

MAHINDRA ELECTRIC MOBILITY LIMITED: THE ELECTRIC VEHICLES DILEMMA¹

Nitin Gupta wrote this case solely to provide material for class discussion. The author does not intend to illustrate either effective or ineffective handling of a managerial situation. The author may have disguised certain names and other identifying information to protect confidentiality.

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The Indian government wanted to shift 30 per cent of the country's transport fleet to electric by 2030.² It was pushing electric vehicles (EVs) because of its global commitments to control carbon emissions as well as its high dependence on imports to fuel its economic growth.³ India's oil import bill in fiscal year (FY) 2017/18 was expected to be US\$90 billion,⁴ further rising to an estimated \$160 billion by 2030.⁵ The spike in oil prices following the United States' move to impose sanctions on Iran in May 2018 had given a new momentum to India's ambitious EV program, which aimed to reduce oil imports and pollution, cut emissions, and boost energy security.⁶

The government had launched the National Electric Mobility Mission Plan (NEMMP) 2020 in 2013 to achieve national fuel security by promoting hybrid and EVs in the country. In the government's annual budget for FY 2015/16, the NEMMP had initiated a scheme called Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME), which proposed achieving six million–seven million sales of hybrids and EVs in India year on year from 2020 onwards by providing various fiscal (e.g., tax holidays, inexpensive land and power availability, duty exemptions, etc.) and non-fiscal incentives (e.g., waiving road tax and registration charges for electric vehicles) worth ₹87.3 billion⁷ to EV firms until 2020.⁸

Many Indian and foreign automobile firms were finding these initiatives very lucrative and were formulating strategies to aggressively foray into this proposed EV environment. One automobile firm that was quite optimistic about the Indian government's EV endeavour was Mahindra Electric Mobility Limited (MEM). MEM was the pioneer of EV technology in India. Under the brand Mahindra Electric, MEM had a wide variety of EVs, spanning personal and commercial segments. According to MEM's chief executive officer (CEO), Mahesh Babu, the firm's vision was "to become a leading brand in providing customised electric mobility experiences through cutting edge technology."⁹ Babu's vision was backed by MEM's holistic efforts in creating a comprehensive road map for establishing a robust EV ecosystem.¹⁰

Though it seemed that there was a perfect fit between MEM's vision and the Indian government's EV initiative, plans to seamlessly move to EVs ran the risk of total breakdown, as multiple government departments were presenting disparate views on the EV road map, creating confusion among stakeholders.¹¹ In September 2018, many macro and micro issues were present in the overall environment that was being created for EVs. Would companies like MEM be able to effectively formulate strategies and compete successfully in this dynamic and changing business environment?

COMPANY BACKGROUND

MEM was part of the Mahindra Group (Mahindra) conglomerate, which was started in 1945 and had become a \$19-billion global federation of companies by 2018. It operated in 20 key industries, such as automobiles, information technology, financial services, and hospitality, many of which were fairly recent inceptions.¹²

Mahindra's EV initiative began in 2010, when it acquired majority stake in Reva Electric Car Company, India's leading EV manufacturer at that time. The acquired firm was renamed Mahindra Reva Electric Vehicles. By 2016, the firm had branched out to produce a wide variety of EVs. It had also entered powertrain and drivetrain technology, and provided mobility solutions to enable shared electric mobility. As its product portfolio expanded (see Exhibit 1), the firm rebranded itself as Mahindra Electric Mobility (MEM). In FY 2017/18, MEM sold 4,000 EVs, nearly a third of which were cars; the rest were electric rickshaws and vans.¹³

Mahindra had planned to cumulatively invest ₹35–₹40 billion in MEM's EV business, out of which ₹8 billion was to be invested in product development and capacity expansion. Mahindra aimed to have at least four new EV models on the road by 2021. The remainder would be put toward developing a battery-module plant that would have the capacity to make half a million battery modules a year. The plant would also house a battery module pack line. In 2018, MEM joined hands with LG Chem Limited to develop lithium-ion batteries for its EVs. The entire facility, for both module and pack, was expected to begin production in the last quarter of FY 2020. The intent of the company was not only to drive and lead the EV market in India but also to act as a supplier of components. MEM was also developing infrastructure to support an electric-led mobility system.¹⁴ MEM EVs were expected to have an output in excess of 35 kilowatts (kW) per hour and would likely be priced at about ₹1.1 million.¹⁵

Anticipating higher demand, MEM had commenced work towards increasing production capacity for EVs from 5,000 units a year in 2018 to between 60,000 and 70,000 units a year. Despite the limited success of its EVs in the Indian market thus far, the company was expecting huge demand from taxi operators and others in the fleet segment. In 2018, MEM had a pilot project running with 100 electric cars in association with Ola Cabs (Ola), a leading Indian cab aggregator, in the central Indian city of Nagpur. It had formed a similar association with Uber Technologies Incorporated (Uber) to deploy EVs in the major Indian cities of Delhi and Hyderabad. MEM had already supplied 500 EVs to an electric-cab service provider, Lithium Urban Technologies, and had landed an order for 1,000 electric cars from Bangalore-based fleet operator Baghirathi Travel Solutions.¹⁶ In addition, MEM was partnering with Italian design house Pininfarina, which Mahindra had acquired in December 2015 to develop an electric sports vehicle.¹⁷ MEM had also helped Ford Motor Company in developing an electric version of its Aspire entry-level sedan, which would hit the market by 2019. In September 2017, the two companies had signed a memorandum of understanding to explore joint work on EVs and to approach global distribution as a team.¹⁸

Babu had been with Mahindra for 18 years and had worked in the design and development of engine and vehicle platforms—from frugal three-wheelers to Mahindra's flagship models. He was a Fulbright scholar and had completed a program in leadership management at the Tepper School of Business, Carnegie Mellon University, in Pittsburgh. Under his leadership, MEM had launched four new models, including the award-winning e2oPlus. Babu had been instrumental in shaping the electric-mobility solutions of the future through path-breaking initiatives in the commercial-fleet space and by expanding the electric portfolio of both low- and high-voltage drivetrains.¹⁹

THE INDIAN AUTOMOBILE INDUSTRY AND ELECTRIC VEHICLES

The Indian automobile industry was worth \$93 billion in 2018.²⁰ It commanded 22 per cent of India's manufacturing gross domestic product (GDP) and contributed 7 per cent to the country's overall GDP.²¹ The automobile industry and its over 10,000 component manufacturers collectively employed about 30 million people.²² The firms in India had exclusive distributors for their range of vehicles, and a multiple-brand distribution network in the automobile industry was not the norm. Nearly 70 per cent of passenger vehicles (PVs) sold in India fell into the category of small cars. Electric cars accounted for less than 0.1 per cent, and overall EV sales were only 1 per cent of the 3.268 million passenger-vehicle sales in India in 2017. Ninety five percent of EVs on Indian roads were low-speed electric scooters powered by lead-acid batteries, whose speed was less than 25 kilometres (km) per hour.²³ In such a scenario, the Indian government's EV push was dictated by an urgent concern about rising pollution levels in most Indian cities, in addition to its international carbon-reduction commitments and the pressure of the oil import bill.

As a result of the government's initiative, it was expected that by 2030, as many as 40 per cent of new PVs to be sold in the local market would be EVs. Assuming a growth rate of 8 per cent in the PV segment every year, about 71 million new vehicles were expected to be added between 2018 and 2030. Of this, 28.4 million vehicles were expected to be EVs, and the remaining 42.6 million would be equipped with conventional internal combustion engines (ICEs).²⁴

This would lead to a massive technological shift, as ICEs and EV engines had very different powertrains (see Exhibit 2). While a conventional ICE vehicle had 3,000 moveable parts, EVs only had 30 such parts. The configuration of EVs would be different from the ICE, as the engine, transmission, and exhaust would be replaced with an electric motor, invertors, battery pack, and control unit. Hence, the electrical and electronics systems would take precedence over mechanical engineering.²⁵

On the battery front, the economics favoured lithium-ion batteries, as their prices had dropped about 73 per cent—from \$1,000 per kilowatt hour (kWh) in 2010 to \$272 per kWh in 2016. Lithium also had an advantage over oil because it could be recycled for future use. Battery price was an important consideration; creating battery-manufacturing capacity would take up a large part of the investment required to create EVs, as nearly 70 per cent of the cost of an EV was contributed by the battery.²⁶

Experts felt that the cost of batteries might halve by 2020, making EVs more affordable while driving the costs higher for conventional vehicles that had to comply with Bharat Stage 6 emission standards (comparable to Euro 6 emission standards).²⁷ Hence, they believed that EVs would become increasingly viable by 2023, with the Indian manufacturing ecosystem having matured by then.²⁸ However, many also felt that EV technology was still in the evolutionary phase, and there were a lot of uncertainties with regards to cost structures and the evolution of the ecosystem. Between complete EVs and ICEs, there was another set of vehicles, which were called hybrids. These vehicles ran on both battery and ICE and could be an interim solution.²⁹

INDIAN GOVERNMENT INITIATIVES

To lead from the front in its EV endeavour, the Indian government created Energy Efficiency Services Limited (EESL) in 2010, formed under the Ministry of Power. It was a joint venture of four national public sector undertakings: NTPC Limited, Power Finance Corporation Limited, Rural Electrification Corporation Limited, and the Power Grid Corporation of India Limited. EESL's objective was to facilitate energy-efficiency projects that would significantly reduce energy consumption and costs.³⁰ As part of its energy-conservation initiatives, EESL had floated a tender for 10,000 basic electric sedans in August 2017. Tata

Motors Limited (TM) had cornered 60 per cent of the tender, and the rest had gone to MEM. EESL had floated its second global tender for procuring 10,000 electric cars in April 2018.³¹

In May 2018, the Union Ministry of Home Affairs was planning to seek guidance from EESL and switch to EVs, replacing diesel-guzzling vehicles, including heavy trucks and buses, for the seven security forces operating under the ministry.³² In December 2017, the Ministry of Heavy Industries and Public Enterprises had sanctioned ₹4.4 billion to 11 states to procure 390 electric buses, taxis, and automobiles as a pilot project under the FAME scheme.³³

To enhance the infrastructure for EVs in India, in May 2018 the government proposed setting up EV charging stations every 3 kilometre (km) in cities with over a million people and every 50 km on busy national highways. For the further proliferation of EVs, it planned to offer fiscal incentives and facilitated land acquisition for those who were interested in setting up the required EV-charging infrastructure. The government also considered providing subsidies to public sector undertakings in the energy sector, such as NTPC Limited, the Power Grid Corporation of India Limited, and Indian Oil Corporation Limited, to initiate the process of setting up charging stations. Besides these state-run enterprises, Indian automakers including Mahindra and TM and cab-hailing companies like Ola and Uber were all interested in setting up charging infrastructure for EVs.³⁴

As part of the ₹94-billion package for encouraging the adoption of electric and hybrid vehicles among Indian consumers and cab aggregators, the government was planning to offer incentives of up to ₹250,000 for those who would scrap their old gasoline or diesel vehicles and purchase EVs (see Exhibit 3).³⁵

To incentivize Indian manufacturers, in April 2018 the government planned to double the mandatory local content in EVs to 70 per cent in the coming three years and to impose heavy duties on imports. In 2018, the local content in EVs was about 35 per cent, as most companies imported batteries, which accounted for a major cost of EVs. As per the proposal, by 2019 the domestic content in EVs would be increased to a minimum of 50 per cent, which subsequently would be increased to 60 per cent in 2020, and to 70 per cent in 2021.³⁶

COMPETITORS IN THE INDIAN ELECTRIC VEHICLES MARKET

Tata Motors Limited

TM was a part of the \$100-billion Tata Group founded in 1868. TM itself was a \$42-billion organization. It was a leading automobile manufacturer in India, with a portfolio that included a wide range of cars, sports vehicles, trucks, buses, and defence vehicles.³⁷ At the Geneva International Motor Show in March 2018, TM premiered its electric concept sedan—E-Vision—which was set to eventually become the brand's flagship sedan in the Indian market.

TM was operating on three different levels of electrification. The first was a plug-and-play solution with the Electra EV, which would power lower-voltage vehicles like the Tiago, Tigor, Magic Iris, and Ace. The next was to modify the new-age Omega architecture³⁸ for electrification, so as to offer longer-range and faster vehicles. Finally, TM was looking at a dedicated EV architecture in the mid to long term. TM planned for the majority of its vehicles in India to be electrified by 2022, including mild hybrids, hybrids, and battery-operated EVs.³⁹

TM had created an electric-mobility division to have special focus on developing cleaner mobility solutions for the future. Other firms of the Tata Group were roped in to offer a complete turnkey solution: While TM would offer the EV, Tata Power Limited would set up charging stations; Tata Realty and Infrastructure

Limited would build physical infrastructure, depots, or dedicated EV stations; and Tata Consultancy Services Limited would help develop the required software platform.⁴⁰ TM had cornered 60 per cent of the EESL tender. However, the electric cars it provided to EESL were only running 70 to 80 km on one charge, compared to the initial claim of 130 km per charge. This made EESL question TM on performance criteria. With a price point of ₹1.12 million for each TM electric car, this single-charge range was considered inadequate.⁴¹

Maruti Suzuki India Limited

Started as a joint venture between the Indian government and the Suzuki Motor Corporation of Japan in 1981, Maruti Suzuki India Limited (Suzuki) eventually became the largest car manufacturer in India. The Indian government later divested from this venture. In April 2018, Suzuki was the parent company's most successful subsidiary in the world, and at 50.10 per cent, it had the largest market share among PVs in India.⁴² Suzuki, along with Denso Corporation and Toshiba Corporation, had pooled \$180 million in 2017 to build a plant in India for producing lithium-ion batteries.⁴³ Suzuki had also partnered with Japan's largest carmaker, Toyota Motor Corporation (Toyota), to roll out a small electric car for the mass segment in India and elsewhere by 2020.⁴⁴ Its first affordable EV would be based on technology from parent Suzuki Motor Corporation and was to be made before the products that were going to be developed in partnership with Toyota. Thus, the company was working with partners as well as focusing on in-house capabilities to put the ecosystem in place for EVs.⁴⁵

Suzuki was likely to have an EV with a power output of 25 to 35 kW per hour, suitable for the compact-car segment, and possibly priced below ₹1 million. The company was looking for collaborations in the areas of materials handling, battery recycling and reuse, and charging infrastructure. In addition, it would continue to refine its ICE vehicles and make them more fuel efficient and environmentally friendly.⁴⁶

Hyundai Motor India Limited

Hyundai Motor India Limited (HMIL) was a wholly owned subsidiary of Korean automobile manufacturer Hyundai Motor Company (HMC). Since its inception HMIL had been the second-largest car manufacturer and the number one car exporter in India.⁴⁷ In FY 2017/18, HMIL had about a 17 per cent share in the Indian PV market. India was the third-biggest market for HMC globally, behind China and the United States (outside its home market of South Korea), and its share in the company's global revenue was about 15 per cent. The company sold 680,000 million vehicles in FY 2017/18 (including exports).⁴⁸

HMC was developing both battery EVs and fuel cell vehicles.⁴⁹ HMIL was likely to introduce pure electric and hybrid vehicles in India in 2019—a year ahead of Suzuki. HMIL had developed hybrid vehicles for the domestic market, but a spike in the goods and services tax rate for hybrid vehicles compelled the South Korean carmaker to shelve its hybrid vehicles completely and shift to electric ones. It would start with importing completely knocked down units⁵⁰ of its Kona Electric sport utility vehicle (SUV) in 2019 and look at local manufacturing as the market matured. The Kona Electric would be priced between ₹2 million and ₹2.5 million.⁵¹ HMIL was planning to invest over \$1 billion in India by 2020. HMC's Kia Motor Corporation was also planning to manufacture an electric car and hatchback in India, after its entry in the second half of 2019. However, it believed there was a need to address critical issues such as establishing charging infrastructure in India.⁵²

BYD Auto Company Limited

Founded in 1995, the Chinese firm BYD Auto Company Limited (BYD) was a listed company on the Hong Kong Stock Exchange and Shenzhen Stock Exchange. Its automobile business included new-energy

vehicles like EVs.⁵³ In India, BYD had teamed up with lesser-known Indian firm Goldstone Infratech to manufacture electric cars, trucks, and other automobiles with fast-charging batteries that could run up to 400 km on a full charge.⁵⁴ In 2018, it planned to invest ₹2 billion in establishing a plant in India, wanting to make the country its manufacturing hub for exporting EVs to other South Asian nations. BYD planned to manufacture 5,000 electric buses per year in India by March 2021, and it would increase localization content to 70 per cent—which, in 2018, stood at 35 per cent.⁵⁵

Other Prospective Players

Indian consumer durables maker Micromax Informatics Limited also planned to enter EV and battery manufacturing. It was in the advanced stages of testing formalities for the vehicles and had gotten approval for some of its lithium-ion batteries. It was keen on entering the electric two- and three-wheeler categories, where it would compete with the likes of Bajaj Auto Limited, Mahindra, TVS Motor Company, and Piaggio.⁵⁶ Many other Indian firms—such as Hero Future Energies Limited, Ravin Group, Sun Mobility, and Bharat Heavy Electricals Limited—were also venturing into the domain of battery manufacturing for EVs. Being successful in this arena promised massive rewards, as a study done by U.S.-based Rocky Mountain Institute estimated that switching completely to EVs in 2030 could create a battery market of \$300 billion in India. If battery manufacturers imported the cells and assembled the battery, they could capture only 30 per cent of this value, whereas if they imported only the raw materials lithium and cobalt and manufactured the battery locally, about 80 per cent of the value could be captured.⁵⁷

In line with the Indian government's push for EVs, many foreign firms were also keen on taking initiatives. French company FM Logistic had plans to develop green vehicles for environmentally sustainable road cargo transportation in India. It planned to launch the first electric or hybrid truck in India in 2019.⁵⁸ Japanese EV maker Terra Motors Corporation, which sold electric rickshaws in the Indian market, was looking to shift its operational base to India to expand in Asia. Terra Motors' research and development centre in India would design products, control quality, and test specifications of EVs being manufactured in India. The company was looking to introduce in 2019 an electric two-wheeler powered by a lithium-ion battery.⁵⁹ The start-up Uniti Sweden had formed a strategic partnership with the Bird Group for its foray into India. It was going to launch an affordable, five-seater electric city car with a range of 250 km, priced at about ₹250,000 in 2020.⁶⁰ Many other foreign players such as Renault-Nissan, Honda Motor Company Limited, Mercedes-Benz, BMW, Volvo Cars, and Jaguar Land Rover Automotive had also expressed interest in bringing EVs into the Indian market but were awaiting clarity in government policy before finalizing their next course of action.⁶¹

According to a study conducted in 2016 by Variant Market Research, the market in India for lithium-ion batteries was expected to reach \$5 billion in 2024 and subsequently grow at 26 per cent a year. As a result, many battery manufacturers from various countries, like EnerBlu from the United States and Delta Electronics Industry from Taiwan, were looking forward to supplying batteries for EV to Indian firms.⁶²

INDIAN CONSUMERS' PREFERENCES

India was known as a small-car market. However, the country was witnessing an SUV rush. In FY 2017/18, PV sales in India grew by 8 per cent to 3.28 million units, whereas SUV sales grew by 21 per cent, crossing 900,000 units. In the pricier segment (₹1.2 million–₹4 million), three out of four cars sold in India were SUVs. From 14 per cent in FY 2009/10, the percentage share of SUVs in PV sales had risen to 30 per cent. Rising incomes and aspirations had led consumers to go from buying small cars to buying SUVs.⁶³

By showing a preference for SUVs, Indian consumers were behaving like their counterparts elsewhere in the world. SUVs had outpaced industry sales in many markets the world over. In Europe, from a figure of just over half a million in 2000, SUV sales touched 4.6 million in 2017. The United States showed a jump in SUV sales from 3.4 million in 2000 to seven million in 2017. In the case of China, the increase was more dramatic—from 4,600 units in 2000 to 10.7 million in 2017. Between FY 2002/3 and FY 2017/8, SUV sales in India showed more than an eight-fold increase (see Exhibit 4). The thrust of SUVs in the forthcoming EV scenario had led companies such as Volvo Cars and BMW to provide hybrid-engine options. HMIL's Kona Electric SUV would be the company's first EV in India in 2019. Mercedes-Benz was working on the EQ concept EV range, based on its GLC mid-size SUV. TM was designing electric versions of its off-roaders H5X and 45X. MEM was also working on an electric version of Mahindra's popular KUV100 model.⁶⁴

CONCERNs

Despite the government's heavy push, experts felt that electric road transportation was yet to become viable in India due to the dearth of infrastructure, primarily charging stations. There was concern as to how to electrify small cars and make them affordable. Many firms felt that as far as EVs were concerned, there were three major challenges facing them: performance, range, and cost. According to Kenichi Ayukawa, managing director and CEO of Maruti Suzuki, making affordable electric cars was one of the biggest challenges for auto companies, especially as vehicle batteries were very expensive, and there was no public charging infrastructure.⁶⁵

Expert opinion was that the ecosystem to manufacture the battery-management systems, power electronics, and lithium-ion batteries required for EVs was not yet available in India.⁶⁶ On the other hand, India's northeastern neighbour China was already the world's largest EV manufacturer, with almost 60 per cent of the global market share in terms of volume (see Exhibit 5). With active policy support of the Chinese government and large investments in the new-energy space, China was likely to emerge as a trendsetter and significant technology driver in the EV arena in coming years. It was also expected to create a huge ecosystem for battery manufacturing, recycling, and charging infrastructure, as well as other related components of the EV package.⁶⁷ It was believed that in the future, India would have to depend on China for battery imports and that, ultimately, Chinese companies would dominate the Indian market. This was already being seen in many instances. French carmaker Groupe Renault's electric version of the Kwid small car, intended for India, would have batteries and battery-management systems manufactured in China. The current market trend was also showing an increase in the import of automobile parts from China (see Exhibit 6).⁶⁸

Experts were also skeptical about the proliferation of EV usage reducing India's pollution levels, as the country met 75 per cent of its electricity needs by burning fossil fuels. It was felt that EVs on roads would only move the pollution off city roads to its hinterlands, where the required power was generated.⁶⁹ In addition to this, for a power-deficit nation like India, there would be challenges in ensuring adequate supplies needed to run EVs. Besides issues related to charging infrastructure, the need for fast chargers, parking spots, and swappable batteries required robust solutions and public-private partnerships. Experts felt that the push for EVs was largely coming from the central government, and there had been limited policy-level support at the state and municipal levels.⁷⁰

The Indian automotive industry came under the purview of the Ministry of Heavy Industries and Public Enterprises and ministries of road transport and highways. It had faced the brunt of intervention from various regulatory bodies in India like the National Green Tribunal; the Supreme Court; the Goods and Services Tax Council; the National Institution for Transforming India; and the ministries of urban

development, power, and environment and forests. This had led to multiple voices sending out multiple messages, creating an environment of confusion and uncertainty for the industry.⁷¹

Besides stressing EV usage, in 2016 the Indian government also decided that the country would leapfrog from BS 4 emission standards to BS 6 emission standards for all of its gasoline- and diesel-driven vehicles by 2020, which warranted an investment of more than ₹600 billion.⁷² This further stressed the budgets of the research and development departments of many automobile manufacturers, including MEM, which had to work on both EV- and BS 6-compatible engines for the Indian market. With intensifying competition and a success ratio of just two in every 10 new models introduced in the market, return on investment and viability were serious challenges ahead for the vehicle makers.⁷³

There was also a fear that the industry would be shaken up, as close to 60 per cent of automobile industry revenue came from engines and powertrains, which would be under threat in the upcoming EV scenario. There was danger that an EV-based automobile environment in India would make many of the casting, forging, and machining sectors unviable, risking about 1.5 million jobs in an already job-stressed Indian market.⁷⁴

THE WAY FORWARD

In its endeavour to shift 30 per cent of the country's transport fleet to electric by 2030, the Indian government had initiated plans to provide many incentives to public and private enterprises as well as Indian consumers. Despite the multitude of government initiatives and the serious attempts being made by many automotive firms in India, there was still a lack of clarity regarding the various macro- and micro-environmental factors that had to be addressed to make the EV dream a reality in India.

As this change in business environment became imminent, Babu realized that he would need to study competitors' initiatives and that MEM would have to formulate its own strategies. How should Babu approach a competitive analysis of the environment?

EXHIBIT 1: MAHINDRA ELECTRIC MOBILITY PRODUCT PORTFOLIO

Brand	Product Type
e2o Plus	Electric Car, Hatchback
eVerito	Electric Car, Sedan
eSupro	Electric Cargo & Passenger Van
eAlfa Mini	Electric Rickshaw
NEMO—"Next-Generation Mobility"	Electric Mobility Platform

Source: "Explore Range of Electric Cars in India," Mahindra Electric, accessed August 16, 2018, www.mahindraelectric.com/products/; "Electric Car Solutions in India," Mahindra Electric, accessed August 16, 2018, www.mahindraelectric.com/solutions/.

EXHIBIT 2: POWERTRAIN OF ICE VEHICLE VERSUS EV

ICE POWERTRAIN		EV POWERTRAIN	
Component	Percentage	Component	Percentage
Basic Engine	30	Battery System	70
Transmission	25	Electric Motor	20
Control/Injection	20	Power Electronics	5
Exhaust	15	Transmission	5
Auxiliaries	10		

Notes: ICE = internal combustion engine; EV = electric vehicle

Source: Malini Goyal, "Why the Government Is Betting Big on EVs, and Why the Gambit Has Automobile Industry Worried," *Economic Times*, October 1, 2017, accessed May 31, 2018, <https://economictimes.indiatimes.com/industry/auto/news/industry/why-the-government-is-betting-big-on-evs-and-why-the-gambit-has-automobile-industry-worried/articleshow/60895347.cms>.

EXHIBIT 3: INDIAN GOVERNMENT INCENTIVES FOR SWITCHING TO EVS

Vehicle Category	Maximum Number of Vehicles	Average Incentive (₹)	Maximum Factory Price (₹)
High-speed two-wheeler	150,000	30,000	150,000
Low-speed two-wheeler	150,000	20,000	100,000
High-speed three-wheeler	100,000	75,000	500,000
Low-speed three-wheeler	100,000	35,000	300,000
Cars	50,000	200,000	1.5 million
Light commercial vehicle (i.e., commercial van)	4,000	250,000	1 million
Bus	5,000	5 million	30 million
Truck/Heavy-duty vehicle	200	5 million	20 million

Note: EVs = electric vehicles; ₹ = INR = Indian rupee; US\$1 = ₹70.15 on August 17, 2018.

Source: Dipak K. Dash, "Centre Plans Rs 9,000 Crore Sops to Push Eco-Friendly Cars," *Times of India*, May 14, 2018, accessed May 17, 2018, <https://timesofindia.indiatimes.com/business/india-business/Centre-plans-Rs-9000-crore-sops-to-push-eco-friendly-cars/articleshow/64152041.cms>.

EXHIBIT 4: SEGMENT-WISE PV SALES IN INDIA

Segment	FY 2003	FY 2017
Vans	52,000	192,000
Mini/Entry-level Cars	140,000	573,000
Compact Cars	300,000	1.4 million
Mid-size Sedans	92,000	170,000
Executive/Premium/Luxury Cars	64,000	13,000
Utility Vehicles	110,000	920,000
Total	758,000	3.268 million

Note: PV = passenger vehicle; FY = financial year

Source: Malini Goyal, "SUVs Have Become Classier, but Here Is the Big Bump on the Road: Rising Fuel Prices," *Economic Times*, May 26, 2018, accessed May 27, 2018, <https://economictimes.indiatimes.com/industry/auto/news/passenger-vehicle/uv/suvs-have-become-classier-but-here-is-the-big-bump-on-the-road-rising-fuel-prices/articleshow/64334741.cms>.

EXHIBIT 5: GLOBAL EV SALES: TOP 10 COUNTRIES

Country Name	2016	2017
China	351,000	541,000
United States	157,000	199,000
Norway	46,000	60,000
Germany	28,000	57,000
Japan	22,000	55,000
United Kingdom	39,000	48,000
France	34,000	41,000
India	25,000	32,680
Sweden	14,000	20,000
Canada	11,000	19,000

EV= electric vehicle

Source: Compiled by author using data provided in the following sources: "Electric Vehicles: Global Top 10," *Economic Times*, February 7, 2018, Mumbai edition; Sarita Singh, "Mandatory Local Electric Vehicles Content Likely to Be Hiked to 70% in 3 Years," *Economic Times*, April 23, 2018, accessed May 18, 2018, <https://economictimes.indiatimes.com/industry/auto/news/industry/mandatory-local-electric-vehicles-content-likely-to-be-hiked-to-70-in-3-years/articleshow/63886482.cms>; Malini Goyal, "SUVs Have Become Classier, but Here Is the Big Bump on the Road: Rising Fuel Prices," *Economic Times*, May 26, 2018, accessed May 27, 2018, <https://economictimes.indiatimes.com/industry/auto/news/passenger-vehicle/uv/suvs-have-become-classier-but-here-is-the-big-bump-on-the-road-rising-fuel-prices/articleshow/64334741.cms>.

EXHIBIT 6: IMPORT OF CHINESE AUTO PARTS IN LAST FIVE YEARS (US\$ BILLIONS)

	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
Import of Chinese Auto Parts to India	2.5	2.7	3.2	3.2	3.6
Total Imports of Auto Parts	13.7	12.8	13.6	13.8	13.5

FY = financial year

Source: Nabeel A. Khan, "Biggest Threat to 'Make in India': Chinese Capturing India's Automotive Space," *Economic Times*, March 24, 2018, accessed May 18, 2018, <https://economictimes.indiatimes.com/industry/auto/news/industry/biggest-threat-to-make-in-india-chinese-capturing-indias-automotive-space/articleshow/63436140.cms>.

ENDNOTES

¹ This case has been written on the basis of published sources only. Consequently, the interpretations and perspectives presented in this case are not necessarily those of Mahindra Electric Mobility Limited, Indian government departments or ministries mentioned in the case, or any of the above-mentioned organization's employees.

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