17th Urban Mobility India Conference & Expo 2024

ELECTRIFYING INDIA'S ROAD FREIGHT: CHALLENGES AND STRATEGIES FOR MEDIUM AND HEAVY-DUTY TRUCKS

AIM & OBJECTIVES

Aim

The Aim is to develop strategies and recommendations to facilitate the widespread adoption of electric medium and heavy duty trucks (EMHDT's) in road freight transport, addressing sustainability and operational challenges.

Objectives

1. *To assess the global and Indian EMHDT landscape, considering market trends, technology, and regulations.*
2. *To map the involved stakeholders along with their roles and investigate and barriers in the adoption and operation of EMHDTs.*
3. *To explore business models for EMHDT's adoption along with Total Cost of Ownership calculation and mitigation techniques for the identified barriers.*
4. *To provide recommendations for amendments in policies and create a roadmap for sustainable EMHDT adoption in India, considering safety and infrastructure needs.*

INTRODUCTION

What is Medium and Heavy Trucks?

Medium Duty Trucks (10%)
3.5 Ton<GVW<12Ton

Heavy Duty Trucks (30%)
12 Ton< GVW<55Ton

Source: Automotive Research Association of India (ARAI), Vahan Dashboard

80% of total road freight transport is covered by Medium and Heavy Duty Trucks

Source: International Transport Forum

Need of EMHDT's

Growth:

- 71% of India's freight is transported by road.
- 2.2 Trillion Tonne Kilometers in 2022.
- Forecasted demand of 9.6 Trillion Tonne Kilometers in 2050.
- From 4 Million Trucks (2022) to 17 Million Trucks(2050)

Source: Transforming Trucking / Niti Aayog

Fuel Dependence:

- 25% of Nation's Diesel Consumption.
- India is the 3rd highest fuel importer.
- 40% of total fuel consumption.
- Four Times by 2050.

Source: RMI

Emissions:

- Freight Vehicles represent is 3% of the total vehicle fleet yet are responsible for 34% of road transport emissions.
- Only HDT's accounts for 80% of pollution by road freight transport.

Source: NITI Aayog, WRI

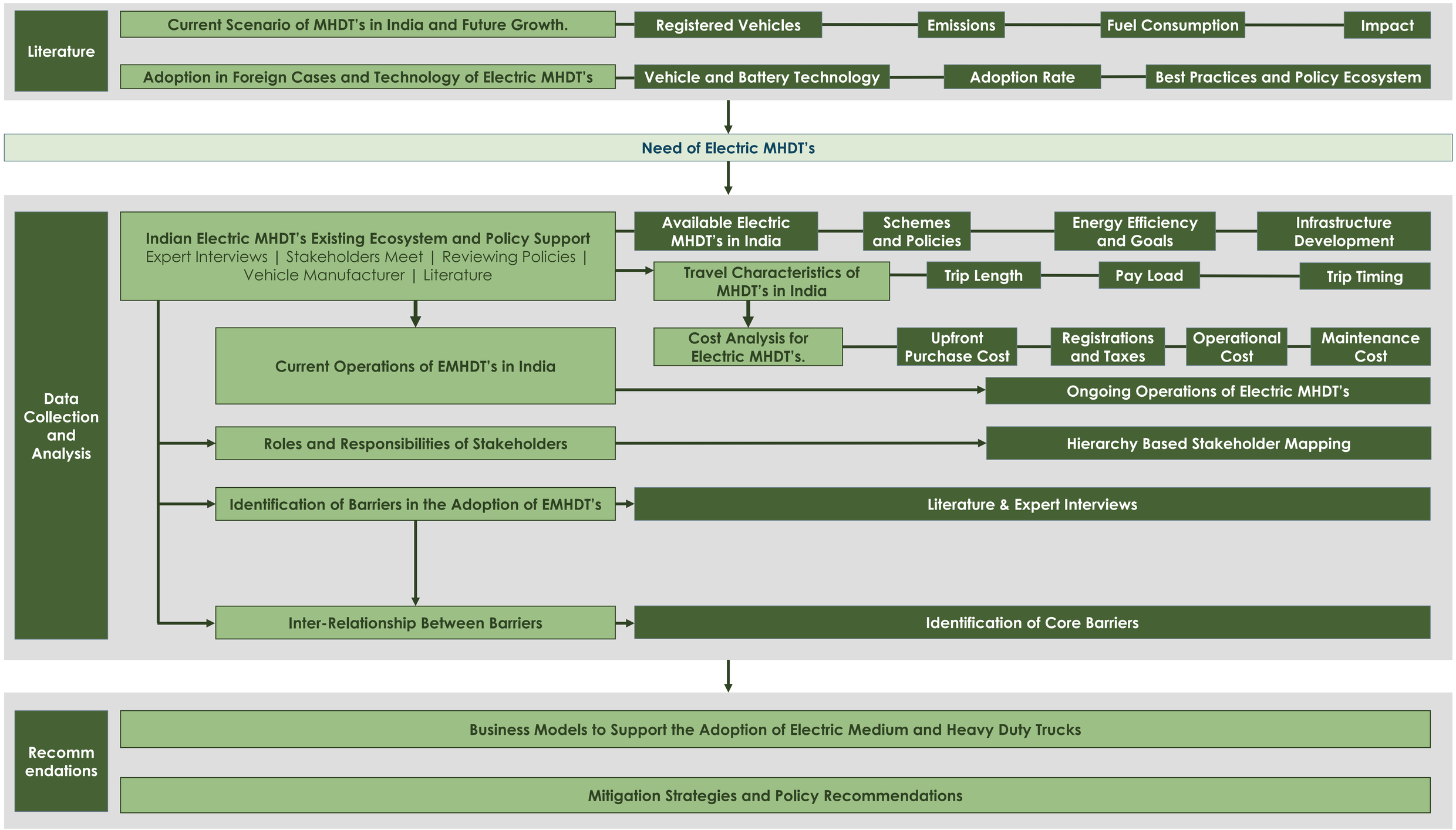
Logistics Cost:

- India's logistics cost i.e. around 14% is comparatively higher.
- Transportation cost is 62% of Logistics Cost.
- Fuel Price is one of the major contributor – 50% of transportation cost.

Source: RMI, Fleetex

INTRODUCTION

Methodology



Source: Author Generated

LITERATURE

Battery Technology

Commonly Used Battery Technologies in EMHDT's

Lithium-Nickel-Cobalt Oxide (NCA) — *Energy Density – 230Wh/kg*

Lithium-Nickel-Manganese-Cobalt Oxide (NMC). — *Energy Density – 275Wh/kg*

Battery Ageing

- Calendar Ageing – Based upon Time
- Cycle Ageing – Based Upon Charge Cycles

Change in Cost of Batteries

- 2010 - $1100/kWh
- 2020 - $137/kWh
- 2023 - $100/kWh

Source: Bloomsberg

Environmental Impact – Cradle to Grave

Emissions Intensity (Lifecycle GHG)	**Diesel**	**GmCO2/Litre**		**3579**		
	Electric	GmCO2/kWh		701		
		Units	7.5MT	12MT	25MT	40MT
Fuel Economy	Diesel	Km/Litre	8	5.5	3.45	2.2
	BET	Km/kWh	2.50	1.69	0.88	0.49
Emissions	Diesel	Km/Litre	446.9	650	1036.3	1625.1
	BET	Km/kWh	288.3	427.3	820.2	1485.1
GHG Reduction BET			**35%**	**34%**	**21%**	**9%**

Source: Freight Trucks in India are Primed for Electrification | 2022 | Nikit Abhyankar

Available EMHDT's in India

Model / Specifications	IPL Tech Rhino 5536	Ashok Leyland AVTR 55 T	Ashok Leyland BOSS 14 T
Gross Vehicle Weight (GVW)	55 Ton	55 Ton	14 Ton
Payload Capacity	40 Ton	42 Ton	9 Ton
Approximate Price*	1.15 Cr	1.25 Cr	80 Lakhs
Battery Capacity	258 KWH	301 KWH	201 KWH
Battery Weight*	2.5 T	2.4 T	1.4 Ton
Range	160 KM	185KM	230 KM
Battery Price*	65 Lakhs	70 Lakhs	40 Lakhs
Charging Time	90 Min (20%-100%)	90 Min	120 Min
Charging Equipment Required*	150 KW	240 KW	120 KW
Charging Equipment*	12 Lakhs	18 Lakhs	8 Lakhs

Information Shared by E Truck OEM's during Meeting
** Approximate Cost , *Information not available in public domain*

Source: Author Generated

Government Schemes and Policies

NEMMP — Incentives – Vehicle/Charger , Formulation of State EV Policies
- Ministry of Heavy Industries

PLI — Make in India, Advanced Chemistry Cell, Auto Components
- Ministry of Heavy Industries

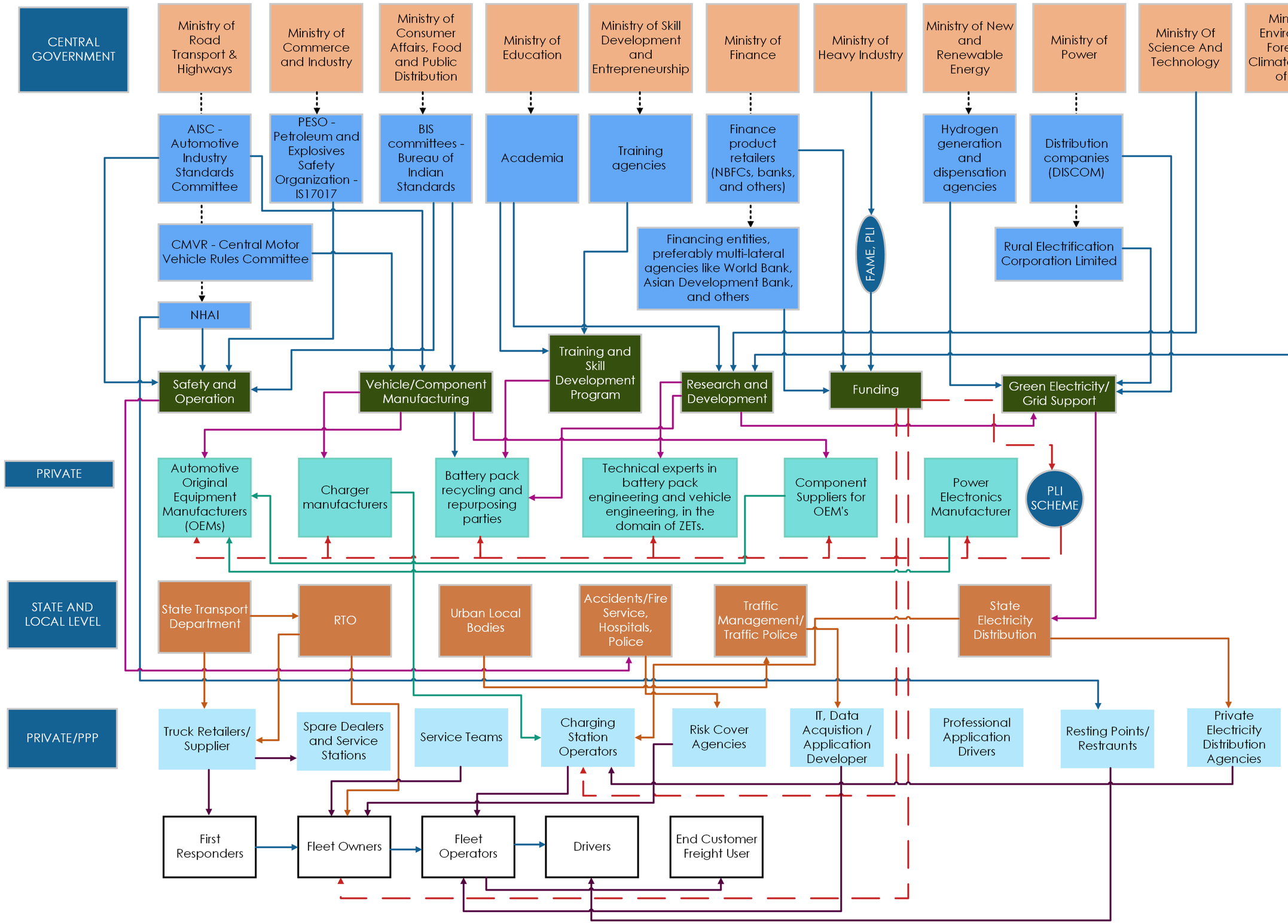
FAME — Fiscal and Non Fiscal Incentives, EMHDT's not Included
- Ministry of Heavy Industries

PM E-Drive — Outlay of INR 500 Cr to promote E-Truck Adoption
- Ministry of Heavy Industries

Current Operations of EMHDT's

- Operated in Closed Loop Environment
- In Cement Industries and Other Mining Sites
- In House Charging Equipment
- Proposed Charging Infrastructure development between **Mundra and Morbi Port**(200KM)

STAKEHOLDER MAPPING

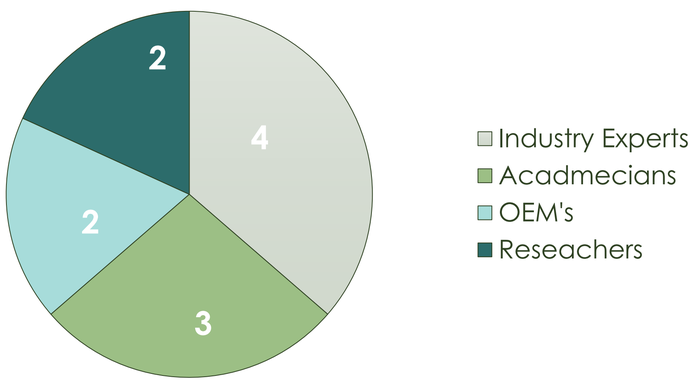


DATA COLLECTION AND ANALYSIS

Identified Barriers from the Literature

Barriers	Publication 01	Publication 02	Publication 3	Publication 04	Publication 05	Publication 05
Total Cost of Ownership	Martín Tanco (2019)	Thomas Earl (2018)	Qamar S(2021)	Theodora Konstantinou (2022)	Nikit Abhyankar (2022)	Bjorn Nykvist (2021)
Charging Infrastructure	Chandana K (2023)	Qamar S(2021)	Lisa Melander (2022)	Muhammad Qasim (2021)	Harrison John Bhatti (2022)	Claire Sugihara (2023)
Battery Technology	Chandana K (2023)	Shishir Bhardwaj (2022)	Harrison John Bhatti (2022)	Lisa Melander (2022)	Heikki Liimatainen (2018)	Burke, Andrew (2022)
Charging Duration	Shishir Bhardwaj (2022)	Theodora Konstantinou (2022)	Claire Sugihara (2023)	Burke, Andrew (2022)	Jimmy O'Dea (2020)	Behyad Jafari (2021)
Policies and Schemes	Thomas Earl (2018)	Lisa Melander (2022)	Harrison John Bhatti (2022)	Theodora Konstantinou (2022)	Burke, Andrew (2022)	Sudhendu Jyoti Sinha (2021)
Grid Mix	Theodora Konstantinou (2022)	Nikit Abhyankar (2022)	Xizhao Zhang (2022)	Burke, Andrew (2022)	Marissa Moultak (2017)	Jimmy O'Dea (2020)
Range Anxiety	Claire Sugihara (2023)	Heikki Liimatainen (2018)	Rahul Bagdia (2021)	Shishir Bhardwaj (2022)	Aviral Yadav (2023)	
Alternative Fuel Technology	Xizhao Zhang (2022)	Burke, Andrew (2020)	Marissa Moultak (2017)	Jimmy O'Dea (2020)	Rahul Bagdia (2021)	Andrzej Łebkowski (2017)
Payload Compromise	Bjorn Nykvist (2021)	Claire Sugihara (2023)	Marissa Moultak (2017)	Andrzej Łebkowski (2017)	Aviral Yadav (2023)	

EXPERT INTERVIEWS



Professors and Researchers
- IIT Kharagpur
- IIT Guwahati
- NIT Meghalaya

OEM's
- Ashok Leyland
- IPL Tech

Industry Experts
- AEEE
- ICCT
- WRI
- pManifold

Set of Questions

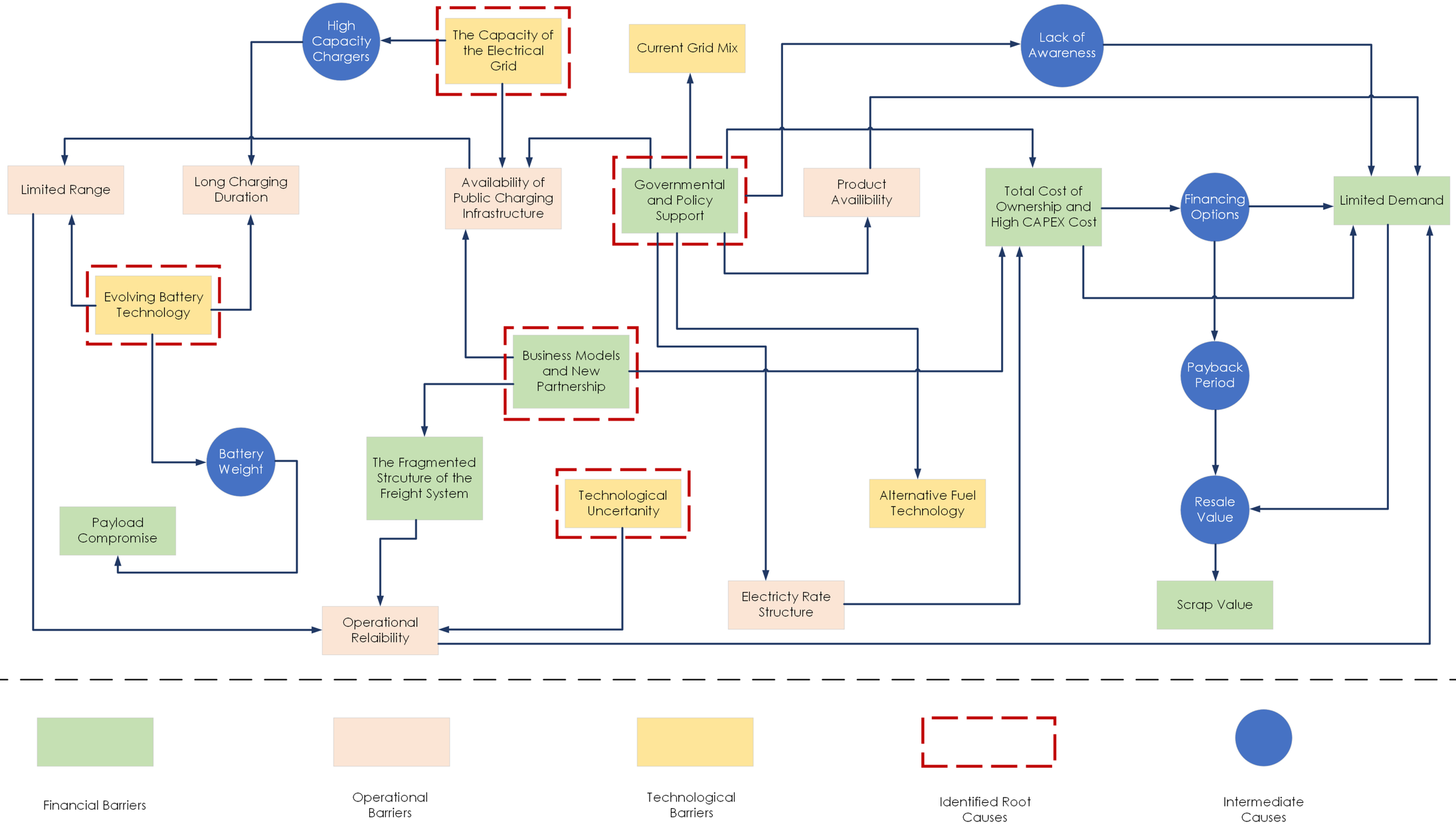
- Role of Electric Mobility in India
- Fuel Consumption and Emissions
- Vision for Electrification of Heavy Duty Vehicles
- Trip Behavior of Indian Trucking Industry
- Revenue Generation by HDV's
- Schemes and Polices
- Electricity Generation
- Business Models
- Grid Support
- Charging Infrastructure and Costs

Extracted Barriers from the Interviews

Product Availability	Operational Reliability	Grid Capacity and Support
Technological Uncertainty	Scrap Value	Heterogeneous Operational Structure
Limited Demand	Electricity Rate Structure	Lack of Business Models

ANALYSIS

Derived Relationship Between Barriers



Source: Author Generated

Identified Core Barriers

- Evolving Battery Technology
- Capacity of Electrical Grid
- Government and Policy Support
- Business Models and Partnerships
- Technological Uncertainty

ANALYSIS

Total Cost of Ownership Calculator

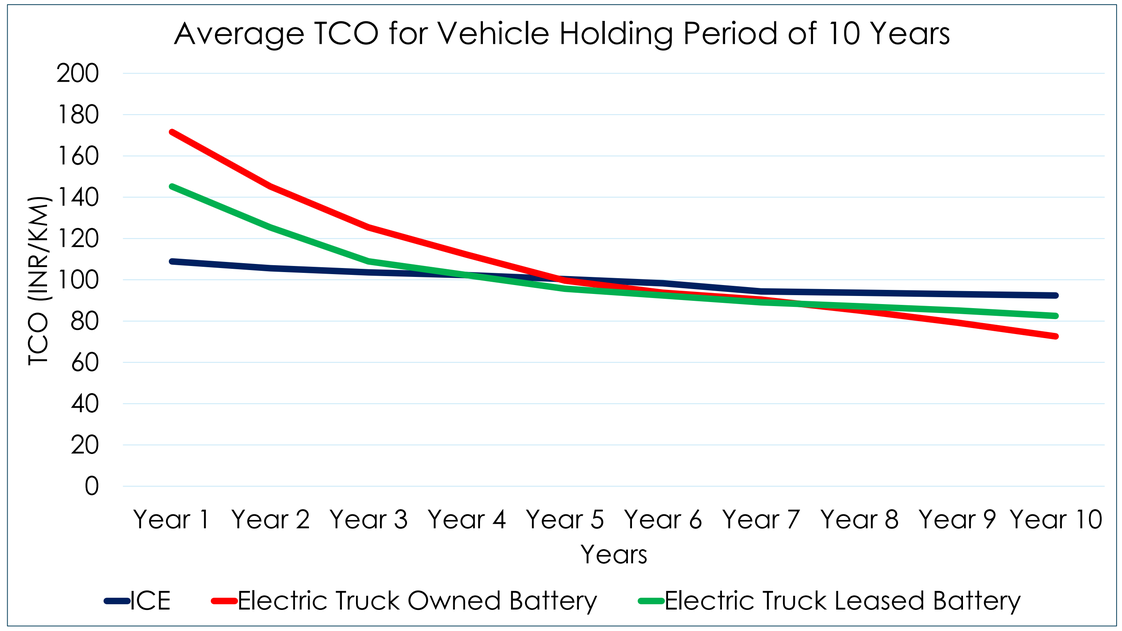
Considered Values for TCO Analysis

Considerations	ICE Based 55 T Truck	Electric 55 T Truck (Owned Battery)	Electric 55 T Truck (Leased Battery)
Vehicle Holding Period	10 Years	15 Years	15 Years
Daily Distance Travelled/Day	400 KM	400 KM	400 KM
Purchase Cost	50,00,000	1,25,00,000	70,00,000
Tax+ National Permit	200000	0	0
Financial Incentive* (As per LCV's in FAME 2)	0	5,00,000	10,00,000
Annual Maintenance + Tires	540000	500000	510000
Battery Replacement (Frequency)	NA	After Every 3,00,000 KM	NA
Battery Replacement Cost	NA	NA	50,00,000
Fuel/Charging Cost	100/Litre	12/kWh	40/kWh
Toll Tax/KM	5/KM	0	0
Insurance	70,000	80,000	1,00,000
Diesel/Electricity/Maintenance Growth Rate	5%		
Discount and Resale Rate	10%		

**Data Collected during the Meeting with ICE Truck Operator and Electric Truck Manufacturer*

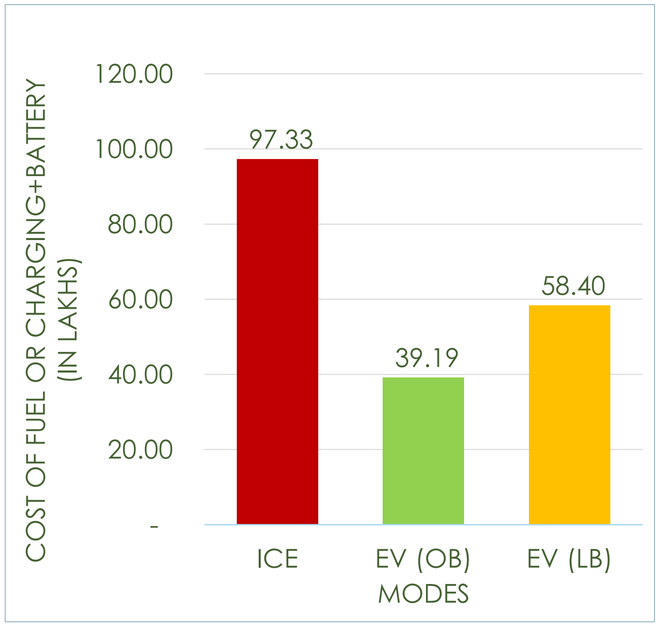
Source: Author Generated

Average TCO at the End of 10th Year



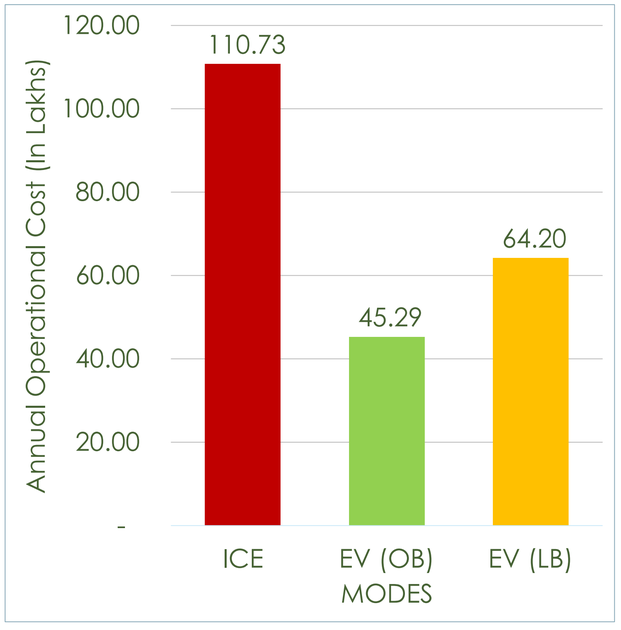
Source: Author Generated

Annual Fuel / Charging + Battery Cost



**Driver Wages are not Involved into Calculation*

Annual Operational Cost



Source: Author Generated

ANALYSIS

Factors Considered For Business Models

- Investment into Charging Infrastructure Development
- Govermental Support and Policies
- EMHDT's Demand and Adoption Rates
- Partneships and Collaborations
- Operational Reliability
- Revenue Generation

Business Models in the Ecosystem of EMHDT's

Ownership Model

1. Government Incentives to Reduce the Upfront Cost.
2. Resale Rights
3. Long Term Advantages – Lower TCO
4. Usage of Charging Equipment to Charge Other Vehicles.

Leasing and Rental Model

1. Short Term and Long Term Leasing.
2. Zero Upfront Cost
3. Benefits of Lower Operational Costs.
4. Benefits of Lower Maintenance Costs.

Business Models in the Ecosystem of EMHDT's

Subscription Based Model

1. Subscriptions Based on KM Driven or Time Period.
2. Advantageous for Occasional Needs
3. Optimal Fleet Utilization.
4. Subscription Fee Comprehensively Covers All Services.
5. Financial Predictability.

Charging Infrastructure as Service

1. Offset Significant CAPEX Cost.
2. Government Fiscal and Non Fiscal Incentives.
3. Promotes Development of Robust Charging Infrastructure.
4. Maximum Utilization of Created Infrastructure.

Battery Leasing and Swapping Model

1. Reduces Upfront Cost by Almost 50%.
2. Subscription Based Upon KM Driven.
3. Direct Relation Between KM Driven and Per kWh Charge.
4. Initially Effective for Fleet Operates of Major Freight Corridor.

Fleet Aggregation and Pooling Model

1. Instrumental in Maximizing the use existing fleet.
2. Reduction in Total Cost of Ownership.
3. Creation of Common Platform is Required.
4. Formulation of Unified Operations.

Business Opportunity for Land Owners/ Resting Stop Owners

1. Land Leasing to Charging Point Operators.
2. Truck Depots and Service Centers.
3. Resting Stops Can Be Equipped with modern Facilities and Charging Infrastructure.

Source: Author Generated

MITIGATION STRATEGIES AND POLICY RECOMMENDATIONS

- **Research and Development in the Domain of Battery Technology and Clean Manufacturing.**
  - Limited Range, charging duration, payload compromise.
  - Cheaper and environmentally sustainable manufacturing process. – Life cycle emissions will reduce.
- **Strengthening of Existing Power Grid and Development of Renewable Power Generation**
  - Charging duration will reduce with the usage of high power charging equipment.
  - Emissions reduction in power generation will directly reduce life cycle emissions of EMHDT's
- **Fiscal Incentive for EMHDT's buyers**
  - Reduce upfront cost, will directly attract buyers.
- **Regulation of Electricity Rate Structures for the Charging of Electric Vehicles**
  - Directly reduce the charging cost and impact total cost of ownership.
- **Introduction of Awareness and skill development programs**
  - Remove Misconceptions between fleet operators and increase demand of EMHDT's
- **Defining the Forecasted Market Penetration of Various Alternative Fuel Technologies for ZET.**
  - Bring confidence between policy makers and investors to fuel up the process financially.
- **Introductions of Financing Options with Lower Rate of Interest.**
  - Directly attract the fleet owners to invest into the technology.
- **Incentives for the OEM's and Auto Component Manufacturers.**
  - Push manufactures for the production which will directly brings multiple options to the buyers.
- **Mandates for Unified and Standard Charging and Battery Infrastructure**
  - Allow easy charging and battery swapping process.
- **Pilots for Retrofitting of Existing Fleet**
  - Conversion of existing fleet which will reduce the upfront cost significantly. Along with the benefits of low operational cost
- **Tightening of Fuel Emission Standards**
  - Push fleet owners to shift towards ZET's.
- **Usage of Containerized Cargo**
  - Reduce the turn around time to improve efficiency and usage of EMHDT's.
- **Electrification of 7 major Corridors – Caters 50% of vehicle freight transport.**
  - Major Fleet will affect and maximum utilization of developed infrastructure
- **Funded Pilot Projects and Appreciate closed loop environment usage.**
  - Bring confidence in buyers as well as testing of EMHDT's will be carried out
  - Identification and rectification for Indian usage of EMHDT's

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THANK YOU!