Project Dissertation Report on

ASSESSING THE AUTOMOBILE SECTOR AND ITS FUTURE SCOPE

Submitted by

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2K20/DMBA/100

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CERTIFICATE

This is to certify that the work titled **'Assessing the automobile sector and its future scope'** as part of the final year Major Research Project submitted by Rinkush in the 4th Semester of MBA, Delhi School of Management, Delhi Technological University during January-May 2022 is his original work and has not been submitted anywhere else for the award of any credits/ degree whatsoever.

The project is submitted to Delhi School of Management, Delhi Technological University in partial fulfillment of the requirement for the award of the degree of Master of Business Administration.

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DECLARATION

I hereby declare that the work titled **'Assessing the automobile sector and its future scope'** as part of the final year Major Research Project submitted by me in the 4th Semester of MBA, Delhi School of Management, Delhi Technological University, during January-May 2022 under the esteemed guidance of Assistant Professor Mr Yashdeep Singh, is my original work and has not been submitted anywhere else.

The report has been drafted by me in my own words and is not copied from elsewhere. Anything that appears in this report which is not my original work has been duly and appropriately referred/ cited/ acknowledged.

Rinkush

(Roll No 2K20/DMBA/100)

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I am highly indebted to Delhi School of Management, Delhi Technological University for providing me an opportunity to work on this project. Lastly, I would like to express my gratitude to all the honorable faculty members and the PHD Scholars for sharing their experience and expertise on this project. I have put all my efforts to ensure that the project is concluded in the best possible manner and also ensured that the project is error-free.

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EXECUTIVE SUMMARY

This report outlines the technical potential that the Indian auto sector faces, with a focus on passenger vehicles (cars). It strives to explain the decisions that Indian automakers will make by attempting to comprehend the factors that will impact acceptance of upcoming new technology. Connectivity, electric powertrains, autonomous vehicles, and industry 4.0 are all possibilities. Clearly, the most crucial elements that will push vehicle OEMs (Original Equipment Manufacturers) to depart from their established business structures are government rules and market pull. In interviews with industry leaders, it was revealed that they will be obliged to gradually electrify their fleet in order to stay up with the changing market environment. Despite existing product and eco-system problems, OEMs will face a difficulty in developing the requisite market pull for electric vehicles. Once the problem of BS VI adoption is overcome, the attention will shift to electrification. Other technologies such as connection, autonomy, shared mobility, and so on will acquire prominence, but they will be supplemental product qualities that will assist attract customers rather than the main offer in and of themselves. The government must likewise use extreme caution when guiding the industry in a particular direction. It must resist the urge to make judgments on behalf of the sector and instead allow market forces to choose which technology or opportunity should be adopted. Finally, we propose a government policy direction that applies a weighted average-based emission standard for all manufacturers.

In this study, we will focus on the future scope of the automobile industry in India, and what is the scope of Electric vehicles or FCEV's will diminish the scope for EV's or any other new technology will disrupt the market.

Also, if autonomous cars and Industry 4.0 will work in the Indian environment, running autonomous cars as a public transport can give relief in accidents and traffic jams caused by human errors.

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INTRODUCTION

The global automobile business is currently in flux, with corporations adopting various strategies to stay ahead of the technological curve and catch the next generation of customers who are growing more time-sensitive, tech-savvy, and environmentally conscious. The auto industry's supply chain has dramatically improved since Ford invented the assembly line for manufacturing, giving rise to a well-established system, with an auto OEM at the top sourcing from multiple tiers of component suppliers. Government restrictions, market conditions, and technological advancements are forcing vehicle manufacturers to abandon their well-established traditional model today.

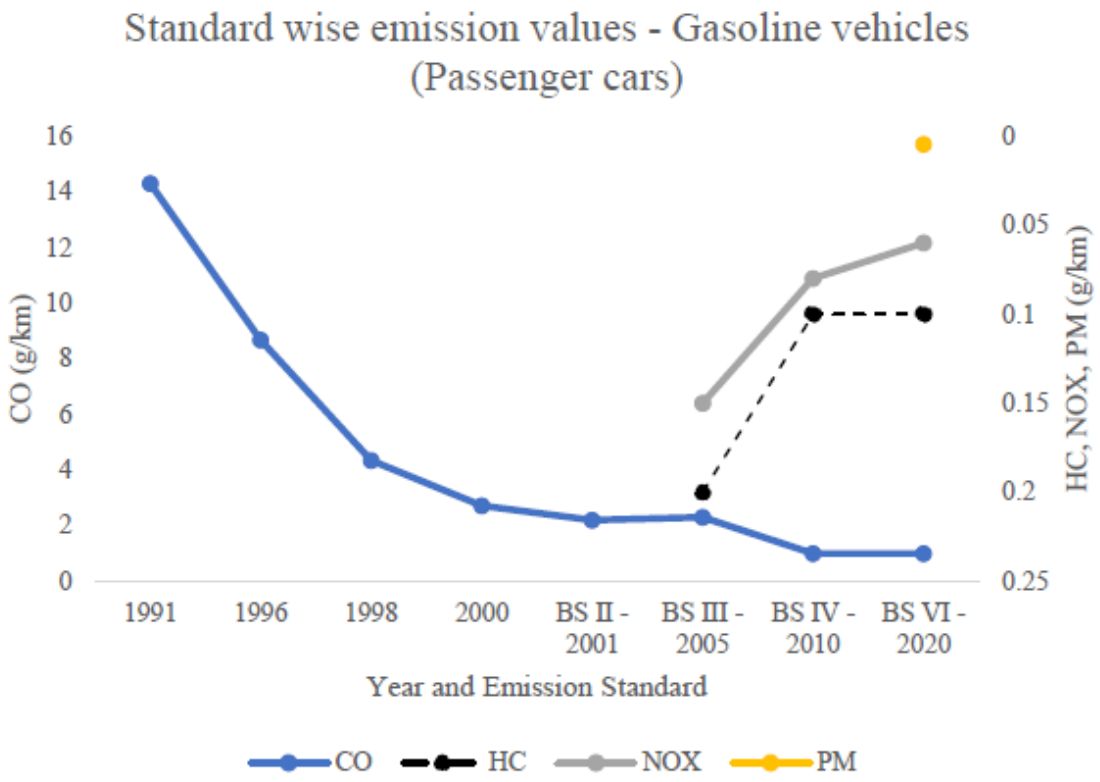

Figure 1. Gasoline vehicle emission standards
(Particulate matter levels introduced for Gasoline

Government laws on emissions, safety, and other factors have driven automakers to develop more environmentally friendly and safer vehicles. The announcement from the Union Ministry of Road

Transport and Highways implementing the BS VI emission standard from April 2020 was the first step in this direction. This builds on the nationwide implementation of BS IV emission regulations that began in 2017.

Figures 1 and 2 depict the evolution of gasoline and diesel passenger automobile emission requirements from 1991 stage norms to BS VI in 2020. In comparison to BS IV requirements, BS VI mandates a 68 percent decrease in NOx and an 87 percent reduction in PM (particulate matter) for diesel cars, while gasoline cars are required to reduce NOx by 25 percent. The requirement for gasoline cars now includes particulate matter standards. It's worth noting the government's choice to skip beyond BS V standards and jump straight to BS VI. With minor changes, the Bharat stage norms were adapted from European emission standards. The BS IV stage was implemented in stages, with some places adopting the BS IV norms as early as 2010, but the nationwide implementation didn't happen until 2017. The BS VI emission standards, on the other hand, took effect across the country in one fell swoop in April 2020; to ease the transition, the Petroleum Ministry pledged to provide BS VI fuel from 2020. Starting in April 2018, BS VI fuel was accessible in Delhi, with the possibility of expanding to the entire National Capital Region (NCR) from April 2019. When the compatible fuel was released, certain automakers, such as Volvo, were considering offering BS VI vehicles in these areas. Other automakers, on the other hand, have said

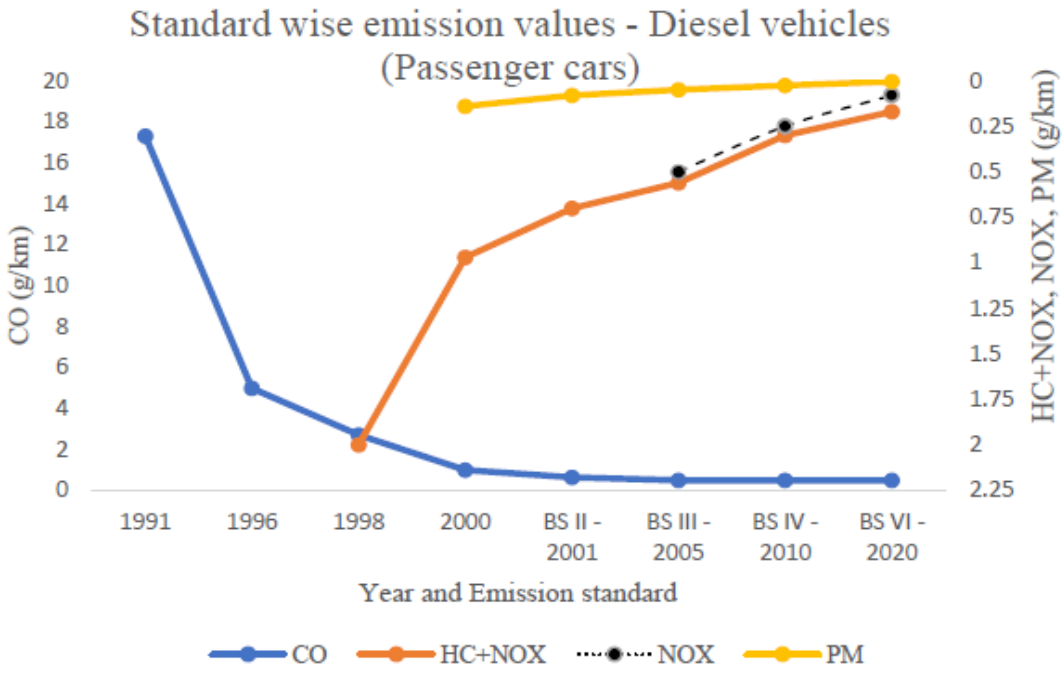

Figure 2. Diesel vehicle emission standards

that they will not sell BS VI compliant vehicles before the deadline (possibly due to cost and inventory considerations). Though BS IV vehicles operating on BS VI gasoline would not result in significant reductions in emissions, the government sees this as a political and policy signaling statement demonstrating its commitment to a cleaner environment.

Given that Delhi, India's national capital, has been suffering from dangerous levels of pollution (Particulate Matter 10 greater than 300), this push is critical. On November 8, 2017, Delhi's air quality index measurement was 999, much above the 'Hazardous' standard of pollution, earning it the dubious title of 'Most Polluted City on Earth'. Vehicle exhaust is a key contributor to the city's poor air quality, and the Delhi state government was forced to implement the 'Odd-Even rationing' policy, which permitted only odd-numbered vehicles to go on roadways on odd days and even dates (this move was not very popular). The Voluntary Vehicle Fleet Modernization Program (V-VMP) devised by the Transport and Highways ministry is another government initiative aimed at reducing vehicle pollution. Vehicles that have been in service for 15 years or longer will be discarded under this plan. The main reason for the scrappage policy is that 15-year-old heavy trucks are responsible for 65 percent of emissions. The draught V-VMP policy proposes that automobiles sold before March 31, 2005, be brought under its jurisdiction, with an estimated 28 million vehicles falling within this category. As a result, the Indian government has pushed the business to become more ecologically conscious. Euro 7, which Indian authorities tend to follow, released in 2020, with implementation started in 2020, and it is expected to focus on reducing CO2 limitations rather than contaminants.

The shift toward electrification of drivetrains is another much discussed issue. The three regions where manufacturers have begun to make gains with their electric vehicle efforts are the United States, Europe, and China. This has been fueled mostly by the regulatory authorities' carrot and stick policies, which include incentives for OEMs, tax rebates for purchasers, and pollution control standards.

In FY 2017, China led the global automotive market with 25.7 million automobiles sold, followed by the United States of America with 17.23 million cars sold. With 3.61 million car sales, India is ranked sixth in the global market; it is believed that 0.8-1 percent of these sales are electric vehicles, such as BEVs and PHEVs (Plug-in Hybrid Electric Vehicles). China leads with 602,000 electric vehicle registrations, followed by the United States with 200,000 registrations8. Figure 3 depicts the sales of electric vehicles from 2012 to 2017.

Figure3 shows the sales of electric vehicles from 2012 to 2017

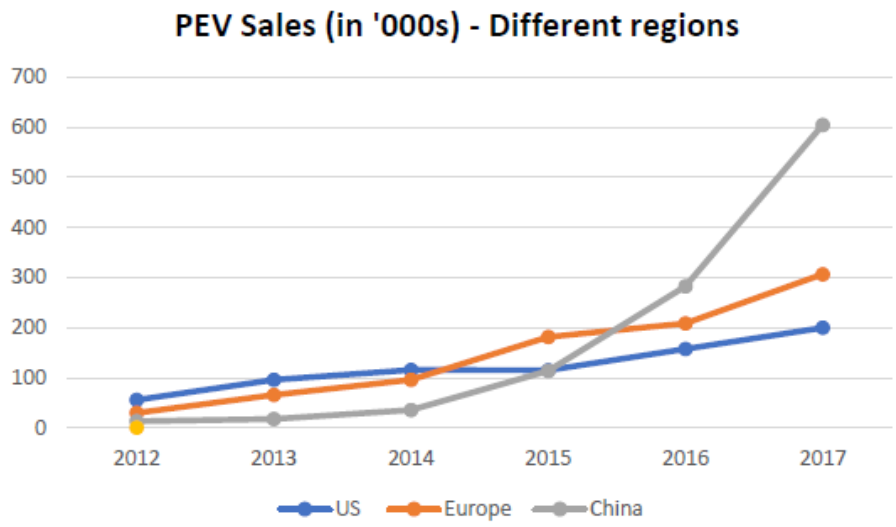

Figure 3. PEV Sales - Includes PHEV and BEV

California and nine other states in the United States have implemented a ZEV (Zero Emission Vehicle) program, which is based on 'ZEV credits' granted to each automaker based on the type of vehicle sold. Fuel cell-based automobiles, battery electric vehicles, and plug-in hybrid electric vehicles are all eligible for the credits. The ZEV credits that must be maintained are dependent on each automaker's share of non-electric car sales, which is 4.5 percent in 2018 and will slowly climb to 22 percent by 2025. It is essential that 55 percent of the minimum ZEV credits each year originate from the sale of BEVs (Battery Electric Vehicles) and FCEVs to ensure that automakers do not avoid investing in electric technology (Fuel Cell Electric Vehicles). The sort of powertrain technology used and the battery's range are used to determine credit. Plug-in hybrids receive between 0.4 and 1.3 ZEV credits each car sold, whereas BEVs and FCEVs receive between 1 and 4 credits. Furthermore, to level the playing field for all OEMs, excess credits can be carried over to the next year and credits can be traded between OEMs.

On the technology front, advances in machine learning, artificial intelligence, and natural language processing have opened up new and radical possibilities, such as autonomous cars with varying degrees of autonomy. New players such as Google, Apple, Intel, and Uber, who are predominantly

technology-based companies, are leading this charge10. This has put a lot of pressure on big global OEMs to either start their own program or collaborate with tech firms. With new uses, the Internet of Things (IoT) has expanded into industry. It has ushered in a new phenomenon known as Industry 4.0, which is the next frontier for smart manufacturing facilities with greater machine communication.

Similarly, customer behavior shifts such as carpooling, ride-sharing, and other forms of mobility as a service are shifting the focus away from vehicle ownership and toward mobility as a service. Companies like Uber, Ola, Lyft, Grab, and others are facilitating this change. This transition has necessitated the development of new goods such as Purpose-Built Vehicles, which reduce production and distribution costs.

Objectives

1. Attempt to analyze and anticipate the adoption of these technologies, business models, and other factors by Indian car OEMs, as well as the problems they confront, in light of Indian regulations and market conditions, in this article.

2. To assess the future potential of the Indian Automobile Industry.

3. To propose that the government take a green car policy strategy that is technology neutral and allows market forces to operate.

4. To know the scope of Electric vehicles and will FCEV's will diminish the scope for EV's or any other new technology will disrupt the market.

5. To study if autonomous cars and Industry 4.0 will work in the Indian environment, running autonomous cars as a public transport can give relief in accidents and traffic jams caused by human errors.

LITERATURE REVIEW

The literature review is an important part of any research project since it provides the necessary information for the researcher to frame the research study on the chosen topic. The main goal of this is to examine past findings in order to identify research gaps in previous studies and to explain the research problem that we have chosen.

Keeping the study objectives in mind, the review of related literature is organized as follows:

Implementation of BS VI, Government regulation on drivetrain regulation, Standardization and Battery swapping, Emission of EV's, Industry 4.0, Autonomous Cars.

Implementation of BS VI

The Union Ministry of Road Transport and Highways announced in September 2016 that the BS VI emission standards will apply to all cars built on or after April 1, 202012. Vehicles built before April 2020 that meet BS IV criteria will not be registered after June 30, 2013, allowing automakers to plan their production and inventories properly. OEMs face a technical and marketing hurdle as a result of this notification. This transition from BS IV to BS VI is unprecedented in the Indian car sector, as well as a first for worldwide players.

Following the Supreme Court's order mandating the sale of only BS IV compliant vehicles after March 2017, automakers have prepared to meet the BS VI deadline. This was evident in discussions with executives from all of the major auto manufacturers. They believe that BS VI implementation is a major priority in day-to-day operations, with engineering and technical teams leading the charge to make their vehicles BS VI compliant. In comparison to gasoline vehicles, diesel vehicles will require more considerable rework to become BS VI compliant. Because BS VI compliance will become a point of parity and cannot be promoted as a differentiation, the executives believe that marketing teams will need to adopt a different strategy. Despite the OEMs' enormous investments in upgrading their product line to ensure compliance with the requirements, this is the case.

With the final rounds of testing underway, almost all OEMs are ready with technology to make BS VI a reality. Except for Indian domestic auto OEMs like Tata and Mahindra, which had to

invest heavily to make their offers BS VI compliant, other OEMs selling cars in Europe already had the requisite technologies in their vehicles, which they would bring to their Indian company. Controlling PM (Particulate Matter) and NOx (Nitrous Oxide) emissions is the fundamental trade-off in a BS VI compliant diesel engine design. A low PM output raises NOx emissions, whereas a decrease in NOx raises PM in the exhaust gasses. These two goals are made possible by the following technologies:

- Particulate Matter reduction: It is very common with a Diesel Particulate Filter built-in.
- NOx reduction: There are numerous methods such as EGR (Exhaust Gas Recirculation), lean NOx trap, SCR (Selective Catalytic Reduction), etc.

OEMs are attempting to optimize their NOx and PM emissions using a combination of the following technologies in order to obtain the best potential cost and performance results. Implementing these exhaust treatment technologies in a vehicle, along with supporting systems such as software, fuel filters, and so on, will raise the price of a diesel vehicle by 12-20 percent (for a car costing INR 1 million), while a similarly priced gasoline vehicle will likely increase by 46%. Given Indian consumers' price sensitivity, this increase in price may result in a move toward gasoline-powered vehicles. Volume OEMs will benefit from economies of scale, while smaller players will see their diesel portfolio suffer. New buyers may opt for gasoline-powered automobiles, with diesel limited to SUVs, executive sedans, and premium vehicles.

Another OEM executive stated that the BS VI implementation will be simple to achieve because the company merely had to modify its assembly lines to incorporate Euro VI compatible technologies already in place in their European operations, and that there will be no significant R&D costs. This statement applies to all global OEMs such as Volkswagen, Ford, Hyundai, Renault, Toyota, and others who have developed BS VI powertrains for advanced markets such as Europe, North America, and Japan; the challenge would be for Indian OEMs who have been limited to the Indian market and do not have the backing of a global OEM. Tata Motors and Mahindra & Mahindra are examples of this.

Government Regulations on Drivetrain Electrification – The Driving Force for Change

The electric vehicle business was uncontrolled in the beginning, and in 2013-2014, the country saw a proliferation of electric rickshaws in various parts of the country. Tripura was the first state to regulate the electric vehicle sector, enacting the 'Tripura Battery Operated Rickshaws Rules, 2014,' which required e-rickshaws to be registered. Parallel to this, India's Union government announced the National Electric Mobility Mission Plan 2020 (NEMMP) in 2013, with a goal of putting 6-7 million new full-range electric vehicles on the road by 2020, including 4-5 million two-wheelers. This was done in order to ensure national energy security, reduce environmental effects, and promote domestic industry.

The FAME initiative, which was established in April 2015, was a huge push for EVs. The system provided rebates and lower taxes as incentives for adoption. Subsidies for battery technology (hybrid or full electric) were set based on the vehicle. It cost between INR 29,000 to INR 138,000 for two-wheelers and INR 138,000 for four-wheelers. The scheme's first phase, which was supposed to last only two years, was extended to March 2018. Around 60% of the INR 1.27 billion paid through the FAME scheme which was used to support the purchase of mild hybrid vehicles.

The FAME scheme was revised in to remove mild hybrids from demand-based incentives because they consumed the majority of the funding, with the government believing that mild hybrids were not materially speeding the development of full-range EVs. The sales of Maruti Suzuki's Ciaz and Mahindra's Scorpio, which were the best-selling mild hybrid cars, were damaged. The FAME program had been expanded to support the purchase of 163,997 vehicles as of November 2017. In addition, the FAME scheme provides INR 0.3 billion in funding for battery research and development, with INR 2.4 million going to the Non-Ferrous Materials Technology Development Centre in Hyderabad and INR 6.1 million going to IIT Kanpur.

The founding of Energy Efficiency Services Limited stressed the importance of EV adoption (EESL). EESL (Energy Efficiency Services Limited) is a public-private partnership formed by four public-sector companies with the goal of reducing the nation's carbon footprint, primarily through efficiency initiatives. It has taken an unusual step in procuring electric vehicles from automakers and leasing them to government offices across the country, with a total number of EVs expected to reach about 500,000. Apart from the fuel savings and CO2 reductions, EESL believes that this step will function as a catalyst in kicking off the EV revolution, both for auto OEMs and

for the development of the necessary charging infrastructure. The EESL, which is part of the Indian government's Ministry of Power, has issued a tender for 10,000 electric vehicles.

Tata Motors won the tender by quoting INR 1.12 million for each electric vehicle. Mahindra later agreed to match the lowest bidder. On November 15, 2017, Mahindra began delivering 150 e-Vertios, while Tata Motors delivered the first of 250 Tigor EVs on December 14, 2017. The scheme's second phase will buy 9500 electric vehicles, with dates to be determined.

The government started a pilot e-mobility initiative in December 2017 with the goal of providing INR 4.37 billion in subsidies to 11 cities for the purchase of 320 electric buses, 370 taxis, and 720 three-wheelers.

States, in addition to the Union government, are attempting to boost EV adoption on their own, notably through industry-friendly regulations and subsidies. Few Indian states have led the EV trend, including Karnataka, Telangana, and Maharashtra.

The State of Karnataka's Electric Vehicle and Energy Storage Policy was published in 2017.

The state of Karnataka published the Karnataka State Electric Vehicle and Energy Storage Policy 2017 in response to the need for a transparent incentive structure to accelerate EV adoption across the state, with the goal of making Karnataka the preferred destination for EV manufacturing. The paper identifies three impediments to EV adoption.

- High battery technology costs.
- A limited range of current batteries, and a lack of suitable charging infrastructure.
- Apprehension on the part of the consumer.

Policy Measure:

- Making land available, with power, water, sewage, and other testing facilities.
- All electric vehicles, including e-rickshaws and e-carts, are exempt from paying taxes.
- Encourage the use of shared mobility services like electric scooters.
- During the policy term, 1000 electric buses will be implemented.
- Plans are in the works to develop a BIS standard charging equipment that will need charging infrastructure in public buildings.
- Creating a venture capital fund to invest in EV mobility research.

Concession details:

- Subsidy for investment promotion.

Size	Incentive	Cap
Microenterprises	25% of the value of Fixed Assets	INR 1.5 million
Small enterprises	20% of the value of Fixed Assets	INR 4 million
Medium Manufacturing enterprises	-	INR 5 million

- Stamp duty exemption on credit and hypothecation deeds.
- Payment of the land conversion charge.
- A 50% subsidy for the construction of an Effluent Treatment Plant.
- Electricity tariff exemption during the first five years of operation.

Emissions from electric vehicles (EVs)

Though electric vehicles are lauded for their zero emissions from the tailpipe, one must also consider emissions from the electricity generation source. An automobile's pollution may be quantified in three ways:

- Well to Tank (WTT)
- Tank to Wheel (TTW)
- Cradle to Gate (CTG)

Well to Tank (WTT) is a measurement of pollution caused by the manufacturing of fuel, whether it's gasoline or diesel for traditional ICE cars or electricity for electric vehicles. The tailpipe emissions are measured from the tank to the wheel (TTW). These two combined form the pollution pathway known as Well to Wheel, which provides a comprehensive picture of total pollution generated by vehicle use. Electricity is required to power an EV; hence a closer examination of the power generation source is required. Thermal power accounts for 66.20 percent of installed power in India, with coal-fired thermal reactors accounting for the majority.

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With the bulk of coal plants polluted well above the legal limits, it's debatable whether a full-fledged EV strategy would be cost-effective, especially when factoring the long-term expenses of healthcare and environmental deterioration.

Fuel	**MW**	**% of Total**
Total Thermal	2,18,960	**66.20%**
Coal	1,92,972	58.30%
Gas	25,150	7.60%
Oil	838	0.30%
Hydro (Renewable)	44,963	**13.60%**
Nuclear	6,780	**2.00%**
RES* (MNRE)	60,158	**18.20%**
Total	**3,30,861**	
* Installed capacity in respect of RES as on 30.09.2017.		
* RES (Renewable Energy Sources) include Small Hydro Project, Biomass Gasifier, Biomass Power, Urban & Industrial Waste Power, Solar and Wind Energy [43]		

Table 2. Split of Power generation sources - India

Table 2 demonstrates that India's electricity generation is primarily based on thermal power. According to one study, total emissions from electric vehicle manufacture range between 87 and 95 grams of carbon dioxide equivalent per kilometer (CO_2 eq./km), whereas ICEV (Internal Combustion Engine Vehicle) production produces only 43 grams CO_2 eq./km. The study indicates that electric vehicles are not always helpful and should not be encouraged in areas where coal is heavily used for power44. The use of electric vehicles (EVs) has the potential to move pollution from localized urban mobile centers (ICEVs) to a centralized location in the form of power plants. The auto sector should acknowledge this and encourage the government to adopt an inclusive

energy policy aimed at shifting the power mix to cleaner sources like solar, wind, and nuclear, which can provide better advantages due to lower emissions.

Fuel Cell Electric Vehicles (FCEV's)

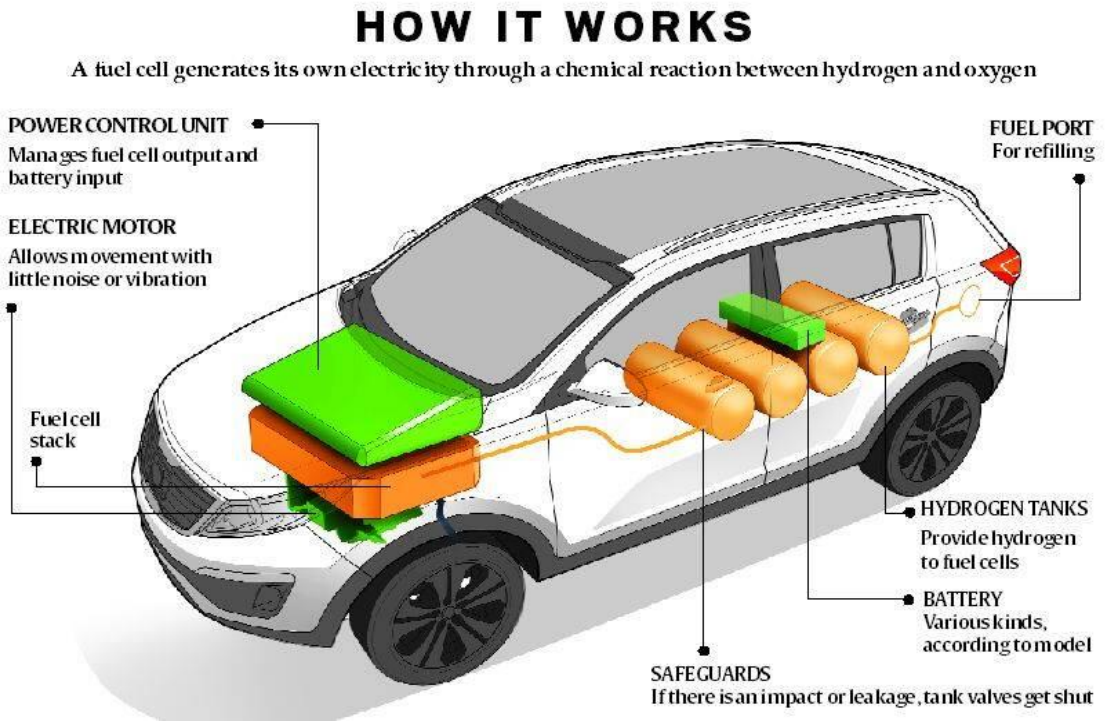
Fuel Cell Electric Vehicles derives energy from fuel cell powered by hydrogen, instead of drawing energy only from battery and electricity. It generates electricity by fostering reaction between hydrogen and ambient oxygen.

Fuel Cell Electric Vehicle use power generated by hydrogen powered fuel cells and uses battery for only auxiliary functions such as starting the engine and storing regenerative energy by braking. So, FCEV don't need plug in charge for battery, but need hydrogen as a fuel for operating.

Advantages:

- FCEV is more efficient than conventional internal combustion engine.
- No tailpipe emissions.
- Only emit water & water vapors.
- Can run up to 300 miles in full tank.
- Also, the hydrogen tank can be filled in few minutes.

Disadvantages:



- Hydrogen is made out of fossils.
- It is a costly process to produce hydrogen.
- Hydrogen is not easy to contain and even the transportation is difficult.

This is where green hydrogen comes into the game. Green hydrogen is produced from electrolysis of water. Also, the energy required for electrolysis is produced with the help of renewable resources like wind energy, solar energy. This is why it is called green hydrogen.
Still, it is very expensive to produce green hydrogen due to high cost of electrolysis system. Also, large scale production is an issue. Researchers are looking for a inexpensive catalyst, which can help in producing large scale production and electrolysis through alkaline system.

Industry 4.0 (Smart Factories)

The Internet of Things (IoT) in industry is at the heart of Industry 4.0. Industry 4.0 has been heralded as the next big thing for increasing manufacturing facility productivity and efficiency. It has made ripples in the European and American markets for its ability to boost efficiency while also acting as a substitute for labor whose costs are rapidly rising.
Companies in nations such as Germany, where Industry 4.0 was born, are quickly embracing the notion. Bosch GmbH, for example, has begun the process of transforming all of its 250 global facilities into smart factories, including ones in India. Ford is deploying collaborative robots to install shock absorbers in its Fiesta vehicles in the United States.
Indian automakers are warming to the idea of smart digital manufacturing, but they aren't seeing enough benefits yet. Almost all of the industry leaders we spoke with agreed with this. The current focus is on closing specific supply chain gaps and bringing suppliers up to speed with the changing regulatory environment. End of Line (EOL) testing via computer vision and quality checks of sub-assemblies are two use cases that have been envisaged for the near future.
The focus on product liability and traceability, as well as the compulsory adoption of ABS, airbags, and other safety features, will motivate companies to use more IoT technology in their factories.
Industry 4.0 adoption in India will be spearheaded by international OEMs, according to a consultant from a renowned firm who has previously worked closely with Bosch. Instead of modernizing the entire facility, companies such as Ford, Toyota, Hyundai, and Volkswagen will

bring Industry 4.0-based production lines unique to their European models. These models will be designed from the ground up using Industry 4.0 architecture, which will be transferred to their Indian counterparts in the future. As a result, Indian manufacturing plants will have 4-5 lines of Industry 4.0-compliant machinery, with legacy systems making up the rest of the plant. Companies have set aside specialized budgets for research into increased factory automation. The Indian government has also encouraged the business to shift from low-margin to high-margin items in order to boost export value. More models are projected to be made in India and shipped to countries all over the world, thanks to the government's push for exports. This will hasten the implementation of Industry 4.0 standards, which allow machines to connect with one another via an Intranet and the Internet.

A multi-national tier 1 supplier executive remarked concerning Industry 4.0 that, despite a separate push by the company's Industry 4.0 business division, the car manufacturers have been hesitant to adopt it. The substantial up-front investments required for Industry 4.0 adoption have been a major roadblock, and the benefits have not been convincing enough to justify the move. Despite the fact that labor expenses are a source of worry, Indian OEMs think that labor is significantly less expensive than automation. This is in contrast to developments in Europe and the United States, where labor rates have risen while the cost of utilizing robots has reduced, resulting in increased use of Industry 4.0 applications.

One of the other hurdles in mainstream adoption of Industry 4.0 was brought to light by a Managing Director of a consultancy firm who works with both OEMs and start-ups. Many OEMs have a combination of old and new machines. While many new machines have sensor capabilities to generate data that can be used in additional data analytics, many older machines lack this capability. He also predicted that individual Industry 4.0 initiatives would be completed in the next 3 to 5 years.

These, however, will not be the ultimate digital connected factories because they will not take off for another 8-10 years, by which time vehicle architectures will have altered to suit market-driven competitive actions and novel production methods.

Industry 4.0 will not be one of the opportunities that Indian OEMs would follow strongly. In contrast to Europe and the United States, the underlying truth is that the Indian labor market will continue to be cheaper in the near future. Opportunities like Industry 4.0 will be overlooked unless they make financial sense for OEMs. Industry 4.0 solution providers such as Bosch, Siemens, and

others, on the other hand, will endeavor to adapt, downsize, and customize their products to fit the Indian market.

Autonomous cars

In India, the lack of road discipline is a key impediment to the implementation of self-driving automobiles. Even if world-class road infrastructure can be built, driverless cars require lane keeping and cautious overtaking to function. A separate piece of legislation is also needed to clarify concerns like product liability in the event of an accident or other disaster. With today's technology, autonomous vehicles still require some manual intervention, especially in congested areas. As a result, automakers are not optimistic about the development of autonomous driving technologies in the near future.

Volvo's patented 'Drive Pilot' technology is already being used to develop driverless vehicles in Europe. There are five stages of autonomous vehicles, starting with Level 1 (basic functions like cruise control and pedestrian detection) and progressing to Level 5 (fully autonomous driving without the need for a driver to interfere). Volvo is currently testing Level 4 autonomous vehicles in Europe.

Given the road infrastructure, driving behavior, buyer price sensitivity, and political situation in India, some OEMs expect to introduce Level 2 or Level 3 automation by 2022. There are two dimensions to change: passenger-centric changes (passenger immersive experience, safety features), and passenger-centric changes (passenger immersive experience). Ease of travel, affordability, and vehicle-centric improvements are all factors to consider (In-Vehicle network, cameras & sensors, electrification of drivetrain, autonomous driving, etc.). When the market pull matches the technology push, the technologies will come to fruition.

- Level 0 – Completely manual
- Level 1 – Driver Assistance
- Level 2 – Partial Automation → Industry's expectation of Indian market
- Level 3 – Conditional Automation
- Level 4 – High Automation → OEMs experimental technology
- Level 5 – Full Automation

The regulatory drive is acting as a catalyst for change. Mixed autonomy is presently under development in Europe and could be available by 2020-21, when the automobile can drive alone for short distances. Regulatory monitoring and product liability regulations must be created in tandem with the industry. By 2023, some OEMs predict that the Indian market will have adopted Level 2 (Partial Automation). Though autonomous driving has made advances in passenger vehicles, the technology has yet to catch on in commercial trucks. The size of buses is growing in developing markets, such as attached/elongated buses and double-decker buses, posing a challenge for the development of autonomous driving systems for commercial vehicles such as trucks and buses. Some companies feel that the Indian market will take a long time to accept this technology in public transportation systems.

The first autonomous cars would be designed for closed places such as zoos, tech park campuses, industries, and so on. After that, the concept may be expanded to encompass more open regions such as designated highway areas, and so on. In India, autonomous vehicles may not be available until 2025, when roads have improved and technology has matured.

RESEARCH METHODOLOGY

We used a combination of primary and secondary sources. We began with secondary research in order to narrow down the technology/opportunities that the Indian car sector is currently facing. This list was compiled using news stories, company financial statements and strategic plans, government regulatory notices, and expert interviews conducted as part of the primary research. Implementation of BS VI, electrification of drivetrains, Industry 4.0 (Smart factories), mobility-as-a-service, and autonomous vehicles were among the topics covered.

In-depth interviews with three experts from prominent companies in the auto ecosystem formed the bulk of the primary research. A detailed interview questionnaire was created after identifying the areas that vehicle OEMs are considering adopting. To account for the shifting regulatory and commercial climate, the interviews were spread out across two months. We acquired comments from specialists in car OEMs and tier 1 suppliers through these interviews. Participants were encouraged to express their opinions on topics other than those stated in the interview questions, which were semi-structured.

Also, a questionnaire was formed to get the responses from industry experts as well as the general public to get to know about the preferences and what they think about the scope of the technologies and if these technologies can be successful or not.

Objectives

1. Attempt to analyze and anticipate the adoption of these technologies, business models, and other factors by Indian car OEMs, as well as the problems they confront, in light of Indian regulations and market conditions, in this article.

2. To assess the future potential of the Indian Automobile Industry.

3. To propose that the government take a green car policy strategy that is technology neutral and allows market forces to operate.

4. To know the scope of Electric vehicles and will FCEV's will diminish the scope for EV's or any other new technology will disrupt the market.

5. To study if autonomous cars and Industry 4.0 will work in the Indian environment, running autonomous cars as a public transport can give relief in accidents and traffic jams caused by human errors.

DATA COLLECTION

We have used a questionnaire and interview as a tool for the collection of data. We prepared the set of questions after a detailed study on the topic. The set of questions aims to give us insights on the preferences and what people think about the scope of the technologies and if these technologies can be successful or not.

Data Analysis

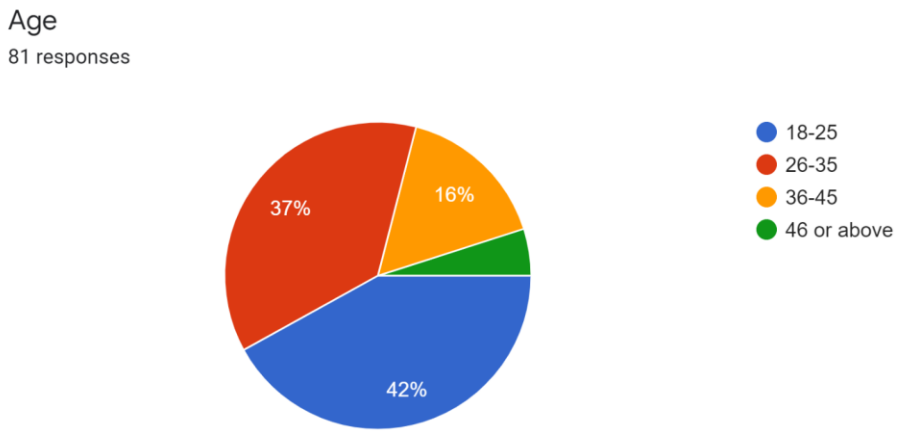
Questionnaire Survey

(Form Link: https://docs.google.com/forms/d/1LVBzcF80zwPY-NRa_teG-aT5NZH2yMq7XY_cqlH6MzI/edit)

Demographics

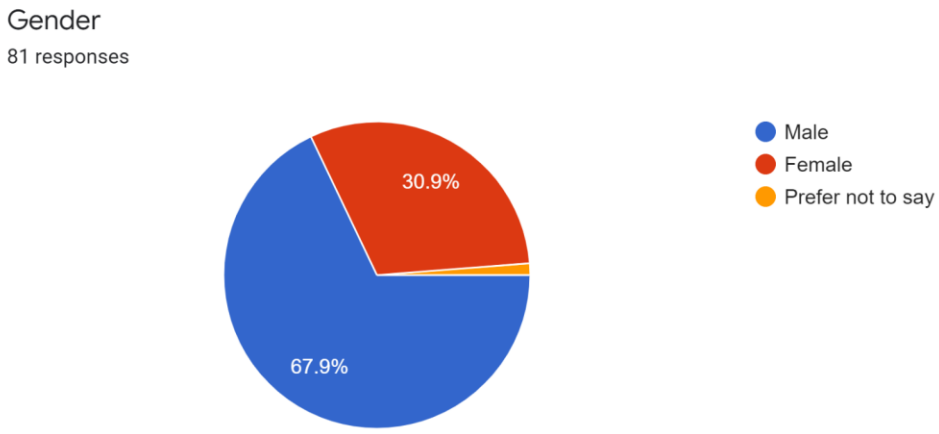
The questionnaire was sent to the respondents via WhatsApp. It was filled by people in Delhi and North India of different age groups, gender, and occupation. The factors will be analyzed in this section.

Q-1 In which age group do you belong?



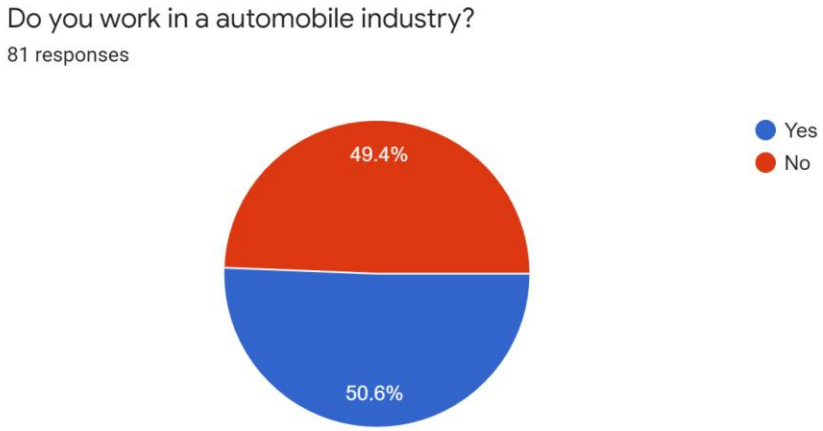
The age ranges were divided into four categories. The age group 18-25 had the most respondents (34), followed by 30 respondents in the age group 26-35, 13 respondents were from 36-45 and 4 respondents in the age group 46 and above.

Q-2 Gender of respondents.



The findings of a survey that inquired about people's gender, it can be noticed that 55 respondents are male, while 25 are female. One respondent who filled out the poll was Non-Binary.

Q-3 Are they working in the Automobile Industry?



The above figure shows whether the person is working in the automobile industry or not. Almost 50.6 % of respondents are working in the automobile industry, while 49.4% are not.

Q-4 Does the person own a car?

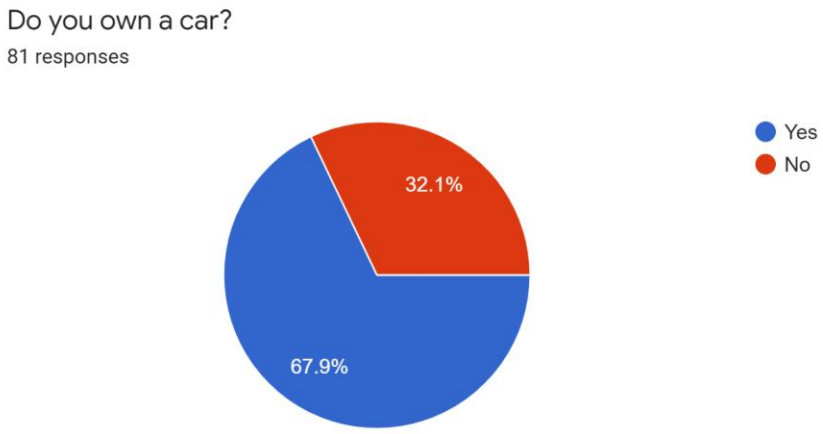
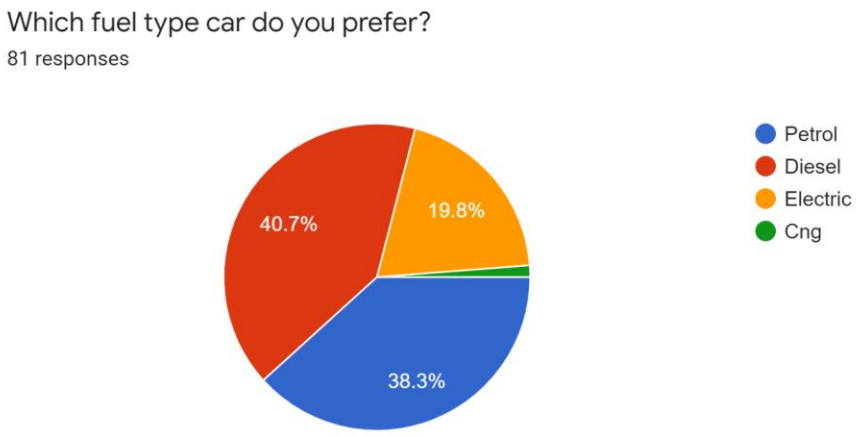


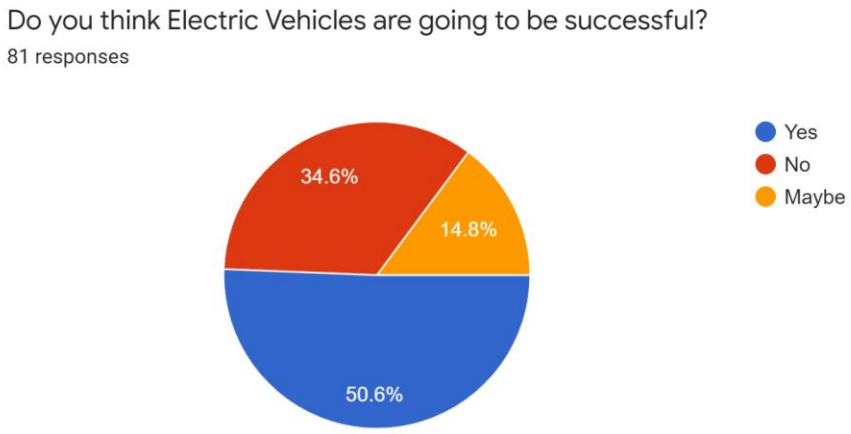
Figure shows that 67.9% of respondents own a car while 32.1% don't.

Q-5 Which fuel type car one prefers?



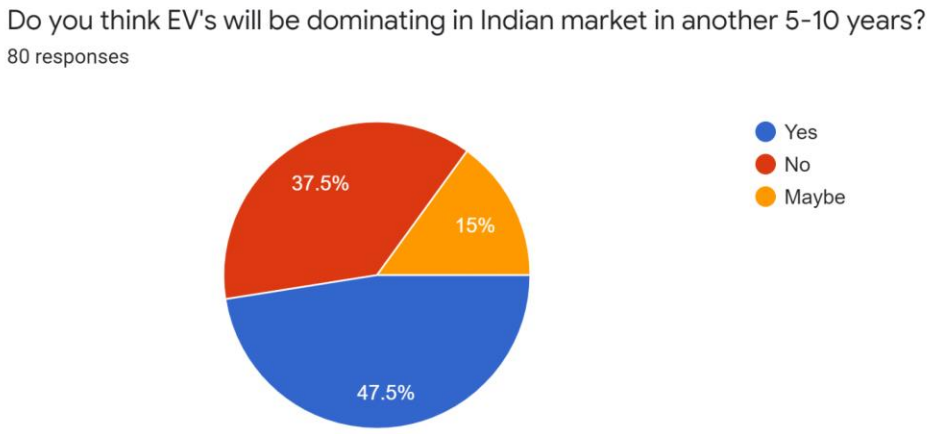
The figure shows that most consumers (40.7%) still prefer diesel cars and petrol cars (38.3%), while the trend is shifting and it shows 19.8% do prefer electric cars and 1.2% prefer CNG.

Q-6 Do you think Electric Vehicles are going to be successful?



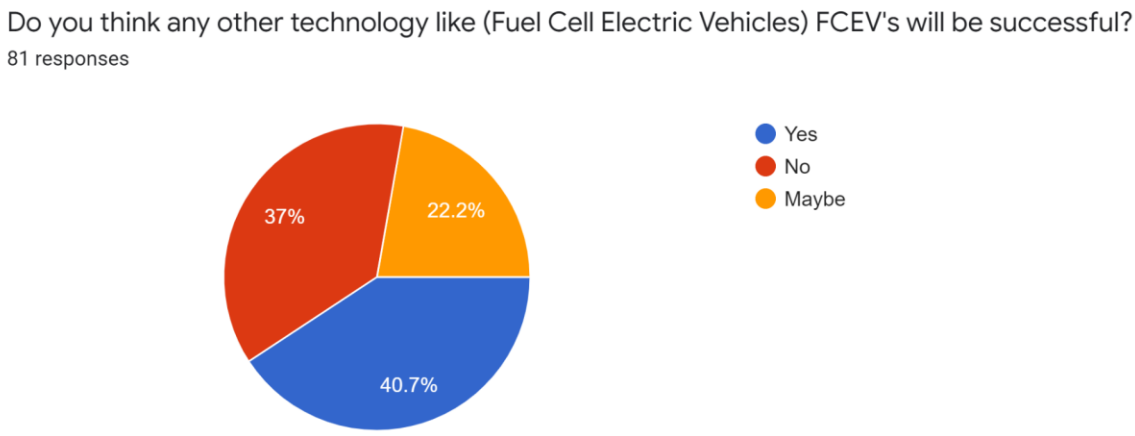
The figure shows that 50.6% respondents do think that EV's will be successful while 34.6% think otherwise and the remaining 14.8 % are still in doubt.

Q-7 Do you think EV's will be dominating in the Indian market in another 5-10 years.



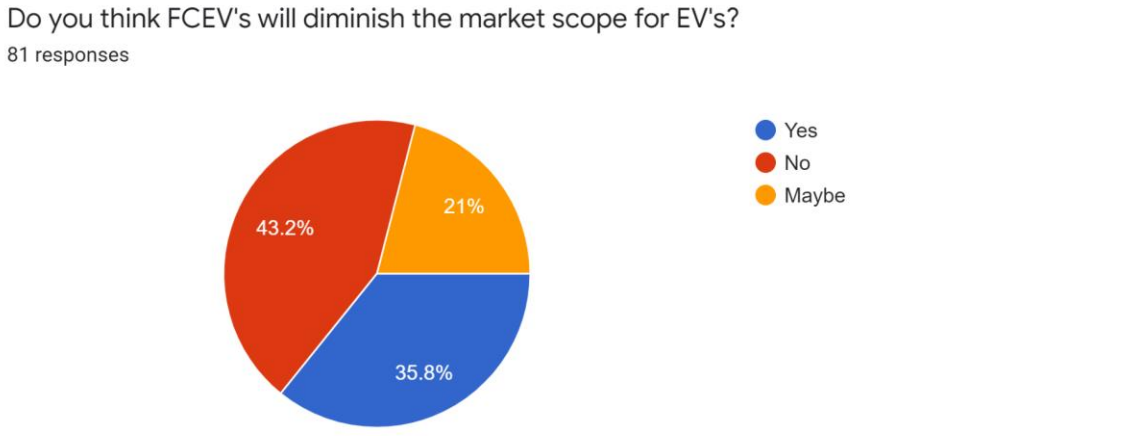
Many respondents do think that EV's will be dominating the market which constitutes 47.5% , while 37.5 % of respondents don't think so and 15 % are in doubt about the situation.

Q-8 Do you think any other technology like (Fuel Cell Electric Vehicles) FCEV's will be successful?



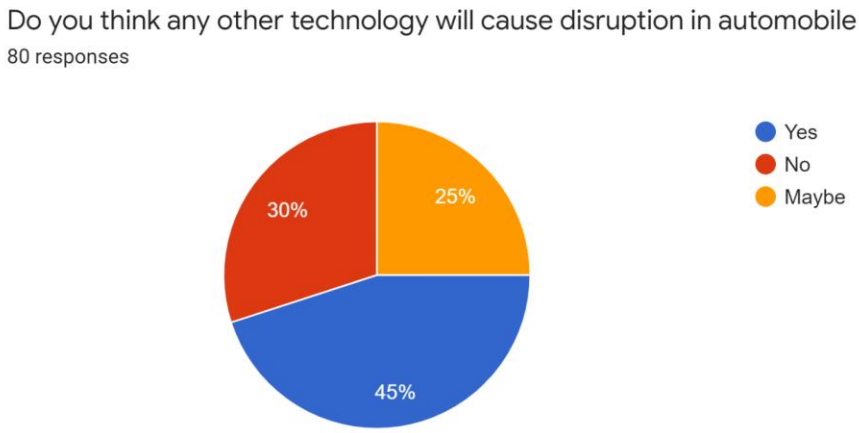
Many respondents do feel like technologies such as FCEV can be successful, which constitutes 40.7%, while 37 % of respondents don't think so and 22.2 % are in doubt.

Q-9 Do you think FCEV will diminish the market scope for EV's?



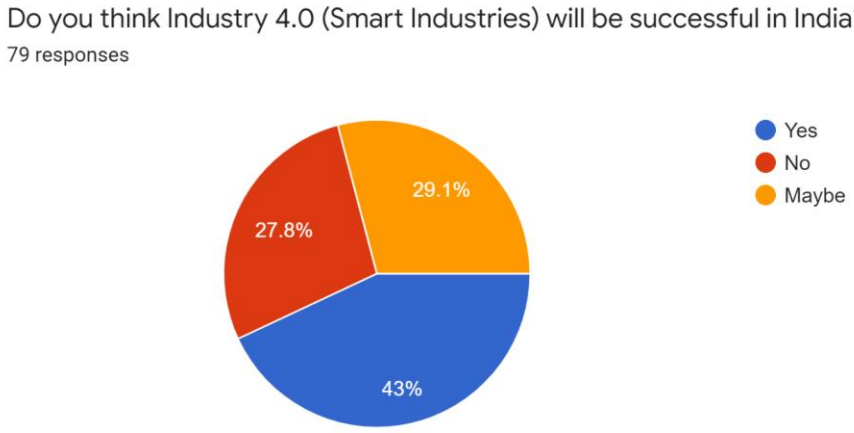
While respondents do think that FCEV can work but still many feel like it won't diminish the scope for EV, 35.8 % think it can diminish the scope for Ev while 43.2% don't and 21% are not sure.

Q-10 Do you think any other technology will cause disruption in the automobile sector?



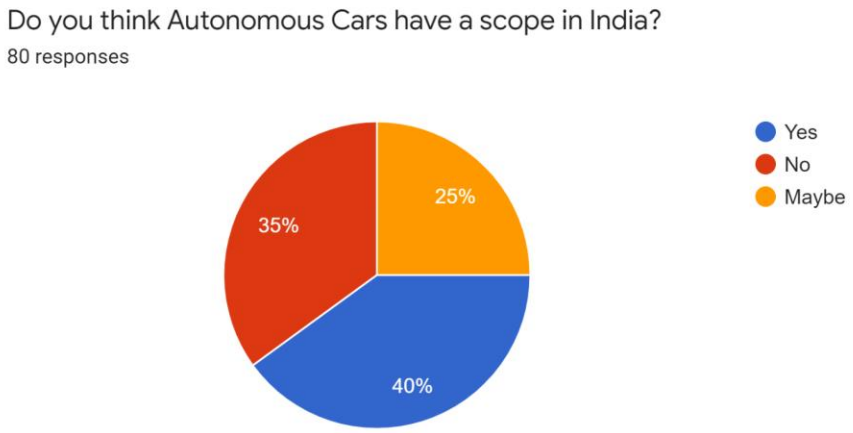
45% respondents, which is the most, think that any other technology will disrupt the market, while 30% don't and 25 % are not sure.

Q-11 Do you think Industry 4.0 (Smart Industries) will be successful in India?



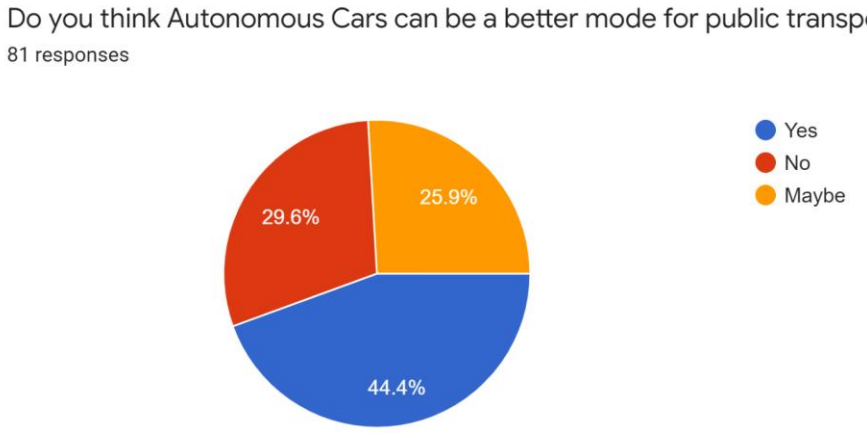
43% do think it will be, while 27.8 don't and 29.1% are not sure.

Q-12 Do you think Autonomous Cars have a scope in India?



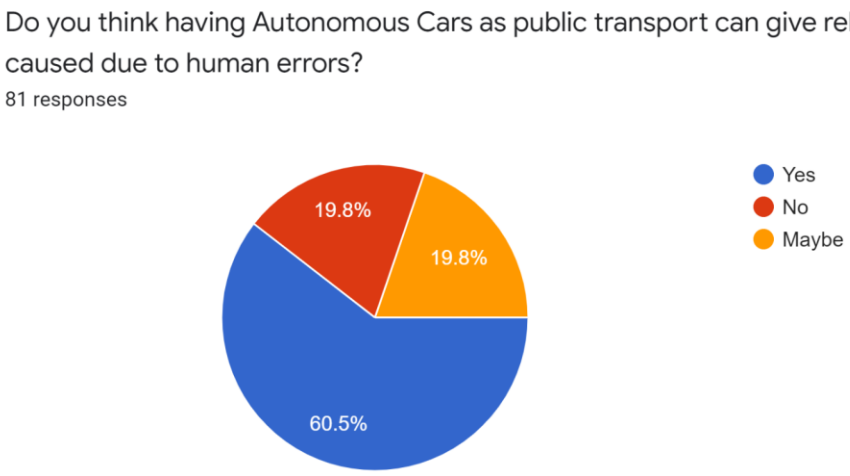
Autonomous Cars are catching the eye of many persons , 40 % also thinks that it can work under Indian environment, while 35% don't and 25% are not sure.

Q-13 Do you think Autonomous Cars can be a better mode for public transport?



Public transport is widely used in India and 44.4% do think that autonomous vehicles can be a better mode of transport, while 29.6 % don't and 25.9% are not sure.

Q-14 Do you think having Autonomous Cars as public transport can give relief in traffic and accidents caused due to human errors?



Traffic and accidents due to human errors are a common scenario in India, and 60.5% respondents do think autonomous cars can solve this while 19.8 % don't think so and also 19.8 % are not sure.

Data Analysis based on Interviews with Industry Experts

The analysis from the interviews tells us about the views of Industry experts on the emerging technologies and it can be seen how they think differently.

They do know about the technologies in and outs. Also, they believe in EV but at the same time they know about the shortcoming EV has. And, how FCEV can take on if economical hydrogen can be produced at large scale. Even, they believe any other new technology can disrupt the market. This is the main difference of surveys from questionnaire and interviews.

Also, they do believe Autonomous Cars and Industry 4.0 is the future like the results came from questionnaire, but they know these things will take time to be implemented in Indian market taking the expenses and Indian factories work culture. Now, the EV is the focus and technologies like Industry 4.0 and Autonomous Car still has a long way to be implemented in India.

Implications and Recommendations

According to the secondary research and primary data collection through questionnaires and interviews with industry experts, we have some findings in assessing the automobile sector and its future scope in India.

We find that the government is trying to find new opportunities and industry experts are working on proving emerging technologies so that there are less emissions and an environment friendly innovation. This is the reason; government has asked industries to stop the production of BS IV and also provide subsidies for Electric vehicles and technologies like FCEV which can work on green hydrogen. Nitin Gadkari arrived at parliament in Toyota Mirai (A green hydrogen FCEV concept car).

From the data and the responses, we found that people still prefer to buy Petrol and Diesel cars as it is a viable option at this time. But people are also preferring EV's and Tata and Mahindra are doing pretty well in the EV sector. Tata has set up a different entity for EV's and has invested 700 crores. Also, Tata is at the top position in sales of EV's in India. Tata has also set up various Tata power charging stations

People do hesitate to buy electric vehicles due to various reasons, as it is a little expensive and also due to the perception of less power in driving. Also, because of the charging issue and the limitation of kms, a car can cover in single charge.

There are new technologies like FCEV which can solve these problems, it is more efficient than conventional IC engine, has a hydrogen fuel tank, no tailpipe emissions that is there in EV's too, can run up to 300 miles and also can be refilled in a few minutes.

But, according to responses from questionnaire and industry expert interviews, EV's still can dominate the Indian market in coming years. As long as there is tech (if researches can find the catalyst for cheap electrolysis of water) which can produce green hydrogen at large scale at an economical rate.

It is also found that Industry 4.0 and autonomous cars are the future because of the advancements in the IOT, AI and ML. This will be the new normal but it will take its time to be implemented in the Indian environment.

Also, it is believed that autonomous cars if used as public transport and there are less owned private cars, then there will be a decrease in the no. of accidents which are mostly due to human errors and this will also help in reducing the traffic because of the human errors.

Limitations of the study

There are certain limitations of the study which are as follows: -

• Data collection was restricted to the working people in the automobile industry in Delhi NCR.

• The major limitation of this study is due to time constraints and also a limited group of people has been taken as respondents.

CONCLUSION

Conclusion

The information gathered from the questionnaire survey and interviews was examined and interpreted. Based on the analysis, the research on the topic 'Assessing the automobile sector and its future scope' has been finished.

According to the study, Indian automakers are aware of new potential but are not aggressively pursuing them for a variety of reasons. Adoption has been driven primarily by government directives. BS VI implementation will be the primary emphasis of all Indian OEMs in the coming years, up to 2020. Following that, OEMs' next priority would be the electrification drive, which is also the subject of our plan. With the exception of a few forward-thinking companies, most OEMs remain wary about the electrification possibilities. However, in order to avoid falling behind, all businesses are organizing teams to work on electrification. There appear to be a lot of outstanding questions that need to be addressed in order to guide the automaker's electric vehicle strategy.

The CV market has prioritized connected cars as the third priority. It will take longer for costs to fall and for cars to enter the mid-market category. Connectivity and telematics will play a key role in commercial vehicles, with both OEMs and start-ups offering solutions. As a result, commercial vehicle manufacturers may find connection more profitable than electrification, and it may take precedence over it right away.

FCEV can be a disruptive technology and be the game changer only if researchers can find a cheap catalyst for electrolysis of water and a way to economically produce hydrogen at large scale. This can be a bigger player in the game than EV.

Industrial IoT connectivity can only begin when organizations are confident in their cost-benefit analysis and are willing to take a long-term view. There will be pockets within the factory that will be equipped with sensors and analytics capability on an as-needed basis, and none of the players expressed a strong desire to upgrade the entire factory.

Autonomous vehicles are still a long way off for India's auto sector. ADAS (Advanced Driver Assistance System), auto parking, and other amenities may become increasingly prevalent in the premium car category, but they will largely remain novelties. OEMs do not appear to have spelled out any plans to work on autonomous vehicles. Executives appeared to be the least thrilled about self-driving cars, a sentiment reflected by the majority of Indian drivers.

Appendix

1. Name –
2. Gender
   A) Male
   B) Female
   C) Prefer not to say
3. In which age group, do you belong?
   A) 18-25 years.
   B) 26-35 years.
   C) 36-45 years.
   D) 46 years and above.
4. Do you work in the automobile industry?
   A) Yes
   B) No
5. Do you own a car?
   A) Yes
   B) No
6. Which fuel type car do you prefer?
   A) Petrol
   B) Diesel
   C) Electric
   D) Other
7. Do you think Electric Vehicles are going to be successful?
   A) Yes
   B) No
   C) Maybe

8. Do you think EV's will be dominating the Indian market in another 5-10 years?
   A) Yes
   B) No
   C) Maybe
9. Do you think any other technology like (Fuel Cell Electric Vehicles) FCEV will be successful?
   A) Yes
   B) No
   C) Maybe
10. Do you think FCEV will diminish the market scope for EV's?
   A) Yes
   B) No
   C) Maybe
11. Do you think any other technology will cause disruption in the automobile sector?
   A) Yes
   B) No
   C) Maybe
12. Do you think Industry 4.0 (Smart Industries) will be successful in India?
   A) Yes
   B) No
   C) Maybe
13. Do you think Autonomous Cars have a scope in India?
   A) Yes
   B) No
   C) Maybe

14. Do you think Autonomous Cars can be a better mode for public transport?

A) Yes

B) No

C) Maybe

15. Do you think having Autonomous Cars as public transport can give relief in traffic and accidents caused due to human errors?

A) Yes

B) No

C) Maybe

Interviews

Interview No. 1 From K.K Rawat

Abbreviations

Interviewee - I

K.K Rawat - K.K

I- Hello

K.K- Hello

I- Good Morning Sir, Rinkush this side

K.K- Good Morning

I- How are you, Sir?

K. K-. I am doing fine.

I- Sir, actually I want to ask you some questions on the emerging technologies and future scope in the automobile industry.

K.K- Yes, sure, go ahead.

I- So what do you think, will electric vehicles dominate the Indian market in another 4-6 years.

K.K- Well, electric vehicles are indeed starting to get a market now and many players are trying to get into it. But it depends if any other innovation comes into the market, EV's won't be able to dominate.

I- Ok, FCEV can be that new tech that can diminish EV's and get itself into the game.

K.K- In my views, FCEV still has to find a way to do some research to produce hydrogen fuel in an economical way as it costs way too much and if this green hydrogen can be produced on a large scale economically, then it can surely be the game changer.

I-That is really insightful, Sir. Can you please share your views on Industry 4.0 being implied in India?

K. K- Industry 4.0 is also emerging and with the help IOT and ML, manufacturing can be more efficient in every possible way. But, to be implemented in India it will still take some years.

I- And what about Autonomous Cars?

K. K- If that could happen then, it would be a huge relief as there are many accidents due to human errors. But self-driving cars are still in the testing phase and people do have a question, is it safe? So, with improvements in AI and ML, this tech might shock everyone. And that might be the new future.

I- Sir, my next question is related to this only if autonomous cars can be used as public transport and can it help in declining accidents and traffic in the Indian environment?

K. K- To be able to be successful in the Indian environment, a lot of things have to be changed and it can be as the government is looking for new opportunities and if this can help in decreasing accidents which it surely can. So, maybe in another 10 years we won't even own a car and still have a luxury transport system with smooth experience.

I- Thank you so much Sir for your precious time, it was really insightful talking to you?

K. K- Thank you.

Interview No. 2 From Kapil Chopra

Abbreviations

Interviewer: I

Kapil Chopra: KC

I- Hello Sir.

KC- Hello

I- How are you?

KC- Good Rinkush, how about you?

I- I am also fine. Sir, actually I want to ask you some questions on the emerging technologies and future scope in the automobile industry.

KC- Yes, sure.

I- So what do you think, will electric vehicles dominate the Indian market in another 4-6 years.

KC- Well, the way things are going on right now and how every OEM player wants to be in the game of EV's. So, I do think EV's will dominate the market in some time.

I- Ok Sir, and what about FCEV, can it affect the market of EV's?

KC- FCEV are still in the research stage and to produce hydrogen economically at large scale will be a task. This is still going to take some time. But if it gets done, then it can surely change the game.

I- And what do you think about Industry 4.0?

KC- Well, with the growing tech in AI and ML, this will be the future. But in India, it will still take some years to implement this.

I- Sir, what about autonomous Cars here in the Indian environment?

KC- Tesla is trying its best in this technology with the help of some other big players and in the U.S. too, the self-driven cars in the introduction phase. So, surely it will be a long time for India and for the Indian environment, they surely have to work on AI a lot better and improvise it according to the Indian environment.

I- And can these autonomous cars be used as public transport and also help in decreasing traffic and accidents that occur due to human errors?

KC- If these autonomous cars projects can be implemented successfully then it surely can help in the situation and reduce traffic and accidents.

I- That is all from my side, Sir. Really nice talking to you. Thank you.

KC- Ok, Rinkush. Bye.

Interview No. 3 From Rahul Gahlot

Abbreviations

Interviewer: I

Rahul Gahlot: R

I- Hello, Rahul Sir.

R- Hello, Rinkush.

I- Sir, actually I want to ask you some questions on the emerging technologies and future scope in the automobile industry.

R- Definitely, I will be glad to answer the questions.

I- Sir, what do you think, will electric vehicles dominate the Indian market in another 4-6 years.

R- It depends, EV's are in the market for too long but now it is getting the hype and response. Maybe it will dominate the market looking at the current scenario.

I-Ok Sir, and what about FCEV, can it affect the market of EV's?

R- It can definitely, it is more environment friendly and with green hydrogen it makes more sense but to be able to get it done, there needs a lot of work and research to make it a large-scale production.

I-And what do you think about Industry 4.0?

R- Well, it is surely the future and with the advancements in IOT, AI and ML, this will be the new normal.

I-Sir, what are your thoughts on autonomous Cars in the Indian environment?

R- Well, anything can be possible. We used to think that electric vehicles are not for Indian consumers but things are starting to change and self-driven cars can also be in the market in the coming future.

I- Sir, also do you think autonomous cars can be used as public transport and less private cars on the road and this will help reduce traffic and accidents?

R- Yes, it can be the case and also with self-driven cars there are less chances of errors and surely it will help reduce traffics and accidents.

I- Thank you, Sir for your time and it was really nice talking to you as always.

R- Happy to help anytime, Rinkush. Bye. Take Care.

REFERENCES

Bibliography

- *Automobile Industry in India, Indian Automobile Industry, Sector, Trends, Statistics*. (n.d.). Www.ibef.org. https://www.ibef.org/industry/india-automobiles
- *India & the Future of Automotive Industry - CII Blog*. (n.d.). Www.ciiblog.in. https://www.ciiblog.in/india-the-future-of-automotive-industry/
- Bajpai, H., Tandon, A., Sinha, A., Sehgal, R., Assistant, R., & Mehta, M. (n.d.). *The Future of Work in the Automotive Sector in India Perspectives from the Ground*. https://cis-india.org/internet-governance/future-of-work-in-automotive-sector.pdf
- *(PDF) Recent Developments and Future Prospects in the Indian Automotive Industry*. (n.d.). ResearchGate. Retrieved May 2, 2022, from https://www.researchgate.net/publication/37593034_Recent_Developments_and_Future_
- *Indian automotive sector: Creating future-ready organisations*. (2019). https://www.pwc.in/assets/pdfs/industries/automotive/indian-automotive-sector.pdf
- *A STUDY ON AUTOMOBILE INDUSTRY IN INDIA*. (n.d.). Retrieved May 2, 2022, from https://absjournal.abs.edu.in/abs-Journal-Volume-6-isuue-1-june-2018/abs-j-v-6-i-1-june-2018-article-13.pdf
- Tripathy, A., Shanker, B., & P, K. (2018). Future of Indian Auto Industry: Choices and Challenges. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3147878
- Wikipedia Contributors. (2019, February 7). *Electric vehicle*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Electric_vehicle\
- *Why The Future of Electric Vehicles Appears Promising in India*. (2021, June 29). ELE Times.https://www.eletimes.com/why-the-future-of-electric-vehicles-appears-promising-in-india
- *Alternative Fuels Data Center: Fuel Cell Electric Vehicles*. (2019). Energy.gov. https://afdc.energy.gov/vehicles/fuel_cell.html
- Wikipedia Contributors. (2019, March 25). *Self-driving car*. Wikipedia; Wikimedia Foundation. https://en.wikipedia.org/wiki/Self-driving_car

- *Industry 4.0 in automotive Digitizing the end-to-end automotive value chain Steering into Industry 4.0 in the automotive sector Page 7 GM's Kevin Quinn on driving value with additive manufacturing.* (n.d.). https://www2.deloitte.com/content/dam/insights/us/articles/automotive-news_industry-4-0-in-automotive/DI_Automotive-News-Supplement.pdf
- *Industry 4.0 and the Automotive Industry*. (n.d.). Www.assemblymag.com. https://www.assemblymag.com/articles/96568-industry-40-and-the-automotive-industry
- *The future of work in the automotive industry: The need to invest in people's capabilities and decent and sustainable work Issues paper for the Technical Meeting on the Future of Work in the Automotive Industry*. (n.d.). https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/meetingdocument/wcms_741659.pdf

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