Manufacturing

This section provides key inputs on EV Component Manufacturing Opportunities for corporate leaders.



Opportunity Snapshot: EV Component Manufacturing

Manufacture key EV components such as electric motors, controllers & drivetrain systems

Market Signals

- EV growth driving demand for localized component supply chains
- Strong policy push via PLI schemes
- Annual Market size by 2030: ₹ 20,000 - 25,000 Cr

What Makes or Breaks It?

- Cost-competitive manufacturing at scale
- Technology capability in power electronics (inverters, BMS, controllers)
- Strong OEM partnerships for long-term supply contracts

Why It Matters NOW?

- OEMs pushing for localization to reduce costs and supply risks
- Rapid scaling in 2W/3W EV segments and fleet adoption
- Opportunity to integrate into global EV supply chains

Well Aligned Opportunity for

- Auto component manufacturers (Tier 1 / Tier 2 suppliers)
- Electronics and semiconductor players
- Battery and powertrain startups

Key Challenges

- Competition from China
- High quality and reliability standards for OEM integration

Business Models

- Partner with OEMs for platform-level supply agreements
- JV with global tech players for advanced components

Explore this opportunity further with EAI
consult@eai.in / Call Muthukrishnan - +91 9952910083

Introduction and Business Case

EV component manufacturing spans motors, controllers, inverters, power electronics, axles, chargers and thermal systems — the backbone of the EV value chain beyond batteries. Localising these components cuts import dependence, reduces costs and creates a robust domestic supply base.

With India's EV market set to surge, component manufacturing represents both a large industrial opportunity and a strategic necessity for self-reliance under *Atmanirbhar Bharat*.

Market Potential for EV Component Manufacturing in India

Estimates for market potential provided below are for non-battery EV components, mainly motors, inverters, chargers and charge controllers and power train components such as axles.

Year	Market Size (₹ Cr)	Drivers
2025	4,000-5,000	Demand from 2W/3W OEMs; FAME-II localisation mandates.
2030	20,000-25,000	Scale-up in 4W EVs, buses, CVs; localisation of drivetrains & electronics.
2040	1,10,000-1,30,000	Deep EV penetration; India as an export hub for global supply chains.

Market Segments and Applications

Segment	Applications	Business Model	Key Drivers
Integrated e-drive systems	Motors, inverters, gearboxes	Tier-1 system supply to OEMs	OEM push for compact, integrated propulsion
Power electronics (inverters, converters)	Traction control, energy conversion	High-volume component supply	Efficiency, range, and cost pressure
Electric traction motors	Passenger & commercial EVs	Standardized motor platforms	Global EV volume growth
Power semiconductors (Si / SiC)	Inverters, onboard chargers	Semiconductor manufacturing + long-term OEM	Shift to high-efficiency SiC architectures

		supply	
Onboard chargers & DC-DC converters	Vehicle charging & power distribution	Modular power electronics platforms	Fast-charging adoption
Thermal management systems	Battery, motor, cabin cooling/heating	System integration with vehicle platforms	Battery performance & durability needs
E-axles & drivetrain modules	Integrated motor-drive-axle units	Plug-and-play drivetrain solutions	OEM demand for faster EV development
Contract EV component manufacturing	OEM-designed subsystems	Build-to-spec manufacturing services	OEM asset-light strategies
Software-enabled EV components	Controls, diagnostics, OTA-ready hardware	Component + software monetization	Software-defined vehicle transition

Typical Project Capacities & Investments Required in India

Component Line	Typical Capacity (annual)	Indicative CapEx (₹ Cr)	Notes
Traction Motors (PMAC/IPM/Induction)	100k-300k units	120-300	Stator/rotor machining, winding, magnet insertion, end-of-line dynos.
Inverters / Power Electronics (Si/SiC)	100k-250k units	100-220	SMT + power module assembly, potting, burn-in; SiC adds test complexity.
e-Axles (motor+inverter+gearbox)	50k-150k units	250-600	Precision gear line, assembly & NVH labs; OEM validation heavy.
Onboard Chargers (3.3-22 kW) & DC-DC	150k-400k units	60-150	SMT + power stages; automotive-grade reliability testing.
Thermal Systems (liquid plates, chillers, pumps)	150k-400k packs-equivalent	40-120	Vacuum brazing, leak/pressure tests, coolant validation.
Wiring Harness & Busbars	300k-800k sets	25-70	Crimping, overmoulding, HV insulation/hipot test.
Connectors/Relays /Contactors (HV/LV)	500k-1,500k units	30-100	Tooling-intensive; UL/IEC automotive certifications.

Transmission / Gear Sets (EV)	80k-200k units	120-280	Gear cutting, hardening, grinding, clean-room assembly.
Telematics/VCU/ECU	250k-700k units	25-60	Electronics + embedded software; cybersecurity testing.
DC Fast Chargers (30-180 kW)	5k-20k units	30-90	Power stacks, dispensers, safety; field service network key.
Die-cast/Stamped Enclosures	10k-50k tonnes	150-350	Giga/HPDC presses, toolroom; also serves battery/PCS housings.

Underlying Technologies & Processes

Element	Options	Key Traits
Motors	BLDC, PMSM, induction, hub motors	Efficiency, torque, cost trade-offs across segments.
Controllers & Inverters	Si/SiC-based electronics	SiC improves efficiency, reduces losses, critical for fast charging.
Power electronics	DC-DC converters, onboard chargers	Enable safe, efficient charging and power flow.
Thermal management	Air-cooled, liquid-cooled, phase change	Keeps batteries & motors within safe limits.
Transmission & axles	Integrated e-axles, gear reduction systems	Improve compactness and efficiency.
Charging hardware	Portable AC chargers, DC fast chargers	Localisation cuts costs, ensures compatibility.
Integration	Software + hardware co-design, BMS links	Defines overall efficiency and reliability.

Key Challenges

Challenge Area	Key Issues	Business Impact	India Specific	Strategic Implications
Supply Chain Localization & Import Dependency	Dependence on imported electronics, semiconductors, magnets, and advanced materials	Cost volatility and supply disruptions	China-dominated supply chains; geopolitical risks affecting sourcing	Develop local vendor ecosystem and multi-source procurement strategies

Rapid Technology Evolution & Platform Changes	Frequent changes in EV architectures, battery systems, and power electronics	Risk of product obsolescence and stranded investments	Diverse OEM standards; evolving vehicle platforms	Flexible manufacturing lines and modular component designs needed
Demand Uncertainty & OEM Concentration Risk	Component demand tied closely to EV adoption rates and OEM production cycles	Revenue volatility and capacity utilization risks	Policy-driven market growth; varying adoption across vehicle segments	Diversify across 2W, 3W, passenger, commercial EVs, and stationary storage components
Cost Competitiveness & Margin Pressure	Price pressure from OEMs and competition from global suppliers	Thin margins for Tier-2/Tier-3 manufacturers	Scale advantages of global players; high tooling and certification costs	Move up value chain into high-tech components (BMS, software-integrated electronics)
Capital Requirements & Quality Compliance	Investment needed for automation, testing, certification, and safety standards	Increased upfront costs and longer ROI timelines	Strict automotive standards (AIS, ISO); skilled workforce shortages	Invest in advanced manufacturing capabilities and quality systems early

Prominent Players in the Indian Market

Company / Entity	Focus Areas
Bosch India	Motors, inverters, controllers for 2W/4W EVs.
Valeo India	Powertrain components, onboard chargers.
Mahle Electric Drives	E-motors and drive systems.
Lucas TVS	Hub motors, controllers; partnerships with 24M for advanced systems.
Minda Industries (UNO Minda)	EV-specific switches, controllers, charging components.
Sona Comstar	EV driveline, hub motors and differential assemblies.
Rico Auto, Musashi Auto	Transmission and drivetrain parts.

Exicom Tele-Systems	Charging and power electronics.

Innovation Perspectives

Innovation	Business Opportunity	For Senior Management
Integrated e-drive platforms	Platform supply contracts across multiple OEMs	Fewer parts, lower cost, faster OEM adoption
Power-electronics leadership (SiC)	SiC module fabs, long-term supply lock-ins	Step-change in range and charging speed
Software-defined components	Component-plus-software subscriptions	Recurring revenue beyond part sales
Standardized EV component platforms	Global standardized component ecosystems	Scale economics and faster time-to-market
Thermal systems as performance enablers	Premium thermal platforms for EV OEMs	Direct impact on range, safety, and fast charging
Component modularization for OEM speed	EV kit" subsystems for new entrants	Reduces OEM engineering burden
Semiconductor–component vertical integration	Chip-to-system integration platforms	Supply security + performance tuning
Component data & diagnostics platforms	Predictive maintenance & analytics services	Improves reliability and lifecycle value
Low-carbon & traceable components	Green-premium component contracts	Meets OEM Scope-3 and regulatory needs
Contract manufacturing for EV subsystems	EV component manufacturing services	Flexible capacity and faster scaling

Concentric & Satellite Opportunities

- Motor, inverter & e-axle suppliers: Concentric Tier-1 ecosystem producing high-efficiency drivetrains, SiC inverters and integrated e-powertrains for OEMs.
- Thermal management & enclosure fabricators: Local manufacturers of cooling plates, housings and battery-safe materials designed for tropical climates.
- Connector, harness & power electronics vendors: Domestic supply chains for HV connectors, relays and busbars to reduce import dependency.
- Testing, validation & certification labs: Facilities for EMC, NVH and functional safety ensuring automotive-grade reliability and export readiness.

- Automation & tooling service providers: Firms building specialised assembly lines, robotics and precision dies for EV component mass production.
- Software & firmware engineering firms: Satellite innovators creating motor control, BMS and VCU software IP for domestic and export markets.
- Circular supply chains & recycling partnerships: Collaboration with recyclers for copper, aluminium and magnet recovery to close material loops.

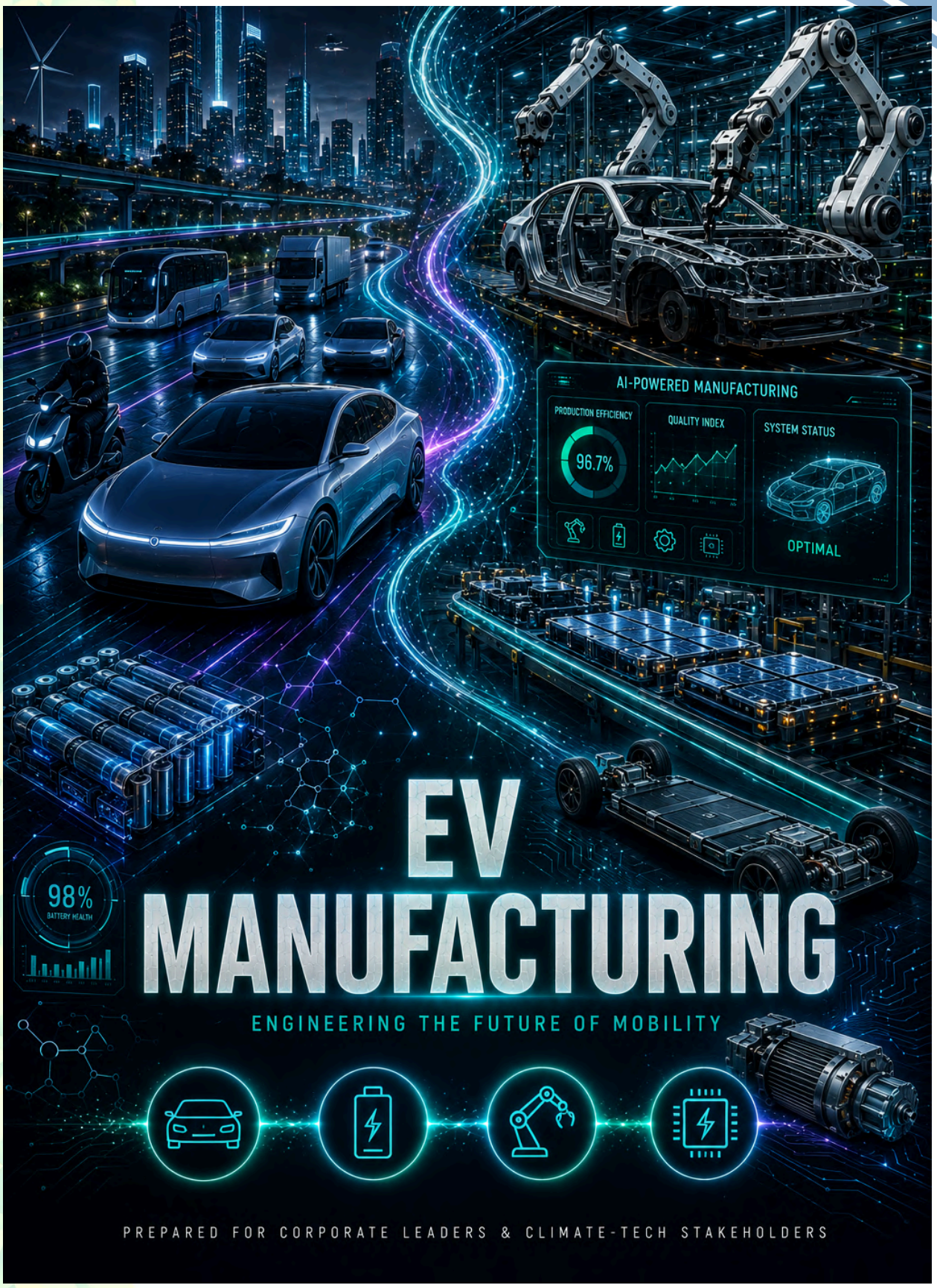
Key Takeaway for Senior Management

Takeaway	Details
Value concentrates in a few "system-defining" components—not across all parts	• Margins and bargaining power accrue to components that define vehicle performance and safety • ***Examples**:* battery packs & BMS, e-axles, inverters, power modules (SiC), thermal management • **Recommended innovation focus:** system-level engineering and performance optimization • **Highlight:** suppliers of system-defining components become strategic partners, not price-takers
Automotive-grade quality and reliability are the real entry barriers	• OEM qualification cycles, PPAP, ASPICE/ISO, and long-term warranties create high switching costs • ***Sub-components**:* functional safety (ISO 26262), EMC compliance, lifecycle testing, traceability
Platform reuse beats single-model customization	• Components designed for reuse across 2W/3W/PV/CV platforms scale faster and cheaper • ***Examples**:* modular inverters, standardized e-axles, scalable BMS architectures • **Recommended innovation focus:** modular, software-configurable component platforms • **Competitive advantage:** higher volumes per SKU and lower capex per program
Software is increasingly embedded in hardware value	• Control algorithms, firmware, diagnostics, and OTA capability drive differentiation • ***Examples**:* motor control software, inverter firmware, BMS analytics, predictive maintenance • **Competitive advantage:** recurring revenue, data moats, and customer lock-in

Next Steps for Corporate Leaders

EV component manufacturing is moving into an expansion phase as electrification accelerates across two-wheelers, three-wheelers, commercial fleets, and passenger vehicles. Localization trends, supply-chain resilience priorities, and government incentives are creating opportunities for new entrants and existing automotive suppliers.

This could be an attractive climate tech opportunity for industries and firms in specific sectors and industries keen on catering to this market.


AI-POWERED MANUFACTURING
PRODUCTION EFFICIENCY
96.7%
QUALITY INDEX
SYSTEM STATUS
OPTIMAL
98%
BATTERY HEALTH
EV
MANUFACTURING
ENGINEERING THE FUTURE OF MOBILITY
PREPARED FOR CORPORATE LEADERS & CLIMATE-TECH STAKEHOLDERS

Mobility
EV Manufacturing

This section provides key inputs on EV Manufacturing Opportunities for corporate leaders.

Highlights

- Structural demand growth driven by electrification mandates, declining battery costs, urban air-quality regulations, and total cost of ownership advantages over ICE vehicles
- Value shifting from vehicles to platforms, where software, battery systems, power electronics, and vehicle architecture determine competitiveness more than assembly scale
- Value shifting from vehicles to platforms, where software, battery systems, power electronics, and vehicle architecture determine competitiveness more than assembly scale
- Multiple segment opportunities across 2W/3W, passenger EVs, commercial fleets, and last-mile logistics, each with distinct economics and adoption curves

Key recommendations for corporate leaders include:

- Focus on platform-led vehicle architectures (skateboard platforms, modular components) to enable faster model rollout and cost efficiencies
- Build software and data capabilities across vehicle control, diagnostics, OTA updates, and fleet analytics
- Target fleet and B2B demand first (logistics, mobility, corporate fleets) to accelerate scale and utilization

Opportunity Snapshot: EV Manufacturing

Manufacture electric vehicles (2W, 3W, 4W, buses) using battery-powered drivetrains

Market Signals

- India EV penetration rising rapidly: 2W/3W (>10–15%), 4W (still <5%)
- Demand led by fleet operators (last-mile, e-commerce, ride-hailing)
- Annual Market size by 2030: ₹ 1,40,000 - 1,50,000 Cr

What Makes or Breaks It?

- Cost competitiveness; Lower running cost vs ICE (~₹1–2/km vs ₹6–8/km)
- Reliable battery sourcing & integration (range, safety, lifecycle)
- Strong distribution and after-sales service network

Why It Matters NOW?

- Improving affordability due to falling battery costs
- Strong regulatory push (FAME-II, state EV policies, PLI schemes) towards e-mobility

Well Aligned Opportunity for

- Auto OEMs and EV startups
- Fleet operators integrating vehicles
- Electronics and component manufacturers

Key Challenges

- Charging infrastructure gaps (especially for 4W and buses)
- Higher upfront price compared to conventional vehicles
- Supply chain dependency (cells, electronics)

Business Models

- Focus on high-adoption segments (2W, 3W, commercial fleets)
- Localize components (battery packs, motors, controllers)
- Partner with fleet operators for assured demand

Introduction and Business Case

India's EV manufacturing opportunity spans 2W, 3W, 4W, buses and commercial vehicles — the engines of the transport transition. With policy pushes (FAME-II, PLI), state incentives and rising consumer adoption, EV manufacturing is becoming a strategic industry for job creation, technology development and fossil fuel import reduction.

Localised EV production also enables India to build a strong export base for Asia and Africa, making it both a domestic growth story and a global supply chain opportunity.

Market Potential for EV Manufacturing in India

Year	EV Sales (units)	Market Size (₹ Cr)	Drivers
2025	20-22 lakh	45,000-50,000	Dominated by 2W/3W; bus orders scaling.
2030	60-65 lakh	1,40,000-1,50,000	30% penetration target; 4W adoption accelerates.
2040	2-2.2 crore	5,00,000-5,50,000	Near-total penetration in 2W/3W; buses & CVs mainstream.

Market Segments and Applications

Segment	Applications	Business Model	Key Drivers
Mass-market passenger EVs	Urban & suburban mobility	High-volume platform manufacturing + OEM sales	Regulatory mandates & total cost of ownership parity
Premium & performance EVs	Luxury, long-range personal mobility	Margin-led, software-enhanced vehicle sales	Consumer demand for performance, tech, and brand
Affordable / entry-level EVs	First-time EV buyers, emerging markets	Cost-optimized platforms + scale sourcing	Price sensitivity & urban electrification
Electric SUVs & crossovers	Family and multi-purpose vehicle	Platform sharing across segments	Global SUV demand + electrification
Electric pickup trucks	Personal and commercial hauling	Iconic model electrification	Fleet electrification + fuel savings

Electric commercial vans	Last-mile delivery, logistics	Fleet contracts + volume sales	E-commerce growth & city emission rules
EV platforms for multiple brands	Passenger & commercial vehicles	Modular skateboard platforms	Capex efficiency & faster model rollout
Software-defined EVs	Connected, autonomous-ready vehicles	Vehicle + software monetization	Digital features, OTA updates, data revenues
Vertically integrated EV manufacturing	EVs + batteries + power electronics	End-to-end value chain control	Cost reduction & supply-chain security
Regionally localized EV production	Domestic EV markets	Localized manufacturing & compliance	Trade policy, incentives, and supply resilience

Typical Project Capacities & Investments Required in India

Project Type	Typical Capacity (annual)	Indicative CapEx (₹ Cr)	Notes
2W EV final assembly	0.3-1.0 million units	300-800	Stamping outsourcing common; in-house pack line boosts control.
3W EV assembly	50,000-200,000 units	80-250	Modular GA lines; swapping-ready variants for fleets.
Passenger car EV plant	50,000-200,000 units	1,200-3,000	Body shop, paint, GA; e-axle integration; vendor park adds 15-25% capex externally.
E-bus manufacturing	1,000-5,000 buses	300-900	Depot charging integration, stainless/aluminium bodies.
Battery pack line (captive)	1-3 GWh/yr	120-450	LFP/LMFP-first; AIS-156/038 compliance lab included.
e-Drive (motor+inverter)	100,000-300,000 units	250-600	SiC ramp readiness; dyno & EMC labs.

Underlying Technologies & Processes

Element	Options	Key Traits
Vehicle platforms	2W, 3W, 4W, buses, CVs	Segment-specific designs; cost vs. range priorities.
Drivetrains	BLDC, PMSM motors; integrated e-axles	Defines efficiency, torque and cost.

Battery integration	LFP/NMC packs, swappable modules	Safety, performance and cost are critical.
Charging systems	AC onboard, DC fast, swapping interfaces	Interoperability and grid readiness.
Thermal management	Air/liquid cooling for packs & drivetrains	Ensures reliability in Indian climate.
Vehicle intelligence	Telematics, OTA updates, V2G features	Improves fleet economics and user experience.
Manufacturing processes	Stamping, welding, automation, final assembly	Localisation and lean supply chains cut costs.

Key Challenges

Challenge Area	Key Issues	Business Impact	India Specific	Strategic Implications
Supply Chain Localization & Import Dependence	Heavy reliance on imported battery cells, semiconductors, and electronics	Cost volatility and production disruptions	Dependence on China and global supply chains; currency risks	Invest in local component ecosystem and strategic supplier partnerships
Cost Competitiveness & Profitability Pressure	High upfront vehicle costs compared to ICE vehicles	Margin pressure and slower consumer adoption	Price-sensitive Indian market; subsidy-dependent demand	Focus on platform optimization, localized manufacturing, and scale economies
Charging Infrastructure & Ecosystem Maturity	Limited charging network affecting adoption	Demand growth uncertainty impacting production planning	Uneven infrastructure development across states and cities	Align manufacturing strategy with infrastructure expansion and fleet segments
Policy Dependence & Regulatory Evolution	EV demand influenced by incentives and regulatory frameworks	Business model uncertainty with policy shifts	FAME schemes, state subsidies, and tax policies evolving	Diversify across segments and maintain flexible pricing strategies
Technology Transition & Competitive	Rapid innovation cycles in batteries,	Risk of technological obsolescence	Increasing competition from global OEMs	Invest in software differentiation, modular platforms,

Intensity	software, and vehicle platforms	and high R&D costs	and startups	and partnerships

Prominent Players in the Indian Market

Company / Entity	Focus Areas
Tata Motors	Market leader in EV 4Ws and buses; Nexon EV, Tigor EV; electric bus orders nationwide.
Mahindra Electric	Strong in 3W/4W EVs; scaling SUV EV platforms.
Ola Electric	Leading EV 2W manufacturer; expanding into 4Ws; giga-factory plans.
Ather Energy	Premium EV 2W maker with proprietary packs and software.
TVS Motor / Bajaj Auto	Rapidly scaling e-2W and e-3W platforms.
Hero Electric / Okinawa / Ampere	Volume players in affordable e-2Ws.
BYD India	Premium EV 4Ws, buses; local assembly with expansion plans.
Ashok Leyland (Switch Mobility)	Electric buses and light commercial EVs.

Innovation Perspectives

Innovation	Business Opportunity	For Senior Management
Software-defined vehicles (SDVs)	Vehicle software platforms & subscriptions	Recurring revenues, faster feature evolution
Skateboard & modular EV platforms	Platform licensing & contract manufacturing	Capex efficiency and speed to market
Vertical integration of batteries	Integrated EV–battery ecosystems	Cost, supply security, performance
Cost-down through simplification	Ultra-low-cost EV platforms	Structural cost advantage
Fleet-first EV manufacturing	Fleet-dedicated EV programs	Guaranteed demand and fast scale
Regionalized EV	Replicable regional EV hubs	Incentive capture & supply

manufacturing		resilience
Vehicle-as-a-Service (VaaS)	EV subscription & leasing platforms	Higher lifetime value
Fast-charging–optimized EV design	Premium charging-enabled models	Superior user experience
EVs as grid assets (V2G)	V2G-enabled fleet solutions	Monetizable flexibility
Circular EV manufacturing	Circular mobility ecosystems	Regulatory and cost advantage

Concentric & Satellite Opportunities

- Battery pack & drivetrain integration: Co-located facilities assembling packs, motors and inverters into modular vehicle architectures.
- Component and sub-system suppliers: Tier-1 and Tier-2 networks producing chassis, harnesses, sensors and control units aligned with Make-in-India goals.
- Testing & homologation centres: National labs providing AIS, EMC and safety certification to accelerate market readiness and exports.
- EV design & prototyping studios: Satellite R&D houses focusing on lightweight materials, aerodynamics and platform modularity.
- Financing & leasing innovations: Fleet-leasing, battery-as-a-service and green credit models enabling wider adoption and cash-flow stability.
- Charging, swapping & service infrastructure: End-to-end mobility ecosystems integrating depots, digital payments and predictive maintenance.
- Recycling & second-life battery ecosystems: Circular collaborations recovering metals, refurbishing packs and repurposing components into stationary storage.
- Structural adhesive dispensers: Automated robots applying high-strength glues replacing 70% welds; focusing on e-rickshaws and e-2 wheelers.

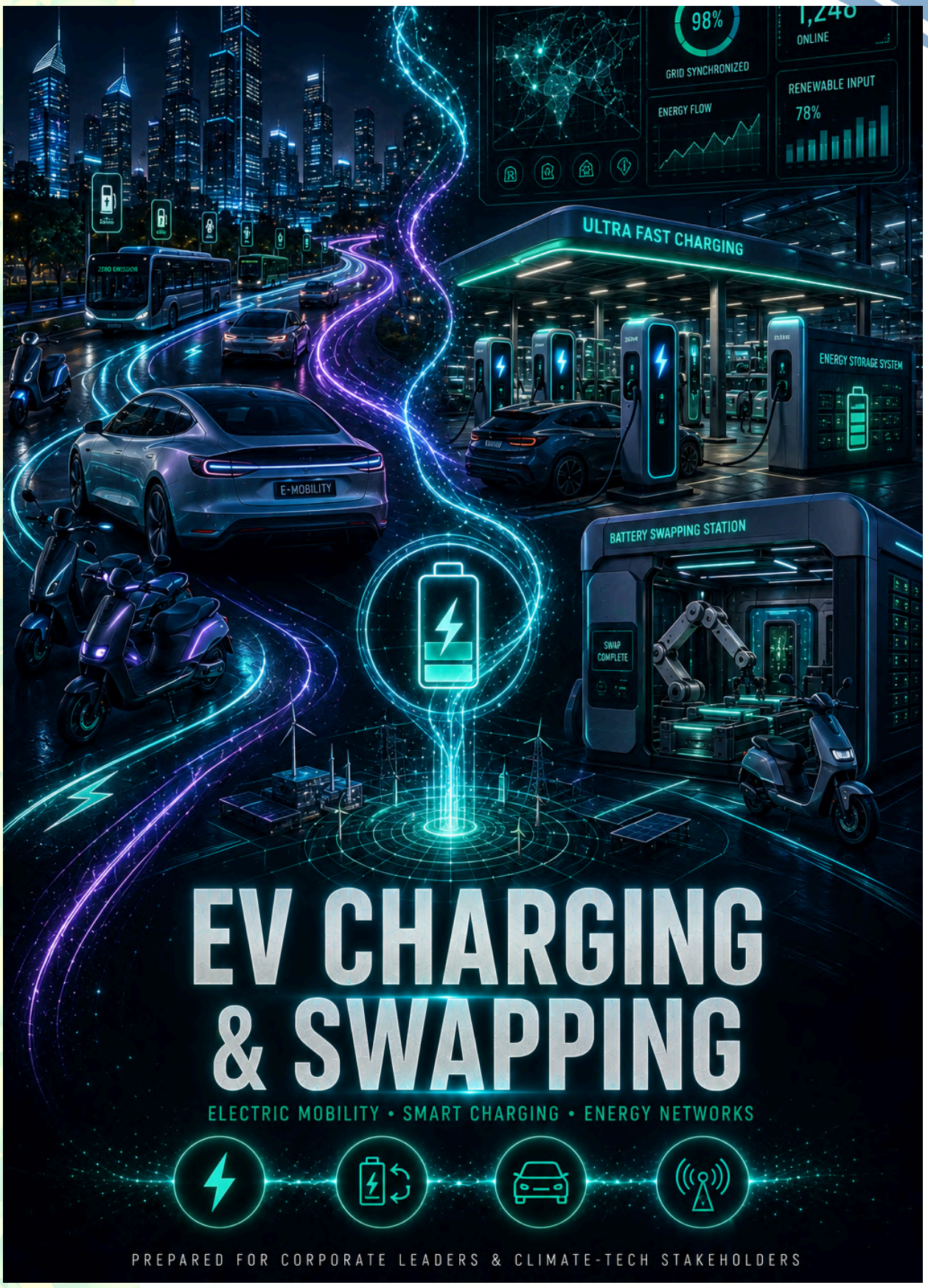
Key Takeaway for Senior Management

Takeaway	**Details**
EV manufacturing is a platform and systems business, not a vehicle assembly business	• Long-term winners are defined by control over **battery systems, power electronics, software, and vehicle architecture**, not just body-in-white and assembly scale • ***Examples****:* skateboard platforms, integrated e-axles, centralized vehicle control units (VCUs). • **Recommended innovation focus:** modular vehicle platforms and system-level integration • **Competitive advantage:** faster model launches, lower unit

	costs, and higher platform reuse across segments
Battery strategy is the single biggest determinant of cost and differentiation	• Battery pack design, sourcing, and lifecycle performance drive 30–40% of vehicle cost • ***Sub-components**:* cell chemistry selection, pack engineering, thermal management, BMS software • **Recommended innovation focus:** chemistry-agnostic pack platforms and advanced battery intelligence
Software and data are becoming core value creators	• EVs are software-defined products with ongoing monetization potential • ***Examples**:* OTA updates, remote diagnostics, energy optimization, fleet analytics • **Recommended innovation focus:** vehicle OS, cloud connectivity, and data-driven services • **Competitive advantage:** recurring revenue streams and long-term customer lock-in
Fleet and B2B segments are the fastest path to scale and profitability	• Fleet buyers value TCO, uptime, and analytics more than brand • ***Examples**:* last-mile logistics, corporate fleets, shared mobility • **Recommended innovation focus:** fleet-specific vehicle variants and digital fleet management tools • **Competitive advantage:** predictable demand, faster scale-up, and lower customer acquisition costs
Localization and ecosystem partnerships are strategic, not tactical	• Supply-chain resilience and localization affect margins and delivery reliability • ***Examples**:* local power electronics, motors, battery components, software partners • **Recommended innovation focus:** co-development partnerships and localized platform ecosystems • **Competitive advantage:** faster iteration cycles and supply security

Next Steps for Corporate Leaders

EV manufacturing in India is entering a scale-up phase as electrification accelerates across two-wheelers, three-wheelers, passenger vehicles, and commercial fleets. Policy incentives, falling battery costs, and fleet-led adoption are driving OEM activity and opening space for both incumbents and new entrants.This could be an attractive climate tech opportunity for industries and firms in specific sectors and industries keen on catering to this market


98%
GRID SYNCHRONIZED
ONLINE
ENERGY FLOW
RENEWABLE INPUT
78%
ULTRA FAST CHARGING
ENERGY STORAGE SYSTEM
E-MOBILITY
BATTERY SWAPPING STATION
SWAP COMPLETE
EV CHARGING & SWAPPING
ELECTRIC MOBILITY • SMART CHARGING • ENERGY NETWORKS
PREPARED FOR CORPORATE LEADERS & CLIMATE-TECH STAKEHOLDERS

Mobility
EV Charging / Swapping

This section provides key inputs on EV Charging / Swapping Opportunities for corporate leaders.

Highlights

- Critical infrastructure layer for EV adoption - Charging and swapping networks directly determine EV penetration, utilization, and customer confidence across 2W/3W, passenger, and fleet segments.
- Multiple monetization pathways emerging - Revenue from energy sales, subscriptions, fleet contracts, advertising, data services, and grid services
- Strong policy and ecosystem tailwinds - Government incentives, urban planning mandates, and OEM partnerships accelerating deployment and utilization
- Under-optimized software and systems - Interoperability, fast charging, battery swapping, software platforms, and energy management remain under-optimized—creating room for winners

Key recommendations for corporate leaders include:

- Focus on logistics hubs, commercial fleets, 2W/3W corridors, and captive demand before retail expansion
- Align with OEMs, fleet operators, utilities, and real-estate owners to lock in demand and sites
- Enable smart charging, load management, and integration with solar/BESS for margin and resilience

Opportunity Snapshot: EV Charging & Swapping

Provide energy to EVs via charging stations or battery swapping networks

Market Signals

- High growth in 2W/3W swapping and 4W fast charging networks
- EV adoption accelerating; hence strong demand for public and fleet charging infra
- Annual Market size by 2030: ₹ 10,000 - 12,000 Cr

What Makes or Breaks It?

- Reliable uptime + fast charging/swapping cycles
- High utilization (>25–35% load factor) via fleet tie-ups
- Strategic site selection (high-traffic corridors, urban hubs)

Why It Matters NOW?

- Charging infra is a key bottleneck for EV adoption
- Fleet electrification (e-commerce, ride-hailing) driving high utilization demand
- Opportunity for recurring revenue

Well Aligned Opportunity for

- Energy companies and utilities
- Fleet operators and mobility platforms
- Infra developers and charging startups

Key Challenges

- Low utilization in early stages
- High capex: ₹5–15 lakh per charger (AC/DC mix)
- Grid connectivity and land access constraints

Business Models

- Deploy chargers in urban hubs, highways, and fleet depots
- Build battery swapping networks for 2W/3W fleets
- Partner with OEMs and fleet operators for assured demand

Explore this opportunity further with EAI
consult@eai.in / Call Muthukrishnan - +91 9952910083

Introduction and Business Case

As EV adoption accelerates, charging and swapping infrastructure becomes the backbone of India's e-mobility transition. Reliable, accessible and affordable charging reduces range anxiety, improves fleet economics and ensures grid integration of millions of EVs. Charging caters to private and long-haul users, while swapping offers fast turnaround for 2W/3W fleets.

Together, these create a scalable energy distribution network, reduce oil imports and enable India to meet its EV30@2030 targets. And in the process present a large and attractive opportunity for Indian businesses and corporates.

Market Potential for EV Charging / Swapping in India

Year	Market Size (₹ Cr)	Chargers / Swap Stations	Drivers
2025	2,000-3,000	~100,000 chargers; ~2,500 swap stations	Early FAME-II incentives; fleet electrification.
2030	10,000-12,000	~500,000 chargers; ~10,000 swap stations	30% EV penetration; urban infra scale-up.
2040	30,000-35,000	>1.5M chargers; >25,000 swap stations	Mass adoption across passenger & commercial fleets.

Market Segments and Applications

Segment	Applications	Business Model	Key Drivers
Highway DC fast charging	Long-distance travel	Asset-heavy network ownership	Range anxiety reduction
Urban public fast charging	City commuting, ride-hailing	Utilization-driven station economics	Urban EV density growth
Destination & workplace charging	Offices, malls, hotels	Host-funded / revenue-share model	Dwell-time charging demand
Fleet & depot charging	Delivery, buses, logistics	Long-term fleet contracts	Fleet electrification mandates
OEM-led charging ecosystems	Brand-specific EV charging	Vehicle-integrated charging networks	Customer experience differentiation

Energy-major charging networks	Retail fuel sites, highways	Integrated energy retail model	Fuel-to-electrons transition
Platform-based charging networks	Mixed public & private charging	Hardware + SaaS platform	Asset-light scaling
Battery swapping (passenger vehicles)	High-utilization urban EVs	Battery-as-a-Service (BaaS)	Downtime reduction
Battery swapping (2W / 3W)	Urban mobility, delivery	Standardized battery infrastructure	Standardized battery infrastructure
Charging hardware & technology	Fast chargers, software	Equipment sales + service contracts	Infrastructure build-out

Typical Project Capacities & Investments Required in India

Type	Typical Capacity	Indicative CapEx (₹)	Notes
AC Public Charging (Level 1/2)	7-22 kW per gun	0.6-2.5 lakh / gun	Apartments, offices, malls; low grid impact.
DC Fast (Light Vehicles)	30-60 kW	8-20 lakh / gun	2W/3W/4W mixed use; metro corridors.
DC Fast (HPC)	120-180 kW	25-45 lakh / gun	Highway hubs; split cabinets + liquid-cooled cables.
Ultra-Fast (HPC+)	250-360 kW	60-120 lakh / gun	Premium highway / fleet depots; high demand charges.
Bus Depot Charging	1-5 MW aggregate	₹5-15 Cr / depot	60-200 e-buses; pantograph/CCS mix; load management.
Battery Swapping - 2W/3W	50-300 swaps/day/site	₹10-25 lakh / swap kiosk + ₹1-3 Cr battery pool	Economics driven by utilisation + battery financing.
Battery Swapping - LCV	30-100 swaps/day/site	₹40-90 lakh / site + ₹3-8 Cr battery pool	Standardisation critical; depot-first model.
Hub with PV+BESS	200-800 kW PV + 0.5-2 MWh BESS	₹3-12 Cr	Shaves peaks; arbitrage; improves uptime where the grid is weak.

Underlying Technologies & Processes

Feature	EV Charging	Battery Swapping
Infrastructure	Chargers + grid	Battery lockers + charging backend
Time to Charge	30 mins to 6 hours	<2 minutes
Vehicle Compatibility	Needs standard plug	Needs standard battery interface
Battery Ownership	Owned by user	Owned by operator
Tech Focus	Grid & power electronics	Battery pack + IoT + logistics
Smart Charging	Maximize battery life	Off-peak hour charging to minimize cost

Key Challenges

Challenge Area	Key Issues	Business Impact	India Specific	Strategic Implications
Utilization Risk & Demand Uncertainty	Charging infrastructure utilization dependent on EV adoption rates	Delayed revenue realization and lower ROI	EV penetration varies by state, vehicle segment, and urban density	Focus on fleet segments (2W/3W/logistics buses) with predictable demand
Capital Intensity & Profitability Challenges	High upfront investment in chargers, grid upgrades, batteries (swapping), and land	Long payback periods and margin pressure	Low tariffs and price-sensitive users limit revenue potential	Develop asset-light models and strategic partnerships (OEMs, fleets, real estate)
Grid Connectivity & Infrastructure Constraints	Power availability, grid capacity, and approval timelines impact	Slower rollout and operational complexity	DISCOM approvals vary regionally; grid reliability challenges	Select locations aligned with grid capacity and renewable integration

	deployment			
Technology Standardization & Interoperability Issues	Different charging standards, battery formats, and OEM specifications	Operational inefficiencies and scaling challenges	Fragmented ecosystem, especially in swapping for 2W/3W segments	Support open standards and collaborate with OEM ecosystems
Policy, Regulatory & Location-Specific Risks	Evolving incentives, tariff structures, and state policies	Business model uncertainty and regional variability	State-specific EV policies; land regulations; electricity pricing structures	Maintain regulatory flexibility and diversify geographic footprint

Prominent Players in the Indian Market

Company / Entity	Project Details
Tata Power EZ Charge	India's largest public EV charging network with 80,000+ home, public and fleet charging points.
Fortum India	Operates fast-charging corridors on highways and in metros; partnerships with OEMs and DISCOMs.
ChargeZone	Building fast-charging highways and urban hubs; 13,000+ charging points installed.
Magenta ChargeGrid	Provides grid-integrated charging stations, solar-powered chargers and fleet charging hubs.
Jio-BP Pulse	JV of Reliance & BP; setting up multi-energy stations with EV charging across India.
Battery Smart	Delhi-based startup; India's largest 3W battery swapping network with 30,000+ daily swaps.
Bounce Infinity	Provides scooter battery swapping and operates swap stations in metro cities.
Ola Electric	Developing Hypercharger network for its 2W EVs; 100+ stations under rollout.
Ather Energy	Runs Ather Grid — a network of fast chargers across 100+ cities.

Innovation Perspectives

Innovation	Business Opportunity	For Senior Management
Charging as a location-based platform	Real-estate–anchored charging platforms	High utilization + long-term moat
Fleet-first charging economics	Depot charging + fleet energy contracts	Faster breakeven, predictable cash flows
Battery-as-a-Service (BaaS)	Subscription-based battery platforms	Lowers EV upfront cost
Ultra-fast charging hubs	Highway energy hubs	Enables EV parity with ICE refueling
Swapping for high-utilization segments	Urban swapping networks	Superior for taxis, delivery, 2W/3W
Software-defined charging networks	Charging SaaS & energy management platforms	Higher margins via optimization
Energy retail integration	Energy retail integration	Increases customer stickiness
Grid-interactive charging (V2G-ready)	Grid-services-from-charging models	Monetizes flexibility
Standardization & interoperability	Neutral charging marketplaces	Accelerates adoption
Carbon-aware & renewable-linked charging	Green charging certificates & contracts	Corporate ESG demand

Concentric & Satellite Opportunities

- Charger manufacturing & component supply: Domestic production of DC fast chargers, cables, connectors and switchgear to meet Bharat/DC-001 and CCS standards.
- CPO & EMP network operators: Concentric players building interoperable charging and payment ecosystems across highways, cities and fleets.
- Battery swapping infra & logistics firms: Operators managing battery pools, kiosks and data-driven routing for 2W/3W and LCV fleets.
- Renewable-powered charging hubs: Integration of rooftop solar and BESS at charging depots to stabilise grids and lower operating costs.

- Digital payment & roaming platforms: Unified UPI-based solutions enabling frictionless billing and real-time energy settlement between operators.
- Fleet energy management & analytics platforms: Satellite systems optimising charging schedules, SoC and total cost of ownership for logistics operators.
- Battery health & recycling alliances: Cross-sector ecosystem reclaiming used batteries for stationary storage, ensuring circular value retention.

Key Takeaway for Senior Management

Takeaway	Details
Charging & swapping is an energy-platform business, not a hardware rollout	• Value accrues to networks that control software, utilization, pricing, and grid interaction—not just charger counts • ***Examples****:* network operating systems, dynamic pricing, roaming/interoperability layers • **Competitive advantage:** higher utilization, faster payback, and ecosystem lock-in
Utilization beats footprint as the primary economic driver	• ROI depends more on charger/swapping throughput than on site count, and thus emphasis should be on generating predictable revenues and superior unit economics • ***Sub-components****:* fleet contracts, depot charging, 2W/3W corridors, logistics hubs • **Recommended innovation focus:** demand aggregation and fleet-first deployment models
Swapping wins where uptime and speed matter; charging wins where dwell time exists	• The two models serve different use cases and should be deployed selectively • ***Examples****:* swapping for 2W/3W fleets and last-mile delivery; fast charging for highways and commercial hubs • **Recommended innovation focus:** hybrid networks combining charging + swapping • **Competitive advantage:** broader addressable market with optimized capex
Grid integration and energy management are emerging value pools	• Smart charging reduces peak demand and unlocks grid services revenue • ***Examples****:* demand response, peak shaving, solar + BESS integration • **Recommended innovation focus:** AI-driven load management and energy optimization • **Competitive advantage:** lower energy costs and additional revenue streams
Data and customer experience	• Seamless payments, reliability, and analytics

determine long-term defensibility	drive repeat usage • ***Examples:*** app-based discovery, uptime SLAs, predictive maintenance • **Competitive advantage:** sticky customers and network effects

Next Steps for Corporate Leaders

EV charging and battery swapping are entering a scaling phase as electrification accelerates across logistics, last-mile, shared mobility, and municipal fleets. Multiple infrastructure models — including depot charging, public fast charging, and swapping — are progressing in parallel as policy, OEM alignment, and fleet economics improve.

This could be an attractive climate tech opportunity for industries and firms in specific sectors and industries keen on catering to this market.