Bruce Henderson Insight | Ideathon

Vidyut

An Electric Vehicle Charging Network Solution
By IITK Consulting Group

Meet the Presenters

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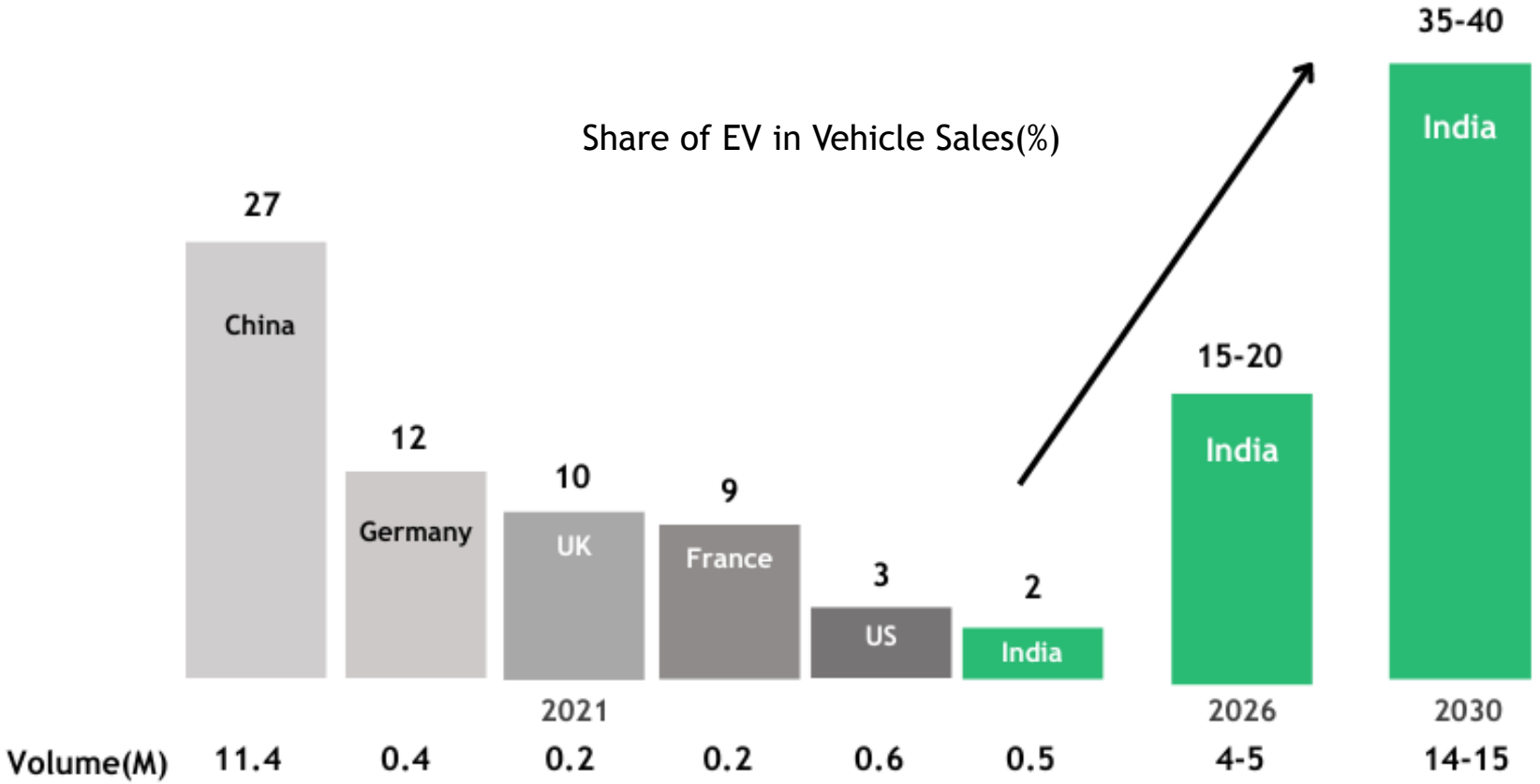
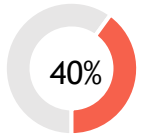
Problem to be Solved

Current condition of EV industry and its roadblocks

- Unprecedented rise of EVs in India between 2019-21 (422% in 2W and 75% in 3W)
- Lack of supporting public charging infrastructure
- Largely affecting public transport and last-mile delivery sector



When asked, why not switch to EV?



More expensive

High maintenance

No unified charging facility

Lack of charging infrastructure for public transport

Why EV Charging Optimization?

1:135

Public charging point to EVs ratio:
Current - 1:135
Ideal - 1:6

Only 1 public charging station every 900 km

Takes 6-7 hours for an electric vehicle to charge fully

Government schemes failing to reach desired goal due to infrastructural constraints

Where do we fit in?

Targeting areas with low EV charging points to EVs ratio

Using GNN based technology for route optimisation

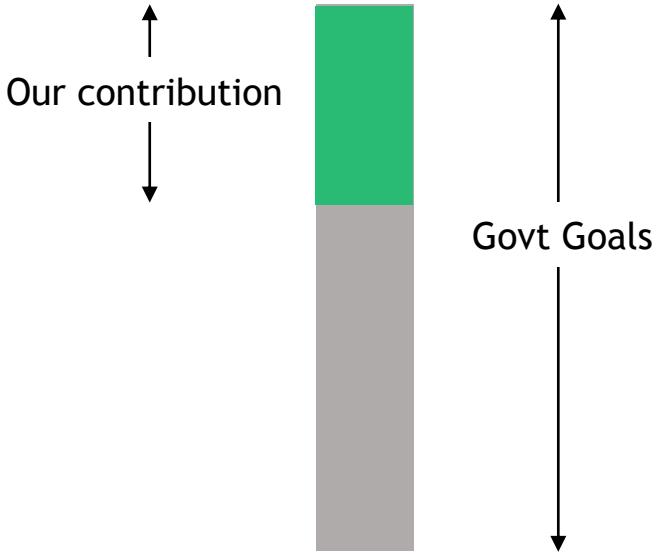
Fast charging services for public transport industry

Bringing wireless technology customized for India, decreasing energy usage to up to half

Our business will serve as the EV network charging service provider to the growing EV market with an expected CAGR of 49% between 2022-30.

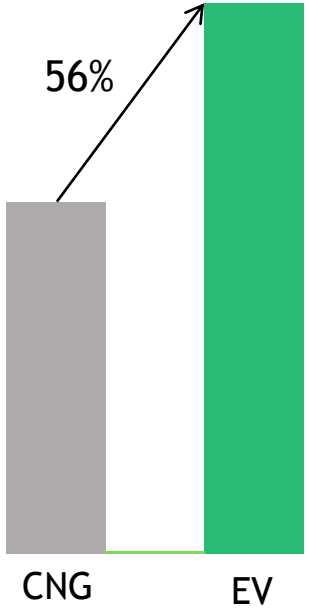
Vidyut’s goal for the EV industry and its users

Facilitating Government Objectives



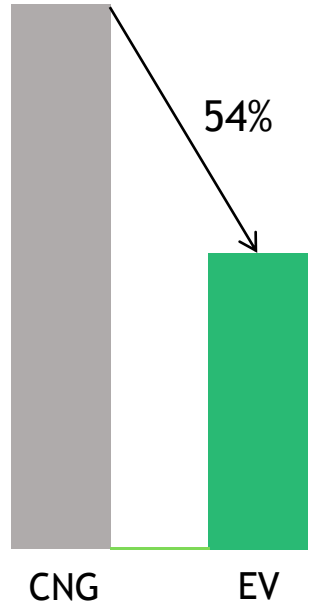
FAME-2 EV Charging goals

Increase the profit margins



EARNINGs/DAY

Contributing for COP26



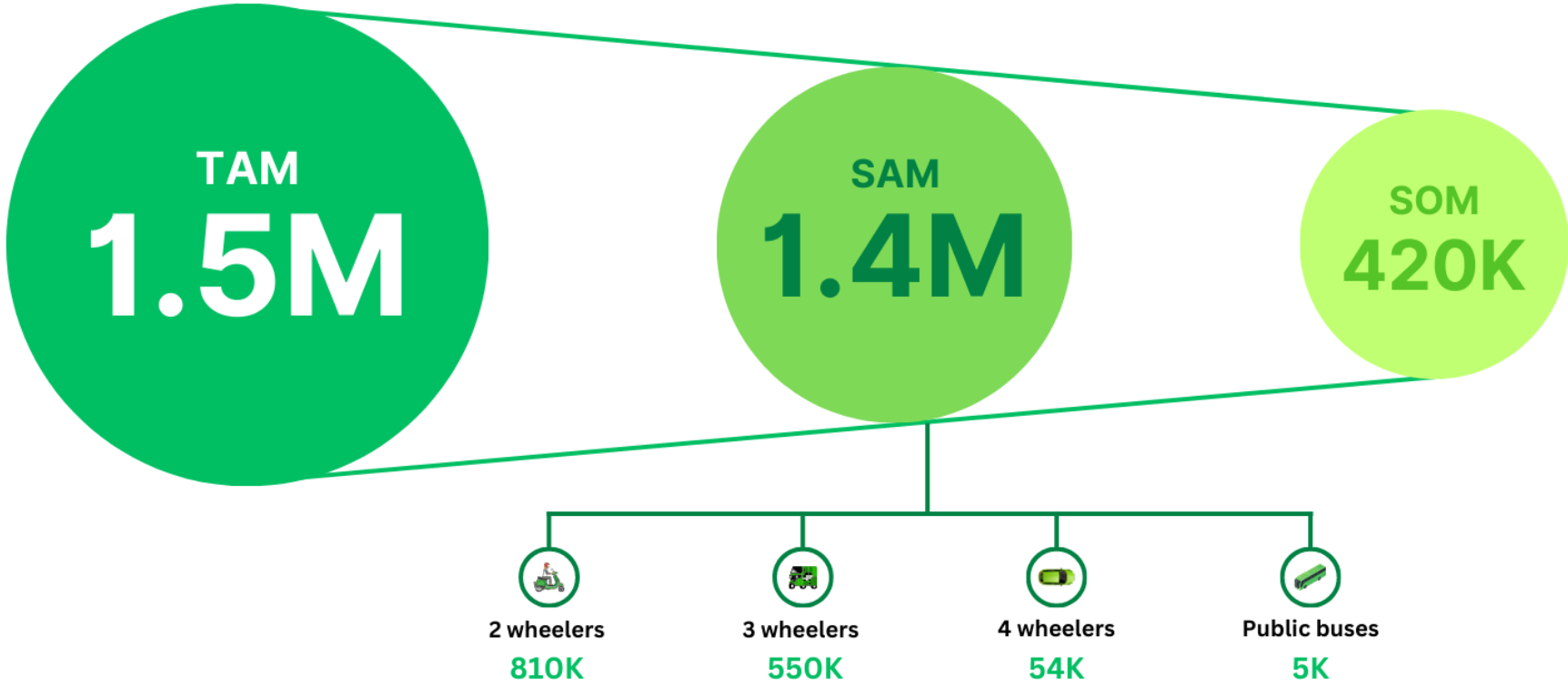
CO_2 EMISSIONS

To be the pioneer in facilitating and empowering a green mobility network by providing public transportation infrastructure

Market Size

Our Target EV Population

*No. of EVs



- TAM: Total Number of EVs present in India.
- SAM: Public transport (3w)
  Last minute Delivery (2w)
- SOM: Estimate % share of our business in the market

Thus, the 2W and 3W will act as the focus of our business plans and setup.

Potential Market Size of Charging Industry

The total market value ultimately boils down to the value of the cost of charging and swapping the batteries.

$$\sum_{i=1}^{n}[(Cost\ of\ charging(per\ hour)) * (Time\ taken\ for\ charging)] + [(Cost\ of\ swap) * (total\ number\ of\ swaps)]$$

~Where n represents the total number of vehicles

Method	Cost	Time Taken
Battery Swapping	Rs. 200-300 per swap	Instant
AC charging	Rs. 9 per unit	3-6 hours
DC charging	Rs. 18 per unit	30-60 minutes

The current market value comes up to be:

$ 2.2 Billion

Competitive Analysis

Comparative study for Battery Swapping Infrastructure

FEATURES	ECHARGE UP	GOGORO	SUN MOBILITY	VOLTUP	OUR MODEL
Adaptability to different Batteries	Both 2W & 3W	Only 2W	Both 2W & 3W	Both 2W & 3W	Standard 2W & 3W
Location Optimizations	Scattered	Setting up in India	Network in 18 cities	Scattered	GNN Based setup
Time Efficiency	Book on site	Subscription plans	2 minute swaps	Subscription plans	Pre book using app
Supporting App	Basic level features	Real time status	Basic level features	Real time status	Optimized routes
Renewable Energy	No such policy	No such policy	Active Integration	No such policy	Future Integration

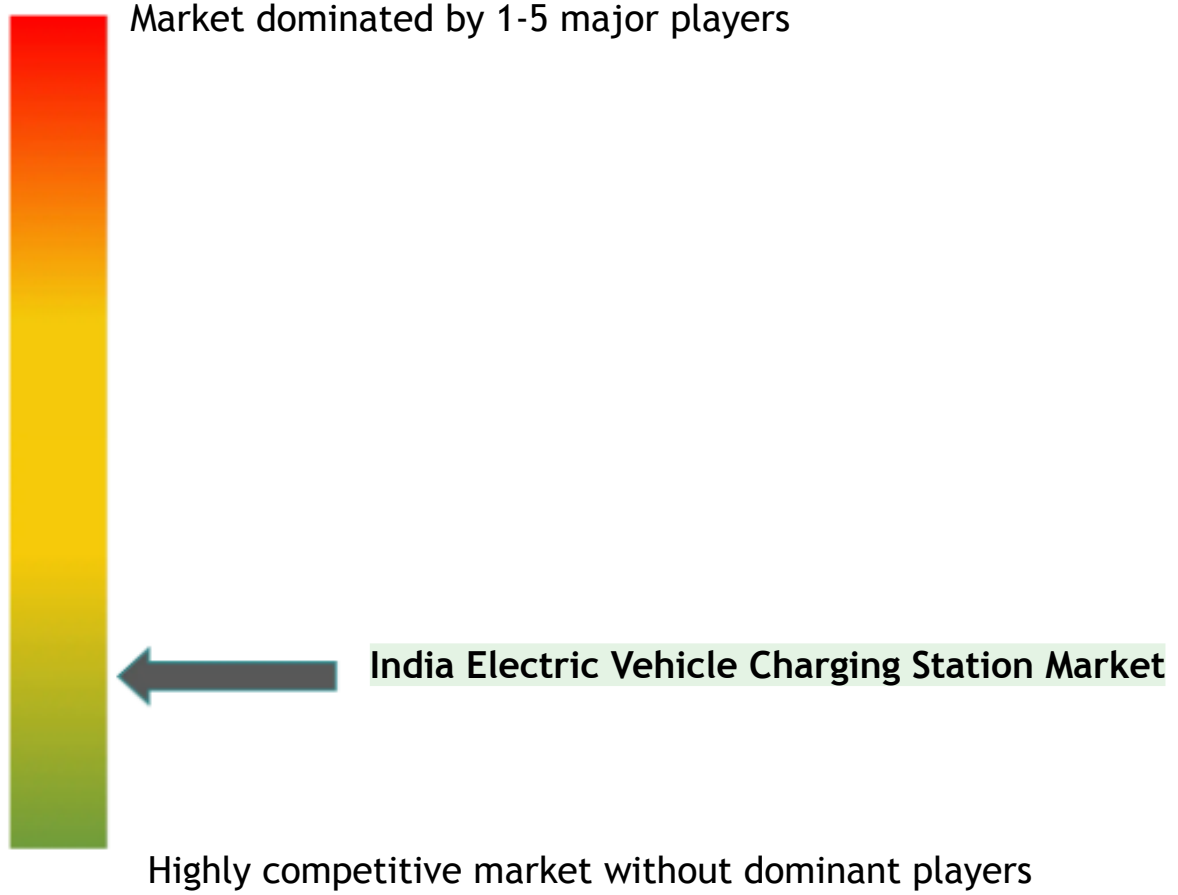
Comparative study for Wired Charging Infrastructure

FEATURES	TATA POWER	ATHER ENERGY	FORTUM	MAGENTA POWER	OUR MODEL
Adaptability to different EV models	✓ Standard EVs	✗ Only Ather 2W	− Common EVs	− Last mile focussed	✓ Standard EVs
Charger Options	✓ Both AC & DC	✗ Only DC	✓ Both AC & DC	✗ Only AC	✓ Both AC & DC
Location Optimizations	− Scattered	− Ather specific	− Building in India	− Scattered	✓ Using ML(GNN)
Supporting App	− Basic level	✓ Optimized routes	− Basic level	✓ User-friendly plans	✓ Optimized routes
Renewable Energy	✗ No such policy	✗ No such policy	✓ Using solar power	− Active Research	− Future Integration

Opportunity to Enter Current EV Charging Sector

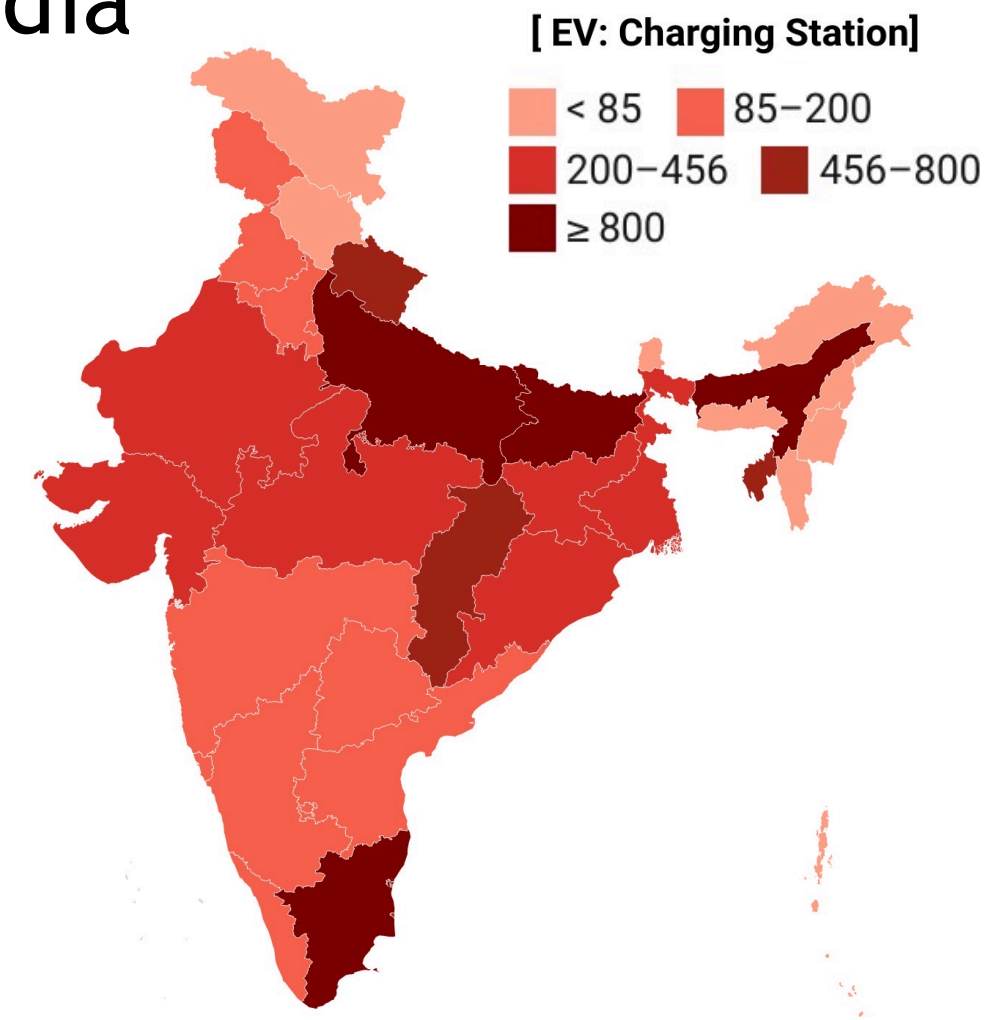
Therefore, to capture the market share and to become the dominant player, our model's USP would be:

- Optimized charging network location
- Adaptability to different models



Market Entry

EV to Charging station ratios in India



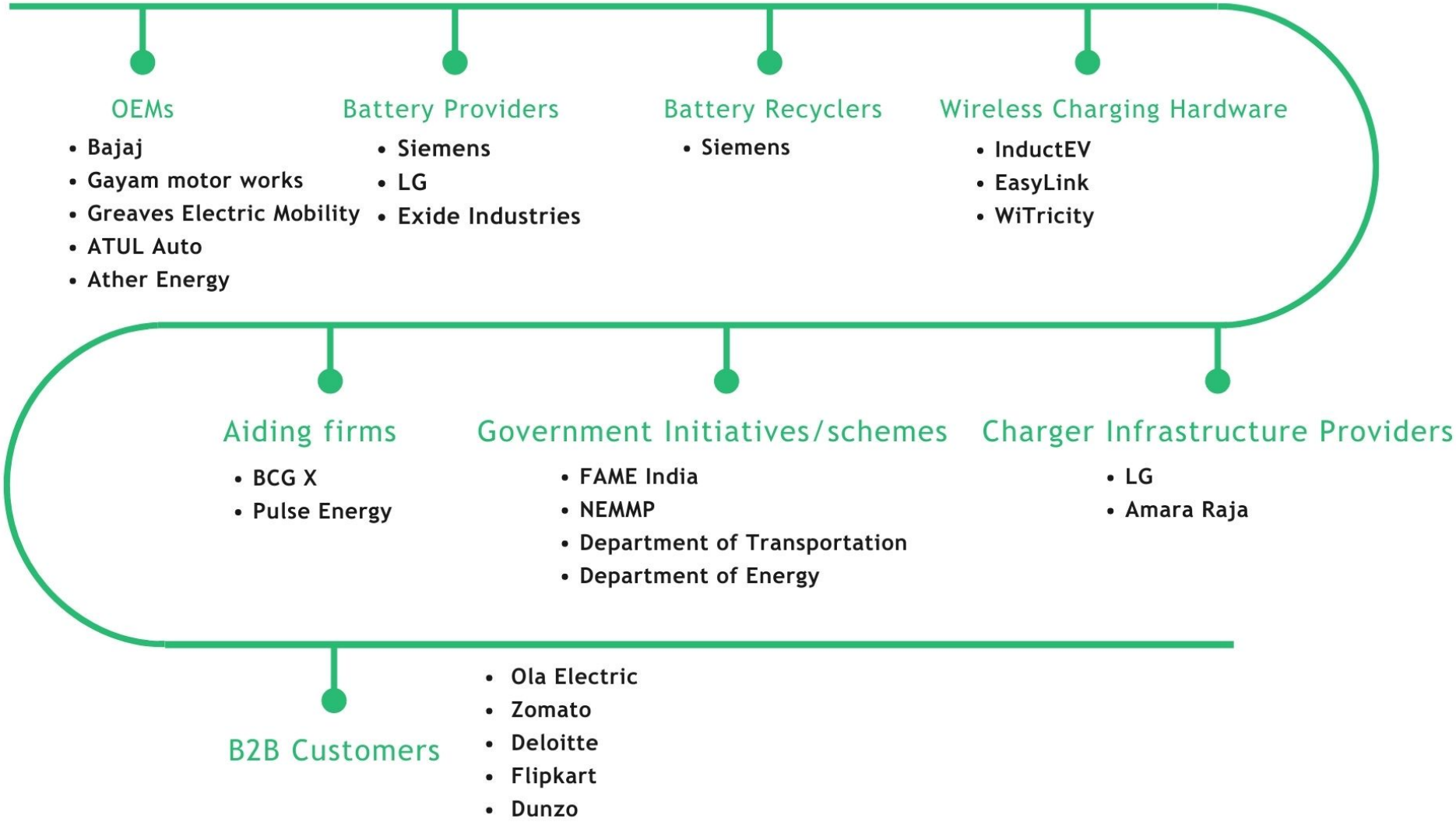
- **Uttar Pradesh** - largest electric vehicle proportion but one of the worst EV : Charger ratio
- Electric rickshaws (403411) : 85% EV population in UP
- 207 public charging stations with **only 134 being active**

UP acts as the ideal Market Entry point for our business with various government incentives in UP also supporting our plan.

Phase-wise plan for entering the EV charging market

	Phase I	Phase II	Phase III
	Battery Swapping Model	**Optimized Charging Station**	**Wireless Charging Model**
Goal	• Fast charging facilities for 2 and 3W EVs • Reduced downtime, and cost savings	• Charging for larger public vehicles • Flag bearers as EV 4W market expands	• Low infra-charging tech • Easy charging for larger vehicles
Approach	• Fast charging for 2 and 3-wheelers • Partnerships with petrol pumps • Battery inventory with chip technology • Attractive pricing and incentives	• Optimized locations using GNNs • Region-specific DC:AC charger ratio • Utilize renewable energy sources • Flexible to the technological advances	• Adapt wireless charging tech to India • Charging pad at transportation hubs • Secure at least 25% parking area • Govt collaborations for specialized paths

Essential to partner with network providers



We will be entering the market by collaborating with existing companies in EV industry and will build on towards working as an independent business.

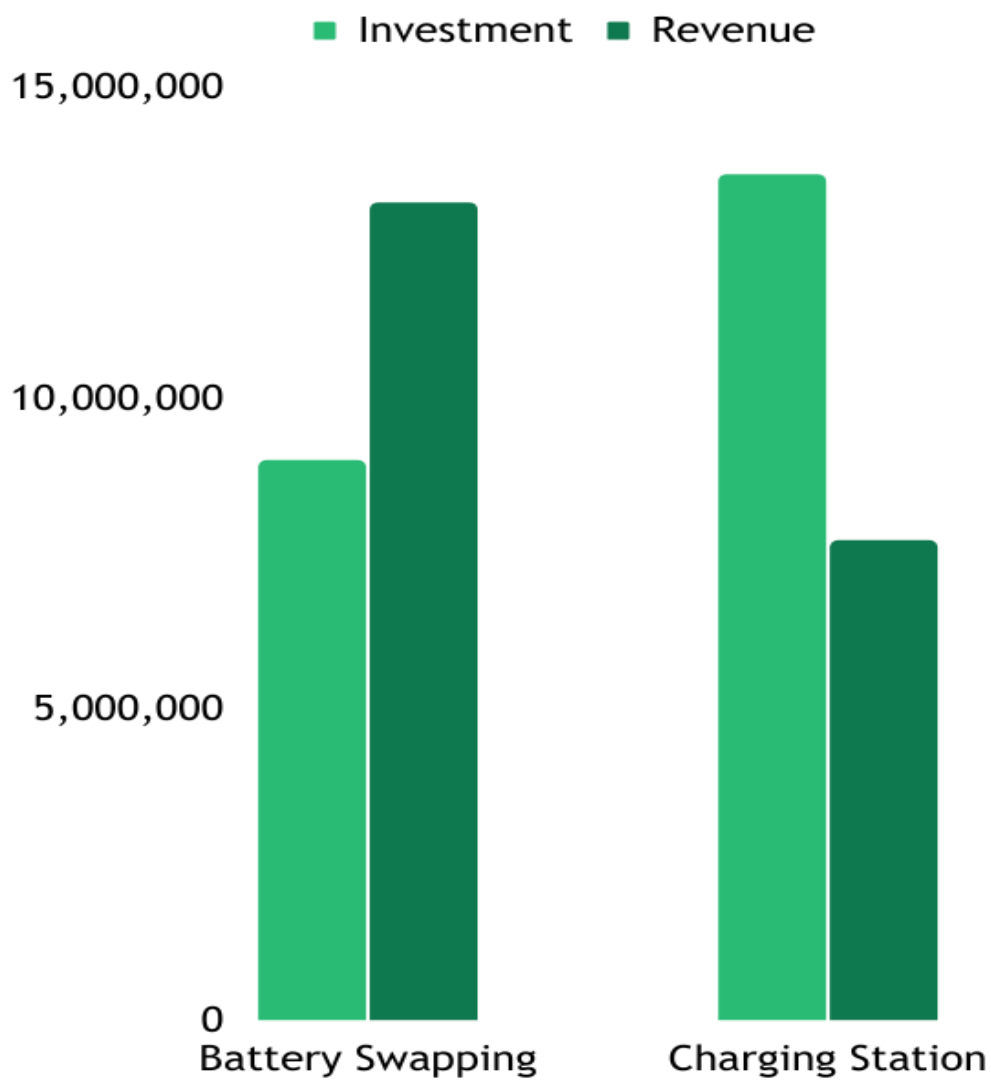
Model for UP and Potential Risks

Income Model for UP

- 3839 charging stations (4 charging port/station)
- 9834 battery swapping stations

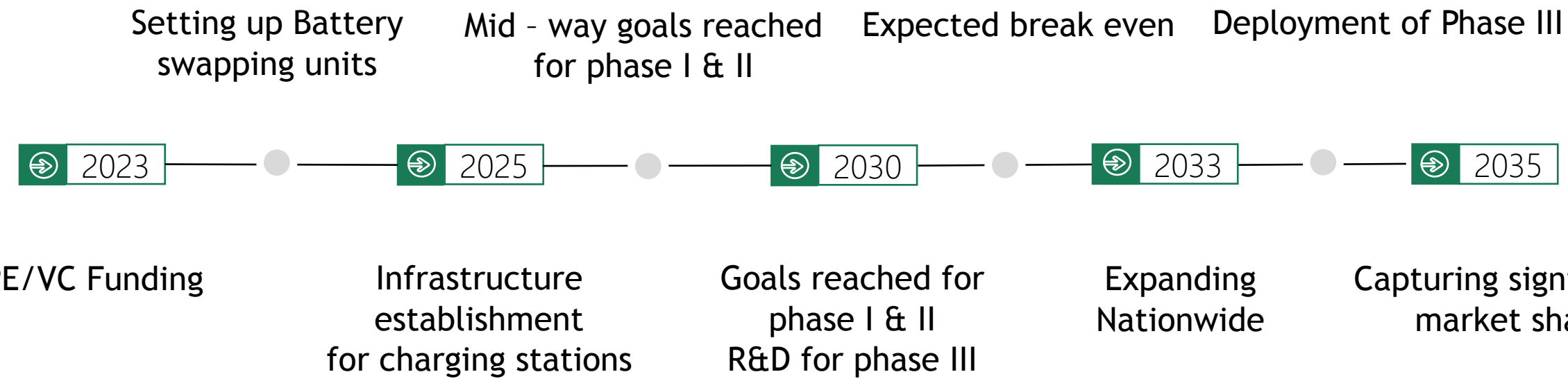
Risk Analysis

- Irregular Electricity Supply In UP
- Land for the infrastructure
- Declining Lithium reserves



Swapping stations will lead the business model in UP due to its lower infrastructural demands and relative immunity to irregular electricity supply

Timeline: Expected to break even in 7-10 years



We will complete the phase 1 & 2 setup by 2030 to align with the government plans & begin with phase 3.

“ In the face of transportation challenges,
we have a choice: to be passengers or drivers of change.
Let's choose to be the drivers who steer India towards a cleaner and greener future. ”

THANK YOU

APPENDIX

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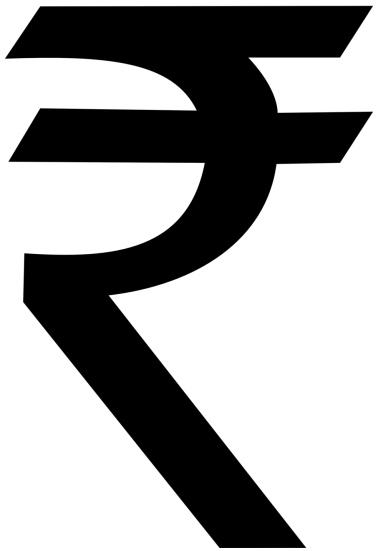
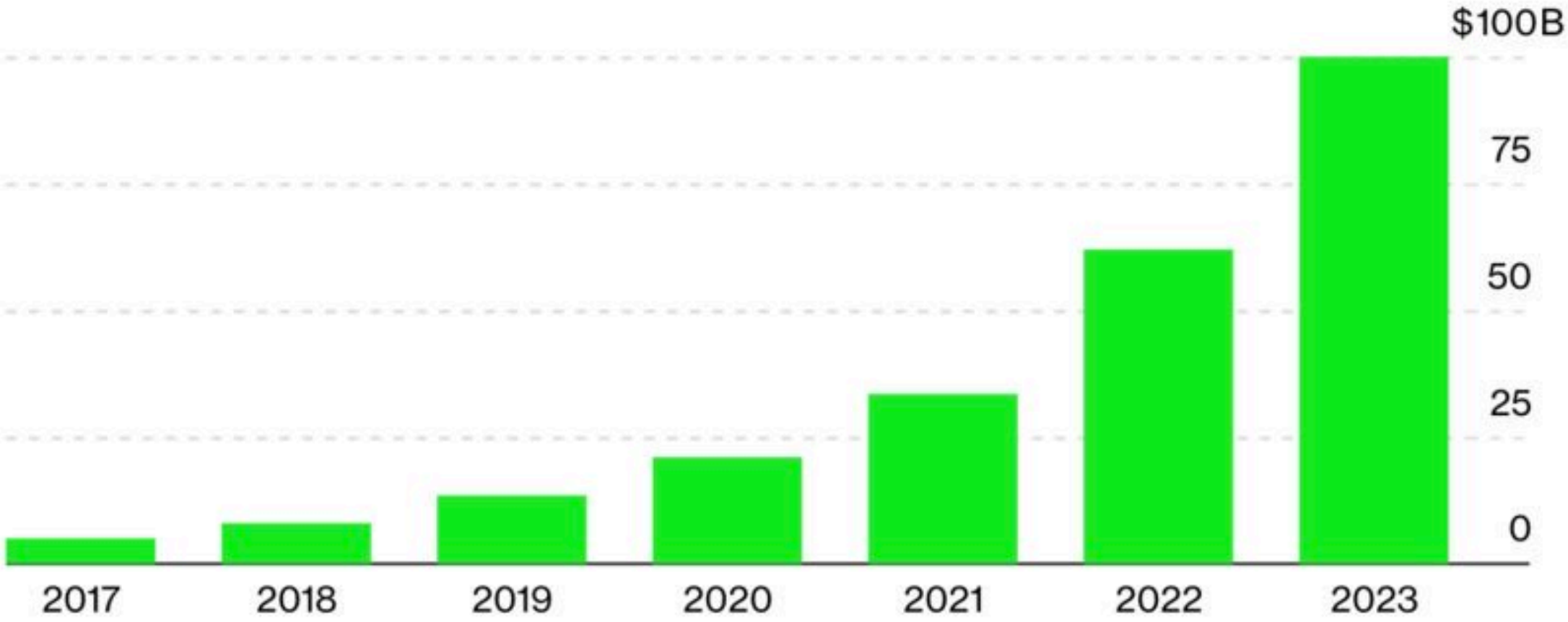


Union Budget 2023: The budget promotes the sustainable mobility industry by making domestic EV manufacturing more competitive. Some highlights from the budget announcement include:

- Basic custom duty exemption on the import of machinery required to manufacturing lithium-ion batteries used in EVs as well as on auto-mobile parts and sub-systems
- Custom duty reduction from 21% to 13% on lithium-ion batteries
- Extension of concessional basic customs duties for EV/ hybrid batteries
- Additional budget allocation to support scrapping of old vehicles
- Emphasis on promoting the production of green hydrogen and biogas

EV Charging Investment May Top $100 Billion Next Year

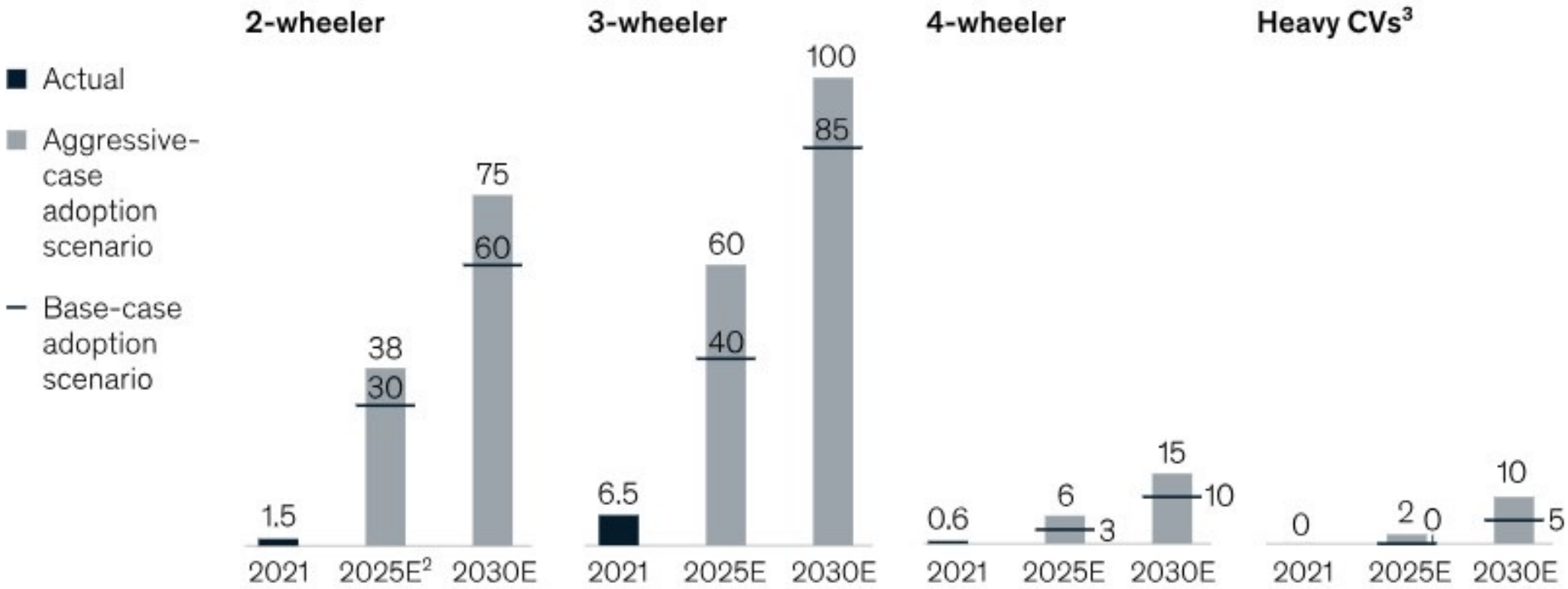
Cumulative investment in charging hardware, installation and maintenance



Source: BloombergNEF
Note: 2022 and 2023 figures are estimates.

India is likely to see more electric two-wheeler and three-wheeler sales than four-wheelers and heavy commercial vehicles.

Share of battery electric vehicles (BEV) among new-vehicle sales in India, %

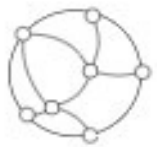


	2-wheeler	3-wheeler	4-wheeler	Heavy CVs[3]
Overall CAGR 2021–30, %	~5	~20	~6	~10
EV[1] CAGR 2021–30, %	~60	~60	~45	~60

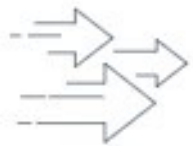
Charge point operators can deflect competitive pressure by cultivating locations, partnerships, and ecosystem services.

Competitive-differentiation framework for electric-vehicle-charging infrastructure

Core utilization drivers



Location
- Dense network of chargers
- Macrolocations (eg, an EV-dense state) and microlocations (eg, a site in a high-traffic area along a major highway)
- Strong reliability and uptime
- Meaningful scale



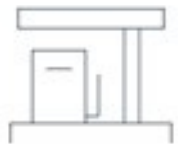
Speed
- Charging speeds that meet customers' needs, according to use cases
- Connectivity to all car brands

Partnerships
- Network partnerships for customer stickiness, exclusivity, and scale
- OEM partnerships
- Passenger and commercial fleets

Ancillary profit drivers

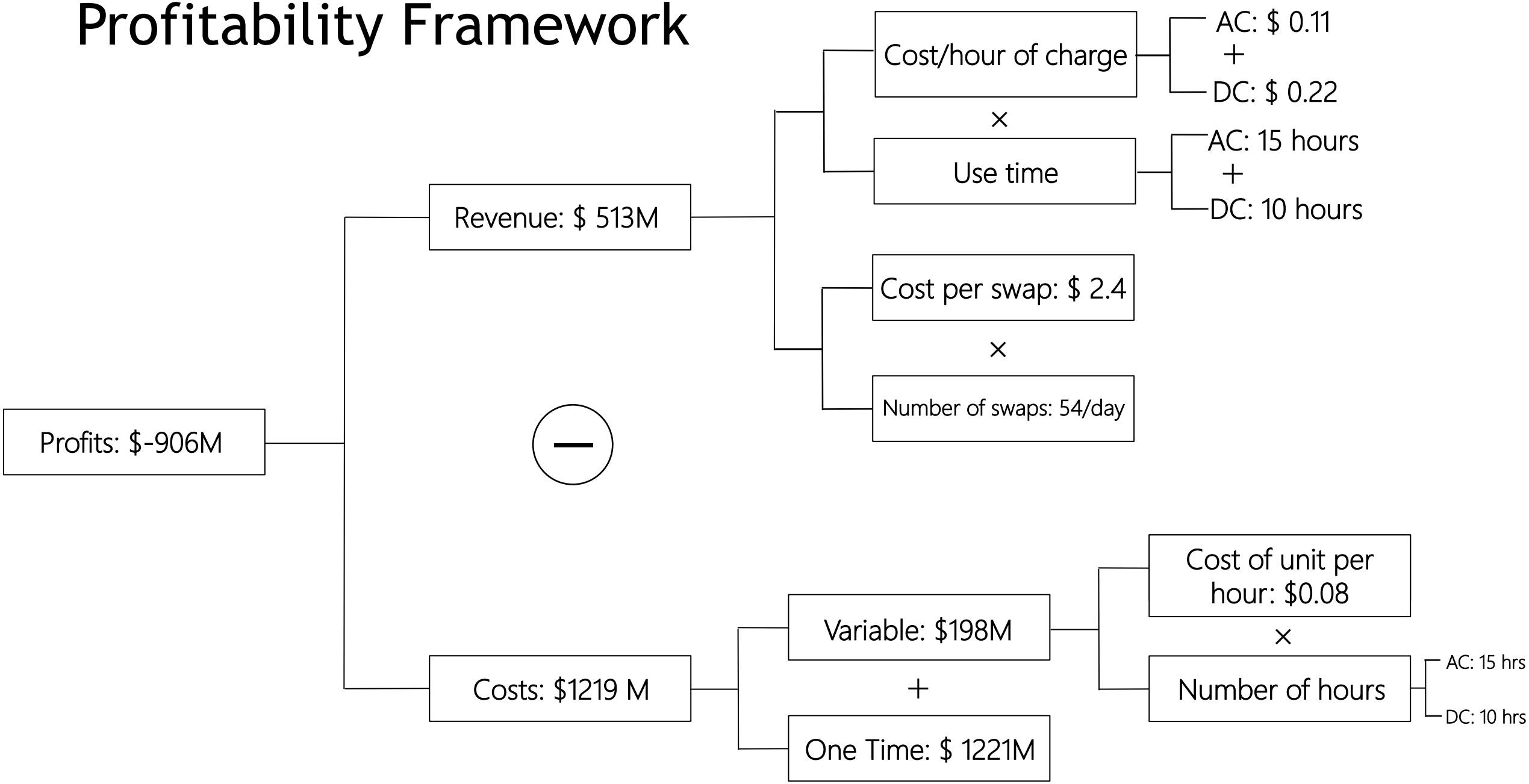
Ecosystem services
- Charging-related revenues, such as charger reservations
- EV/mobility-related co-marketing partnerships
- Convenience- and consumer-related revenues (eg, those for package deliveries to cars, or revenues from coffee shops located at or near charging sites)

Enabler



Customer experience
- Brand reliability
- Seamless technology integration
- Subscription/loyalty programs

Profitability Framework



Profitability Framework: Post Break Even

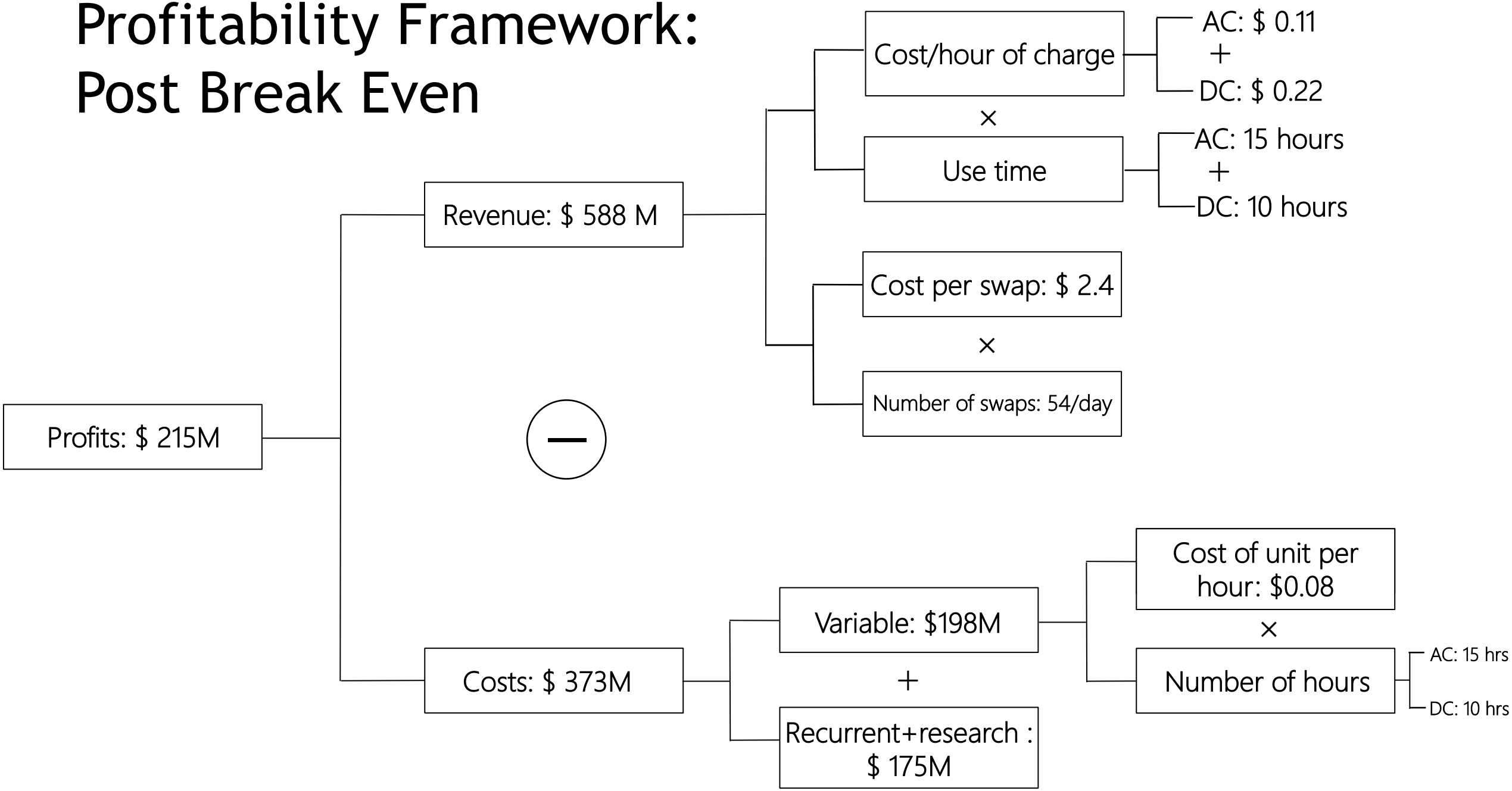


Table 7: State-level EV policies and their targets *2018 data

State	Targets
Karnataka Electric vehicle and Energy Storage policy 2017	➲ 1000 e-buses by 2030 ➲ 100% three-wheelers / four-wheelers moving goods will be encourage to transit to electric mobility by 2030 ➲ Incentives for first 100 fast charging stations
Telangana Electric Vehicle Policy Draft 2017	➲ Telangana State Transport Corporation to set a target of 100% electric buses by 2030 for intracity, intercity, and interstate transport ➲ Government will set up first 100 fast charging stations in GHMC
Maharashtra's Electric vehicle and related infrastructure Policy 201	➲ Increase number of EVs registered in Maharashtra to 5 lakh ➲ To generate an investment of Rs. 25,000 crore in EV
Uttar Pradesh Electric Vehicles Manufacturing Policy 2018	➲ Public Transportation – 1000 EV buses by 2030 ➲ Private Transportation – State government will encourage electric 2-wheeler taxies for short distance mobility, and existing auto rickshaws will be encouraged to resort to EV technology ➲ Goods Transportation – Further, to promote adaptability of EV in Goods transportation, EV-3 wheelers, 4-wheelers mini goods vehicles will be encouraged in GB Nagar, Ghaziabad, Agra, Lucknow, Kanpur, Varanasi
Kerala EV Policy	➲ 1 Million EVs by 2022 ➲ Pilot Fleet of 200,000 two- wheelers, 50,000 three wheelers, 1000 goods carriers, 3000 buses and 100 ferry boats by 2020 ➲ Part of Public Transport fleet of 6000 buses to be made electric by 2025
Tamil Nadu EV Policy	➲ Attract ₹50,000 crore in investments and create 1.5 lakh new jobs ➲ 100 per cent road tax exemption for all types of EVs, capital subsidies, reimbursement of State GST, subsidy on land cost and special incentives for job-creating EV projects
Draft Delhi Electric Vehicle Policy 2018	➲ Battery Electric Vehicles (BEVs) 25% of all new vehicle registrations by 2023 ➲ 50% of the public transport bus fleet zero emission by 2023

How policies in UP would help

		Gujarat	Maharashtra	Karnataka	Uttar Pradesh	Tamil Nadu	Andhra Pradesh
Capital Incentives	Stamp Duty Exemption	✓	✓	✓	✓	✓	✓
	Interest Subsidy	×	✓	✓	✓	×	×
	Infra Interest Subsidy	×	×	×	✓	×	×
	Capital Subsidy	✓	×	✓	×	✓	✓
Operational Incentives	EPF Reimbursement	×	×	×	✓	×	×
	Indirect Tax Subsidy	✓	✓	✓	✓	✓	✓
	Electricity Duty	✓	✓	✓	✓	✓	✓
	Interest Subsidy in Industrial research	×	✓	✓	✓	×	×
Bespoke Incentives package based on investment size		✓	✓	✓	✓	✓	✓
Differential incentives package based on location		✓	✓	✓	✓	✓	

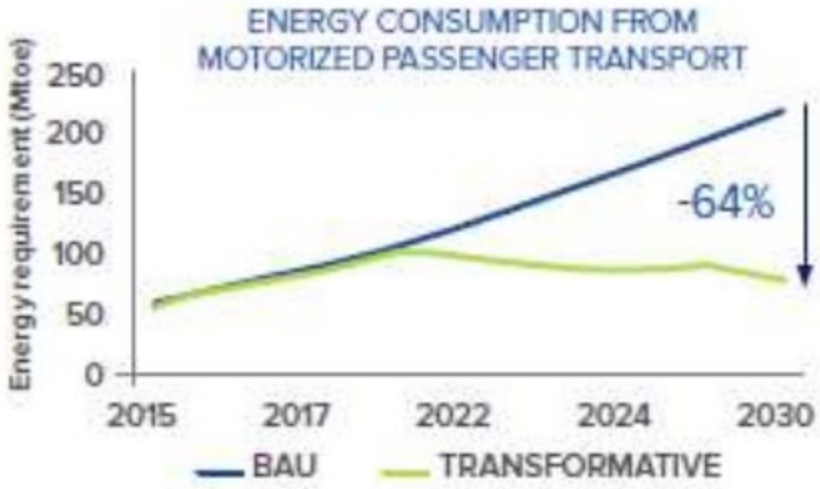
How much money can be saved up

Fuel Security Risks

India currently depends on large scale imports of crude to meet most of its mobility fuel needs

India can save 64% of passenger mobility-related energy demand in 2030 by pursuing a shared, electric & connected solution.

This could result in a reduction of 156 Mtoe (~US $ 60 Bn.) in diesel & petrol consumption for that year.



Source: NitiAyog/RMI Report on Transformative Mobility Solutions for All

ENERGY CONSUMPTION ADJUSTMENT

$EC = \alpha + \beta \times \text{Curb weight} + \varepsilon$

Here, α is a constant, ε is the error term, and ß is the coefficient that estimates on average how much energy consumption will increase for every additional kilogram in curb weight. The result is shown in Table. We find that, on average, each kilogram increase in curb weight is correlated with a 0.056 Wh·km-1 increase in energy consumption.

Regression result for energy consumption adjustment

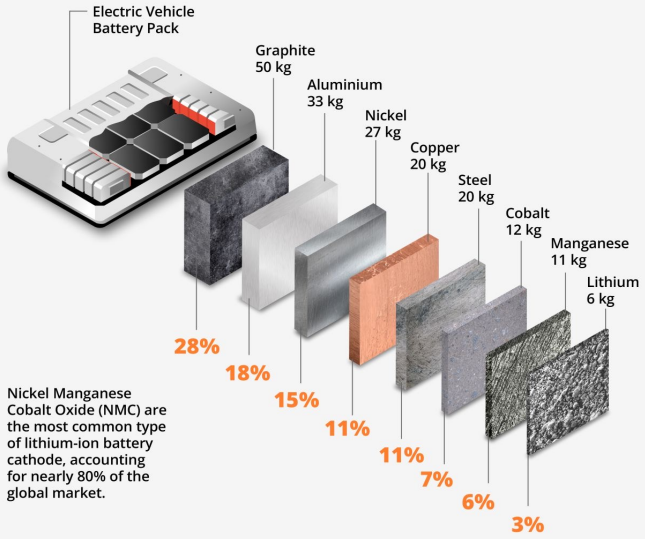
Dependent variable	Energy consumption (Wh/km)
Curb weight (kg)	0.056***
Cons	58.01
N	3061
R-sq	0.37

Note: Three stars (***) denote that the corresponding variable is significant at 0.001 level

COMPONENTS OF AN EV BATTERY

The growth of electric vehicles demands more mining of key critical minerals.

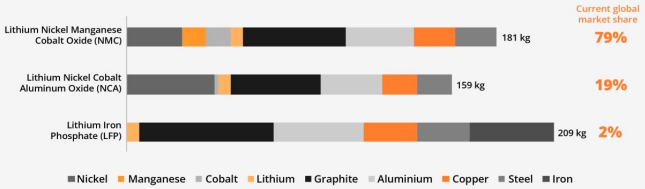
Average composition of NMC Lithium-ion Batteries



Nickel Manganese Cobalt Oxide (NMC) are the most common type of lithium-ion battery cathode, accounting for nearly 80% of the global market.

Source: Transport & Environment, Statista

Average Composition of Top Lithium-ion Batteries



Source: Transport & Environment, Statista

Abbreviations

NMC - Lithium Nickel Manganese Cobalt Oxide - $LiNiMnCoO_2$

NCA - Lithium Nickel Cobalt Aluminum Oxide - $LiNiCoAlO_2$

LFP - Lithium Iron Phosphate - $LiFePO_4$

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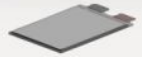
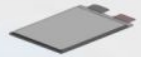
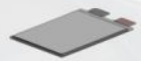
ENERGY minute

TYPES OF CELL FORMATS PRODUCED BY MANUFACTURERS OF ELECTRIC VEHICLE BATTERIES

CIC energiGUNE
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

MANUFACTURER	FORMAT
LG Chem	 CYLINDRICAL  POUCH
SAMSUNG	 CYLINDRICAL  PRISMATIC
SK innovation	 POUCH
CATL	 PRISMATIC
Panasonic	 CYLINDRICAL
northvolt	 PRISMATIC
VERKOR	 POUCH
Gotion	 PRISMATIC
FARASIS	 POUCH
Envision AESC	 POUCH

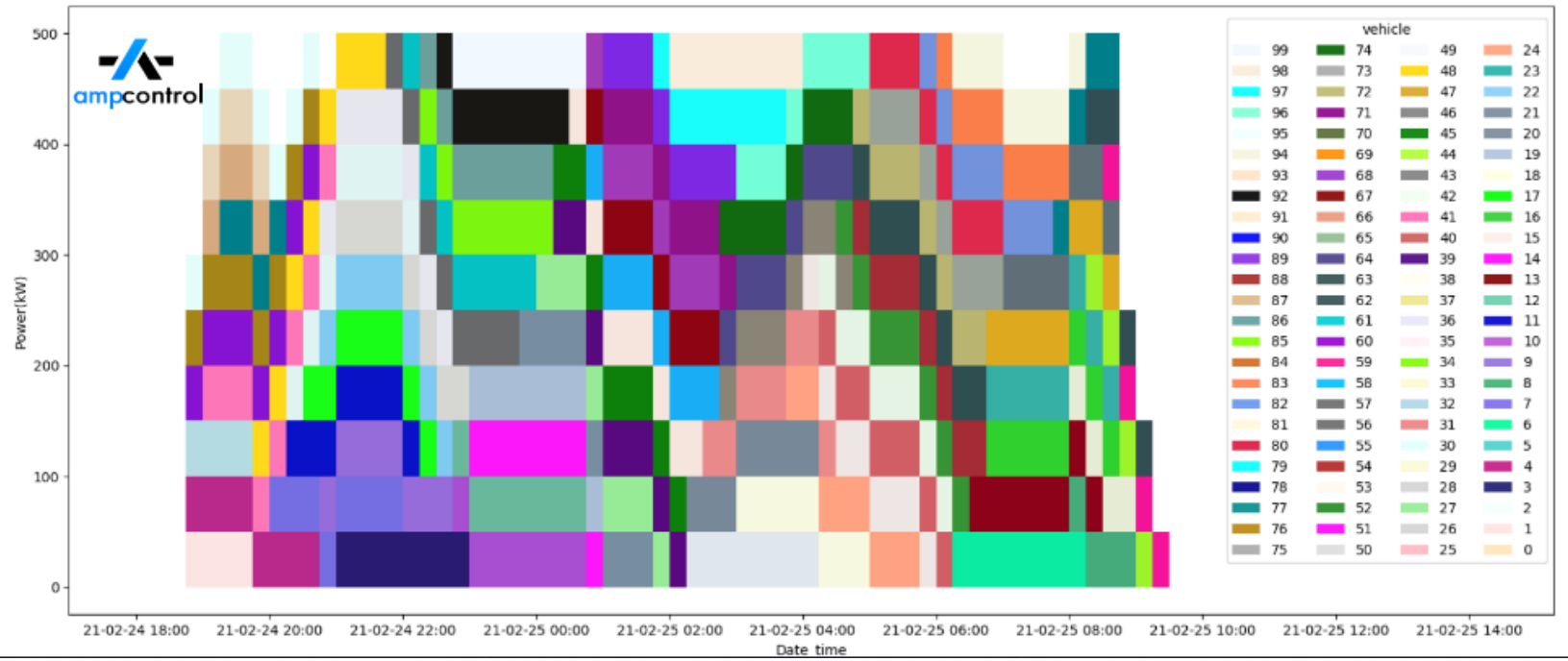
Source: Public information

DC charging only

We used our software to simulate how the fleet would charge with DC chargers only. We considered 10 x DC chargers with 500 kW each. Due to the power limit at the location, we can't install more charge points.

The simulation shows that

- The DC chargers are fully active the entire night
- Not all vehicles are able to charge
- Some vehicle charged but couldn't reach a full charge on-time



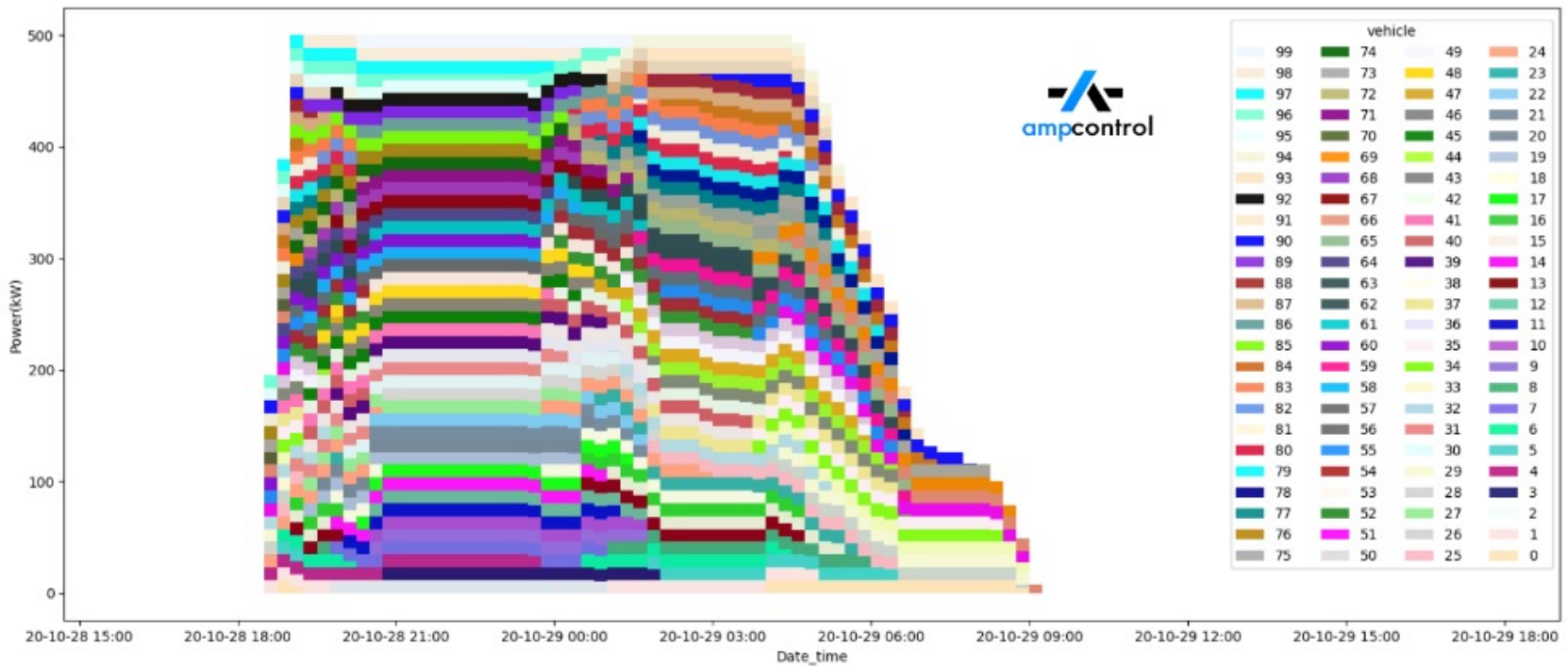
https://www.ampcontrol.io/post/ac-or-dc-charging-stations-which-is-best-for-electric-fleet-vehicles

AC charging only

For the second simulation, we considered a different setup. We equip the location with 100 AC chargers and use intelligent load management from Ampcontrol to optimize the utilization.

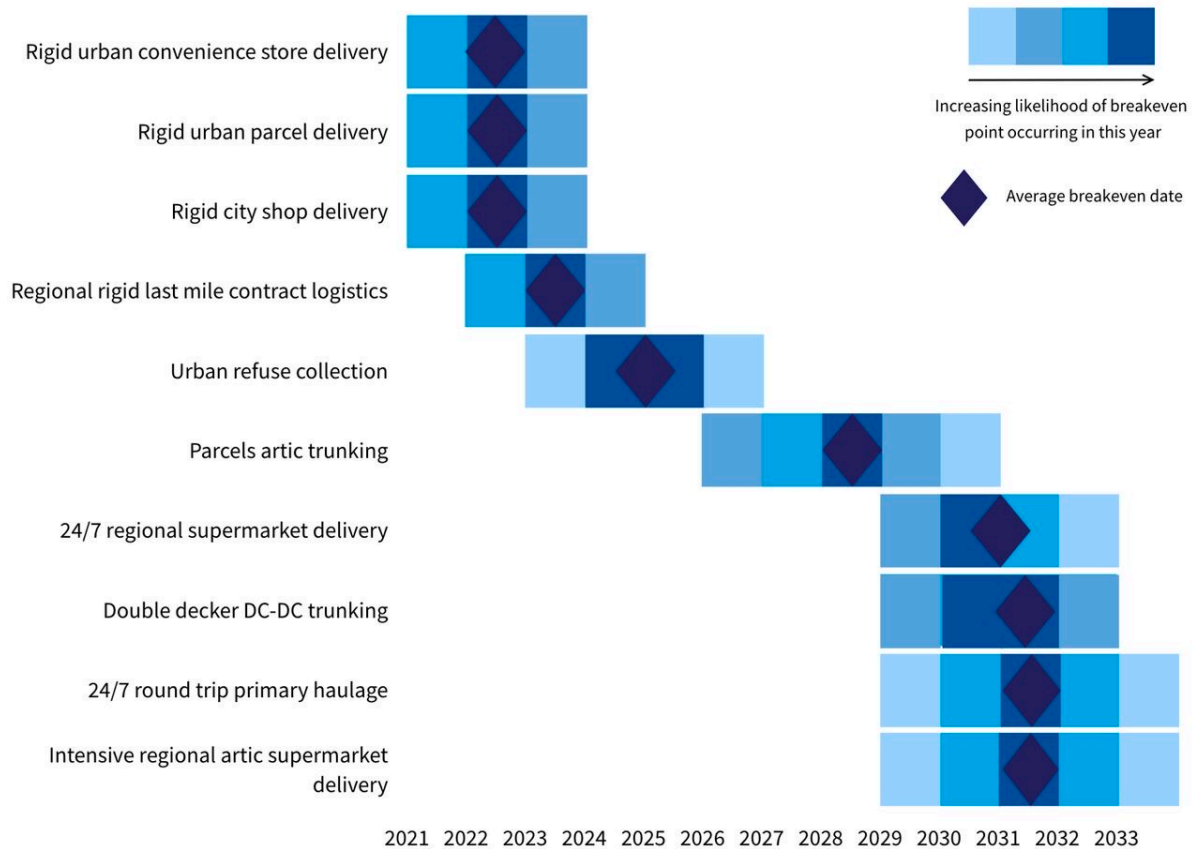
The simulation shows that:

- the AC chargers could charge even more vehicles
- all vehicles are able to charge
- all vehicles receive a full charge



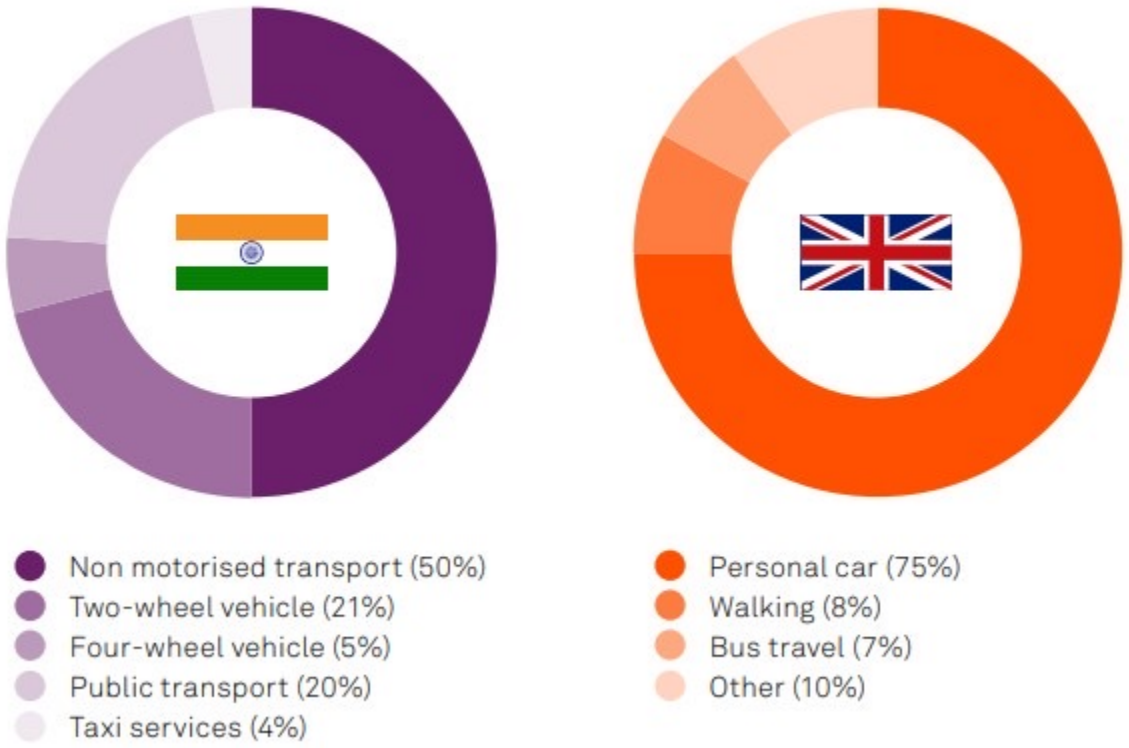
Electric trucks will soon be cheaper to own and run than diesel

Total cost of ownership break-even dates in the most common UK use cases



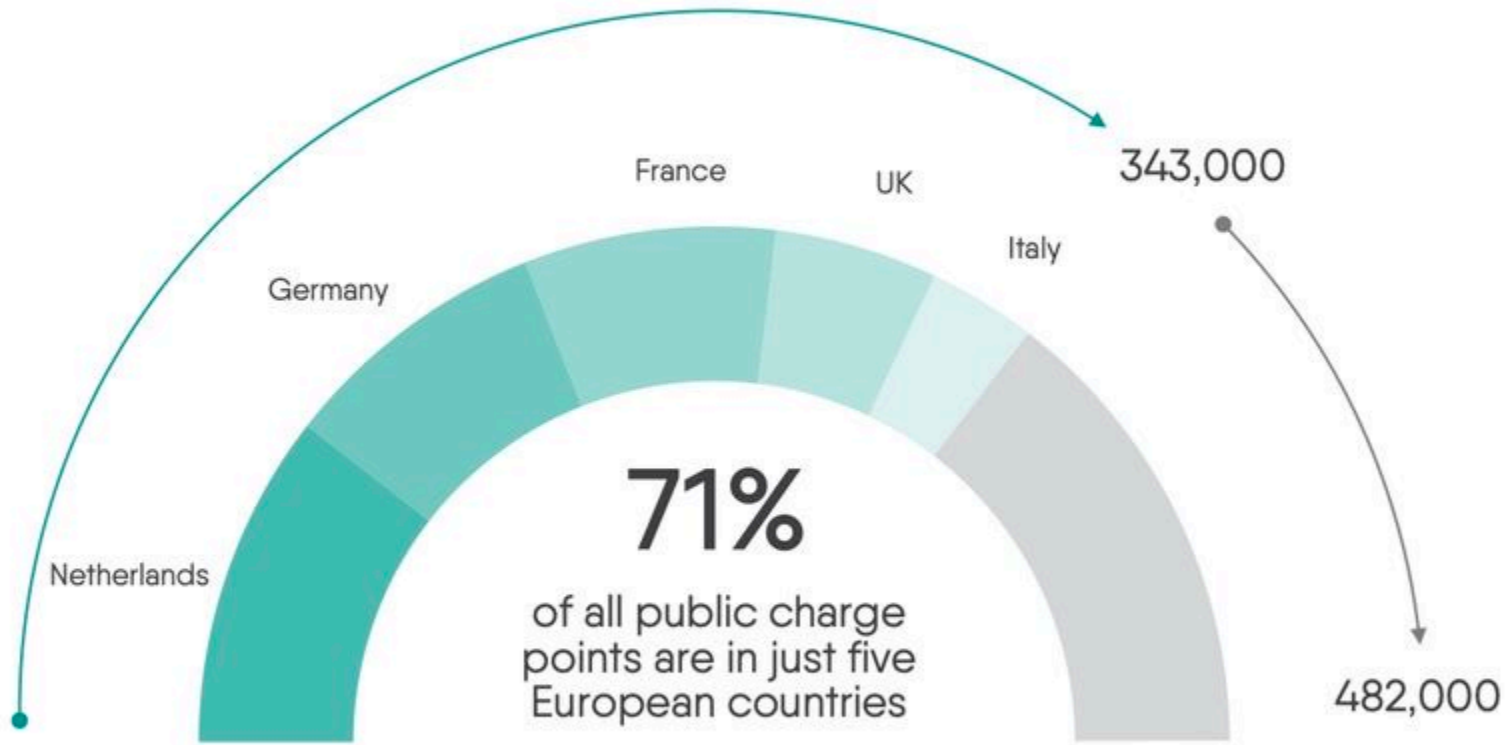
TRANSPORT & ENVIRONMENT
transportenvironment.org

Difference of travel behavior between India and UK



The infrastructure for walking and cycling is generally inadequate in India, and many would likely opt for other ways of travelling if given the opportunity.

EV public charge points in Europe



7	EU27 countries have fewer than 1,200 charge points

Optimized locations and operations enhance customer satisfaction

There are a variety of public charging vendors to choose from in Norway, and therein lies part of the problem: customers find it inconvenient to maintain multiple mobile apps. And widespread system glitches—including limited options for direct payment, poorly designed parking spots, short charging cables, and malfunctioning hardware—frustrate customers and can heighten their anxiety over charger availability. In Norway's latest annual EV charging survey, half of respondents claimed that fast chargers occasionally do not work.[11]

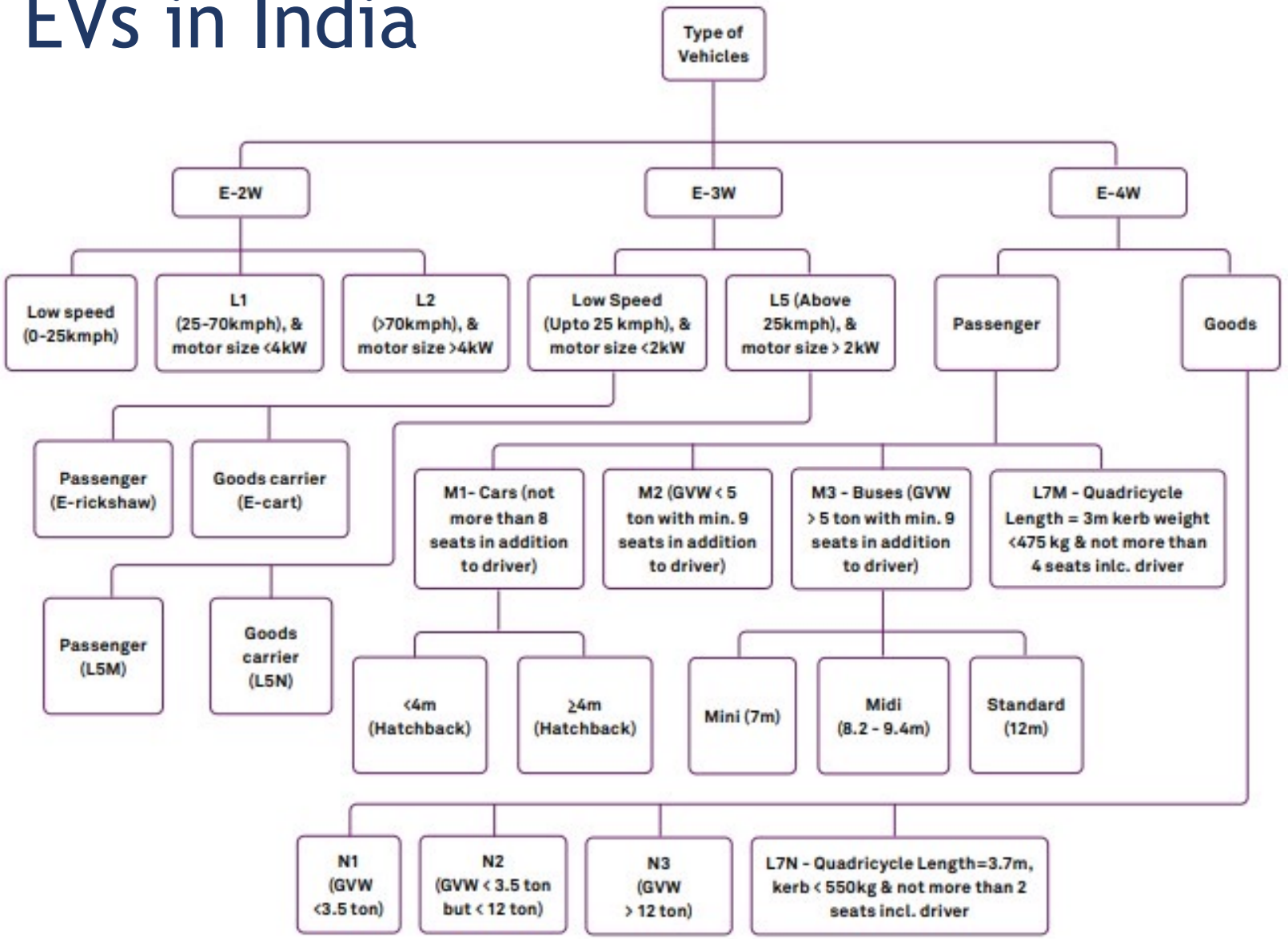
Further trying customers' patience and creating anxiety are Norway's highly dispersed EV charging system and the relatively low numbers of chargers per site, both of which create queuing and extend wait times. Larger sites with higher concentrations of chargers are needed, rather than smaller sites spread across the country. Addressing this need presents challenges for charging site operators that initially planned to host a few chargers on small sites; they now struggle to install new chargers and to upgrade on-site energy management at larger sites. Nevertheless, Norway's operators are now correcting course, introducing a range of large, purpose-built EV charging sites in high-use locations, especially along highways.

Analysis has shown that EV charger utilization depends largely on time of day and location of chargers.[12] EV charging utilization is hyperlocal. The utilization of a charger located on the same block as a busy coffee shop or movie theater could be markedly different from that of a charger situated two blocks away from these locations. Identifying and securing the most popular sites early on can thus offer competitive advantage, especially in space-constrained urban centers and on highways. And as competition over prime public charging locations intensifies, it becomes increasingly important for operators to own or contract the sites for extended periods. This helps avoid potential non-renewals of contracts due to site owners opting to establish their own charging operations at these locations.

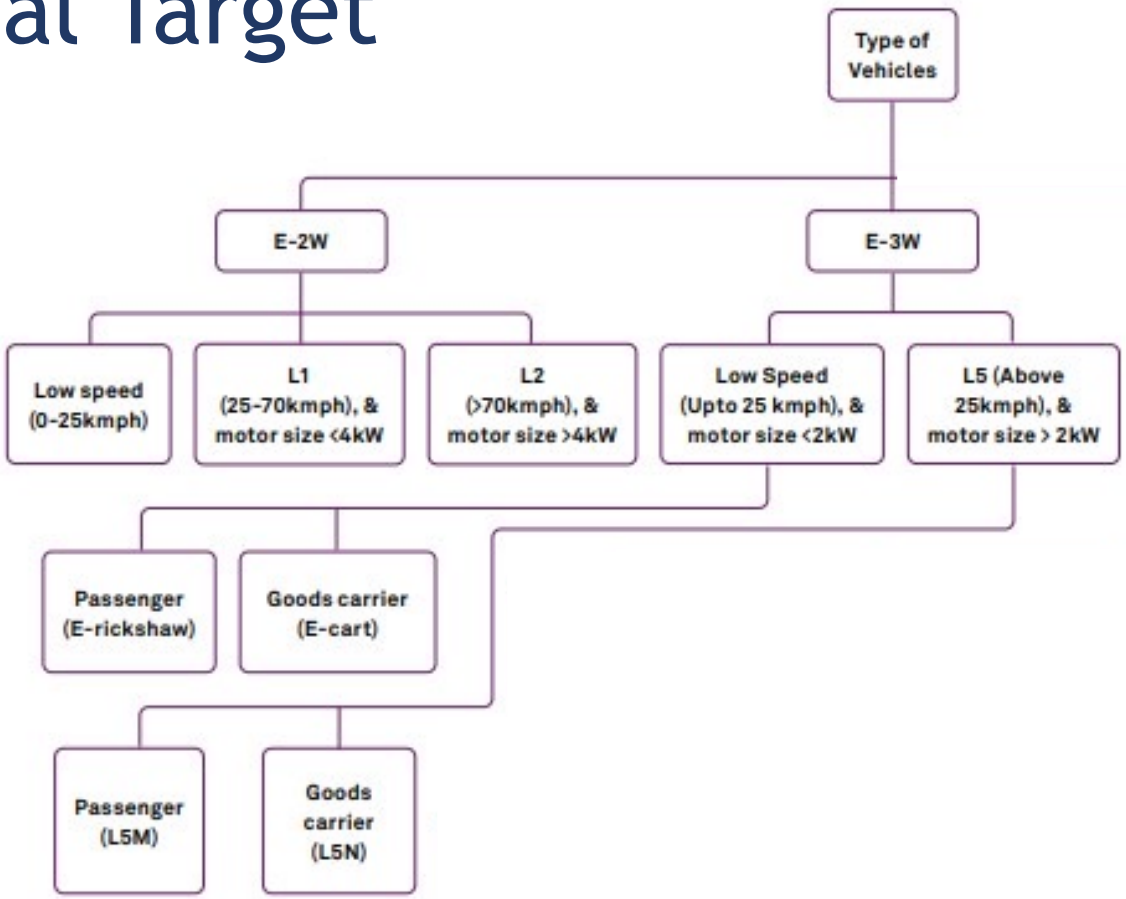
Certain areas may support charging solutions beyond placing chargers at service stations or in front of gyms and hotels. These solutions might include creating large-scale, multipurpose, public e-mobility hubs in the most popular EV charger locations and integrating battery swaps and car sharing with other commercial and residential property uses. Opportunities to create such multiuse stations in Norway are on the rise. These stations' potential to boost EV adoption, increase driver satisfaction and confidence, and diversify options for investment and public amenities is considerable. Additionally, emerging urban-mobility developments such as autonomous vehicles will give rise to further innovation and investment in charging infrastructure. As new technologies develop, nimble companies with established EV positions will be best situated to adapt to them and gain market advantage.

How we have imagined our wireless infrastructure

Types of EVs in India



Our Initial Target



Other ways EV adoption can help

Improved public health

Approximately 5 lakh (500,000) EVs subsidised by the Delhi EV Policy can avoid 159 tons of fine particulate matter (PM2.5) over the lifetime of the vehicles.[31]

Reduced carbon dioxide emissions

EVs eligible under the FAME II scheme can abate over 74 lakh (7.4 million) tonnes of CO2 over their lifetime.[32]

Enhanced energy security

EVs eligible under the FAME II scheme can result in oil import savings worth a cumulative INR 17.2 thousand crores ($US2.3 billion) over their lifetime.[33]

how much oil do electric vehicles save?

When vehicles shift toward electric, the oil that would have been used by their combustion engine counterparts is no longer needed, displacing oil demand with electricity.

Here is how different types of EVs contribute to that displacement.

Annual plug-in car sales are expected to rise from **6.6M** in 2021 to **20.6M** in 2025.

2021

2025E