Major Research Project

GROWTH OF EV INDUSTRY IN INDIA

Submitted By

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CERTIFICATE

This is to certify that **Nipun Jain (2K21/DMBA/77)** has submitted the project report titled **'Growth of EV Industry in India'** in partial fulfillment of the requirements for the award of the degree of Master of Business Administration (MBA) from Delhi School of Management, Delhi Technological University, New Delhi during the academic year 2022-23.

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DECLARATION

I hereby declare that the work titled **'Growth of EV Industry in India'** 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 2023 under the guidance of Dr. P.K. Suri is my original work and has not been submitted anywhere else.

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

Nipun Jain

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I have put all my efforts to ensure that the project is completed in the best possible manner and also ensured that the project is error-free.

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EXECUTIVE SUMMARY

In India, the market for affordable, less-polluting electronic vehicles is growing. Automobile associations are transforming the industry by developing innovative new variations of vehicles. The EV market is expanding rapidly, and greater developments are anticipated for upcoming models. Existing vehicle manufacturers are looking for new electric vehicle models now that they are aware of the shift. Developed countries like the UK and France have been pushing to ban the sale of gasoline and petroleum-powered vehicles completely by 2040. Experts predict that within five years, all new car sales in Europe will likely be electric. Within the automotive industry, driving vehicle manufacturers and organizations are facing growing responsibilities and competition.

Energy experts predict that the economies of developing nations such as India will spur demand for vehicles, and that since there will be fewer problems with the waste products of fossil fuels, these countries' legislative agendas will prioritize EV development. As the EV industry develops, many groups plan to offer EV charging stations.

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INTRODUCTION

1.1. General Background

Currently, environmental degradation is a global issue. One of the number one air pollution is harmful emissions from combustion engines. Electric vehicles are being vigorously marketed around the world in order to offset the impact of fossil gasoline pollution and to resolve environmental issues. Different governments are encouraging people to move to EVs by ways of facilitating the change. Previous researches indicate that the electric car's excessive price, charging infrastructure unavailability, time and variety tension serve as impediments to consumer adoption. The Government of India has called for 'handiest electric vehicles' on highways by 2030.

Climate Change is the best international assignment of our generation. Challenges of this enormity require radical extrude which could handiest be brought via way of means of absolutely new thinking. We are being pressured to reconsider the way to maintain our contemporary exceptional of life: the manner we generate strength and heat, our strength utilization and consumption, the meals we consume and the way we produce it, the manner we flow around. Our contemporary existence and the related emissions are certainly not sustainable. Transportation is the main issue in India in terms of pollution. Not only does it account for more than 20% of our total national emissions, it is the largest growth region by far. Transport emissions in India have risen by 165 percent since 1990; our Kyoto commitment was only 13 percent. We had 800,000 vehicles on Indian roads in 1990, 10 years later it

was 1.3 million, and now it's 2 million. In terms of meeting carbon goals, most observers regard transport as an impossible field to tackle.[1]

1.2. Scope of the Study

- Market analysis: This involves examining the current and future market trends, consumer behavior, and demand for electric vehicles. It also involves analyzing the competition, pricing strategies, and market share of various companies operating in the industry.
- Technological advancements: This involves understanding the latest technological developments in the EV industry, including advancements in battery technology, charging infrastructure, and autonomous driving systems.
- Regulatory environment: This involves analyzing the policies and regulations governing the EV industry, including incentives and subsidies for electric vehicles, emission regulations, and infrastructure development plans.
- Supply chain analysis: This involves studying the supply chain of the EV industry, including the production and distribution of electric vehicles, battery components, and charging infrastructure.
- Environmental impact: This involves analyzing the environmental impact of electric vehicles, including their carbon footprint, and the potential benefits of electric vehicles in reducing greenhouse gas emissions.[2]

1.3. Problems identified in the Implementation of EV in India

Given the slowing of the Indian economy, electric cars are seen as the future of the automobile sector. India's EV industry is heavily reliant on government subsidies and innovation. The government must invest in technology that is equipped for the future while also combating the slowdown.

This created a significant gap in the Indian market for electric vehicles, which has complicated plans for the development of EV technology there.

India's government offers many of incentives, but the absence of adequate infrastructure and high EV costs are felt by both business and consumers.

The current issues with the uptake of electric cars in India must be examined in order to comprehend where the next stage of growth will occur. These range from structural issues to customer attitudes, but they all have an impact on how EVs will develop in India as a whole.[3]

1. Insufficient infrastructure for charging
2. Reliance on imported batteries
3. Dependence on foreign parts
4. Financial incentives for regional manufacturing
5. EVs are currently quite expensive
6. A lack of high-performance EV choices
7. India's inadequate energy supply in some areas
8. A lack of good upkeep and repair choices

1.4. Field of study and relationship to the EV industry

Worldwide, there is a change taking place as nations switch over to using electric cars. More than 1.2 million electric vehicles—of which 2/3 were pure electric vehicles (BEV)—were sold in 2017. With a 73% increase in sales, China has been the main driver behind the worldwide growth of electric car sales. By 2030, there will be more than 125 million electric vehicles on the road worldwide, according to a projection from the International Energy Agency (IEA), according to Chetan Manny, co-

founder and vice president of Sun Mobility and Although the La Only a small number of nations, including France, the United Kingdom, Norway, China, and now India, have made the switch to electric cars.

The government's financial incentives to buy electric vehicles and the development of a public charging infrastructure are the key causes of this strong sales of electric automobiles. The motivations are inspiring.

Global investment levels in electric cars are rising as well.

Alternative fuel vehicles will be popular in India for a variety of additional factors in addition to its environmental and user-friendliness benefits. First, India has the natural resources to create power for electric vehicles from a variety of sources without relying on foreign oil imports. The infrastructure needed for electric cars, such as power distribution infrastructure, is already there in all of our cities, and adding more ones will only be somewhat more expensive than replacing LPG, CNG, or petrol and diesel for interurban use.[4]

The range of electric vehicles will grow two to three times thanks to battery technology like lithium ion and sodium nickel chloride. Electronics and motors of the next generation will cost less and perform 15% better. Battery leasing and power sales will reduce product prices and expand market share. Costs will drop by 10% to 15% as more cars become electric.

Electric cars have not achieved popularity despite being the centre of such technology creation in India due to limited backing from the federal and state governments. Although the government has decreased customs charges on three of the imported parts for battery vehicles to 10%, there doesn't seem to be much of a drive to lower the price of these cars. Exemptions from uniform excise duty for essential inputs and components as well as policies for completed electric cars are further efforts that should be implemented to lower the cost of electric vehicles. Several nations also

provide subsidies for electric cars in order to advance the technology and lower pollution.

To promote electric vehicles in India, the general approach of the public, the automotive industry, and the government is required. Over the next five years, India will benefit greatly from good government policies and strong backing from enterprises and commercial organizations.

And last, individuals need to understand more about these methods. Given the growing costs of alternative fuel cars, particularly petroleum products, and rising levels of fuel consumption, the media should do its part to inform the public about the advantages of these vehicles. caused by fossil fuel emissions. Therefore, people's mindsets must change from being individualistic to being environmentally conscious.

Are Indians ready?

There are two factors that should be focused on convincing price-conscious Indian consumers about electric vehicles: the cost of ownership and the quality of the vehicle. Increasing demand for EVs and better performing vehicles will be important to meet the 2030 target. Also, in the long term, EVs are cheaper to maintain and maintain.

Customers must thus be aware of the possibilities of electric automobiles. They must realize that solar energy can already be used to power electric automobiles, and that this investment grows quickly as solar energy replaces far more expensive petrol. Many people also worry about running out of batteries and becoming trapped. The government will take care of rapid charging stations on roads and in public locations that can charge automobiles / bicycles in less than 30 minutes, and there will be choices for charging vehicles at home.

“Opportunities and challenges”

India has a chance to dominate the electric car market with a 60% worldwide growth rate. The absence of a supporting supply chain, a manufacturing ecosystem, and infrastructure, however, slows adoption down. In addition, we have a system of enabling governmental regulations that is independent of technology. Companies must get early financial help in order to equalise the taxes levied on batteries and electric automobiles. For their customers, products and services have significant costs and values.

The high upfront cost of electric cars (mostly because of the cost of batteries), the lengthy charging times, range anxiety, and the absence of charging infrastructure are the four key barriers, from the user's perspective. India, a lot more conscientious market, will only make the changeover to electric mobility when it deems it to be advantageous and lucrative, much like the existing system for internal combustion engine (ICE) cars.[5]

1.5. Research Questions

1. How are electric vehicle companies trying to lower the price of EV?
2. What is the current status of EV battery value chain in India?
3. What is the importance and ranking of these strategies?
4. How are the companies making EVs more attractive to customers?

1.6. Overall Objectives

- To understand the market trends: This includes analyzing the market demand, consumer behavior, and market competition in the EV industry. The aim is to identify the key drivers and barriers to the growth of the EV industry.

- To evaluate the technological advancements: This includes analyzing the latest technological developments in EVs, such as battery technology, charging infrastructure, and autonomous driving systems. The objective is to understand the potential benefits and limitations of these technologies in advancing the EV industry.
- To assess the regulatory environment: This includes analyzing the policies and regulations that govern the EV industry. The aim is to understand the incentives, subsidies, and other regulatory frameworks that promote or hinder the growth of the EV industry.
- To examine the supply chain: This includes studying the production, distribution, and logistics of EVs and related components, such as batteries and charging infrastructure. The objective is to understand the supply chain dynamics and identify potential bottlenecks that could impact the growth of the industry.
- To evaluate the environmental impact: This includes assessing the carbon footprint and other environmental impacts of EVs. The aim is to understand the potential benefits of EVs in reducing greenhouse gas emissions and mitigating climate change.

Chapter 2

LITERATURE REVIEW

There is a major technological push in one of the world's largest automotive industries, with major players such as Tesla, Toyota and General Motors operating globally, and Emflux Motors and Ather Energy as the major players in the Indian industry.

According to Zhang et al. (2016), a framework for calculating the elasticity of EV supply and demand was unveiled. The authors considered the cost of EVs, their technology, and their advantages (such as bus lane access, toll waivers, and charging station density). The authors' claim that pricing is a detriment and innovative automobile technology is a key positive component was confirmed. Except for access to bus lanes, which can be harmful in the case of private consumers, incentives are also beneficial.[6]

Price and technology have less of an impact on prospective company EV owners, and there is also a significant difference between potential personal and corporate EV owners. Since 2013, battery technology has advanced and the range that EVs can travel has increased, indicating that the density of the charging station may not be critical but that it is extremely important to intelligently allocate charging stations. Authors have suggested that higher charging station density has a high effect on potential EV owners.

Smith et al. (2017): Instead of manufacturing types of equipment needed for an electric vehicle such as batteries, engines, and the Internet of Things (IoT), larger companies prefer to combine with smaller companies. This is the latest field where there is an upper hand for Indian companies. To boost their device capabilities and to decrease the development time of the finished product, big

corporations merge with smaller companies. Demand for electric vehicles has risen rapidly in the last decade in many countries, such as China, Germany and the United States. But still, due to drawbacks such as lack of charging stations, less vehicle range and many more, electric vehicles are considered to be the second personal vehicle choice.

2.1. Current EV Industry

The transition to electric cars is a topic in the transportation, technology, and oil industries. A number of state and federal agencies are working to increase the use of electric vehicles in India. The mandatory public charging infrastructure guidelines were published by the Ministry of Power, the model building bylaws that facilitated private charging infrastructure provisions were published by the Ministry of Housing and Urban Affairs, and the Ministry of Heavy Industries pioneered the purchasing subsidy programme for electric vehicles. The Ministry of Power mandated that all public charging stations put in place after December 2018, when the article was released, have one of five distinct types of chargers. The availability of the necessary charger has a negative impact on a public charging station's commercial feasibility and prevents private players from setting up public charging stations on their own. Undoubtedly, the adoption of electric cars in India might expand with coordinated efforts from central ministries and state agencies, as well as with the right policy enhancing input mechanisms.[7]

Policy support required for faster adoption of electric vehicles

Even though the government can boost market demand by purchasing subsidies, theycan assist producers with tax relaxations and other such benefits.

- State governments may provide electric vehicles with road taxes.
- State agencies may have a partial or full toll tax waiver.

- Central government should make long-term roadmaps at the national level and release more R&D grants for improved domestic production of EVs and EV components.
- At the level of the city, reductions in local taxes, such as property tax, could reduce the land costs for charging stations.

Latest Trends of Electric Vehicles in India

Three-wheeler adoption is expected to be around 65% -70% by the end of this decade. Electric two-wheelers are expected to have only 25% -35% penetration, with a plethora of startups offering different product ranges at an attractive price and ownership models. They are made more commercially viable by their price and fuel economy.

This progress is comparable to China, where the groundwork for growth was laid by electric bikes and scooters. Also ready for EV adoption are intra-city transport buses. These segments are likely to be accompanied, and then others, by fleet cabs.

With more than 80 percent of ICE sales coming from the segment, India is the largest two-wheeler market. In the four-wheeler market, the penetration of EVs has remained extremely poor at ~0.1 percent.

There are still many gaps to be filled in the four-wheeler EV market, such as a small number of products, high costs, inadequate promise of batteries, poor efficiency and an underdeveloped charging ecosystem. Once these holes are closed, sales are expected to pick up.

Segment wise analysis - EV Penetration			
Segment	Sub segment	EV Penetration %	
		2025	2030
2W	Scooters	15 - 25%	50 - 70%
	- B2B	40 - 60%	60 - 80%
	- B2C	13 - 18%	40 - 60%
	Motorcycles	1 - 2%	10 - 20%
	Overall	**7 - 10%**	**25 - 35%**
3W	**Overall**	**35 - 45%**	**65 - 75%**
4W - PV	Personal	1-3%	10-15%
	Commercial	5-10%	20-30%
Buses	STUs	15%-25%	25%-40%

Figure 1: Segment wise analysis-EV Penetration

(Source- https://www.pv-magazine-india.com/2020/11/05/electric-vehicle-adoption-in-india-will-be-led-by-three-wheelers/)

EVs are on track to fulfill their pledge as game-changers for the automotive industry. The adoption curve is expected to be driven by the two-wheeler (2W) and three-wheeler (3W) segments, followed by e-buses and passenger taxis.

The next decade is projected to be the decade of electric vehicles, taking a step further into the dream of electric mobility. The growth of electric vehicles around the world and India is inevitable. In 2019-20, sales of electric vehicles, excluding e-rickshaws, grew by 20 percent in India. Electric vehicles offer zero emissions from the tail pipe and a reduction in urban air pollution.[8]

Around the world

Electric vehicle adoption has grown rapidly over the past ten years, with the global stock of electric passenger vehicles exceeding 5 million in 2018, an increase of 63 percent from the year before. A total of 2.3 million electric vehicles were on the road in China in 2018, up from 39% in 2017. Comparatively, the United States accounted for 22% of the world fleet and Europe for 24%.

Worldwide, sales of electric vehicles are dominated by Europe and the United States, with China coming in second.

Existence in India

In India, electric vehicles have opened up enough business opportunities both within the country and around the world for automotive companies. India has strong hopes that a high degree of penetration in e-mobility would be reached by 2030.

Government Regulations and Policies

No one disputes that the Indian government is making every effort to promote EVs, but the Faster Adoption and Manufacture of Electric Vehicles (FAME) programme has received criticism from the business community in the past. The government first focused on standardizing vehicles while ignoring popularity in favor of efficiency. An infrastructure system for EV charging is now being prepared by the government. The government is ready to tax non-electric automobiles more severely even if the sales of electric vehicles do not need such a forced switch. And this has put pressure on the car industry's original equipment manufacturers.

A total of 11 state governments, including Kerala and Telangana, have developed detailed policies for electric cars in addition to the federal government. Several states have established objectives to draw sizable investments for the EV market.

According to Tamil Nadu's EV strategy, the state would invest INR 50,000 Cr in EV production and the creation of a vast ecosystem for the market. This plan is expected to generate 1.5 lakh employment. Similar to other states, the government of Uttar Pradesh has an EV strategy that promotes the usage of hybrid and plug-in electric cars during the transitional period and wants to establish a network of two lakh charging stations by 2024 (including fast, slow, and

swapping). By 2030, it also plans to replace 70% of the fleet of public transportation vehicles with electric cars, bringing the total number of electric vehicles on the road to 1 million across all categories.

“Centre’s Focus on Manufacturing”

The government has suggested a five-year strategy to encourage the construction of factories that facilitate the phased, large-scale production of competitive, integrated batteries and cells:

- The Motor Vehicle Act may serve as an enabler to reduce the GST rate for electric cars from 12% to 5% and to totally eliminate road tax.
- Electricity rates for recharging EVs might be 50% of the standard national rate for recharging at home and at work.
- Energy firms (such IOCL, HPCL, IGL, etc.) can make investments in the construction of charging networks, particularly rapid charging stations on intercity routes like state and federal roads. It's possible that the emphasis will be on renewable energy sources.

Comparison between India and US Electric Vehicles

The following chart illustrates how the member nations of the EVI (Electric Vehicles Initiative) compare to the market or stock share for EVs:

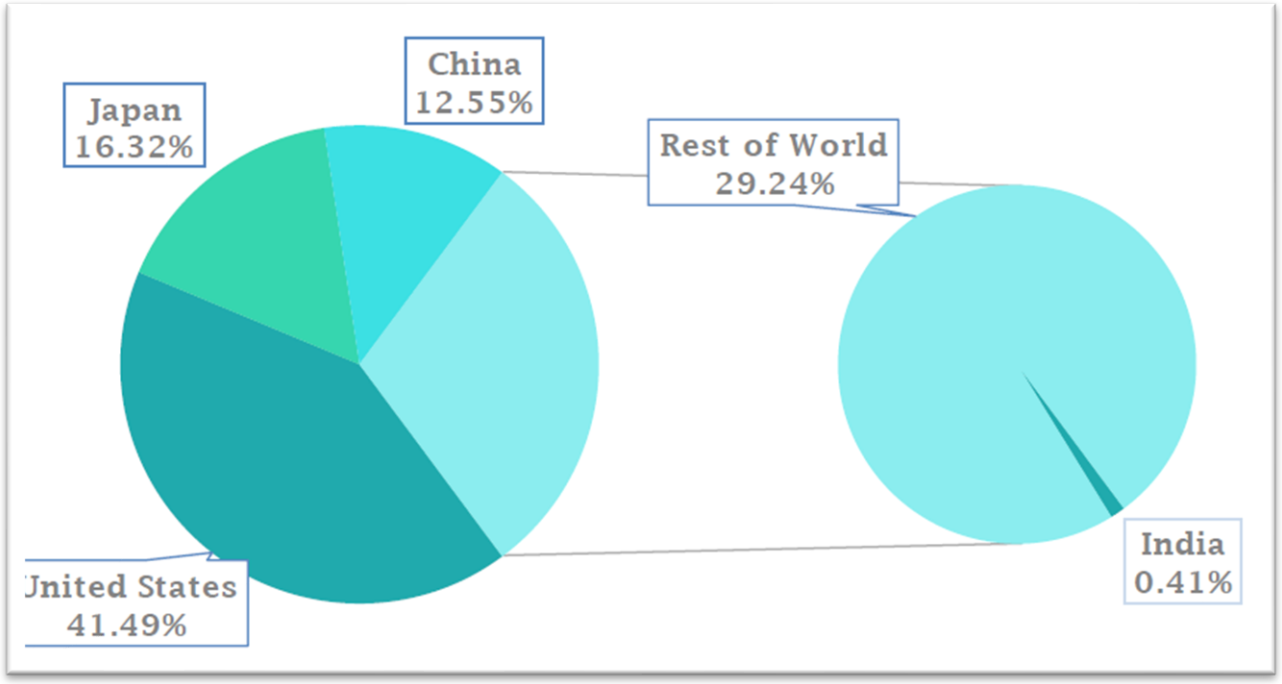

Figure 2: India and US Electric Vehicles

(Source:- https://auto.economictimes.indiatimes.com/news/passenger-vehicle/cars/a-deep-dive-into-world-ev-market-in-india-only-8-of-new-car-sales-will-be-electric-by-2030-against-28-globally-says-report/82570153)

The development of plug-in electric cars is being financed in the US by the federal government as well as several state and municipal entities. Since 2010, 1.6 million legal plug-in electric vehicles have been sold in the United States cumulatively, 1 million of which are all-electric vehicles.

Plug-in electric passenger car market share increased from 0.14% in 2011 to 0.75% in 2014, then fell to 0.66% in 2015. The take rate then increased to 1.13 percent in 2017, hit a record high of 2.1 percent in 2018, and then slightly declined to 1.9 percent in 2019.[9]

According to a New York Times article from August, individuals may significantly reduce their carbon footprint with little effort by driving only 10% less every year, or around 1,350 fewer miles. The total yearly CO2 emissions in the US might be decreased by 110 million metric tonnes thanks to this

accomplishment. That is equivalent to shutting down 28 coal-fired power plants for a year.

Driving less will significantly reduce carbon emissions, but the rise of electric vehicles may also have an effect in the decades to come. As of 2018, there were more than one million electric vehicles on American roads, and the demand for them appears to be growing quickly, according to a briefing from Consumer Surveys. There are currently over 40 different types of electric cars on American roadways, up from only three in 2010. In order to compete with Tesla, luxury automakers like Jaguar, Mercedes, and Audi intend to release electric car versions. Kia, Hyundai, and Nissan are now providing more accessible choices.

India's attention to next-generation mobility has clearly gained momentum under the present administration, although the "National Electric Mobility Mission Plan (NEMMP) 2020" was first launched in 2013 by the previous administration. This puts into perspective the bipartisan efforts being made to promote green transportation and electric vehicles. Since then, the nation has demonstrated a willingness to adopt a 360-degree approach in its quest to become an EV nation.[10]

2.2. Key Industry players

- Hero Electric
- Tata Motors
- Ather Energy
- Mahindra Electric
- Lohia Auto
- BYD Olectra
- Hyundai Kona Electric
- Ashok Leyland

2.3. Economic and Environmental Impact

Through the implementation of the Marine Emissions Trading Scheme (METS), the economic impact of marine transportation on the environment is discussed in terms of CO2 emissions. After that, the International Maritime Organization (IMO) will assess the relative socioeconomic effects of regional segmentation, means of transportation, and the anticipated influence on the shipping business. Data on fuel consumption (FC) from the IMO economic model is calibrated with predicted FC growth rates, emission growth rates, and emissions (based on the link between FC growth rates and world trade growth rates).

From 2007 to 2030, it is anticipated that international shipping would have a 356% greater economic and environmental effect. With a maximum emission growth rate of 207% and a minimum emission growth rate of 110%, METS has decreased CO2 emissions by 54–93%. The external cost per tonne of gasoline utilised is anticipated to rise by 16%, while the rate may drop to 5% due to the anticipated increase in fuel prices. Additionally, it was discovered that determining the external cost per tonne of transport might lead to an imbalance between the real payment contribution and the pollution issue. As a result, we recommend that the International marine Organization (IMO) assume control of, lead, and coordinate the global carbon trading programme since the present marine transport tariff system is not accountable for the external costs of CO2 emissions.

The United Nations Conference on Commerce and Development (UNCTAD) estimates that shipping accounts for over 80% of global commerce and that industry as a whole contributes between 1% and 3% of global GDP. The rise in global population is anticipated to boost many nations' GDPs and raise demand for goods like food and raw resources. The demand for marine transportation would rise globally as a result, which would increase CO2 emissions, which are projected to increase by 2050 by between 200% and 300% under mid-range

scenarios. Carbon Dioxide is the most released primary greenhouse gas (GHG) by ships and it has a 98% chance of causing global warming. On the basis of a research by the International Maritime Organization (IMO), which regulates environmental protection and maintaining maritime resources, ships are thought to have contributed 3.3% of the world's CO2 emissions in 2007. This is 1.05 million tonnes of CO2 annually. Cruising at a slower pace, which short-term decreases ocean emissions but increases long-term land-based CO2 emission levels, is a frequent way to minimize CO2 emissions. something makes the opposite worse.

The marine transport industry is unique from other transport industries since it is international, whereas other types of transportation are more susceptible to local rules. In order to function correctly and satisfy the expanding demand, international shipping needs its own set of regulations and standards. In response to growing environmental awareness, the International Maritime Organization (IMO) created the Energy Efficiency Design Index (EEDI), which is a technical tool and standard for new ships, as well as the Operational Energy Efficiency Index (EEOI), which is a continuous operational measure for shipping operators. The operational and financial advantages of using the equipment IMO suggests are identified. Due of the vast diversity in the area, the IMO lacks information on cost reduction as well as cost reduction activities. This issue may be resolved by implementing our trading system for emission permits, known as the Marine Emissions Trading Scheme (METS), which lowers both overall emissions and the price of emission reduction.[11]

Chapter 3

METHODOLOGY AND PROCEDURE

3.1. Qualitative and Quantitative methods

Qualitative and quantitative research methods can both be useful in studying the electric vehicle (EV) industry, depending on the research questions and objectives of the study.

Qualitative research methods collect and analyze non-numerical data such as interviews, focus groups, and case studies. Qualitative research can help to provide in-depth insights into the experiences, attitudes, and perceptions of individuals or groups regarding EVs. For example, qualitative research can be used to understand the consumer behavior and decision-making processes when it comes to purchasing an EV. Qualitative methods can also be used to study the barriers and challenges to the adoption of EVs, such as the availability of charging infrastructure or the perception of limited driving range.

Quantitative research methods collect and analyze numerical data through surveys, experiments, or statistical analyzes. Quantitative research can provide a broader perspective on the EV industry by collecting data from a large sample size. For example, quantitative research can be used to assess the marketdemand for EVs, track the sales volume and market share of different EV models, or estimate the environmental impact of EVs compared to traditional vehicles. Quantitative methods can also be used to evaluate the impact of policy interventions or incentive programs on the adoption of EVs.

In summary, both qualitative and quantitative research methods can be useful in studying the EV industry. Qualitative research can provide in-depth insights into the attitudes and perceptions of individuals or groups, while quantitative research

can provide broader perspectives on the industry through statistical analyzes and large sample sizes. A combination of both methods can help to provide a comprehensive understanding of the EV industry.

3.2. Research Design

- The policy structure and subsidies for EVs in India are defined in Introduction and the need for stability in the policy and fiscal incentives for the EV sector is stressed.
- Literature Review explains internationally and nationally the business outlook.
- Methodology and Procedure assesses the financial viability in India of EVs (4-wheelers).
- Finally, Findings and Discussion are presented before the final Conclusions and Recommendations.

3.3. Main results

1. **Low Maintenance Costs**

   The maintenance cost is the first and foremost reason that can inspire you to purchase an EV. If you purchase a car with an IC engine, it will have more mechanical components, which will make maintenance more complicated and difficult. Because of their basic structure and operations, EVs are easy and cheaper to manage.

2. **EVs have no noise of their own**

   The silent working functionality is another advantage that an EV can offer over any current vehicle. The reasoning is clear, there's no motor under the hood, so there's also no noise. However quiet the cabin of a car with an engine might be, because of its fully silent operation, an EV will still provide you with a more relaxed ride. In order

to make it safe for pedestrians, the EVs are so quiet that producers have to add fake sounds.

3. **No more fuel price hikes**

   To buy an EV, there is no need to think about the fluctuating regular prices of petrol and diesel anymore.

4. **Convenient Charging at Home**

   EVs have a big benefit as one can easily plug in the car for 4-5 hours at home. The house, on owning an EV, can be your fuel station. EVs also have fast charging capabilities nowadays, keeping them to less than an hour.

5. **Easy to drive**

   All electric vehicles are gearless, starting directly from an electric scooter and going all the way to an electric bus. EVs are also an absolute joy to drive because the gear mechanisms do not have to be controlled.

6. **Environment Friendly**

   Although the planet was under lockdown, the earth has fixed itself and now the climate can be kept in mind while making a decision. Buying an EV will decrease the carbon footprint because no pollution can occur.

7. **Government Incentives**

   The advantages of an EV purchase are not confined to the vehicle itself. Now, since EVs are the future, the government also wants the public to purchase an EV.

3.4. Specific results

Why EV Adoption is Crucial for India?

A sizeable portion of global vehicle sales today come from India, one of the biggest automotive markets in the world. Public transportation frequently predominates as a form of transportation in Tier II, Tier III counties, and rural areas. According to a Greenpeace report, India has to take its time transitioning

to more environmentally friendly and renewable energy sources since air pollution causes more than 1.2 million fatalities worldwide each year.

In light of the growing pollution issue, the Indian government has been supporting alternate transportation options—primarily electric vehicles—more and more during the past several years. Since EVs run on electricity rather than fossil fuels, they produce very little emissions and may be the solution to India's growing air pollution issue.

The Indian government has also made plans to convert the entire nation to electric vehicles by 2030, seeing the potential of EVs. To that goal, the central government said in January 2017 that it would pay up to 60% of the cost of research and development (R&D) for creating the domestic low-cost electric technology.

After announcing 2 international auctions for the purchase of up to 20,000 EVs, the government, led by PM Narendra Modi, is now preparing to offer financial support of up to INR 8,730 Cr under the second phase of FAME India.

Different state governments have started or are implementing specific laws on EVs in an effort to smooth the transition to electric cars, while NITI Aayog has established a special task group to submit suggestions for the Union government.

Among the other states that have implemented or are in the process of doing so are Maharashtra, Andhra Pradesh, Goa, Uttar Pradesh, and others. Interestingly, a survey by the Society of Manufacturers of Electric Vehicles found that the biggest number of EV sales occurred in Gujarat, West Bengal, Uttar Pradesh, Rajasthan, and Maharashtra during the fiscal years 2016–17.

According to the study's findings, Gujarat topped the list selling slightly over 4,330 units. WB came in second with 2,846 units sold, followed by UP with

2,467 total electric car sales during that time. Maharashtra finished in sixth with sales of 1,926 EVs, while Rajasthan recorded sales of around 2,388 EVs.

Additionally, between 2016 and 2017, 25,000 electric vehicles were sold in India. All electric two-wheelers and four-wheelers that were sold between 2016 and 2017 and are now operating satisfactorily in the states indicated were the subject of the research.

With India's yearly increase in sales volume, it has been suggested that the demand for electric vehicles (EV) is anticipated to see double-digit growth rates. In addition, the research "Electric mobility in India: exploiting partnership and nascency" asserted that EV adoption in India is being fueled by stricter emission regulations, falling battery prices, and growing user awareness despite the lack of mainstream electric vehicles.[12]

Chapter 4

FINDINGS AND DISCUSSION

4.1. Analysis of the Result

A quarter of GHG emissions are caused by the transportation sector. Maximum GHG emission is in China (25.9%), then USA (13.87%) followed by India (7.45%).

The tagline "The EV30@30" was used in the 2016 Eighth Clean Energy Ministerial's campaign. The participating nations reiterated their dedication to EV adoption. By 2030, the goal was to have EV market share of 30% overall, with 10% market share for each of the following categories: passenger cars, light commercial vehicles, buses, and trucks.

India is becoming more committed to lowering pollution levels and its carbon impact. By 2030, the nation plans to switch over to electric vehicles. The government wants automakers to switch to EV manufacturing, which would decrease the cost of oil by USD 60 billion, reduce emissions by 37%, and lessen reliance on fuel imports, providing protection from the volatility of crude prices and exchange rates.[13]

To tackle the barriers to EV adoption, the government is looking at the battery swapping option model. Also, the difficulties are presented by size and power of the batteries. Depending on the manufacturers/models, these may change. Since the model is a little complicated, it requires a similar vehicle design to fit the same battery, which is challenging. Battery renting is an additional option that might lower the cost of purchase. However, there is still a big problem with the simple accessibility of charging.

Even if it is not yet imminent, India must soon make the switch to EVs. Large pollution and uncontrolled urbanization are destroying many cities. So, unacceptable deterioration occurs there with the primary cause being vehicle emissions.

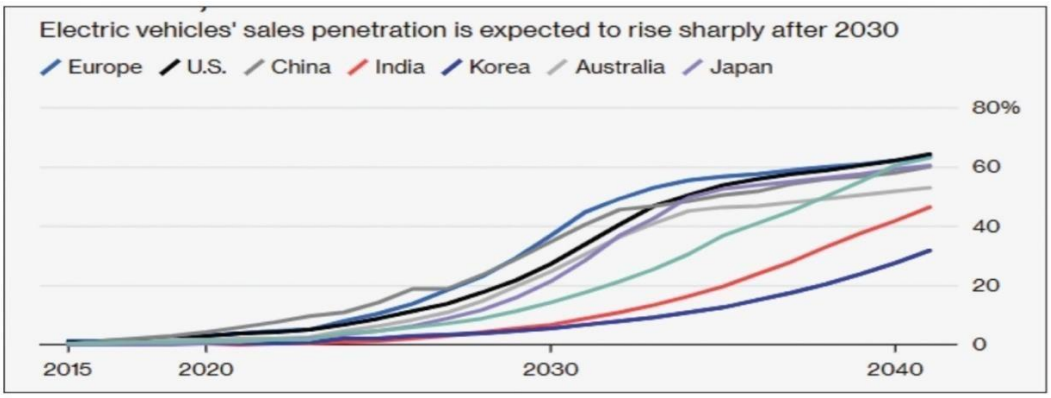

Figure 3: Global EV sales

(Source:- https://auto.economictimes.indiatimes.com/news/passenger-vehicle/cars/a-deep-dive-into-world-ev-market-in-india-only-8-of-new-car-sales-will-be-electric-by-2030- against-28-globally-says-report/82570153)

There are a total of 13 nations in the "Rest of the World" pie, including India. The list of their EV stocks is below:

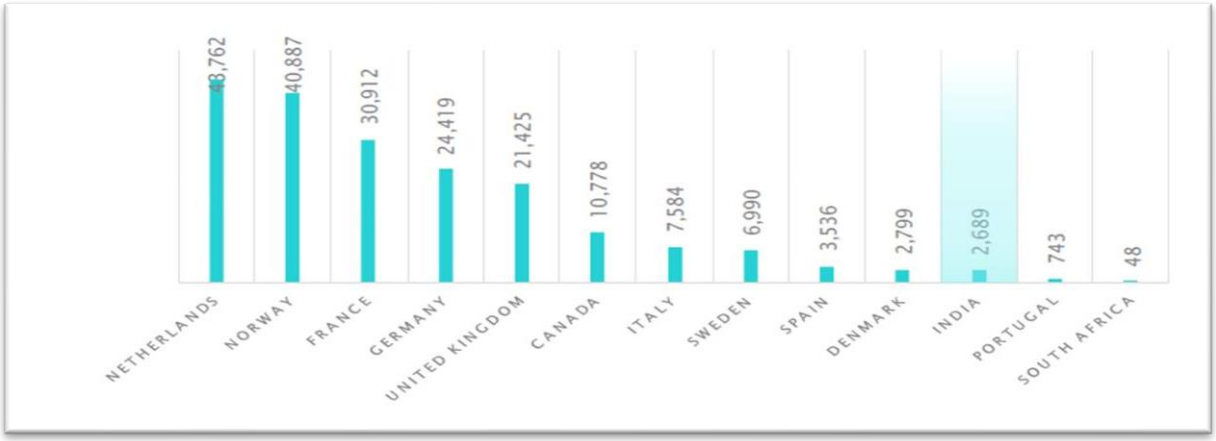

Figure 4: Number of EV stocks

(Soure:- https://en.wikipedia.org/wiki/Electric_car_use_by_country)

India clearly lags behind in the deployment of EVs, and at current rate, it would not be able to achieve the goals of the National Electric Mobility Mission Plan.

The effectiveness of EVs on a worldwide scale has already been demonstrated. But what are the methods that have been employed to develop the EV industry globally? Figures below illustrate the overall percentage share of investments made in several areas, such as infrastructure, research development & demonstration (RD & D), and fiscal incentives.[14]

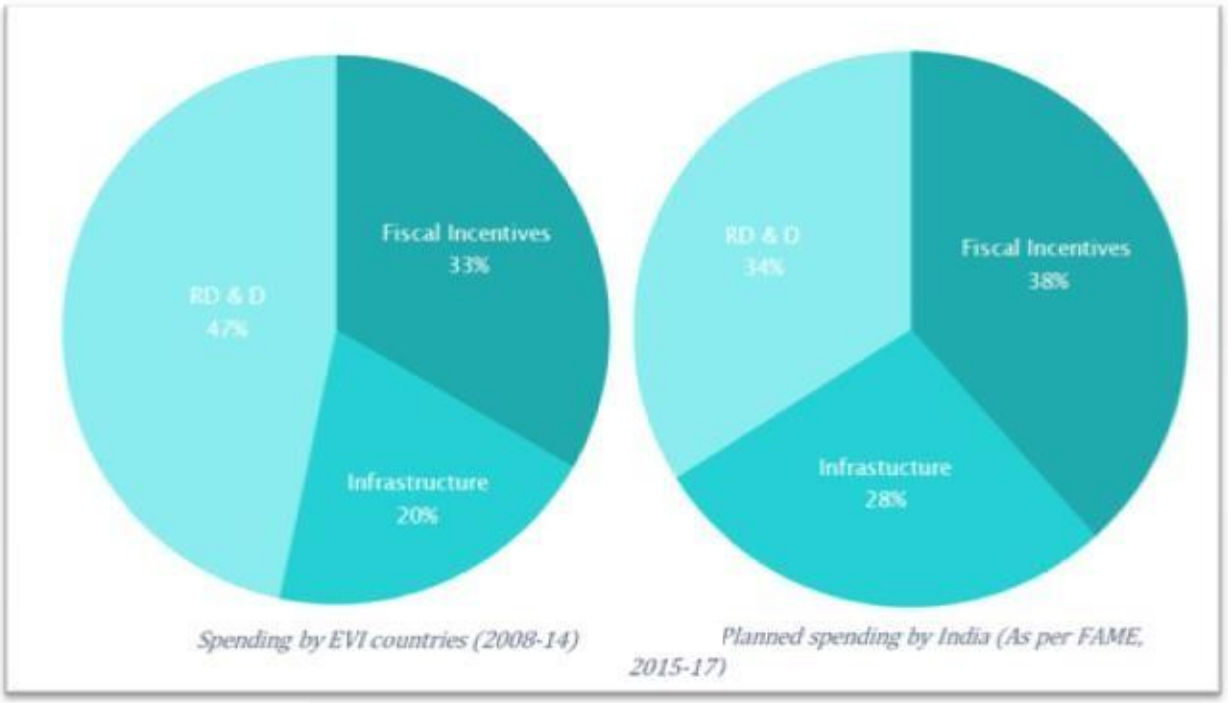

Figure 5: Spending by EVI countries

(Source:- https://en.wikipedia.org/wiki/Electric_car_use_by_country)

It appears that India allocated its portion for fiscal incentives correctly. But where does India rank in relation to the rewards given by various nations? The following

chart illustrates how several nations have allocated money for infrastructure, incentives, and Research, Development, and Demonstration (RD & D):

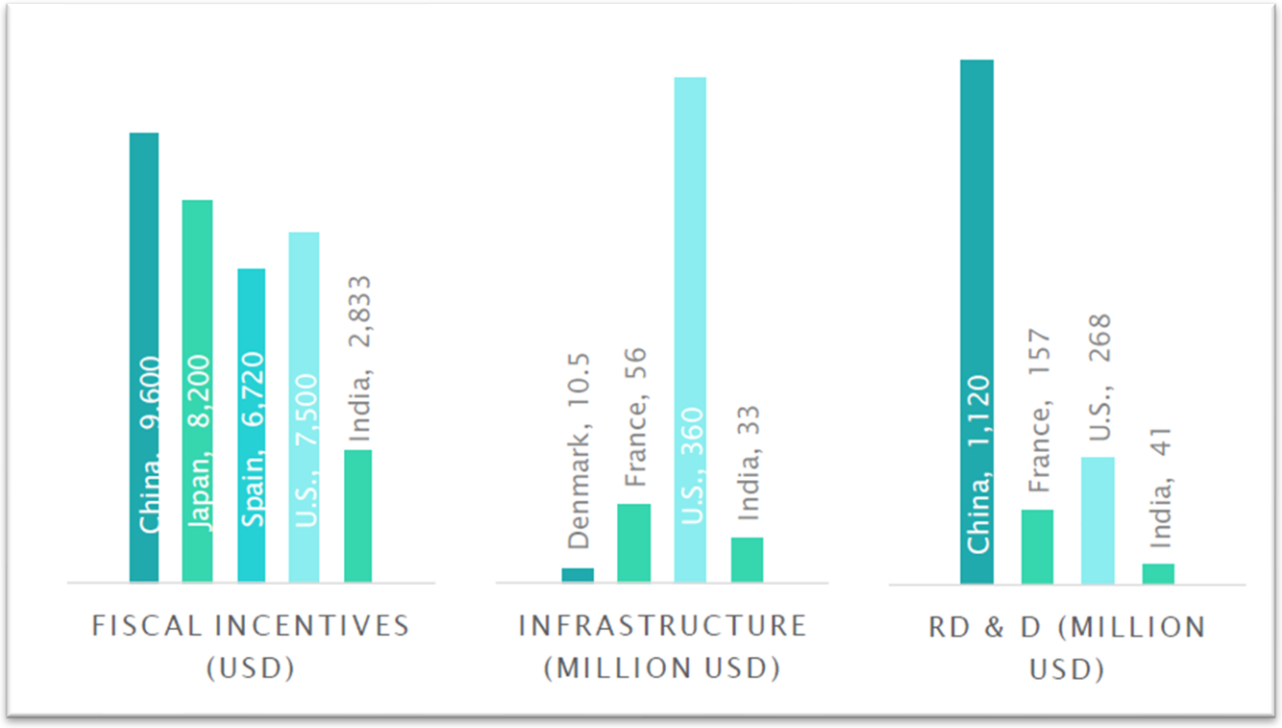

Figure 6: Fiscal Incentives

(Source:- http://metropark.in/fiscal-incentives/)

India clearly falls behind in all aspects, including project demonstration, infrastructure finance, and incentives. However, this does not mean that India's use of electric cars is over. Well-conceived ventures have the power to reshape the market. India may learn from the tactics that have effectively impacted the world.

Chapter 5
CONCLUSIONS

5.1. Conclusions

The objectives of this project have been primarily attained as follows:

- To understand the market trends: This includes the analysis the market trends by studying the market share, projected growth values and India's readiness with respect to other nations by going through their sales penetration, investment in R&D and infrastructure.
- To evaluate the technological advancements: This includes analyzing the latest technological developments in EVs, such as battery leasing and swapping to fit the battery size in different car models, charging infrastructure that was made more accessible via the development of miniscule charging ports, and autonomous driving systems.
- To assess the regulatory environment: This involves the assessment of Indian government's focus on implementing new policies to support the manufacturing and increased sale of EV vehicles such as NEMMP.
- To examine the supply chain: There has been a considered the logistics of various components and raw material for the products and how the pressure on supply chain of conventional fuel-based cars decreased thus decreasing the prizes of oil globally by USD 60 billion and decreased reliance on other environmentally important components.
- To evaluate the environmental impact: There are huge environmental benefits of developing this market and reducing the market share of fuel-based vehicles, the main being reduction in GHG emissions by 37% and consequently decreasing the air pollution and global warming.

It should also be noted that the United States' National Research Council came to the following conclusion in 2010: "Climate change is occurring, is almost certainly caused by human activity, and poses significant risks for a broad range of human and natural systems." But it's also true that a lot of us have come to understand how crucial our role as humans is in avoiding it. Currently, clean and green energy are hot topics. The relevance of renewable energy as a necessary step to help mitigate the consequences of global warming has already been demonstrated by the globe. In 2013, the globe installed 143 GW more capacity for renewable energy than coal, natural gas, and oil put together (141 GW). The requirement for energy utilization is analogous to the transition in energy generation towards renewable sources. The relevance of alternative fuel cars is recognized in the transportation industry as a replacement for petrol and diesel powered vehicles, which create Green House Gases (GHG). Alternative fuel cars are less developed technologically than conventional vehicles, thus they need greater capital investment and additional infrastructure to become profitable. If developing nations like India want to create a viable market for electric vehicles (EV), they must properly spend their financial resources.

Measures like facilitating real estate acquisition at advantageous locations, capital subsidies, or interest subvention on capital expenditures should be taken into consideration in order to make charging infrastructure financially feasible for the initial low demand scenario. Also reduced should be the minimum number of charging stations needed to qualify for incentives under ministry of electricity regulations. In order to support single window approvals and provide the necessary power infrastructure to handle increased electrical load, assistance from state authorities is also required. It will be beneficial to reduce demand uncertainty for the kind of charging equipment and result in greater utilization of the infrastructure by finalizing the charging requirements for all vehicle types.

5.2. Recommendations

- Insufficient Charging Infrastructure: There should be establishment of miniscule charging infrastructure so as to make it easy for people to embrace EVs.
- Lack of knowledge: The benefits of electric vehicles are not well known by the general population and most of the people in the major EV growing markets are hesitant to buy them mainly due to the OEMs lack of explanation of the vehicle's features and usability to those interested to buy them. Thus, proper training to sale staff and spreading knowledge by using social media platforms should
- Lack of manufacturers: One of the main causes of the delayed market expansion of electric transportation is the dearth of EV manufacturers in India, particularly in the 4-wheeler category. Additionally, only Indian EV producers are eligible to receive subsidies under the FAME plan.
- Although it appears that the government is eager to introduce the subsidy programmes, its limited engagement in EV-boosting initiatives has given the impression that the market does not place much value on electric automation. So, the government should establish new projects to put focus on the EV market and make people realize its uses, advantages and benefits.
- Importance of subsidy: It is obvious that the FAME subsidy is insufficient to persuade prospective car owners to choose an electric vehicle. At least until the EV market matures, the State Governments should support the Central Government's efforts to deploy EVs by waiving off the registration tax imposed on an EV purchase.
- Battery swapping: It is a technology used in the electric vehicle (EV) industry that entails replacing depleted batteries with fully charged ones. A motorist can save time and ease range anxiety by switching their

exhausted battery for a fully charged one at a battery swapping station rather than waiting for it to charge.

- Car Sharing: The main benefit of car sharing is that users don't have to purchase the pricey EVs that are now on the market. They may instead rent out the EVs. Such initiatives not only help with employment (drivers), but they also assist the nation's economy and ecology (by reducing congestion). It would be wise to investigate the feasibility of an electric car sharing pilot project. Possibly, Ola and Uber might introduce EV fleets to attract short-distance commuters and get a "green" status symbol, or the government could compel Ola and Uber to have a reasonable number of EVs in their fleet.
- Electric Buses: It is evident that India's urban areas have a very efficient mass transportation system due to the country's huge and dense population. Electric buses have been the buzz of the town for a while, and their potential for growth in nations like China and Australia is unheard of. China has successfully developed the quickest charging stations for electric buses, with a charge time of less than 10 seconds, adding to the benefits. ABB also showed off a related innovation24 that charges an electric bus while it's moving in around 15 seconds. Imagine such e-Buses operating on BRTS routes; with the majority of the infrastructure already in place, this could be implemented more quickly than other projects in India where a BRTS infrastructure already exists.
- Creating competition and motivation for the performance-oriented market: It can be accomplished by launching campaigns to raise awareness or by holding contests. Parallel to this, manufacturers may decide to enter the performance-driven industry and test if they can outperform what they are currently doing. The electric vehicle's design output will ultimately determine its own market.

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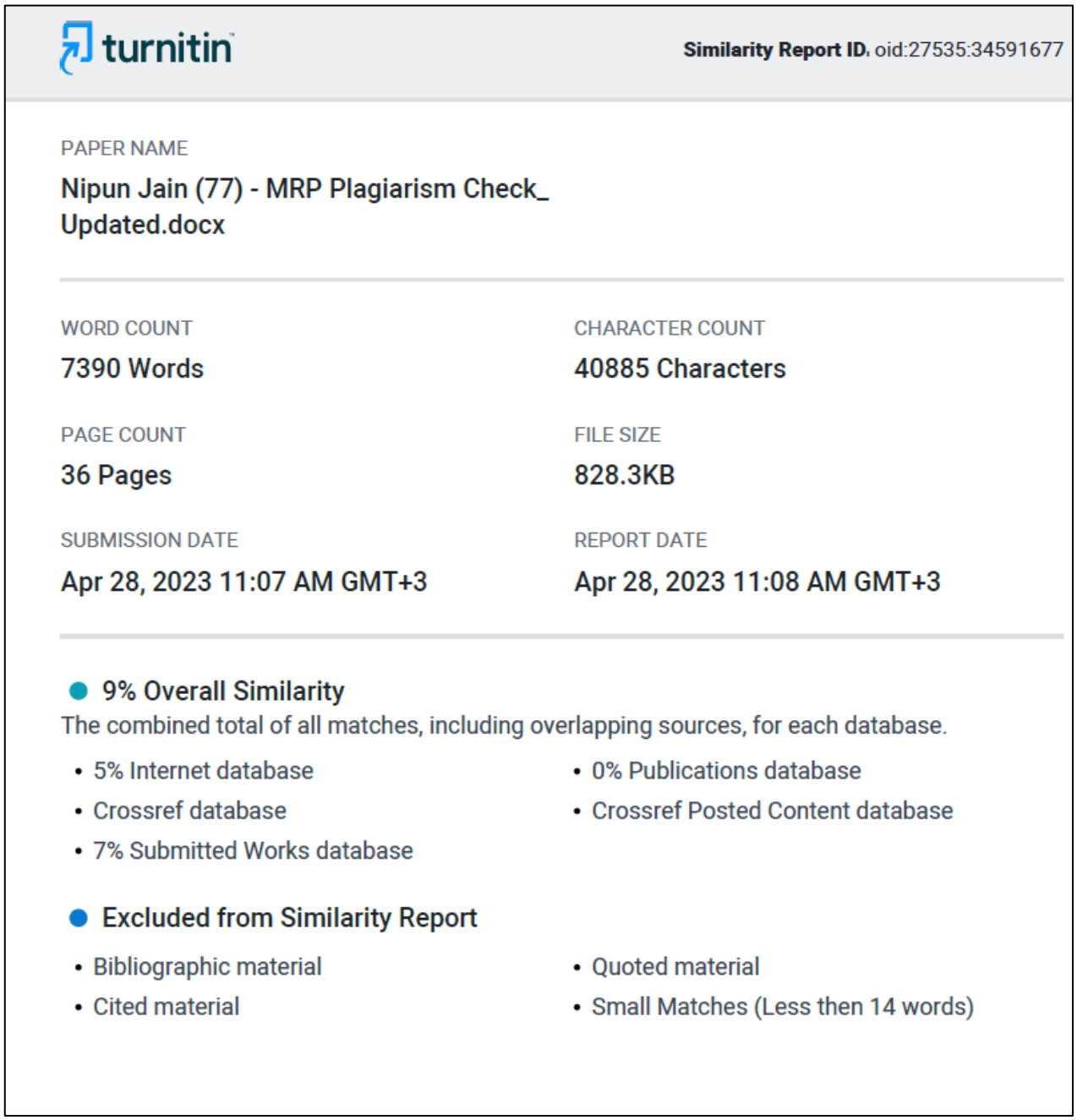

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