Climate And Sustainability Initiative

INDIA'S AUTO INDUSTRY

MAPPING THE COURSE TO NET ZERO BY 2070

Vaibhav Pratap Singh, Priyadarshini Alok

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Authors: Vaibhav Pratap Singh, CSI ; Priyadarshini Alok, SSEF

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CLIMATE AND SUSTAINABILITY INITIATIVE PTE. LTD.
10 ANSON ROAD #33-10 SUITE C INTERNATIONAL PLAZA
SINGAPORE 079903

info@csiglobal.co | www.csiglobal.co

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Executive summary

India has committed to achieving net-zero emissions by 2070 (PIB, 2022). Decarbonising the transportation sector is critical to this mission, given that it was responsible for about 13 per cent of the country's total greenhouse gas (GHG) emissions in 2016 (UNFCCC, 2021). This report focuses on the financial implications of realising a net-zero transition in the auto sector — the investments and costs involved and potential gains. Decarbonising this sector could create an opportunity for growth in the mobility industry, particularly in the case of road-based electric vehicles (EVs). The auto sector transition could lead to an overall market creation of more than USD 19.7 trillion by 2070, with cars accounting for 63 per cent of the market and contributing nearly USD 15.5 trillion.[1]

The report is based on a net-zero pathway outlined in Table 1, which provides the automobile sales scenario from 2020 to 2070 as identified by Chaturvedi and Malyan (2021) and Singh and Sidhu (2021). The report investigates the costs associated with achieving net-zero emissions, and, particularly, the investments original equipment manufacturers (OEMs) will have to make to keep pace with the transition. The analysis further evaluates the revenue opportunities that transitioning offers across vehicle segments for OEMs and the market value of these new vehicles, based on their estimated ex-showroom prices. Additionally, the report analyses the demand for new and replacement batteries, which currently drive the majority of EV costs, and the necessary investments to produce them locally. The report also presents potential revenue for the government through tax collection on auto sales. Moreover, it delves into the financing required until 2070 to enable consumers to purchase these vehicles and evaluates some financing solutions to facilitate a smooth transition, particularly for new vehicle types like EVs.

[1] All USD quoted are fixed at a constant USD 2020 value.

Key findings

Our analysis suggests that OEMs in various vehicle sectors will need to invest USD 323 billion to produce electric vehicles alongside existing technologies. This investment could generate revenue of USD 14.1 trillion for OEMs until 2070. Additionally, the automobile sector's transition could potentially lead to revenue collection of USD 4.1 trillion in Goods and Services Tax (GST) for the exchequer during 2020–2070.

Further, to meet the calculated annual battery demand of around 1,716 GWh by 2070 and achieve complete domestic production, manufacturers will have to invest USD 196 billion until 2070. Eventually, by the year 2070, the battery demand for all EVs in the country will be met locally by 172 giga-factories, of 10 GWh capacity each. To meet the demands locally, this could begin with building a single factory around 2025.

Financial challenges and solutions

At the same time, to achieve this transition, India would require vehicle loans worth USD 9.6 trillion until 2070. The volume of auto loans for new vehicles would need to increase over 20 times from around USD 20 billion in 2020 to over USD 410 billion annually by 2070. Auto loan portfolios would need to grow at an annual rate between 6–18 per cent over the next two decades. Policymakers and regulators will need to provide support to ensure that financing keeps pace with sales, or else the transition may falter.

To promote the sales of new categories of vehicles – like electric vehicles – across all sections of society, newer kinds of auto loans with longer tenures and at competitive costs are necessary. We recommend that to finance this transition, policymakers, financial institutions, OEMs, and other stakeholders work on solutions, such as first-loss guarantees for financial institutions and lines of credit for EVs, and other solutions. The report proposes both short- and long-term solutions to improve the flow of finance to support EV growth in the country.

1. Introduction

At the 2021 United Nations Climate Change Conference (CoP27), India announced that it would achieve net-zero carbon emissions by 2070 (PIB, 2021). To achieve this goal, India will have to decarbonise major carbon-emitting sectors, including its power, industries, and transport sectors, which account for 40 per cent, 20 per cent, and 13 per cent of its total emissions (UNFCCC, 2021). The current report focuses on the net-zero pathway for the automobile sector, which is one of the biggest contributors to the manufacturing gross domestic product (GDP) of India at 7 per cent and is one of the largest employers in the country (PIB, 2023). Also, this is likely to be the most consumer-focused among the decarbonisation transitions of the three major carbon-emitting sectors mentioned above.

In this report, we present an overview of the potential growth trajectory the Indian automobile sector must take to achieve net zero by 2070, focusing on the scenario detailed in Table 1.[2] We provide an overview of forecasted vehicle sales, investments required, tax collection, and potential battery requirements. Additionally, we explore the financing needs of consumers to purchase these vehicles and briefly examine financing solutions required to address the challenges faced by new vehicle categories such as electric vehicles (EVs). The analysis encompasses various vehicular categories including two-wheelers (2Ws), three-wheelers (3Ws), cars, buses, and trucks.

We present the investments required for decarbonising the automobile sector as well as the gains various stakeholders can accrue from the transition. In this report, we examine the investments that original equipment manufacturers (OEMs) will have to make, the size of the market across vehicle categories, and taxation potential. We also examine scenarios under different tax slabs and financing opportunities across five-year time blocks until 2070. We also map the battery manufacturing capacity required to sustain new EV sales, the battery replacement demand, and the investments needed to establish domestic manufacturing capacity. Further, we focus on the financial barriers that hinder consumers from switching to EVs and potential solutions to these barriers.

[2] This scenario assumes a greater share of personal vehicles in the overall transportation sector to achieve net-zero emissions by road-based transport by 2070.

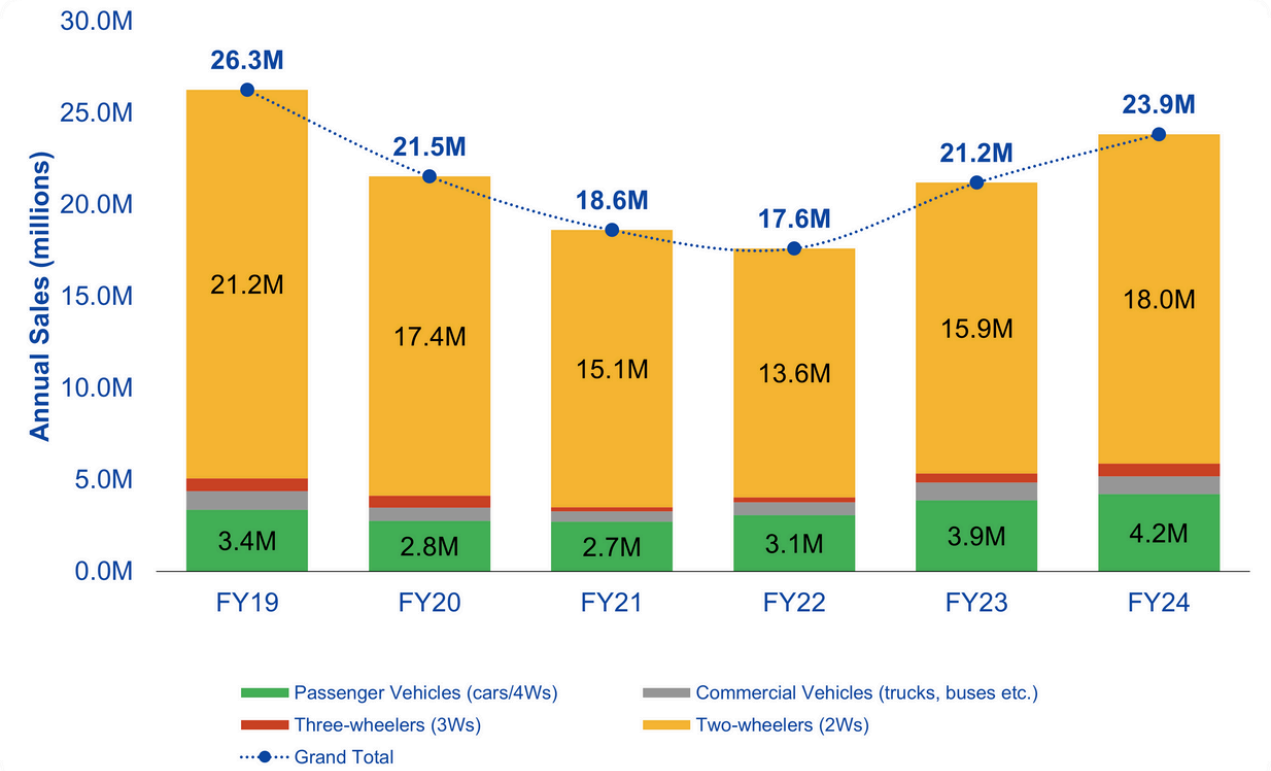
1.1 India's automobile market

The dominant contributor to India's automobile sales are two-wheelers (2Ws), with sales contributions of 14–21 million units annually over the last six years between FY19 to FY24, and passenger vehicles, which have consistently contributed 3–4 million units over the period. The other significant contributors are three-wheelers (3Ws), which added 0.3–0.7 million units annually in sales between FY19 and FY24; commercial vehicles, including trucks, smaller vehicles, and buses, which added around 0.6–1 million units in sales to the total auto market, which varied between 18–26 million units in annual sales during this period.

Over the six years between FY19 to FY24, various automobile categories first experienced a downtrend due to the pandemic, supply-side constraints (like electronic chip shortages), and other factors, which impacted sales. However, they experienced a rebound in FY23–24.

FIGURE 1:

Automobile sales across major vehicle categories in India up to FY24



Source: SIAM data. The total includes quadricycle sales, which is in the hundreds. Commercial vehicle sales data includes light-duty vehicles (LDV), medium-duty vehicles (MDV), and heavy-duty vehicles (HDV), trucks, and buses (SIAM, 2024). Detailed data available in Annexures: Table 1A.

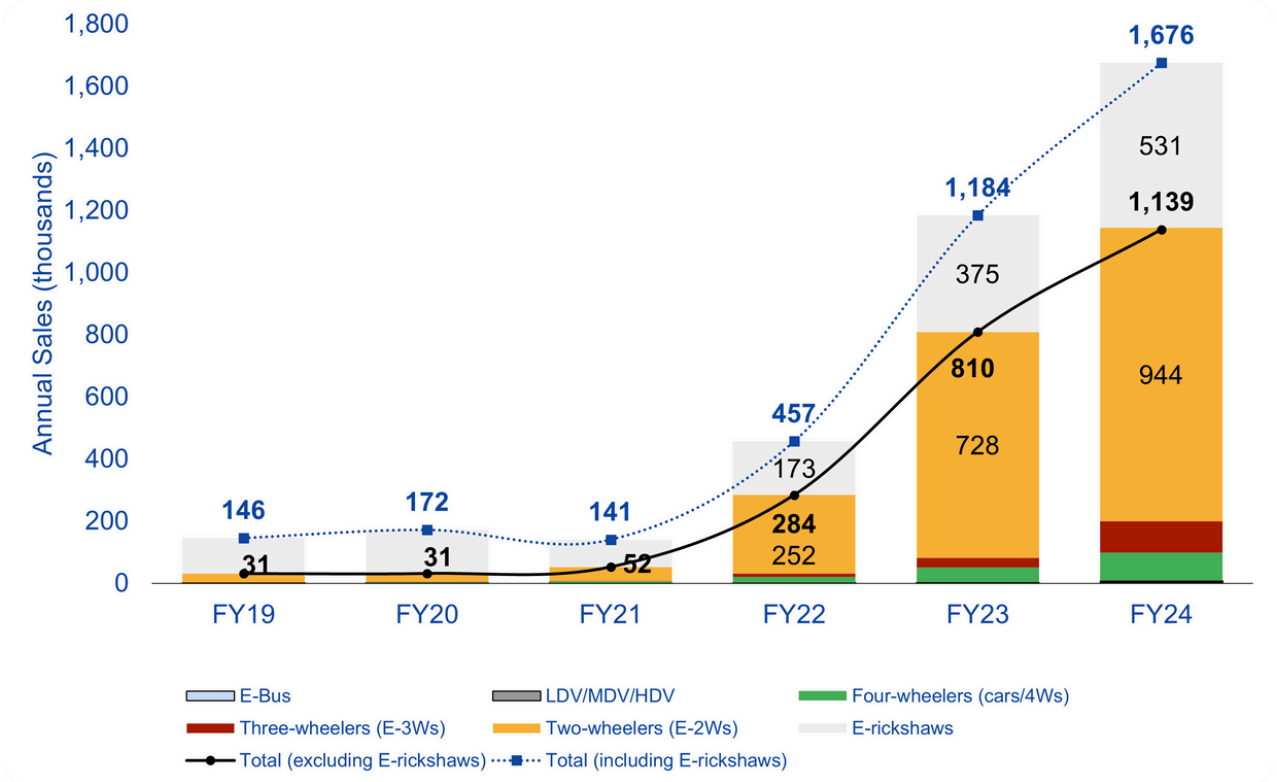
1.2 EV sales transition in India

The transition to electric vehicles (EVs) in India has made significant progress with the assistance of government support and incentives. The government's demand creation support, particularly through incentives such as the Faster Adoption and Manufacturing of Electric and Hybrid Vehicles Phase II (FAME II), which was applicable between April 2019 and March 2024, provides incentives to consumers for the purchase of

approved models under the scheme. Additionally, various state-specific incentives in India offered by states, as well as other benefits such as the lower goods and service tax of 5 per cent compared to the 28 per cent and upwards, including the Cess on conventional ICE vehicles, have contributed to the demand creation for EVs in the country. This transition's growth is evident in Figure 2, which illustrates the transition of EV sales in India over the past six years.

FIGURE 2:

India's electric 2W sales shot up in FY22–FY24, surpassing e-rickshaws



Source: VAHAN Dashboard; car data derived by adding commercial and personal car registrations for the year. Detailed data available in Annexures: Table 2A.

Electric two-wheelers (E-2Ws) became a major contributor to EV sales over FY22, FY23, and FY24, with annual sales of around 0.25, 0.73, and 0.94 million units, respectively. During these years, E-2Ws contributed 2, 4, and 5 per cent of the total two-wheeler sales. Also, FY23 was the first year when the total number of EVs sold surpassed the million sales mark, with the sale of 1.2 million EV units, contributing to over 5 per cent of vehicle sales in the country.

Methodolgy

Vehicular sales (S): We compiled the sales scenario using the analysis in Chaturvedi and Malyan (2021) and Singh and Sidhu (2021) and presented it in Table 1. The table provides automobile sales across vehicle categories over five-year periods, categorised into EV and non-EV sales.

Investments (I): Based on sales and investment benchmarks, taking into account past performance and accounting for increased costs due to new technology investments (EV), we calculate the investments needed by OEMs to produce vehicles in a more efficient energy regime. The formula for investments (I) is I = S * (the benchmark for producing a million units over five years). The estimated investments for producing a million units of two-wheelers, three-wheelers, cars, buses, and trucks over five years are USD 11.7 million, USD 9.95 million, USD 232 million, USD 394 million, and USD 394 million, respectively. These investment benchmarks are expected to increase annually at 2.5 per cent until 2040, and at 1.2 per cent subsequently, until 2070, based on the need to meet new emission norms and adopt new technologies.

OEM revenue (R): We calculate the revenue potential for OEMs from new vehicle sales across different vehicle categories, including EVs. This assessment is based on industry benchmarks of sales-to-investment ratios, derived from an analysis of the financial data of OEMs. The revenue (R) is calculated using the formula: Revenue (R) = Investments (I) * (Benchmarks for revenue to investments for each vehicle category). We assume annual investment to sales revenue benchmarks of 1.4 per cent for two-wheelers, 1 per cent for three-wheelers, 2.4 per cent for four-wheelers/cars, and 2.2 per cent for bus and truck manufacturers.

Market value of the vehicle (MV): The market value or ex-showroom price is calculated by adding the OEM revenue, dealer margin, and the tax (GST). Market Value (MV) = Revenue (R) + Dealer Margin (D) + Tax (GST charges at 28 per cent). Benchmark dealer margins of 5 per cent for 2Ws, 3 per cent for 3Ws, 5 per cent for 4Ws, and 2 per cent for buses and trucks, with an additional 28 per cent for GST are assumed.

Tax collection/GST (T): We calculate the potential GST collection at two different rates (5 per cent and 28 per cent) for electric vehicles (EVs) and 28 per cent for all automobile sales, using the formula used for the market value.

Finance required (F): The financing required for different vehicle categories (as shown in Table 2.1) has been estimated. We have calculated the finance requirements as a share of the vehicle sales value for each category.

Battery required (B): To determine the battery requirements, we consider the typical battery size for each vehicle category and volume of new sales. The replacement demand is influenced by the battery life (number of charge cycles), average annual usage, and range per charge. More details and assumptions can be found in Table 9.1A.

2. Analysis

Within this section, we analyse the net zero sales scenario of various automobiles, including both EVs and non-EVs, from 2020 to 2070. Moreover, we project the investments required by the OEMs to manufacture these vehicles, as well as the revenue and market opportunity that these projected sales could lead to under the scenario showcased. We also analyse potential scenarios for tax collection by the government arising from auto sales. Finally, we explore the battery requirements and investments needed under an indigenous production scenario.

2.1 Net-zero sales scenario

The following section describes the net-zero pathway outlined in Table 1, which compiles the automobile sales scenario identified by Chaturvedi and Malyan (2021) and Singh and Sidhu (2021). Under Table 1, we compile the sales pathway by which the auto sector will be able to achieve net-zero emissions by 2070 across five-year time blocks. The sales are broken into EV and non-EV sales for each of the considered categories.

TABLE 1:

Expected vehicle sales across vehicle categories under a net-zero scenario over five-year periods

Sales volume (In millions)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
2W electric	3	39	53	92	76	86	63	68	50	50
2W others	84	87	42	23	9	6	4	2	0	0
2W (total)	**88**	**126**	**95**	**115**	**85**	**92**	**67**	**70**	**51**	**50**
3W electric	0.2	1.1	2.7	2.2	1.6	1.2	0.9	0.6	0.5	0.4
3W others	4.3	3.0	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0
3W (total)	**4.4**	**4.1**	**3.7**	**2.5**	**1.7**	**1.2**	**0.9**	**0.6**	**0.5**	**0.4**
4W electric	0.2	2	11	26	41	41	69	82	99	112
4W others	14	18	22	19	19	19	22	25	23	21
4W (total)	**14**	**20**	**33**	**45**	**61**	**61**	**91**	**107**	**122**	**133**
Bus electric (in thousands)	10	50	60	72	65	58	52	47	43	38
Bus others (in thousands)	94	73	46	32	20	13	10	6	2	1
Bus (total) (in thousands)	**104**	**123**	**106**	**104**	**85**	**71**	**62**	**53**	**44**	**39**
Truck electric	0.01	0.1	0.2	0.4	0.7	1.2	1.8	2.9	9.1	9.6
Truck others	3.8	3.9	4.1	5.9	5.0	5.5	6.3	4.9	3.7	2.6
Trucks (total)	**3.8**	**3.9**	**4.3**	**6.3**	**5.6**	**6.6**	**8.1**	**7.8**	**12.8**	**12.2**
Total sales	**110**	**154**	**136**	**169**	**153**	**160**	**167**	**185**	**186**	**196**

Source: Authors' compilation based on Chaturvedi and Malyan (2021) and Singh and Sidhu (2021). The table presents new sales per vehicular category over five-year periods. The trucks category includes LDV/MDV and HDV sales.[3]

Table 1 shows the projected sales for various types of vehicles – electric and non-electric – under the net-zero 2070 scenario and their expected evolution over the next few decades. According to the projections, total automobile sales are expected to reach 196 million units in the five-year period ending in 2070. The estimates suggest that two-wheelers and three-wheelers will be the major EV categories in the current decade and continue to grow in popularity.

Electric four-wheelers are expected to experience double-digit sales growth in 2025–2030. Simultaneously, heavier commercial categories, such as trucks, may see a rapid shift towards electrification from 2035 onwards.

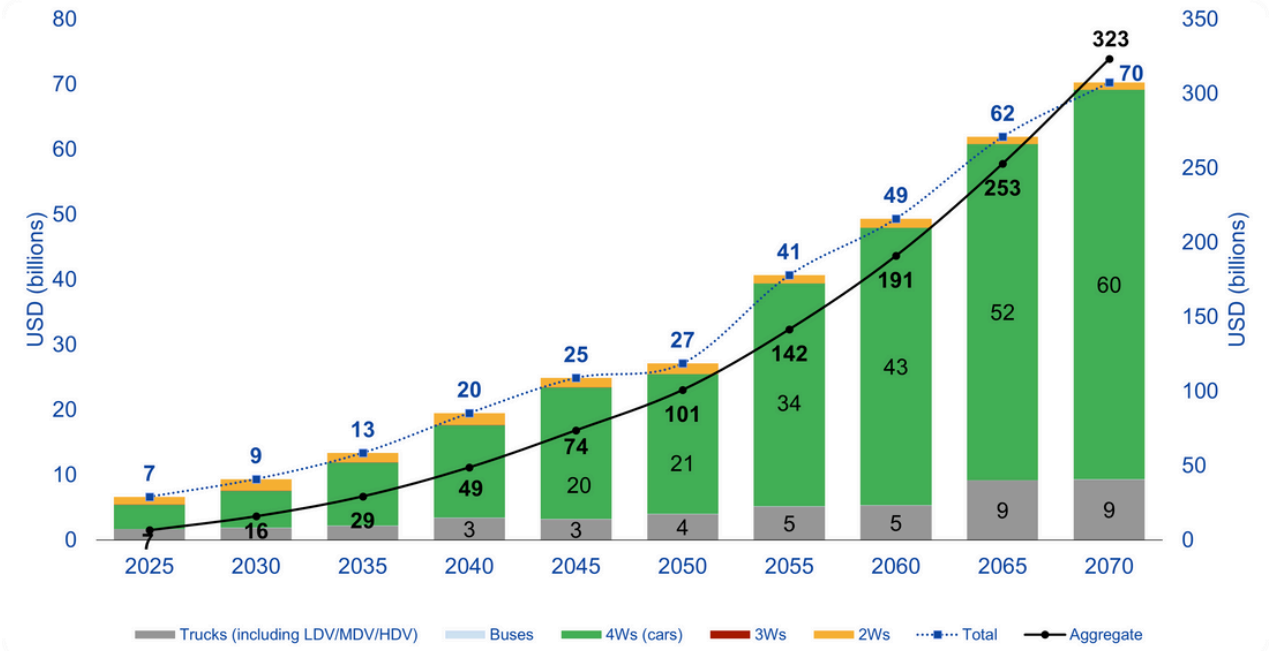
[3] Table 1 presents just one scenario for achieving net zero by 2070. However, in a policy scenario, the focus shifts more towards buses and other public transportation. In that case, the increase in the use of private cars and other modes of private transportation may not be as significant as depicted in this scenario.

2.2 Costs and opportunities of the transition

The section focuses on the costs associated with transitioning towards net-zero emissions, particularly the investments that will need to be made by OEMs to keep pace with the transition.

FIGURE 3:

The investments required to achieve a net-zero transition will majorly be driven by car and truck OEMs



Source: Authors' analysis. The investment required per vehicle type per million manufacturing capacity is in USD (rates as of 2020). Investments required to produce a million vehicles for an OEM = (Average Fixed Asset + Average R&D Cost)/Average Production Capacity/Average Life of Plant in Years.[4] Detailed data available in Annexures: Table 3A.

To decarbonise road transportation, **OEMs will need to increase their investments several-fold**.

It is estimated that by 2070, OEMs will need to invest a total of USD 323 billion to decarbonise the transportation sector. Achieving net zero by 2070 will require an increase in investment from USD 7 billion in the five years ending in 2025 to USD 70 billion in the five years ending in 2070. The largest share of investments – amounting to around USD 263 billion until 2070 – is likely required in the four-wheeler category. Additionally, truck manufacturers are anticipated to invest over USD 45 billion by 2070 to meet domestic demand.

In the EV industry, initial investment costs tend to be higher in the first few years. We observe this trend in the case of companies like Tesla Inc. One reason for Tesla's higher costs is that it is a vertically integrated company – a large part of its investment costs are incurred by Tesla, as an OEM, rather than its suppliers, unlike in the

[4] We assume the total investment required over five years to be USD 11.7 million, USD 9.95 million, USD 232 million, USD 394 million, and USD 394 million for the production of a million units of two-wheelers, three-wheelers, four-wheelers (cars), buses, and trucks, respectively. We calculated these figures by analysing the annual report data of the leading OEMs in each category for six years. The evaluated OEMs include Ashok Leyland, Atul Auto, Bajaj Motors, Hero MotoCorp, Hyundai India, Mahindra Motors, Maruti Suzuki India, Tata Motors, and TVS Motors. The investment benchmarks for each subsequent period, to meet new emission norms and adopt new technologies, are assumed to increase annually at 2.5 per cent until 2040 and at 1.2 per cent subsequently until 2070.

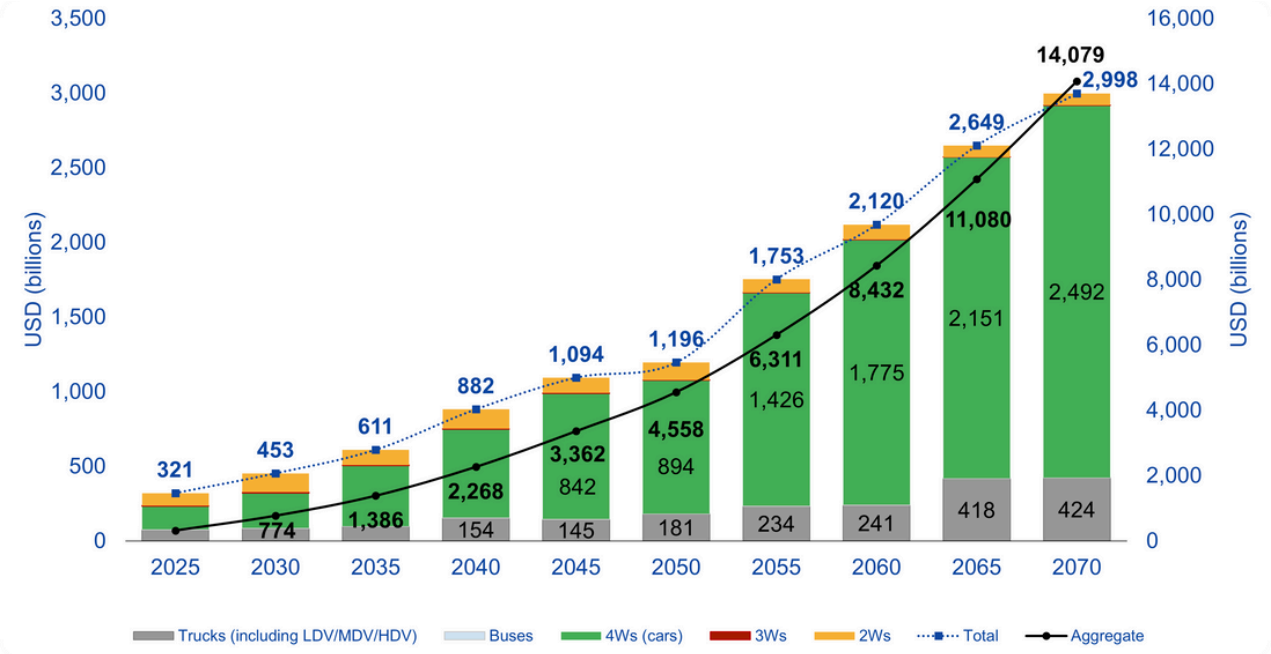
traditional auto manufacturing industry, where manufacturers are heavily dependent on suppliers for components, allowing them to keep their fixed costs lower. For Tesla, the ratio of investment costs to the revenue from sales for the fiscal year 2023 was approximately 5 per cent – similar to its R&D costs for that year. These costs were even higher with a smaller sales base in prior years. For this report, we assume that investments in the sector will grow by 2.5 per cent/year until 2040 and 1.2 per cent/year subsequently until 2070 to account for the increased investment share in the beginning part of the transition, owing to the shift to new technologies and improving efficiency mandates.

2.3 Revenue and consumer market opportunity

In this section, we evaluate the revenue opportunities that transitioning offers across vehicle segments for OEMs and the market value of these new vehicles, based on ex-showroom prices. The revenue and market opportunities are further bifurcated into EVs vs. the entire segment including both EV and non-EV sales.

FIGURE 4:

Going net zero presents automobile OEMs with around USD 14.1 trillion in revenue opportunities by 2070



Source: Authors' analysis.[5] *Detailed data available in Annexures: Table 4A.*

» OEMs have the potential to generate significant revenue by decarbonising, with an estimated opportunity to earn USD 14.1 trillion until 2070. Cars will likely make the largest contribution, representing USD 10.3 trillion over the next 50 years.

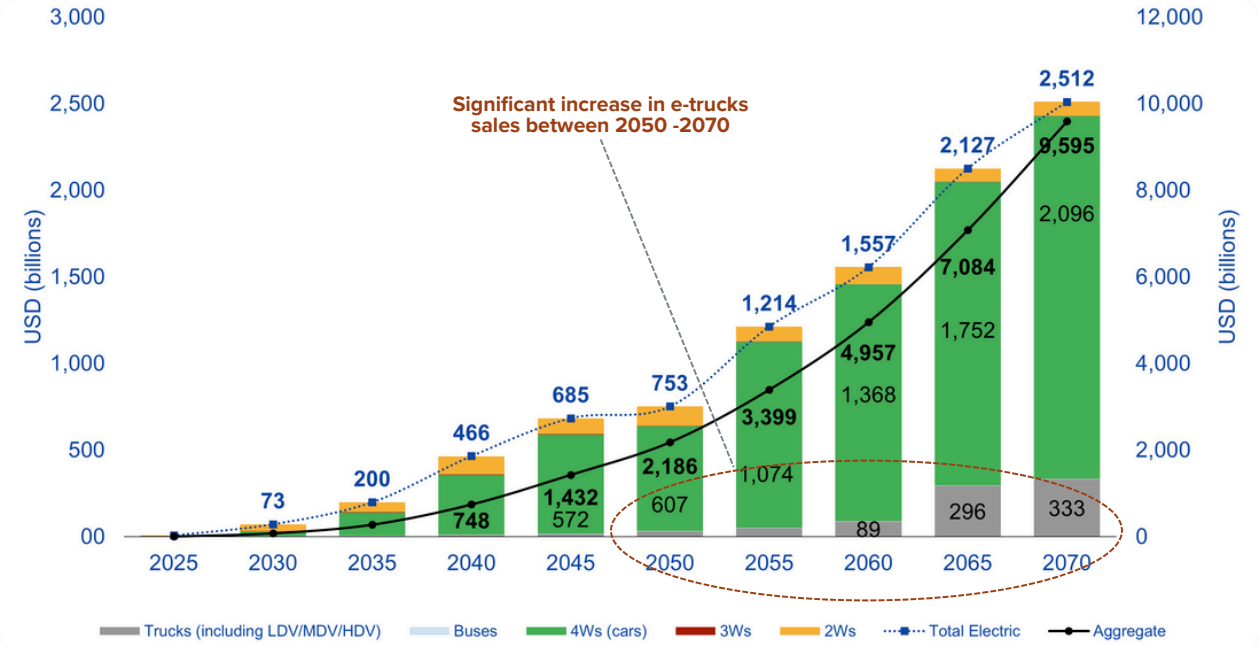
[5] We use annual investments to sales revenue benchmarks of 1.4 per cent, 1 per cent, 2.4 per cent, 2.2 per cent, and 2.2 per cent for 2Ws, 3Ws, 4Ws, bus, and truck manufacturers. This only accounts for the expected revenue from new vehicle sales, not revenue from streams like subsequent component sales and others. We derived these benchmarks from the annual reports of major OEMs and analysed them over the six-year period until 2021. This methodology, may lead to an underreporting of revenues from domestic sales in the initial years of EV penetration, as the costs and revenue of EVs will continue to be higher than those of conventional vehicles. However, by 2030, with inflationary pressures on conventional vehicles and the decreasing costs of batteries and learning rates associated with EVs, revenue analysis is expected to near our reported values.

- As per these estimates, trucks or commercial vehicles will be the second-biggest revenue makers for OEMs, with almost USD 1.9 trillion, representing 15 per cent of the total opportunity, accruing over this period. The rest of the categories, including two-wheelers, three-wheelers, and others, together account for USD 14.1 trillion in revenue until 2070.

The average annual revenue opportunity for auto OEMs could grow over nine times from **USD 64 billion** in 2021–2025 to **USD 600 billion** in 2066–2070.

FIGURE 5:

EVs could add USD 9.6 trillion in OEM revenues by 2070, with cars being the major contributor from 2030 onwards



Source: Authors' analysis. Detailed data available in Annexures: Table 5A.

- According to our analysis, EVs are expected to experience substantial growth in the upcoming years, particularly in the two-wheeler and three-wheeler categories. These categories are expected to achieve a double-digit revenue share in 2025–2030, with a projected increase to 31 per cent and 25 per cent, respectively.

- We expect the EV OEMs' annual revenue to increase from USD 1.6 billion to around USD 502 billion by 2070.

- By 2030, it is estimated that EVs will contribute 7.5 per cent of the total OEM automobile sales revenue.

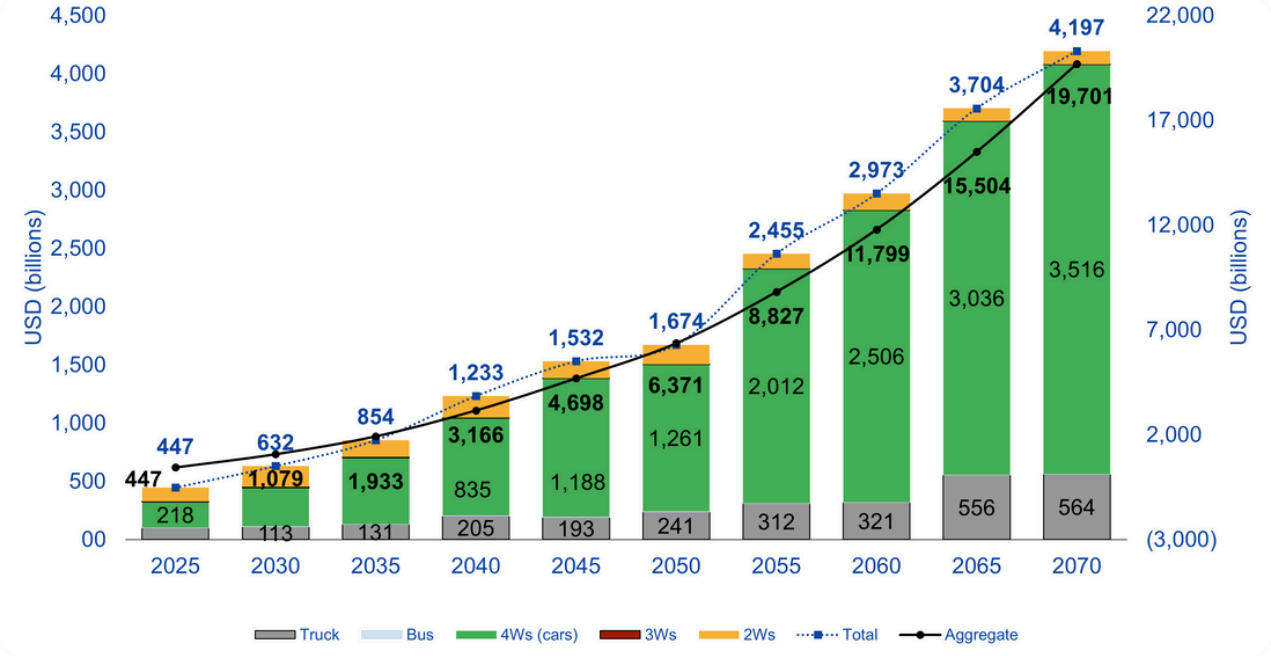
- After 2030, we expect cars to become the largest revenue contributor, contributing over USD 8 trillion in sales during 2020–2070, accounting for 83 per cent of total EV revenues.

» We anticipate a significant increase in e-truck sales between 2050 and 2070. This growth will make the sector the second-highest contributor to electric OEM revenues, accounting for 8 per cent of the total. We expect it to contribute over USD 834 billion to the estimated total EV sales–related revenue of around USD 9.6 trillion. However, the transition to e-trucking could be expedited if there are technological breakthroughs, lower costs, and policy support.

Beyond 2035, the **EV industry is expected to generate more revenue** than non-electric vehicles. The annual revenue from EVs is expected to reach **USD 93 billion** – which will account for 53 per cent of the annual vehicle sales revenue of USD 176 billion during 2036–2040.

FIGURE 6:

Going net zero provides a market opportunity of over USD 19.7 trillion (based on ex-showroom prices)



Source: Authors' analysis.[6] Detailed data available in Annexures: Table 6A.

» Going net zero can create a firsthand sales market worth over USD 19.7 trillion until 2070. Cars represent the bulk of this sales opportunity at USD 15.5 trillion.

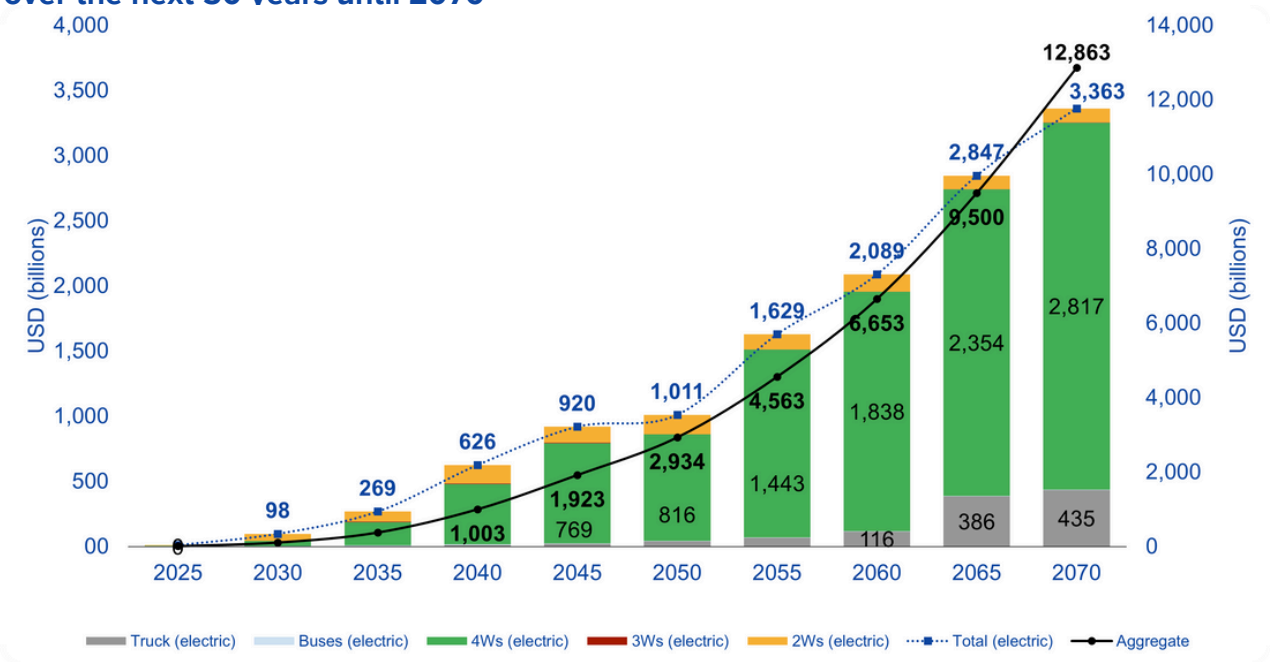
» According to these estimates, trucks will be the second-biggest sales generator in the sector, at USD 2.7 trillion. The other categories, including two-wheelers, with a revenue contribution of around USD 1.4 trillion, three-wheelers, and others will add up to make it USD 19.7 trillion.

» The average annual domestic firsthand sales could increase from USD 89 billion in the five years ending in 2025 to USD 839 billion in the five years ending in 2070.

[6] We assume benchmark dealer margins of 5 per cent for 2Ws, 3 per cent for 3Ws, 5 per cent for 4Ws, and 2 per cent for buses and trucks, with an additional 28 per cent for GST, to derive the sales price of vehicles. The on-road prices of vehicles may turn out to be much higher given registration, insurance, and other charges, for which we have not accounted.

FIGURE 7:

EVs alone can provide a USD 12.9 trillion market (ex-showroom price) opportunity over the next 50 years until 2070



Source: Authors' analysis. Detailed data available in Annexures: Table 7A.

Analysing only the EV sales market value for the period, we find that going net zero can create a firsthand EV sales market worth over USD 12.9 trillion until 2070. **Electric cars represent the bulk of this sales opportunity at USD 10.7 trillion.**

- As per our estimates, among EV categories, trucks and commercial vehicles will be the second-biggest sales generators in the sector over this period, with an 8 per cent contribution at USD 1.1 trillion. Two-wheelers are expected to be the third-largest category, with a total contribution of 7 per cent of the total at USD 1 trillion, and three-wheelers and others will add up to make it a USD 12.9 trillion total EV market opportunity.

- The average annual sales value could increase 309 times from USD 2.2 billion in the five years ending in 2025 to USD 673 billion in the five years ending in 2070.

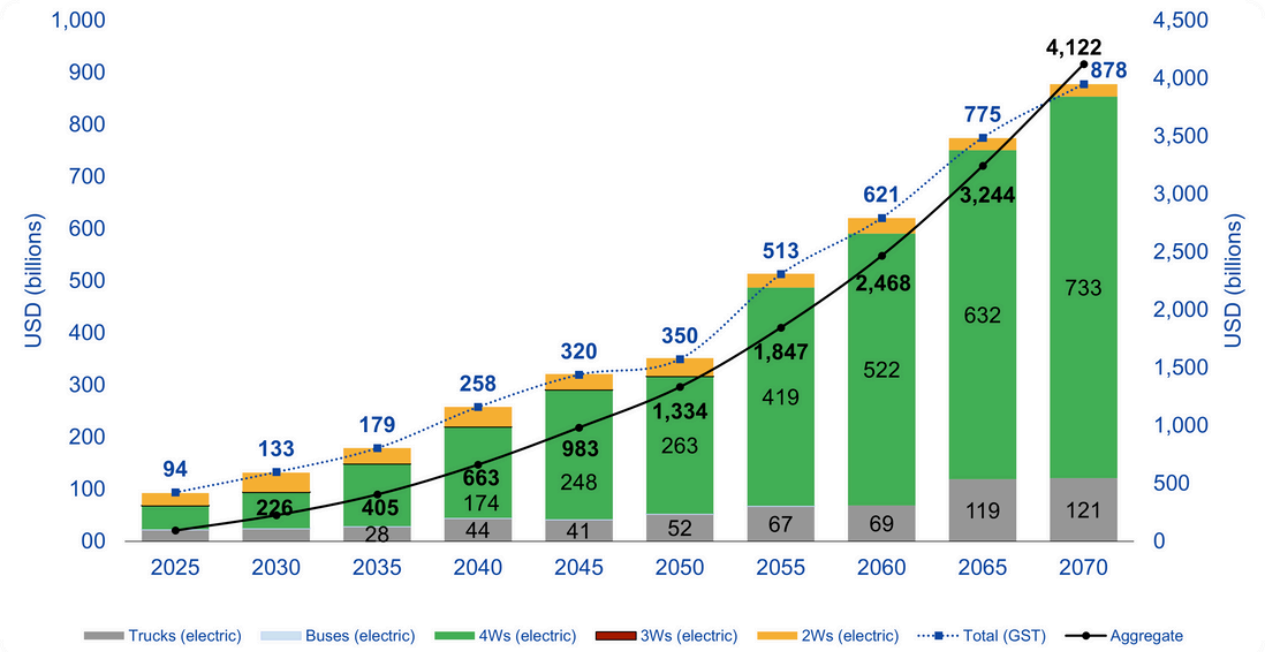
- In the five years until 2030, electric two-wheelers are expected to contribute USD 53 billion in value addition, out of the anticipated USD 98 billion in EV sales.

2.4 Taxation scenarios

This section presents potential scenarios for government tax collection on auto sales. We apply a tax rate of 28 per cent for all new auto sales until 2070; we have assumed no cess charges. For the EV-only sales, we have created two scenarios – one at the current 5 per cent GST charges and the other at 28 per cent, which is the current tax rate for conventional internal combustion engine (ICE) based vehicles.

FIGURE 8:

The tax collection potential is highest for cars at USD 3.2 trillion of the total USD 4.1 trillion for the entire automobile sector



Source: Author's analysis. This calculation assumes a flat 28 per cent GST on the price, including the dealer margin. Detailed data available in Annexures: Table 8A.

- At a GST of 28 per cent for all categories, on par with the current rate for ICE (without considering CESS), the tax collection potential is highest for cars at USD 3.2 trillion of the total USD 4.1 trillion for the entire automobile sector.

- Annual GST collections in the auto sector have the potential to increase from USD 19 billion in 2025 to USD 176 billion by 2070.

- Until 2070, cars and trucks are expected to contribute the most to the total expected revenue collections, with cars accounting for USD 3.2 trillion (78 per cent) and trucks contributing USD 587 billion (14 per cent).

EV subsidy and lower tax regime

EVs currently receive three layers of incentives in India. This includes an upfront subsidy under the Faster Adoption and Manufacturing of Hybrid and Electrical Vehicles (FAME) scheme and its successors, a lower GST rate of 5 per cent compared to the 28 per cent (or higher rate) charged on internal combustion engine (ICE)

vehicles, and an additional subsidy from some states on purchases, lower road taxes, and other benefits.

TABLE 2.1:

Until 2070, GST collections from EV sales at 28 per cent, on par with the current GST regime for ICEs, can add USD 2.8 trillion to total tax collections

GST collections at 28 per cent against EV sales (in USD billion)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2W electric	1	12	17	31	27	32	25	29	23	24	**220**
3W electric	0	0	1	1	1	1	0	0	0	0	**5**
4W electric	1	8	39	102	168	179	316	402	515	616	**2,346**
Bus electric	1	1	1	1	1	1	1	0	0	0	**6**
Truck electric	0	0	1	3	5	9	15	25	84	95	**238**
Total GST	**2**	**21**	**59**	**137**	**201**	**221**	**356**	**457**	**623**	**736**	**2,814**
Aggregate – end of the period	2	24	83	220	421	642	998	1,455	2,078	2,814	
Average annual	*0*	*4*	*12*	*27*	*40*	*44*	*71*	*91*	*125*	*147*	*56*

Source: Author's analysis. This calculation assumes a flat 28 per cent on the price, including the dealer margin for each category.

TABLE 2.2:

Continuing with the current rate of 5 per cent, GST collections from EV sales may add a total of USD 502 billion to automobile sales–related collections by 2070

GST collections at 5 per cent against EV sales (in USD billion)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2W electric	0.2	2.1	3.0	5.5	4.8	5.8	4.5	5.1	4.1	4.2	**39**
3W electric	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	**1**
4W electric	0.1	1.5	7.0	18.1	30.0	31.9	56.4	71.8	92.0	110.0	**419**
Bus electric	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1**
Truck electric	0.0	0.1	0.2	0.5	0.9	1.6	2.6	4.5	15.1	17.0	**43**
Total GST	**0.4**	**4**	**10**	**24**	**36**	**39**	**64**	**82**	**111**	**131**	**502**
Aggregate – end of the period	0.4	4	15	39	75	115	178	260	371	502	
Average annual	*0.1*	*1*	*2*	*5*	*7*	*8*	*13*	*16*	*22*	*26*	*10*

Source: Author's analysis. This calculation assumes a flat 5 per cent GST applicable on the price, including the dealer margin for each category.

Policymakers need to be mindful of the GST rates charged on EV production and sales. As Tables 2.1 and 2.2 illustrate, charging GST at 28 per cent could help the government collect around USD 2.8 trillion, compared to USD 502 billion if the GST is 5 per cent. They should also consider the timing, if any, of such an increase in the GST regime, as it could impact the market structure as well as the growth and viability of EVs in the short term compared to ICE vehicles.

2.5 Battery requirements and investments

In this section, we analyse the battery requirements for new EV sales and replacements, which currently drive the majority of EV costs, and the necessary investments to produce them locally. The batteries and drivetrain (including motors) are the most valuable components of all EV hardware. India has already recognised this and is actively promoting local battery manufacturing through production-linked incentive (PLI) schemes. To maintain their competitive advantage in the rapidly evolving battery space, many pure EV OEMs – like Tesla and BYD (both are global players with minimal or no presence in India) – have vertically integrated battery production. Due to the significance of batteries in this sector, we anticipate a growing demand driven by EV adoption until 2070. Given the rapid development of new battery technologies, many of these investments may be made by the OEMs themselves.

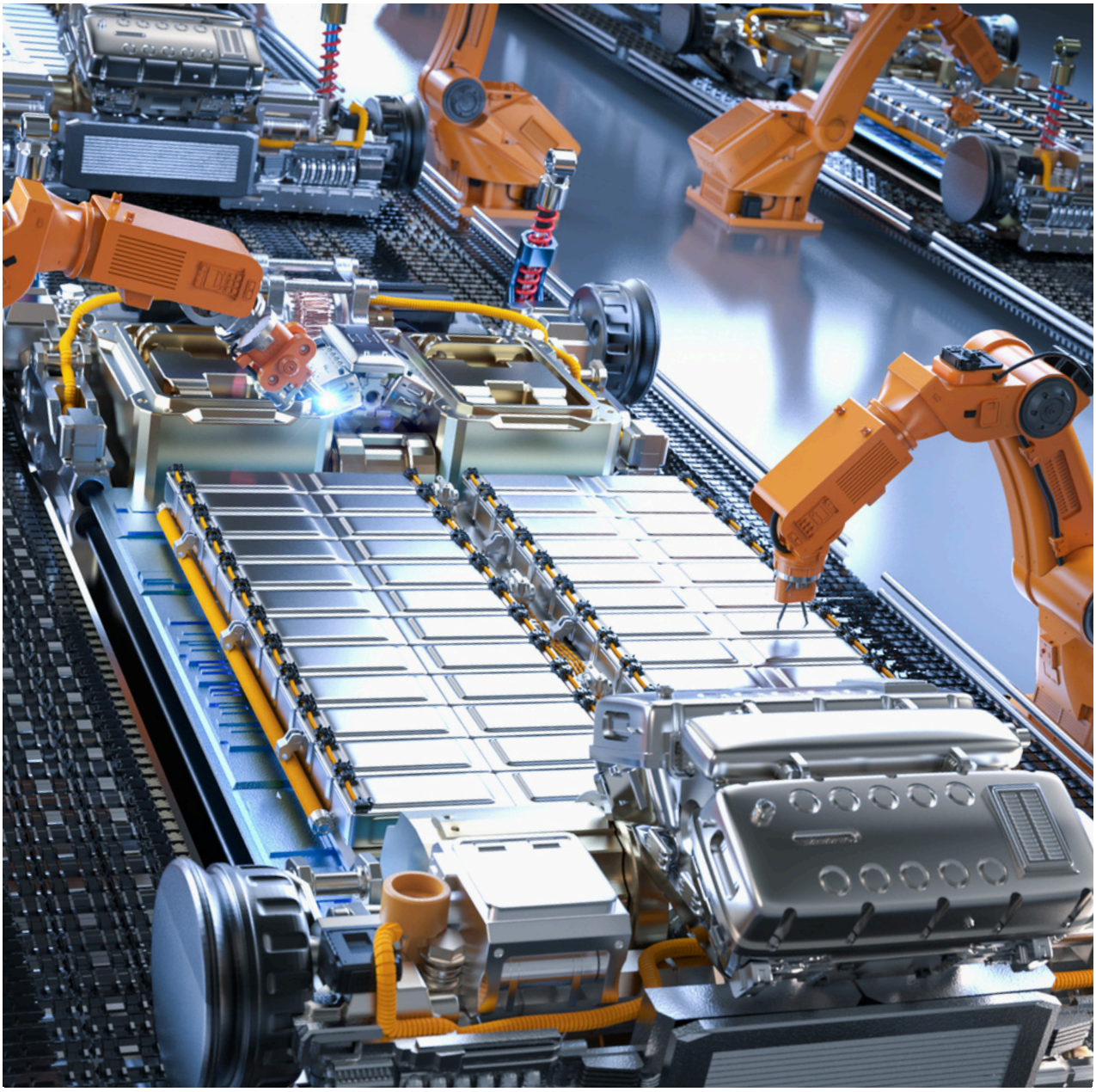
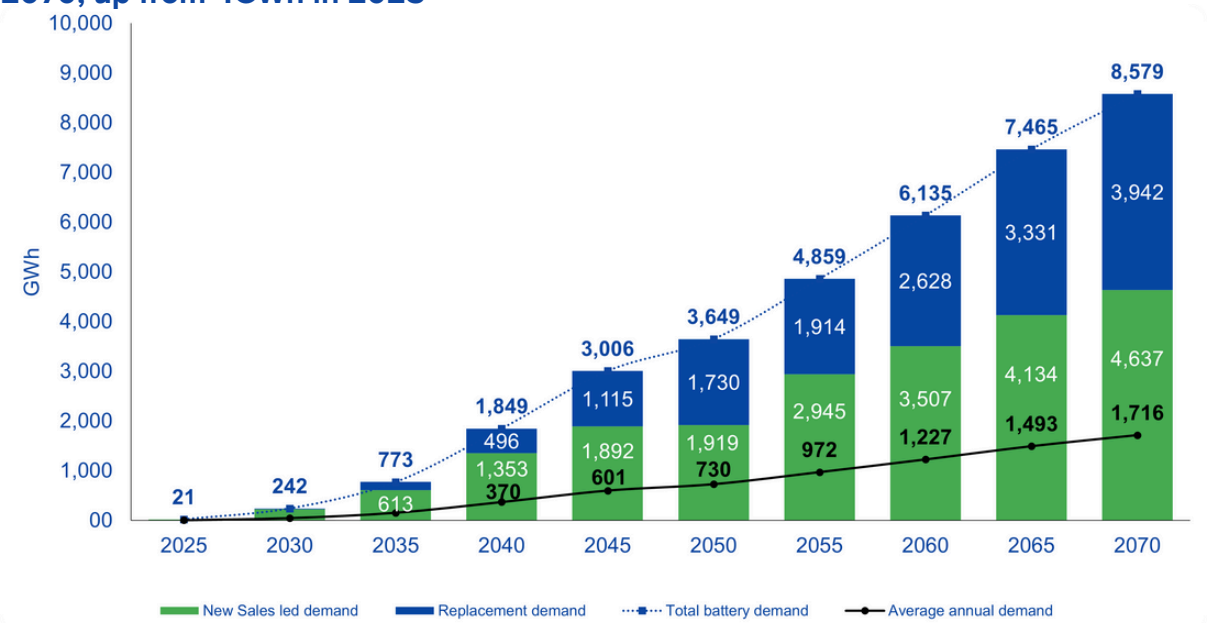


FIGURE 9:

Annual battery demand from new EV sales and replacements could reach 1,716 GWh by 2070, up from 4GWh in 2025



Source: Author's analysis. This calculation does not consider truck demand, as from a long-term perspective, the battery sizes required for deployment in trucks in India are still unclear. Assumptions related to the battery life, size, vehicle life, kilometres, required replacements, and others are available in Annexures: Table 9.1 A.

TABLE 3.1:

Annual battery demand from new EV sales could reach 927 GWh by 2070, up from 4 GWh in 2025

Battery demand new sales (in GWh)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2W electric	9	117	159	277	227	258	189	203	151	149	**1,740**
3W electric	1	5	14	11	8	6	4	3	2	2	**56**
4W electric	10	97	433	1,056	1,649	1,649	2,746	3,295	3,976	4,482	**19,390**
Bus electric	1	6	7	9	8	7	6	6	5	5	**59**
Total battery demand	**21**	**225**	**613**	**1,353**	**1,892**	**1,919**	**2,945**	**3,507**	**4,134**	**4,637**	
Average annual demand	*4*	*45*	*123*	*271*	*378*	*384*	*589*	*701*	*827*	*927*	*425*

Source: Authors' analysis.[7]

TABLE 3.2:

Annual replacement battery demand could reach 788 GWh by 2070, up from almost zero in 2025

Battery replacement demand (in GWh)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2W electric	–	6	74	142	230	247	246	217	198	172	**1,531**
3W electric	–	1	5	14	11	8	6	4	3	2	**55**
Car electric	–	7	69	325	857	1,459	1,649	2,395	3,119	3,758	**13,636**
Bus electric	0	4	12	15	17	15	14	12	11	10	**112**
Total battery demand	**0**	**17**	**161**	**496**	**1,115**	**1,730**	**1,914**	**2,628**	**3,331**	**3,942**	
Average annual demand	*0*	*3*	*32*	*99*	*223*	*346*	*383*	*526*	*666*	*788*	*307*

Source: Authors' analysis.

- With annual battery demand for new vehicles and battery replacements standing at 927 GWh and 788 GWh respectively, the total battery demand could reach 1,716 GWh by 2070.

- We expect that by 2030, electric two-wheeler sales will drive the demand for batteries to 117 GWh, out of the total EV battery demand of 225 GWh.

- When it comes to the sale of new vehicles, cars are expected to be the largest consumers of batteries by 2035. However, two-wheelers may still have a higher demand for battery replacements, as there is a larger stock of older vehicles in India.

- According to our estimates, the average annual demand for battery replacements may increase significantly from almost nothing in 2025 to about 788 GWh by 2070. However, this figure may turn out to be much lower in the future due to improvements in battery technologies – such as longer chemical usability and a better charge-cycle life – resulting in a lower need for replacements.

TABLE 4:

EV batteries provide an investment opportunity worth USD 196 billion until 2070

Battery replacement demand (in GWh)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
No. of factories required to meet average annual demand	1	5	16	37	61	73	98	123	150	172
Additional factory over each five-year period	1	4	11	21	25	16	36	46	53	42
Additional investments (USD billion)	**1**	**3**	**8**	**16**	**19**	**12**	**28**	**35**	**41**	**32**
Cumulative investments (USD billion)		4	12	28	48	60	87	123	163	196

Source: Authors' analysis. Assuming a 20-year lifespan, a giga-factory with a capacity of 10GWh requires a capital expenditure of USD 0.77 billion for battery production.

The **investment required to meet India's EV battery demand is expected to** increase from **USD 1 billion** in the five years ending 2025 and **peak at USD 41 billion** in the five years ending 2065.

- By 2070, India's total battery demand for EVs could be met domestically through 172 giga-factories, each with a battery manufacturing capacity of 10 GWh. The first such factory is expected to be set up in 2025.

[7] This calculation considers an 80:20 split across personal and commercial cars and a 50:50 split between the LCVs and M&HCVs categories of electric buses. We do not consider truck demand, since from a long-term perspective, the battery demand across truck categories in the country is still unclear.

3. Financing required and solutions

This section evaluates the financing required and the rates at which the auto sector loan book needs to increase until 2070 to match the auto sector transition to net zero. We assume the financing penetration to continue to be at the same level as showcased in Table 5.1 for the vehicle categories. For a higher finance availability on par with developed nations, auto loan books may need to increase even beyond the levels calculated here. Further, this section evaluates some financing solutions to facilitate a smooth transition, particularly for new vehicle types like EVs.

TABLE 5:

Auto loan portfolios must surpass overall banking sector loan growth rates

Financing requirements and potential	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Average / Total (2020 - 2070)
2W	54	82	66	84	66	76	58	65	50	52	**653**
3W	2.8	2.7	2.6	1.9	1.4	1.0	0.8	0.6	0.5	0.4	**15**
4W	100	151	261	382	543	577	920	1,145	1,388	1,607	**7,073**
Bus (in million)	1.9	2.4	2.2	2.3	2.0	1.8	1.6	1.5	1.3	1.2	**18**
Truck	70	78	90	141	132	166	214	221	382	387	**1,879**
Total Requirement (A)	**228**	**316**	**421**	**611**	**745**	**821**	**1,194**	**1,433**	**1,821**	**2,048**	**9,638**
Aggregate Requirement	228	543	964	1,575	2,320	3,141	4,335	5,768	7,590	9,638	
Annual financing requirements (B) = (B)/5	**46**	**63**	**84**	**122**	**149**	**164**	**239**	**287**	**364**	**410**	**227**
Annual growth in the auto loan books required to meet the financing needs of the sector	*18%*	*7%*	*6%*	*8%*	*4%*	*2%*	*8%*	*4%*	*5%*	*2%*	

Source: Author's analysis. In this calculation, we assume the auto loan makers' capacity to make yearly loans at USD 20 billion in the year 2020 so that we can calculate the required growth in the banking channels' auto sector portfolio.

TABLE 5.1:

Assumptions used to estimate the financing required across vehicle categories

Vehicle category	Percentage of annual sales being financed	Amount of ex-showroom price financed
2W	60%	80%
3W	70%	60%
4W	80%	60%
Bus	100%	70%
Trucks	100%	70%

- Based on our analysis, the EV market could provide banks and other financial institutes (FIs) a USD 9.6 trillion opportunity to finance the purchase of new vehicles until 2070. We estimate that the annual financing requirements will rise from USD 45 billion in 2025 to around USD 410 billion by 2070 across vehicle categories.

- To address potential funding shortfalls in the automobile industry, automobile financing will need to increase by 2–18 per cent until 2070. This estimate is based on conservative assumptions due to the relatively low proportion of vehicles being financed. Considering these factors, the regulator, the Reserve Bank of India, should explore the possibility of increasing exposure to auto sector financing at a faster pace than other competing sectors of the economy.

- We expect the required financing quantum to be highest for cars at USD 7.1 trillion, followed by USD 1.9 trillion for trucks and 653 billion for two-wheelers during 2021–2070.

3.1 Financing end consumers for the EV transition

To support the switch to EVs, regulators and policymakers will need to boost the financing available to the sector. As a result, the auto loan portfolio will have to grow much faster than the overall banking sector. The auto sector loan portfolio will need to grow by 6–18 per cent until 2040 to maintain current average loan disbursement ratios across vehicle categories. With the emergence of new-age vehicles like EVs, traditional financiers will require support in the form of guarantees and other measures (which we discuss next) to facilitate the transition. Additionally, there should be a focus on expanding traditionally neglected models – like leasing – to further support the growth of EV financing. Without these measures, the transition may not happen as quickly as intended.

3.1.1 Barriers to financing

Given their high operational efficiency, EVs have low operating costs but have higher upfront costs than ICE vehicles. In many cases, the low operating costs of EVs outweigh the initial costs and can provide significant monetary benefits, especially for commercial operations with high usage. This has made it popular among new-age commercial operators, such as fleets, e-commerce, and quick commerce companies. However, the lack of financial products tailored for EVs, and low access to finance, hinders higher EV penetration in India.

A) Short-term issues

Loan products are not attuned to EV operations. In many cases, EV loans are of shorter tenures and marked by high interest rates.

These two factors result in reduced take-home savings in the early years of operation for owner-drivers or even fleets, which dissuades potential buyers from adopting EVs.

- The penetration of loans for EVs across categories is low. As loans for EVs are limited, potential customers continue to purchase ICE vehicles, for which they might have better access to loans.

- As FIs have a poor understanding of the real-world performance of EVs, they continue to supply shorter-tenure loans. FIs are yet to develop risk matrices for the EV asset class and thus tend to be more cautious when funding EVs than ICE vehicles. Another reason for this conservatism is the absence of a secondary market for EVs, which is well-established in the case of ICE vehicles.

B) Long-term issues: financing requirements

Over the long term, the financing requirements of the automobile sector could outgrow the ability of FIs to meet them. The problem could become pronounced from 2025 onwards and slow down the transition to electric, clean, and other new vehicle technologies as they emerge. The financing gap may widen with time if loan portfolios do not grow in tandem with the growth of the sector, which is likely to range from 6 per cent to 18 per cent by 2040. Thus, regulators, OEMs, and other partners will have to foster deeper financial sector participation to grow auto financing by almost 20 times to USD 410 billion by 2070.

3.2 Solutions

To increase the involvement of FIs in the mobility transition over the short term, they may need some guarantees as the risk matrices crystallise.

3.2.1 Short-term solutions

- First-loss guarantees could allow automobile financiers to provide better terms for the purchase of EVs. India could replicate the model of the Credit Guarantee Trust for Micro and Small Enterprises (CGTMSE), which the Small Industries Development Bank of India (SIDBI) hosts for SME loans provided by participating FIs, could allow automobile financiers to provide better terms of finance for the purchase of EVs. A limited-period guarantee could allow participating institutions to avoid risk but still lend to customers for EV purchases, providing longer-tenure loans at more feasible rates of interest. Also, such a facility could strengthen financing by allowing for the passing a higher approval of loans similar to those of the ICE vehicle category, thus deepening loan penetration among EVs.

- Green lines of credit: Since some participating FIs are looking to make a niche in EVs but limited access to financing sources with favourable terms, green lines of credit are a useful solution. These would allow on-lenders to make loans that are more attuned to the EV category and its usage – i.e., loans that are marked by longer tenures and low rates of finance, given the line of credit has similar attributes. A similar approach increased the availability of finance for the distributed solar sector in India and can be replicated with some changes for EVs.

- Others: Policymakers will need to consider alternative financial solutions to develop EV ecosystems, including charging, which can help alleviate the range anxiety associated with EVs and encourage wider adoption. One potential solution is to provide accelerated depreciation for fleet and charging point owners, thereby incentivising the uptake of EVs and encouraging investment in the charging business. This could be especially useful given that charging businesses often have negative working capital cycles.

3.2.2 Long-term solutions

Since the long-term needs of the sector could outgrow the pace of automobile loan financing in India, focusing on refinancing could help FIs increase their participation in the auto loan market. Refinancing is the process by which banks and FIs extend credit to other FIs that have already provided loans to customers. This allows the original lenders to free up their funds and continue making new loans, thus increasing their lending capacity.

By refinancing existing automobile loans, banks and FIs can manage their liquidity efficiently. When a bank provides a loan for a vehicle purchase, it ties up a considerable amount of funds for an extended period. Through refinancing, the bank can replenish its liquidity and continue to meet the demands of new loan applicants.

Solutions by OEMs

- Extended warranty and maintenance packages: To provide additional value to borrowers, the auto financier can collaborate with automobile manufacturers and dealerships to offer extended warranty and maintenance packages. This gives customers peace of mind, as they know that their vehicles are covered for an extended period and are less likely to incur unexpected repair costs.

- A guaranteed buyback option: To avoid the issue of the lack of a secondary market, companies can introduce a guaranteed buyback option for certain EVs. This means that after a specified period (e.g., three or four years), the company guarantees that it will buy the vehicle back from the borrower at a predetermined price. This feature may also appeal to customers who like to upgrade their vehicles frequently or have the assurance of a buyback value.

- Upscaling new business models: Given the scale of financing required, options like annualisation/subscription and leasing can help support the FI fund the purchase of EVs. Annualisation (also known as subscription), or spreading out the initial expenses of EVs, is a method already in common use for traditional ICE vehicles. Implementing annualisation for EVs ensures that upfront costs and ongoing expenses like fuel, maintenance, and insurance are evenly distributed as yearly costs (Singh et al., 2020). The leasing of vehicles is a nascent practice in the Indian automobile sector. Policy support for setting up leasing companies, by levying reduced or negligible GST rates, can help make leasing more attractive and perhaps support direct financing of the vehicles. Such leasing products – if priced competitively – could allow commercial operators a faster transition to EVs, as they will not have to worry about their performance and other factors associated with the lack of knowledge of EVs. As the same would have to be taken care of by the leasing company, the company operating them can focus on core operations.

Conclusion

To achieve its 2070 net-zero target, the Indian auto sector will rely on electric vehicles (EVs), with two- and three-wheelers leading the transition, followed by electric cars and heavy vehicles. This shift will necessitate significant investments in new technologies and manufacturing, with an estimated total investment by OEMs of USD 323 billion by 2070. However, this transition also presents a sizeable revenue opportunity of over USD 14.1 trillion for automakers, along with a market (Ex-showroom price) creation of over USD 19.7 trillion by 2070. Consumers will benefit from a wider range of cleaner and potentially more affordable vehicles, while financiers could explore new avenues for growing their portfolios, such as EVs.

India's auto industry is on the cusp of a major transformation, and battery manufacturing to meet the demand has the potential for substantial value creation within the country's borders. Successful support for this transition could also enable the government to significantly increase tax revenue from auto sales, contributing to achieving net-zero emissions in the automobile sector.

This transformation requires a multi-pronged approach, including strategic infrastructure development, technological innovation, consumer financing solutions, and robust policies. Consumer-based financing will need significant support, and the financing sector may need to exceed the country's overall credit growth to maintain the pace of transition. This roadmap provides a framework for navigating the transition and unlocking the considerable economic and environmental benefits it presents.

Annexures

TABLE 1A:

Automobile sales *(In Millions)* in India

Category	FY19	FY20	FY21	FY22	FY23	FY24
Passenger vehicles (cars/4Ws)	3.38	2.77	2.71	3.07	3.89	4.22
Commercial vehicles (trucks, buses and others)	1.01	0.72	0.57	0.72	0.96	0.97
Three-wheelers (3Ws)	0.70	0.64	0.22	0.26	0.49	0.69
Two-wheelers (2Ws)	21.18	17.42	15.12	13.57	15.86	17.97
Grand total	**26.27**	**21.55**	**18.62**	**17.62**	**21.20**	**23.85**

Source: SIAM data; grand total includes sales of quadricycles, which are in the hundreds. Commercial vehicle sales data includes LDVs/MDVs/HDVs, trucks, and buses. (SIAM, 2024)

Table 2A:

EV sales *(In thousands)* in India across categories (FY19–FY24)

EV categories	FY19	FY20	FY21	FY22	FY23	FY24
Two-wheelers (E-2Ws)	28	27	45	252	728	944
Three-wheelers (E-3Ws)	1	2	2	11	31	101
Four-wheelers (cars/4Ws)	2	2	5	19	47	90
LDV/MDV/HDV	1	0	0	1	1	5
E-Bus	0	0	0	1	2	4
E-rickshaws	115	141	88	173	375	531
Total (excluding E-rickshaws)	**31**	**31**	**52**	**284**	**810**	**1,139**
Total (including E-rickshaws)	**146**	**172**	**141**	**457**	**1,184**	**1,676**

Source: VAHAN Dashboard; car data is derived by adding commercial and personal car registrations for the year.

TABLE 3A:

Expected OEM investments

OEM investments (In USD million)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total (2020–2070)
2Ws	1.17	1.78	1.42	1.83	1.43	1.65	1.27	1.41	1.09	1.13	**14.17**
3Ws	0.05	0.05	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01	**0.26**
4Ws (cars)	3.71	5.62	9.70	14.21	20.21	21.45	34.21	42.61	51.63	59.80	**263.14**
Buses	0.05	0.06	0.05	0.06	0.05	0.04	0.04	0.04	0.03	0.03	**0.44**
Trucks (including LDV/MDV/HDV)	1.68	1.87	2.16	3.38	3.18	3.99	5.15	5.31	9.19	9.32	**45.23**
Total	**6.65**	**9.37**	**13.38**	**19.51**	**24.90**	**27.14**	**40.68**	**49.38**	**61.94**	**70.29**	**323.24**
Aggregate - end of the period	6.65	16.01	29.40	48.91	73.81	100.95	141.64	191.01	252.95	323.24	

Source: Authors' analysis. The investment required per vehicle type per million manufacturing capacity is in USD (as of 2020). Investment required to produce a million vehicles for an OEM = (Average Gross Asset + Average R&D Cost)/Average Production Capacity/Average Life of Plant in Years.[8]

TABLE 4A:

OEM revenue opportunity

OEM revenue(USD billion)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2Ws	83	127	102	131	102	118	90	101	78	81	**1,012**
3Ws	5.0	4.9	4.7	3.4	2.5	1.8	1.4	1.1	0.9	0.7	**26**
4Ws (cars)	154	234	404	592	842	894	1,426	1,775	2,151	2,492	**10,964**
Buses	2.1	2.6	2.4	2.5	2.2	1.9	1.8	1.6	1.4	1.3	**20**
Trucks (including LDV/MDV/HDV)	76	85	98	154	145	181	234	241	418	424	**2,056**
Total	**321**	**453**	**611**	**882**	**1,094**	**1,196**	**1,753**	**2,120**	**2,649**	**2,998**	**14,079**
Aggregate - end of the period	321	774	1,386	2,268	3,362	4,558	6,311	8,432	11,080	14,079	
Average annual	*64*	*91*	*122*	*176*	*219*	*239*	*351*	*424*	*530*	*600*	*282*

Source: Authors' analysis.[9]

[8] We assume that the total investments required over five years are USD 11.7 million, USD 9.95 million, USD 232 million, USD 394 million, and USD 394 million for the production of 1 million units of two-wheelers, three-wheelers, four-wheelers (cars), buses, and trucks, respectively. We calculated these figures by analysing the annual report data of the leading OEMs in each category over six years. The evaluated OEMs include Ashok Leyland, Atul Auto, Bajaj Motors, Hero MotoCorp, Hyundai India, Mahindra Motors, Maruti Suzuki India, Tata Motors, and TVS Motors. We assume that the investment benchmarks for each subsequent period, based on the need to meet new emission norms and adopt new technologies, will increase annually at 2.5 per cent until 2040 and at 1.2 per cent subsequently until 2070.

TABLE 5A:

Revenue opportunities for EV OEMs

EV OEM revenue(in USD billion)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2Ws electric	3	39	57	105	91	110	86	98	77	81	**747**
3Ws electric	0.2	1.3	3.5	2.9	2.3	1.8	1.4	1.1	0.9	0.7	**16**
4Ws (cars) electric	3	28	133	345	572	607	1,074	1,368	1,752	2,096	**7,978**
Buses electric	2.1	2.6	2.4	2.5	2.2	1.9	1.8	1.6	1.4	1.3	**20**
Trucks electric (including LDV/MDV/HDV)	0.3	1.7	4.1	10.3	16.8	32	51	89	296	333	**834**
Total electric	**8**	**73**	**200**	**466**	**685**	**753**	**1,214**	**1,557**	**2,127**	**2,512**	**9,595**
Aggregate – end of the period	8	81	281	748	1,432	2,186	3,399	4,957	7,084	9,595	
Average annual	*1.6*	*15*	*40*	*93*	*137*	*151*	*243*	*311*	*425*	*502*	*282*

Source: Authors' analysis.

Table 6A:

Automotive sales market opportunity

Auto market opportunity(in USD billion)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2Ws	117	179	143	185	144	166	128	142	110	114	**1,428**
3Ws	6.8	6.7	6.4	4.6	3.3	2.5	1.9	1.5	1.2	1.0	**36**
4Ws	218	330	570	835	1,188	1,261	2,012	2,506	3,036	3,516	**15,472**
Buses	2.8	3.5	3.2	3.3	2.9	2.6	2.4	2.2	1.9	1.8	**27**
Trucks	102	113	131	205	193	241	312	321	556	564	**2,738**
Total	**447**	**632**	**854**	**1,233**	**1,532**	**1,674**	**2,455**	**2,973**	**3,704**	**4,197**	**19,701**
Aggregate – end of the period	447	1,079	1,933	3,166	4,698	6,371	8,827	11,799	15,504	19,701	
Average annual	*89*	*126*	*171*	*247*	*306*	*335*	*491*	*595*	*741*	*839*	*394*

Source: Authors' analysis.[10]

[9] We use benchmark annual investments to sales revenue values of 1.4 per cent, 1 per cent, 2.4 per cent, 2.2 per cent, and 2.2 per cent each for the 2Ws, 3Ws, 4Ws, and bus and truck manufacturers. This only accounts for the expected revenue from new vehicle sales and not for revenue from streams like subsequent component sales and others.

[10] We assume the benchmark dealer margin of 5 per cent for 2W, 3 per cent for 3W, 5 per cent for 4W, and 2 per cent for buses and trucks, and an added 28 per cent GST to derive the sales price of the vehicles. The on-road prices of the vehicles may turn out to be much higher given the registration, insurance, and other charges, for which we have not accounted.

TABLE 7A:

EV sales market opportunity

EV market opportunity (in USD billion)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total (2020–2070)
2Ws electric	4	53	77	141	123	148	115	131	104	108	**1,004**
3Ws electric	0	2	5	4	3	2	2	1	1	1	**16**
4Ws electric	4	38	179	464	769	816	1,443	1,838	2,354	2,817	**10,723**
Buses electric	3	3	3	3	3	3	2	2	2	2	**26**
Trucks electric	0	2	5	13	22	42	67	116	386	435	**1,089**
Total electric	**11**	**98**	**269**	**626**	**920**	**1,011**	**1,629**	**2,089**	**2,847**	**3,363**	**12,863**
Aggregate – end of the period	11	109	378	1,003	1,923	2,934	4,563	6,653	9,500	12,863	
Average annual	*2*	*20*	*54*	*125*	*184*	*202*	*326*	*418*	*569*	*673*	*257*

Source: Authors' analysis.

Table 8A:

Potential GST collections against auto sales until 2070

GST collections at 28 per cent against auto sales (in USD billion)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2Ws	24	37	30	38	30	35	27	30	23	24	**298**
3Ws	1	1	1	1	1	1	0	0	0	0	**8**
4Ws (cars)	45	69	119	174	248	263	419	522	632	733	**3,223**
Buses	1	1	1	1	1	1	1	0	0	0	**6**
Trucks	22	24	28	44	41	52	67	69	119	121	**587**
Total GST	**94**	**133**	**179**	**258**	**320**	**350**	**513**	**621**	**775**	**878**	**4,122**
Aggregate – end of the period	94	226	405	663	983	1,334	1,847	2,468	3,244	4,122	
Average annual	*19*	*27*	*36*	*52*	*64*	*70*	*103*	*124*	*155*	*176*	*82*

Source: Authors' analysis. This calculation assumes a flat 28 per cent GST applicable on the price including the dealer margin.

TABLE 9A:

Battery demand to support the EV transition is expected to increase from 4 GWh annually in 2025 to 1716 GWh by 2070

Battery demand (in GWh)	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	Total / Average (2020–2070)
2Ws electric	9	122	233	420	458	505	435	420	349	321	**3,271**
3Ws electric	1	6	19	24	19	14	10	7	6	4	**111**
Cars electric	10	103	502	1,382	2,505	3,108	4,394	5,689	7,095	8,239	**33,026**
Buses electric	2	10	20	24	25	22	20	18	16	15	**171**
Total battery demand	**21**	**242**	**773**	**1,849**	**3,006**	**3,649**	**4,859**	**6,135**	**7,465**	**8,579**	**36,578**
Average annual demand	*4*	*48*	*155*	*370*	*601*	*730*	*972*	*1,227*	*1,493*	*1,716*	*732*

Source: Authors' analysis. This calculation does not consider truck demand, as from a long-term perspective, the battery sizes across applications of trucks in the country are yet to firm up.

Table 9.1A:

Assumptions for battery-related calculations across vehicle categories

Vehicle type	Battery capacity required (KWh)	Average distance in a single charge (km)	Average distance/ year (km)	Distance run by a vehicle in its lifetime (km)	Battery life based on average usage (years)	Assumed life of the vehicle (years)	No. of batteries replaced per new vehicle sold
2Ws	3	80	6,300	94,500	15	15	1
3Ws	5	130	33,500	3,35,000	4.7	10	1
4W							
Personal	40	262	12,600	1,89,000	25	15	1
Fleet	40	262	70,000	5,60,000	4.5	8	1
Buses							
LCV	200	250	1,14,209	9,13,672	2.6	8	2
M&H CVs	320	250	1,14,209	9,13,672	3	8	2

Source: Authors' compilation based on data from NITI Aayog and other sources. For our calculations, we assume that the chemical usable life of a battery in an electric vehicle is 7–8 years. We also consider a battery's life to be about 1,200 charge cycles.

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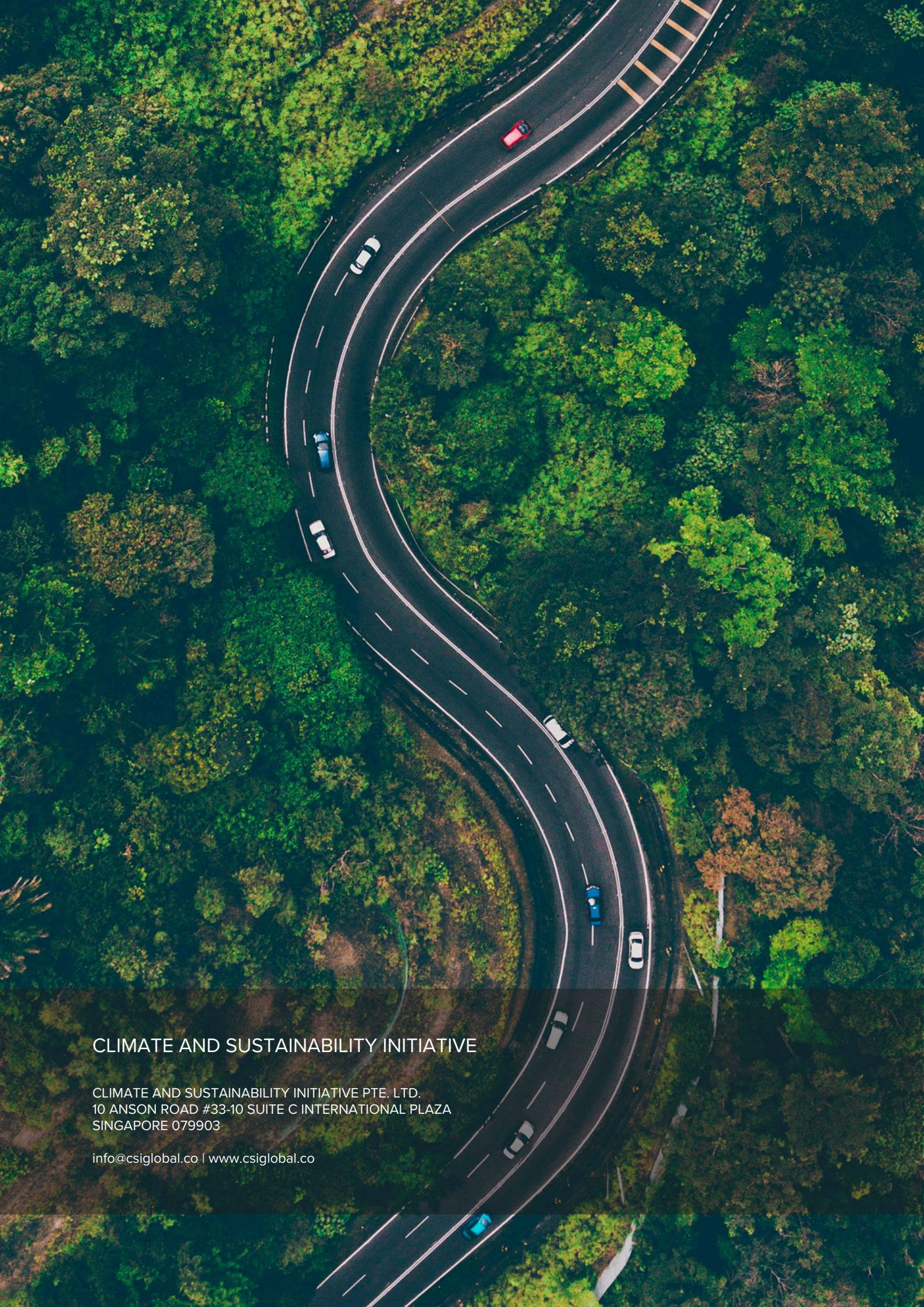
The authors

Vaibhav Pratap Singh
vaibhav.singh@csiglobal.co

Vaibhav Pratap Singh is the Executive Director of the Climate and Sustainability Initiative (CSI). His vision for CSI is to help economies in Asia and Africa transition to a low-carbon future while ensuring that this change is just and equitable for all stakeholders. Before joining CSI, Vaibhav led several key programs at the intersection of finance, power, and transport, collaborating with research[1] institutions and stakeholders in India and abroad. His previous work focused on designing instruments to facilitate clean energy financing, net zero modelling, and credit ratings for banks and NBFCs in the country.

Priyadarshini Alok
priyadarshini@shaktifoundation.in

Priyadarshini manages the Electric Mobility programme at Shakti Sustainable Energy Foundation. She contributes to the design of policies and strategies related to the electrification of transportation. With a master's degree in Transport Planning from the School of Planning and Architecture, Delhi, Priyadarshini specialises in electric mobility, ports, transport planning, feasibility study, and architecture design.



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CLIMATE AND SUSTAINABILITY INITIATIVE PTE. LTD.
10 ANSON ROAD #33-10 SUITE C INTERNATIONAL PLAZA
SINGAPORE 079903

info@csiglobal.co | www.csiglobal.co