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ECONOMIC IMPACT OF TRADIONAL METHOD AND V2H CHARGING MODEL FOR ELECTRIC VEHICLES IN INDIAN SCENARIO

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Abstract

The twenty-first century is beset by several issues, one of the most pressing of which is the preservation of human life. Our inventions and innovations catapulted humanity into the modern period, but the cost was our very life. One such issue is the environmental damage caused by the combustion of fossil fuels. Electric vehicles, as an alternative, have lately gained popularity, but also add to the burden on the electric grid system. But Indian power generation heavily relies fossil fuel with the added load electric vehicles might not make desired impact. In considering a new charging model called V2H charging model had gained popularity. V2H models simply uses use a relay switch that discharges during peak load and charges during lean times. The effectiveness of these two models on Indian consumption has been investigated. These two models are also compared to the traditional charging mechanism. According to a study, the smart charging approach is more efficient.

Keywords: Electric vehicles, Non-renewable resource, and Sustainable development, V2H charging model.

1. INTRODUCTION

The transportation industry now accounts for around 14% of global greenhouse gas emissions, with that figure expected to rise to 50% by 2030. (IEA, 2007). The current transportation system, according to this calculation, is unsustainable. A change of the global transportation system is required to reduce greenhouse gas emissions, air pollution, and dependency on fossil fuels. Electric vehicles (EVs) are a viable transportation technology that, in the near future, can provide sustainable travel. Despite these potential advantages, there are considerable barriers to EV adoption, and they now account for a small fraction of all cars on the road. According to earlier surveys, the two main impediments to EV adoption are battery technical limits and high battery costs (Axsen et al., 2010). As a result, a lot of research is going into getting beyond the performance restrictions imposed by battery weight, mass, and storage space (Payton, 1988; Sovacool and Hirsh, 2009). However, we contend that this viewpoint overlooks key features of EV market resistance. It's vital to consider EVs as part of a socio-technical framework in order to bridge the technology and societal divide. "Technological, cultural, social, political, and economic constraints" are all included in the phrase "social-technical" (Sovacool and Hirsh, 2009). According to Sovacool, (2009), technologists and politicians typically segregate technical and social challenges while discussing technology advancement. However, "social" impediments might be just as troublesome as "technical" ones in the development of EVs for the general consumer market. In this study, we look at socio-

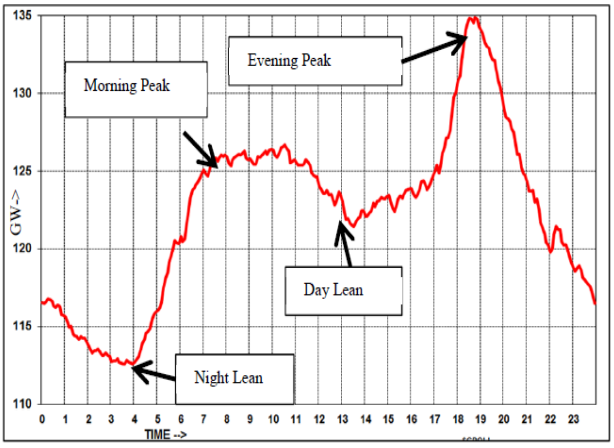
technical constraints, particularly those linked to customers' attitudes regarding electric vehicles from an environmental standpoint. Oil imports are extremely important to India's economy. India utilises about 5% of total global oil production. N. N. Dalei and A. Gupta (Dalei, N. N., & Gupta, A., 2020). According to the Economic Times, India is about to overtake China as the world's second-largest crude oil importer. Electric cars also aided China's transportation infrastructure development. (LiZ. and M. Ouyang, 2011). The electric vehicle (EV) is seen as one of several alternative approaches to reduce energy costs and carbon dioxide (CO2) emissions in the transportation sector (Li and Ouyang, 2011). Because of its low tailpipe emissions and high power drain performance, the battery-powered automobile is being explored as a solution to the present challenges connected with regular combustion engines. Despite the fact that an IC engine can only convert 33% of total energy to productive labour under ideal conditions, humanity have relied on inefficient IC engine devices for more than a century. Energy efficiency accounts for less than 15% of total energy use. In today's society, this type of failure is exceedingly expensive (Joshi, A., 2020).

As one of the world's fastest expanding economies, India has been a substantial contributor to global air pollution. (S. K. Guttikunda, K. A. Nishadh, and P. Jawahar, 2019). One of the possibilities they offered was the usage of electric vehicles for daily commutes. Because India is on a similar road to the United States, the government will have to address this issue sooner or later. All countries have pledged to minimise their use of nonrenewable resources. Nations are reducing their oil usage, demonstrating a strong commitment to long-term development. However, being a growing country, India's oil consumption has risen year after year.

Electric cars are an unavoidable technology that must be used in the future to maintain the country's long-term existence. With this aim in mind, India's National Electric Mobility Mission Plan (NEMMP) 2020 was announced in 2013. India's government aimed to sell 7 million electric and hybrid automobiles by 2020. As a consequence, the country's fuel security and oil consumption have both improved. Regrettably, the aim was not met as quickly as it should have been. (M. A. R. Kumar and D. S. Padmanaban, 2019).

Vehicle tailpipe emissions were linked to around 361,000 premature deaths worldwide from ambient PM2.5 and ozone in 2010, and about 385,000 in 2015, according to the study. 70% of these consequences were expected to occur in the four major vehicle markets in 2015: China, India, the European Union, and the United States (Susan at el, 2019). Air pollution, particularly particulate matter, is a big problem in India, and transportation is a key contributor to the country's air quality problems. Air pollution kills 1.1 million people in India each year, according to the 2017 Global Burden of Disease study, making it the country's fifth biggest cause of death. Transportation sources account for around a third of PM emissions in India, as well as a somewhat greater share of nitrogen oxides, another group of toxic substances. Due to its small vehicle fleet in proportion to its enormous population, India has exceptionally low per capita transportation emissions. The fleet, on the other hand, is continuously growing: total vehicle sales (including motorbikes) increased from over 10 million in 2007 to over 21 million in 2016, and the total number of cars on the road is expected to nearly quadruple to around 200 million by 2030.

Analysing the electricity demand pattern (Gaur, K at el, 2016) in this paper the demand for electricity of the national is analysed and they had made the following diagram.

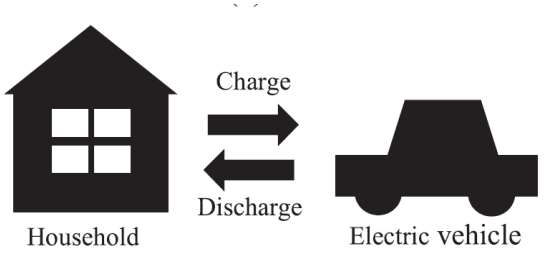


As shown in the diagram, the peak consumption starts from 6 PM to 9 PM and the lean period from 1 AM to 5 AM. This type of consumption put a lot of difficulty in the power production sector. Due to this some auxiliary power production units has to be turned on to meet the requirement of power. Also some states have imply load shedding to manage this heighted load during this peak hours. During lean time some of the generators are made to run at idle condition because that much power is not required. Load of power production capacity is underutilized due to this cycles of peak and lean time. Also some of non-renewable sources such as Solar, Wind, Tidal energies are produced during the day time and the peak consumption happen at night time.

In Japan, self-consumption of photovoltaic (PV) energy has become commercially important. Japan has set a goal of becoming renewable energy the country's principal source of power. A feed-in tariff (FIT) programme has supported PV installation in the residential sector. This method guarantees that electric power providers buy surplus PV electricity, ensuring that PV systems are viable. The cost of acquiring a unit, on the other hand, has been decreasing year after year, and it has already reached the same level as the cost of power. Furthermore, from 2019, the purchase price of properties where the FIT buying term (10 years) has finished has decreased. When the unit purchase price of PV power falls below the price of electricity, self-consumption of surplus PV electricity becomes more profitable than selling the electricity. Energy storage equipment, such as storage batteries, is essential to commercialise PV technology independently.

In the paper “Evaluation of residential power supply by photovoltaics and electric Vehicles” (Takuya Higashitani at el, 2021) studied the possibility of using electric vehicles as source to store the surplus energy produced by the photo voltaic system in japan.

This study examines the use of electric vehicles (EVs) to help India's uneven distribution of consumption. Surplus PV electricity may be stored in the on-board storage battery of an electric vehicle and utilised while driving. Furthermore, an EV can send its stored electricity to a habitation provided a power conditioning system (PCS) is constructed linking the EV to the house distribution board. This is known as a V2H (vehicle-to-home) system (S. Vadi at el, 2019). With the use of V2H technology, EVs may be utilised as domestic storage systems, similar to stationary batteries. As a consequence, the self-consumption of PV power may rise, which, as previously indicated, benefits both residences and the grid. Equipment that permits power to be delivered from an electric car to a home is known as vehicle-to-home equipment.



The purpose of the study

The purpose of this study is to see find out efficiency of the V2H charging model in Indian scenario. V2H charging model try to give back the power during the peak usage and thereby reducing the peak load. The method is trying to reduce the fluctuation by giving back the power during peak. The study try to find out the model is effective in Indian perspective.

2. Objectives

- To find effect of V2H charge model on India’s daily power consumption cycle.
- To find out whether it is more effective than tradional charging method
- To suggest government, companies and customer to implement the improved version

3. Methodology

This research is an analytical study and quantitative research method was applied. The goal of the study is to discover India's consumption patterns and to determine what

those patterns are under V2R charging model. The consumption trend of the Indian electricity sector was gathered from multiple government sources for this study. Data on energy utilization are examined. Under different method is analysed

Data Collection Tools

Data used in this research are secondary data which have been collected from other research papers as well as annual reports of different government departments. Other data are formed by the analysis of the data collected. The data are collected from ministry of statistics and programmes implementation, Ministry of power, Ministry of New and Renewable Energy and other related departments.

4. Analysis and discussions

Assumptions

Since this research try to find out the futuristic conditional we can considering electric vehicles consist of half of the total number vehicles under the category of two wheeler, three wheeler and light motor vehicles which is a probable situation in the future. Also we try to incorporate the power requirement at that time.

Also it's assumed that there is at least 20 % charge left after the give back to system in V2H Charging Model and also only 80 % of the power is used for a day by both model. Also it is assumed that 90 % of the charging happen during the night time which is after the 10 PM to 6 PM time.

Analysis

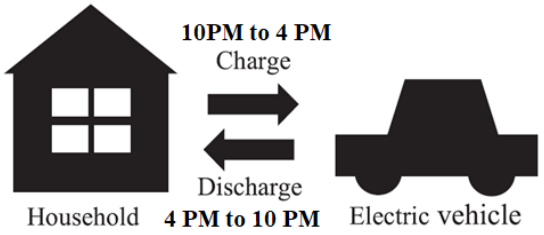
Within ten years, we expect electric vehicles to account for half of all vehicles in the two-wheeler, three-wheeler, and four-wheeler categories. According to the most recent data, India has a total vehicle population of around 295.5 million. Two-wheelers account for around 73.5 percent of all vehicles. Passenger four-wheelers account for roughly 14% of the market, while three-wheelers account for around 3%. The car sector is expanding at a 9% annual rate. Taking it into account we calculated the total number of cars in the area to be somewhere about over 700 million automobiles on the road.

Electric two-wheelers are expected to sell 257.25 million units, electric four-wheelers will sell 49 million units, and electric three-wheelers will sell 13.5 million units. (Assuming that 50% of all cars are electric.)A scooter travels an average of 4380 kilometres per year, compared to 12,000 kilometres for passenger automobiles and 5600 kilometres for three-wheelers. So the total consumption of power will be around 130 BU. So roughly around .35 BU power is demanded by EV per day.

The generation of electricity has risen at a constant pace of 5.1 percent during the previous decade. So, if we assume the same rate of increase for the following ten years, it will be about 2250 BU which means roughly around 6 BU power is consumed by India per day

V2H Charging Model

In this model, charge left inside the electric vehicles is used to power the house using V2H charging circuit. When we connect the vehicle to the plug it will act as secondary source of power for the house during the peak hours. In India the peak usage time is consider to be from 6 PM in the evening to 10 PM. Whatever charge is left in the battery of the vehicles is given back to system and it became completely empty by 10 PM. Then the circuit reconnect the device to the power source after the peak time is over. So the vehicle is charged from the power supply. Which means even we connect the device to the charger it will act as a power source. Only after 10 PM the Smart circuit will allow the vehicle to get charged. So ninety percentage of the charging happen from 10 PM to 6 AM in the morning. Rest ten percentage are mostly distributed evenly during time gap from 6 AM to 4 PM

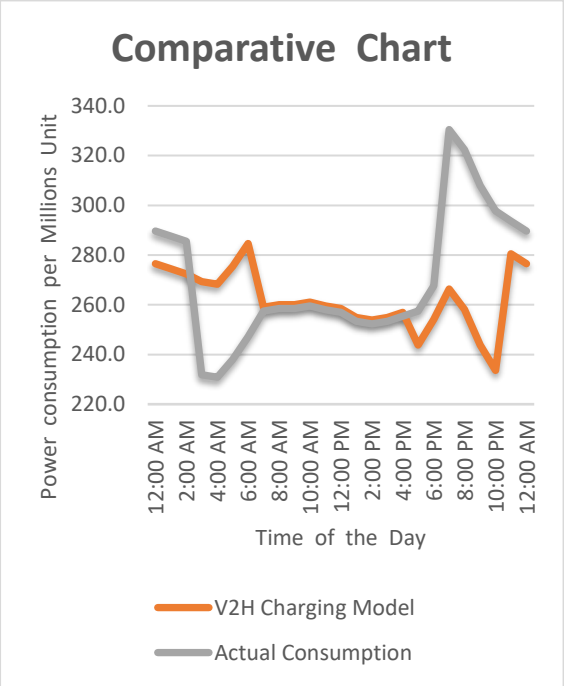


5. Results

V2H Charging Model

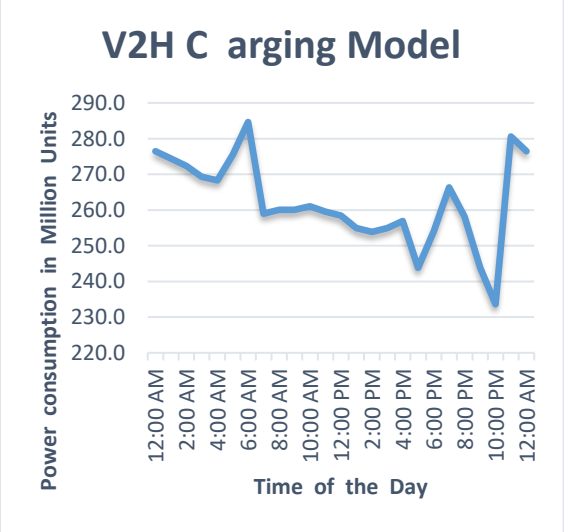
The test result of V2H charging model is shown below

Figure 4: *Smart charging Model*



As shown in the figure 3 V2H charging model least fluctuation of power consumption, peak value is around 285 MU and least value is around 235 MU.

Figure 5: *Smart charging Model*



6. Conclusion

V2H charging Model is very effective method to reduce fluctuation of power consumption. With the help of V2H charging system power fluctuation can be reduce to a great extent. Around fifty percentage of the fluctuation in power consumption can be reduced by smart charging method.

When the traditional and V2H charging Model compare, it is found out that V2H c charging model seems to be more efficient than tradional Model in Indian scenario under the given assumptions. It was capable of reducing fluctuation by f

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