

# Analyzing Adoption of Electric Vehicles in India for Sustainable Growth Through Application of Technology Acceptance Model

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**Abstract-** The growing concern for the environment, increasing prices of oil and alarming pollution levels in the country has led the government to urge citizens to adopt eco-friendly modes of transport particularly Electric Vehicles (EVs) and Plug-in Hybrid Electric Vehicles. Absence of a robust charging infrastructure and high cost of EVs serves as a major deterrent to adoption of electric vehicles. This research studies the potential of setting up Electric Vehicles in India as well as policies and other requirement to push adoption and promotion of Electric Vehicles. The main purpose of this research is to analyze the effects of consumer's knowledge about EVs, perceived risk, perceived usefulness, and current financial incentive policies on consumer's intention to adopt EVs using Technology Acceptance Model.

**Keywords:** *Electric Vehicles, Technology Acceptance Model, Eco-friendly mode of transport, policy implications, EV Market.*

## I. INTRODUCTION

The growing concern over climate change and environmental pollution has urged governments across the world to promote switching to Electric Vehicles. The adoption of Electric Vehicles has several other benefits as well, ranging from reduction in cost of transportation to the average consumer as the cost of electricity is far less the cost of petroleum. Moreover, the entire economy stands to get benefit as it will lead to reduction in imports of oil in countries like India.

The electric vehicle market in India is changing for the better due to the various programs and policies initiated by the government. Government departments too have made certain policy announcements which reveal the government's intention and efforts towards promoting faster adoption of EVs in the country. But there remains a lot to be done in this regard if the government is to achieve its ambitious plan of penetrating 30% electric vehicles on Indian roads by 2030.

The government needs to take several initiatives in area of setting up a robust charging infrastructure in the country which is a prerequisite for the adoption of Electric Vehicles technology. This is because the EVs don't have the range that Internal Combustion Engine (ICE) cars do and require frequent charging. Removal or reduction of import duties on

electric vehicles and electric vehicle components is another action needed to be taken to encourage people to switch to EVs from internal combustion engine cars. This will lead to reduction in the cost of electric vehicles in the country as high cost of the electric vehicles in India is another major factor which make people prefer internal combustion engine cars as compared to electric cars.

The transportation sector across the world is undergoing a transition, the main reasons for which are technological, macro-economic and environmental changes. The advent of 'Mobility' as a service and increasing viability of Electric Vehicles will soon lead to a change on the way we travel.

The Electric Vehicles and its adoption amongst the masses comes with a set of challenges which might be unique to the region in comparison to its western counterparts. One major challenge being the sheer size and variability of the automobile industry in India from cars to autos to rickshaws.

Another major challenge is the large number of two wheelers and three wheelers which present greater opportunities. As a large chunk of the Indian population resides under the lower middle class and middle-class segment which are conscious both in terms of running costs and the capital expenditure while purchasing new vehicles. They might choose to buy electric two-wheelers over four-wheelers and as a result many believe that India's electric vehicle market might need to be more focused towards this customer segment.

One more challenge which most electric vehicle manufacturers in India are facing is the need to bring down the overall manufacturing cost of the electric vehicle, a major part of which is the cost of the Lithium-ion batteries. The only way to control this cost is to start manufacturing these in the country itself and incentivize manufacturing of other electric vehicle components.

The manufacturers should also, in addition to providing the basic functionalities and bringing down the cost of the vehicles, cater to the changing needs and preferences of the customers. They must try to provide features and functionalities like those of Internal Combustion Engine cars. The electric cars manufactured in India, mostly by

Mahindra do not have the features, range and functionality consumers would normally expect in the same price bracket. The government will have to work together, enhance the affordability and functionality of electric vehicles to encourage large scale adoption.



## II. POLICY IMPLICATIONS IN INDIA FOR PROMOTING THE ADOPTION OF ELECTRIC VEHICLES

### A. Tax Rebate under Section 80EEB

A deduction for interest payments up to Rs 1, 50,000 is available under Section 80EEB. An individual taxpayer may have an electric vehicle for personal use or for business use. This deduction would facilitate individuals having an electric vehicle for personal use to claim the interest paid on the vehicle loan.

### B. Switch Delhi Campaign

Chief Minister of Delhi Arvind Kejriwal on 4<sup>th</sup> Feb 2021 launched the 'Switch Delhi' campaign to promote electric vehicles and appealed to people to buy such vehicles to combat pollution in the city. He mentioned that his government will hire only electric vehicles for various purposes in the next six weeks.

He asked delivery chains and big companies, resident welfare associations, market associations, malls and cinema halls to promote electric vehicles and set up charging stations at their premises.

The government has fixed an ambitious target of 25 per cent electric vehicles among total vehicle registrations in Delhi by 2024, he added.

The Government of India has set up the **National Electric Mobility Mission Plan (NEMMP) 2020** to promote hybrid electric vehicles under the NEMMP 2020, an incentive scheme, **Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME)**, was launched in 2015 to reduce the cost of hybrid and electric vehicles to the consumers and to encourage adoption by the masses.

The National Institution for Transforming India (NITI) Aayog, in May 2017 came out with a prospectus for the transformation of mobility in the country, containing a set of actions and solutions to speed up adoption of EVs and make India a leader in Electric Mobility

The Ministry of Power launched the new **National Electric Mobility Programme (NEMMP)** in 2018 to focus on developing the charging infrastructure and set of appropriate policies to set a target of having 30% electric vehicles on Indian roads, by 2030. Energy Efficiency Services Limited (EESL), is the government enterprise which is held responsible for the implementation of the program as well as creation of demand for electric vehicles in the country.

## III. FASTER ADOPTION AND MANUFACTURING OF ELECTRIC VEHICLE (FAME) SCHEME

FAME Scheme was formed by the Ministry of Heavy Industries in 2015 to motivate the production and promotion of environment friendly vehicles including electric vehicles and hybrid vehicles, by providing a range of incentives for the same.

It was established under the NEMMP, with main objective to provide incentives in the form of subsidies and other incentives for the faster adoption of electric vehicles in the country. All major types of electric vehicles in the country were listed in the scheme and are benefited from the scheme.

## IV. REVIEW OF LITERATURE

The automobile industry is at its maximum growth since few years because of revolutionary changes in IT and greater living standards created by the citizens of India. The booming market obviously puts a lot of pressure on the available stagnant resources like crude oil, natural gas, fossil fuels etc. The supply and demand are crossing the breakeven point and the situation can be worsened if an alternative doesn't replace the existing crisis. The Electric Vehicle (EV) is one of the alternative solutions to overcome the crises. But EV market is at a nascent stage in India when compared with other developed and emerging countries (Ganneri Giridhar and A. K. Digalwar, 2011)<sup>1</sup>.

In wake of the very recent initiative by the Indian government under the Faster Adoption and Manufacturing of Hybrid and Electric Vehicle (FAME) scheme 2015, to provide subsidies for electric vehicle purchase, the cost difference between electric vehicle and conventional diesel vehicle is bridged to an extent. Cost disadvantage of electric vehicle and peak levelling of Indian power grid by identifying and exploring potential cost benefit avenues to

reduce the payback period of EV's and thereby making them a technology of our everyday life rather than an idealistic plan of a distant future (Anu G.Kumara Anmol M.Akhil V.S, 2015)<sup>2</sup>.

Energy saving and environmental management are the two-key feature for automobile development in the world. Electric vehicle addresses these two criteria by creating a clean and green environment. A detailed overview of types of EV and its challenges are enlightened. Though this green vehicle is advantageous it has its own challenges in building the standard charging infrastructure and battery. Decongesting the charging network can be implemented by setting more charging stations in the private and public localities. This would manage the demand of the power sector to a greater extent. Since Vehicle-to-Grid (V2G) is a viable technology in the coming years every domestic consumer can become a prosumer<sup>3</sup>. Today, climate change due to global warming is a significant concern to all of us. India's rate of greenhouse gas emissions is increasing day by day, placing India in the top ten emitters in the world. Air pollution is one of the significant contributors to the greenhouse effect. Transportation contributes about 10% of the air pollution in India. The Indian government is taking steps to reduce air pollution by encouraging the use of electric vehicles. But success depends on consumer's sentiment, perception and understanding towards Electric Vehicles (EV). In his study, Rabindra Jena tried to capture the feeling, attitude, and emotions of Indian consumers towards electric vehicles. He extracted opinions valuable to prospective buyers (to know what is best for them), marketers (for determining what features should be advertised) and manufacturers (for deciding what features should be improved) using Deep Learning techniques (e.g. Doc2Vec Algorithm, Recurrent Neural Network (RNN), Convolutional Neural Network (CNN)<sup>4</sup>.

Simon Shepherd, Peter Bonsall, Gillian Harrison (2012), focused on subsidies and stated that subsidies have little impact on taking-up EVs. Word of mouth, vehicle life, emission rates assumed can impact more than policy or vehicle factors in case of EVs<sup>5</sup>. Pradeep Kumar Tareiab Pushpendu Chanda Himanshu Gupta 2021 did on Indian EVs focusing on technological, infrastructural, financial, behavioral, and external barriers. And threw light on the strength of the relationship among the barriers of EV adoption is structured based on the relative driving and dependence power<sup>6</sup>. Electric vehicle as a viable option in India if power generation shifts to clean mix (Vikas Nimesha Debojit harmab V. Mahendra Reddyc Arkopal Kishore Goswamia, 2020)<sup>7</sup>.

Rajalakshmi Subramaniama, Rahul Dhinakaran (2021) envisaged in their study on using electric vehicle for facilitating door delivery of online orders. As electronic commerce is continued to grow and will add 36 percent much delivery vehicles onto roads by 2030 and create 32 %

more carbon dioxide than they perform nowadays. They suggested that electronic commerce firms must move away from petrol engines and come up with EVs delivery vehicle that are much cleaner, cheaper and sustainable for delivery boys<sup>8</sup>. Smaïl Benzidiaa, Ruxandra Monica Lucab, Sergiy Boikoc (2021) did a study to compare business models- electric versus hybrid vehicles. Threw light on channels which positively influence customer satisfaction towards electric vehicles. And shed light on the value propositions positive influence on the customer satisfaction for hybrid vehicles. And stated that customer relationships positively influence customer satisfaction for both types<sup>9</sup>.

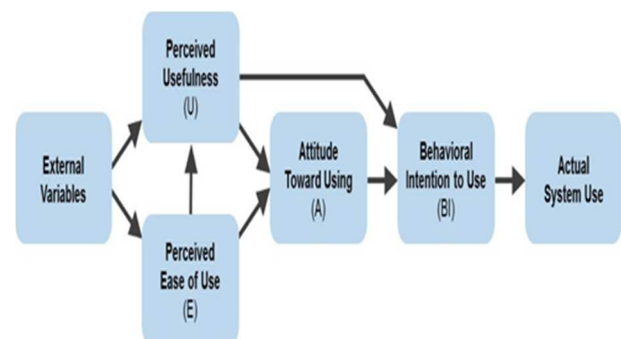
## V. RESEARCH METHODOLOGY

The study has been conducted using primary data in the form of survey through questionnaire filled by 200 respondents. In the initial pages of the report, current scenario of electric vehicles and government policies and their impact have been described. The main purpose of this research is analyzing adoption of electric vehicles in India for sustainable growth through application of technology acceptance model.

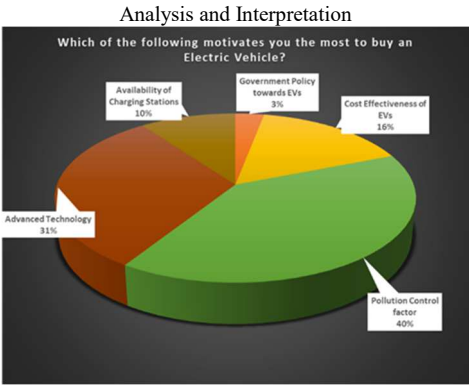
This research paper analyze the effects of consumer's knowledge about EVs, perceived risk, perceived usefulness and current financial incentive policies on consumer's intention to adopt EVs using technology acceptance model. The model is empirically tested using questionnaire survey data collected from 200respondents in India.

### • Objectives

1. To understand the current scenario of electric vehicles in the country, to encourage faster adoption and achievement of goals set by the government for the same.
2. To analyse adoption of electric vehicles in India for sustainable growth through application of technology acceptance model.
3. To analyse the potential of the electric vehicle market in India in years to come and suggest methods to overcome the challenges.

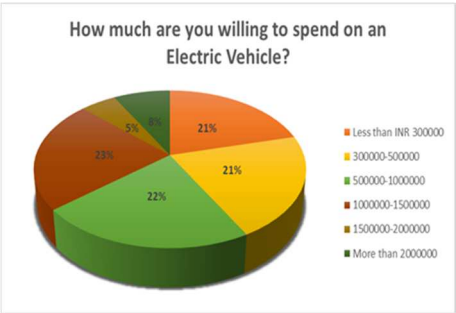


Technology Acceptance Model



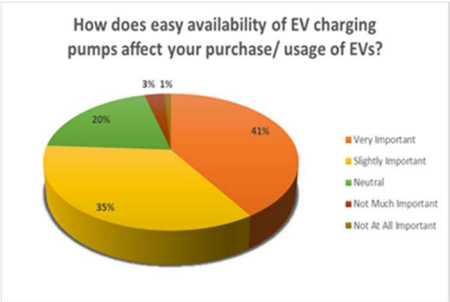
40% respondents find pollution control to be the top factor that motivates them to buy an electric vehicle followed by advanced technology 31% and cost effectiveness of EVs 16%.

External variables which are considered as per TAM are government policies towards EVs, cost effectiveness of EVs, pollution control factor, advanced technology, legal scrapping rules of vehicles etc.



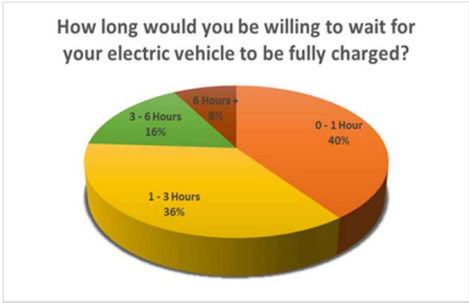
42% (21%+21%) respondents are willing to spend less than Rs. 5,00,000 to purchase an electric vehicle, 22% are willing to spend between Rs. 5,00,000 to 10,00,000 and 22% are willing to spend between 10,00,000 to 15,00,000 to buy an electric vehicle.

As per TAM the respondents in India have behavioral intention to use (BI) the electric vehicles if they are available at affordable prices as other internal combustion engine cars.



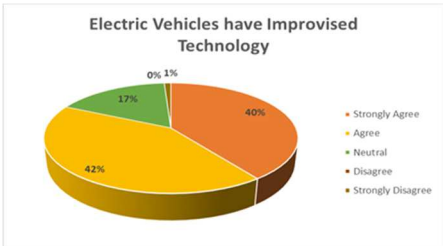
41% respondents strongly agree, and 35% respondents agree that easy availability of EV charging pumps would affect their purchase/usage of EVs.

Perceived Ease of Use (E) as per TAM plays a very important role. If EV charging pumps are readily availablethrough out the country, then the consumers would be happy to purchase EVs



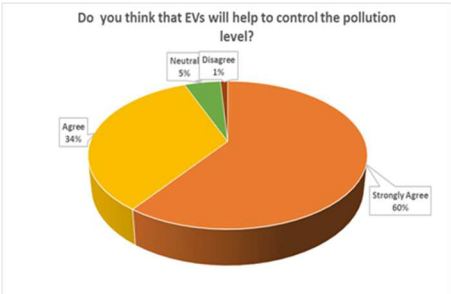
40% respondents said that they are willing to wait less than 1 hour for their electric vehicle to be fully charged, 36% are willing to wait between 1-3 hours and only 8% respondents are willing to wait more than 6 hours for their EV to be fully charged.

Perceived Ease of Use (E) as per TAM is again analyzed here. If EV charging pumps are readily available and charging of EVs can be done in less than one hour, then majority of respondents would be delighted to buy Electric Vehicles.



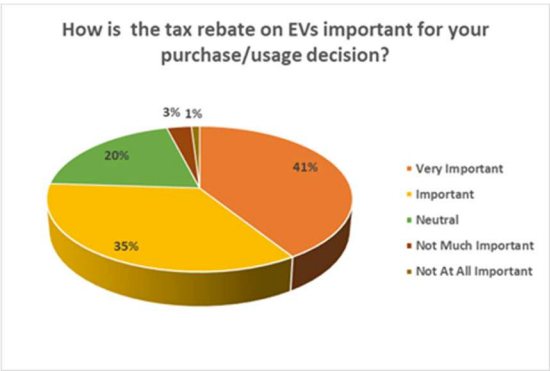
Majority of respondents (82%) agree that Electric Vehicles have improved technology.

TAM variable of Attitude towards Using (A) is analyzed here. The attitude of consumers is positive towards EVs as they believe that it has improved technology.

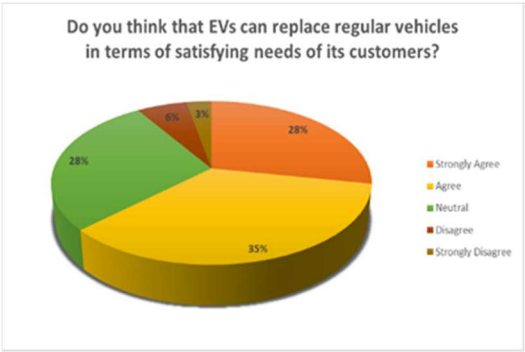


Perceived Usefulness (U) of electric vehicles is analyzed here. 94% (60% + 34%) respondents think that EVs will help to control the pollution level in the country.

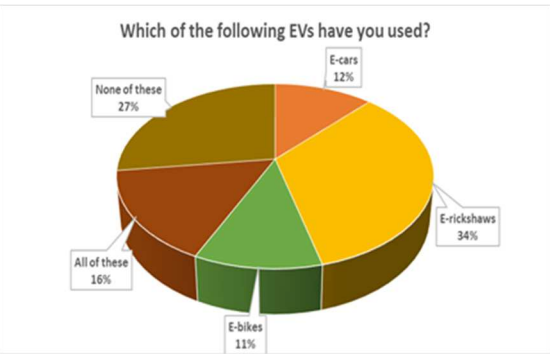
Switch Delhi campaign is creating awareness among people about how switching to EVs can help control pollution levels.



Perceived Usefulness (U) of TAM is studied here, 41% respondents find tax rebate on EVs very important and 35% find them important for their EV purchase/usage decision.

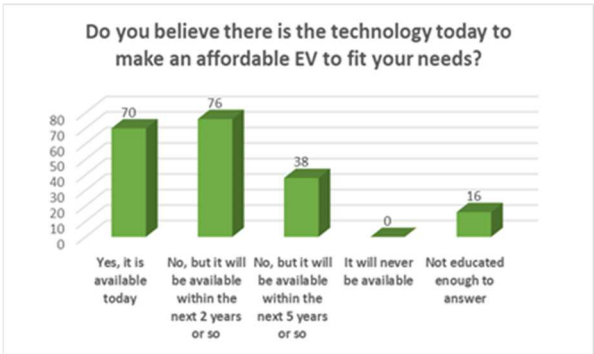


Perceived Usefulness (U) of Electric Vehicles as per TAM is again analyzed here. 63% (35%+28%) respondents think that EVs can replace regular vehicles in terms of satisfying needs of its customers.



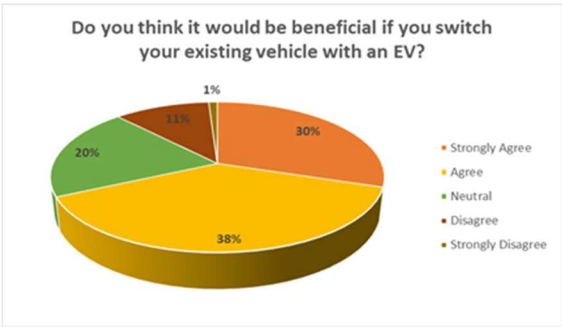
Actual System Use of Technology Acceptance Model is analyzed here. 34% of respondents have already used E-

rickshaws, 12% have used E-cars, 11% have used E-bikes and 16% have used all of these.

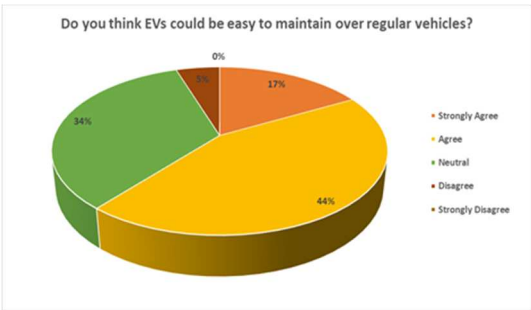


70 respondents out of 200 believe that there is the technology today to make an affordable EV to fit our needs and 76 respondents believe that such an improved technology will be available within next two years.

TAM variable of Attitude towards Using (A) is analyzed here. The attitude of consumers is acceptable and positive towards EVs as they believe that our government and manufacturers of EVs are working towards improved technology.



Behavioral Intention to Use (BI) of TAM is studied here, 30% respondents strongly agree and 38% agree that it would be beneficial if they switch their existing vehicle with an EV.



Perceived Ease of Use (E) as per TAM is again analyzed here. 44% respondents agree that EVs could be easy to maintain over regular vehicles.



