

# Pathways for Zero Emission Truck Transition in India

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# About the Study

Establishing the need for zero-emission truck (ZET) transition



Meta-review of Total Cost of Ownership (TCO) studies across USA, Europe and China for different fuel technologies



Studying the techno-economic feasibility of truck segments in India through TCO analysis for battery electric trucks



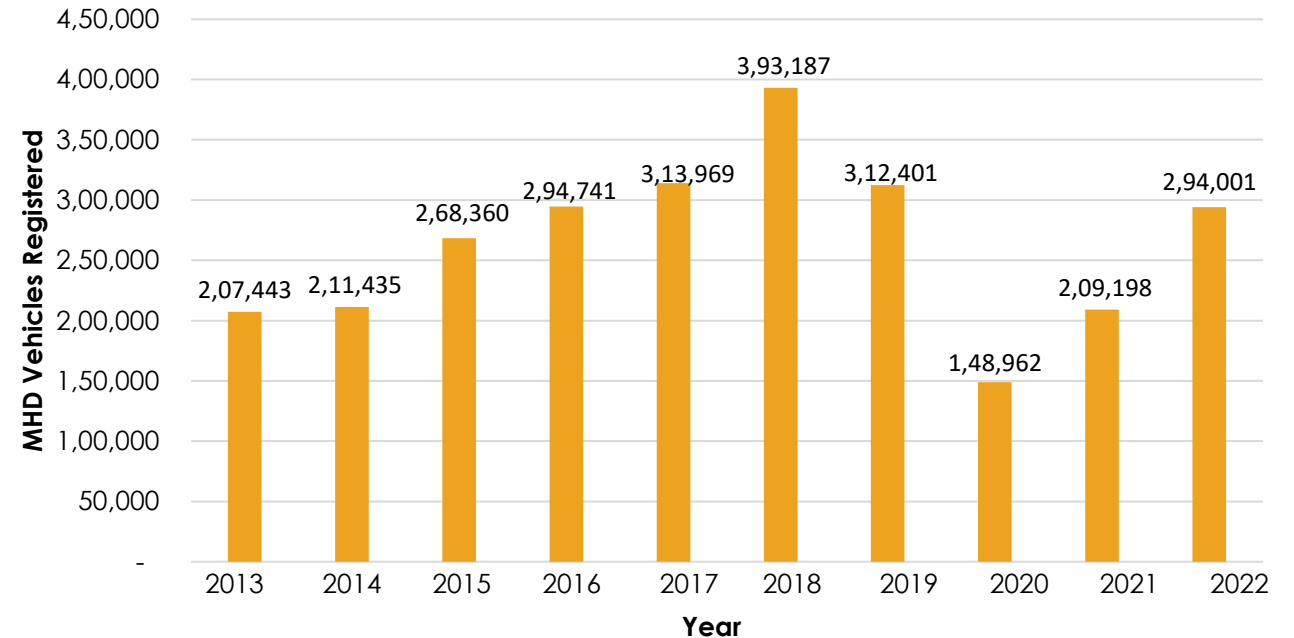
Identifying policy levers for ZET transition from global case studies



**Developing a four-pillared roadmap for ZET transition in India**

# India's trucks landscape

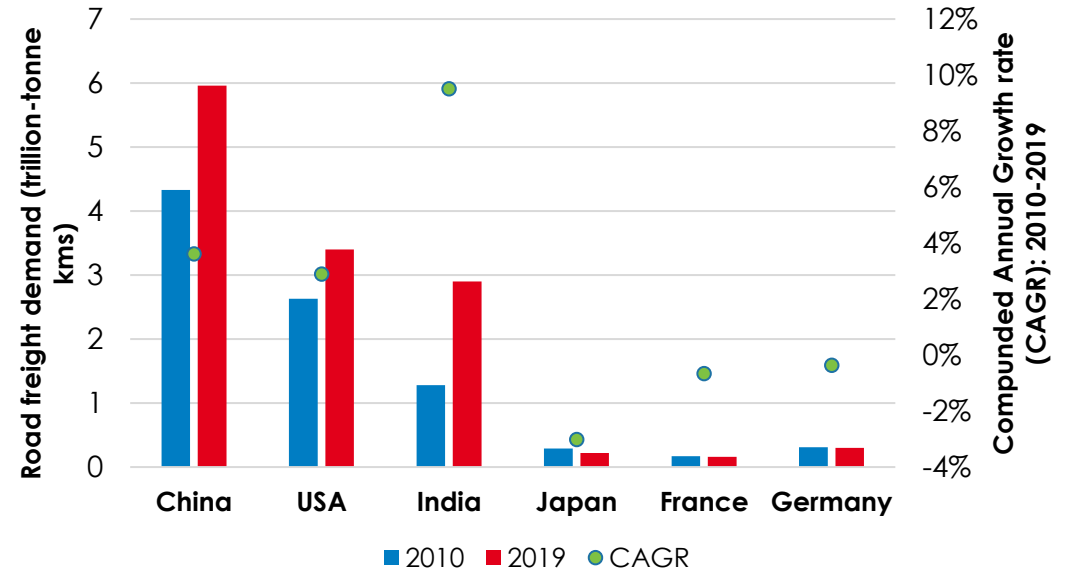
Category	Definition/ Homologation
N1	Motor vehicles used for carriage of goods with GVW not exceeding 3.5 tons.
N2	Motor vehicles used for carriage of goods with GVW exceeding 3.5 tons but not exceeding 12 tons.
N3	Motor vehicles used for carriage of goods with GVW exceeding 12 tons.



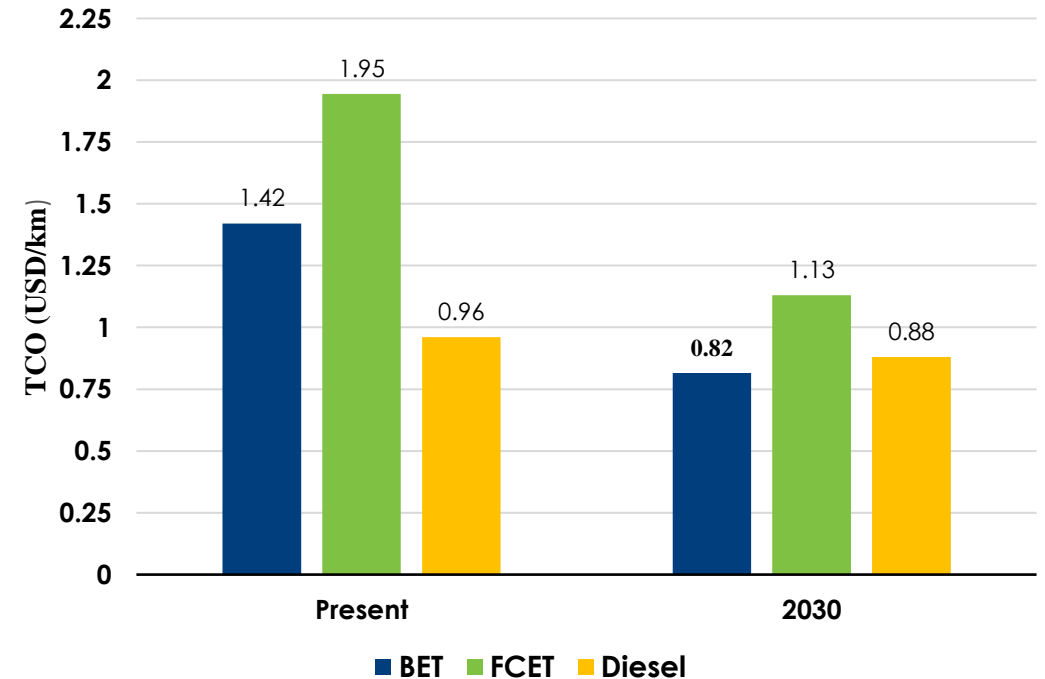
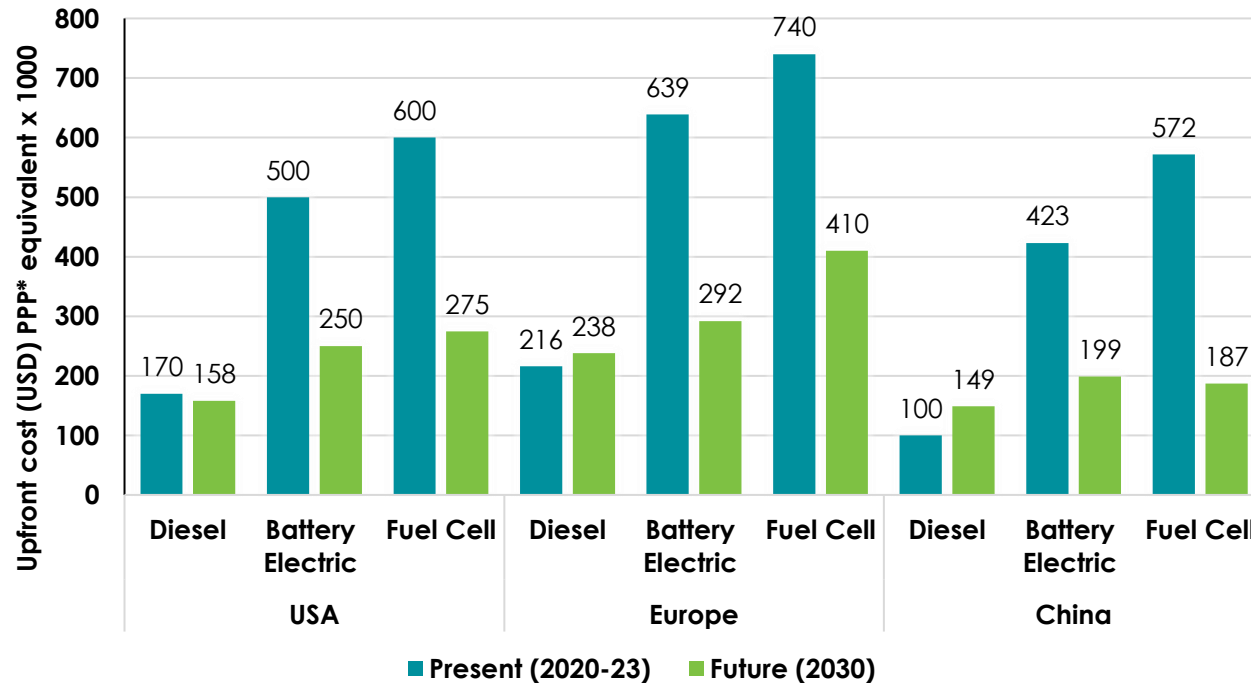
- Commercial vehicles are categorized based on their Gross Vehicle Weight (GVW)
- Medium and Heavy-Duty trucks (N2 & N3) constitute about 2% of annual vehicle sales
- Over 90% of MHD trucks operate on diesel fuel

# Need for Zero Emission Trucking in India

- Road freight caters to 70% of the total freight movement in India making it the 4<sup>th</sup> largest market in commercial vehicle sales
- Road freight demand in India grew by a CAGR of 10% between 2010-19, highest among the major economies of the world
- MHD trucks constitute only 3% of the vehicle stock but contribute over 35% of the CO2 emissions
- MHD trucks consume over 50% of India's oil demand
- Road freight demand is expected to reach 9.6 trillion tonne-km in by 2050 from 3 trillion tonne-km in 2020



# Globally HD-BET to be cost-competitive starting 2030\*



- BETs emerge as the most viable option globally for heavy-duty trucks by 2030
  - Median TCO of \$0.78/km which is 12% cheaper than diesel and 31% cheaper than FCETs
- TCO parity for BETs in 2030 driven by 40% reduction in battery pack cost and 30% truck efficiency improvement relative to 2023
- Upfront cost of BETs and FCETs decrease by about 55% in 2030 from present

# TCO Analysis for India



<b>Truck GVW</b>	<b>12</b>	<b>18</b>	<b>28</b>	<b>55</b>
<b>Use Case</b>	Perishable goods	FMCG	Urban municipal waste	Steel sheet rolls
<b>Distance per day (km)</b>	200	500	100	300

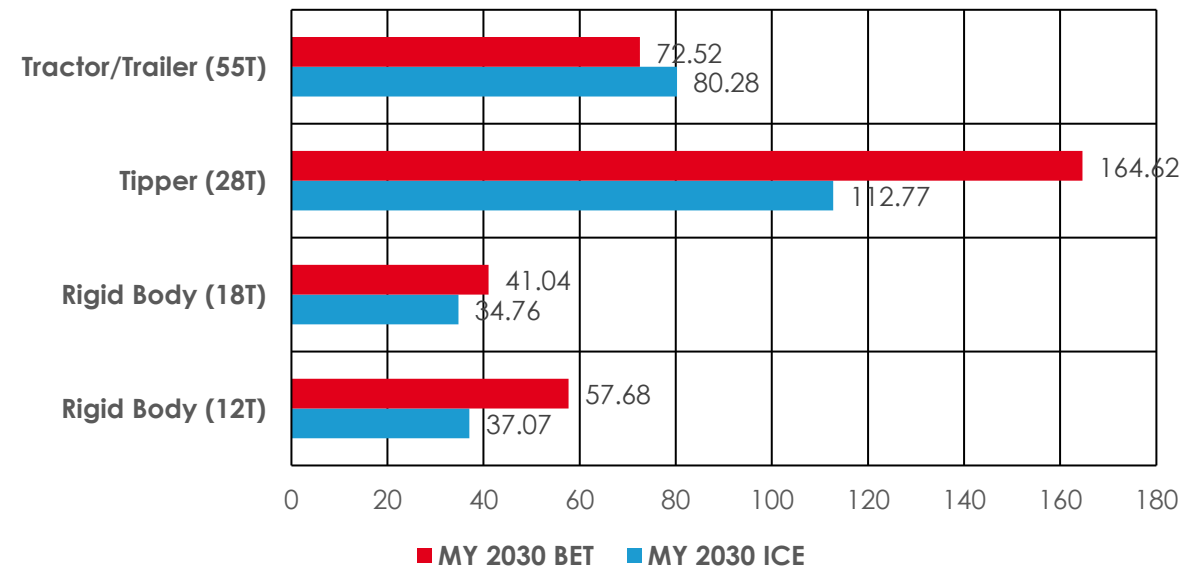
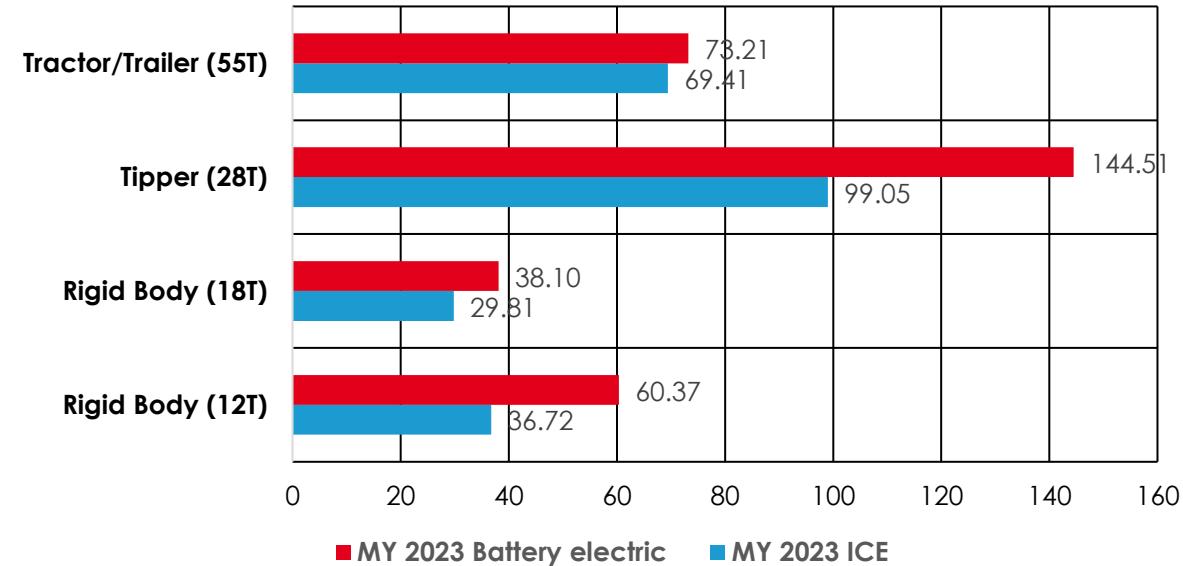
- Rigid trucks between 3.5–25T constitute 75% of medium and heavy-duty truck sales in India therefore considering 12T and 18T truck segments
- 28T tipper considered due to its closed-loop application for municipal solid waste
- 55T tractor-trailer considered due to heavy industry use and specific routes
- WRI-UC Davis tool used for techno-economic analysis of the truck segments

# 55T battery electric truck becomes cost competitive to diesel in India in 2030

- For 2023, with no incentives, TCO\* (INR/km) for battery electric 55T tractor trailer and 18T rigid truck is only 5% and 28% higher than ICE counterparts
- For 2030, battery electric 55T becomes about 10% cheaper than diesel equivalent without incentives
- For 2030, the TCO differential for battery electric 18T from diesel equivalent decreases to 18% without incentives
- 55T and 18T have an early mover advantage for electrification

## \*TCO (INR/km) as NPV at 6% over 15-year vehicle life

**Assumptions:** Battery life: 7 years, constant vehicle, operational, and financing parameters in 2023 and 2030, DC fast charging, diesel price: INR 94/l in 2023 with 4% annual increase till 2030, electricity price: INR 10.5/kWh in 2023, INR 16.6/kWh in 2030. Maharashtra as reference state for tolls and electricity price



# TCO of BETs in 2023 most impacted by daily distance travelled



Parameter	Case	12 T	18 T	28 T	55 T
Interest rate	Interest parity for EV and ICE	3%	2%	5%	3%
	EV fleet discount for interest rate	8%	6%	13%	9%
Distance travelled per trip	25% increase in distance travelled per trip	14%	11%	18%	14%
	25% decrease in distance travelled per trip	-20%	-17%	-29%	-22%
Electricity price	25% increase in electricity price	-4%	-9%	-2%	-4%
	25% decrease in electricity price	4%	8%	2%	4%
Road toll	Road toll exemption for battery electric trucks	12%	8%	0%*	12%

- Increasing the distance travelled per trip by 25% reduces the BET TCO by 14% on an average across truck segments
- Road toll exemptions for 12T and 55T, 25% electricity price reduction for 18T, and interest rate subvention for 28T emerge as parameters impacting TCO in sensitivity analysis



# Key policy levers for ZET transition in major economies



## United States

- EPA Phase-3 GHG emission reduction targets of 15-53% from 2027 - 32
- ACT rule with ZET adoption targets of 40-55% by 2035 in California
- Heavy Vehicle Incentive Program (HVIP) for ZETs in California



## European Union

- Fuel economy regulations with CO2 reduction of 45% by 2030 and 90% by 2040 levels for MHDVs
- Purchase incentives for electric trucks in major economies
- Alternative Fuel Infrastructure Regulation (AFIR)



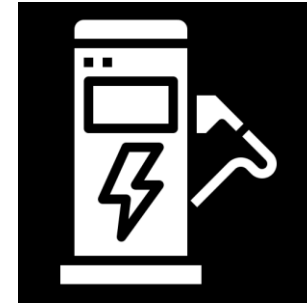
## India

- Fuel economy regulations for medium and heavy-duty vehicles
- FAME and PLI scheme for EV adoption

# Four-pillared Roadmap for ZET transition in India



Vehicle Technology



Infrastructure and Operations



Financing and Business models



Policy and Regulatory framework

# Vehicle Technology

- Define Zero-emission Trucks
  - Regulatory clarity on scope of ZETs and near-ZETs such as H2-ICE
  - California defining ZETs on zero tailpipe emissions and NOx standards for H2-ICE
- Developing a technology readiness assessment framework
  - Scoring zero-emission truck technologies for different GVW categories and use cases
  - Determining clear policy interventions and industry action
- Prioritise truck technology choices
  - Battery electric emerging as the dominant technology
  - Tailoring policy to enhance dominant technology production and adoption

# Infrastructure and Operations

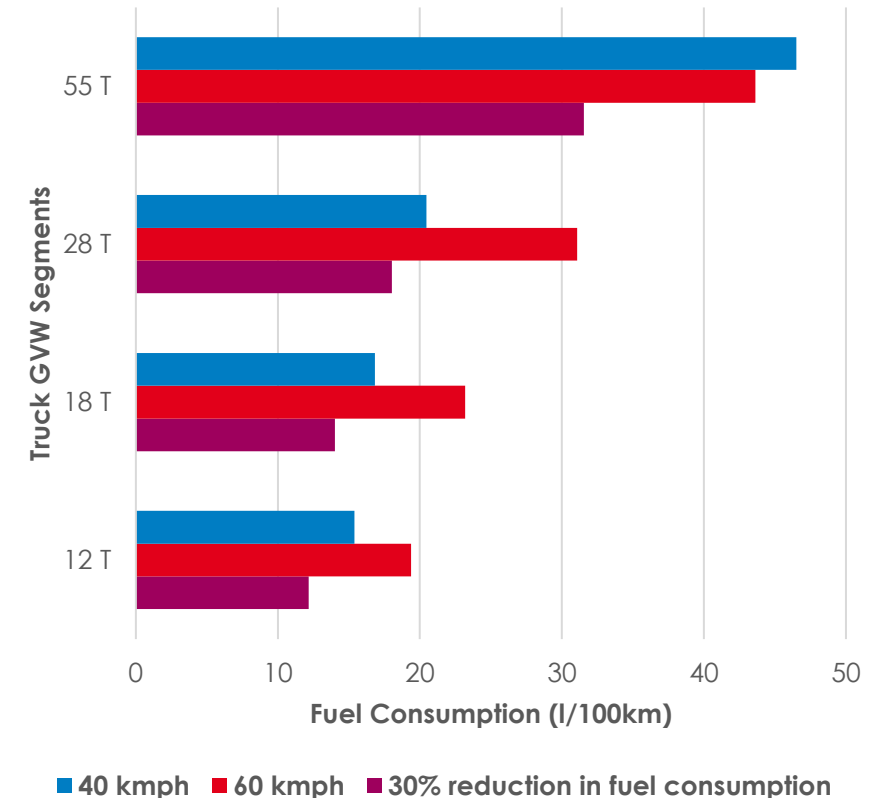
- Fulfill diverse charging infrastructure needs
  - Developing depot charging along with public charging infrastructure
  - Off-shift charging to fulfill more than 50% of charging needs for urban and regional applications
- Create a network of charging infrastructure through involving industry
  - Developing fast charging infrastructure along 11 identified industrial corridors
  - Opportunity for truck manufacturers to establish high-power charging infrastructure like Daimler in US and Milence in Europe
- Rationalise electricity tariff for charging
  - Extending separate EV charging stations tariff rates to trucks
  - Dynamic time-of-use charging tariffs aligned with off-shift/depot charging at night

# Financing and Business models

- Interest subvention for electric trucks
  - EV fleet discount rate could reduce electric trucks TCO by 9% on an average
  - Drawing lessons from reduced interest rates for electric cars fleet for ride-hailing services
- Demand aggregation through large shippers and public agencies
  - Demand generation for 7,700 electric trucks by major shippers under e-FAST
  - Leveraging lessons from e-bus demand aggregation for public fleets in heavy industries, drayage and municipal trucks
- Exploring innovative financing models
  - First-loss protection scheme to guarantee minimum residual value for early ZETs
  - Dynamic pay-per-km leasing scheme by asset leasing companies

# Policy and Regulatory Framework

- Prioritising ambitious CO2 emission standards for MHDTs
  - Shifting to CAFE norms from per-vehicle standards allowing technology flexibility and market-based credits trading
  - Fast-tracking development of Bharat Energy Efficiency Tool (modelled on EU's VECTO) for monitoring CO2 emissions
- Setting manufacturers' sales targets
  - Sales mandate having considerable impact on EV adoption across California, China
  - Considering setting a target of 10% sales share of ZETs by 2030
- Encouraging sub-national action for ZET adoption
  - Road tax waiver and inclusion in state EV policies
  - Priority entry in cities for ZETs
- Designing tailored purchase incentives for ZETs



# Summary of key actions

Prioritise electrification for early-mover truck segments in India

Strengthen CO2 emission regulations for trucks and shift to CAFE norms for MHD trucks

Set ambitious manufacturer and fleet sales target

Plan, invest, and involve industry in developing charging infrastructure

Institute interest subvention and risk-sharing mechanisms for electric truck financing

Encourage and support sub-national policy and regulatory action

**Thank you!**

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