



## High-Level 16th Regional EST Forum in Asia

Sustainable Urban Mobility Solutions- Empowering Cities towards Low Carbon Pathways for Achieving Co-benefits & Economic Resilience in the SDGs Era

11 December 2024

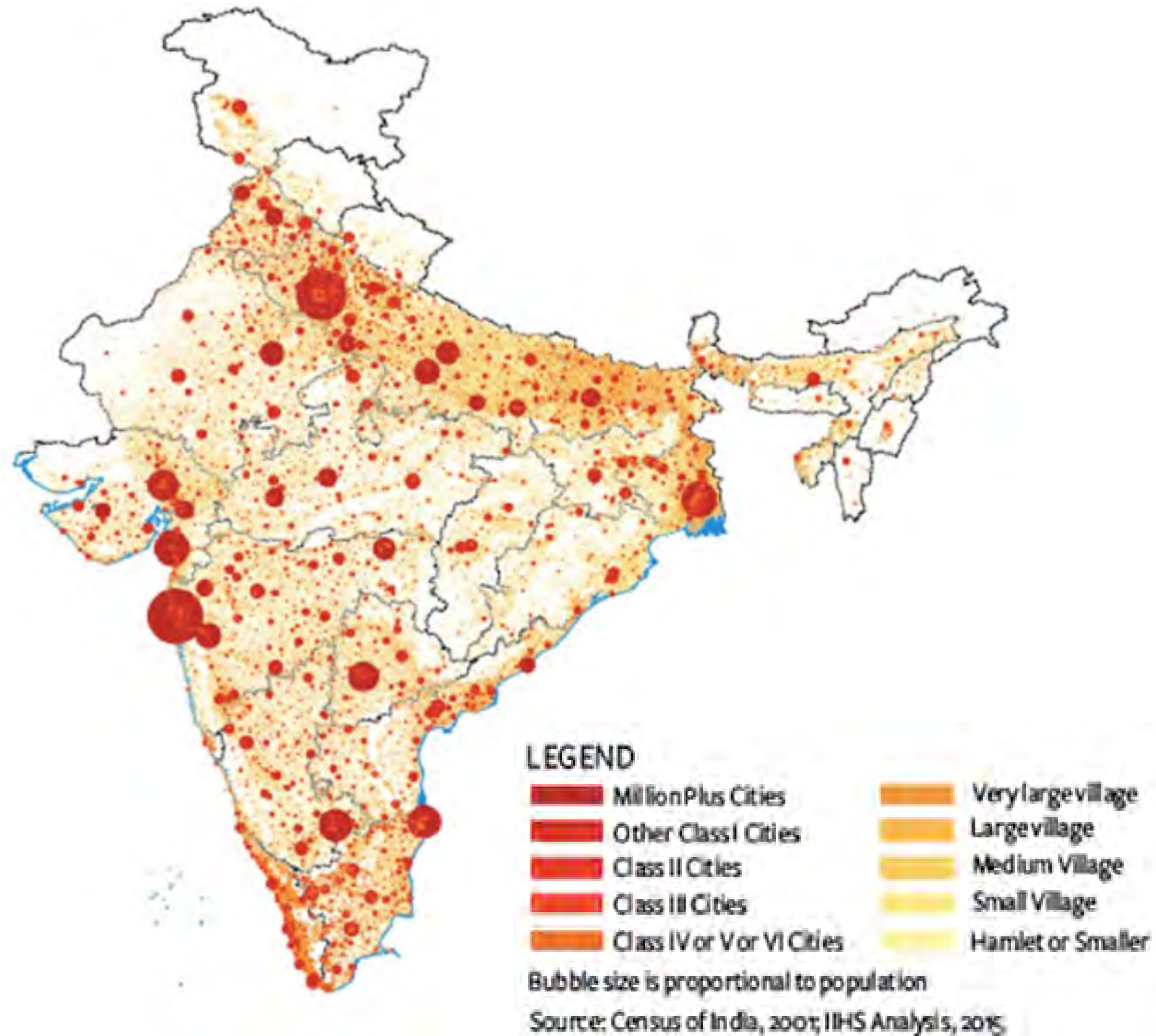
# ELECTRIC MOBILITY TRANSITION IN INDIA



WRI INDIA



# INDIA: A SNAPSHOT



TOTAL POPULATION

**1.4 billion**

URBAN POPULATION

**0.5 billion**

**(25.87%)**

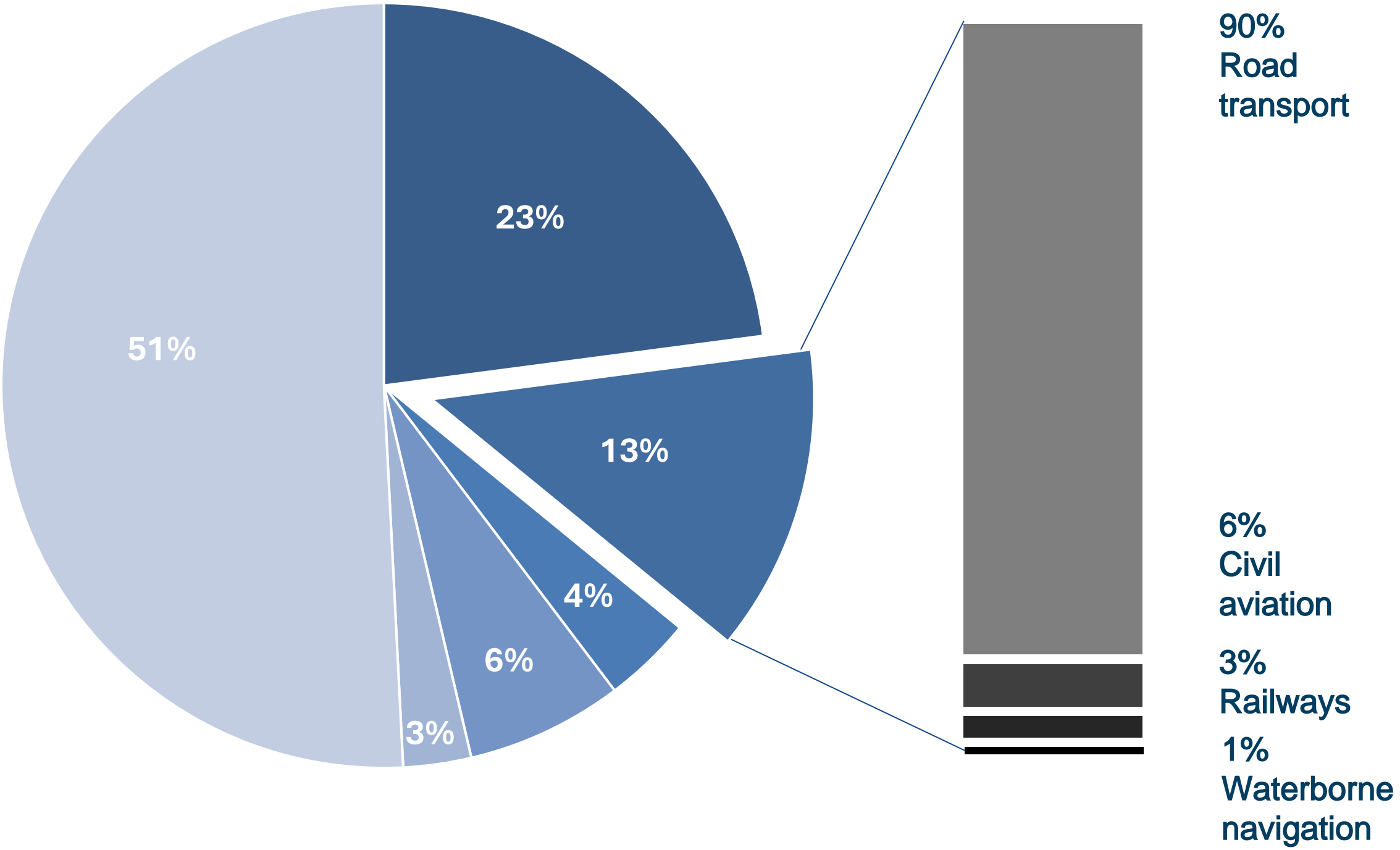
GDP PROJECTED GROWTH RATE

(2023)

**7%**

# INDIA GHG EMISSIONS: TRANSPORT SECTOR

Distribution of CO2e Emissions- Energy Sector



■ Manufacturing ■ Transportation ■ Fugitive Emissions ■ Building ■ Other Fuel Combustion ■ Electricity

- The share of energy sector in India's total greenhouse gas (GHG) emissions for the year 2019 was **71.87%**.
- Road transport accounts for 90% of the emissions from the transport sector.
- In the business-as-usual (BAU) scenario, **CO<sub>2</sub>** emissions from the transport sector are expected **to grow** by more than **200% by 2050**.

Sources: MoEFCC. (2021). India: Third Biennial Update Report to the United Nations Framework Convention on Climate Change. Ministry of Environment, Forest and Climate Change, Government of India; Kumar, Megha et al (May 2022). Decarbonizing India's Road Transport: A Meta-Analysis of Road Transport Emissions Models.

# NATIONAL-LEVEL POLICY INITIATIVES FOR EVs IN

2013

National Electric Mobility Mission Plan 2020 - A roadmap for electric mobility with an outlay of **USD ~1.68 billion**

2015

**FAME-I** scheme launched

2016

\*MoRTH announces provision of EV charging in model building Byelaws

2018

- MoRTH exempts EVs from permit requirements
- Ministry of Power releases Guidelines and Standards for EV charging infrastructure

2019

- Income tax benefit for EVs
- GST on EVs and charging stations reduced to 5%
- **FAME-II** launched with an outlay of **USD ~1.2 billion**

2021

- Production Linked Incentive (PLI) Scheme for Advanced Automobile and Auto Components with an outlay of **USD 3.2 billion**
- PLI Scheme for National Program on Advanced Chemistry Cell (ACC) Battery Storage with an outlay of **USD 2.2 billion**
- Vehicle Scrapping policy announced

2022

- Draft Battery Swapping Policy released
- MoEFCC\*\* releases Battery Waste Management Rules, 2022.
- MoHUA released stringent standards for EV battery testing standards.

2023

- India becomes a member of the Mineral Security Partnership (MSP)
- PM e-Bus SEWA launched with the **central financial assistance of USD ~2.4 billion**

# TRAJECTORY OF ELECTRIC MOBILITY TRANSITION

## Current Stock (as of Nov 2024)



Two-wheelers

2,370,069



Three-wheelers

1,763,058



Cars

1,84,970



Buses

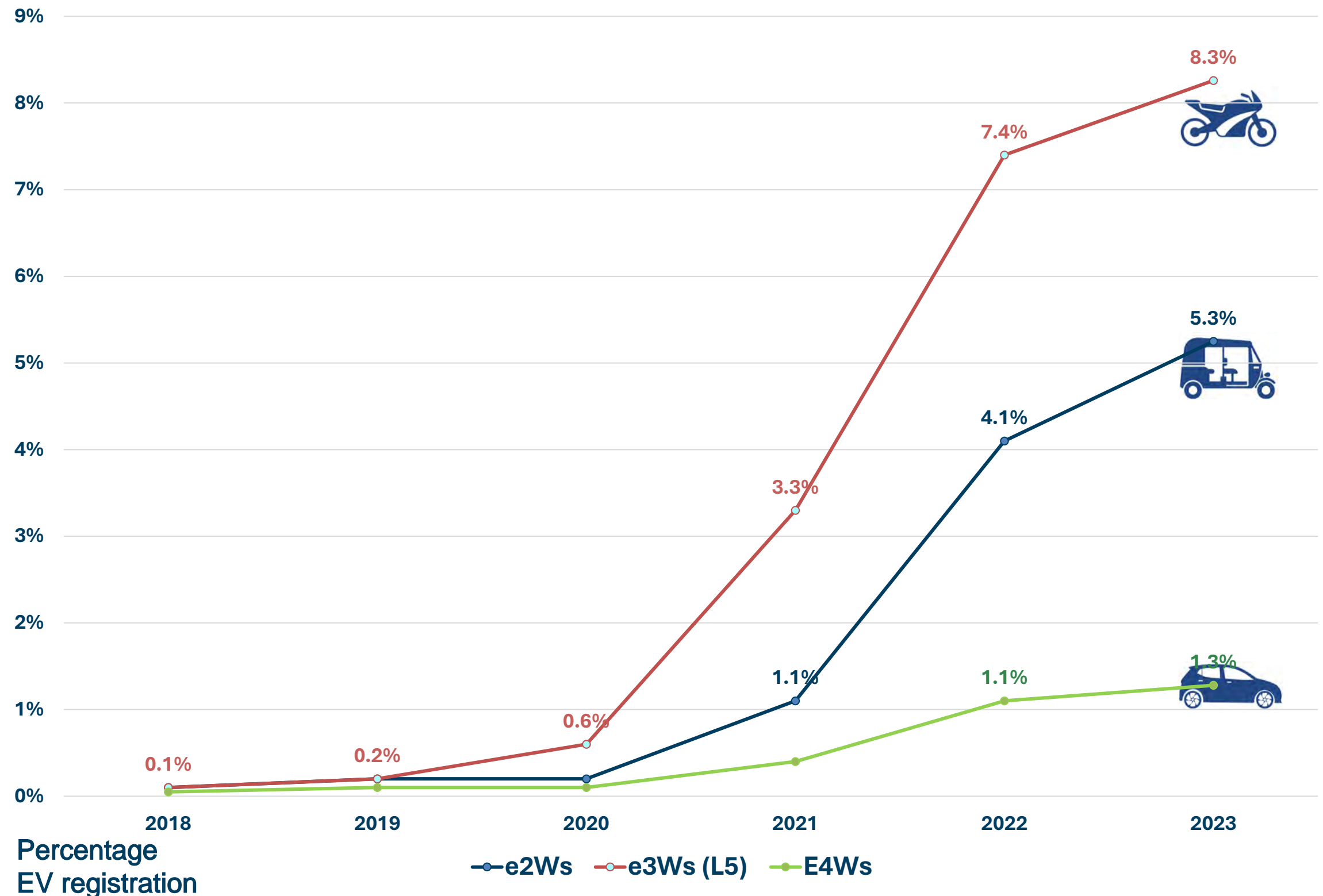
9,391



Public chargers as of March 2023

6,586

## EV REGISTRATIONS BY SEGMENT



Source: Vahan Data; \*Conservative scenario is the Stated Policies Scenario (STEPS) and optimistic scenario is the Announced Ambitions Scenario (APS)– IEA EV Outlook 2022; \*\* For 2019 & 2020: Not inclusive of Telangana, AP, MP and Lakshadweep, For 2021: Not inclusive of AP, MP and Lakshadweep

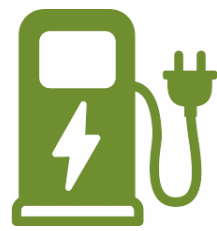


# ELECTRIC VEHICLE PENETRATION RATES AND MARKET SIZE

## EV MARKET SIZE

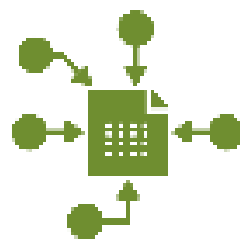
**\$206 billion**

entire EV market up to 2030



**\$1.8 billion**

for EV charging infrastructure in 2030



**\$19.1 billion**



**\$7 billion**

For EV batteries in 2030



- EV penetration rates have increased from 0.5% in 2018 to 6.8% in 2023.
- The EV penetration rate is estimated to be about 30% by 2030 in a conservative scenario, scaling up to almost 45% in an optimistic scenario.\*



# WRI INDIA'S SUPPORT TO EV CHARGING



दिल्ली सरकार  
आप की सरकार

## Workplace Charging Guidebook

A guidebook for employers on planning, installing, and managing electric vehicle charging at the workplace in Delhi

November 2021



Image credit: Priya Darshan/Shutterstock



दिल्ली सरकार  
आप की सरकार

## EV Charging Guidebook for Shopping malls

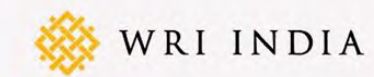
A guidebook for shopping mall owners on planning, installing, and managing electric vehicle charging at shopping mall(s) in Delhi

February 2022



Image credit: Convo

A report by Dialogue and Development Commission of Delhi (DDC) and WRI India



दिल्ली सरकार  
आप की सरकार

## Residential EV Charging Guidebook

A guidebook for planning, installing and managing electric vehicle charging, in all types of residential areas, in Delhi

February 2022



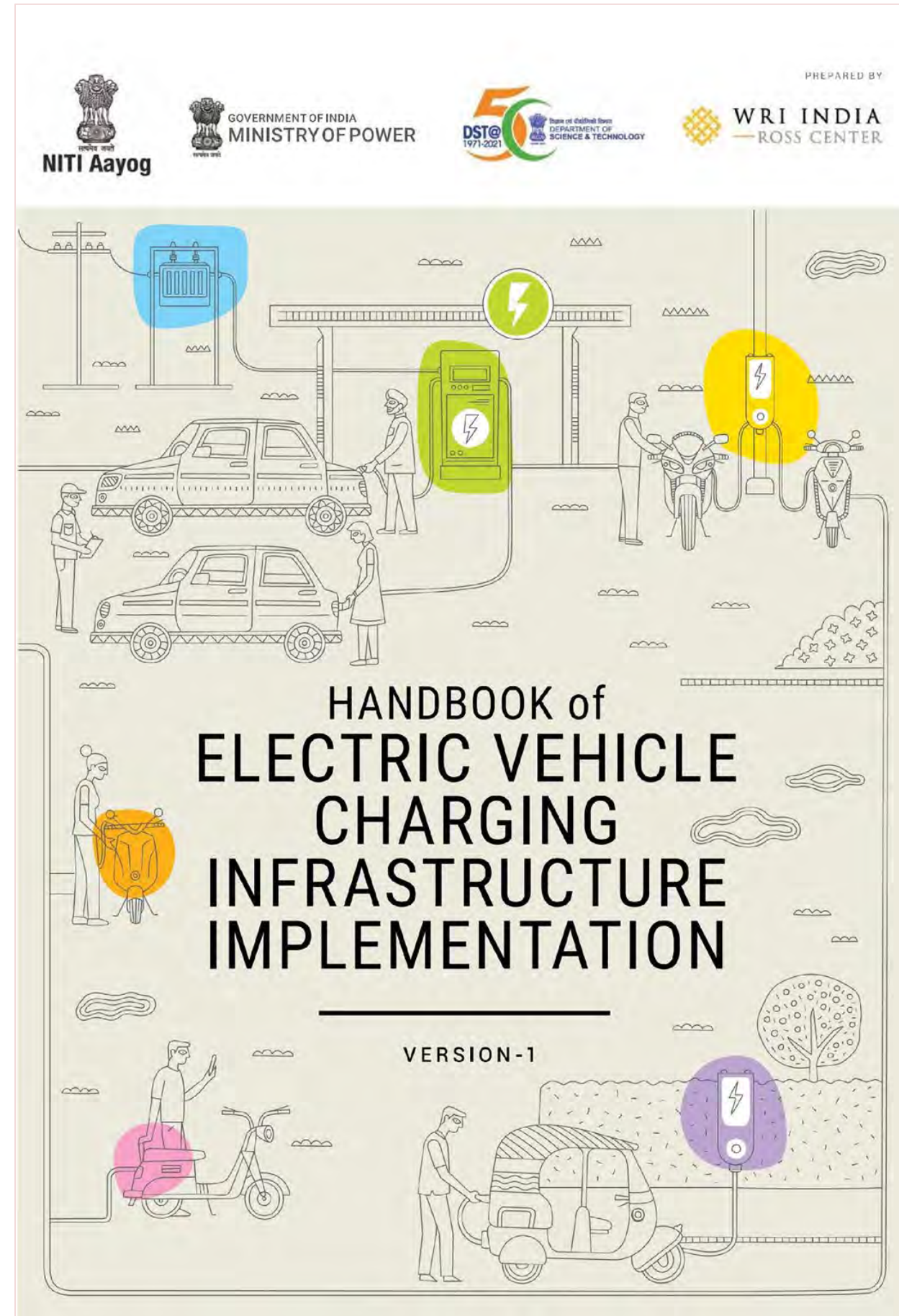
Image credit: Eren Goldman/Unsplash

A report by Dialogue and Development Commission of Delhi (DDC) and WRI India





# WRI INDIA'S SUPPORT TO EV TRANSITION







# ELECTRIC BUSES



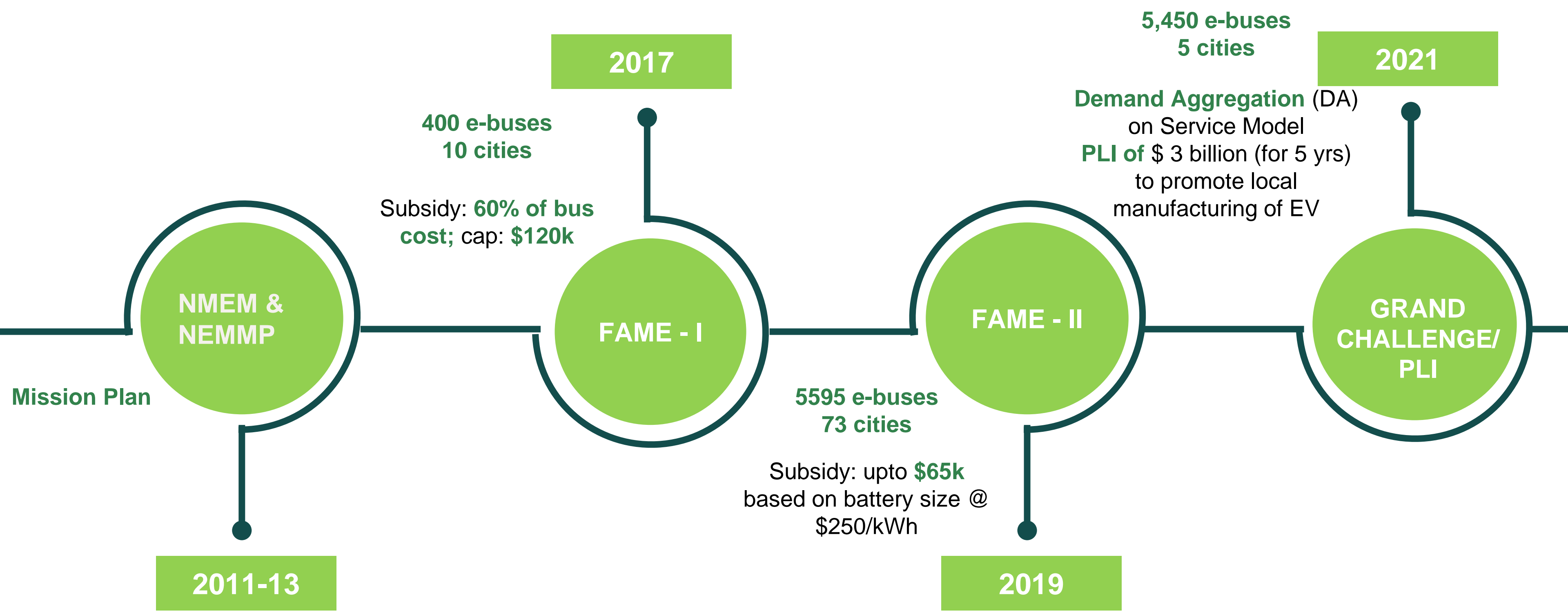
# PUBLIC TRANSPORT IN INDIA

## Buses are the primary form of public transportation in India

- **90%** of road-based passengers in India rely on buses for transportation
- **399 million** passengers travel by bus every day
- With **~2 million** buses on the roads, India has the **third-largest** bus fleet in the world, after Indonesia and China.
- Share of Public Buses - **7%**



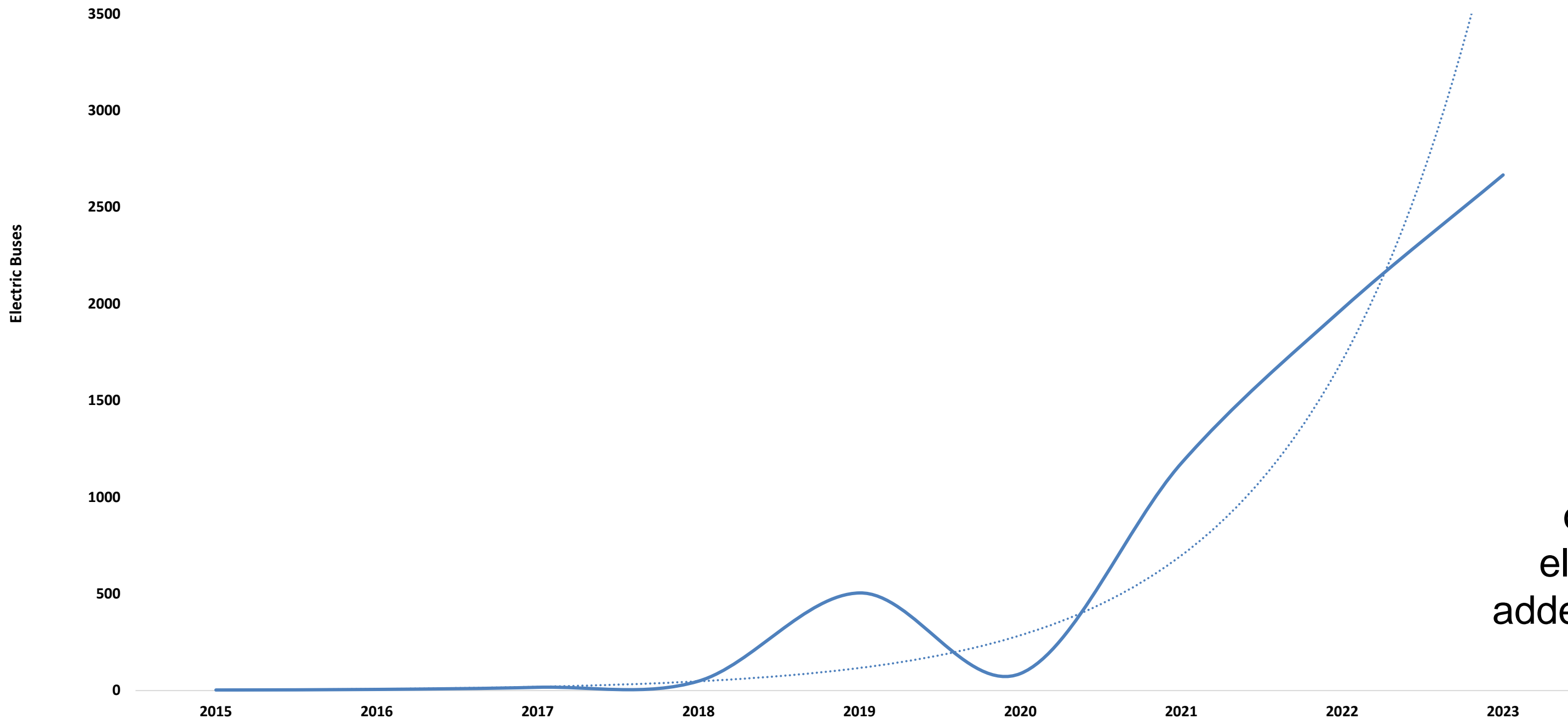
# POLICY INITIATIVES FOR EBUS ADOPTION IN INDIA





# ACCELERATING ADOPTION OF BUSES IN INDIA

## Growth in Registered Number of Electric Buses (2015 – 2023)



**39%**

CAGR in registered electric buses in the past 5 years (2019 – 2023)

**19%**

of the overall registered electric buses have been added in 1<sup>st</sup> quarter of 2024

FAME - I

FAME - II / GC (EV) / State Support + Grand Challenge + NEBP

# GREENING THE BUS

WRI India has supported the **Ministry of Housing and Urban Affairs (MoHUA)** through evidence-based research to develop the scheme and its guidelines. The WRI India team has been stationed in MoHUA for 3 years, supporting policy development, framework for **scheme rollout, and conceptualization of National Intelligent Transport Management System (ITMS) platform.**

**10,000**  
e-buses

**169**  
cities

**\$6.9 bn**  
project cost

**\$2.4 bn (35%)**  
Gov contribution



Electric Bus  
Operations



Bus Depot  
Infrastructure



Associated Power  
Infrastructure



National Common  
Mobility Card (NCMC)



Intelligent Transit  
Management System



Bus Priority  
Infrastructure





# INDIA ELECTRIC BUS STORY

Target of 800,000 e-buses in the next 10 years. A **100x growth** demands a collaborative approach

## Scale of Operations

Mobility and energy infrastructure at scale needs streamlined management and communication .

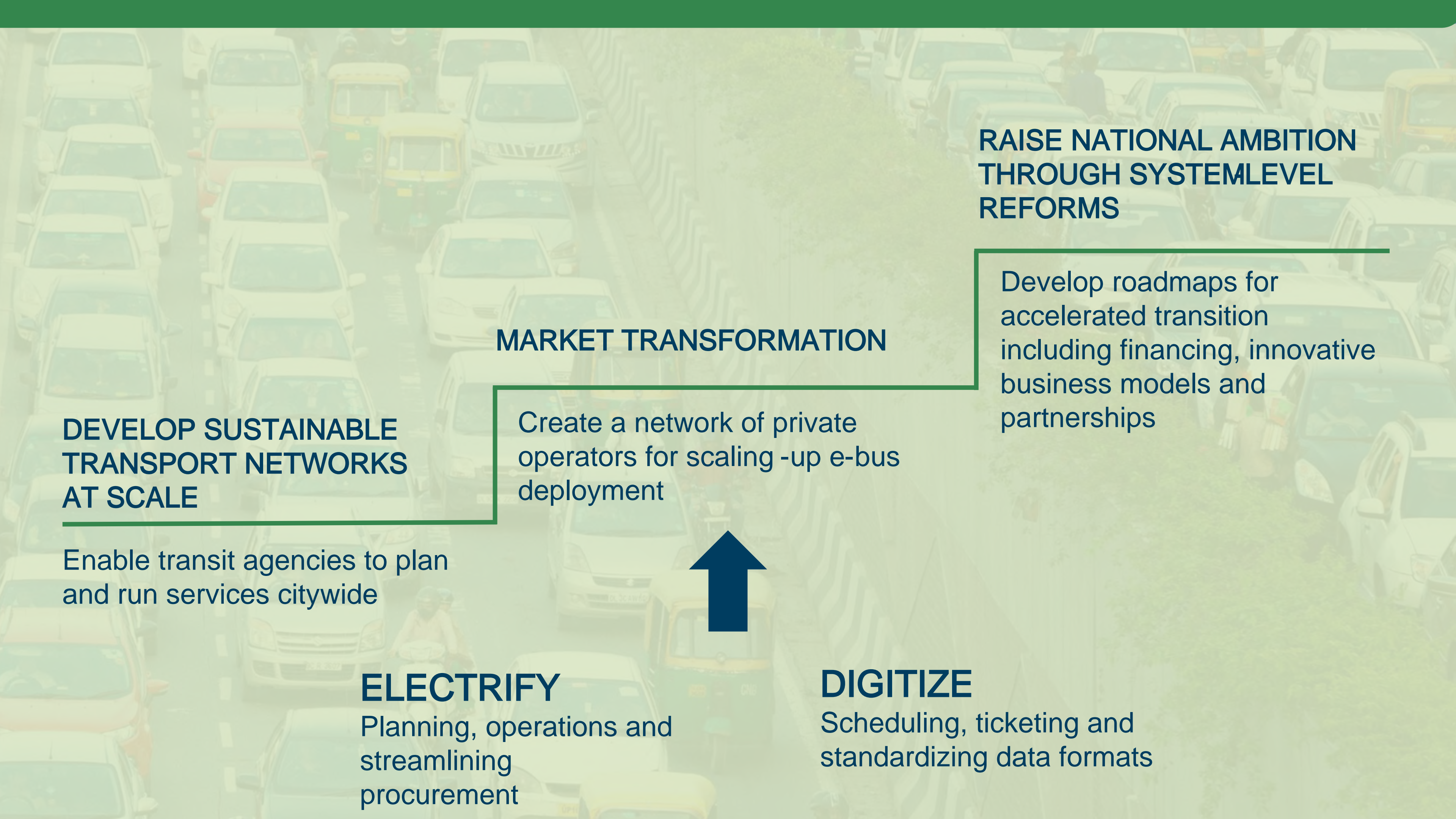
## Investment and Innovation

Partnerships to leverage private sector strengths in financing and efficiency.

## Broader Engagement

Collaboration for sustainable growth with diverse stakeholders.





## RAISE NATIONAL AMBITION THROUGH SYSTEMLEVEL REFORMS

Develop roadmaps for accelerated transition including financing, innovative business models and partnerships

## MARKET TRANSFORMATION

Create a network of private operators for scaling -up e-bus deployment

## DEVELOP SUSTAINABLE TRANSPORT NETWORKS AT SCALE

Enable transit agencies to plan and run services citywide



## ELECTRIFY

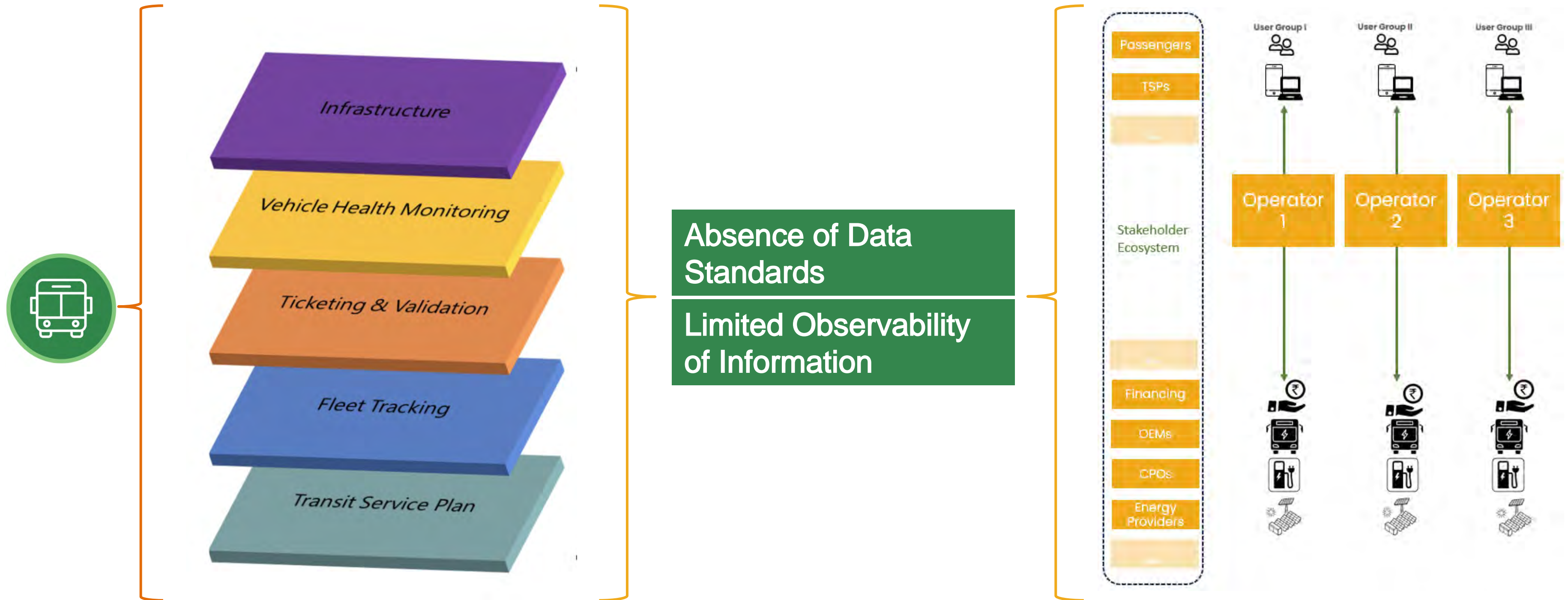
Planning, operations and streamlining procurement

## DIGITIZE

Scheduling, ticketing and standardizing data formats



# CURRENT ECOSYSTEM GAP



**Limited Bus Discovery and Utilization:** Over ₹1,000 crore spent on ITS for public buses, with little value added and unreliable operational data capture



# OPEN E-BUS BLUEPRINT

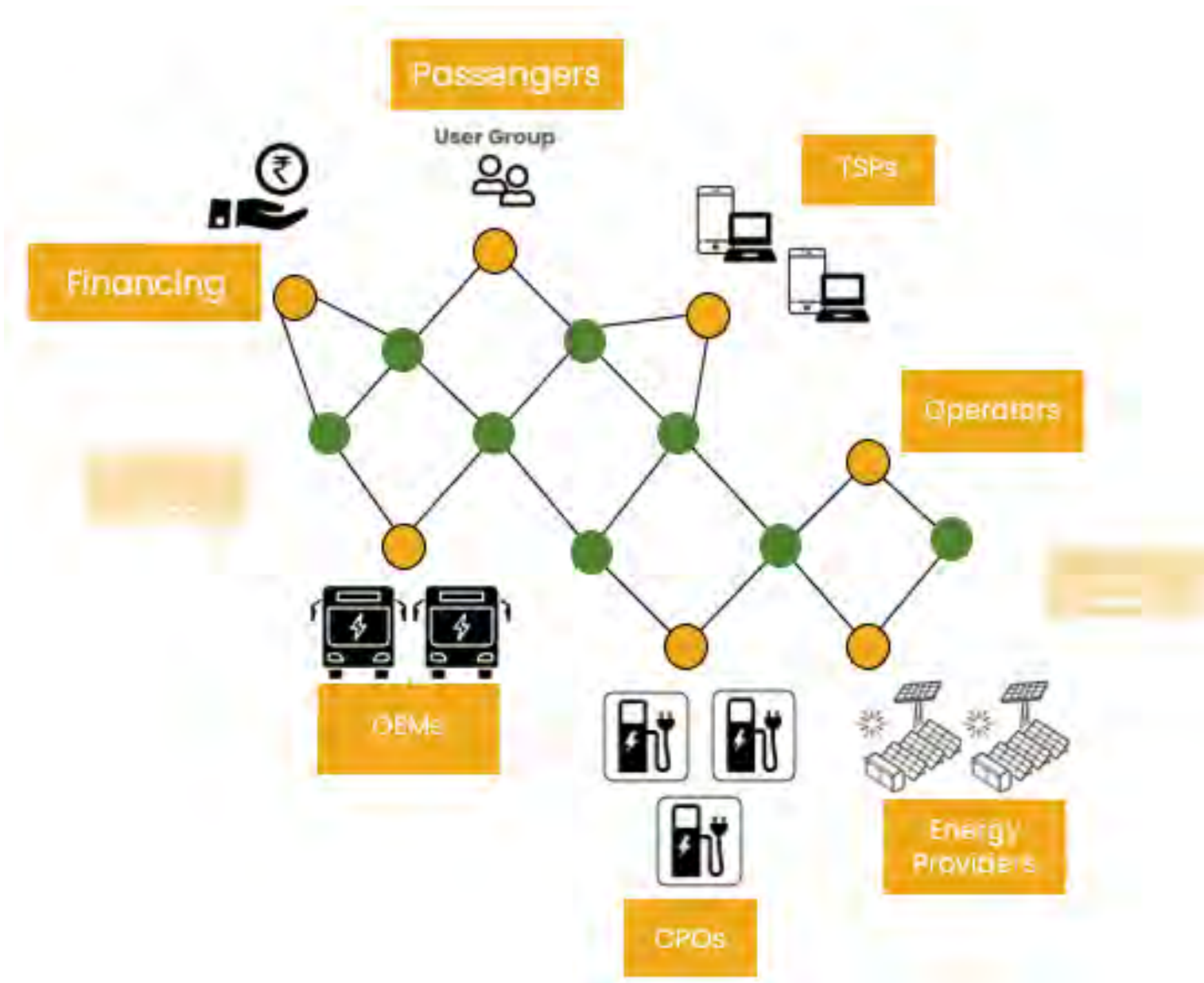
## Integrates:

- Technology architecture (observability)
- Governance (standards and specifications)
- Market-driven innovation - to support diverse stakeholder needs

## KEY BENEFITS

- Shift from technology to foundational digital building blocks in bus transport for scalable solutions
- Empower innovators to create cost effective and market driven tools for deploying the e-bus infrastructure
- Enable multi-sectoral stakeholders to contribute and benefit from the e-bus transition

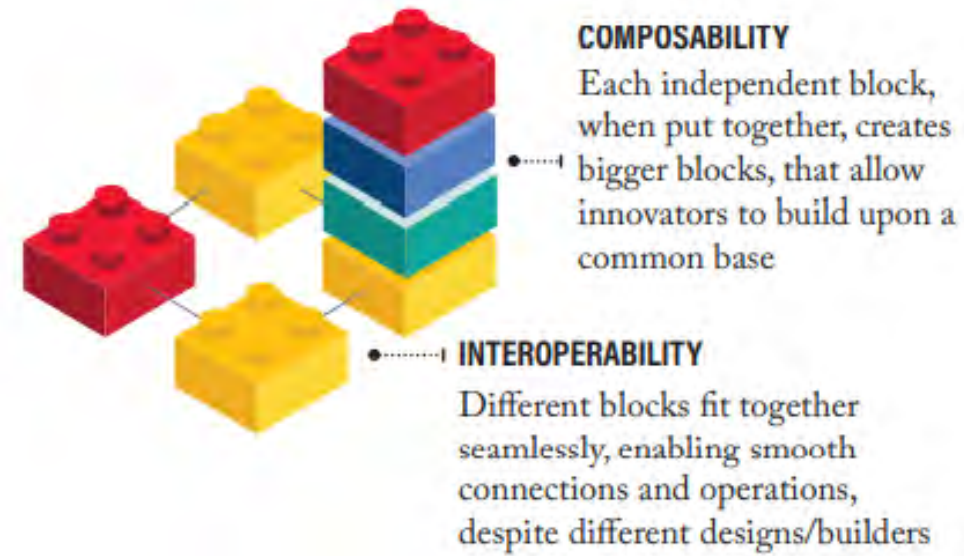
## UNIFIED LANDSCAPE FOR BUSES



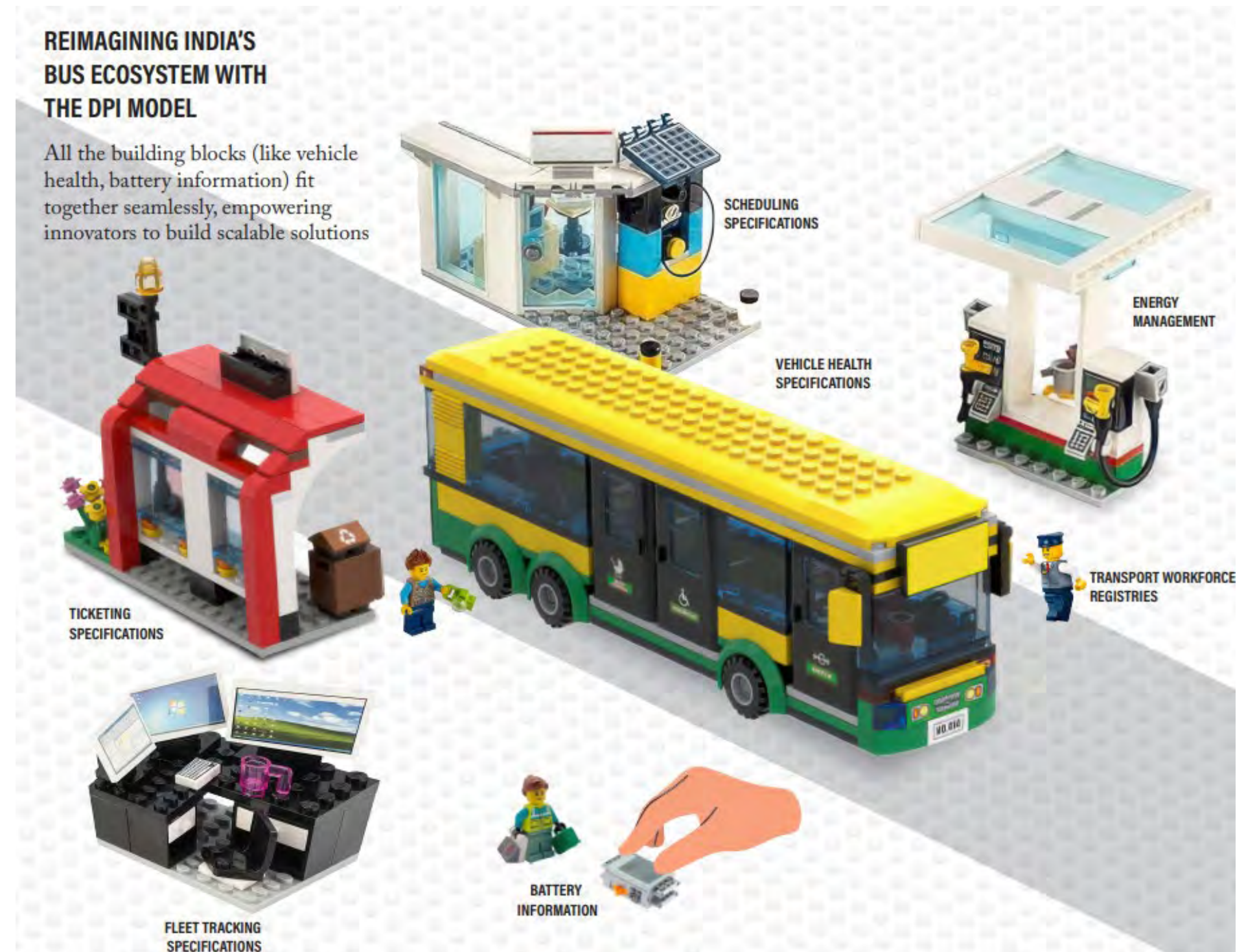
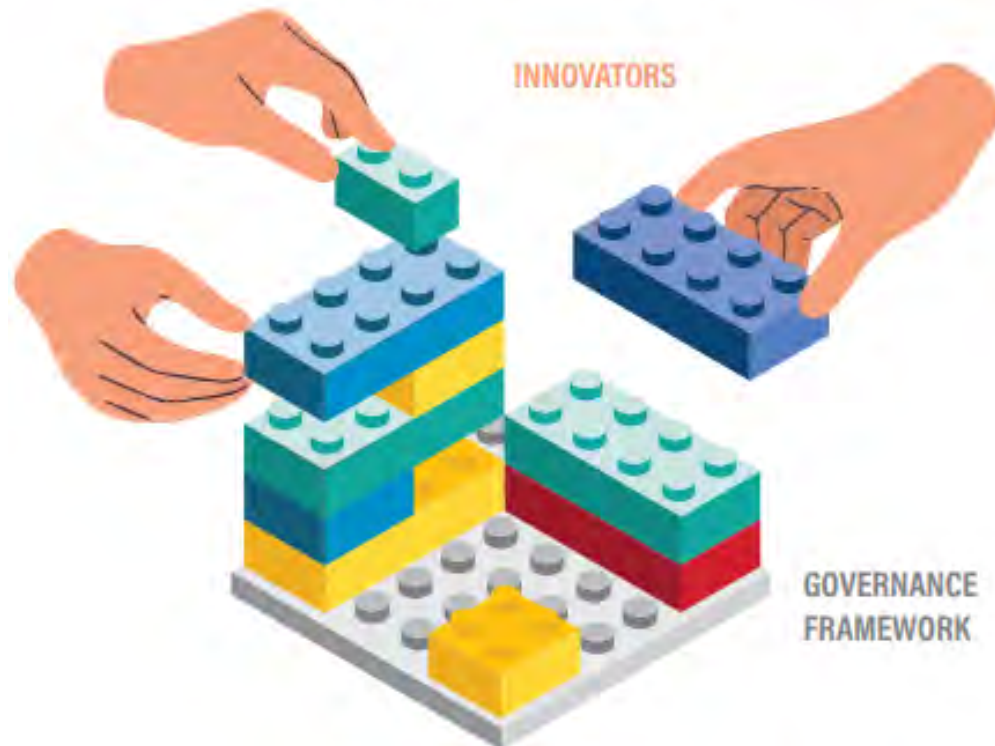


# REUSEABLE BUILDING BLOCKS

## DPI THINKING



INNOVATORS BUILD SOLUTIONS WITH THE BLOCKS UPON A SOLID FOUNDATION LAID BY GOVERNANCE FRAMEWORKS





# WRI INDIA PUBLICATIONS



WORKING PAPER

## Open e-bus blueprint

WRI India - Rajit K Bhat, Pawan Mulukutla, Prashanth Bachu, Avinash Dubedi, and Madhav Pai  
FIDE - Dr. Pramod Varma, Sujith Nair, and Anirban Sinha

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*Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback, and to influence ongoing debate on emerging issues.*

**Suggested Citation:** Bhat, R.K., A. Sinha, P. Bachu, S. Nair, R. Prakash, P. Mulukutla, A. Dubedi, M. Pai and P. Varma, 2024. "Open e-bus blueprint" Working Paper. WRI India and FIDE.

### HIGHLIGHTS

- With the unprecedented success of bus electrification in India and our broader goal of 30 percent electric vehicle (EV) penetration by 2030, we have an opportunity to electrify over 8 lakh buses.
- Given the different dynamics of operating electric buses – along with legacy communication issues in India's bus sector – a digitalized system of managing bus operations is a potential game changer in this transition.
- India has been a pioneer in using Digital Public Infrastructure (DPI) to resolve systemic problems at scale. This paper frames the concept of the open e-bus blueprint for e-bus service platforms based on successful DPI principles.
- Key benefits include shifting from specific technologies to foundational building blocks, allowing scalable e-bus infrastructure while empowering innovators and stakeholders to contribute and benefit from the e-bus transition.
- The paper curates the principles, key elements, and potential use cases of the open e-bus blueprint, offering a framework for wider stakeholder discussion.



WORKING PAPER

## Real-world electric bus operation: Trend in technology, performance, degradation, and lifespan of batteries

Dr. Parveen Kumar, Pawan Mulukutla, and Priyansh Doshi

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**Suggested Citation:** Kumar, P., Mulukutla P., and Doshi P., 2023. "Real-world electric bus operation: Trend in technology, performance, degradation, and lifespan of batteries" Working Paper. WRI India. Available online at [doi.org/10.46830/wriwp.22.00097](https://doi.org/10.46830/wriwp.22.00097)

### HIGHLIGHTS

- The pace of bus electrification is increasing in order to decarbonize the public transportation system. Lithium-ion batteries form the most valuable component of an electric bus from a cost and performance point of view.
- The lifespan of an e-bus battery is reduced due to accelerated battery degradation under non-optimal operating conditions. Temperature extremes induce battery ageing, impacting the e-bus operational capacity, safety, and replacement ratio. This can spike the total cost of ownership, compromising the economic viability of e-buses.
- Availability of real-world operational data for e-buses is limited globally, and almost absent in India. This paper analyzes cell-level experimental data for popular battery technology on degradation under variable conditions and compares it with real-world case studies, to deduce scenarios for best performance under Indian climatic conditions.
- For a given route, the battery sizing and charging strategy should consider the energy consumption requirement and efficiency of an e-bus. The battery pack must be equipped with an efficient thermal management system to maintain optimum battery temperature.
- In batteries, an advanced battery management system must be used for real-time monitoring and data collection. Data availability will be crucial for developing required standards, regulations, and testing ecosystems to ensure the adoption of best practices.



WORKING PAPER

## Assessing financing challenges for implementing the large-scale electric bus program in India

Manish Dutta Pandey, Aswathy KP, and Pawan Mulukutla

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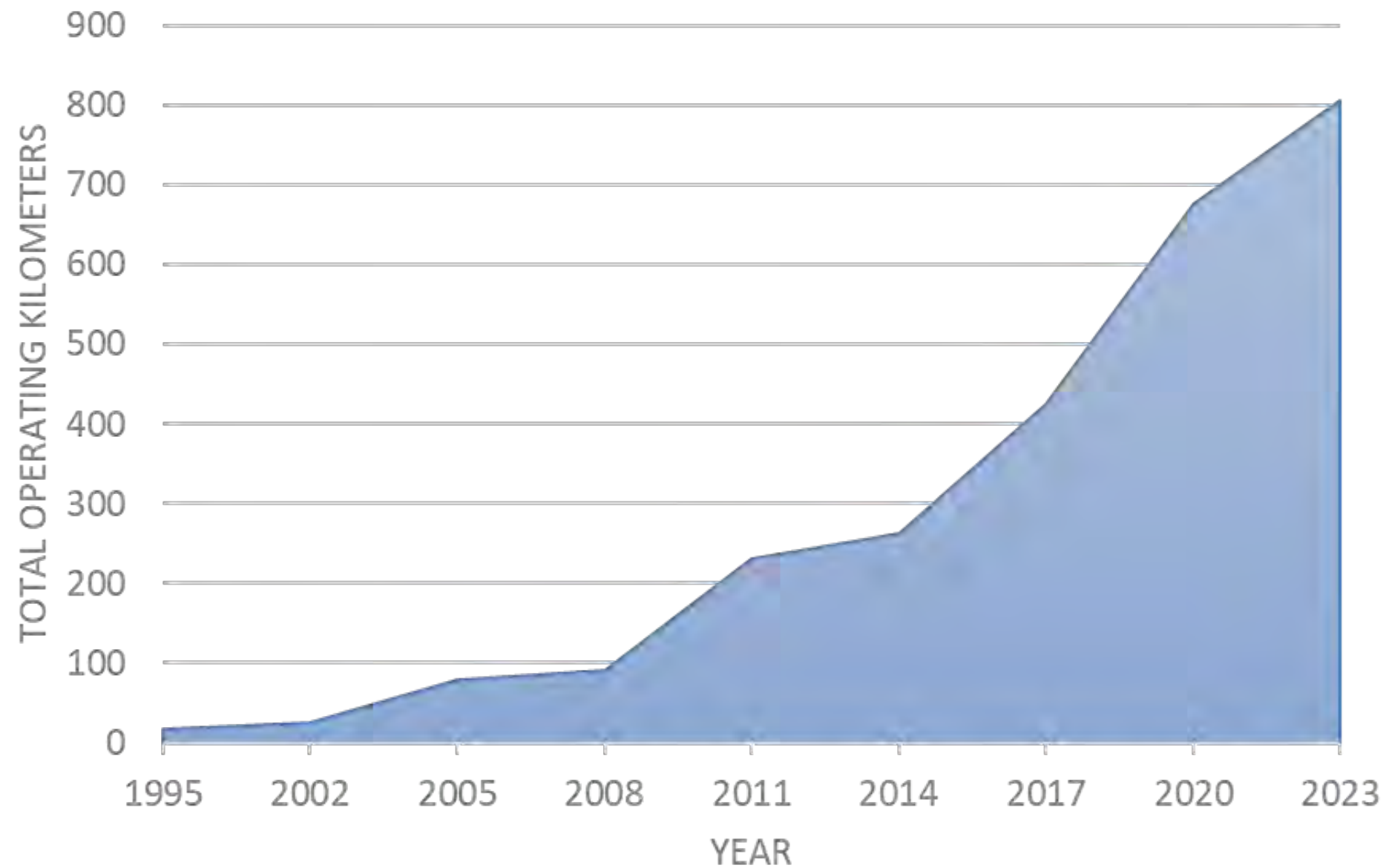
**Suggested Citation:** Pandey, M.D., Aswathy KP and P. Mulukutla, 2024. "Assessing financing challenges for implementing the large-scale electric bus program in India." Working Paper. WRI India. Available online at <https://doi.org/10.46830/wriwp.23.00087>.

### HIGHLIGHTS

- India is at an early stage of an unprecedented bus fleet transition, aiming to deploy 50,000–60,000 electric buses (e-buses) in the coming years, which will require an estimated US\$7.75 billion (INR 643 billion) in debt financing.
- Unlike earlier models, where buses were usually procured and operated by public transport agencies (PTAs), new e-buses will be deployed through public-private partnership models, where private operators receive gross-cost contracts from PTAs to run e-buses.
- Given the high capital requirements, effective e-bus financing is critical for scaling up India's e-bus program. This working paper aims to understand the early-stage challenges in India's e-bus financing from financier and operator perspectives, drawing from interviews with multiple stakeholders and experts.
- Bus financiers are wary of PTAs' poor financial health and the potential performance risks of new technologies. Therefore, they demand significant collateral from operators through corporate guarantees, making it difficult for operators to bid for many e-bus projects due to the significant debt implications.
- Payment security mechanisms, greater transparency in the financial and operational performance of e-buses, and banking sector reforms could alleviate some of these issues. However, long-term sustainability requires reforms to improve PTAs' efficiency and financial performance.

# METRO IN INDIA

India has invested heavily in metro rail systems – especially in the last decade – to reduce urban congestion, emissions, and road crashes:



**₹1,87,500 CR**  
INVESTED IN  
METRO RAIL  
PROJECTS SINCE  
2010



# METRO IN INDIA

Yet, many metro rail systems show considerable potential to improve ridership:

## Projected vs. Actual ridership of Metro Rail systems in India

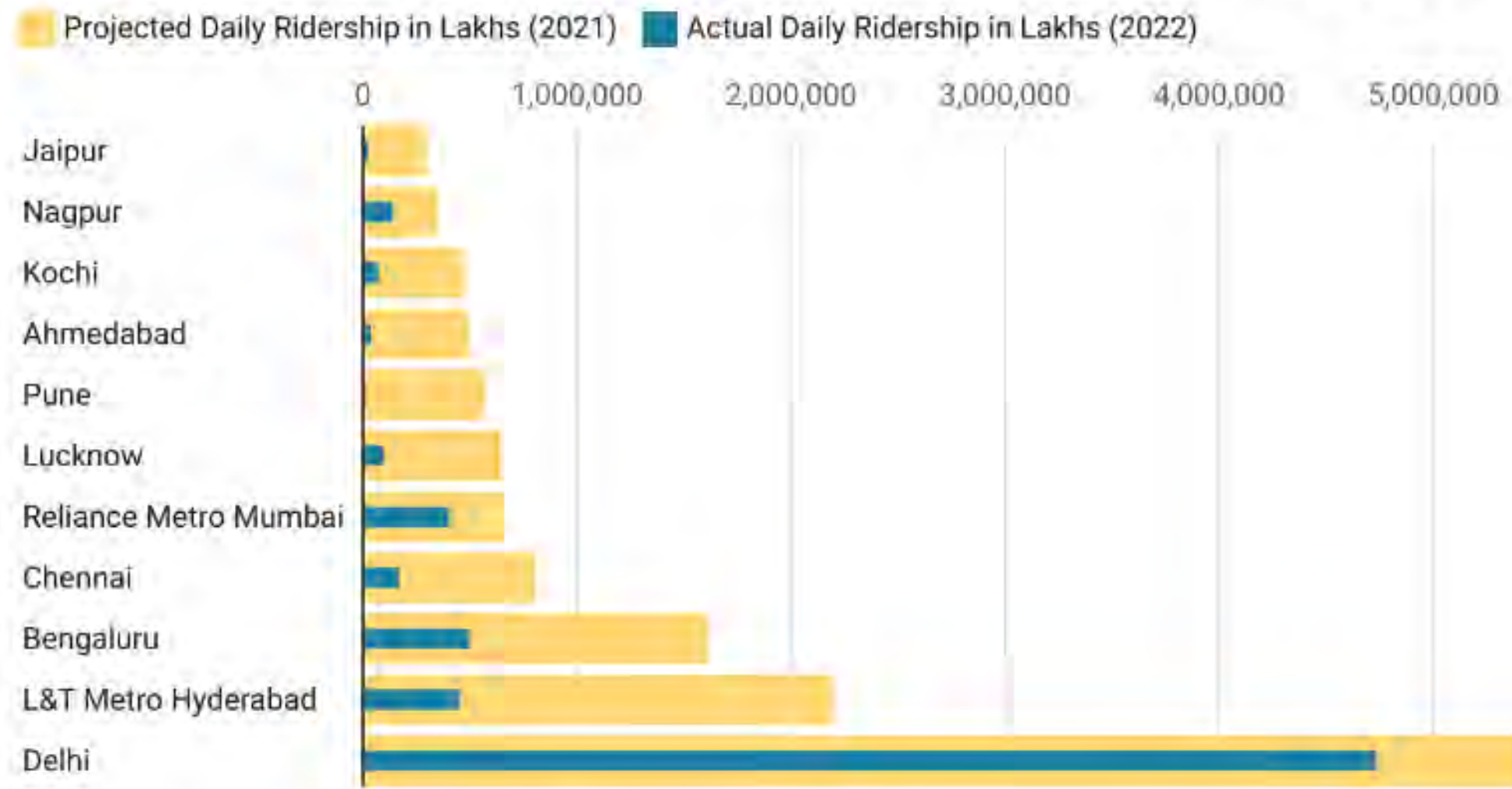


Chart: WRI India • Created with Datawrapper

70%

potential metro users surveyed said poor connectivity or access to the metro prevented them from using it

# UNDERSTANDING THE GAP

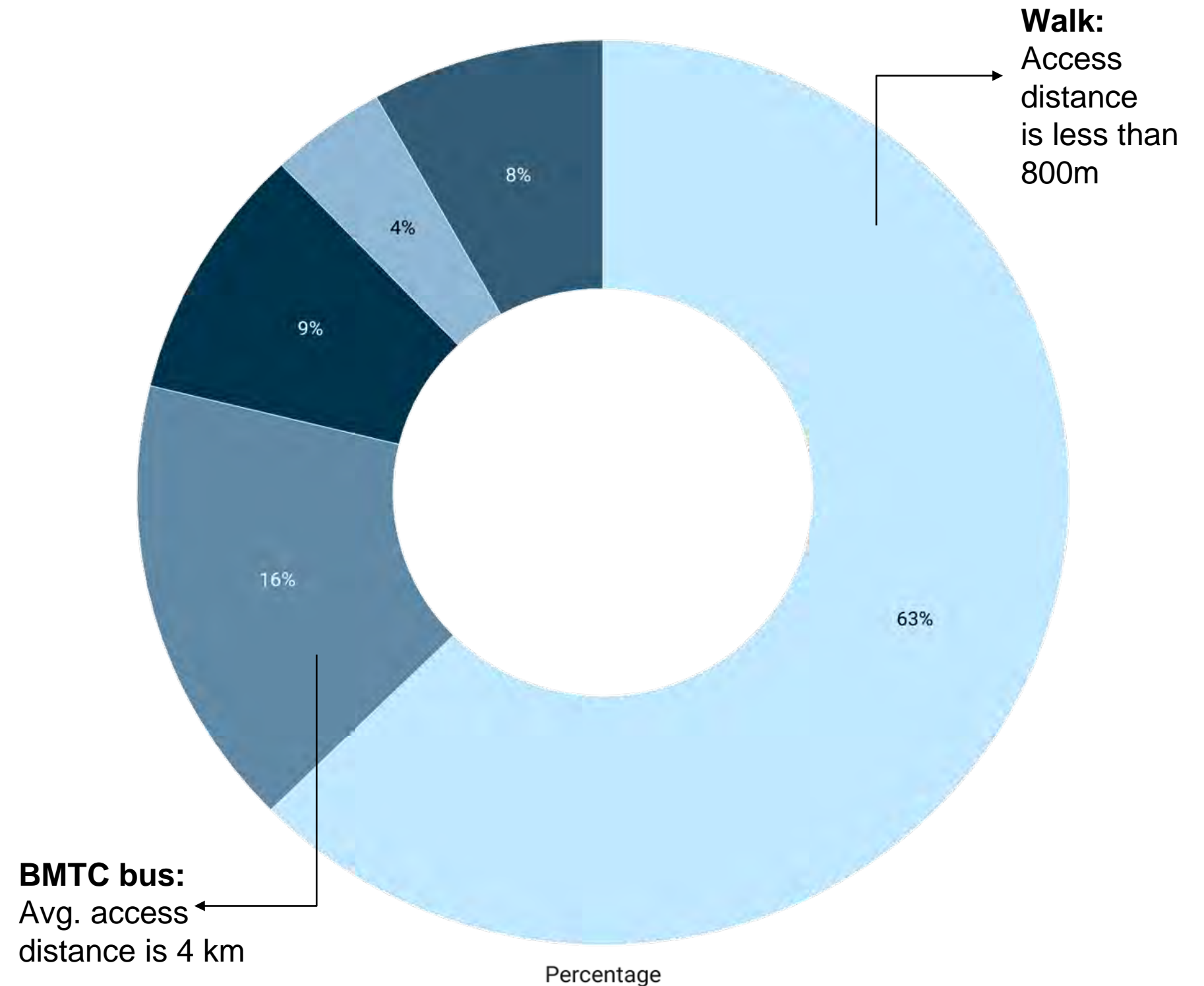
Commuters **primarily walk or use the bus** to access the metro.

Creating more on-demand, last-mile solutions could potentially attract more commuters who travel between **1-4 km** to reach the metro.

## Existing metro commuters predominately use walk or bus to access the station

Percentage of commuters' mode choice to access the metro

Walk BMTC Auto (Regular) Two-wheeler (Self-driven) Other modes



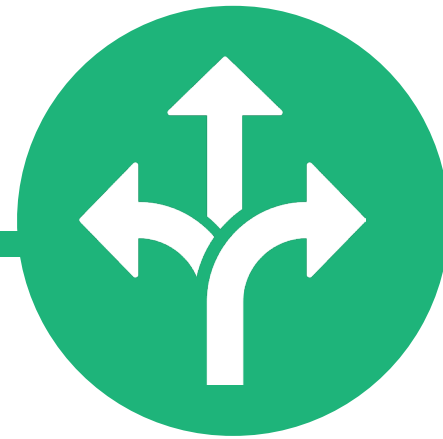




# WHY WOMEN-DRIVEN ELECTRIC 3WHEELERS?



Provide safe and reliable last-mile solutions



**Flexible:**

- Can operate across various road types
- Fixed-route or on-demand vehicles



Vehicle capacity ideal for providing good last-mile services to the metro in Bengaluru



- Providing entry point for women
- Relatively easier vehicle to train and onboard drivers



Low-emission vehicles



# LOW EMISSION ACCESS TO PUBLIC TRANSPORT (LEAP)



**30** DRIVERS  
TRAINED UNDER LEAP

LEAP HAD **903**  
COMMUTERS WHO USED THE  
SERVICE MORE THAN ONCE

A TOTAL OF **7387**  
TRIPS COMPLETED BY  
LEAP

**4828** KG  
CO2 EMISSIONS REDUCED  
BY INDUCING MODE SHIFT  
AMONG COMMUTERS

LEAP COVERED A TOTAL OF  
**30,356** KM  
OVER A SIX MONTH PILOT

A CSR initiative by

**ALSTOM**  
• mobility by nature •

Implemented by



WRI INDIA



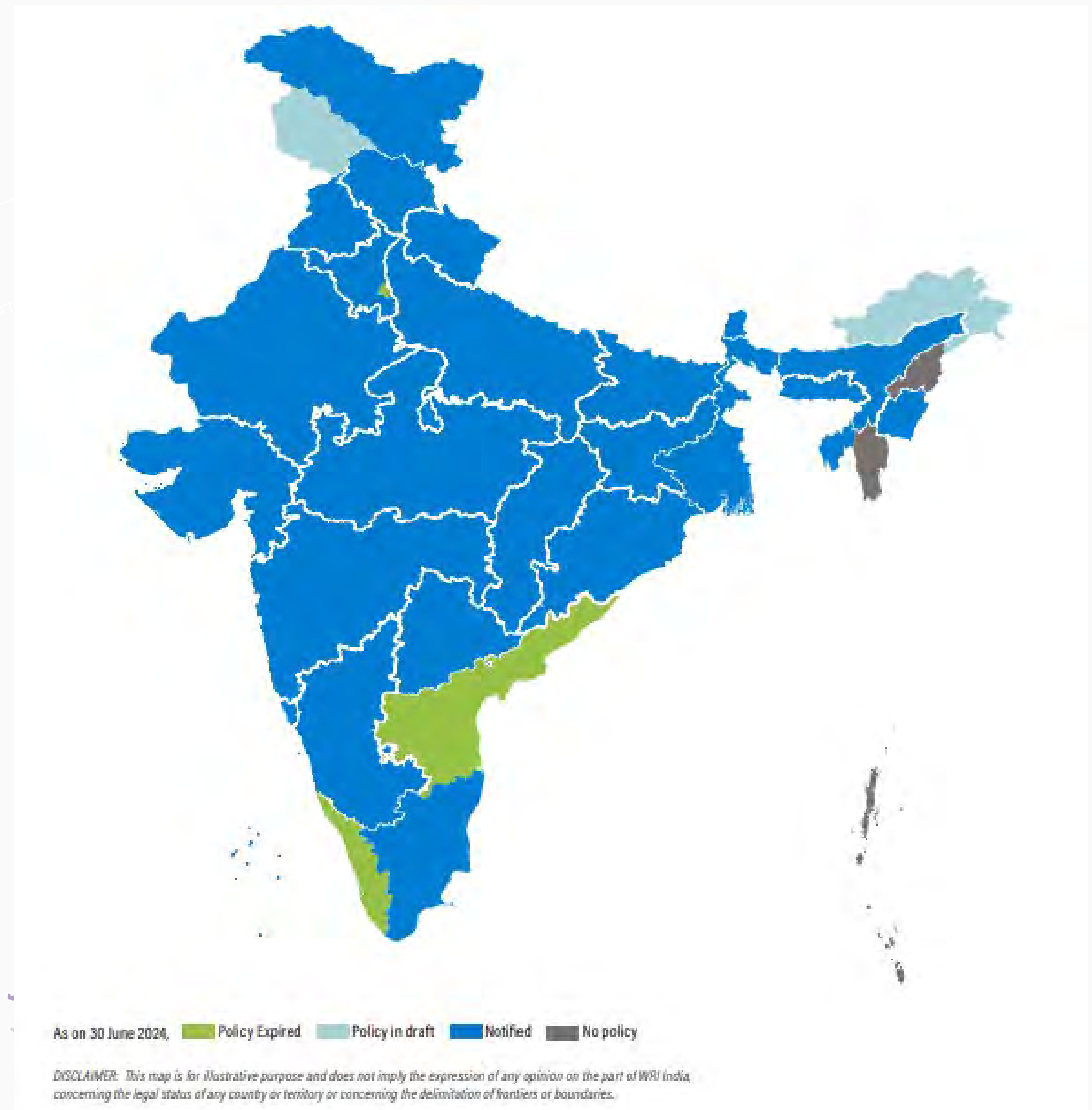


# SUBNATIONAL ACTION



# STATE-LEVEL EV TRANSITION

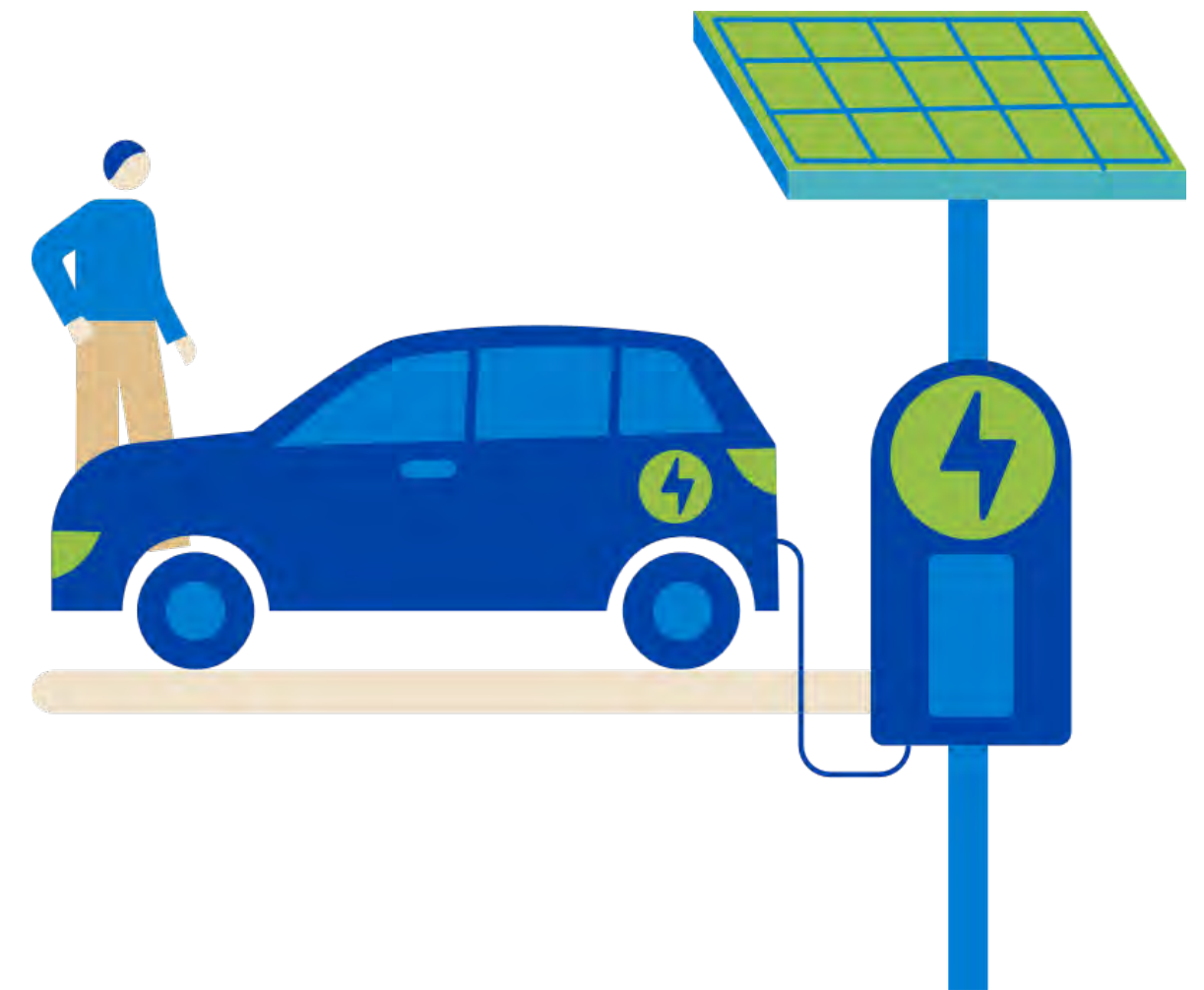
26 states and union territories (UTs) have notified state level e-mobility policies, while 5 states and UTs have announced draft policies. WRI India has been working with various governments at the sub-national level like Gujarat, Uttar Pradesh, Maharashtra, Bihar and Delhi to accelerate EV adoption across different modes of transport.



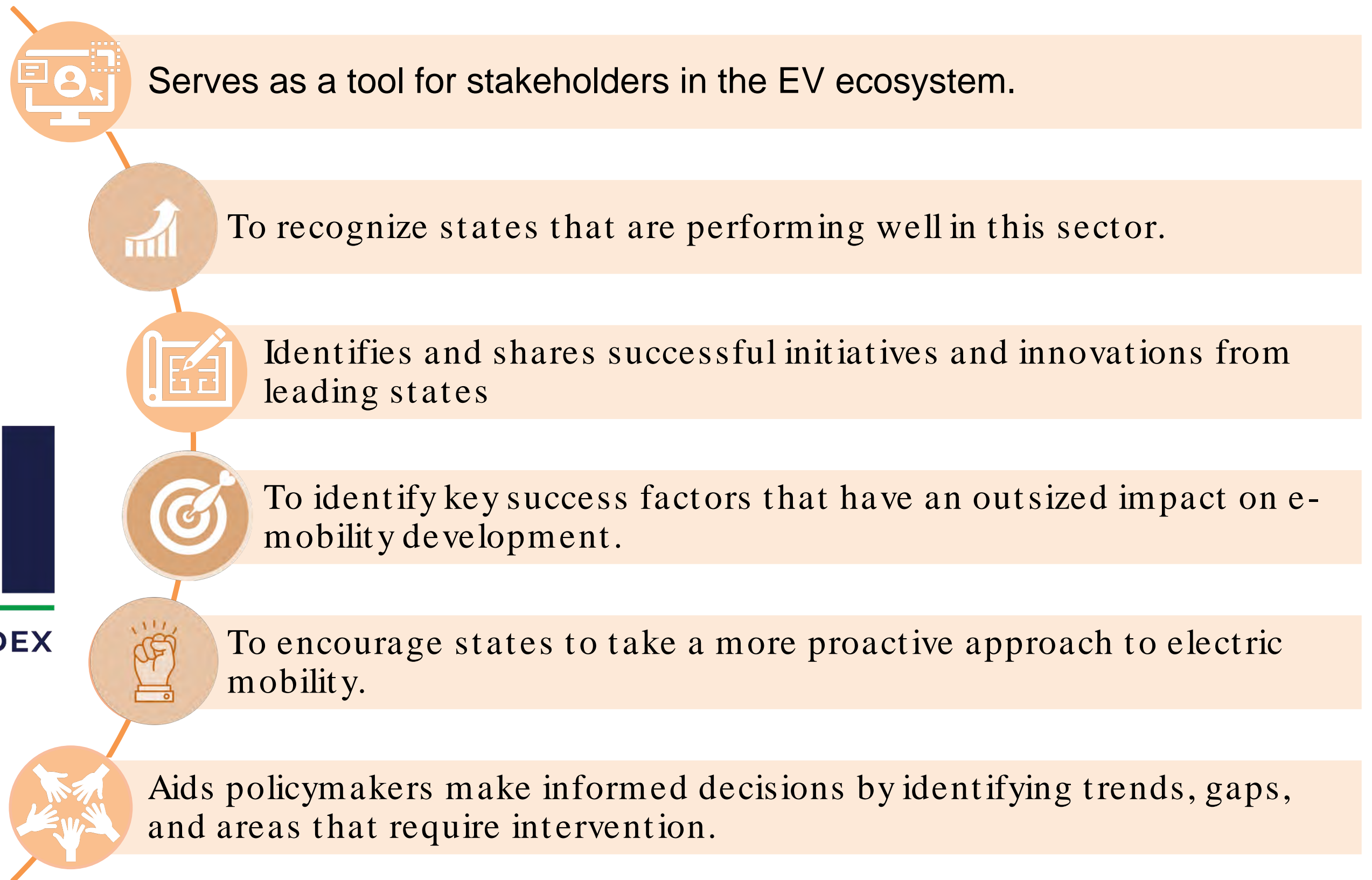


# INDIA ELECTRIC MOBILITY INDEX (IEMI)

- ❖ The **India Electric Mobility Index (IEMI)** is a dynamic platform that assesses performance of the **28 states and 8 union territories** in their ambition and progress in **accelerating the e - mobility transition** .
- ❖ The IEMI will be a **first -of -its -kind government initiative** , with use of **open datasets** to capture the rapid changes taking place in the dynamic EV ecosystem.
- ❖ Globally, the IEMI is the **first electric mobility index at subnational level** , that will provide a comparative and ongoing evaluation of e -mobility development in Indian states.



# PURPOSE OF THE INDEX





# IEMI STRUCTURE

The Index Structure includes 3 Themes and 16 Performance Indicators . Each theme has Outcome and Enabler Indicators , which denote the overall e-mobility performance of a state .

Theme name	Indicator type	Indicator	Source
Transport Electrification Progress	Outcome	1. Private Electric Vehicle Adoption Rate	Vahan Database
		2. Commercial Electric Vehicle Adoption Rate	Vahan Database
	Enablers	3. Governance Initiatives	State EV Policies
		4. Purchase Incentives	State EV Policies
		5. Transition Incentives	State EV Policies
		6. Operational Support Initiatives	State EV Policies
		7. Fuel Price Parity	Electricity tariff orders, Indian Oil Corporation & Acko.
Charging Infrastructure Readiness	Outcome	8. EV to EV Charger Ratio	BEE EV Yatra
	Enablers	9. Capital Subsidies for Charging Infrastructure	State EV Policies
		10. Charging Infrastructure Development Initiatives	State EV Policies
		11. Building Byelaws for Charging	State EV Policies
		12. Share of Renewable Energy Generation Capacity	Central Electricity Authority
		13. Power Availability	Reserve Bank of India Statistics
EV Research and Innovation Status	Outcome	14. EV Startups	Startup India
	Enablers	15. R&D Initiatives	State EV Policies
		16. Patents	Controller of Patents





# ELECTRIC FREIGHT



# INDIA'S ROAD FREIGHT EMISSIONS

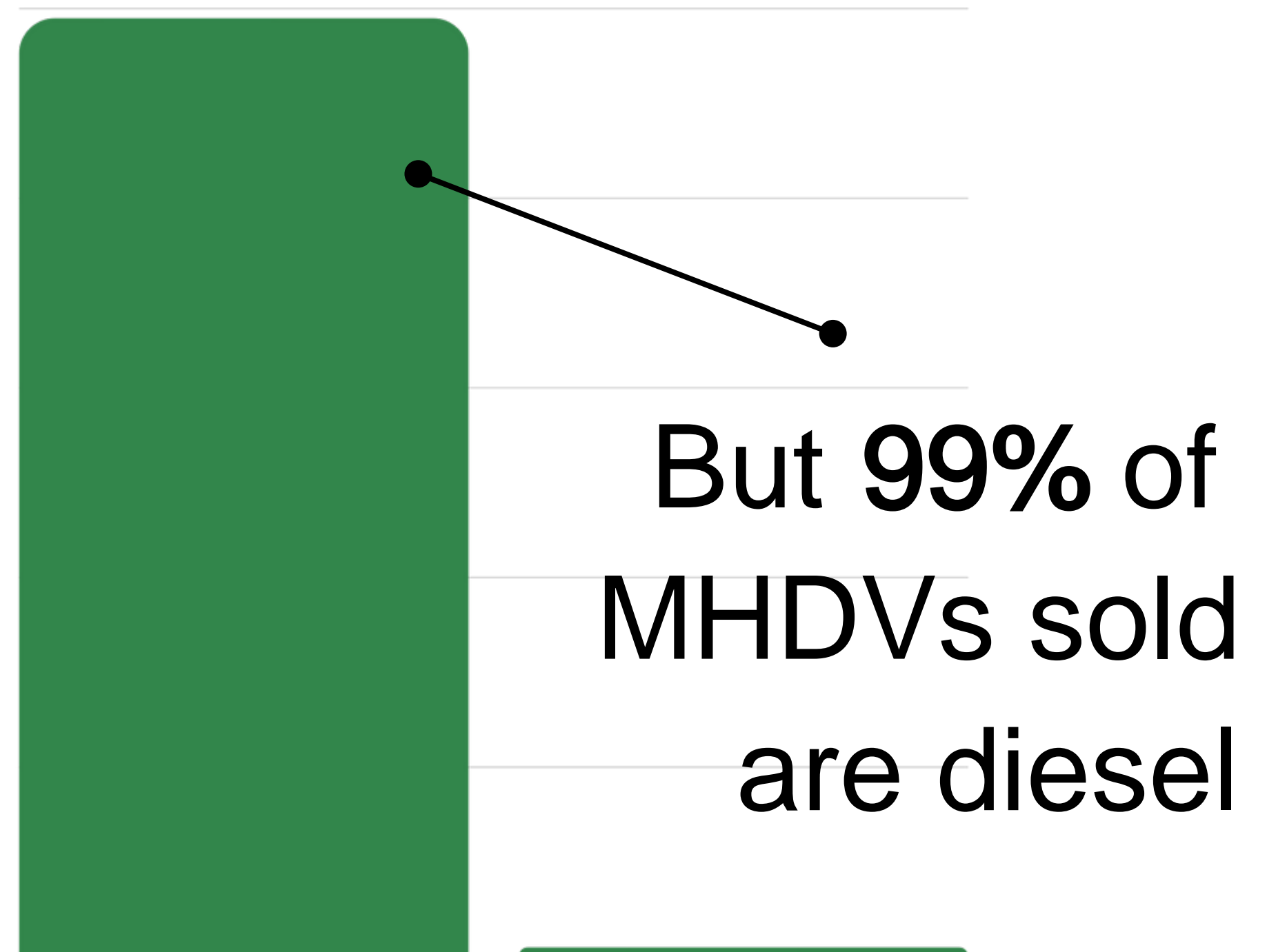
Road freight, with a small fraction of vehicles, contributes significantly to India's road transport emissions.



If left unchecked, this can grow to **60%** by 2050.

# INDIA'S ROAD FREIGHT SALES

India has become the  
6<sup>th</sup> largest market for  
MHDV sales









To achieve India's Net Zero 2070 target, research shows that at least **79%** of Indian freight has to go electric by 2070.



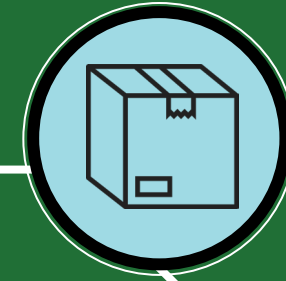
## Shippers

*Consigning goods to be transported from one place to another*



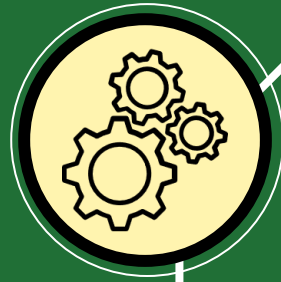
## LSPs

*Transporting goods by owned or rented fleet*



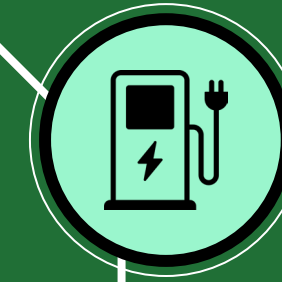
## OEMs

*Designing and manufacturing freight vehicles*



## CPOs

*Installing, operating and maintaining EV charging infrastructure*



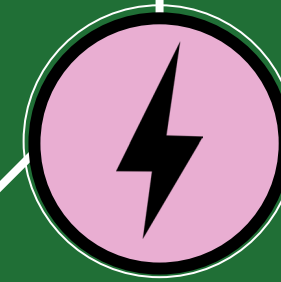
## Financiers

*Sourcing essential funds for logistics operations*



## DISCOMs

*Distributing electricity to CPOs*



# Mapping the Freight Ecosystem





# E-FAST INDIA



Led by



सत्यमेव जयते

**NITI Aayog**

Secretariat



WRI INDIA





**E-FAST'S**

**VISION**  
Making electric

trucks a reality for  
**every truck owner** in  
India

# E-FAST'S THREE PILLARS

## Scalable Pilot and Demand Aggregation

Pilot projects play a crucial role in identifying the right product for specific use cases, addressing on-ground challenges effectively. Collaboration among stakeholders and exploring various financial and business models further boosts confidence within the ecosystem.



## Economic Viability and Financing

Conducting a detailed study of unit economics is imperative to address the higher capital costs associated with transitioning to electric trucks. Gathering verified data provides clarity and lays the groundwork for overcoming financial obstacles.

## Long-term Policy Trajectories

Advancing freight electrification requires supportive policy action at multiple levels - central, state and local. Implementing freight -specific measures such as incentives, fuel-efficiency norms, supply-side mandates and support for infrastructure development can contribute significantly to enhancing affordability and accessibility.





# E-FAST'S GROWTH

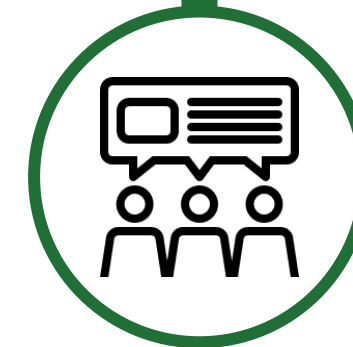
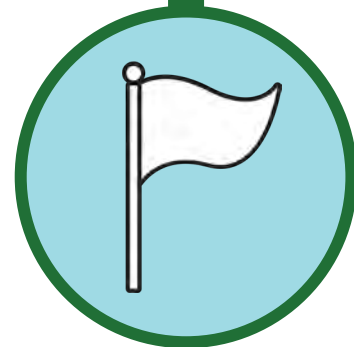
65+  
industry  
partners

17  
knowledge  
partners



# E-FAST'S GROWTH

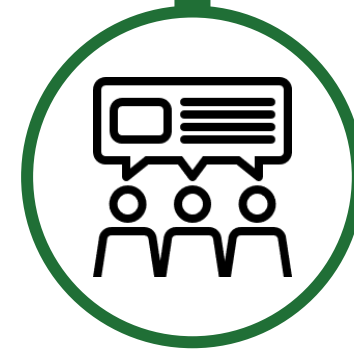
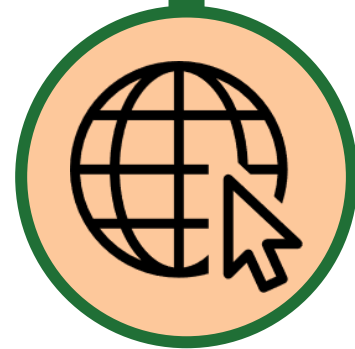
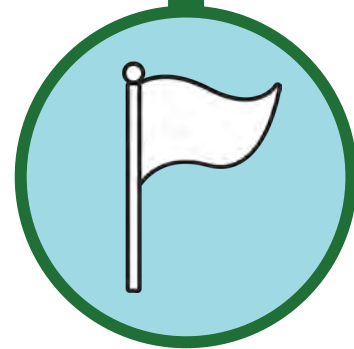
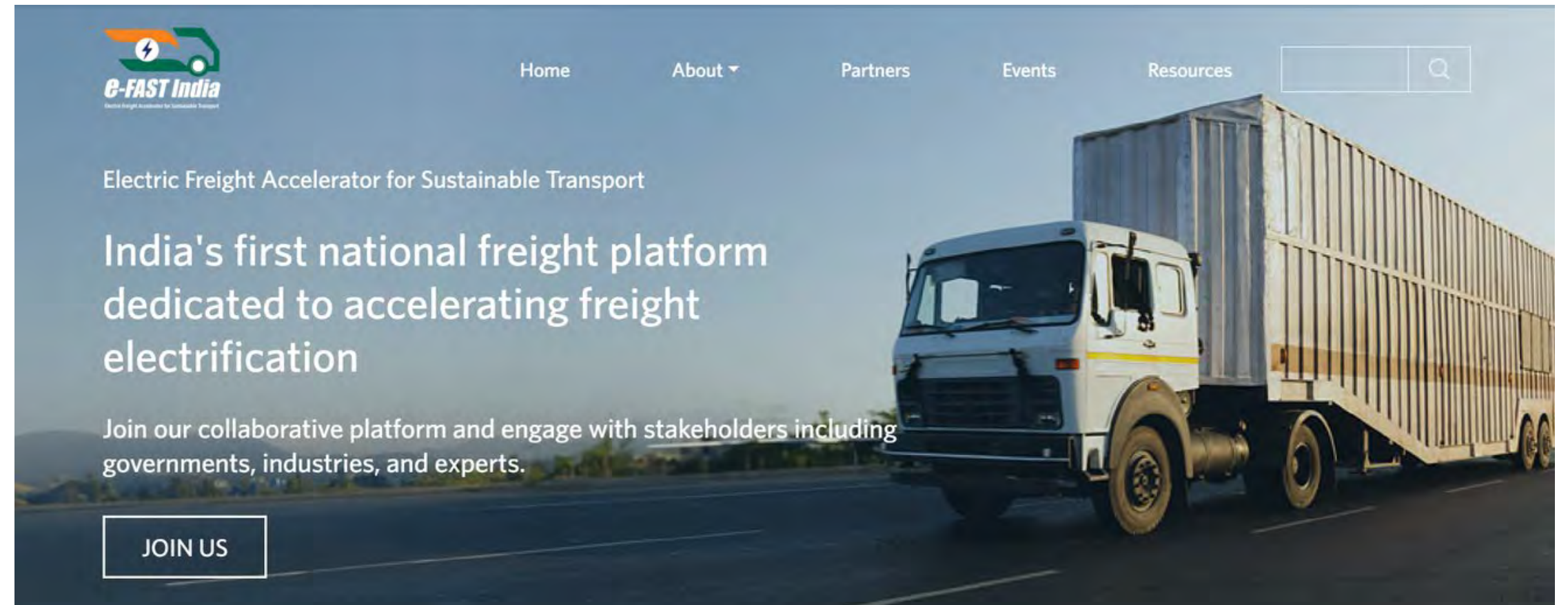
Launched e-FAST India on  
September 7, 2022





# E-FAST'S GROWTH

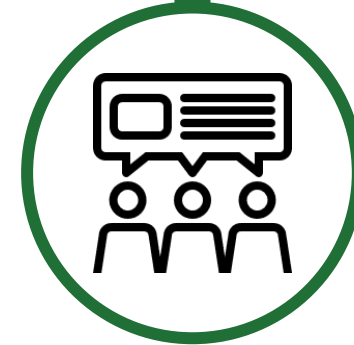
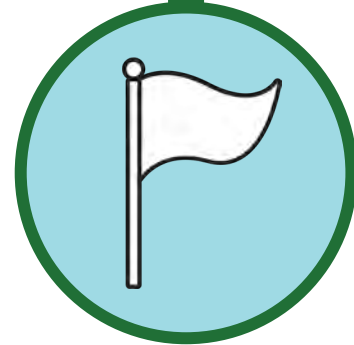
Launched e-FAST India's website in **July 2023**



# E-FAST'S GROWTH

# 7,750

e-freight vehicle demand  
signaled at Clean Energy  
Ministerial in **July 2023**

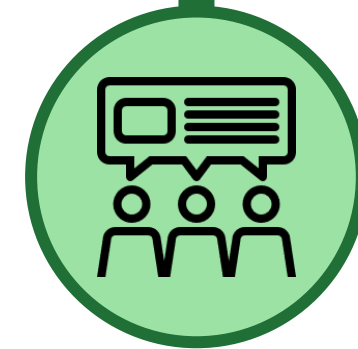
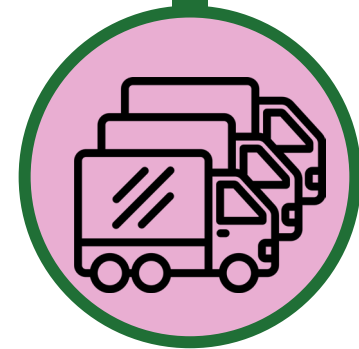
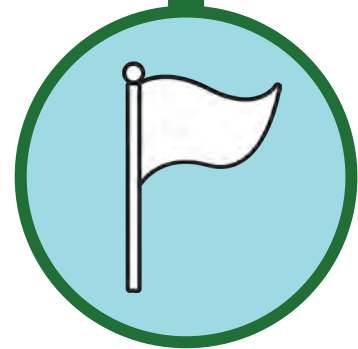




# E-FAST'S GROWTH

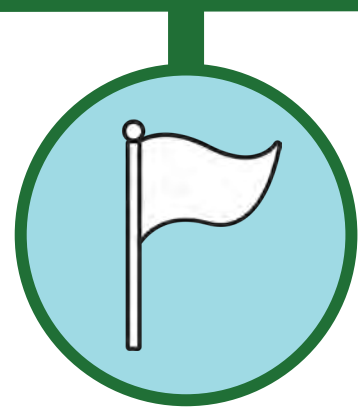
# 15

Focus group stakeholder consultations conducted across industry, government and academia



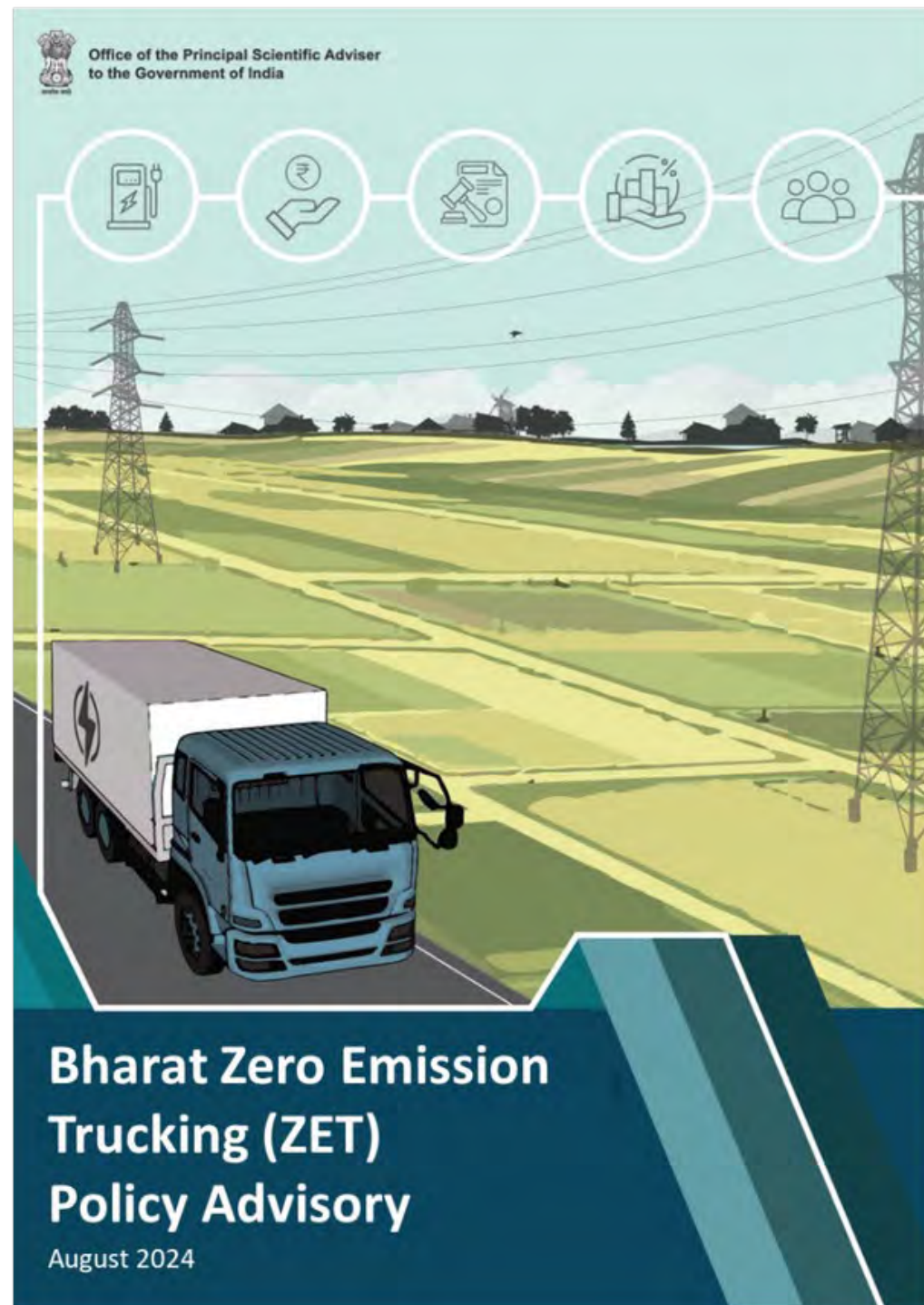
# E-FAST'S GROWTH

Supported the **Bharat ZET Policy Advisory**, a framework for policies needed to advance freight electrification in India





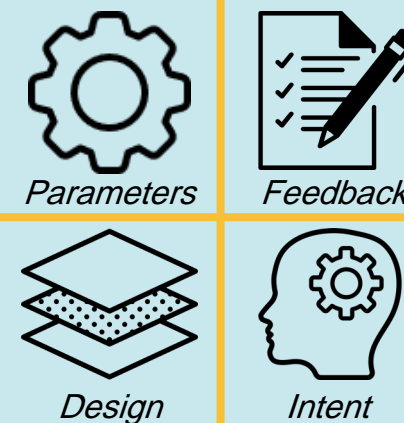
# BHARAT ZET POLICY ADVISORY



We identified the need for an advisory to provide policy support to trucking industry stakeholders for India's zero emission transition.



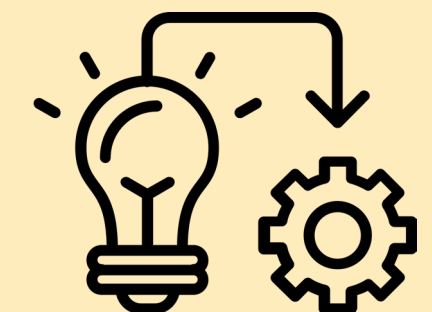
Inputs  
**gathered** from  
industry



**Structured** it  
through  
Donella  
Meadow's  
framework



**Identified**  
stakeholders –  
core, catalytic  
and distractive

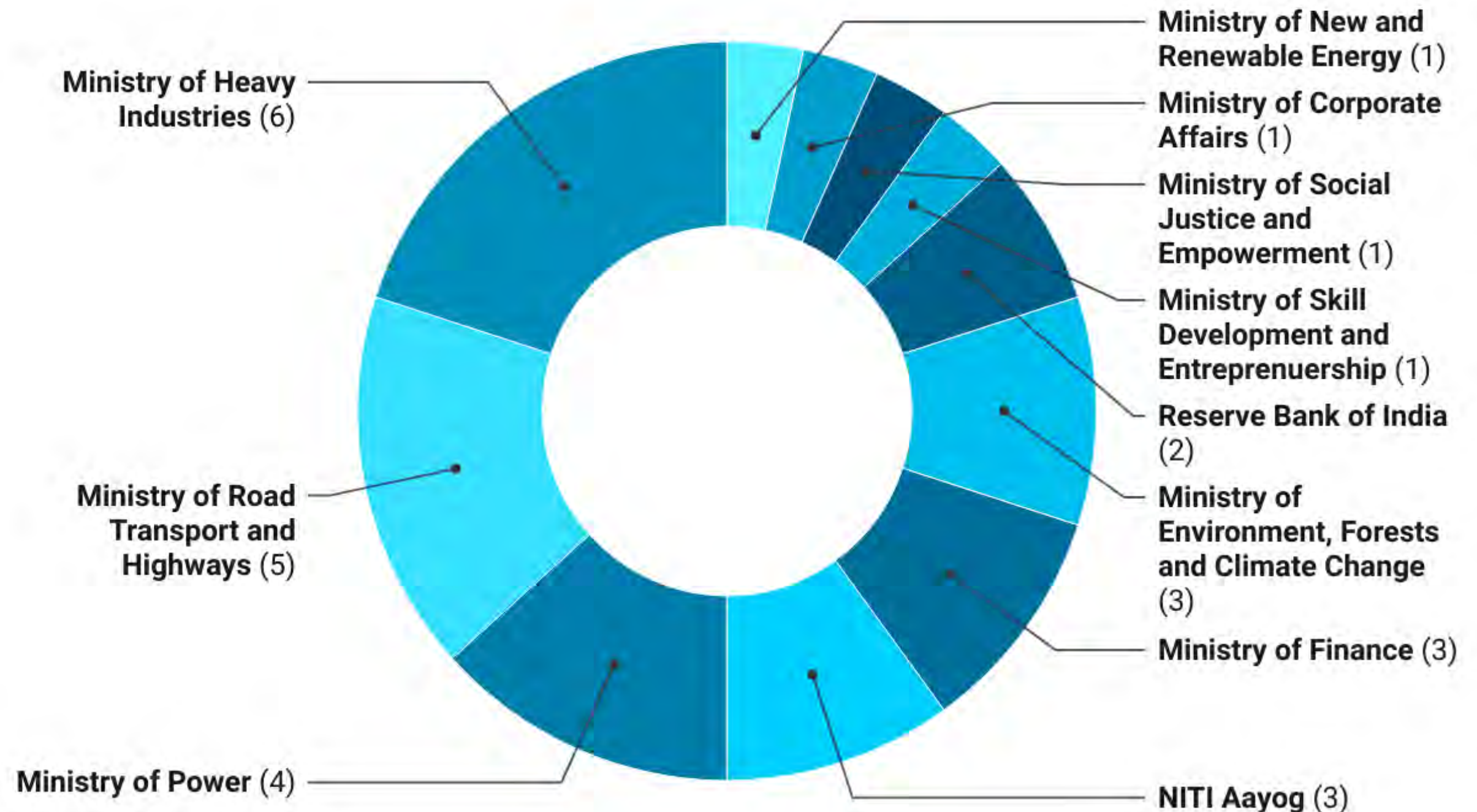


**Implemented**  
a stakeholder  
lens to look at  
interventions

# BHARAT ZET POLICY ADVISORY

30

interventions were identified as critical by the Policy Advisory Panel



Ministry -wise distribution of 30 policy interventions



# HIGHWAY ELECTRIFICATION

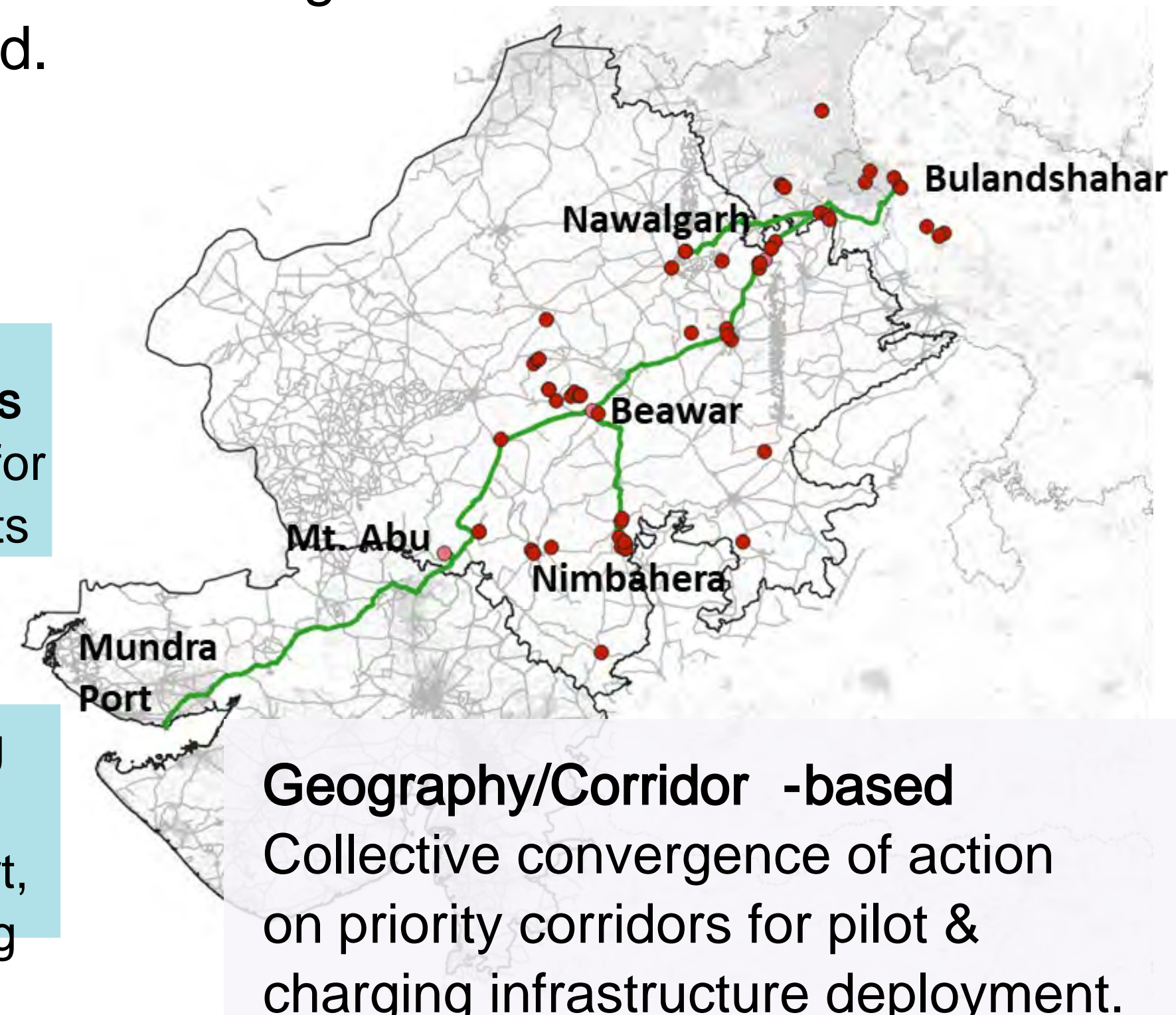
Integration of charging infrastructure along prioritized freight corridors through estimating supply and energy demand.

**Corridor Finalization**  
as per freight volumes,  
industry profiling

**Business Case Analysis**  
Use case analysis for  
scalable pilots

**Infrastructure  
Assessment &  
Planning**  
Demand and supply  
mapping

**Deployment of Charging  
Infrastructure & Pilots**  
Financing support,  
deployment & monitoring



# TRANSLATING AMBITION TO



## **DEMAND AGGREGATION**

Aggregate demand to accelerate ZET adoption

## **FINANCE**

Accessible financing solutions for ZETs

## **SCALABLE PILOTS**

Deploy scalable pilots with ready to abate sectors such as cement, steel, etc.

## **POLICY**

Stakeholder workshops on PSA's Policy Advisory Roadmap

## **STAKEHOLDER ENGAGEMENT**

Discussions and awareness drives with ecosystem-wide stakeholders



# TRANSLATING AMBITION TO



**15,000**  
e- trucks within 5  
years





WRI INDIA

THANK YOU

