Bharat Cleantech Manufacturing Platform: E-mobility Indigenisation Pathways

Accelerating an Aatmanirbhar, Green and Viksit Bharat

bharat CLIMATE FORUM

Council for International Economic Understanding

Dalberg

As India rapidly moves towards meeting its NDCs, indigenisation of cleantech manufacturing is critical for an *Aatmanirbhar* and *Viksit Bharat*

India has national targets and projections across renewable energy and e-mobility for 2030…

300 GW Solar
installed capacity[1]

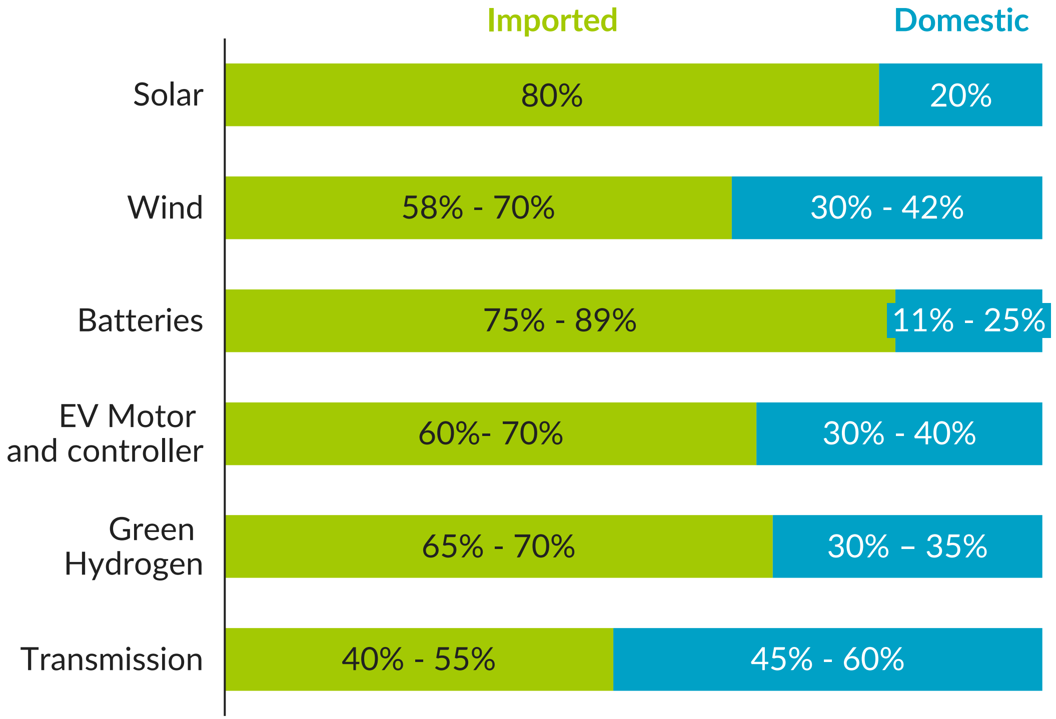
30% EV *sales penetration*[2]

100 GW Wind
installed capacity[3]

5 MTPA Green Hydrogen
production[4]

… but cleantech supply chains are heavily import-dependent and need to be indigenised for an Aatmanirbhar Bharat

Cleantech manufacturing import dependence across the value chain, 2023



Source: (1) MNRE; Solar capacity projection extrapolated from CEA's 2032 Solar capacity projections, assuming linear growth in capacity; (2) NITI Aayog ; (3) ET ; (4) MNRE - NGHM; MNRE, Ministry of Power; Economics Times; BNEF's installed and announced capacity; IEA, India – World Energy Investment 2024 – Analysis; NITI, India's Power Sector | Capacity & Generation Mix; PIB, India's Ethanol Push: A Path to Energy Security, CEEW, Strengthen India's Clean supply chain, 2024; Bain, India Electric Vehicle Report, 2023; Policy circle; Economist Impact, Scaling clean energy: financing and transition strategies for India's sustainable future

The Platform could support the National Manufacturing Mission to target at least 50% indigenisation of cleantech manufacturing value chains by 2030 enabling net-zero ambition with indigenous production

The Platform's potential to accelerate development of incremental indigenous capacity can be observed across sectors

Sector-wise goals

	Solar	Wind	BESS	E-mobility	Green Hydrogen	Transmission
Installed capacity						
2030 targets	300 GW[1]	100 GW[2]	230-240 GWh[3]	30@30[4]	5 MTPA[6]	648,190[7] ckm
% value chain indigenisation*						
Current levels (est.)	~20%	~35%	~20%	~35%[5]	~35%	~55%
2030 target (Proposed)	~50%	~60%	~45%	~50%	~60%	~70%

May decline due to shifting and unstable demand of domestic components amid intensified global competition

Note: *Indigenisation is domestic value contribution across cleantech value chain from raw materials to end production for all components; : (1) MNRE; (2) ET; (3) Estimated requirements under National Electricity Plan (NEP) 2023 of CEA; (4) NITI Aayog ; (5) For EV Motors and controllers; (6) MNRE - NGHM (7) 2032 target from National Electricity Plan Volume II – Transmission of CEA

Source: MNRE, Ministry of Power; Economics Times; BNEF's installed and announced capacity; IEA, India – World Energy Investment 2024 – Analysis; NITI, India's Power Sector | Capacity & Generation Mix; PIB, India's Ethanol Push: A Path to Energy Security, NEP 2023 of CEA; EV Reporter, India's electric vehicle supply chain landscape | An overview, 2024

A detailed strategy and action plan for the focus sectors would be developed to achieve these goals and objectives and build the cleantech indigenisation pathways for these sectors

Sector-wise gaps would be identified and addressed with all stakeholders across each cross-cutting theme in alignment with the National Manufacturing Mission

Enablers:
Policy recommendations; Trade partnerships; Public and private stakeholder recommendations; Demand and supply drivers; Leveraging AI for Climate and cleantech manufacturing

Sectors

- Solar
- Wind
- BESS
- E-mobility
- Green Hydrogen
- Transmission

Cross-cutting themes

Demand Acceleration	*Drive demand and adoption of output, incl.* ***Quality Control Orders (QCOs)***
R&D Ecosystem	*Drive technology sharing, adoption and indigenous R&D*
Upstream Raw Materials	*Streamline raw material sourcing (e.g. critical rare earth elements; bio-energy feedstock etc.)*
Capex & Infra	*Address machinery sourcing & infrastructure requirements (e.g., grid connectivity)*
Skilled Workforce	*Bridge skilling gaps for specialized and non-specialized workforce*
Financing	*Identify financial instruments and mechanisms to reduce the funding gap* *Identify levers to improve* ***Ease of Doing Business*** *to attract investments*

bharat
CLIMATE FORUM

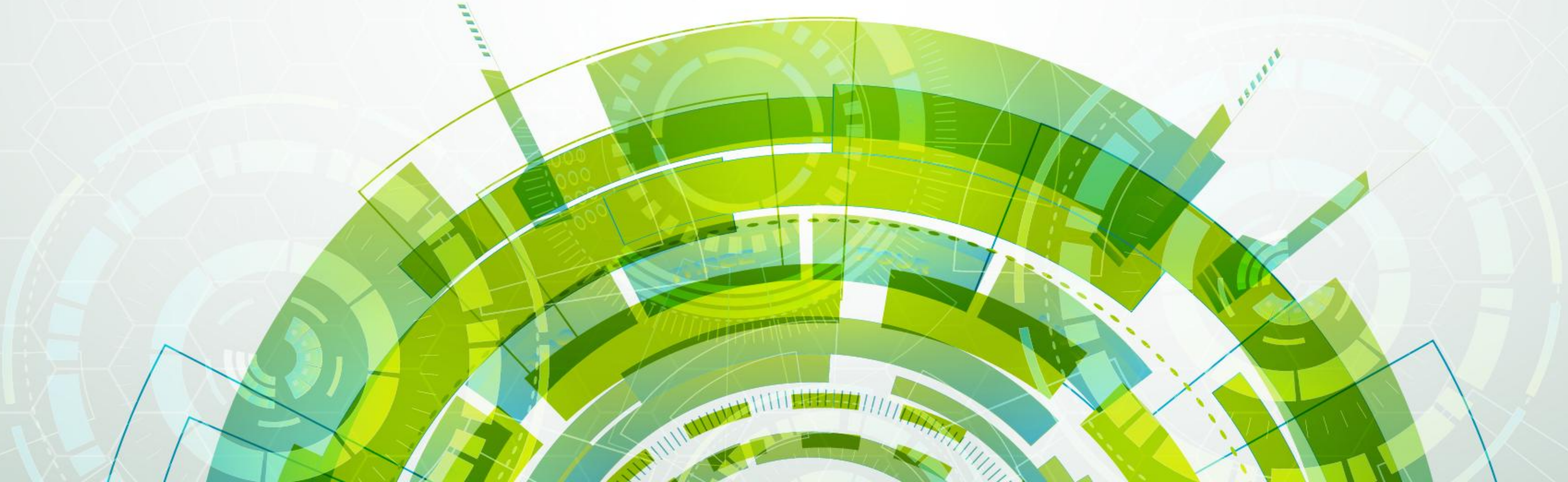
TABLE OF Contents

Council for
International Economic
Understanding

Dalberg

SECTION ONE

CURRENT E-MOBILITY LANDSCAPE: GLOBAL AND INDIA



EVs comprise a range of technologies that can serve as alternative to fossil fuel vehicles to deliver cleaner mobility for people and goods

HEV
Hybrid electric vehicle

Instead of using an external plug to charge the vehicle, the electricity generated by the HEV's braking system is used to recharge the battery. This is called 'regenerative braking' and is also used in BEVs, PHEVs and FCEVs.

Petrol

PHEV
Plug-in hybrid electric vehicle

Powered by a combination of liquid fuel and electricity. They can be charged with electricity using a plug but also contain an internal combustion engine that uses liquid fuel.

Petrol + Electricity

BEV
Battery Electric Vehicle

Fully-electric, meaning they are solely powered by electricity and do not have a petrol, diesel or LPG engine, fuel tank or exhaust pipe. BEVs are also known as 'plug-in' EVs as they use an external electrical charging outlet to charge the battery.

Electricity

Current focus[1]

FCEV
Fuel Cell Vehicle

Use a fuel cell instead of a battery, or in combination with a battery or supercapacitor, to power their electric motors. FCEVs are typically fueled by hydrogen and usually provide greater range than BEVs.

Hydrogen Fuel

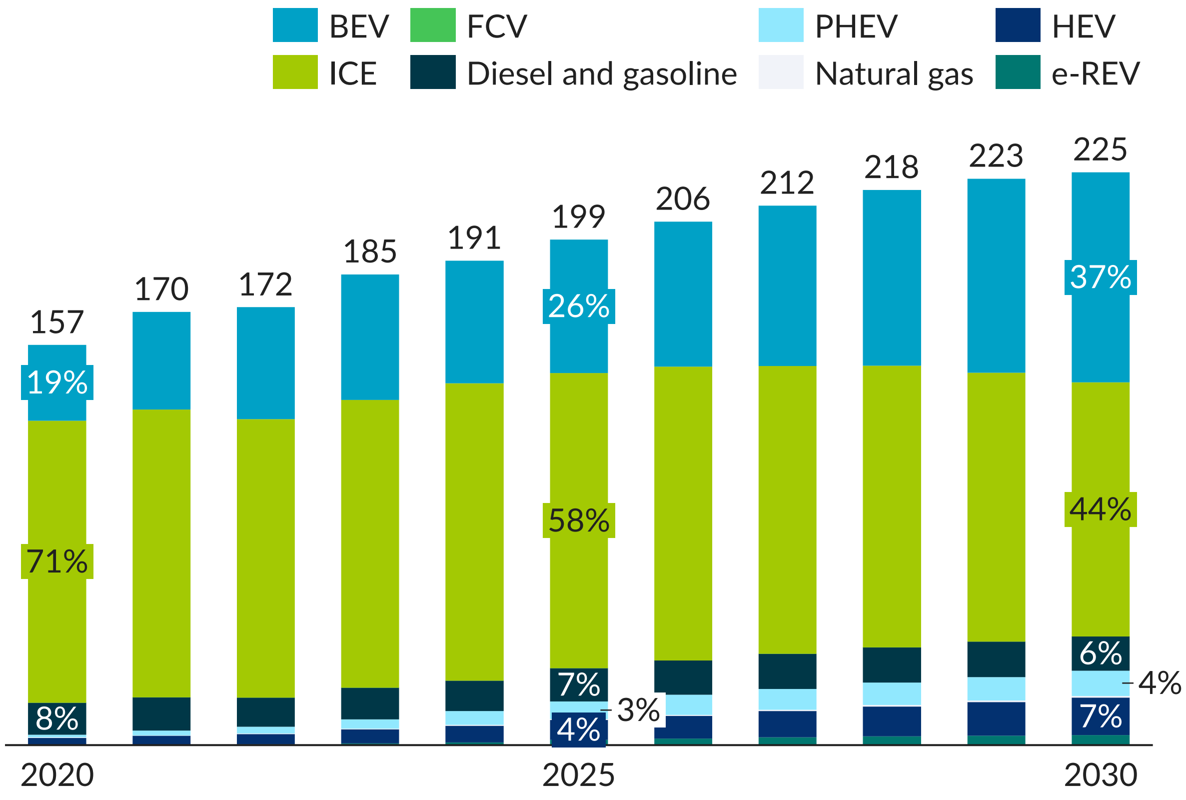
---

(1) PHEVs have only been excluded from the analysis on charging infrastructure requirements, due to minimal charging requirements and preference of at-home/office charging

Globally, one in five vehicles sold in 2020 was an electric vehicle[1]; by 2030, BEVs are expected to make upto 37% of total annual automotive sales

Global penetration of BEVs[2] in annual vehicle sales has risen to ~25% and could further grow to 37% by 2030

Global vehicle sales by drivetrain type, Million vehicles, 2020-2030



Penetration is mainly driven by a limited set of countries, with China, Germany and UK as frontrunners

Global status on adoption of Battery Electric Vehicles

Stage	BEV Share (%)	Number of Countries	Leading Countries
Mass Adoption	>15%	25	*China, Germany, UK*
Tipping Point	5%-15%	25	*USA, South Korea, India*
Early Adoption	2%-5%	10	*Brazil, Poland*
Nascent	<2%	90	*Japan, Mexico, Philippines*

(1) Considering only Battery Electric Vehicles; (2) Battery Electric Vehicles

Source: BloombergNEF, Long –Term Electric Vehicle Outlook, 2025; BCG, Changing Lanes: EV Strategies in the US, Europe and China, 2025

Government of India has set ambitious targets to reach 30% EV penetration by 2030 and 50% localisation; several policy measures are accelerating this shift

The existing policies and market drivers have led to a 7. 7% sales penetration of EVs in FY 25 and the Government envisions to reach a 30% sales penetration by 2030

2013

National Electric Mobility Mission Plan NEMMP (2020) launched with a target of **~6-7 Mn xEVs** (Pure EVs, HEVs) units sold in India by 2020

Legend
Demand incentives
Supply incentives

2015-19

FAME-I launched with INR 795 Cr (INR 100 Cr extension in 2018) with demand incentives[1] of INR 495 Cr and charging infra incentives of ~ INR 30 Cr

GST for EVs set at 12% v/s 28% for ICE

Tender procurement of 10K EVs by EESL, kickstarting uptake in OEM volumes

localisation & DVA mandates introduced under FAME II

- In country manufacturing mandate of 40–50% localisation to qualify for demand incentives.
- Phased Manufacturing Programme roadmap issued

2019-24

FAME-II launched with INR 10K Cr (INR 1.5K Cr Extension) with demand Incentives for E2Ws, E3Ws, E4Ws of INR 7K Cr, E-Buses for INR 3.2K Cr and Charging infra: INR 839 Cr

GST on EVs slashed to 5%

INR 3.3K Cr SPECS scheme launched with 25% Capex reimbursement

PLI Schemes launched for Auto/components (INR 26K Cr), Advanced Cell Chemistry (INR 18K Cr) and Electronics (INR 5K Cr)

Electricity as a Service permitted by Ministry of Power to boost infra investments.

Direct purchase of RE made easier for CPOs under Green Energy Open Access Rules

2024-Present

INR 11K Cr PM E-DRIVE scheme launched with demand incentives for E2Ws/E3Ws of INR 2.68K Cr; INR 4.39K Cr for E-Buses, INR 2K Cr for charging infra, and targets 22.1K fast chargers for E4Ws, 48.4K for E2Ws/E3Ws, and 1.8K for E-buses

SPMEPCI scheme launched to promote the manufacturing of EVs in India

- Approved OEMs to invest a minimum of INR 4.1K Cr
- 25% DVA within 3 years
- 50% DVA within 5 years

2025-Progress

5.675 Mn EVs[2]
(~7.67% sales penetration in FY25)

62 OEMs
registered to avail demand incentives under FAME II

29K Public Charging Stations
installed

83 CPOs operating
(PSUs & Private)

30-35% localisation level

2030-Vision

30% EV penetration
target in total vehicles sold set by Govt. of India at
50%
localisation levels

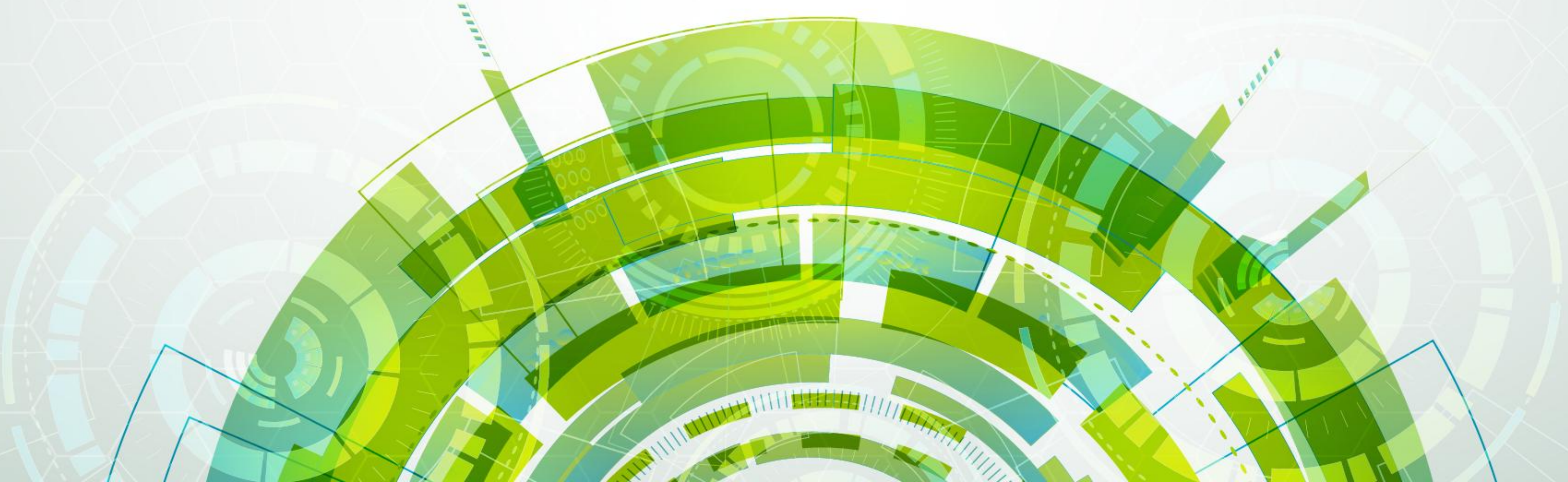
---

(1) Segment based subsidy and not per kWh; ~ Bureau of Energy Efficiency, Dalberg Analysis (2) Total stock of EVs till 2025

Source: PIB MHI, FAME India Scheme, 2019; PIB MHI, Scheme outlay of FAME India Scheme Phase II, 2024; MHI, Operational Guidelines for PM E-DRIVE Scheme, 2024; VAHAN Dashboard; PIB MHI, Initiatives to improve EV sector, 2025; PIB MHI, MHI sanctions 7432 EV Charging Stations under FAME-II, 2023; Bureau of Energy Efficiency, Charging Point Operators, Accessed October 2025; PIB MHI, Adequacy of EV Charging Stations, 2025; PIB, Wheels of Change: India's Electric Leap for Green Mobility, 2025

SECTION TWO

EV INDIGENISATION PATHWAYS FOR INDIA



Current localisation across EV manufacturing in India is at 30–35%, though it varies across components; domestic capacity additions have been announced by several large players

ILLUSTRATIVE

Localisation across the EV value chain is mainly driven by Chassis and Body manufacturing

Key components	Battery Pack	BMS	Motors	Power Electronics	Chassis and Body	Others
BOM Split	35-40%	5-10%	5-15%	10-20%	15-25%	10-15%
Current component DVA[2]	10-20%	30-40%	30-40%	40-50%	80-90%	40-50%

Green and brown-field investments being announced to improve current levels of localisation

Key announced investments	Battery Pack	BMS	Motors	Power Electronics	Chassis and Body	Others
	133 GW incremental Battery Pack capacity announced over 19 GW existing capacity, by Li Energy, PureEV, etc.	Xbattery raised ~ INR 20 Cr to locally develop BMS, Ashok Leyland's INR 5,000 Cr investment in Battery ecosystem includes BMS	Japanese Auto-manufacturers, DENSO Corp and Nidec announced total ~ INR 800 Cr investment in Motor manufacturing plants	German Auto giant, Schaeffler invested ~ INR 360 Cr in an ICE and EV domestic powertrain manufacturing	UP Government announced INR 700 Cr investment to develop EV hub in Kanpur	Uno Mindo announced INR 423 Cr investment into green-field powertrain manufacturing plant (including E-axles)

However, import reliance for critical sub-components and raw materials could hinder localisation

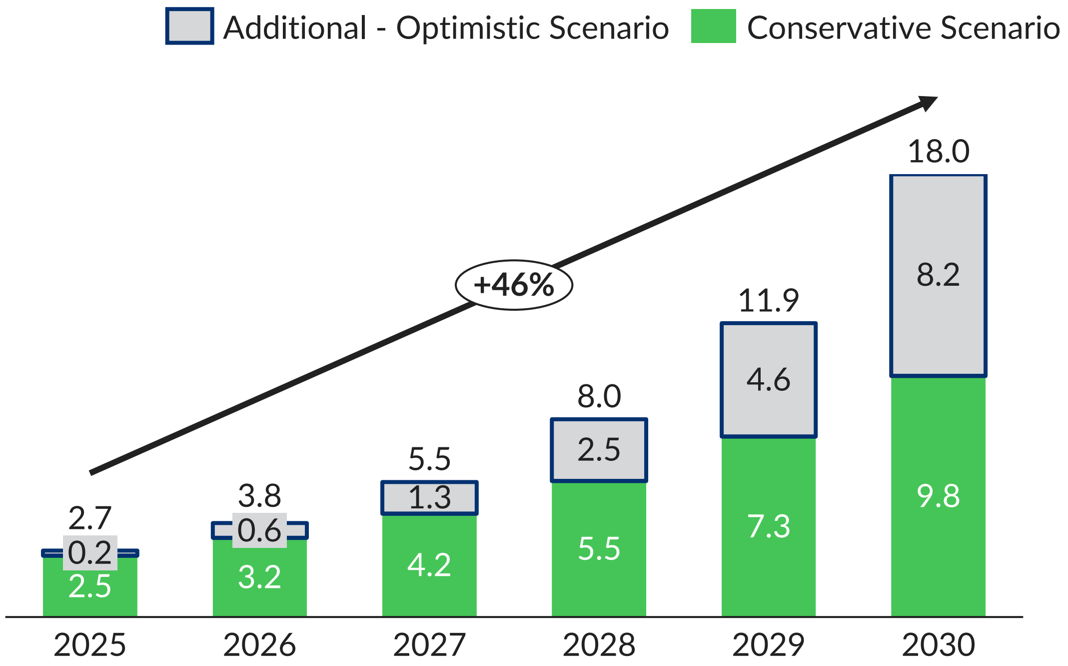
Critical dependencies	Battery Pack	BMS	Motors	Power Electronics	Chassis and Body	Others
	CAM, AAM precursor materials	Semiconductor chips for integrated circuits	REO[1] magnets, specialized steel	Semiconductors for inverters, DC convertors, testing infrastructure		Testing infrastructure and semiconductors

---

(1) Rare Earth Oxide; (2) localisation could vary between vehicle segments, for our analysis we have considered overall localisation across segments; Sources: EV Reporter, Xbattery secures USD 2.3 Mn in Seed funding, 2025; EV Reporter, Ashok Leyland invests in battery manufacturing, 2025; Invest UP, DENSO to invest INR 250 Cr in EV component plant, 2025; Nikkei Asia, Japan's Nidec to build USD 66 Mn Auto-parts plant, 2024; EV Story, Schaeffler says invested INR 1,700 Cr in powertrain, e-mobility and other segments over last 3 years, 2025; ET Auto, UP Govt to invest INR 700 Cr in EV manufacturing in Kanpur, 2025; India Today, Uno Mindo to setup plant for EV powertrain components worth INR 423 Cr, 2025

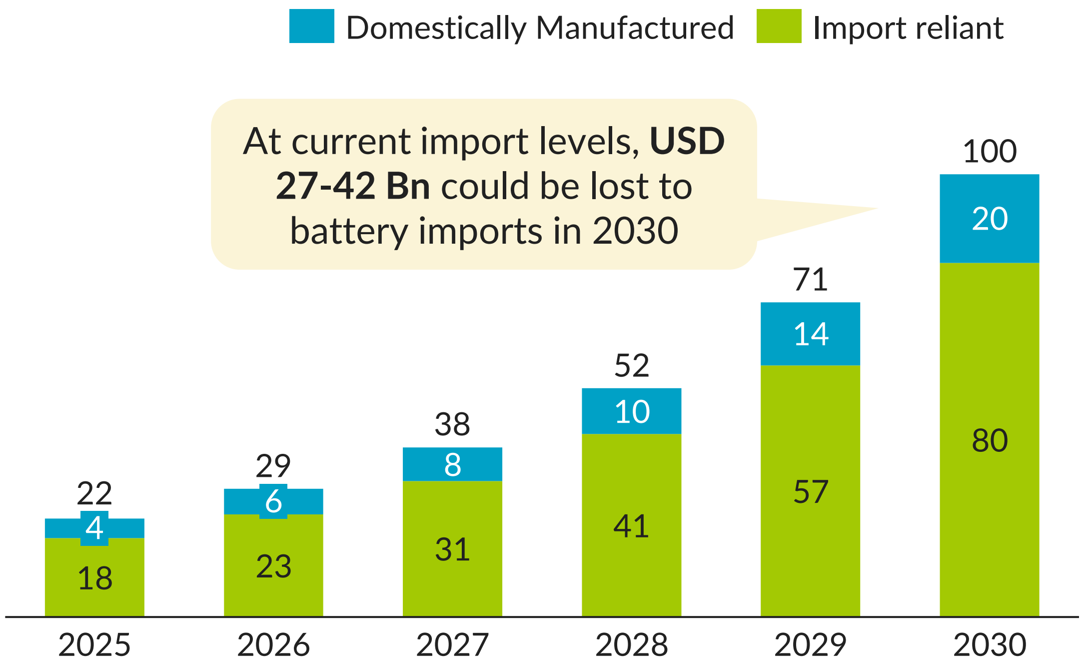
Continued import dependency can lead to USD 9.8-18 billion dollars in import bill in 2030 across the EV value chain (excluding batteries), and dependency for batteries can result in a USD 27-42 Bn import bill

India's expected annual import bill for EVs, USD Bn, 2025-2030[1]



Heavy **import reliance across the EV sector** (spanning multiple components), could result in **USD 9.8-18 Bn lost in imports** across the EV value chain (excluding batteries) in **2030**

India's import dependence for battery requirement in mobility, GWh[2]



At current import levels, **USD 27-42 Bn** could be lost to battery imports in 2030

Import dependence for batteries expected to rise as EV penetration rises, resulting in import bills as high as **USD 27-42 Bn**, for **batteries alone** in **2030**, Further detailed in **Batteries Indigenisation Pathways**

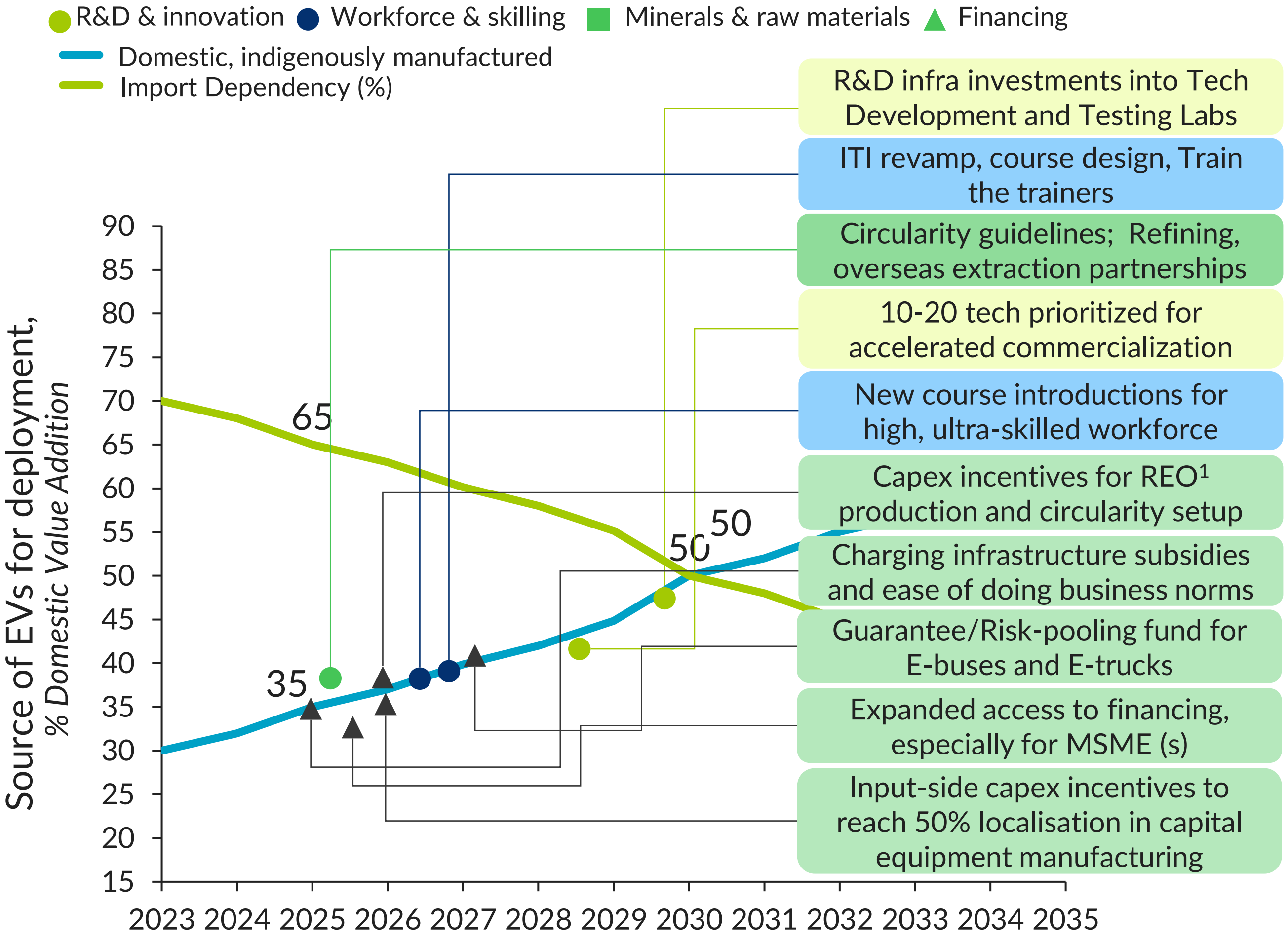
---

(1) Import bill has been calculated by considering expected annual vehicle registrations, assuming 65% import reliance till 2030. Cost of imports has been calculated by considering the current EV Market value and adjusting for inflation and margins. Current EV Market value has been considered in the range of USD 6-8 Bn based on secondary research and value of total vehicles into average price; (2) Battery demand estimations assume achievement of 30@30 target with 30% EV penetration by 2030. Refer to Battery Indigenisation Pathways for details; Source: GOI Ministry of Commerce and Industry, Tradestat Data Bank, Accessed in October 2025; Spherical Insights, Top 15 EV Companies in India, 2025; DataMint Intelligence, India EV Market Growth Forecast, 2025

Interventions focused on improving DVA across EV manufacturing (specifically on Batteries, BMS, Motors and Power electronics), could help reduce India's import reliance from 65-70% to 50% by 2030

ILLUSTRATIVE

EV Indigenisation Pathway to increase domestic manufacturing



R&D infra investments into Tech Development and Testing Labs

ITI revamp, course design, Train the trainers

Circularity guidelines; Refining, overseas extraction partnerships

10-20 tech prioritized for accelerated commercialization

New course introductions for high, ultra-skilled workforce

Capex incentives for REO[1] production and circularity setup

Charging infrastructure subsidies and ease of doing business norms

Guarantee/Risk-pooling fund for E-buses and E-trucks

Expanded access to financing, especially for MSME (s)

Input-side capex incentives to reach 50% localisation in capital equipment manufacturing

Key interventions across EV value chain:

- Scaling **penetration across Vehicle Segments** by scaling **charging infrastructure** and deploying focused programs for **E-bus** and **E-trucks**
- Driving **indigenous R&D** across EV components by supporting **INR 4.5K-6.9K Cr** investments across **infrastructure** and **grants**
- Securing access to **Rare Earth Oxides (REOs)** by supporting **INR 4.6K-5.5K Cr** capex investment across **REO production** and **magnet circularity**
- Developing **Ultra-High** and **High Skilled workforce** via investment in **training programs**, **specialized courses**, etc.
- Supporting EV **manufacturing capacity expansion** by driving **INR 31.1K-37.3K Cr** capex investments across **component** and **equipment manufacturing** capacities

Source: Dalberg Analysis

Targeted investments across enablers like demand and boosting R&D can help drive further localisation within the EV ecosystem (1/2)

Demand & Market Architecture

- **INR 4,000 Cr** incremental investment to enable CPOs to build and operate cumulative **8.7 lakh charging points**
- **INR 4,900-5,500 Cr** investment to support adoption of additional **~ 65,000 E-Buses** and ~ **27,000 E-Trucks by 2030**
- INR **31,700 Cr**[1] has already been allocated under PM E-DRIVE and PM E-bus Sewa to drive EV adoption across vehicle segments

Overall **Government** fiscal investment required:

INR 40,600-41,200 Cr

R&D & Product Innovation

- **50-50 co-financing** from government and private sector to scale EV R&D ecosystem
- Support building **4-6** technology **Development Labs**[2] and **2 Testing Labs** for R&D on **10-20 indigenous battery technologies**
- **Efforts led by a Core Working Group**[3] with industry-academia-government representation

Overall **Government** investment (50% of total investment required):

INR 2,250-3,450 Cr[4]

Upstream Raw Materials & Critical Inputs

- Provide **INR 120-260 Cr capex subsidies** to support development of light and heavy REO[5] production capacity
- Offer **INR 780-840 Cr** in capex subsidies to support development of Rare Earth Magnet recycling facilities
- Mandate **stockpiling** of Rare Earth Oxides equivalent to **25% of annual demand for 2030**

Overall **Government** investment :

INR 900-1,100 Cr

***Detailed in Annex:** Demand Acceleration; R&D Ecosystem; Upstream Raw Materials*

---

(1) Refers to available, undisbursed funds from announced budgets under PM E-DRIVE, PM E-Bus Sewa and PM E-Bus Sewa Payment Security Mechanism schemes; (2) Upgrading current/ building new labs; (3) Potentially set up by MNRE/ANRF; (4) Includes 50% of total INR 2.5-4.5K Cr infrastructure investment and INR 1-1.2K Cr in government grants to be matched by private sector (5) Rare Earth Oxides;

Targeted investments across enablers like demand and boosting R&D can help drive further localisation within the EV ecosystem (2/2)

Capital Equipment & Infrastructure

- Support existing capital equipment manufacturers to indigenise **building up to 50% equipment** for Power electronics, Motors and BMS manufacturing domestically
- Draw from synergies across **EV components** and other **electronics sectors** and support development of **PCB Assembly** capacity to further localise **Charging Infrastructure manufacturing**

Overall capex investment required for domestic machinery manufacturing:

INR 9,000-16,000 Cr

Talent & Workforce

- Develop **"Train the Trainer" program**, dedicated master's programs, and industry-government funded **on-the-job training** with global exposure to retain ultra-skilled talent
- **Start certificate, specialization courses**, industry co-delivered modules, internships for high skilled
- Develop **standardized courses**, demo labs and allocate **upgradation budget for 1,000 ITIs** to train low-skill workforce

Overall **Government** investment :

INR 3,000-5,000 Cr

Financing & Taxation

- Driving additional investment in **EV manufacturing** via capex subsidies worth **~INR 4,600-8,700 Cr** with special focus on MSMEs,
- Interest support worth **~ INR 5,800 – 9,000 Cr** on capex finance costs
- **Additional capex subsidies** of **INR 2,000-3,600 Cr** can catalyze capital equipment manufacturing capacity
- **INR 3,400-12,000 Cr** available from budget allocated under Auto PLI

Overall **Government** fiscal incentives required:

~INR 24,600 Cr

*Achieving **50% indigenisation** across the EV value chain requires **INR 71-75K Cr** total government investment by 2030 and could result in cumulative **USD 6.4-10.6 Bn** of total import bill savings till 2030.*

***Detailed in Annex:** Capex and Infra; Workforce; Financing*

bharat CLIMATE FORUM

Council for International Economic Understanding

Dalberg

These investments into the EV manufacturing value chain could help capture several opportunities till 2030

~ INR 150,000 Cr

Annual market potential across Batteries, BMS, Power electronics and Motors by 2030

USD 6.4-10.6 Bn

Cumulative import bill savings from 2025-30[1]

~6 lakh jobs

Across EV manufacturing value chain by 2030

INR 20,000-24,000 Cr

Annual export potential across Power electronics, BMS and Motors by 2030

INR 165,600-230,000 Cr

Capex financing gap closure for EV manufacturing[2] by 2030

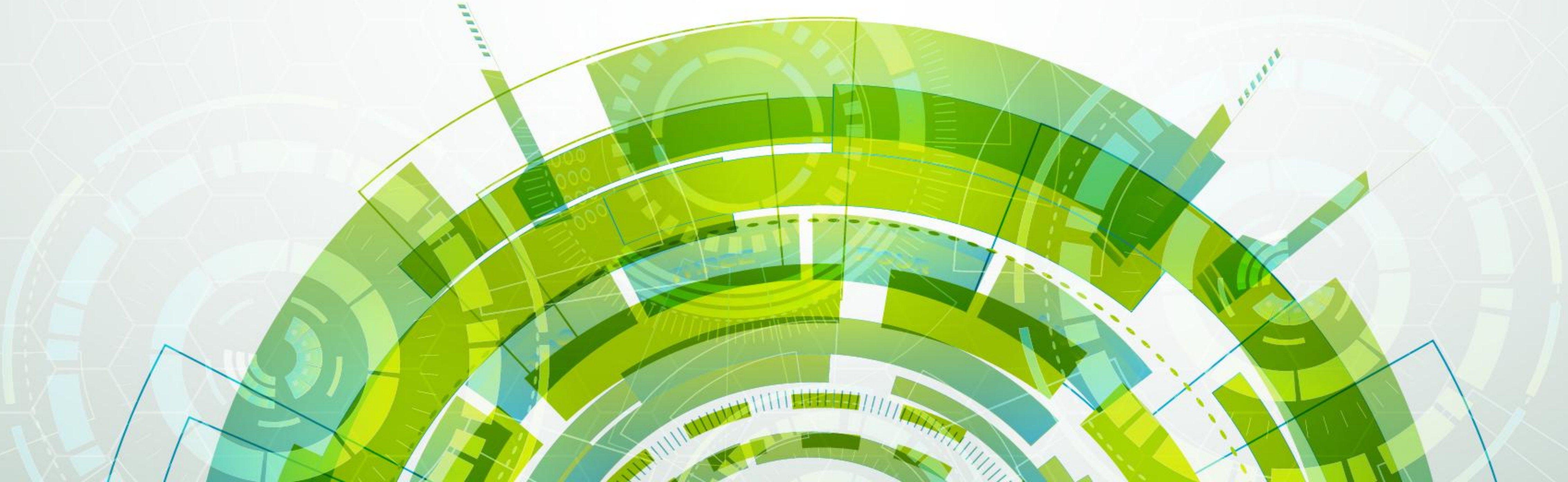
Detailed in Annex: *Potential Jobs*; *Export Potential*; *Capex Financing – Component*, *Capex Financing – Capital Equipment*

---

(1) Import bill savings by reducing import reliance from ~65% to 50% across the EV value chain. Import Bill savings exclude savings from battery localisation; (2) Includes capex financing for EV component, charging infrastructure, capital equipment manufacturing, vehicle assembly, interest costs and other capex investments; Source: Dalberg analysis; CPI, Roadmap for an Automotive Technology Upgradation Financing Facility, 2025

SECTION TWO, SUB-SECTION A

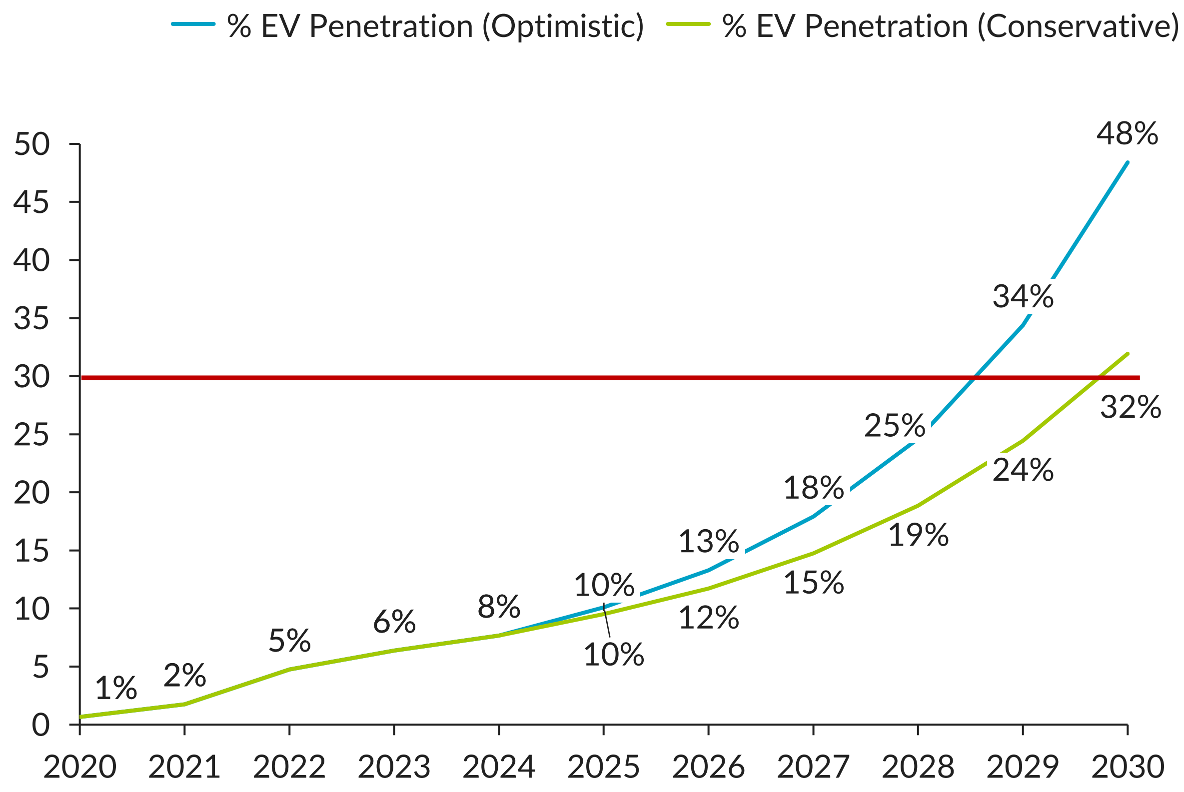
E-MOBILITY INDIGENISATION PATHWAYS FOR INDIA: DETAILED BY CROSS-CUTTING THEMES



1 Demand | India is on track to exceed its 30% EV sales penetration target by 2030, but penetration in 4Ws, bus and trucks segments is expected to remain limited

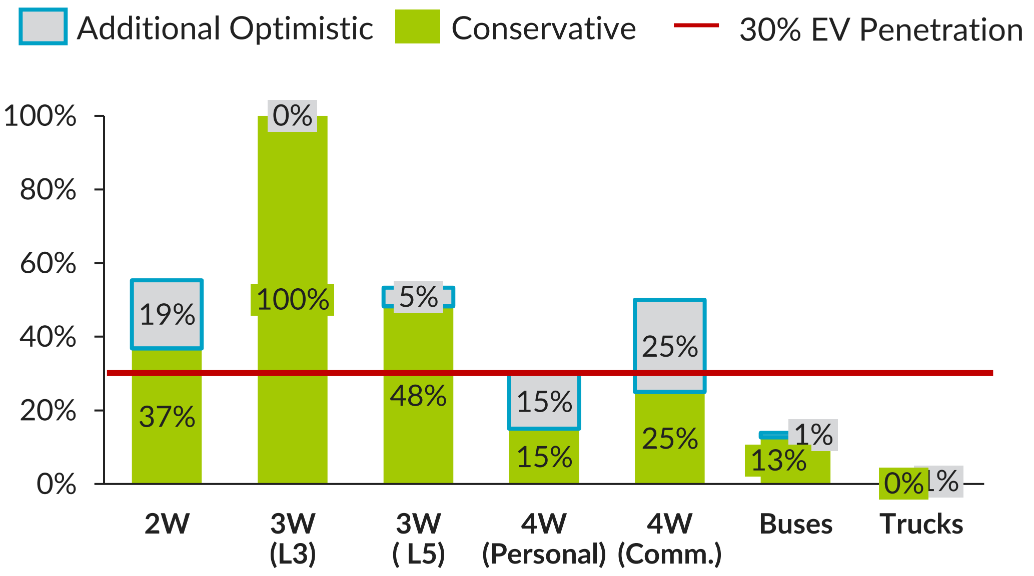
Driven by policy momentum and TCO[1] parity in 2W and 3W segments, India is poised to meet 30% EV sales penetration targets by 2030

Annual sales penetration of EV, %, 2020 – 2030



However, 4Ws, Buses and Trucks expected to see slowest adoption and therefore lower penetration by 2030

Segment wise EV Penetration by 2030, %



Total Cost of Ownership by Segment, INR/km

☐ Segment with TCO for EV > ICE

EV	0.7-2	2.94	1.87	19	4.5	33	9-73
Non-EV	2.5-3.3	4.25	3.6-4.5	12-15	6.3-7.2	40	7-48

Detailed in Annex

---

(1) Total Cost of Ownership

Source: Dalberg Analysis, Industry Reports, VAHAN Dashboard

1 Demand | Targeted interventions needed to scale EV penetration beyond 2W and 3W segments – next push to come from developing charging infrastructure, enabling product innovation & financing

	Pathway	Investment Required	Target outcomes	KEY ENABLERS
A	Supporting product innovation in E-trucks & financing interventions in E-buses	INR 4,900-5,500 Cr[2]	- ~65,000 E-Buses & ~27,000 E-Trucks to be added by 2030	- Enabling tech transfer in MHDT[6] segment and launching innovation challenges for OEMs for new products - Outlining an additional ~INR 3,000 Cr as guarantee pool fund under the existing PM E-Bus Sewa PSM Scheme to support adding ~32k more buses
B	Offering Viability Gap Funding to offset price increase in E4Ws due to improved localisation	INR 4,500-6,500 Cr *Capped at 4W OEMs; already included in Battery Indigenisation Pathways, not proposed as additional investment within this document*	- Potential to add ~5.1 Mn E4Ws till 2030	- Extending existing subsidies (e.g., FAME II), spread over the next 4 years and linked at various stages of the EV production to offset the 15-25% price increase in E4W segment - Addressing the key challenges with the design and execution of subsidy disbursement to improve the effectiveness of policy
C	Enabling CPOs[1] to expand charging infrastructure by improving business viability of setting up and operating charging stations	INR 4,000 Cr[3]	- Supporting establishment of ~7.5 Lakh additional charging points by 2030, with focus on top 5 Metro cities[4] (by EV adoption) in India, and top 20[5] high volume freight corridors	- Subsidizing EVSEs and upstream charging infrastructure for depot CPOs - Building a one window system for CPOs for the entire end-to-end process of setting up a charging station - A centralized end-consumer app built on the existing capabilities of BEE and e-AMRIT with features such as locations of charging stations, waiting time, etc.

*Additionally, **~INR 31,700 Cr** available undisbursed funds under **PM E-DRIVE** and **PM E-bus Sewa** and **INR 4,800-5000 Cr private sector investment** will be required to support higher adoption of E-trucks and E-buses, and accelerate charging infrastructure development*

(1) Charging Point Operator; (2) Detailed ahead; (3) Refers to incremental investment required for scaling charging infrastructure. Detailed ahead, (4) Delhi, Bangalore, Mumbai, Hyderabad, Pune, (5) MHI, PM E-DRIVE: Draft guidelines on EV PCS, 2024; (6) Medium and Heavy-Duty Trucks

1A **Demand |** An investment of INR 4,900-5,500 Cr across product and financing levers is needed to boost E-Bus and E-Truck penetration which is currently at just ~3% and 0.01% in their respective vehicle stocks

Both E-Bus and E-Truck segments currently witness less than 5% EV penetration but face different challenges; improving penetration for E-Buses requires focus on providing financing support whereas E-Trucks need a product centric approach

Critical Solution

	E-Bus		E-Truck	
	Challenge	Solution	Challenge	Solution
Product	Heavy battery packs and lack of model diversity reduce passenger capacity, range, and adaptability for varied routes	Support OEM–Tier-1 partnerships and pilot grants to develop missing variants (mini/midi, hill-city, high-heat battery-thermal packages)	High battery weight cut payload capacity by 15–20%, restricting route economics	Establish a HDETs[3] Technology Access Window to co-finance OEM licensing and validation for Indian duty cycles; launch product innovation challenges
Financing	1.3–2.5X higher upfront costs, delayed GCC[1] payments, and mismatched loan tenures constrain cash flows and private lending	Allocate additional INR 2,900–3,000 Cr as a guarantee/risk-pool fund to back 32K additional buses under the existing PM E-Bus Sewa PSM scheme[2]	2-3X higher upfront costs, limited financier trust due lack of proven business models, resulting in finance costs higher by ~7 percentage points	Setup National Performance Registry/Guarantee Fund (additional INR 2,000-2,500 Cr) to enable risk-sharing; extend subsidy cap under PM e-Drive to first 10K E-trucks
Charging	Slow charging and waiting time increases downtime effectively requiring 1.2 E-buses to replace 1 Diesel/CNG bus	Plan depots with a 1:3 charger-to-bus ratio and provision HT grid capacity upfront; pilot wireless charging pads at bus stops to cut downtime	Limited availability of dedicated fast and ultra-fast charging points along highways could result in low economic feasibility; high charging costs (INR 18-23/kWh)	Target ~2GW truck charging by 2030 in 5 key states, anchoring rollout with MoP's 12 e-Highway corridors
Operations	Range limits, low charger-to-bus ratio, and limited technician capacity reduce fleet reliability	Mandate telematics, predictive maintenance, and charger-queue management in GCC KPIs with standardized training for drivers and technicians	Higher operational costs driven by greater downtime (for charging), limited driver/technician skills	Mandate shipper-fleet-CPO tripartite MOUs for guaranteed volumes; promote algorithmic routes and charge scheduling to maximize payload-time economics

Detailed in Annex

(1) Gross Cost Contract Models; (2) Refer to additional interventions on top of the existing initiatives and incentives under the PM E-bus Sewa Scheme; (3) Heavy-Duty E-truck

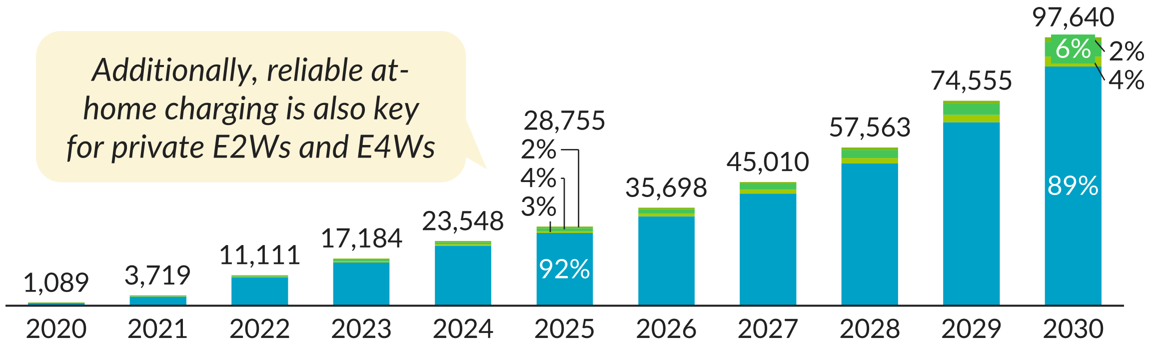
1C Demand | Strengthening the business case for CPOs, alongside an additional investment of INR 4,000 Cr, will be critical to achieve 8.7 lakh charging points by 2030 to meet the energy needs of India's growing EV stock

India needs 8.7 Lakh charging points across Public and Depot charging points, by 2030 to support growing EV registrations

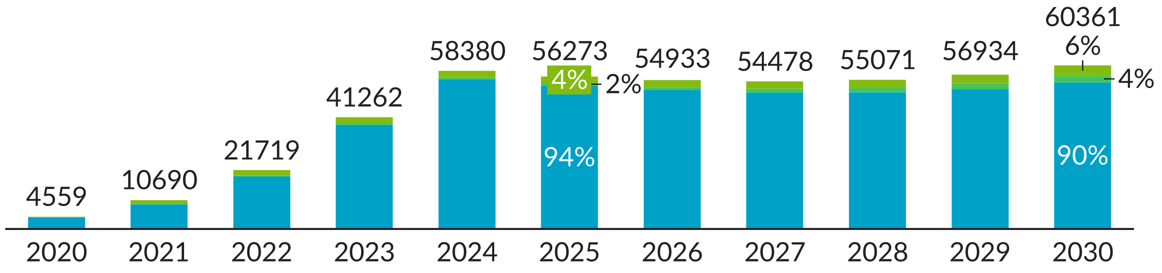
Annual incremental charging infrastructure requirement *(Added on YoY basis)*

🟩 CCS II (120 kW) 🟩 CCS II (60 kW) 🟩 Type II AC (22 kW) 🟦 Type II AC (7.4 kW)

Public Charging Points (Added on YoY basis)


Additionally, reliable at-home charging is also key for private E2Ws and E4Ws

Depot Charging Points (Added on YoY basis)



Targeted interventions and ~INR 4K Cr investment required to overcome existing challenges, and scale charging infrastructure

Key interventions to scale charging infrastructure[1]

Support Business Economics for CPOs

Subsidizing EVSEs and upstream charging infrastructure for depot CPOs in addition to the subsidies provided under PM E-DRIVE

Improve "Ease of Doing Business" for CPOs

Building onto the existing one window portal by certain DISCOMs to expand its scope to entire end-to-end process of setting up a charging station and also availing the relevant subsidies for CPOs

Facilitate Grid Load Management

An consumer app built on the existing capabilities of BEE and e-AMRIT to balance utilisation of different charging stations to manage grid load

INR 4,000 Cr

additional investment[2] required to set up adequate charging infrastructure

---

(1) These are additional interventions on top of the existing initiatives such as capped electricity tariffs, reduced GST on EVSEs, ToD pricing to manage demand, etc.; (2) Meeting the 2030 target of 8.7 lakh charging points, requires support for 7.5 Lakh additional charging points beyond currently installed 29,000 stations (equivalent to ~1.2 Lakh charging points). Under PM E-DRIVE, INR 2,000 Cr has been allocated for 72,000 charging stations (equivalent to ~2.5 Lakh charging points). Thus incremental 5 Lakh charging points are needed to meet the 2030 target (~2X the current subsidy coverage), necessitating ~ INR 4,000 Cr in extra investment.

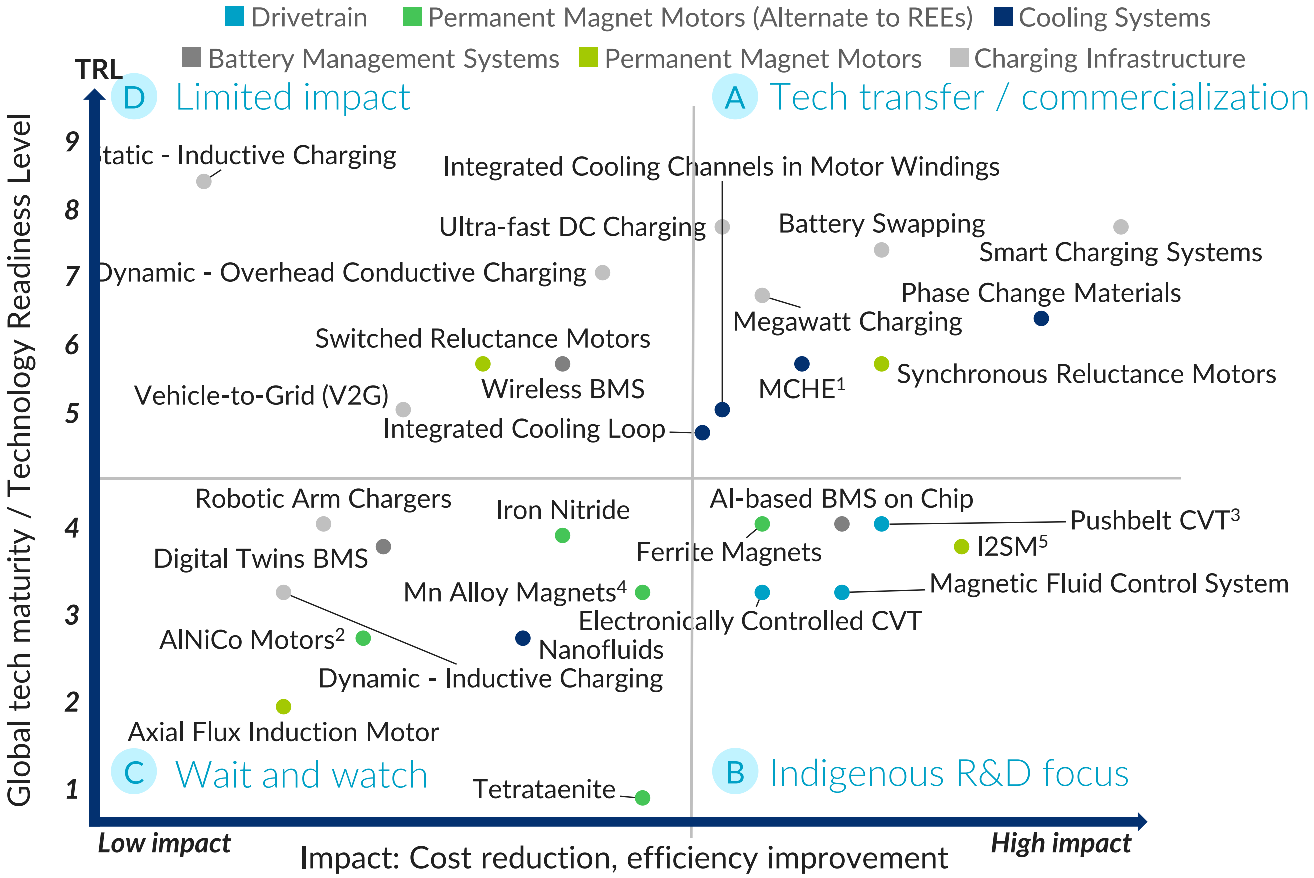
Detailed in Annex

2

R&D | Build a collaborative R&D ecosystem with industry-academia-government collaboration to support prototyping to commercialization for 10-20 indigenous innovations across the EV value chain

The R&D ecosystem would require industry and academia participation and shared investment of INR 4,500-6,900 Cr on infrastructure investment, grants and capital access to fuel indigenous R&D and innovation for prioritized EV technologies

Focus R&D and innovation technologies in E-mobility:



Key insights on R&D ecosystem development

- **MHI/MoP and ANRF could set up a Core Working Group** with industry-academia-government representation **to lead efforts on** infrastructure set up, grants, private participation[6]
- **Industry participation crucial** to identify the right priority 10-20 innovations where industry could support commercialisation
- **INR 5,000-7,700 Cr** total EV R&D investment required
  - **R&D infrastructure:** INR 2,800-5,000 Cr (EV tech development: INR 1,700-2,800 Cr; EV tech testing: INR 1,100-2,200 Cr)
  - **Project grants:** INR 2,200-2,700 Cr
  - **INR 2,250-3,450 Cr** government investment required
- **Distinct, open-access R&D labs to be set up under PPP structure** across public and private sector[7] focusing on **select, high-quality labs** maximising resource efficiency and public-private collaboration

Detailed in Annex: *Steps*; *Infrastructure*; *Funding*

(1) MCHE: Microchannel Heat Exchanger; (2) AlNiCo: Aluminium-Nickel-Cobalt; (3) CVT: Continuously Variable Transmission; (4) Mn: Manganese; (5) I2SM: In Rotor Inductively Excited Synchronous Motors; (6) For tech identification and funding; (7) Upgrading existing/ building new; Source: Academia and industry experts; US Small Business Administration, Annual Report, 2022

2

R&D | India could invest INR 2,800-5,000 Cr across 6-8 R&D labs to upgrade current E-mobility R&D labs, establish new facilities, and ensure needed human resource and efficient lab operations

	DEVELOPMENT LABS	TESTING LABS
Number of labs	**4-6 development labs** *3-4 COEs (motors, power electronics, systems integration and 1-2 innovation centers*	**2 new testing labs** *Upgrades to 1-2 current labs (e.g., ICAT labs to test innovation and compliance perspective); set up of 1-2 new labs for Pilot scale testing*
Cost of labs	**INR 1,700-2,800 Cr**	**INR 1,100-2,200 Cr** *Investment across innovation, compliance and pilot testing labs* *Prioritize investment for* ***innovation testing*** *labs to carry more technologies to pilot stages*
Prospective existing infrastructure for upgrade	**IIT Delhi:** Centre for Automotive Research and Tribology **IIT Madras:** Centre of Excellence in Advanced Automotive Research	**Central testing facility** **DHI CoE for E-mobility under Automotive Research Association of India** **ICAT:** Labs, testing facilities, etc.

Machinery needs

High precision equipment *suited for R&D which is* ***customizable and agnostic*** *across different EV and battery segments*

- Material R&D and chemical wet-lab equipment
- Rotor magnet insertion equipment, SMT[1] lines
- Battery cell simulators, current and voltage measuring tools

- Material testing equipment
- Efficacy testing machines (including lab, field, and commercial testing)

Manpower and support needs

- **Trained manpower** with ability to use advanced equipment (separate upskilling for current researchers)
- **Independent management team** reporting to own Board vs. public/ private sector researchers to ensure maximum utilization, efficient operations
- **Market needs assessment** of upcoming tech trends to inform relevant research

---

(1) Surface Mount Technology used to assemble Printed Circuit Boards used in Battery Management Systems and Power electronics

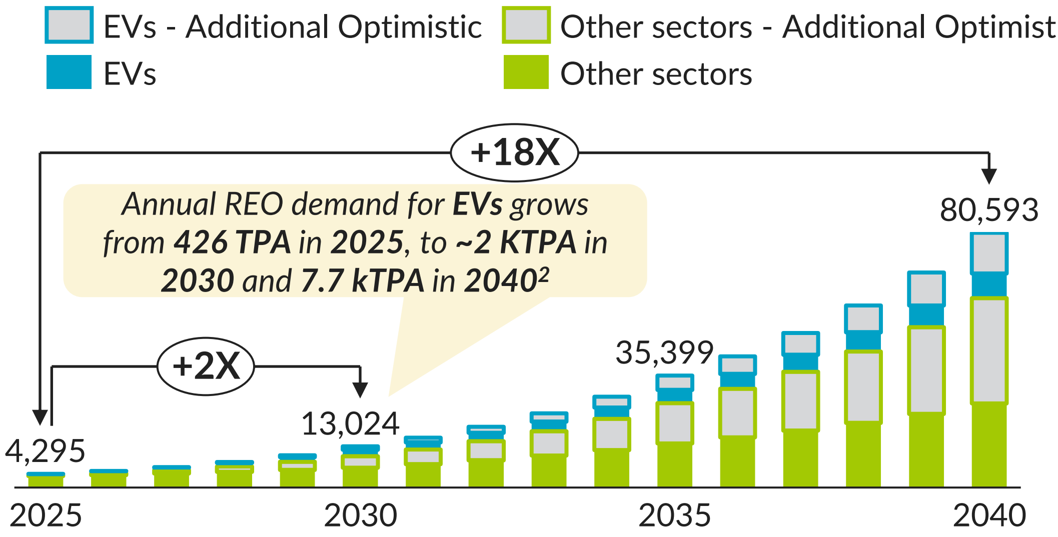
Source: Academia and industry experts

3 Upstream: Raw Materials | India could meet at least 50% rare earth oxide demand domestically by 2030 with INR 750-1,500 Cr cumulative investment in domestic refining, supported by investments in circularity and stockpiling

Rare Earth Oxides are critical minerals for various sectors of strategic importance, but are subject to heavy import reliance on China:

- Rare Earth Oxides (REO) are key **raw materials** across **EV motors**, **Wind Turbine generators** and **defense applications,** amongst others
- **Domestic demand** for REOs, for the **EV sector**, currently stands at **400-450 TPA**; this is expected to grow ~5X to **2-3 KTPA by 2030**
- China holds **~60-90% of global REO value chain**, while India faces **~90% import reliance** for the minerals (across domestic demand for standalone (REO) and finished good forms (magnets))
- While India has some domestic Oxide production capacity under IREL, **capacity expansion** is critical to meet expected **2X** growth in demand by 2030 and **18X** by 2040 (optimistic scenario)

India's annual Rare Earth Oxide demand, 2025-2040, TPA



*Annual REO demand for **EVs** grows from **426 TPA** in **2025**, to **~2 KTPA** in **2030** and **7.7 kTPA** in **2040**[2]*

Key pathways for increased self-reliance include stockpiling efforts and investments in domestic refining and circularity capacities:

	Ⓐ Domestic mineral refining	Ⓑ Scaling Circularity	Ⓒ Import diversification and stockpiling
Details	Global and domestic mineral extraction with domestic refining	Closed loop recycling for Rare Earth Oxide recovery from end-of-life magnets	Stockpiling up to 25% of annual demand for Rare Earth Oxides
Cumulative Investment by 2030	**INR 750-1,500 Cr** incremental capex for additional **3-5 kTPA** Rare Earth Oxide production capacity, **INR 120-260 Cr** government support	**INR 4,400-4,700 Cr** upfront capex for **6.5-7 kTPA magnet recycling** capacity and government support worth **INR 780-840 Cr**	**INR 5-10 Cr** upfront capex for developing rare earth storage facilities

Detailed ahead

Further detailed in Annex

(1) Includes cumulative electricity and upfront capex subsidy, interest subvention and impot duty waiver till 2030, only for 2040 Graphite refining capacity targets (detailed ahead);
(2) Refers to conservative scenario demand estimates; Sources: IEA, Global Critical Minerals Outlook, 2025; CFR, China in Africa: March 2025, 2025; USGS, Mineral Commodity Summaries, 2025; Dalberg Analysis

3A

Upstream - Domestic Refining | INR 120-260 Cr capex subsidies till 2030 could support development of incremental 2,000-4,250 TPA domestic capacity for Light and 470-700 TPA for Heavy Rare Earth Oxides

Existing and announced domestic REO production capacity is not cost competitive and not sufficient to meet 50% demand locally

- **Domestically produced Rare Earth Oxides** (if dependant entirely on imported feedstock – Rare Earth Concentrates) are up to **35% more costly** than **imported** Rare Earth Oxides (landed cost)
- Despite Oxide capacity announcements (by **IREL** and **GMDC**), India is slated to meet only **26-47%** of **annual Rare Earth Oxide demand**, domestically

Development of requisite incremental REO capacity is impeded by key challenges

- **Limited domestic Rare Earth exploration and extraction:** India has the 3rd largest stock of Rare Earth Reserves globally but needs substantial exploration efforts to develop active mines; domestic deposits limited to Light REOs
- **Regulatory challenges in gaining private sector support:** Existing regulatory hurdles and unattractive operational norms (e.g., revenue sharing), disincentivize private sector participation
- **Low downstream demand from magnet manufacturing:** Magnets are a critical downstream product for REOs, but domestic magnet manufacturing is at nascent stage

Interventions across mineral exploration and extraction, oxide production and downstream demand could help boost localised REO production

Expanding Exploration and Extraction

- **Expedite** exploration and composite license **auctions** for domestic **REE blocks**
- Secure access to **Heavy Rare Earth Ores** by exploring **G2G partnerships with Myanmar, Australia, etc.**

Scaling Mineral to Oxide Capacity

- Secure **low-cost Rare Earth Concentrate** and facilitate **tech transfer** to support **Heavy REO capacity** (Light REO: Australia, Brazil; Heavy REO: Australia, Myanmar)
- Support initial **capacity development** for **Heavy** and incremental **for Light REOs** through capex subsidies

Total Capex: INR 750-1500 Cr
Capex subsidies[1]: INR 120-260 Cr

Securing Downstream Demand

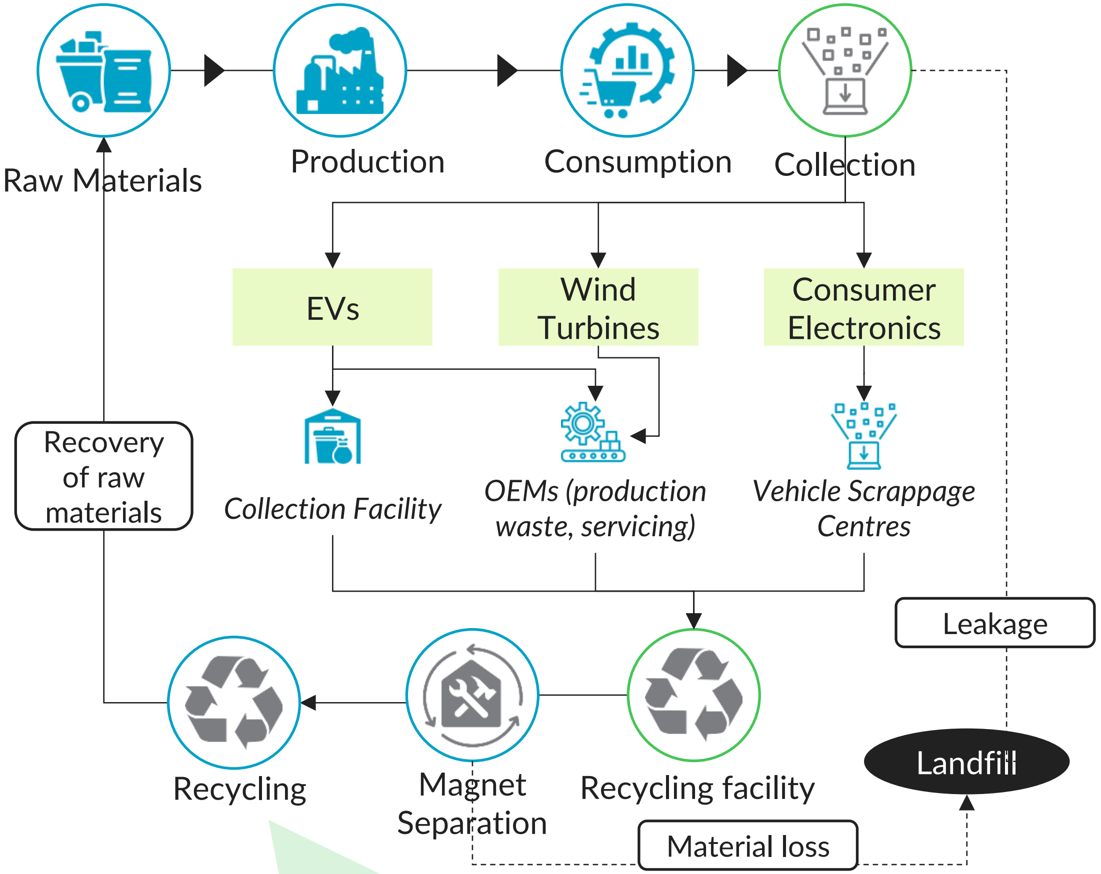
- Identify sources for **low-cost raw materials** to support **cost competitiveness** and promote offtake
- Offer idle PSU land sites to magnet manufacturers at subsidized rates

(1) Capex subsidies to be disbursed at 20% of capex investments;
Source: Dalberg analysis, expert consultations

3B

Upstream - Circularity | Capex investments in developing magnet recycling facilities could enable recovery of ~2 kTPA REOs from end of life permanent magnets used across EVs, Consumer Electronics and Wind turbines

Circularity for permanent magnets draws from 3 key sources of waste – EVs, Consumer Electronics and Wind Turbines



Raw Materials

Production

Consumption

Collection

EVs

Wind Turbines

Consumer Electronics

Collection Facility

OEMs (production waste, servicing)

Vehicle Scrappage Centres

Recovery of raw materials

Leakage

Recycling

Magnet Separation

Recycling facility

Landfill

Material loss

REO recovery potential by 2040:
~ 2,000 TPA

Key interventions and enablers across collection and recycling required by 2030 to enable REO recovery from used Magnets:

XX – Projected annual potential by 2040

Collection
7,384 TPA waste collected

- Cumulative **INR 14,200-16,500 Cr capex investment**[1] by 2030 to support development of **160-180 battery waste collection centers and additional ~350-600 Vehicle Scrappage Centers**, enabling high magnet waste collection rates from consumer electronics and EVs

Recycling
6,988 TPA waste recycled

- **Boost economic feasibility for recyclers:** Price guarantee measures, 2-year GST deferrals on feedstock, and access to imported magnet scrap from regions with higher EV scrap availability (EU/US)
- **Scale magnet recycling capacity:** Support **INR 3,900-4,200 Cr** investment in REO recovery capacity development via **INR 780-840 Cr capex subsidies**
- **Targeted policy support:** Exception approvals for recycling startups meeting threshold requirements, easing Red Category restrictions[2]

Total Capex: INR 4,400-4,700 Cr
Capex subsidies[3]: INR 780-840 Cr

(1) Covered in the investments proposed under the Battery Indigenisation Pathways; (2) As detailed in Battery Indigenisation Pathways; (3) Capex subsidies to be disbursed at 20% of capex investments; Source: Dalberg Analysis, expert consultations

Capital equipment & infrastructure | Power electronics, Motors, BMS and Batteries are key components to prioritize localisation efforts and achieve 50% DVA[1] but face significant import reliance for key capital equipment

COMPONENT	POTENTIAL SYNERGIES	KEY UNLOCK[7]
Power Electronics	***Sub component manufacturing and PCB Assembly*** • **Ongoing policy momentum** (*ECME[2]*) and, **synergies with other sectors** *(consumer and industrial electronics)*	*PCB Assembly*
Motors	***Stator and component manufacturing, motor assembly*** • Existing **non-permanent magnet, motor manufacturing capacities** for stator, rotor and *magnet housing*	*Motor Assembly, using specialized winding techniques (e.g., Hairpin Winding)*
Battery Management Systems (BMS)	***Software development and PCB Assembly*** • Existing **policy support on PCB assembly** and **domestic capacity for software development** – India formed **~20%** overall **APAC software market[3]** in 2024	*Software development and PCB Assembly*
	PARALLEL FOCUS	
Battery Pack	***Pack assembly, sub-component level manufacturing for insulation, casings, etc.*** • Ongoing policy efforts **running parallelly** – **ACC[4] PLI** and **PM e-Drive** schemes	*Electrode manufacturing, cell formation and assembly[5]*
Charging Infrastructure	***PCB Assembly for Electric Vehicle Supply Equipment (EVSEs)*** • Existing **policy focus** (**PMP[6]** for **PM e-Drive** and **FAME II** Schemes) driving 60-70% localisation in some cases • **PCB Assembly** aligns with other sectors and EV components	*PCB Assembly*

However, there's significant import reliance for capital equipment

~70-80%

import reliance for SMT[8] machines used in PCB Assembly

~60%

import reliance for Rotor Magnet Insertion and Balancing machines used in Motor Assembly

~70-80%

import reliance for machines used across Cell formation and assembly

---

(1) 50% DVA across the EV value chain; (2) Electronics Component Manufacturing Scheme; (3) APAC software market exclusive of Japan and China; (4) Advanced Chemistry Cell; (5) Detailed in the Battery Indigenisation Pathways; (6) Phased Manufacturing Programme; (7) Refer to slides in Annex for components de-prioritized in the short term; (8) Surface Mount Technology; Source: IDC, India Software Market to hit USD 18.4 Bn, 2025

4 **Capital equipment & infrastructure** | INR 9-16K Cr investment in building domestic capacity for key machines used across these components can reduce import reliance and support achieving 50% DVA across EV value chain

Pathways to source key capital machinery for domestic EV component and charging infrastructure production:

🟢 *High* 🟡 *Medium* 🔴 *Low*

Pathway criteria	**1** **Domestic manufacturing** for *select EV equipment with existing industry synergies*	**2** **Import** *highly specialized, advanced EV capital equipment with no industry synergy*
Synergies with other sectors	🟢 Equipment for sophisticated electronics, e.g., SMT[1] equipment for PCB[2] assembly used in BMS, Power electronics, EVSEs[3], consumer electronics, defence, etc.	🔴 No synergies in specialized EV-centric equipment, e.g., precision machining for thermal management systems
Tech expertise	🟡 Fewer improvements needed for existing technology, e.g., Rotor Magnet Insertion machines, currently used for magnet insertion into BLDC[4] motors	🔴 Emerging semiconductor fabrication (e.g., GaN[5] Semiconductors), coil winding tech (Hairpin winding) – led by Taiwan and South Korea, nascent in India
Pathway unlocks	Leverage synergies with other sectors: • SMT machines with Display-Module Assembly, incentivized under Scheme for Electronic Components Manufacturing • Rotor balancing machines with medical, aerospace, defence and electronics sectors (MRI machines, fans, transformers, etc.)	• Develop G2G partnerships to secure continued access to key machines (e.g., Germany, Taiwan, South Korea – have existing equipment manufacturing capacity) • Explore sourcing models such as equipment leasing systems and centrally operated pay-per-use facilities – reducing cost of and improving access to key machines
% Expected Capex contribution	• 45-50% Capex required across component manufacturing can be indigenised (across PCB and Motors assembly) • e.g., Rotor Magnet Insertion and SMT Solder Paste Printing Machines	• 50-55% Capex across Power electronics, BMS and Motors could remain import reliant • e.g., Coil Winding, SMT Pick and Place Machines, SMT, Automated Optical Inspection Machine

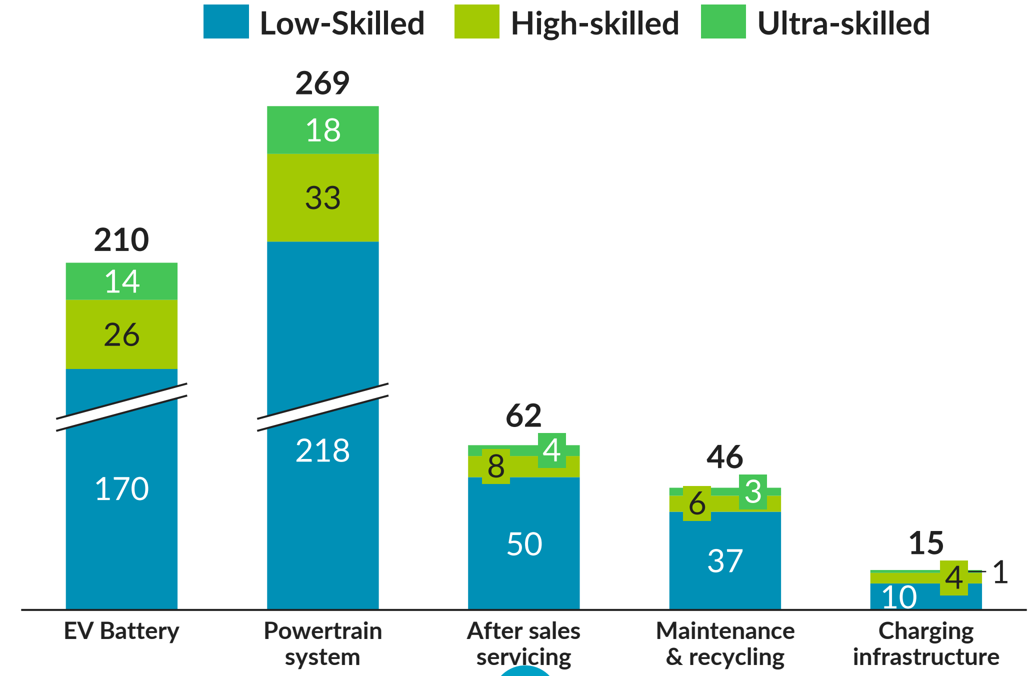
Development of these domestic manufacturing capacities would require cumulative ***INR 9,000-16,000 Cr investment till 2030****, supported by targeted subsidies (Refer to Financing Section for details)*

(1) Surface Mount Technology; (2) Printed Circuit Board; (3) Electric Vehicle Supply Equipment (4) Brush-less Dynamic Current Motors; (5) Gallium Nitride

5 **Workforce** | India would require ~6 lakh additional ultra, high, and low-skilled workers[1] across EV manufacturing value chain by 2030 with priority to train Ultra and High-Skilled workforce

To build a ready workforce, targeted interventions would be required across four critical levers including trainers, course design, employability, finance; with skilling efforts focusing on strengthening industry linkages and global partnerships

Projected (2030) additional workforce requirement for EV manufacturing value chain, in '000



Total budget[2]
INR 7,300-12,900 Cr

Total government share
INR 3,000-5,000 Cr

Levers: 🟢 Trainer 🟡 Course Design 🔵 Employability

Focus

Ultra Skilled

- 🟢 Develop "Train the Trainer" program for 200 – 300 trainers / academicians / professors from Top 100 engineering colleges[1]
- 🟢 Attract EV experts from Global OEMs (EU, South Korea, Japan China) to train faculty at Tier 1 engineering colleges (Top 20)
- 🟡 🔵 Launch master's programs in tier 1 colleges with demo and R&D labs, blending technical skills with policy and regulatory skilling
- 🔵 Develop industry-government funded on-the-job training initiatives with global exposure to retain R&D talent in India

High Skilled

- 🟡 🔵 Introduce EV component manufacturing certification and specialization courses in Top 100 engineering colleges with demo, R&D labs
- 🟡 🔵 Co-deliver cleantech manufacturing modules, and internships at manufacturing plants for engineering students

Low Skilled

- 🟡 Create standardized courses and qualification packs aligned with industry-defined competencies
- 🟡 Develop modules for retraining workers from adjacent industries like automobile mechanics (for EV Servicing and assembly) or electronics technicians (for Battery pack or BMS assembly)

Detailed in Annex

---

(1) Includes both direct and indirect workers; (2) The total budget covers training costs and demo and R&D facility investment, across skill levels

6

Financing | INR 228.6-302.6 K Cr would be required during 2025-30 to achieve 50% indigenisation across the EV value chain, build a cohesive R&D ecosystem and train the required workforce

Government funding of INR 71.4-75.4K Cr would be required across demand acceleration, R&D, workforce skilling and subsidies on electricity, capex and interest by 2030 to achieve these goals

Theme	Total Funding Required (INR Cr)	Government Funding Required (INR Cr)	Key Activities	Potential outcomes
Demand & Market Architecture[1]	45,500-46,200	40,600-41,200	Subsidies for E4Ws, E-buses and E-trucks segment to drive further adoption and improving the business case of charging stations for CPOs	Additional 5 Mn E4Ws, 65,000 E-buses, 27,000 E-trucks and 8.7 lakh charging points by 2030
R&D & Product Innovation	5,000-7,700	2,250-3,450	4-6 R&D development and 2 testing labs for EV Component level R&D; INR 1,000-1,200 funding for project grants	Indigenous development of EV Component technologies; accelerated adoption of early-stage innovative global technologies
Upstream Raw Materials & Critical Inputs	5,200-6,200	900-1,100	Input subsidies on capex for domestic Rare Earth Oxide production capacity; investment in magnet recycling facilities to support circularity	Reduce import dependency on refined Rare Earth Oxides; meet Oxide demand through recycled Permanent magnets
Capital Equipment & Infrastructure	165,600-230,000	~24,600	Ⓐ Indigenous production of up to 50% equipment for Power electronics, Motors, BMS and EVSEs[2];	Reduce import dependence for equipment where feasible; drive accelerated EV capacity expansion
			Ⓑ Capex & interest support across component & charger manufacturing, & vehicle assembly	Improved manufacturing capacity and efficiency, potentially leading to higher localisation for EVs
			Ⓒ Structural modifications to Auto PLI[3]	Enabling greater access to, and utilization of PLI
Talent & Workforce	7,300-12,900	3,000-5,000	Training additional 6 Lakh ultra, high, and low skilled workers across the EV value chain and setting up demo training and R&D facilities	Ensuring a stable supply of workers, reducing attrition and lowering training costs for manufacturers
TOTAL	228,600-302,600	71,400-75,400		

Ⓧ *Detailed ahead*

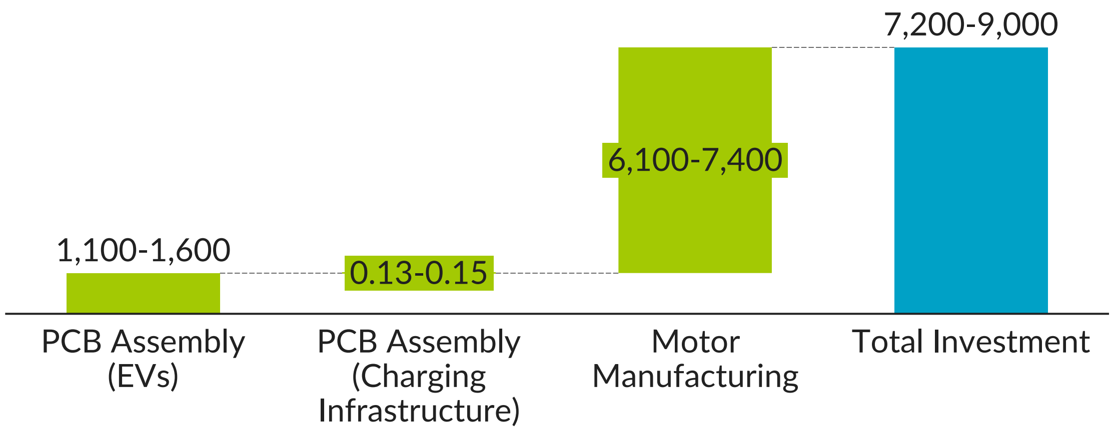
---

(1) Includes ~INR 31,700 Cr available undisbursed funds under PM E-DRIVE and PM E-bus Sewa to drive EV adoption across vehicle segments; (2) Investment estimations for this intervention have been covered in the Financing section; (3) Auto and Auto Components PLI

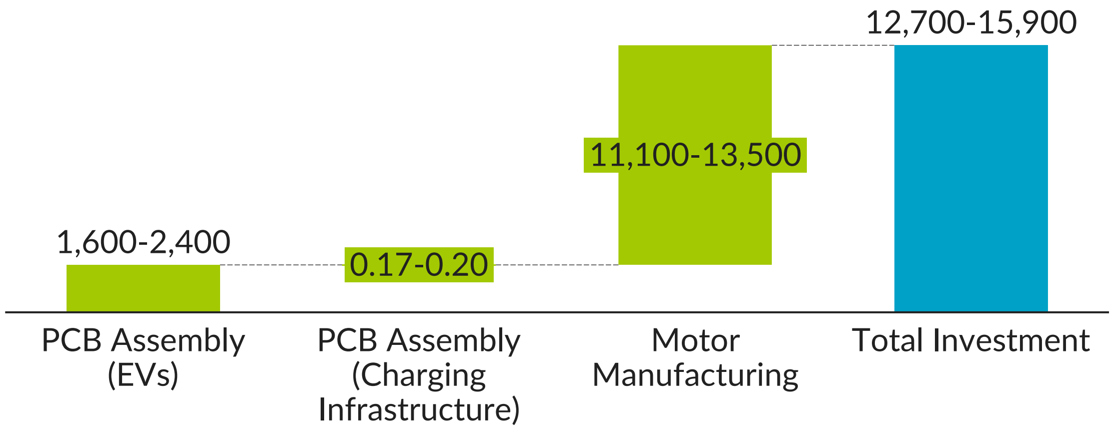
6A Capex and Infrastructure | Additional Capex subsidies of INR 1,800-2,250 Cr in Conservative and INR 3,175-3,975 Cr in Optimistic scenario can support development of local capital equipment manufacturing

Cumulative investment required to develop capital equipment capacity to support 50% localisation across EV ecosystem, INR Cr[1]

Conservative Scenario[2]



Optimistic Scenario[2]



Key Insights:

- Scaling capital equipment availability for PCB Assembly can unlock localisation across multiple sectors – building the foundation for backward integration into PCB manufacturing
- Some players already claim 60-70% localisation on charging infrastructure, and PCB Assembly for EVSE's could further improve localisation

Key machines to indigenise[3]:

- **PCB Assembly:** Reflow Oven, Loading and Unloading, Solder Paste Printing and Wave Soldering Machines
- **Motor Manufacturing:** Rotor Magnet Insertion and Rotor Balancing Machines

Total investment required:

Conservative Scenario:
INR 8,100-10,100 Cr

Optimistic Scenario:
INR 14,200-17,800 Cr

Subsidy required @ 25%[4]:

Conservative Scenario:
INR 1,800-2,250 Cr

Optimistic Scenario:
INR 3,175-3,975 Cr

(1) Investment limited to capital equipment for EV sector; (2) Scenarios in line with the scenarios used to forecast annual EV registrations – detailed in Demand Acceleration section; (3) Machines with synergies with other industries are considered. Investment for PCB Assembly excludes Pick and Place, and Automated Optical Inspection machines, and Investment for Motor Manufacturing excludes CNC Machines and Coil Winding Machines; (4) Similar subsidies of 25% exist under Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS) for power electronics and PCBs. This recommendation aims to ensure these benefits cascade to the EV sector.

6B

Capex and Infrastructure | Financing EV manufacturing ecosystem is expected to require ~INR 156.7-213.8K crore till 2030 across OEMs and auto component manufacturers, partially covering interest costs

INR 124-164K Cr capex investment and INR 12-18K Cr government support required for EV ecosystem by 2030

	Investment required *(INR crore)*	Subsidy Support[1] *(INR crore)*
Component manufacturing		
BMS & other systems	~5.6K	~0.5K
Motors	~9K	~0.8K
Power electronics	~11.2K	~1K
Working capital needs	~18K	-
OEM–led Vehicle assembly	26-63.7K	2.3-5.7K
Charging infrastructure manufacturing[2]	40.6-52.2K	0.7K
Other ecosystem investments[3]	3.7-13.6	
TOTAL	124-163.5K	~12.4-18.2K

The expected component manufacturing capex investment is expected to increase to INR 55K crores by 2035, of which INR 14K crores will be needed for the MSME segment

Additionally, government led concessional finance of INR 5.8-9 K Cr can be provided to support EV ecosystem manufacturers cover interest costs of INR 32.7-50.3K Cr[4]

MSMEs disproportionately affected by financing challenges and require targeted interventions to meet 50% localisation targets, and maintain their current 25% share in industry's turnover

TRL Band	Recommended instruments & interventions
TRL 1–3 Idea to lab proof	• **Dedicated innovation fund:** A pooled pre-seed EV innovation fund blending public R&D grants with private catalytic capital • **Challenge-based innovation prizes:** Prize-based competitions for EV MSME innovations in motor design, battery packaging, and electronics
TRL 4–6 Prototype to pilot in a relevant environment	• **Blended-finance bridge funds:** Structures that pair concessional debt or first-loss guarantees with private VC. • **Extended EvolutionS-type programs:** Larger ticket sizes (INR 2–5 Cr vs. INR 50 lakh) through state incubators, tied to performance milestones • **OEM-backed pilot funds:** Co-financing pools where OEMs and Tier-1s share pilot risk with MSMEs • **Enhance utilization of equity fund from SIDBI:** Simplify access and broaden eligibility for MSMEs while building readiness programs for equity investments
TRL 7–9 Pilot plant to commercial scale	• **MSME-tier PLI:** Lower eligibility thresholds and milestone-based disbursal • **Interest subvention funds:** Dedicated concessional loan window reducing MSME borrowing costs from ~12–14% down to 7–8% • **Transition funds with co-investment:** Government-backed cornerstone investors catalyzing family offices/DFIs into MSME tech-upgrade funds

---

(1) Capex subsidies calculated at a 10% rate; (2) Subsidy support for charging infrastructure estimated is above and beyond INR 4,000 Cr specified as a demand intervention, and is required only in optimistic scenario; (3) Available budget under the Auto and Auto Component PLI that is expected to be required in the ecosystem; (4) Interest costs assume 11% interest rate, 70% Debt component and a 7 year loan tenure for capex financing. 20% of these costs are expected to be met via the government led concessional debt

6C **Capex and Infrastructure |** Expanding PLI scope and boosting inclusivity are key measures to improve effectiveness of PLI funds in driving ecosystem level development for domestic EV manufacturing

While the Auto PLI[1] scheme has witnessed some success, EV ecosystem faces some challenges in effective fund disbursal

PLI list currently anchored towards legacy players:

- High threshold requirements (INR 10K Cr annual revenue for OEMs and INR 500 Cr for s) limit startup and MSME participation
- Non-PLI status for such players results in challenges in accessing finance and investments – stifling innovation and limiting risk appetite amidst startups, limiting innovation in the EV sector

Current PLI structure is narrow in its focus on outcomes:

- Current structure of the scheme doesn't incentivize ecosystem level development, due to narrow focus limited to DVA in manufactured goods
- However, there are other, equivalently critical outcomes that can be tied to the PLIs – for e.g. R&D, Workforce, Exports)

Overcoming these challenges and improving the effectiveness of funds allocated under PLIs requires structural amendments

Separate set of threshold limits for small-scale actors:

- Re-evaluate PLI process and eligibility criteria to make them friendly to startups and MSMEs
- PLI status could enable access to finance and investment for non-legacy actors, facilitating innovation in the sector

Tie PLI requirements to other critical sector outcomes:

- Expand fund disbursement metrics to track broader ecosystem outcomes (e.g., number of patents filed, job creation, export volume)
- Widening PLI focus could result in innovation and scale-up across upstream (REOs, Rare Earth Magnets) and downstream segments (new-tech based components)

---

(1) Automobile and Auto-Component Industry PLI

ANNEX

SUB-SECTION ONE

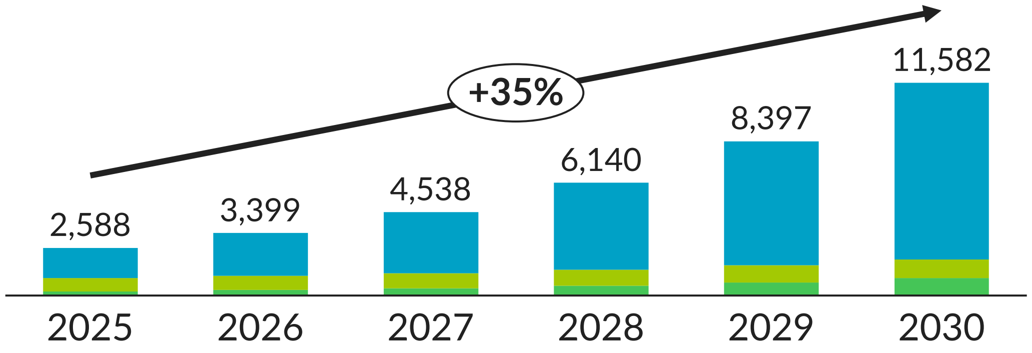
DEMAND & MARKET ARCHITECTURE

India's annual EV registrations are expected grow to 4X by 2030, with the potential for ~6X growth by 2030, driven by recent policy support measures and active market innovation

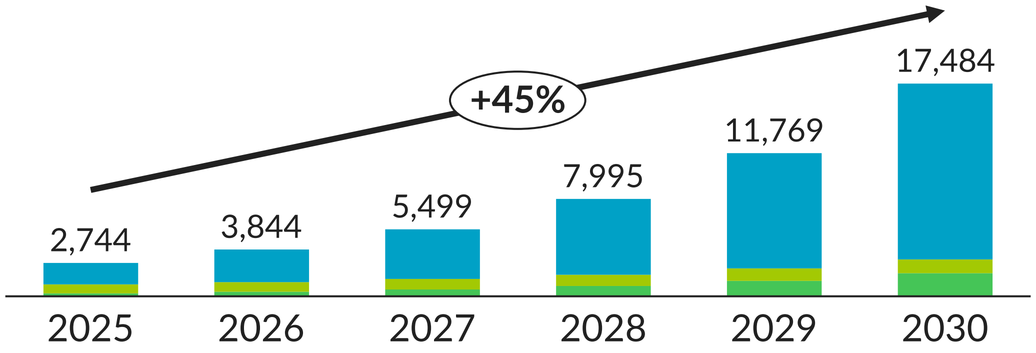
Projected annual EV registrations, '000 vehicles, 2025 – 2030

🟦 EV - 2W 🟩 EV - 3W 🟩 EV - 4W 🟩 E-Bus 🟦 E-Trucks

Conservative Scenario



Optimistic Scenario



Scenario Descriptions

Conservative scenario assumes:

- **No additional subsidies** announced beyond PM E-DRIVE, and the existing schemes are just extended
- **Limited advancement in Total Cost of Ownership** across vehicle segments
- **Limited product innovation** and therefore limited model availability across all EV segments and limitations on range of EVs (particularly in E4Ws, E-Buses & E-Trucks)

Optimistic scenario assumes:

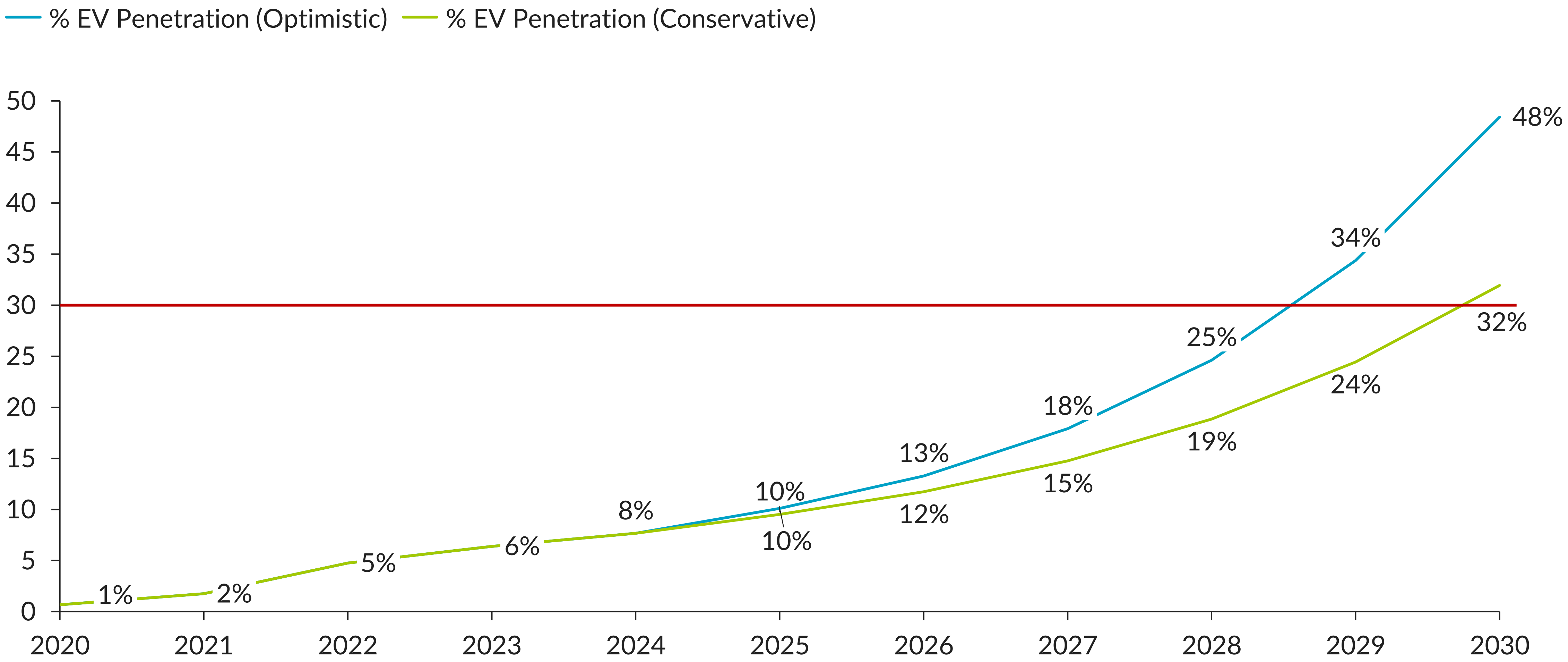
- **E2Ws & E3Ws**: **Electrification** of **high speed 2Ws** & continued subsidies beyond 2026
- **E4Ws**: ACC PLI helps boosting **R&D** in batteries **bringing down the battery costs** and more models in the entry level segment for 4Ws
- **E-buses**: Gross Cost Contract **(GCC) Models** and other alternative financing solutions driving up the penetration in **private bus market** & **SRTUs**
- **E-trucks: Product innovation** enables the **right price point** for operators to transition, and additional subsidies announced on top of the existing subsidies under PM E-DRIVE scheme
- **Charging Infrastructure:** Adequate **fast and ultra-fast** charging infrastructure is built in **top 5 Metros** by EV adoption and **top 20** high volume **freight corridors**

Source: Dalberg Analysis, Industry Reports, VAHAN Dashboard

India is expected to reach 32-48% EV penetration in EV sales, exceeding its target of 30% penetration by 2030

From an overall EV sales view across vehicle segments, India is well placed to meet its EV 30@30 target

Annual sales penetration of EV, %, 2020 – 2030

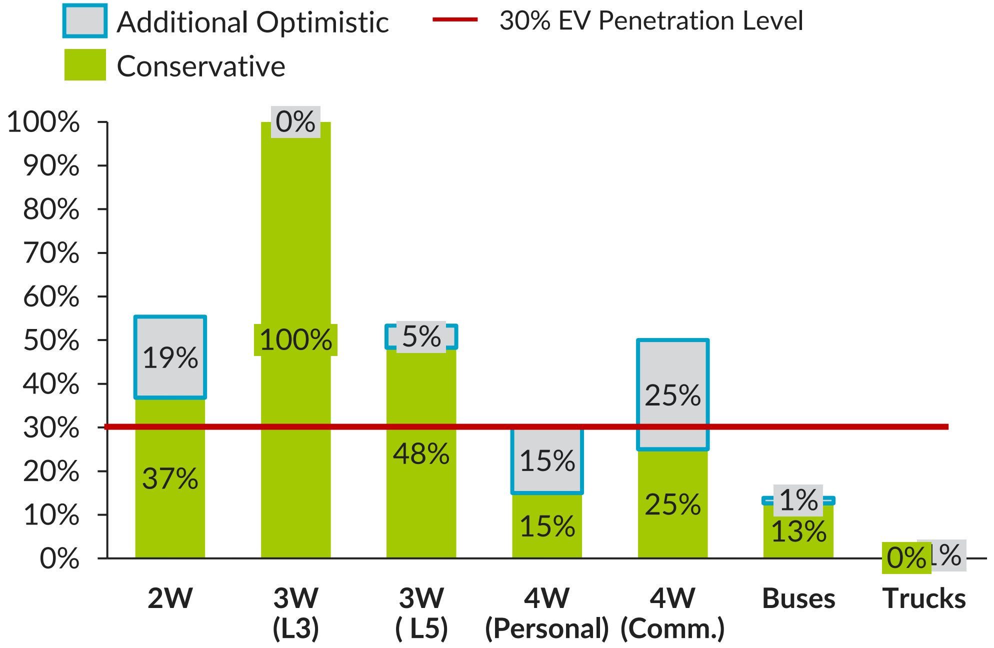


Source: Dalberg Analysis, Industry Reports, [VAHAN Dashboard]

While adoption momentum in 2W and 3W segments will drive progress in the 4W segment, penetration in buses and trucks segment is expected to remain limited

4Ws, E-Buses & E-Trucks to see slowest adoption and therefore lower penetration

Segment wise EV Penetration by 2030, %



Total Cost of Ownership by Segment, INR/km

▢ Segment with TCO for EV > ICE

EV	0.7-2	2.94	1.87	19	4.5	33	9-73
Non-EV	2.5-3.3	4.25	3.6-4.5	12-15	6.3-7.2	40	7-48

Driving adoption beyond conservative scenario needs focus on segment specific challenges (e.g., cost of ownership, financing etc.)

E2Ws

- Electrification is mostly limited to mopeds and low-speed E-2Ws, not high-speed bikes
- Rider safety concerns in low-speed E-2Ws category for last mile delivery solutions and Q-Commerce Industry
- Uncertainty in resale value leading to higher loan premiums and interest rates for E-2Ws

E3Ws

- Fragmented market compared to highly concentrated ICE market making it highly competitive
- Nascent battery-swapping infrastructure, critical to reducing charging time in commercial uses

E4Ws

- Higher Total Cost of Ownership for personal use case compared to CNG/ICE models due to lesser utilization
- Exclusion of private use case E-4Ws in key schemes (FAME II scheme, PM E-DRIVE scheme)
- Competition from SHEVs[1] and HEVs[2] given their higher efficiency

E-Buses

- Significantly higher upfront cost (1.3~2.5x of ICE equivalent models)
- Limited number of intercity bus models meeting required benchmarks for daily operations
- Financing risks and high bank guarantees required for Gross Cost Contract models
- Reluctance in private bus market for lack of assured revenues and adoption roadmap

E-Trucks

- Significantly higher upfront cost (2~3x of ICE equivalent models)
- Battery weight reduces range-per-charge creating a payload penalty

(1) Self-Charging Hybrid Electric Vehicle; (2) Hybrid Electric Vehicle;
Source: Dalberg Analysis, Industry Reports, VAHAN Dashboard

Boosting EV adoption would require addressing existing demand blockers such as gaps in product offerings and expectations, lack of charging infrastructure but also mitigating the impact of higher DVA on EV prices

Existing demand blockers

Persistent challenges including inadequate **charging infrastructure** (~ **100K deficit** of charging points as of Aug 2025) limited availability of **finance** for commercial segments (up to **7%[1] higher interest rates** as compared to equivalent ICE Buses and Trucks)

Increasing localisation will raise EV prices and dampen demand

At 50% localisation, domestic manufacturing of batteries, motors, and electronics could raise EV prices by **15–25%** despite current subsidies and PLI Schemes

Landed cost of **Batteries** will **primarily drive this increase** in EV prices – *Domestically produced Batteries could be **40% costlier** than imported batteries.*

This could result in a need for **Viability Gap Funding** worth **INR 4,500 - 6,500 Cr**, particularly for **E-4Ws**, as proposed in the Battery Indigenisation Pathways – not covered in this document to avoid duplication.

---

(1) 7% higher interest rates on a percentage points basis. For e.g., Interest rates on Diesel trucks are around 10%, whereas on E-Trucks are 17%

Source: Dalberg Analysis, RMI and CoEZET, Comprehensive Guide to Financing the ZET Transition in India, 2024

To promote further EV adoption, the next push has to come from building adequate charging infrastructure, enabling product innovation & financing to reduce the upfront costs and adoption incentives

	Pathway	Investment Required	Target outcomes	KEY ENABLERS
A	**Supporting product innovation in E-trucks & financing interventions in E-buses**	**INR 4,900-5,500 Cr[2]**	• ~65,000 E-Buses & ~27,000 E-Trucks to be added by 2030	• Enabling tech transfer in MHDT[6] segment and launching innovation challenges for OEMs for new products • Outlining an additional ~INR 3,000 Cr as guarantee pool fund under the existing PM E-Bus Sewa PSM Scheme to support adding ~32k more buses
B	**Offering Viability Gap Funding to offset price increase in E4Ws due to improved localisation**	**INR 4,500-6,500 Cr** *Capped at 4W OEMs; already included in Battery Indigenisation Pathways, not proposed as additional investment within this document*	• Potential to add ~5.1 Mn E4Ws till 2030	• Extending existing subsidies (e.g., FAME II), spread over the next 4 years and linked at various stages of the EV production to offset the 15-25% price increase in E4W segment • Addressing the key challenges with the design and execution of subsidy disbursement to improve the effectiveness of policy
C	**Enabling CPOs[1] to expand charging infrastructure by improving business viability of setting up and operating charging stations**	**INR 4,000 Cr[3]**	• Supporting establishment of ~7.5 Lakh additional charging points by 2030, with focus on top 5 Metro cities[4] (by EV adoption) in India, and top 20[5] high volume freight corridors	• Subsidizing EVSEs and upstream charging infrastructure for depot CPOs • Building a one window system for CPOs for the entire end-to-end process of setting up a charging station • A centralized end-consumer app built on the existing capabilities of BEE and e-AMRIT with features such as locations of charging stations, waiting time, etc.

*Additionally, **~INR 31,700 Cr** available undisbursed funds under **PM E-DRIVE** and **PM E-bus Sewa** and **INR 4,800-5000 Cr private sector investment** will be required to support higher adoption of E-trucks and E-buses, and accelerate charging infrastructure development*

(1) Charging Point Operator; (2) Detailed ahead; (3) Refers to incremental investment required for scaling charging infrastructure. Detailed ahead, (4) Delhi, Bangalore, Mumbai, Hyderabad, Pune, (5) MHI, PM E-DRIVE: Draft guidelines on EV PCS, 2024; (6) Medium and Heavy-Duty Trucks

A Despite strong policy momentum, the growth of commercial segments such as E-trucks and E-bus segments lags critically behind E2Ws and E3Ws in terms of penetration

Multiple policies, subsidies and initiatives have been launched to expedite the E-bus and E-truck adoption

E-Buses

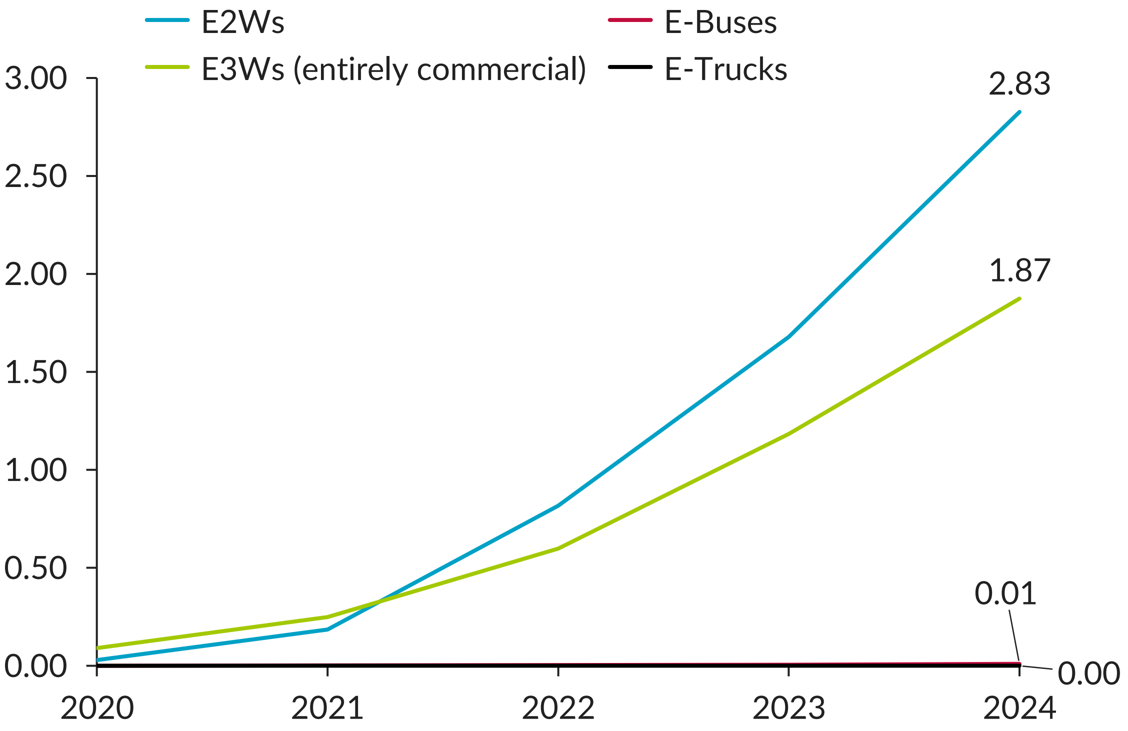
- Under **FAME II** (2019-24), **6,862 E-buses** were sanctioned for intra-city public transport
- In the subsequent **PM E-DRIVE** scheme an additional outlay of **INR 4,391 Cr** was dedicated for E-buses
- Parallelly, a dedicated **PM E-Bus Sewa** scheme was launched to enable deployment of **38,000 E-buses** with a **INR 3,435 Cr** between FY 2024-25 & 2028-29

E-Trucks

- First policy support came in July 2025 under the PM E-DRIVE scheme with incentives ranging from **INR 2.7 - INR 9.6 lakh based** on the Gross Vehicle Weight (GVW) for scrapping an old diesel truck and buying an E-truck
- An estimated **5,643 E-Trucks** across the **N2 & N3 categories** to be supported with a focus on **1,100 E-trucks in Delhi** considering the urgent need to improve air quality in the city

However, the segment wise stock penetration for E-buses & E-trucks stands at a nominal 3.12% & 0.01% respectively

Total EV stock for E2Ws, E3Ws, E-buses & E-trucks (2020-2024), Mn units



Source: Dalberg Analysis, PIB MHI, Current status of FAME-II scheme, 2025, MHI, Operational Guideleines for PM E-DRIVE, 2024, PIB MHI, Implementation of E-buses Scheme, 2024, MOHUA, PM E-Bus Sewa Scheme Guidelines, 2023, MHI, PM E-DRIVE: Amendment in Innovative Vehicle Enhancement, 2024

A While several challenges hinder adoption across these segments, financing remains the key barrier for E-buses, whereas product readiness poses the main challenge for E-trucks

LEVERS	E-BUSES	E-TRUCKS
Product	• **Heavy battery** packs reduce cabin and luggage space, lowering **passenger capacity**, **range** and ground **clearance** • **Limited model diversity** (9–12 m standard buses dominate; smaller feeder / **mini-bus variants scarce**) • **Issues** with **battery management system** software and batteries in extreme operating conditions	• **Few models** exist in **heavy-duty long-haul trucking**, which is currently responsible for **49%** of transport sector emissions • **Increased weight** from batteries can **reduce the payload capacity** by **15-20%** thus lowering potential revenue • Existing battery capacity and degradation over time further reduces range limiting route options
Financing	• **1.3 – 2.5X** more **expensive** than diesel buses • **Delayed** or **irregular payments** from STUs / PTAs under Gross Cost Contracts (GCC) • **Concession tenure** (10–12 years) often **mismatched** with **loan tenure** (6–7 years), creating negative cash flows • **Limited participation** from **private financiers** and NBFCs; dependence on sovereign or blended finance	• **2–3X** more **expensive** than diesel trucks • Financiers hesitant due to **lack of proven business models** Lenders charge higher premiums and **interests** up to **7 percentage points higher** than ICE variants • Covered by few insurers due to limited operational data and uncertainty about repair/replacement costs, and residual value • Lag in **subsidy announcement** and **disbursal** render public efforts disadvantageous – cause **misguided price expectations**
Charging – infrastructure related	• **Slow charging and poor depot infrastructure** cause more downtime therefore ~**1.2 E-buses needed to replace 1 diesel bus** • Depot electrification is **expensive** and grid dependent with High Tension (HT) lines costing **~ INR 10 Cr**	• **Limited access to charging stations** along highways; existing ones can prioritize cars, **lack fast** and **ultra-fast charging points** • Limited charging infrastructure **prevents economic feasibility** for Heavy-duty long-haul trucking – typically requires a **single charge cycle** to last **almost an entire day** for feasibility • **High charging costs** – rates of **INR 18–23/kWh** increase operational expenses
Operations	• Route scheduling due to range and charging downtime affect reliability • Low charger-to-bus ratio and **limited driver/technician training**	• **Charging adds downtime** thereby increasing the overall operational costs as trip time increases • Limited driver/technician skills and fragmented logistics ecosystem

Source: Expert Interviews, ITDP India, Status of Electric Buses in India, 2022; CEEW, Road ahead for Private E-buses in India, 2024; WRI India, Real world electric bus operation: Trend in technology performance, degradation, and lifespan of batteries, 2024; ICCT, Charging infrastructure needed to support India's full transition to battery electric trucks by 2050, 2025; CEED India, Decarbonizing India's trucking sector: Potential for Zero-emission trucks, 2025; CPI, Just transition to Zero-emission Trucking in India, 2024; Office of PSA, ZET Adoption in India and its Impact on Emission and Energy Report, 2025;

A Action is needed across multiple fronts to expedite adoption of e-buses and e-trucks with spends totalling INR 4,900-5,500 Cr

LEVERS	E-BUSES	E-TRUCKS
Product	• Fund **OEM–tier-1 partnerships** and pilot grants **to bring missing variants** (mini/midi, hill-city configs, high-heat battery–thermal packages)	• Create a **Heavy-Duty E-truck technology access window** to boost **tech transfer** between global E-truck innovators and Indian OEMs for licensing/CKD kits, validation for Indian duty cycles (heat, grades, axle loads) • Launch an innovation challenge for OEMs to engineer e-trucks tailored to Indian conditions
Financing	• Allocate an additional **INR 2,900–3,000 Cr** as a guarantee / **risk-pool fund** to back PPP / GCC contracts to support **32K more buses** under PM E-Bus SEWA PSM scheme • Classify **E-buses** under **priority sector lending** and associated **charging** and upstream infrastructure under **infrastructure financing**[1]	• Set up a national performance-registry / **guarantee fund** with capital of **INR 2,000-2,500 Cr** to support underwriting and risk sharing for NBFCs / insurers underwriting e-truck fleets • **Extend** and **increase** the **subsidy** cap under PM E-DRIVE for the **first 10,000 E-trucks**
Charging – infrastructure related	• Plan depots to a **1:3 charger-to-bus benchmark** and budget HT grid works upfront • Piloting **charging pads embedded at bus stops** to enable wireless charging for buses during the stoppage time	• Target **~2 GW** truck charging by 2030 in **5 key states** (>70% charging demand), clustering **≥350 kW** chargers with rest/parking at toll-proximate sites; align roadmaps with site-level grid agreements and anchor **rollout along Ministry of Power's 12 E-highway corridors** • Develop a clear framework to **standardize battery packs for E-trucks** to enable battery swapping infrastructure
Operations	• **Mandate telematics, predictive maintenance, and charger-queue management in GCC KPIs**, with standardized state-level driver and technician training to optimize schedules and charging	• Require shipper-fleet-CPO tripartite MOUs for guaranteed volumes and SLAs, plus **algorithmic route** and **charge scheduling** to **maximize payload-time economics**

Critical Solution

---

(1) Infrastructure financing: Refers to the multifaceted process of securing capital for the development, construction, maintenance, and upgrading of large-scale public and private infrastructure projects; Source: Dalberg Analysis, Expert Interviews, MHI, SOP for PM E-Bus Sewa Payment Security Mechanism Scheme, 2025, SmartcitiesDive, Wireless charging for electric transit buses, 2024, MoP, Annexure on EV Charging Infra guidelines, 2022; Office of PSA, ZET Adoption in India and its Impact on Emission and Energy Report, 2025

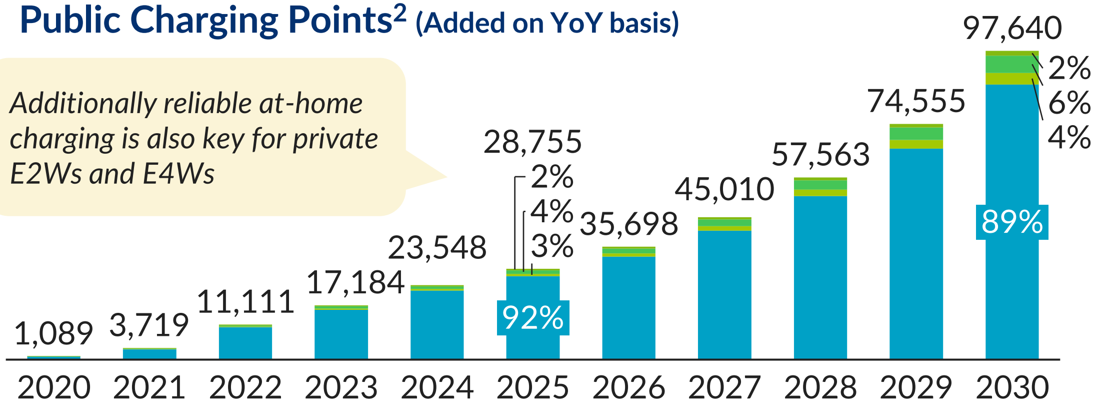
C

Building more than 8.5 lakh charging points (public & depot) in India is necessary for meeting energy needs of growing EV stock and drive further adoption by boosting consumer confidence

India will need to have 3.95 lakh public charging points & 4.75 lakh depot charging points in an optimistic scenario[1]

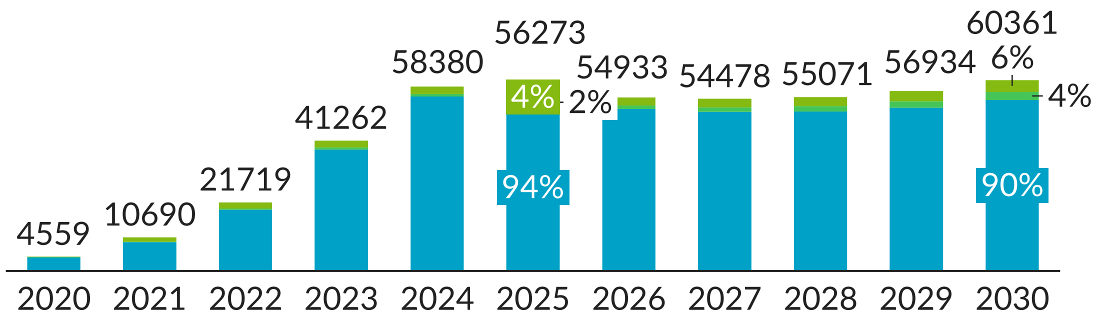
🟩 CCS II (120 kW)
🟩 Type II AC (22 kW)
🟩 CCS II (60 kW)
🟦 Type II AC (7.4 kW)

Public Charging Points[2] (Added on YoY basis)



Additionally reliable at-home charging is also key for private E2Ws and E4Ws

Depot Charging Points (Added on YoY basis)



Investment in charging infrastructure is an urgent priority since it is a critical enabler for demand acceleration

Industry reports indicate positive correlation between uptake in demand and charging infrastructure

- **29%** prospective EV buyers need **gas station-equivalent coverage** of charging stations and **24%** want **higher charging speeds** as their **tipping point** to buy an EV
- **24%** of hybrid EV buyers cite **charging station availability** as a barrier in buying an EV

Building charging infrastructure has further driven the EV adoption

- A US study shows that on **adding one charging station** per 1k people, there will be a **2% increase** in **EV adoption**
- Building residential charging infrastructure has led to a **15% increase in EV ownership** among residents within the first year

---

(1) PHEVs have been excluded from the analysis on charging infrastructure requirements, due to minimal charging requirements and preference of at-home/office charging; (2) Charging Station: A site with one or more charging points which can provide charging to more than one vehicle at a time; Source: Dalberg analysis; McKinsey and Company, New twists in the electric-vehicle transition: A consumer perspective, 2025; Oliver Wyman Forum, Why electric vehicles are here to stay, 2025; Iowa State University, Effects of Charging Infrastructure on EV Adoption: US Study, 2024, AMPPAL, Percentage of increase in EV sales when charging station installed at apartment building, 2025

C

However, meeting 2030 charging infrastructure targets will require overcoming key challenges such as poor CPO business models, complex approvals, and grid load management

1 Poor business proposition for CPOs due to under utilization

- **Under utilization:** Public charging infrastructure globally remains severely underutilized making the time for **cost recovery** for CPOs in some cases as long as **48 months**
- **High Upfront Cost**: The equipment cost of setting up a charging station (2 fast charger and 2 slow charger) is around **INR 30 lakh.** Additionally, setting up large scale public and depot charging stations in metro cities is a problem due to lack of plot area and higher leasing costs
- **Electricity Tariffs**: Electricity tariffs in high load areas are high for CPOs despite the subsidized tariffs. Ex: High tariffs in port areas

2 Complex regulatory approvals for setting up Charging Stations

- **Complex Regulatory Landscape:** CPOs find it difficult to coordinate with multiple different stakeholders (Land Dept., Finance Dept., DISCOMs) at the same time and meet their requirements in tandem
- **Asynchronous Policies:** Persistent misalignment between state and central fire safety guidelines means resident societies often deny NOCs for EV charging installation, citing unresolved fire safety concerns
- **Longer Subsidy Disbursement Timelines:** CPOs have reported delays in tendering, implementation and post implementation phase with the disbursement of subsidy on charging equipment and upstream infrastructure taking place in tranches and spread over a timeline of 52 weeks

3 Grid load due to congested energy demand

- **Increase Grid Load At Peak Charging Times:** During peak charging times (night-time in residential areas and day-time at industrial areas) there is significant load on the installed grid load capacity leading to higher tariffs
- **Limited Informational Awareness:** Limited information about the real-time availability of charging guns and expected wait times at stations often causes EV users to crowd popular locations, increasing overall wait times and inefficiency

Source: Expert Interviews, Cyril Amarchand Mangaldas, State v/s Residential Societies on fire NoCs, 2025; MHI, Operational Guidelines for EV Public Charging Stations, 2025; ICCT, Barriers and policy opportunities for public charging infrastructure in Haryana, 2024; Cars24, EV Charging Station Cost in India, 2025; Energy Strategy Reviews, Financial Feasibility of EV charging stations in Thailand, 2025; EV Blogs, EV Charger manufacturing process in India explained, 2025

C

Although, the Government has already taken steps in the right direction with several initiatives, following interventions with incremental ~INR 4,000 Cr of investment in charging infrastructure can help address gaps

	Support Business Economics for CPOs	*Improve Ease of Doing Business for CPOs*	*Managing Grid Load*
Current initiatives	• Govt. agencies encouraged to lease sites at concessional rates via a standard 10-year model agreement with minimum revenue-share of INR 1/kWh • EV charging tariffs capped at DISCOM's Average Cost of Supply (ACoS): 0.7× ACoS during solar hours and 1.3× ACoS otherwise • GST on EV chargers/stations reduced to 5% from 18%	• No electricity trading license required to set up & operate a charging station • DISCOMs must provide new connections to CPOs within a specified number of days depending on the charging station's location • Customer friendly and an online single-window system for application and granting electricity connection to CPOs • Standardized safety and inspection norms for EVSEs	• 2024 EV Charging Guidelines incentivize charging during "solar hours", smart charging, V2G technology integration for CPOs • Bureau of Energy Efficiency, e-AMRIT portal and several other CPOs have individual end-consumer apps for charging infrastructure
Proposed future interventions	• Subsidizing EVSEs and upstream charging infrastructure for depot CPOs • Standardizing the subsidized rates for land as a percentage of the property value • GST on charging services to be reduced from 18% to a lower tax slab (preferably 5% or a tax exemption) • Facilitating/Building a CPO focused portal/app to help them track the utilization rates and other key business metrics	• Building onto the existing one window system by several state DISCOMs for electricity connection, a portal for the entire end-to-end process for CPOs (including application for land-lease, procurement of EVSEs, DISCOM connection, green meter conversion, etc.)	• A consumer centric app built on the existing capabilities of BEE and e-AMRIT with features such as locations of charging stations, waiting times at a particular station, estimated cost of charging, route planning, etc. • Special power lines for public and depot charging stations to have uncongested demand with concessional tariffs
Investment Required	• Government already allocated INR 2,000 Cr in subsidies, additional subsidies worth INR 4,000 Cr needed to reach 8.7 Lakh Charging points		

Prioritized Solution

Source: Expert Interviews, MHI, Operational Guidelines for EV Public Charging Stations, 2025 ; Cars24, EV Charging Station Cost in India, 2025, Energy Strategy Reviews, Financial Feasibility of EV charging stations in Thailand, 2025, CEEW, What is the cost of charging EVs?, Energy Reports, Empowering E-mobility: Day ahead dynamic time of use tariff for EV charging, 2024 , MoHUA, Amendments in Model Building Bye-laws for Charging Infra, 2019, PIB MoF, GST rate on EVs reduced from 12% to 5%, 2019, PIB MHI, India accelerates National EV Charging Grid under PM E-drive, 2025

SUB-SECTION TWO

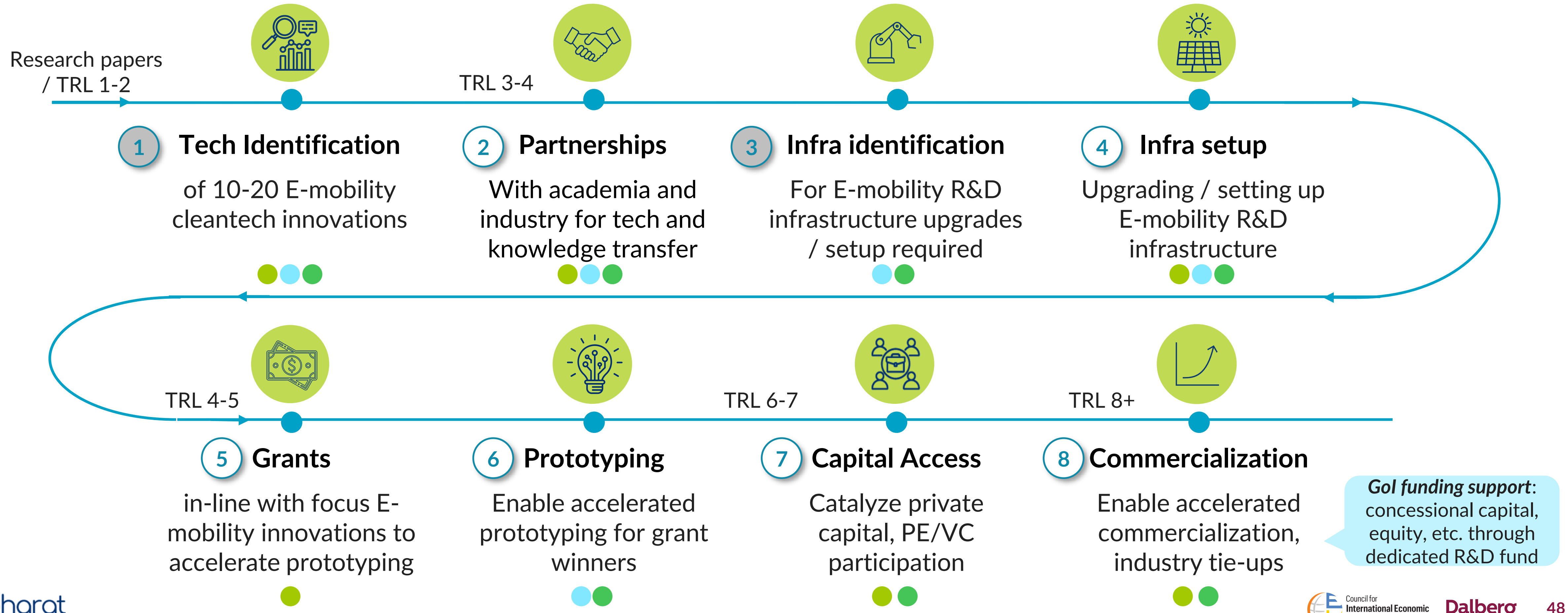
E-MOBILITY R&D & PRODUCT INNOVATION

India could accelerate indigenous innovation across the electric mobility value chain from identification to prototyping and commercialization through an industry-academia-government collaborative approach

MHI, MoP and ANRF could establish a Core Working Group (with representation from industry bodies like SIAM & A; academia and government) to spearhead this effort and engage relevant stakeholders across various steps

Steps for E-mobility cleantech R&D acceleration

🟡 MHI, MoP and other line ministries 🔵 Academia 🟢 Industry ⓧ Detailed ahead



Research papers / TRL 1-2

ⓧ 1 **Tech Identification**
of 10-20 E-mobility cleantech innovations
🟡🔵🟢

TRL 3-4

2 **Partnerships**
With academia and industry for tech and knowledge transfer
🟡🔵🟢

ⓧ 3 **Infra identification**
For E-mobility R&D infrastructure upgrades / setup required
🔵🟢

4 **Infra setup**
Upgrading / setting up E-mobility R&D infrastructure
🟡🔵🟢

TRL 4-5

5 **Grants**
in-line with focus E-mobility innovations to accelerate prototyping
🟡

6 **Prototyping**
Enable accelerated prototyping for grant winners
🔵🟢

TRL 6-7

7 **Capital Access**
Catalyze private capital, PE/VC participation
🟡🟢

TRL 8+

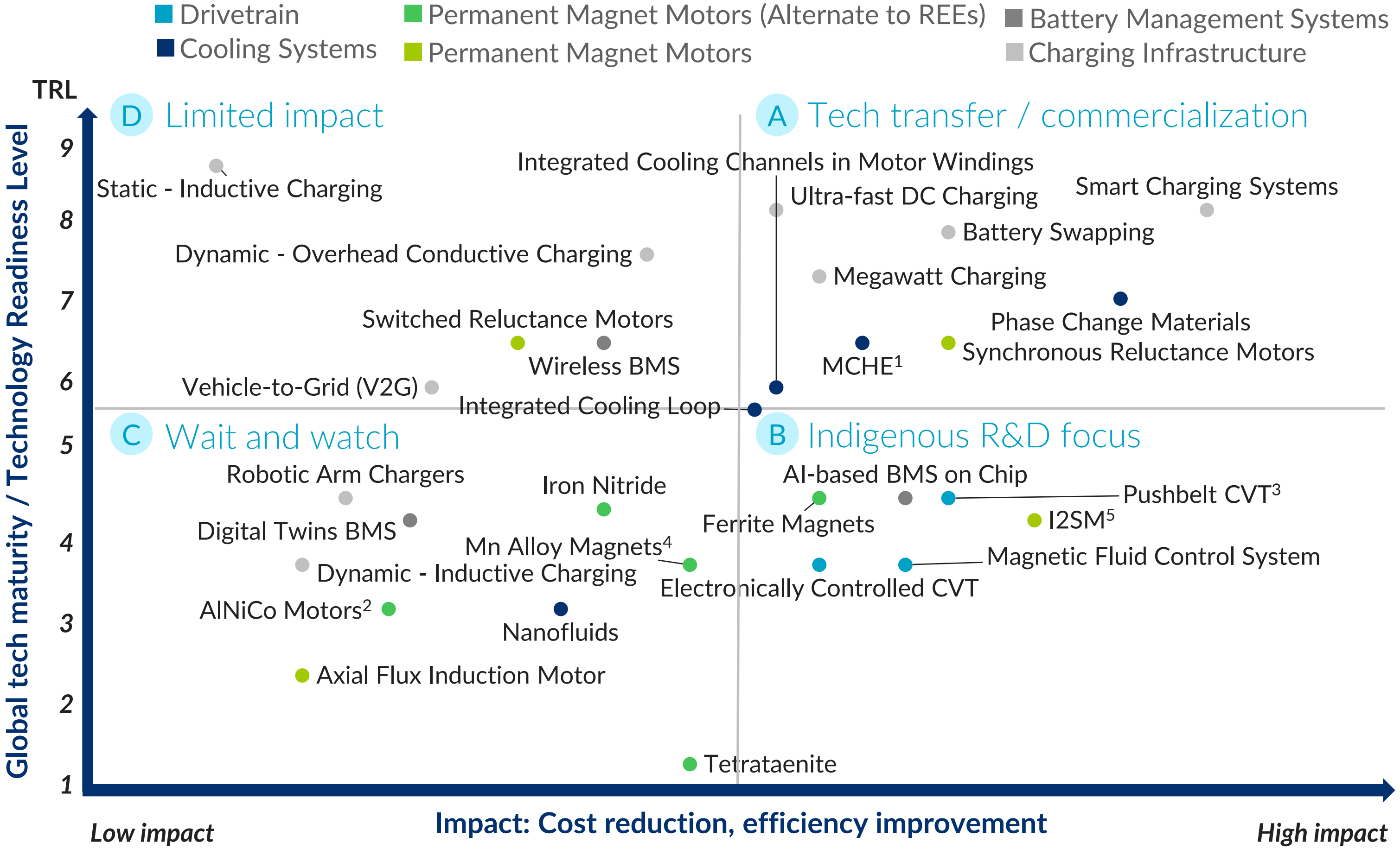
8 **Commercialization**
Enable accelerated commercialization, industry tie-ups
🟡🟢

GoI funding support: concessional capital, equity, etc. through dedicated R&D fund

High impact E-mobility technologies such as Pushbelt CVT, Ferrite Magnets, etc. could be prioritized to drive targeted R&D efforts across critical EV systems and components – Drivetrain, Motors, Cooling Systems, etc.

NON-EXHAUSTIVE

Focus R&D and innovation technologies: E-Mobility



Key Insights

Top 10-20 technologies for commercialization / tech-transfer and indigenous R&D display greater efficiency than conventional variants:

- **Tech transfer:**
  - **Synchronous reluctance motors** and **phase change materials** offer greater efficiency than conventional variants (PMSM⁶ and Liquid cooling);
  - **Ultra-fast DC** and **Megawatt Charging Systems** reduce vehicle down-time to nearly that of regular gas station refueling
- **Indigenous R&D:**
  - **Ferrite Magnets** offer comparable power efficiency, and **In-Rotor Inductively Excited Synchronous Motors** demonstrate greater efficiency than PMSMs;
  - **Pushbelt** and **Electronically Controlled CVT** offer higher transmission efficiency than conventional gear systems

Notes:

Methodology for identification and mapping of key technologies for E-mobility R&D: **(A) Landscape assessment**: Tech mapping (R&D to commercialization stage) and sector-specific stakeholder input to build validated list of potential technologies; **(B) Prioritization based on TRL and impact (cost and efficiency)** - Efficiency: Energy efficiency, power delivery, safety, etc.; Cost: production, installation & operational cost, etc.

(1) MCHE: Microchannel Heat Exchanger; (2) AlNiCo: Aluminium-Nickel-Cobalt; (3) CVT: Continuously Variable Transmission; (4) Mn: Manganese; (5) I2SM: In Rotor Inductively Excited Synchronous Motors; (6) PMSM: Permanent Magnet Synchronous Motors

Source: Company websites, Startup websites, Research lab websites, The EV Report, Technology Review, Science Direct, Springer, IITs, expert inputs

R&D infrastructure would need to be assessed and set up/upgraded to drive prototyping to commercialization for technologies across the E-mobility value chain

NON-EXHAUSTIVE

Establishing select, high-quality open access R&D development and testing labs as independent facilities operated under a PPP structure, and offering targeted grants to drive public-private collaboration and ensure maximum resource efficiency

KEY LEVERS	RATIONALE
1 **Focus on select, state-of-the-art, open-access facilities**	• Focusing efforts on **select R&D facilities** is critical to **reducing fragmentation** of research across labs and helps in **optimization of infrastructure** and **talent** • Upgrading existing labs into **State-of-art facilities** (e.g. R&D labs at incubation centers such as Centre for Automotive Research and Tribology at IIT Delhi) can **enable efficient utilization of R&D funds** • Ensuring **wider access** (for startups and private sector) to such facilities is critical to **foster technology innovation**
2 **Dedicated grants to support RnD in critical aspects of E-mobility**	• Offering **focused grants** can help develop a **comprehensive EV R&D ecosystem**, promoting indigenised innovation across various **aspects of E-mobility** – (charging infrastructure, EV components (motors, power electronics, etc., batteries), Recycling and second use of EVs) • Drives **investments** towards **priority[1] technologies** which offer cost and efficiency advantages (e.g., Synchronous Reluctance Motors, Phase Change Materials, etc.), across different aspects of E-mobility
3 **Consistent, well-trained manpower**	• **Fixed and well-trained manpower** is critical to ensuring **proper management** and **maintenance** of state-of-the-art equipment, extending the life and utility of infrastructure investments

(1) Refers to technologies highlighted in the previous slide

Source: Academia and industry experts

India could invest INR 2,800-5,000 Cr across 6-8 R&D labs to upgrade current E-mobility R&D labs, establish new facilities, and ensure needed human resource and efficient lab operations

	DEVELOPMENT LABS	TESTING LABS
Number of labs	**4-6 development labs** *3-4 COEs (motors, power electronics, systems integration and 1-2 innovation centers)*	**2 new testing labs** *Upgrades to 1-2 current labs (e.g., ICAT labs to test innovation and compliance perspective); set up of 1-2 new labs for Pilot scale testing*
Cost of labs	**INR 1,700-2,800 Cr**	**INR 1,100-2,200 Cr** *Investment across innovation, compliance and pilot testing labs* *Prioritize investment for **innovation testing** labs to carry more technologies to pilot stages*
Prospective existing infrastructure for upgrade	**IIT Delhi:** Centre for Automotive Research and Tribology **IIT Madras:** Centre of Excellence in Advanced Automotive Research	**Central testing facility** **DHI CoE for E-mobility under Automotive Research Association of India** **ICAT:** Labs, testing facilities, etc.
Machinery needs	***High precision equipment** suited for R&D which is **customizable and agnostic** across different EV and battery segments* - Material R&D and chemical wet-lab equipment - Rotor magnet insertion equipment, SMT[1] lines - Battery cell simulators, current and voltage measuring tools	- Material testing equipment - Efficacy testing machines (including lab, field, and commercial testing)
Manpower and support needs	- **Trained manpower** with ability to use advanced equipment (separate upskilling for current researchers) - **Independent management team** reporting to own Board vs. public/ private sector researchers to ensure maximum utilization, efficient operations - **Market needs assessment** of upcoming tech trends to inform relevant research	

---

(1) Surface Mount Technology used to assemble Printed Circuit Boards used in Battery Management Systems and Power electronics

Source: Academia and industry experts

In addition to government support, private sector (including large OEMs, EV players) investment is required to align E-mobility R&D priorities with industry needs, and build shared R&D infrastructure

Private sector role

Key players: *Large OEMs (Mahindra Electric, TATA Motors, etc.), component manufacturers (Bosch India, Sona Comstar, etc.) and other industry conglomerates (TVS Group, Bharat Forge)*

1 Provide strategic input for industry-aligned R&D

- **Support identification** of scalable, high-impact technologies across the E-mobility value chain and **commercialization pathways**
- **Designate nodal representatives** in industry associations to drive E-mobility R&D beyond firm-level efforts

2 Increase private R&D investment

- **Invest in prototype development and commercialization,** and support **tech transfer** by investments in academia, R&D
- **Invest in shared infrastructure building** (e.g., setup of open-access labs in PPP mode with public sector players)

3 Enable greater R&D infrastructure sharing

- **Enable shared access to existing R&D infrastructure** to maximize resource utility and collaboration

Government support

Key players: *Relevant line ministries, e.g. MHI, MoP, and other related bodies driving R&D efforts, collaboration, and funding (e.g. ANRF, SIAM, A etc.)*

- Ensure integration of **private sector inputs** in decision-making;
- **MHI/MoP** could potentially drive coordination and help align government-industry priorities across **Batteries**, **Motors** and **EV Charging infra**; **MEITY** could potentially provide support for **BMS** and **Power Electronics**

- **Co-finance grants with private sector** basis alignment with focus EV technologies & clear TRL-based commercialization pathways

  INR 1,000-1,200 Cr government grant funding[1] *for E-mobility R&D (Building on existing R&D schemes, e.g. Mission of Advancement in High Impact Areas under ANRF, R&D fund under RDI, etc.), can potentially be disbursed as a* ***1:1 match*** *for* ***private sector contribution***[2]*, or through other financing mechanisms*
- Explore tools such as **public procurement commitments** to support downstream-offtake of domestically developed tech

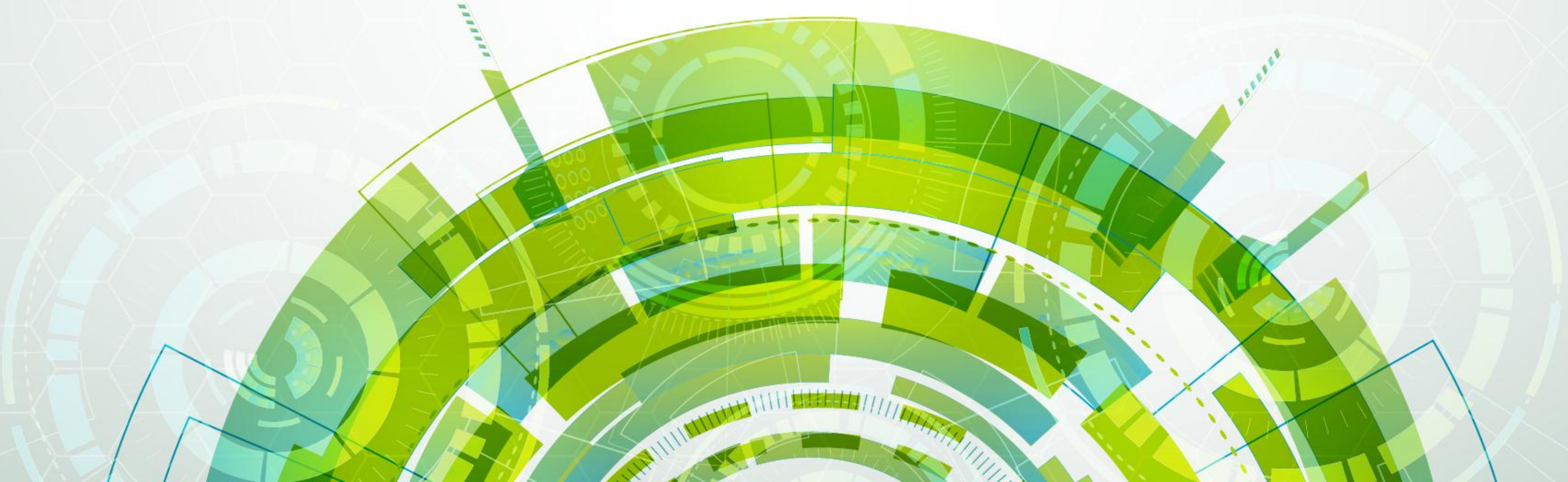
- Facilitate **public-private partnerships, joint R&D mechanisms**, etc. to **setup shared R&D labs**, accessible to start-ups
- Design **incentives/ mechanisms for shared use of private labs** while ensuring protection of intellectual property

---

(1) Broad component level breakup of investment can be found in the E-Mobility R&D Roadmap for India, linked below; (2) Total investment required for E-Mobility R&D INR 5,000-7,700 Cr (R&D infrastructure: INR 2,800-5,000 Cr; E-Mobility R&D grants: INR 1,000-1,200 Cr by Government along with INR 1,200-1,500 Cr by private sector);
Source: Academia and industry experts; Office of the Principal Scientific Adviser to GoI, E-Mobility R&D Roadmap for India, 2024; RDI scheme: Research Development and Innovation (RDI) Scheme, 2025 PIB report

SUB-SECTION THREE

UPSTREAM RAW MATERIALS & CRITICAL INPUTS



Securing supply of and building domestic supply chains for Rare Earth Elements is critical to safeguarding national progress across key strategic sectors such as Cleantech, Space and Defence

Rare Earth Elements (REEs) are critical raw materials[1] for multiple sectors:

- REEs form key raw materials in **EV motors**, **Wind Turbine generators**, **Consumer electronics, space** and **defence sector,** spanning various applications – magnets, catalysts, phosphors, lasers, etc.

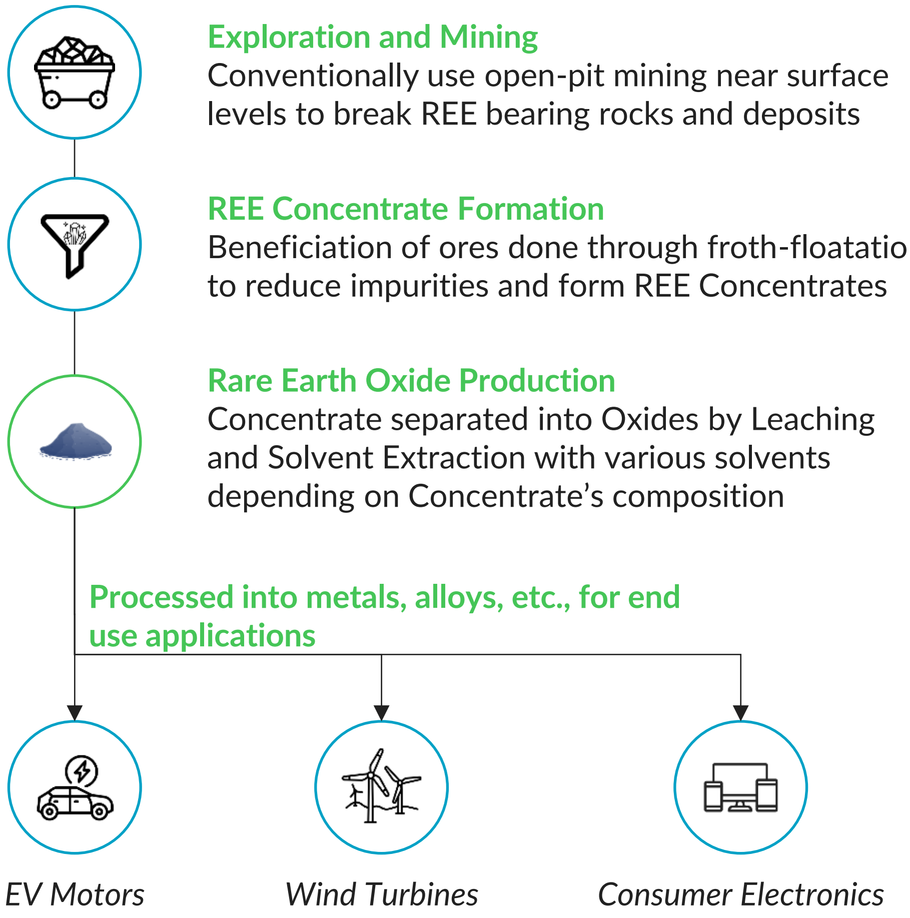
REEs are commonly traded as Rare Earth Oxides (REOs):

- REEs occur collectively in ores, but commonly traded as separated oxides (e.g., **Neodymium Oxide**, **Dysprosium Oxide**)
- Further processed into **metals or alloys** for use in **permanent magnets** (e.g., Neodymium-Iron-Boron magnets) **– key components in EV motors, Wind turbine generators**
- **Heavy REOs** are key materials in strategic sectors such (**space** and **defence**), occur less commonly than Light REOs

REO production is processing heavy:

- REO production requires **cost and resource intensive hydrometallurgical processes** (leaching and solvent extraction) to convert feedstock (**Rare Earth Concentrate**) into separated Oxides

Rare Earth Oxide Value Chain



Exploration and Mining
Conventionally use open-pit mining near surface levels to break REE bearing rocks and deposits

REE Concentrate Formation
Beneficiation of ores done through froth-floatation to reduce impurities and form REE Concentrates

Rare Earth Oxide Production
Concentrate separated into Oxides by Leaching and Solvent Extraction with various solvents depending on Concentrate's composition

Processed into metals, alloys, etc., for end use applications

EV Motors

Wind Turbines

Consumer Electronics

---

(1) Other critical raw materials for E-mobility include Silicon for semiconductors, which has been covered in the analysis on the Solar sector

Sources: MRS Bulletin, Processing the ores of rare-earth elements, 2022; JOM, Material and energy requirement for Rare Earth production, 2013

Today, global rare earth supply is concentrated in China, which controls 67% of Rare earth extraction and 90% of Oxide capacity globally

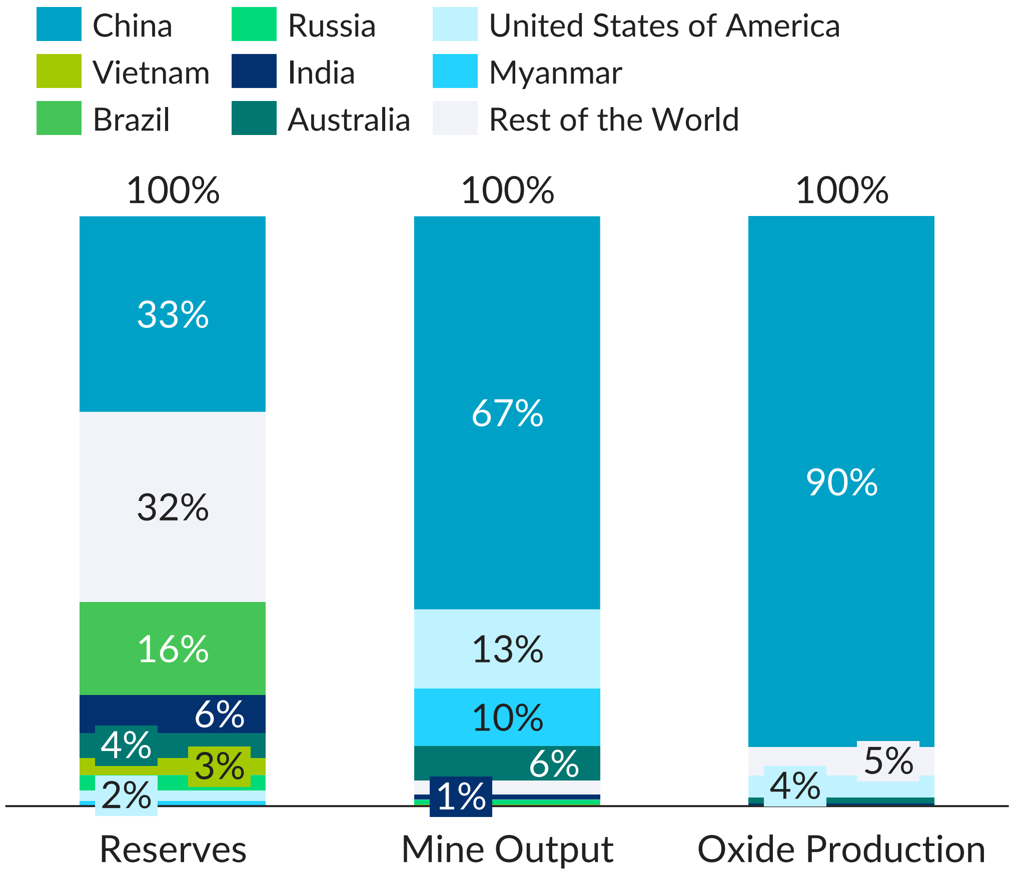
Global Rare Earth Supply is heavily concentrated in China with countries onshoring REO capacities to reduce dependency:

- China has **~33% of global Rare Earth reserves** but accounts for **90% of Oxide production**; dominance to continue as it safeguards supply and invests in new Heavy REO deposits in conflict regions such as **North and East Myanmar**
- **US**, **Canada**, **Malaysia** are **emerging alternative Rare Earth Oxide suppliers** investing in building and scaling oxide production capacity

Despite having significant domestic resources, India has shown limited success in mining them:

- **India** has the 3rd largest REE reserves (**6% of global reserves**) but contributes **less than 1%** to global production
- In FY 25, India imported **~2 kTPA REE Compounds** including Oxides, and **~53 kTPA finished goods (magnets)** – with respectively **60-70%** and **85-90%** of these imports coming from China

Distribution of global rare earths reserves and extraction capacity, % TPA REO equivalent



Sources: Mining.com, China flexes rare earth dominance with million-tonne discovery, 2025; ORF, India's REE Strategy: Turning resources into capacity, 2025; USGS, Mineral Commodity Survey – Rare Earths, 2025; Discovery Alert, Myanmar's Critical Role in China's Rare Earth Dominance, 2025; Investing News Network, Rare Earth Reserves, 2025; Reuters, China backed militia secures control of new rare earth mines in Myanmar, 2025

Currently India has heavy import reliance across finished goods as well as standalone Rare Earth Oxides for use in applications such as EV motors, Wind turbine generators, consumer electronics, etc.

Rare Earth Oxide Demand 2025
4-4.3 kTPA

85%

Finished Goods: Rare Earth Magnets

Majority of total REO demand is met entirely through imports of finished Rare Earth Magnets

Magnet manufacturing requires Rare Earth Oxides, thus domestic magnet capacities could unlock demand for REOs

~100%
Import dependence

China ***Belgium*** ***Canada***

__85-90%__ of Rare Earth Magnet Imports come from __China__

15%

Standalone Rare Earth Oxides

Remaining REO demand is met by a mix of imports and domestic production

50%
Import dependence

China ***Japan*** ***South Korea***

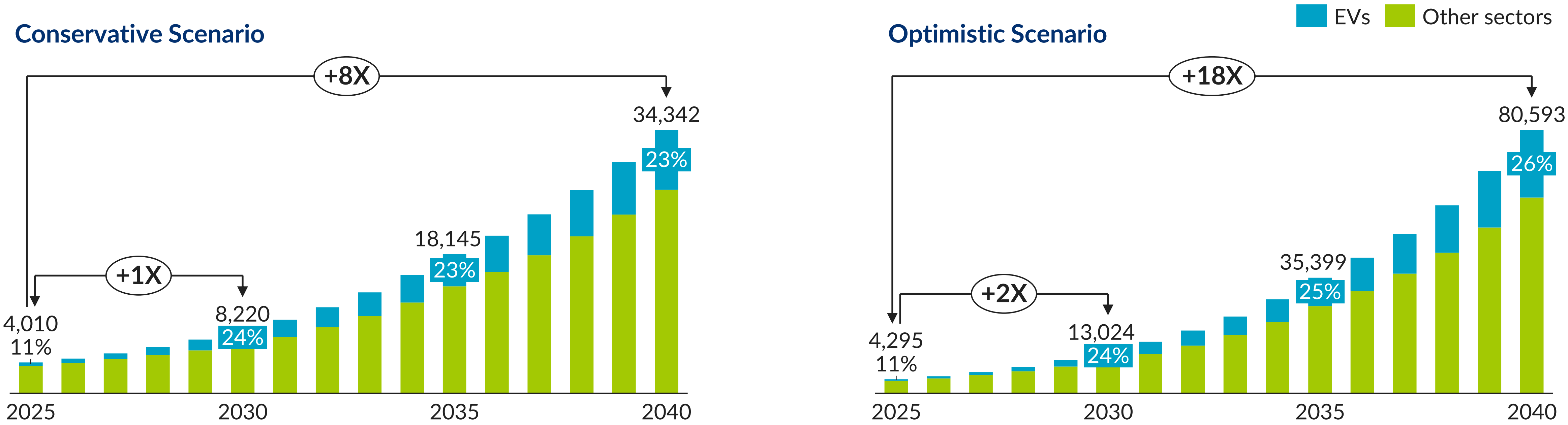
50%
Domestic production by IREL

>90% import reliance faced by India in sourcing **Rare Earth Oxides**, since significant chunk of India's Oxide demand is **tied up in imports of finished goods such as permanent magnets**

If existing import reliance is not checked, India's rising Rare Earth Oxide demand could risk further increasing import reliance for REOs

Annual Rare Earth demand expected to grow by 1-2X till 2030, 8-18X till 2040, compared to 2025, driven by rising EV penetration and policy tailwinds across other sectors such as offshore wind energy, consumer electronics and defense

India's aggregate[1] rare earth oxides demand, 2025-2040, TPA


Conservative Scenario

Optimistic Scenario

*Continued **import dependence** for Rare Earth Oxides could result in **import bills** worth **USD 100-160 Mn** by **2030**, (assuming 90% import reliance)*

*Across scenarios, **95%** of EVs are assumed to have **Rare Earth Oxide magnets** and **REO weight** is considered to be **30%** of permanent magnet weight*

(1) Refers to total REO demand including demand represented by finished REO products (rare earth magnets) and REO itself. It is assumed that 15% of total annual EV demand will continue to be met by imports – REO demand for the same has been excluded from this assessment

<u>Conservative Scenario</u>: (1) In 2025, **EVs** assumed to account for **11%** of **total REO demand;** (2) By 2030, rising EV penetration expected to **more than double EVs' share** to **24%;** (3) Beyond 2030, EV share anticipated to grow at a **deaccelerated pace** due to expected **growth in demand from other sectors** (e.g., Offshore Wind)

<u>Optimistic Scenario</u>: (1) **EV penetration** expected to **rise more aggressively** in the optimistic scenario, thus **increasing absolute REO demand** from EVs; (2) REO demand from **other sectors** expected to rise **proportionately to EVs** in the optimistic scenario due to **policy tailwinds** (e.g., VGF scheme for offshore Wind, National Manufacturing Mission to boost consumer electronics production, rising funding for defence sector); (3) Thus **EVs' share** in total REO demand in optimistic scenario **differs minimally** from conservative

India is already focusing on reducing import reliance by facilitating access to overseas Rare Earth mineral resources and incentivizing downstream demand but still faces challenges in catalysing domestic capacities

India is already doubling down on developing Rare Earth extraction and downstream magnet manufacturing…

KABIL exploring **G2G partnerships** with **Australia, Brazil** and **Dominican Republic** for overseas mining

IREL engaging **South Korea** and **Japan** to support technology transfer for and development of **domestic magnet capacity**

Ministry of Heavy Industries working on an **INR 7,350 Cr** PLI scheme to support development of domestic magnet manufacturing capacities

..but continues to face challenges in scaling domestic REO production and recovery capacity

Exploration and extraction projects have **long lead times** (7-10 years), resulting in delayed access to output and limited uptake by private players due to **extended ROI timeline**

While existing domestic capacity and reserves cover Light REO, India lacks **technical capacity** and **access to deposits** for **Heavy REO production** (critical for **defence** and **space** sectors)

Amidst a growing mineral recycling ecosystem, India lacks **technical capacity** for **REO recovery** from end of life **Rare Earth magnet applications**

Sources: Business Standard, Govt to launch INR 7,350 Cr plan to boost production of rare-earth magnets, 2025

Reducing import reliance on REOs from 85-90% to 50% requires simultaneous efforts across domestic extraction and REO capacity development, and scaling magnet circularity to unlock and domestically meet aggregate demand

Investments in scaling domestic extraction and expanding refining and circularity capacity could support meeting up to 50% of India's total REO demand domestically, supported by key interventions taking place between 2025 and 2030

Pathways for reducing India's Rare Earth Elements import dependance

SOURCES OF MINERALS

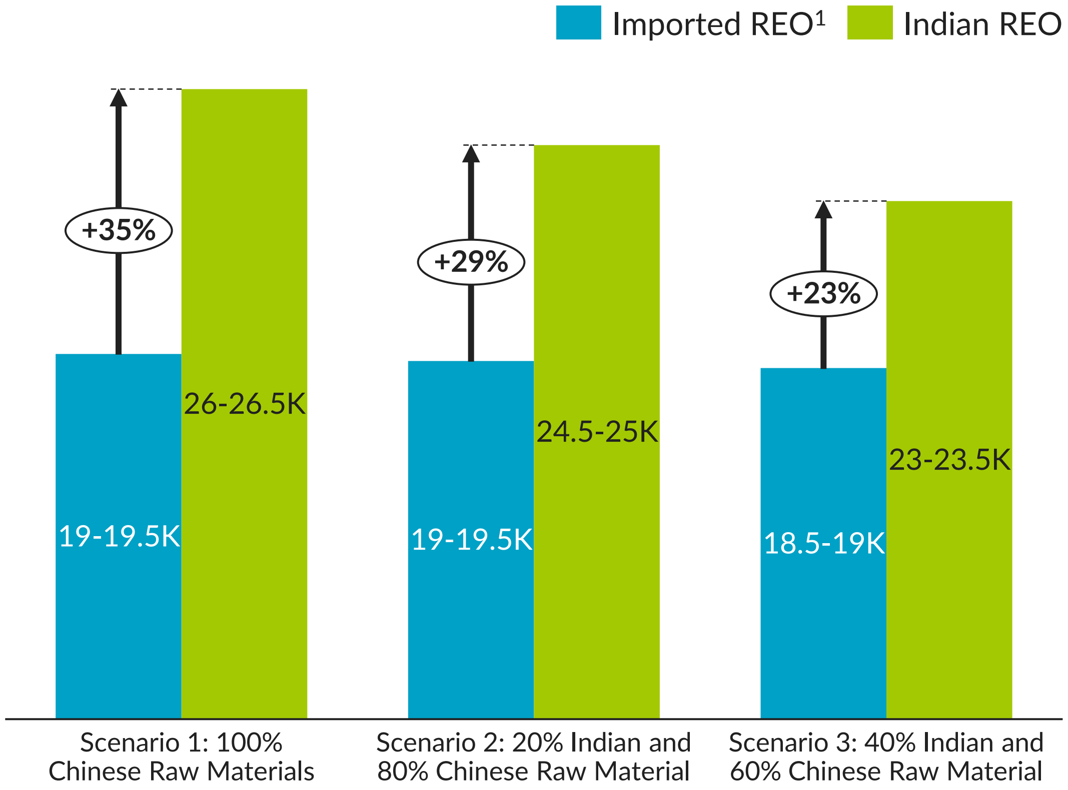
Pathways	Details	2030 Potential	2040 Potential	Investment Required	KEY ENABLERS
		kTPA (% of aggregate demand)	*kTPA (% of aggregate demand)*	*INR Cr by 2030*	
① *Domestic mineral refining*	Global and domestic reserves extraction with domestic oxide production	**Heavy REO:** 0.47-0.7[1], (50%), **Light REO :** 7.8-8.3 (61-65%) in conservative and 10.1-10.5 (50-52%) in optimistic demand scenario[1,2]		**Heavy:** INR 150-210 Cr **Light:** INR 570-640 Cr, INR 1,230-1,320 Cr *(cumulative capex for incremental capacity[3])*	• G2G partnerships with **Australia, Myanmar, Brazil for Light and Heavy REE Concentrate[4]** • **20%** upfront capex subsidies for incremental capacity - **INR 130-140 Cr, INR 260-270 Cr[5]** • Supporting development of **downstream magnet capacity**
② *Scaling circularity*	Closed loop permanent magnet recycling for REO recovery	**REO recovery:** 0.076, (~1%)	**REO recovery:** ~2, (2-6%)	**INR 4,400-4,700 Cr** (cumulative upfront capex for **6.5-7 kTPA** magnet recycling capacity)	• Tech transfer partnerships with prominent recyclers, e.g., Germany's Rocklink • **INR 780-840 Cr** upfront capex subsidies for **magnet recycling facilities** for **2040** • Collection infrastructure capacity expansion • Policy support in setting up recycling infra.
③ *Import diversification & stockpiling*	Stockpiling up to 25% of annual demand for REO	**REO:** 2-3.3, (25%)	**REO:** 8.6-20.2, (25%)	**INR 5-10 Cr** capex for developing storage facility	• Stockpiling targets for **25% of annual demand by 2030 for Rare Earth Oxide forms of REEs**

(1) Capacity requirement considers assumed utilization factors – 60% in both scenarios; (2) Considers total Light REO capacity including total 5.7-6.4 kTPA announced capacity; (3) Refers to total investment required for additional REO capacity targeted beyond announced capacity; (4) Import and overseas mining partnerships under Domestic refining pathway focus on sourcing intermediate raw materials for safeguarding domestic production; (5) Range of capex subsidies across conservative and optimistic demand scenarios

① **Domestic Refining |** Currently India's existing domestic REO capacity is not cost competitive with imported REOs and will require investments in improving feedstock availability to reduce the cost differential

Cost competitiveness of domestically produced REO with imported REO can be boosted by increasing local feedstock (Rare Earth Concentrate) availability, but would require additional interventions to equate it to cost of imported REO

Comparison of landed cost of imported REO and cost of REO domestically produced, USD/MT, ex-GST



Domestic REO production is not cost competitive with imported REOs and is limited by feedstock availability:

- **35% expected difference** in cost of domestically produced REOs and imported REOs², due to dependence on **imported raw material**
- Up to **40% integration** of domestic raw material can reduce the differential by **12%**, but is **limited by low feedstock** (Rare Earth Concentrate) availability

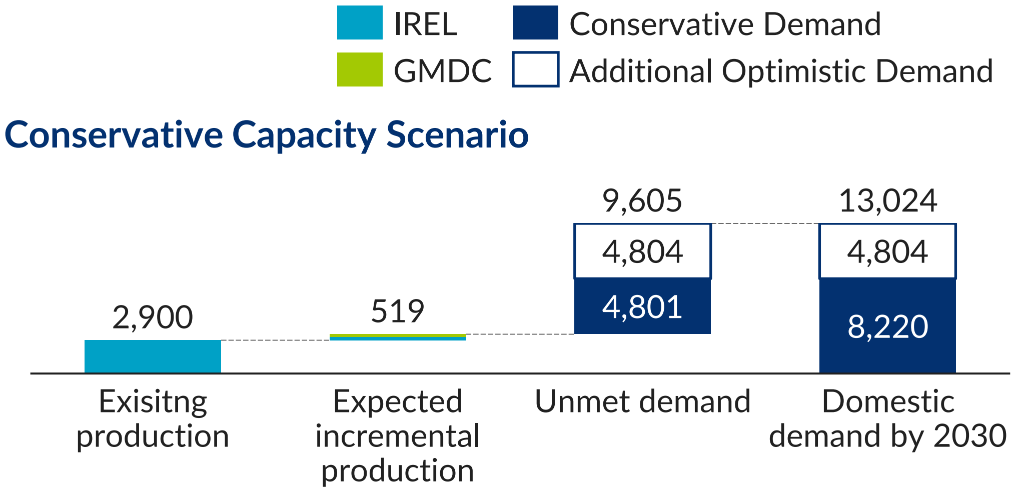
Increasing feedstock availability will not be sufficient to address the cost differential and will require additional support:

- While incremental feedstock (Rare Earth Concentrate) capacity can **bring down the cost differential** between imported and domestically produced REOs, imported REOs will **continue to be cheaper**
- Targeted **input side interventions** such as **electricity and capex subsidies**, **interest subvention** and **protective import duties** are required to make domestic REO cost competitive

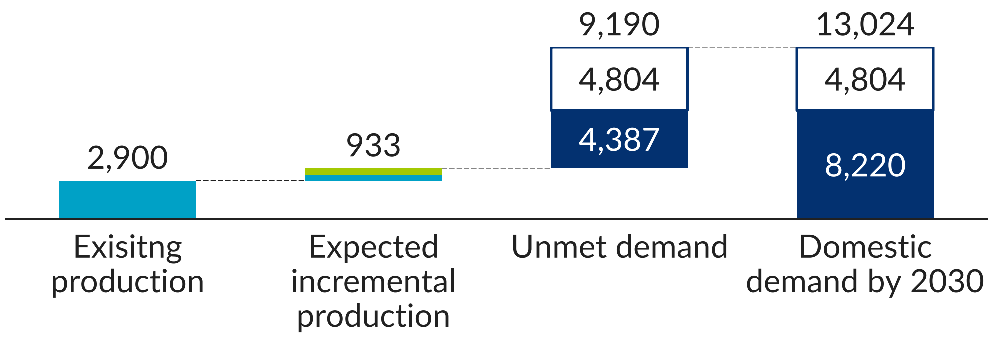
(1) The cost of Imported REO has been adjusted basis the composition of Rare Earth Oxide achieved by mixing Indian and imported Rare earth concentrates in different proportions; (2) Assuming domestic REO production is entirely import dependent for sourcing raw material – Rare Earth Concentrate; Source: Dalberg Analysis; JOM, Material and energy requirement for Rare Earth production, 2013

① Domestic Refining | While IREL and GMDC have announced capacity expansion for REE mining and Light REO production, they're expected to meet 26-47% of REO demand[1], requiring incremental capacity additions

Expected domestic annual oxide production and total demand for Rare Earth Oxides by 2030, TPA



Conservative Capacity Scenario



Optimistic Capacity Scenario

IREL and GMDC announced capacity expansion for Light REO by 2030[2]:

- **IREL** announced **mining capacity expansion** by **4x by 2032**, targeting total 13 kTPA REO capacity by 2032 (**~7.2 kTPA by 2030**)
- **Gujarat Mineral Development Corporation** (GMDC), a mining PSU, announced development of **12 kTPA REO** production capacity by 2028

Incremental capacity additions required to meet 50% aggregate demand domestically and build Heavy REO capacity:

- IREL and GMDC's capacity expansion primarily **targeted at Light REOs** and may be delayed – limited evidence of GMDC's progress on capacity development plans which were targeted for 2028

Scenario descriptions:

Conservative Capacity: Annual production to meet **26-42%** demand in 2030

- IREL slated to meet only **13% of targeted incremental capacity** at current pace of growth[3]; it is assumed GMDC could follow similar success (13% of targets)
- **REO Capacity utilization by 2030** expected to be same as IREL's current Oxide capacity utilization, **~60%**, due to limited **mining output scale up**

Optimistic Capacity: Annual production to meet **29-47%** demand in 2030

- Assuming IREL and GMDC double the rate of capacity addition than the conservative scenario (meet **26% of capacity targets**)
- **REO Capacity utilization by 2030** assumed to remain constant at **60%**

---

(1) Based on aggregate demand which excludes REO demand for 15% of annual EV registrations assuming they may continue to correspond to imported REO components/imported finished vehicles; (2) Vedanta has displayed interest in REO production with Hindustan Zinc winning composite exploration and mining rights to an REE block in 2025, but no capacity announced; (3) IREL needs 30% YoY growth in mine output (FY24-30), against current 5% YoY growth (FY21-24) to achieve their targeted mining capacity expansion; Sources: IREL Annual Reports; Economic Times, Rare earths miner IREL eyes 40% capacity expansion for clean energy, 2023,GMDC, Business Update, 2024

① **Domestic Refining |** Incremental REO capacity additions to further reduce import reliance are limited by key challenges across exploration and extraction, private sector participation and reliable downstream demand

1 Limited domestic Rare Earth exploration and extraction

- Geological Survey of India augments **~480 Mn MT Rare Earth Ores** (varying in quality)
  - These resources are **pending exploration** and are limited to **Light Rare Earth Oxides**
- Success of IREL and GMDC's capacity expansion and development plans is also contingent on successful **acquisition**, **exploration** and **commercialization** of **domestic Rare Earth Deposits**
- Further, limited feedstock availability results in underutilization of existing Oxide capacity – **~60% capacity utilization** of IREL's current REO plant

2 Regulatory challenges in gaining private sector support

- Limited private sector participation in domestic exploration :
  - Less attractive **revenue share norms** for exploration license (EL) holders, involving **long payment timelines** – Mining License holder to pay share of auction premium to EL holder, once Mining License auction concludes
  - **Limited access** to **financial support** offered by NMEDT – schemes typically available to Notified Private Exploration Agencies
- Regulatory challenges (e.g., obtaining **environmental and forest clearances**) add to compliance burden, disincentivizing mining agencies from investments in commercializing deposits

3 Low downstream demand from magnet manufacturing

- **Magnets** represent a large chunk of total REO demand but currently face **~100% import dependence**
- India's limited magnet manufacturing landscape does not provide **long term offtake security** for REO production plants – **limiting investments** in capacity development for **REO production**

Source: PIB Department of Atomic Energy, Parliament Question: Rare Earth Minerals, 2025; The Hindu, Initial findings positive for lithium blocks in Argentina, 2025; Reuters, Indian state firm's seek stake in SQM's Lithium projects in Australia, 2025

1 Domestic Refining | Strategic interventions across mineral exploration and extraction, and oxide production could catalyse requisite incremental REO capacity to achieve 50-65% self sufficiency in REOs

Interventions targeted at scaling mineral extraction, incremental oxide production, reducing costs of domestic Rare Earth Oxides and securing downstream Oxide demand could unlock aggregate REO demand and reduce India's import reliance

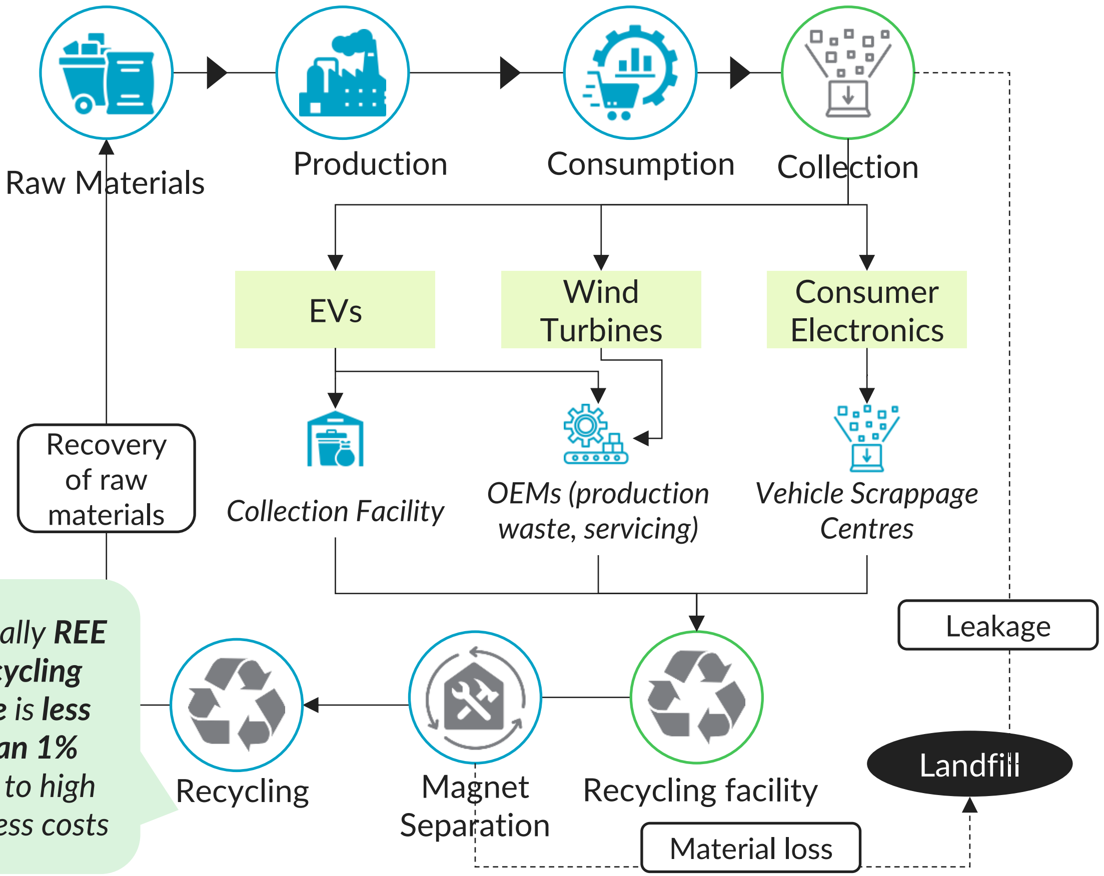
	Expanding exploration and extraction	*Scaling mineral to Oxide capacity*	*Securing downstream demand*
Current progress	• **NMEDT** funded **reimbursement scheme** to refund **50% exploration expenses**[1] • **Fast-tracked approvals** for critical mineral projects by **Environment Ministry**	• **GMDC** announced capacity development for **12kTPA Light REO capacity** by 2028 • **IREL** targets scaling existing 5kTPA REO capacity to **13 kTPA** by 2032	• PLI scheme worth **INR 7,350 Cr** for domestic magnet manufacturing - expected to target **6,000 MT** magnet capacity
Proposed interventions	• **Expedite** exploration and composite license **auctions** for domestic **REE blocks** • Secure access to **Heavy Rare Earth Ores** by exploring **G2G partnerships with such as Myanmar, Australia**	• **Secure low-cost Rare Earth Concentrate** to improve cost competitiveness in short term (Light REO: Australia, US, Brazil; Heavy REO: Australia, Myanmar) • Facilitate **tech transfers with key global refiners** (e.g., Lynas) to support Heavy REO capacity development • Support initial **capacity development** for **Heavy** and incremental **for Light REOs** through capex subsidies to build a strong REE processing portfolio for India	• Support REO off-take agreements with key magnet manufacturers • Identify **low-cost raw materials sources** to support **cost competitiveness** of oxides and promote domestic offtake • Offer idle PSU land sites to magnet manufacturers at subsidized rates
Potential	By 2030, **9-14 kTPA** of **REE concentrate annual production** required to meet raw material demand for targeted domestic REO capacity	**470-700 TPA Heavy REO** capacity to meet **50%** of 2030 annual Oxide demand, and **1,900-2,100 TPA** incremental **Light REO** capacity in **conservative** and **4,100-4,400 TPA** in **optimistic demand scenario**[2]	**1,800 TPA** expected **REO demand** by 2030 from magnet capacity targeted under PLI
Cumulative investment required till 2030		**Conservative Scenario: INR 570-640 Cr** for Light and **INR 150 Cr** for Heavy REO **Optimistic Scenario: INR 1,230-1,320 Cr** for Light and **INR 210 Cr** for Heavy REO capacity	

(1) NMEDT funded scheme – allows for 50% reimbursement on expenses incurred in exploration, repayable upon mine commercialization; (2) Additional nameplate REO production capacity, beyond announced capacity. Targeted to meet at least 50% of 2030 demand domestically in both scenarios at 60% capacity utilization.; Sources: Business Standard, Govt offers 50% refund to license holders for critical mineral exploration, 2024; Business Standard, Govt to launch INR 7,350 cr plan to boost rare earth magnet production, 2025

2 **Circularity** | Circularity for permanent magnet applications of Rare Earth Elements aligns with national focus on boosting REE recycling and has the potential to further reduce dependence on imported Rare Earth Oxides

Rare Earth Elements have a variety of applications and circularity for permanent magnet applications displays strong potential, driven by existing policy focus and growing EV industry (serves as feedstock for magnet recycling)

Permanent magnet circularity value chain:



*Globally **REE recycling rate** is **less than 1%** due to high process costs*

Permanent magnets display strong potential for Circularity:

- Permanent magnets are most common **(25-30% of REE demand)** amongst Rare Earth applications (magnets, catalysts, phosphors)
- Catalyst and phosphor recycling technologies have not yet been commercialized, thus have low potential for circularity

Permanent magnet recycling has an active research and policy landscape:

- Permanent magnet recycling currently dominated by **hydrometallurgical recycling – well documented** recycling process also used for Battery Black Mass recycling
- **Emerging short loop magnet[1] recycling technologies** such as **Hydrogen Decrepitation**, though still **under development**, can recover Rare Earth powders for direct use in magnet production
- Rising domestic focus on Recycling **– INR 1,500 Cr incentive scheme** for critical mineral recycling, including **rare earths[2]**
- Increasing **EV penetration** expected to foster a **growing and reliable feedstock supply** for permanent magnet recyclers

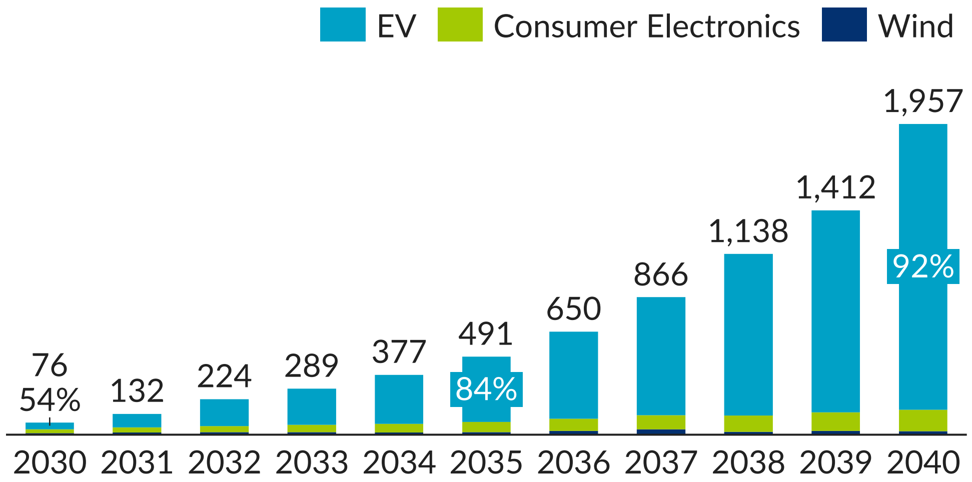
---

(1) Refers to magnet to magnet recycling, which doesn't require separation of recycled material into oxides; (2) The scheme considers e-waste, Lithium Ion Battery scrap and other end of life scrap materials in vehicles such as catalytic converters; Source: TIME, Trump wants Rare Earths but challenging China's dominance will take more than tariffs, 2025; PIB, Cabinet approves INR 1,500 Cr scheme to promote critical mineral recycling, 2025

② **Circularity** | Magnet circularity is a strategic long-term bet; targeted interventions across Magnet Collection and Recycling could meet 2-6% of aggregate rare earth demand by 2040, though the short term potential is low

Recovered Rare Earth Oxides from end-of-life permanent magnets could meet 2-6% total REO demand by 2040

Projected Rare Earth recovery potential, 2030-2040, TPA:

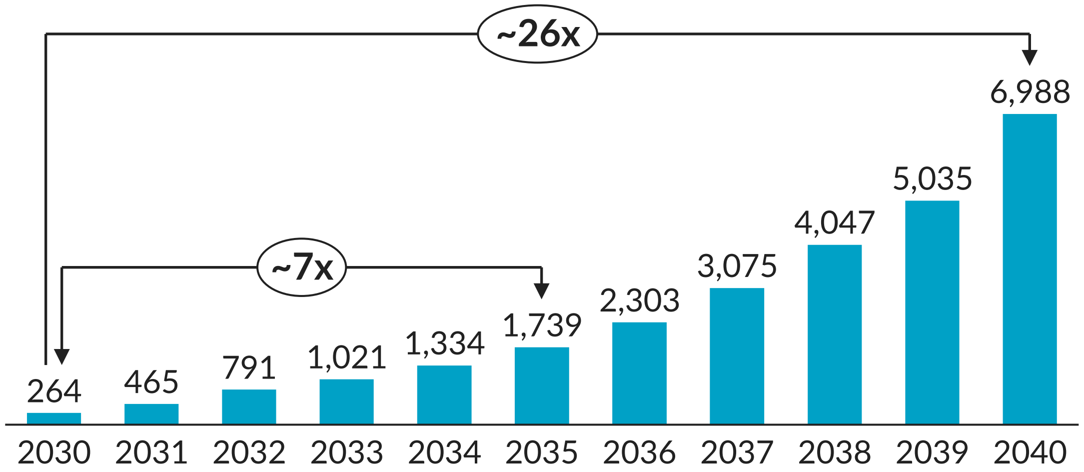


Recently approved INR 1,500 Cr incentive scheme for recycling is stepping stone to building domestic ecosystem:

- Incentives include **Capex subsidies of 20%** on plant and machinery associated with setting up recycling and mineral recovery capacities; **INR 5-10 Cr Opex subsidies**, on achievement of threshold sales

Tapping this potential needs strategic investments in developing 6.5-7 kTPA domestic magnet recycling capacity

Projected Magnet recycling capacity requirement, 2030-2040, TPA:



Opportunity to tap into active momentum in magnet recycling landscape:

- Magnet recycling is **underexplored** in India, with existing rare earth recycling capacity largely focused on **consumer electronics** (e.g., Attero, Recyclekaro)
- Domestic recyclers are beginning to engage in **tech transfers** for **magnet recycling capacity** – BatX engaged with German recycler Rocklink

(1) Refers to target feedstock capacity

Source: PIB, Cabinet approves INR 1,500 Cr scheme to promote critical mineral recycling, 2025; EV Story, BatX-Rocklink Rare Earth pilot to go live in 12 months, commercial production by FY 27, 2025

2

Circularity | Tech transfer partnerships, cumulative INR 4,400-4,700 Cr capex investment in recycling facilities and other policy levers could catalyse circularity potential of ~2 kTPA recovered Rare Earth Oxides by 2040

India's magnet circularity potential is impeded by structural and regulatory challenges, requiring investments targeted at scaling collection infrastructure and supporting economic sustainability and ease of operations for recycling facilities

	COLLECTION	RECYCLING		
Challenges	**Insufficient Infrastructure**	**Low Economic Feasibility**	**Limited Capacity**	**Red Category Industry**
	• Limited E-waste collection centers and Vehicle Scrappage Facilities • 174 registered vehicle scrappage units present against estimated need of 550-750 centers by 2025 and 700-950 by 2030	• Recycled REO not competitive with virgin REO production • Fluctuating mineral prices add uncertainty to economic feasibility • Higher working capital needed to manage inconsistency in feedstock expected in the near term[1]	• Limited domestic focus on magnet recycling as a source of REO recovery	• Recycling is a Red Category Industry in India and faces long approval timelines for establishment and operation of facilities (CTE and CTO) • Challenges in siting land to setup operations
Interventions				
	• Support development of 160-180 E-waste collection facilities[2] and additional ~350-600 Vehicle Scrappage Centers via 20% capex subsidies	• Explore Price Guarantee Measures to boost economic sustainability for recyclers • Explore 2-year GST deferrals on feedstock (permanent magnet scrap/end-of-life motors) • Facilitate access to magnet scrap from EU/US – regions with higher EV scrap availability	• Support development of 6.5-7 kTPA magnet recycling facilities via 20% capex subsidies • Leverage platforms such as EU-India Trade and Tech Council to access existing and new recycling tech	• Offer additional policy support (by relevant ministries) to grant 1-year exception CTO, CTE approvals for up to 50 recycling startups that meet certain threshold requirements[3]
Cumulative Investment till 2030	**INR 14,200-16,500 Cr** capex investment[4] across e-waste and vehicle scrappage facilities		**INR 4,400-4,700 Cr** capex investment for magnet recycling facilities	

(1) This is since key magnet-based industries (EVs, Wind turbines) are nascent sectors in India, resulting in low volumes of waste reaching end of life by 2030; (2) As detailed in the Battery indigenisation pathways; (3) Exception approvals granted by relevant ministry for 1 year, post which due processes on audits and diligence can be carried out to grant permanent certificates; (4) Includes INR 1,200-1,500 Cr capex investment proposed under the Batteries Indigenisation Pathways presentation

3 **Import diversification and Stockpiling |** Leveraging existing MoUs with resource rich nations and stockpiling 25% of 2030 notional REO demand could safeguard India's downstream sectors from global REE supply shocks

As India looks to reduce import dependence, it's imperative to parallelly diversify supply for remaining Rare Earth imports and additionally invest in stockpiling of REOs to safeguard growth of downstream sectors – e.g., Permanent Magnets, EVs

Strategic imports of Rare Earth Concentrates and Oxides could support development of domestic Oxide and Magnet Capacity:

- Low-cost **Rare Earth Concentrate imports** critical to **support cost-competitiveness** and initial **sustainability** for oxide capacity
- Domestic Heavy REO production is dependent on **imports of Heavy REE rich concentrates** due to lack of domestic availability

India could leverage existing bilateral ties and multilateral ties and partner with key resource rich countries to secure these resources:

- **Brazil, Australia, US, Myanmar, Vietnam – key REE rich nations**
  - **Brazil** and **Australia** represent **20% of global REE reserves**
  - **Myanmar's heavy REE rich** reserves form ~90% of China's heavy REE imports
  - **US**, **Myanmar** and **Australia** hold **29% of global mine output**
  - **Vietnam** – emerging RE source targeting **60 kTPA REO capacity** by **2030**
- **Existing bilateral and multilateral relations:**
  - Opportunity to leverage the **Critical Minerals Investment Partnership with Australia**, and **Quad Critical Minerals Initiative**
  - India already exploring REE partnerships with **Brazil**, **Dominican Republic**

In tandem, Stockpiling could supplement import diversification to safeguard domestic manufacturers from global supply risks

- Stockpiling could ensure **continued access to minerals** and protect domestic manufacturers against **global price fluctuations**
- **Focus** stockpiling efforts on **Rare Earth Oxides** – more **stable** forms of elements, serve as **raw materials for multiple applications,** and have a **longer shelf life** increasing the timeline for inventory refreshment
- Establish stockpiling targets - 25% of 2030 demand (2-3.3 kTPA)
- **INR 5-10 Cr** capex investment required for development of **Rare Earth storage facilities**[1]

Leverage either of 2 existing models for stockpiling:

Public-sector led	**ISPRL (India)** - PSU-led acquisition of oil resources, government funded storage infrastructure that can be leased to private sector
Public-private	**JOGMEC (Japan)** - Government mineral stockpile mandate for private sector, supported by interest subvention for private sector

(1) Calculated assuming rare earth storage facility costs could reach around 1-2% of the budget allocated for stockpiling under NCMM, given the low volume of Rare Earth Stockpile requirement; Sources: The Hindu, Initial findings positive for lithium blocks in Argentina, 2025; Reuters, Indian state firm's seek stake in SQM's Lithium projects in Australia, 2025; Rare Earth Exchanges, Vietnam's Rare Earth Awakening, 2025

SUB-SECTION FOUR

CAPITAL EQUIPMENT & INFRASTRUCTURE

Capex and Infrastructure includes various dimensions in the E - mobility ecosystem and amongst them, Capital Equipment and Charging Infrastructure could be prime entry points to focus EV localisation efforts

Manufacturing Facilities and the larger EV ecosystem are 2 key tenets of capex and infrastructure for E-mobility

1 EV Manufacturing Facilities

RnD infrastructure

Includes technology development and testing labs to incorporate innovations in EV components

Pathways to localise RnD covered in the RnD section

Capital Equipment

Includes key machineries and technologies required to manufacture and test various EV components (e.g., CNC machines)

*High **import reliance on machines** required to manufacture EV components leads to **high localisation potential***

Land and On-site facilities

Includes land acquisition for setting up a facility and hardware for establishing utility (electricity, water) connections

Limited potential for indigenisation

Financing requirement[1]:
Developing and scaling EV manufacturing facilities requires investments into RnD equipment and labs, plant and machinery as well as working capital

2 EV Ecosystem

Charging infrastructure

Includes Charging connectors and guns, Charging cables, Electric vehicle supply unit (EVSE) and testing equipment

*Some manufacturers already reaching 60-70% localisation; leveraging **synergies for PCB assembly** across EV manufacturing and **EVSEs[2]** can further improve localisation*

Grid connectivity

Includes transmission and distribution cables

*Existing **grid capacity is sufficient** to meet expected demand from EVs; localisation potential will be analysed in upcoming work*

---

(1) Detailed in the Financing section; (2) EVSE: Electric Vehicle Supply Equipment;

① **Capital Equipment |** Current levels of localisation across manufacturing of EV components is as low as 35%; significant opportunity exists across EV components to boost localisation via targeted interventions

Battery pack and power electronics are critical components to increase DVA, owing to their contribution to the BOM

Key components	Battery Pack[1]	BMS	Electric Motor	Power Electronics	Chassis and Body	Others
BOM Split	35-40%	5-10%	5-15%	10-20%	15-25%	10-15%
Current component DVA[2]	10-20%	30-40%	30-40%	40-50%	80-90%	40-50%
Potential for incremental component level DVA by 2030	***25-35% unlock*** via domestic pack assembly, sub-components level manufacturing – insulation, casings, etc.	***30-35% unlock*** via PCB Assembly, software development	***10-15% unlock*** via domestic stator, rotor manufacturing[3] and motor assembly	***5-10% unlock*** via domestic electronics, interconnects manufacturing and PCB assembly	*Excluded from current analysis as significant existing levels of localisation*	***10-15% unlock*** via domestic parts manufacturing and assembling for VCUs, Infotainment systems,
Critical dependencies	CAM, AAM precursor materials	Semiconductor chips for integrated circuits	REO magnets, specialized steel	Semiconductors for inverters, DC convertors, testing infrastructure		Testing infrastructure and semiconductors

Potential to achieve 45% DVA by 2030

Currently limited by collocated battery cell and BMS development happening outside of India

---

(1) Battery Pack exclusive of Battery Management System (BMS); (2) localisation could vary between vehicle segments, for our analysis we have considered overall localisation across segments; (3) While domestic capacity focuses on stator and motor manufacturing, magnet production can be scaled simultaneously – as mentioned in the Upstream section; Sources: Praxis Global Alliance, Driving self reliance – localising EV components in India, 2025; EV Reporter, Magazine, 2025; Expert consultations

① **Capital Equipment |** Power electronics, Motors and BMS along with Batteries are key components to prioritize localisation efforts and achieve 50% DVA[1], due to alignment with other industries and significant export potential

COMPONENT	POTENTIAL SYNERGIES	KEY UNLOCKS[4] *Short term*	 *Long term*

Power Electronics	*Sub component manufacturing and PCB Assembly*
	- PCB assembly is a critical capacity across consumer electronics, automation, defence sectors
	- Opportunity to leverage ongoing policy momentum to scale domestic capacity
	  - Electronics Components Manufacturing Scheme, focusing on manufacturing of passive hardware components (sensors, connectors)
	  - India Semiconductor Mission focusing on local fabrication, assembly, testing capacities
	  - Domestic Power electronics market could have INR 10K-12K Cr export potential by 2030
		PCB Assembly	Manufacturing for Onboard chargers, DC-DC convertors, etc. via Sensors, connectors and semiconductor manufacturing

Motors	*Stator and component manufacturing, motor assembly* - Potential to leverage non-permanent magnet, motor manufacturing capacities to localise non-magnet components (stator, rotor and magnet housings – form ~55% of motor's BOM) - Domestic Motor manufacturing market could have INR 7.5K-9K Cr export potential by 2030	Motor Assembly using emerging specialized winding techniques (e.g., Hairpin Winding)	Stator, rotor, magnet housing manufacturing
Battery Management Systems (BMS)	*Software development and PCB Assembly* - Existing policy support (PCB assembly), and domestic software development capacity (India accounted for ~20% of APAC software market[2] in 2024), can be leveraged to localise BMS - Domestic BMS market could have INR 2.5K-3K Cr export potential by 2030	Software Development and PCB Assembly	PCB components and semiconductor manufacturing
	PARALLEL FOCUS		
Battery Pack	*Pack assembly, sub-component level manufacturing for insulation, casings, etc.* - Efforts to localise battery packs already running in parallel - existing policies (Advanced Chemistry Cell PLI and PM e-Drive schemes) driving localisation - Additional targeted incentives, policy support could improve DVA at cell and electrode levels[3]	Electrode Manufacturing, Cell Formation and Assembly[3]	

(1) 50% DVA across the EV value chain; (2) Asia Pacific software market exclusive of Japan and China; (3) Further detailed in the Battery Indigenisation Pathways; (4) Prioritized based on synergies with existing manufacturing capacities and expert consultations. "Short term" refers to prioritized unlocks till 2030 and "Long term" refers to time period after 2030; Source: IDC, India Software Market to hit USD 18.4 Bn by end of 2025, 2025

1

Capital Equipment | However, capital equipment for these key components faces significant import reliance on prominent suppliers of these machines – China, Japan, South Korea, etc.

High import reliance for capital equipment required across EV components

Component	Import Reliance[1]	Key Machines that are import dependent
Power Electronics	70-80%	Machines used in PCB assembly - Surface Mount Technology (SMT) Pick and Place machines, Power Module Die Bonder, Sinter Bonder
Motors	~60%	Rotor Magnet Insertion and Embedding machines, Rotor Balancing machines, and Coil Winding machines in line with emerging techniques (e.g., Hair-pin winding)
Battery Management System (BMS)	70-80%	BMS testing equipment and machines used in PCB assembly
Battery Pack	70-80%	Machines across CAM processing and Electrode formation – Coating machine, Calendaring machine, Electrolyte filling machine, etc.

While existing policy focuses on boosting domestic manufacturing of capital equipment, focus on localisation for EV sector is limited

- **Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors** also supports manufacturing for capital equipment and precision tools but focuses only on passive electronic components (sensors, connectors, etc.)
- **Union Budget 2025-26** proposed exempting Battery manufacturing machines, from BCD[2] – disincentivizing localisation of capital equipment

As a result, there's high capital equipment import reliance in EV manufacturing

- **60-80% machines are imported** across the EV value chain, with major import dependence across **Battery pack** and **Power electronics manufacturing** – key components for localisation
- Potential for **synergies with existing machine technologies** being manufactured locally, however, **modifications are required** to enable use in **EV component manufacturing** (e.g., Solder Paste Printing machines, Rotor balancing machines)

These capital equipment imports are mostly concentrated in Asian and European countries

- **China**, **Japan** and **South Korea** are prominent leaders in SMT machine manufacturing – key equipment for developing **power electronics**
- **Germany**, in addition to key Asian players, has strong capacities in **Motor** manufacturing equipment

---

(1) Based on number of machines that are imported amongst all relevant machines to manufacture a component; (2) Basic Customs Duty; Sources: Expert Consultations, Industrial market places (IndiaMart and Alibaba); MEITY, Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors; Press Information Bureau, Union Budget 2025-26 proposes to remove 7 custom tariff rates for industrial goods, 2025

2

Charging Infrastructure | Similarly, EV charging infrastructure has made strides in localisation but import reliance expected to continue in the short term, along capital equipment import reliance driven by need for PCB assembly

While charging ecosystem already claims high localisation, there is a more urgent need to scale infrastructure to meet growing EV demand

Existing policy focus on localisation of charging infrastructure has proven to be successful

- EV Public Charging station deployments under the **PM e-Drive** and **FAME II Scheme** are subject to **Phased Manufacturing Programme** guidelines to support localised assembly and machining
- As a result, some domestic charging infrastructure manufacturers are already reporting **60-70% localisation**

However, additional localisation of charging infrastructure is limited by the urgent need to scale infrastructure – resulting in expected high import reliance in the short term

- Currently, **domestic charging infrastructure manufacturing** (especially across charging guns and EVSEs[1]) is at a **nascent scale,** and developing cost-competitive manufacturing capacities could require **long timelines**
- **Rapid scale-up** required in charging infrastructure to support greater EV penetration – could result in **high import reliance** in the short term – India EV charger market **import shipments** grew by **~23%** between 2020 and 2024
- Thus, **localisation** of the entire charging infrastructure ecosystem could prove to be **strategically difficult** in the **short term**

PCB Assembly for EVSEs[1] is a key opportunity to improve localisation in EV charging

However, EVSEs could offer an opportunity to further improve localisation without hindering infrastructure scale-up

- **PCB assembly** is a prime opportunity to improve localisation for EVSEs
- Localising PCB assembly can drive **synergies** between manufacturing for **EV components** (BMS, Power electronics), **EV Charging infrastructure** and **other electronics sectors**
- However, targeted interventions are needed to reduce **70-80% import reliance** for **capital equipment** (SMT[2]) relevant to **PCB assembly**

As the charging ecosystem scales, localisation for other components could rise

- localisation for other charging infrastructure components such as **Charging guns, connectors** and **cables** can be improved through targeted interventions in the **long term**

(1) EVSE: Electric Vehicle Supply Equipment; (2) Surface Mount Technology; Sources: 6W research, India EV Chargers Market, 2024; MHI, PM e-Drive PMP Amendment, 2025

Capital Equipment | INR 9,000-16,000 Cr investment in building domestic capacity for key machines used across these components can reduce import reliance and support achieving 50% DVA across EV value chain

Building domestic manufacturing for key capital equipment and importing other critical machines are 2 pathways that can be leveraged to source key capital machinery for domestic EV component and charging infrastructure production

🟢 *High* 🟡 *Medium* 🔴 *Low*

	1 **Domestic manufacturing** for *select EV equipment with existing industry synergies*	2 **Import** *highly specialized, advanced EV capital equipment with no industry synergy*
Pathway criteria		
Synergies with other sectors	🟢 Equipment for **sophisticated electronics**, e.g., **SMT[1] equipment** for PCB[2] assembly used in **BMS**, **Power electronics**, **EVSEs3**, **consumer electronics**, **defence**, etc.	🔴 No synergies in **specialized EV-centric equipment**, e.g., precision machining for thermal management systems
Tech expertise	🟡 **Fewer improvements needed** for existing technology, e.g., **Rotor Magnet Insertion machines**, currently used for magnet insertion into **BLDC[4] motors**	🔴 Emerging semiconductor fabrication (e.g., **GaN[5] Semiconductors**), coil winding tech (Hairpin winding) – led by **Taiwan** and **South Korea**, nascent in India
Pathway unlocks	**Leverage synergies** with other sectors: • **SMT** machines with **Display-Module Assembly,** incentivized under Scheme for Electronic Components Manufacturing • **Rotor balancing machines** with medical, aerospace, defence and electronics sectors (MRI machines, fans, transformers, etc.)	• Develop **G2G partnerships** to secure continued access to key machines (e.g., **Germany**, **Taiwan**, **South Korea** – have existing equipment manufacturing capacity) • Explore **sourcing models** such as **equipment leasing systems** and **centrally operated pay-per-use facilities** – reducing cost of and improving access to key machines
% Expected Capex contribution	• **45-50%** across **PCB assembly** for Power electronics, BMS and EVSEs (~30%), and **Motors** (~80%) – e.g., **Rotor Magnet Insertion** and **SMT Solder Paste Printing Machines**	• **50-55%** across Power electronics, BMS and Motors – e.g., **Coil Winding, SMT Pick and Place Machines, SMT, Automated Optical Inspection Machine**

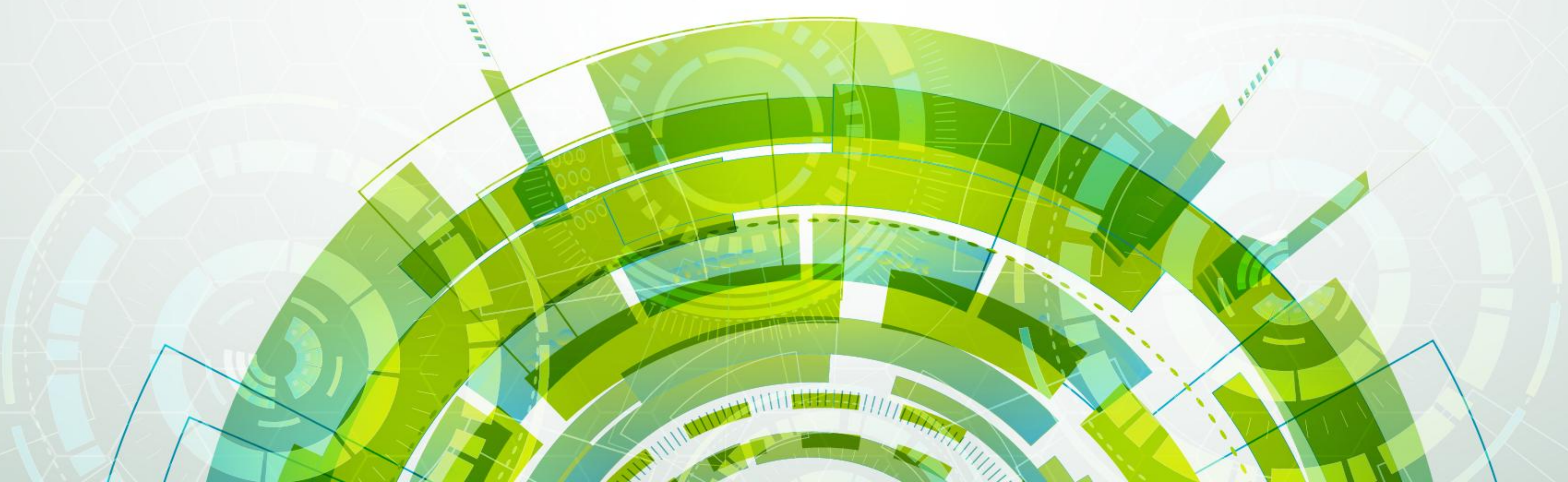
*Development of these domestic manufacturing capacities would require cumulative **INR 9,000-16,000 Cr investment till 2030**, supported by targeted subsidies (Refer to Financing Section for details)*

---

(1) Surface Mount Technology; (2) Printed Circuit Board; (3) Electric Vehicle Supply Equipment (4) Brush-less Dynamic Current Motors; (5) Gallium Nitride

SUB-SECTION FIVE

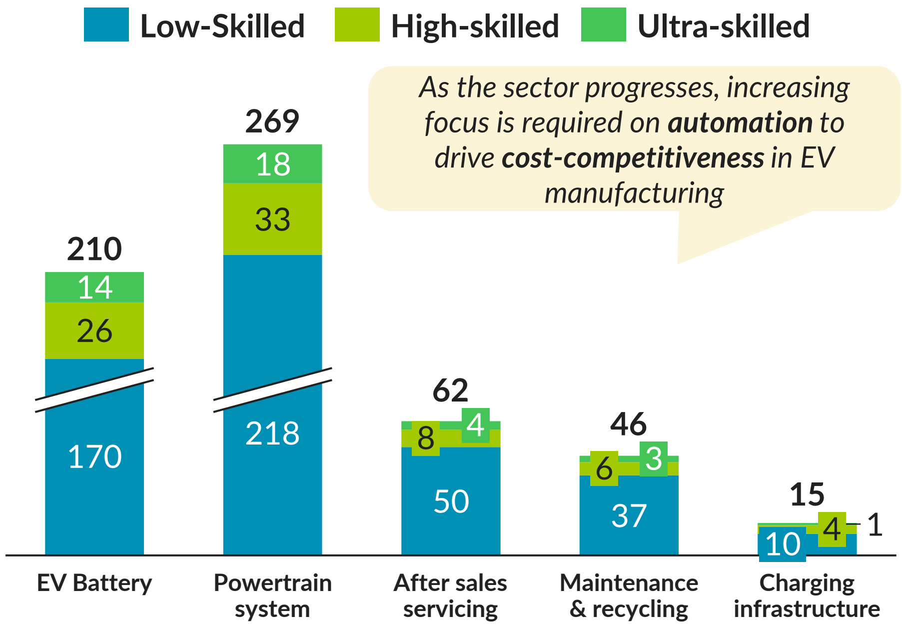
TALENT & WORKFORCE



India would require at least ~6 lakh additional ultra, high, and low-skilled workers[1] across EV manufacturing value chain by 2030

India would need ~25K permanent EV ready talent per year across Ultra, High and Low Skilled workforce by 2030 to achieve >50% indigenisation targets; separately 2/3rds of total workforce would be comprised of temporary low skilled workers

Projected (2030) additional workforce requirement for EV manufacturing value chain, in '000 workers



As the sector progresses, increasing focus is required on ***automation*** *to drive* ***cost-competitiveness*** *in EV manufacturing*

Skill levels and sources of talent for EV manufacturing

Focus

Ultra-skilled	**R&D & Innovation Experts** *Research labs, PhD/Post-graduate programs, Tier-1 engineering institutes*
High-skilled	**Engineers & Technical Specialists** *Tier-1 and Tier-2 engineering colleges*
Low-Skilled[2]	**Production line workers** *ITIs, vocational training programs*

Industry insights

EV Battery:

- Significant need of technicians for assembly/testing and engineers for electrochemistry & thermal management

Powertrain:

- Requires mix of technicians for build and engineers for motor/inverter design
- Regen braking: Primarily engineer-heavy with skills focused on electronics and integration

Maintenance & recycling

- Primarily requires technicians for dismantling, engineers for recovery, plus ultra skills for circular systems.

Total training cost[3]

INR 4,300-7,900 Cr

+

Total demo facility investment[4]

INR 3,000-5,000 Cr

=

Total budget

INR 7,300-12,900 Cr

Includes 1,000 ITI upgradation expenses

---

(1) Includes both direct and indirect workers; (2) Low skill workers includes temporary/contract workers; (3) Training cost for additional workers required across skill levels; (4) R&D and demonstration facilities across ITIs and top 100 engineering institutes

Source: SIAM, EV Talent Landscape in India: Bridging the Skill Gap for 2030, 2025; Industry experts (industry associations, key manufacturing players), Dalberg analysis

Nearly a third of the talent gap for EV would have a high overlap with ICE competencies & skills and therefore, won’t require either fresh hiring or re-skilling and can be supplemented with on the job training/shadowing

Roles with partial skill overlap with ICE vehicle skills can be addressed through reskilling using virtual instructors and simulations, while roles with minimal overlap and will require fresh skilling programs and certifications

◕ *High overlap* ◑ *Medium overlap* ◔ *Some overlap*

Area	Functional Focus	Overlap with ICE/other industries
Battery	Software – Design, product assembly and end of line, testing and validation	◕ Only BMS, HV validation have no ICE equivalent.
	Mechanical design, process setup, simulation, integration, certification & sourcing	◑ Some overlap with ICE in mechanical design and testing, but BMS integration and HV compliance are new.
	Cell assessment, systems & product selection, mechanical- product development, electrical simulation, electrical design, BMS hardware	◔ New competencies in cell chemistry and battery control electronics.
Powertrain System	Powertrain mechanics, quality control & testing	◕ Significant overlap with ICE (gear machining, assembly, QC).
	Systems design	◑ Overlaps in drivetrain layout, but EV motor–inverter design is new.
	Power train electricals, power electronics, thermal design	◔ Power electronics and HV thermal mgmt are new vs ICE.
Regenerative Braking	Drivetrain design	◕ Overlap with ICE drivetrains, but energy recovery integration is new.
	Vehicle dynamics modeling, direct drive applications	◑ EV torque-vectoring/direct drive systems have little ICE precedent.
	Power electronics	◔ No direct ICE analogue; requires new skills.
After-sales Servicing	Servicing – mechanics, quality & inspection, testing and validation	◕ Strong overlap with ICE workshops; EV adds HV safety.
	Servicing – electricals,, battery safety, operating digital interfaces	◑ ICE experience in diagnostics overlaps partly; EV battery safety is new.
Maintenance & Recycling	Product assembly and end of line, mechanical – simulation	◕ Overlap with ICE dismantling/testing, but HV/materials recovery new.
	Product management	◑ General mgmt skills overlap, but EV lifecycle planning is distinct.
	Diagnostic battery management, electrical simulation	◔ No ICE equivalent; unique to EVs.

Source: SIAM, EV Talent Landscape in India: Bridging the Skill Gap for 2030, 2025; Industry experts (industry associations, key manufacturing players), Dalberg analysis

Compared to EV manufacturing, charging infrastructure has far fewer overlaps with ICE, making the ecosystem far more dependent on fresh skilling.

While civil works, wiring, basic O&M skills can be adapted from existing trades, the majority will require fresh skilling in power electronics, grid integration, and compliance

◕ *High overlap* ◑ *Medium overlap* ◔ *Some overlap*

Area	Functional Focus	Overlap with ICE
Manufacturing & Assembly	Cabinet fabrication, connectors, enclosures; integration of power modules	◕ Mechanical fabrication overlaps with ICE suppliers, but EVSE-specific power electronics and safety standards are new.
Installation & Commissioning	Civil works, site prep, electrical wiring, meter integration, utility interfacing	◕ Civil/electrical work overlaps with ICE infra projects, but HV-DC wiring and smart metering are new.
Operations & Maintenance (O&M)	Preventive maintenance, field servicing, remote monitoring, firmware updates	◑ Basic O&M overlaps with ICE fueling infra; EVSE diagnostics and digital monitoring are new.
Testing & Certification	Safety compliance, EMI/EMC, interoperability testing, calibration	◑ ICE has emissions/mechanical testing, but EVSE requires new standards for interoperability and electrical safety.
Program & Ecosystem Management	Grid integration, load balancing, planning, policy & regulatory management	◔ Minimal ICE precedent; EV requires new skills in power systems, regulation, and utility coordination.

Source: TERI, EV Charging in India: Ecosystem Perspectives and Skilling Opportunities, 2025; Industry experts (industry associations, key manufacturing players), Dalberg analysis

Action would be required across four critical levers to successfully build this workforce: reducing foreign trainer dependency, standardizing course design, improving employability and securing financing

Applicability: 🟢 Ultra-skilled 🟡 High-skilled 🔵 Low-skilled

LEVERS	CURRENT STATUS	APPLICABILITY	RECOMMENDATIONS
Trainers	Limited pool of EV-ready trainers; some pilots (like DGT–Shell) are creating a nucleus of master trainers.	🟢🟡🔵	• **Build 'Train the Trainer' pipelines** with tiered specialization (technician, engineer, ultra-skill profiles) supported by standardized toolkits and regular industry immersion programs with OEMs (Tata, Mahindra, Ola Electric) and Tier-1 suppliers (Bosch, Continental)
Course Design	Initial EV modules (90–240h) exist in ITIs/ASDC curricula, but often lack depth and alignment with industry standards	🟢🟡🔵 🟢🟡 🔵	• **Develop modular, stackable skilling pathways** — short-term certifications for technicians, diplomas for engineers, and advanced Master's programs for ultra-specialists in batteries, power electronics, and recycling • **Setting up R&D infrastructure, live demo plants** and access to industry R&D facilities for engineering students • **Embed hands-on labs/demo facilities** within curricula and align programs with ASDC/NSDC frameworks for national recognition and portability. • **Upgrade training labs and existing course structures** (at undergraduate and graduate levels) to align with latest industry developments
Employability	Placement linkages remain weak; many trained candidates are not absorbed due to skill mismatches.	🟢🟡 🔵	• **Live internships** and **on-the-job training** through jointly funded industry-government partnerships • **Link skilling to apprenticeships and placement pipelines**, ensuring job-readiness through mandatory industry-based assessments.
Finance	Disaggregated investment in manufacturing skills – either directly at ITI level or manufacturer-led on-the-job training	🟢🟡🔵 🟢🟡🔵	• Invest **INR 6,500-11,500 Cr** for training programs and demonstration facilities and R&D labs across skill levels through **innovative financing instruments** (e.g., skill bonds) • Catalyze private sector investments in skilling, **CSR and private foundation** funding for ultra-skilled talent development and ITI investments

(1) As per recommendations for R&D infrastructure upgrade in R&D section, leveraging the upgraded infrastructure for training is imperative

Source: Industry experts (industry associations, key manufacturing players)

Skilling efforts for EV manufacturing across skill levels could focus on strengthening industry linkages and global partnerships, along with offering specialized courses in engineering colleges and ITIs

Skill level	Recommendations	Responsible Ministry/Agency
Ultra-Skilled	• **Develop 'Train the Trainer'[1] program** to train 200–300 trainers/academicians from top 100 engineering colleges with help global trainers via G2G partnerships and create domestic Centres of Excellence in batteries, power electronics, and recycling • **Develop Quality Improvement Programs** on similar lines to facilitate industry aligned skill development for teachers and trainers at **Tier 2** and **Tier 3 institutes**	Ministry of Education, Ministry of Skill Development and Entrepreneurship (MSDE), Directorate General of Training (DGT)
	• **Attract EV experts** from the Global OEMs (EU, Korea, Japan, China) to **train academicians and professors** at Tier 1 Engineering colleges (top 25-30)	MSDE, Ministry of Education
	• **Launch dedicated master's programs** that blend technical skills with policy & regulatory skilling (safety, interoperability, grid integration)in tier 1 Engineering colleges	Ministry of Education
	• Develop jointly funded **industry-government on-the-job training initiatives** with global exposure to retain talent in India	Ministry of Education, DGT
High-Skilled	• **Introduce 6-month certification courses** or **1-year function specific courses** (BMS, motor design, powertrain testing), backed by simulation-heavy learning (digital twins, HIL rigs) and joint faculty–industry projects	Ministry of Education
	• **Strengthen industry-academia** by co-delivery of cleantech manufacturing modules, and internships at manufacturing plants for engineering students	Ministry of Education
Low-skilled	• **Develop standardized qualification packs and courses** (HV-safe technician, battery service associate) that reflect a superset of competency requirements defined by private sector manufacturers	National Council for Vocational Education and Training, DGT, Skill Council for Green Jobs, Electronics Sector Skills Council of India
	• **Develop targeted reskilling modules to transition workers from adjacent** industries — e.g., automobile mechanics for EV servicing and powertrain assembly, electronics technicians for battery pack assembly and BMS, and chemical/process engineers for cathode/anode material manufacturing	NCVET, DGT, SCGJ, ESSCI, ITIs

---

(1) The "Train and Trainer" program is applicable to the high-skilled workforce as well

SUB-SECTION SIX

FINANCING & TAXATION

INR 228.6-302.6 K Cr would be required during 2025-30 to achieve 50% indigenisation across the EV value chain, build a cohesive R&D ecosystem and train the required workforce

Government funding of INR 71.4-75.4K Cr would be required across demand acceleration, R&D, workforce skilling and subsidies on electricity, capex and interest by 2030 to achieve these goals

Theme	Total Funding Required (INR Cr)	Government Funding Required (INR Cr)	Key Activities	Potential outcomes
Demand & Market Architecture[1]	45,500-46,200	40,600-41,200	Subsidies for E4Ws, E-buses and E-trucks segment to drive further adoption and improving the business case of charging stations for CPOs	Additional 5 Mn E4Ws, 65,000 E-buses, 27,000 E-trucks and 8.7 lakh charging points by 2030
R&D & Product Innovation	5,000-7,700	2,250-3,450	4-6 R&D development and 2 testing labs for EV Component level R&D; INR 1,000-1,200 funding for project grants	Indigenous development of EV Component technologies; accelerated adoption of early-stage innovative global technologies
Upstream Raw Materials & Critical Inputs	5,200-6,200	900-1,100	Input subsidies on capex for domestic Rare Earth Oxide production capacity; investment in magnet recycling facilities to support circularity	Reduce import dependency on refined Rare Earth Oxides; meet Oxide demand through recycled Permanent magnets
Capital Equipment & Infrastructure	165,600-230,000	~24,600	Ⓐ Indigenous production of up to 50% equipment for Power electronics, Motors, BMS and EVSEs[2];	Reduce import dependence for equipment where feasible; drive accelerated EV capacity expansion
			Ⓑ Capex & interest support across component & charger manufacturing, & vehicle assembly	Improved manufacturing capacity and efficiency, potentially leading to higher localisation for EVs
			Ⓒ Structural modifications to Auto PLI[3]	Enabling greater access to, and utilization of PLI
Talent & Workforce	7,300-12,900	3,000-5,000	Training additional 6 Lakh ultra, high, and low skilled workers across the EV value chain and setting up demo training and R&D facilities	Ensuring a stable supply of workers, reducing attrition and lowering training costs for manufacturers
TOTAL	228,600-302,600	71,400-75,400		

Ⓧ *Detailed ahead*

---

(1) Includes ~INR 31,700 Cr available undisbursed funds under PM E-DRIVE and PM E-bus Sewa to drive EV adoption across vehicle segments; (2) Investment estimations for this intervention have been covered in the Financing section; (3) Auto and Auto Components PLI

Capital Equipment & Infrastructure | Enabling greater EV penetration & localisation requires both financial support to scale Component and Equipment manufacturing capacity, as well as effective support disbursement measures

Three key questions were explored withing Financing for capex and infrastructure:

A **What is the capex investment needed to scale local capital equipment manufacturing?**

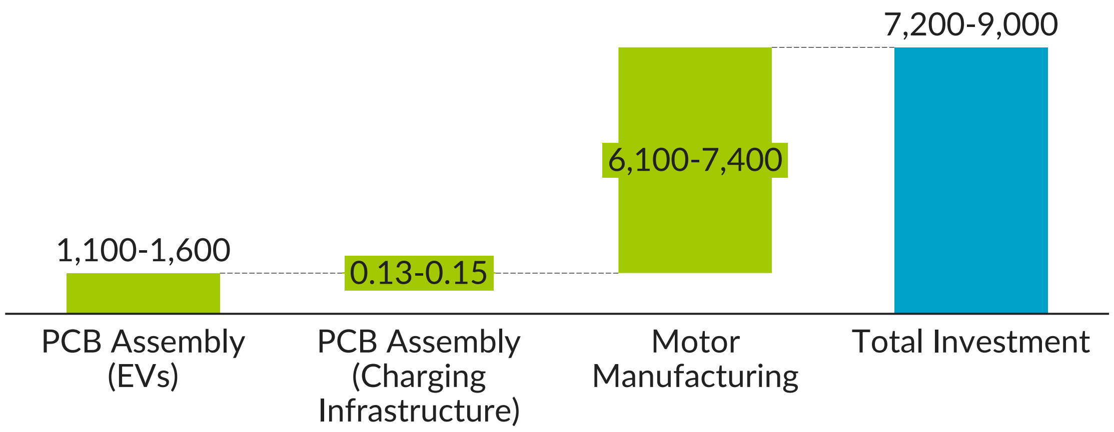
B **What is the total capex and working capital needed to scale local EV component manufacturing ecosystem?**

C **How can existing financing support mechanisms (commonly PLIs) be made more effective in supporting local EV component manufacturing?**

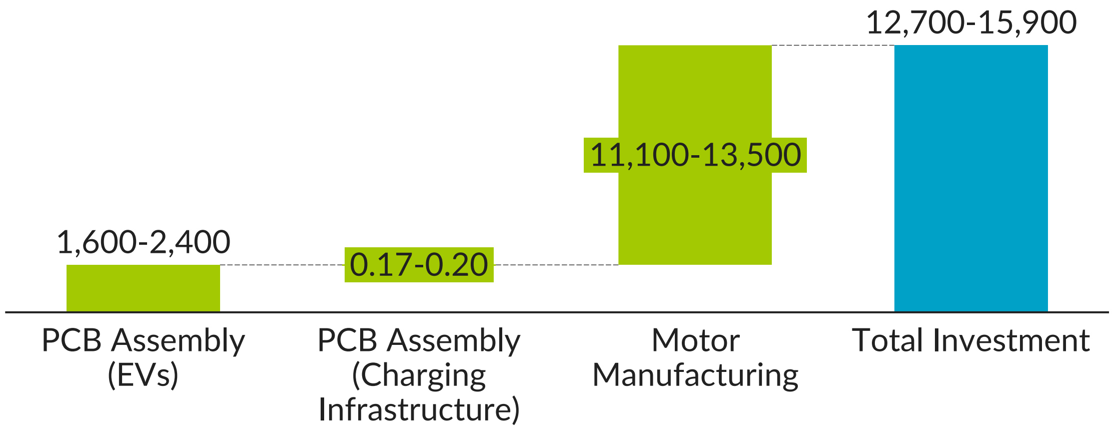
A Capital Equipment & Infrastructure | Development of local capital equipment manufacturing facilities requires additional Capex subsidies of INR 1,800-2,250 Cr in Conservative and INR 3,175-3,975 Cr in Optimistic scenario

Cumulative investment required to develop capital equipment capacity to support 50% localisation across EV ecosystem, INR Cr[1]

Conservative Scenario[2]



Optimistic Scenario[2]



Key Insights:

- Scaling capital equipment availability for **PCB Assembly** can **unlock localisation across multiple sectors** – building the **foundation for** backward integration into **PCB manufacturing**
- Some players already claim **60-70% localisation** on **charging infrastructure**, and **PCB Assembly** for **EVSE's** could further improve localisation

Key machines to indigenise[3]:

- **PCB Assembly:** Reflow Oven, Loading and Unloading, Solder Paste Printing and Wave Soldering Machines
- **Motor Manufacturing:** Rotor Magnet Insertion and Rotor Balancing Machines

Total investment required:

Conservative Scenario:
INR 8,100-10,100 Cr

Optimistic Scenario:
INR 14,200-17,800 Cr

Subsidy required @ 25%[4]:

Conservative Scenario:
INR 1,800-2,250 Cr

Optimistic Scenario:
INR 3,175-3,975 Cr

---

(1) Investment limited to capital equipment for EV sector; (2) Scenarios in line with the scenarios used to forecast annual EV registrations – detailed in Demand Acceleration section; (3) Machines with synergies with other industries are considered. Investment for PCB Assembly excludes Pick and Place, and Automated Optical Inspection machines, and Investment for Motor Manufacturing excludes CNC Machines and Coil Winding Machines; (4) Similar subsidies of 25% exist under Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS) for power electronics and PCBs. This recommendation aims to ensure these benefits cascade to the EV sector.

B

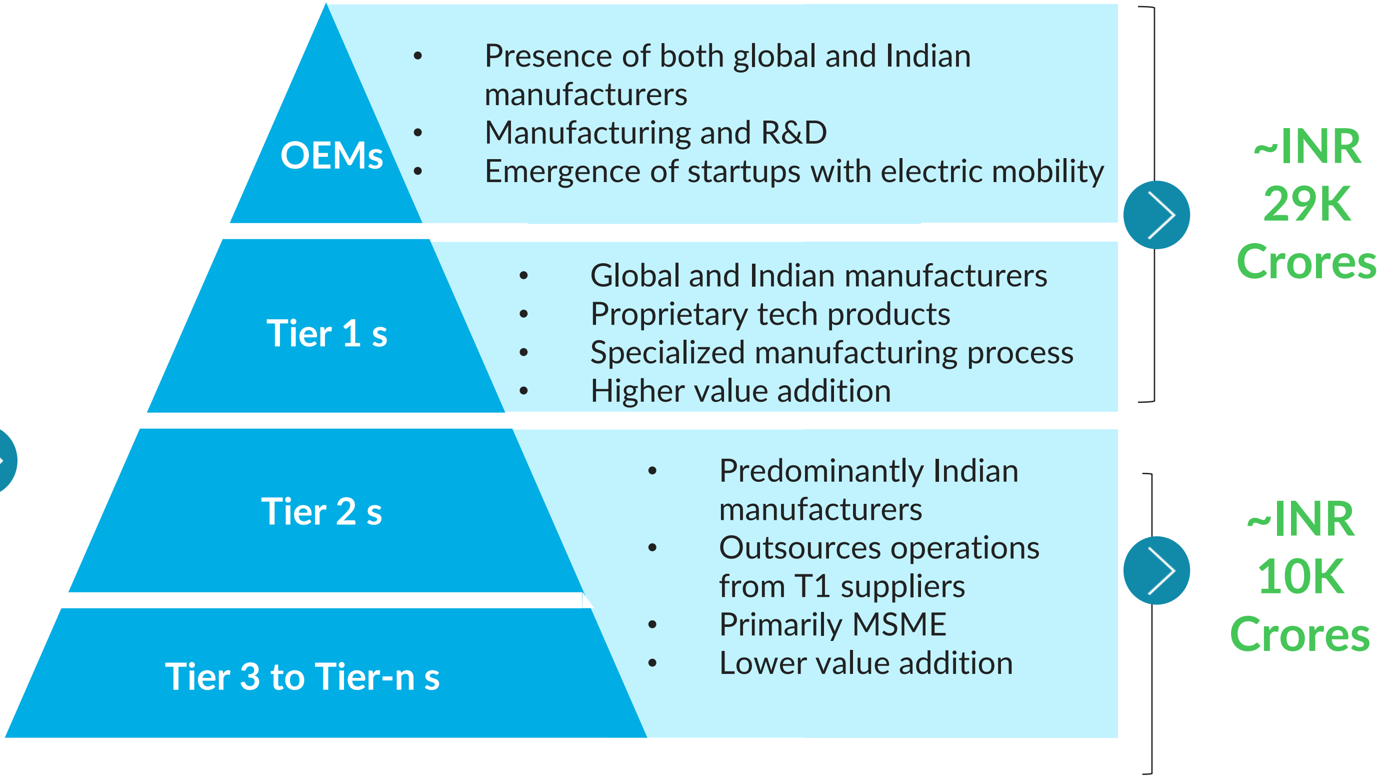
Capital Equipment & Infrastructure | Financing EV manufacturing ecosystem is expected to require ~INR 156.7-213.8K crore till 2030 across OEMs and auto component manufacturers, partially covering interest costs

INR 124-164K Cr capex investment and INR 12-18K Cr government support required for EV ecosystem by 2030

	Investment required *(INR crore)*	Subsidy Support[1] *(INR crore)*
Component manufacturing		
BMS & other systems	~5.6K	~0.5K
Motors	~9K	~0.8K
Power electronics	~11.2K	~1K
Working capital needs	~18K	-
OEM–led Vehicle assembly	26-63.7K	2.3-5.7K
Charging infrastructure manufacturing[2]	40.6-52.2K	0.7K
Other ecosystem investments[3]	3.7-13.6	
TOTAL	124-163.5K	~12.4-18.2K

Additionally, government led concessional finance of INR 5.8-9 K Cr can be provided to support EV ecosystem manufacturers cover interest costs of INR 29.2-44.9K Cr[3]

Financing requirements for component manufacturing will vary significantly between OEMs and auto-component manufacturers



OEMs
- Presence of both global and Indian manufacturers
- Manufacturing and R&D
- Emergence of startups with electric mobility

Tier 1 s
- Global and Indian manufacturers
- Proprietary tech products
- Specialized manufacturing process
- Higher value addition

~INR 29K Crores

Tier 2 s

Tier 3 to Tier-n s
- Predominantly Indian manufacturers
- Outsources operations from T1 suppliers
- Primarily MSME
- Lower value addition

~INR 10K Crores

The expected component manufacturing capex investment is expected to increase to INR 55K crores by 2035, of which INR 14K crores will be needed for the MSME segment

---

(1) Capex subsidies calculated at a 20% rate, similar to existing government schemes; (2) Subsidy support for charging infrastructure estimated is above and beyond INR 4,000 Cr specified as a demand intervention, and is required only in optimistic scenario; (3) Available budget under the Auto and Auto Component PLI that is expected to be required in the ecosystem; (4) Interest costs assume 11% interest rate, 70% Debt component and a 7 year loan tenure for capex financing. 20% of these costs are expected to be met via the government led concessional debt; Source: CPI, Roadmap for an Automotive Component Technology Upgradation Facility, 2025

B

Capital Equipment & Infrastructure | However, MSMEs face heightened challenges when compared to OEMs & Tier 1 s, especially for financing, compliance pressures and in terms of the institutional structures

While the financing needs for Large OEMs and T1 s are large, they can tap into greater sources of finance owing to stronger balance sheets, targeted PLI schemes etc. however, MSMEs face greater critical challenges including -

1 Financial & Market Access Challenges

- **Restricted access to formal credit:** Banks demand consistent profitability, and clean credit records. Lack of collateral further blocks credit access for newer/smaller MSMEs

- **Bias in equity investment:** PE/VC models favor scalable, late-stage, high-growth companies. Early-stage MSMEs capture just 1% of investment value, making it difficult to raise funds at critical growth phases.

2 Cost & Compliance Pressures

- **Prohibitive capital costs for modernization:** Transitioning to EV components requires heavy investment in advanced R&D facilities and specialized machinery, much of which must be imported

- **High overheads limit efficiency:** Complex compliance and credit access challenges generate significant administrative costs. These overheads consume scarce managerial bandwidth and slow MSMEs' ability to focus on growth and competitiveness.

3 Ecosystem Weaknesses

- **Underinvestment in innovation**: Only 22% of total investment (USD 162 million) is allocated to R&D and NPD. Capital flows are directed toward scaling operations rather than supporting innovation.

- **Weak ecosystem integration:** Fragmented supply chains and limited coordination among suppliers, financiers, and technology providers reduce economies of scale and slow modernization.

B Capital Equipment & Infrastructure | Ensuring financing availability for MSMEs across EV tech development lifecycle will be critical especially with acute capital shortages during prototype and early commercialization

TRL Band	Typical Funding Now Available	Core Financing Gaps / Barriers	% of total investment needed
TRL 1–3 Idea to lab proof	• DST, CSIR, academic grants • Startup India Seed Fund • NIDHI-PRAYAS micro-grants- • Founder capital	• Non-academic founders struggle to access public R&D pools • Almost no angel/VC appetite for pre-prototype hardware • Grants (₹10–20 lakh) cover only a fraction of lab & test-rig costs	**~15%** Small capital per project but many ideas. High technical risk; relies on grants/seed funding
TRL 4–6 Prototype to pilot in a relevant environment	• DST EVolutionS grants (up to ₹50 lakh) • Technology Development Board's soft loans • Limited angel / climate-tech seed funds	• Prototyping, tooling & certification need ₹1–5 crore • Public support capped, equity investors still see high-tech market risk • Bank credit unavailable without collateral or revenues	**~35%** Costs jump ~10× vs. lab stage; Government/targeted funds crucial to de-risk this stage
TRL 7–9 Pilot plant to commercial scale	• Series A/B venture equity & venture debt- Bank/SIDBI loans; credit-guarantee schemes (CGTMSE, CGSS) • Central/state capex subsidies; Auto & ACC-Battery PLIs	• Capex of ₹50–200 crore exceeds most MSME balance sheets • PLI eligibility (₹500 crore revenue / ₹150 crore assets) sidelines MSMEs • Working-capital crunch as OEM payment cycles stretch • Banks remain risk-averse despite guarantees	**~50%** Dominates funding needs due to heavy capex. Lower tech risk but still financing hurdles (banks reluctant without de-risking). Largest share ensures MSMEs can build production capacity by 2030.

Chronically underserved

Source: CPI, Roadmap for an Automotive Component Technology Upgradation Facility, 2025

B

Capital Equipment & Infrastructure | A mix of funding instruments will be necessary for MSMEs to meet 50% localisation targets and maintain their current 25% share in industry's turnover

TRL Band	Recommended instruments & interventions
TRL 1–3 Idea to lab proof	• **Dedicated innovation fund:** A pooled pre-seed EV innovation fund blending public R&D grants with corporate CSR/VC catalytic capital • **Challenge-based innovation prizes:** Modeled on global ARPA-E/EIC calls, prize-based competitions for EV MSME innovations in motor design, battery packaging, and electronics. Similar to China's **"Little Giants"** program which certifies high-tech SMEs for preferential loans, subsidies, and research partnerships – demonstrating how early-stage public support plus recognition can unlock MSME innovation.
TRL 4–6 Prototype to pilot in a relevant environment	• **Blended-finance bridge funds:** Structures that pair concessional debt or first-loss guarantees with private VC. • **Extended EvolutionS-type programs:** Larger ticket sizes (₹2–5 crore vs. ₹50 lakh) through state incubators, tied to performance milestones • **OEM-backed pilot funds:** Co-financing pools where OEMs and Tier-1s share pilot risk with MSMEs, ensuring order visibility • **Enhance utilization of equity fund from SIDBI:** Simplify access and broaden eligibility for MSMEs while building readiness programs for equity investments to ensure fuller fund utilization
TRL 7–9 Pilot plant to commercial scale	• **MSME-tier PLI:** Lower eligibility thresholds (e.g., ₹50 crore revenue instead of ₹500 crore) and milestone-based disbursal • **Interest subvention funds:** Dedicated concessional loan window reducing MSME borrowing costs from ~12–14% down to 7–8% • **Transition funds with co-investment:** Government-backed cornerstone investors catalyzing family offices/DFIs into MSME tech-upgrade funds

Source: CPI, Roadmap for an Automotive Component Technology Upgradation Facility, 2025

C

Capital Equipment & Infrastructure | Automobile and Auto Component PLI (critical public support mechanism), witnessed some success, but also faces critical challenges limiting efficient fund disbursal and utilization

The Automobile and Auto-Component PLI has been a valuable tool in boosting domestic EV manufacturing…

115 & 82
applications received and shortlisted respectively across OEMs and s

18 & 4
OEMs received approval for individual products and received incentive payouts respectively

INR 25K Cr
committed as investments under the scheme till December 2024

INR 322 Cr
disbursed as incentives till March 2025

…however, the EV ecosystem faces some challenges in effective fund disbursal under such PLI schemes

PLI list currently anchored towards legacy players:

- **High threshold requirements** (INR 10K Cr annual revenue for OEMs and INR 500 Cr for s) limit startup and MSME participation
- Non-PLI status for such players results in **challenges in accessing finance and investments**, resulting in **12-16% operational disadvantages** compared to PLI awardees
- This could further **stifle innovation** and limit **risk appetite** amidst startups, limiting innovation in the EV sector

Current PLI structure is narrow in its focus on outcomes:

- Current structure of the scheme doesn't incentivize **ecosystem level development**, due to narrow focus limited to **DVA in manufactured goods**
- However, there are other, equivalently critical outcomes that can be tied to the PLIs – for e.g. R&D, Workforce, Exports)

Sources: Mint, PLI-Auto adds three more firms to the roster, 2025; PIB, PLI Scheme for Automobile & Auto Components driving investments, employment and growth, 2025

C

Capital Equipment & Infrastructure | Expanding PLI scope and boosting inclusivity are key measures to improve effectiveness of PLI funds in driving ecosystem level development for domestic EV manufacturing

Structural modifications for PLI Schemes

1

Separate set of threshold limits for small-scale actors

- **Re-evaluate PLI process and eligibility criteria** to make them friendly to startups and MSMEs
- PLI status could **enable access to finance** and investment for **non-legacy actors**, **facilitating innovation** in the sector

2

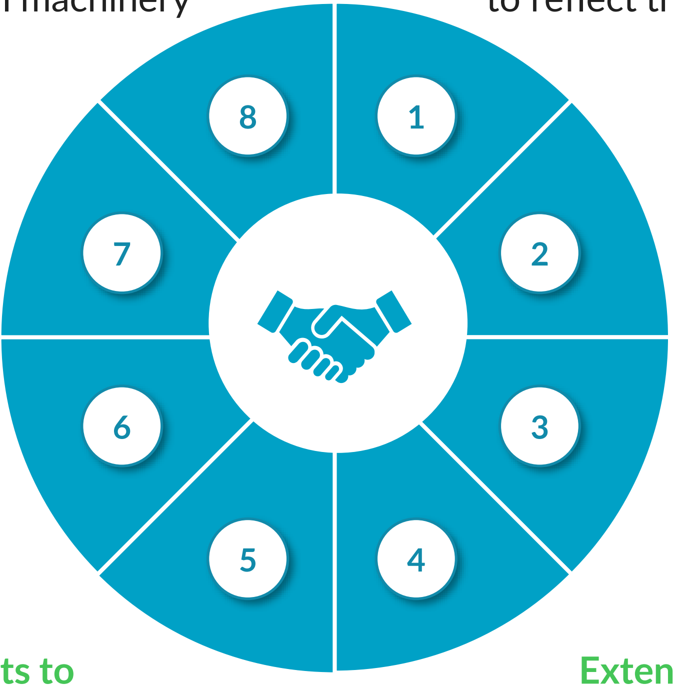
Tie PLI requirements to other critical sector outcomes

- Expand **fund disbursement metrics** to track broader **ecosystem outcomes** (e.g., number of patents filed, job creation, export volume)
- Widening PLI focus could result in **innovation and scale-up** across **upstream** (REOs, Rare Earth Magnets) and **downstream segments** (new-tech based components)

Financing costs could also be lowered via concessional capital from DFIs, MDBs, bilateral funding, and lowering domestic borrowing costs through credit guarantees, concessional lines of credit, among others

NON-EXHAUSTIVE

An enabling environment could be created to facilitate tapping of domestic and international capital sources at concessional rates – targeted policies for EV and other cleantech manufacturers required



Easing access to equity capital by **relaxing exchange listing requirements** on profitability for EV manufacturers to reflect their longer path to profitability

Utilizing GIFT-IFSC's regulatory flexibility and lower transaction costs for green/transition bond listings and attracting foreign equity

Establishing **targeted Cleantech or Energy Transition Indices** to promote passive investment though mutual funds

Extending Priority Sector Lending and **concessional line of credit** to banks for EV manufacturing (similar to China's CERF program)

Structured guarantee instruments and **grants to reduce guarantee fees** to promote green bond issuances among first time issuers

Relaxing regulations to enable pension and insurance funds **invest up to specified limits in lower credit ratings**

Leveraging DFI, Multilateral concessional capital potentially backed by EU, bilateral guarantees, E.g. EU Global Gateway strategy, India-ETFA TEPA

Developing **structured bonds** with DFIs and MDBs **blending INR and foreign currency** denominated tranches to fund projects requiring significant imports of capital machinery

Source: Industry experts (industry associations, key manufacturing players), Dalberg Analysis

bharat
CLIMATE FORUM

Thank you!

Disclaimer and Use Restriction notice

This document has been prepared by Dalberg Development Advisors Private Limited (“Dalberg”) and contains strictly confidential, proprietary, and commercially sensitive information. It is intended solely for the exclusive and internal use of the designated recipient(s) in connection with a specific advisory engagement.

The content, data, analysis, methodologies, and intellectual property contained herein are the sole property of Dalberg and are protected under applicable copyright, trade secret, and other intellectual property laws. Any reproduction, distribution, dissemination, disclosure, copying, or use of this material-whether in whole or in part, and whether in its original form or any modified form-without the prior written consent of Dalberg is strictly prohibited.

This document not be shared with, or disclosed to, any third party- including but not limited to competitors, partners, vendors, or affiliates - without express written authorization from Dalberg. Unauthorized use or disclosure of this material may result in appropriate legal action.

Council for
International Economic
Understanding

Dalberg