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A Study on Demand Forecasting for Electric Vehicles (Ev) Charging Stations in Anathapur

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Abstract

The rapid growth of electric vehicles (EVs) is creating a strong need for reliable and accessible charging infrastructure. This study focuses on analysing and forecasting the demand for EV charging stations in Anantapur. The objective of this project is to understand charging usage patterns and estimate future charging demand based on available EV population and charging activity data. The study uses secondary data such as the number of EV charging sessions, approximate EV population, location details, and time-based charging patterns. Basic data analysis techniques such as trend analysis, graphical visualization, and regression analysis are applied to identify relationships between EV growth and charging demand. This visualization is used to clearly represent demand trends and usage behaviour. The results indicate a steady increase in EV charging demand as the number of electric vehicles grows. The analysis also suggests that charging demand is closely linked to EV population growth. The result for this forecasting shows that existing charging infrastructure may face higher demand in the future, especially in high-usage areas. This project concludes that proper planning and expansion of charging stations will be necessary to support the increasing number of EVs. The findings of this project can help in understanding future charging requirements and assist in developing efficient EV charging infrastructure in Anantapur.

Key Words: Electric Vehicles, Charging Infrastructure, Demand Forecasting, Trend Analysis, APSPDCL

INTRODUCTION

In transportation sector there is major transformation ongoing with the increasing adoption of electric vehicles (EVs). Governments and private organizations are encouraging the use of EVs to reduce air pollution, lower carbon pollution, and decrease dependence on petroleum products. Number of electric vehicles increases, the need for reliable and available charging infrastructure becomes more important.

Demand forecasting is the process of estimating future demand for a product or service using historical data, statistical techniques, and analytical models. In the process of EV charging infrastructure, demand forecasting involves predicting the future outcomes of charging sessions or energy requirements based on factors such as EV population growth, charging patterns, and trend analysis usage.

Time series analysis is a statistical technique used to analyse data collected over a period of time. It helps identify patterns, trends, and seasonal variations in the data. In this project, time series analysis is used to examine how EV charging demand changes over different months. By studying historical charging data, it becomes possible to understand whether demand is increasing, decreasing, or remaining stable.

ORGANIZATION PROFILE

Voltran Electric Pvt. Ltd. is a company operating in the electric vehicle charging infrastructure sector. The company focuses on providing reliable and accessible charging solutions to support the growing adoption of electric vehicles. With the rapid shift toward sustainable transportation, the organization aims to contribute to the development of a modern charging network that meets the needs of EV users. The company is involved in the installation, operation, and management of EV charging stations. These charging stations are designed to serve electric vehicle users in various locations such as highways, commercial areas, and public spaces. By developing charging infrastructure, the company supports the expansion of electric mobility and helps reduce dependence on conventional fuel-based transportation. Voltran Electric Pvt. Ltd. also works on improving charging accessibility and convenience for EV users. The company focuses on efficient charging solutions that reduce waiting time and ensure reliable service availability.

COMPANY NAME: APSPDCL

Board Directors: Siva Sankar Lotheti, IAS (Chairman & Managing Director)

AP Power Sector Reforms envisage creation of Distribution Companies as Government Undertakings. The Andhra Pradesh Gazette No.37 published by the Government of Andhra Pradesh on Friday the 31st of March 2000 declared formally formation of Distribution Companies. In this process, Andhra Pradesh Southern Power Distribution Company was formed for the following six districts of Andhra Pradesh. The Corporate Office and Headquarters of APSPDCL is at Tirupati City. APSPDCL was formed in April 1, 2000 to serve Krishna, Guntur, Prakasam, Nellore, Chittoor and Kadapa districts with a vision to become an efficient utility supplying reliable and quality power, promoting economic development and being self-reliant commercially. After the bifurcation of the erstwhile Andhra Pradesh into the two new states of Andhra Pradesh and Telangana on 2nd June-2014, two more districts Anantapur and Kurnool were added to the Southern Power Distribution Company of AP Ltd.

Need of the Study:

- To understand the rapid growth of electric vehicles has significantly increased the demand for EV charging stations, making efficient planning and management of charging infrastructure a critical requirement.
- To provide an analytical foundation for future EV charging stations.

Scope of the Study

- The scope of this project is limited to analysing historical data between 2024 to 2026 year and forecast future charging demand.
- The study covers the examination of charging demand patterns across different time periods, and assessment of the impact of EV adoption growth and calendar factors such as weekends and holidays.

Objectives of the Study

1. To Study historical EV charging station usage patterns across different time periods.
2. To Analyse the predictive analytics on EV charging demand using suitable forecasting models.
3. To evaluate the impact of EV population growth on charging demand.

RESEARCH METHODOLOGY

- The study is based on secondary data which is collected from Voltran charging station, Rudrampeta bypass, Anantapur.
- Websites: https://www.voltran.in

TOOLS AND TECHNIQUES

- Microsoft Excel – Data cleaning & analysis
- Python
- Power BI / Tableau – Charts and Graphs

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Techniques:

- Time-series analysis
- Regression.

LIMITATIONS OF THE STUDY

- The study is limited to specific geographical coverage at Anantapur
- The forecasting results depend heavily on the quality and availability of the collected data.
- Results from one city or station may not be directly applicable to another due to differences in urban density, income levels, vehicle mix, and infrastructure maturity.

DATA ANALYSIS AND INTERPRETATION IMPORTING AND LOADING DATA

```
import pandas as pd
import matplotlib.pyplot as plt
file_path = r"C:\Users\Admin\Downloads\new excel.xlsx"
df = pd.read_excel(file_path)
print("\n Data Loaded Successfully! Here are the first 10 rows:\n")
print(df.head(27))
```

1. MONTHLY EV CHARGING STATIONS DATA

Data Loaded Successfully! Here are the first 10 rows:

S.NO	Month	Station Id	Location	Area	EV Count	Power Kw	capacity	Charger Type	Average charging Time	Total (Approx
1	Mar-24	646680	Anantapur	Highway	510	60		DC	40 min	4310
2	Apr-24	646680	Anantapur	Highway	550	60		DC	40 min	4523
3	May-24	646680	Anantapur	Highway	470	60		DC	40 min	4520
4	Jun-24	646680	Anantapur	Highway	390	60		DC	40 min	4600
5	Jul-24	646680	Anantapur	Highway	430	60		DC	40 min	4620

6	Aug-24	646680	Anantapur	Highway	560	60	DC	40 min	4710
7	Sep-24	646680	Anantapur	Highway	390	60	DC	40 min	4724
8	Oct-24	646680	Anantapur	Highway	460	60	DC	40 min	4823
9	Nov-24	646680	Anantapur	Highway	580	60	DC	40 min	4830
10	Dec-24	646680	Anantapur	Highway	525	60	DC	40 min	4863
11	Jan-25	646680	Anantapur	Highway	600	60	DC	40 min	5200
12	Feb-25	646680	Anantapur	Highway	690	60	DC	40 min	5250
13	Mar-25	646680	Anantapur	Highway	750	60	DC	40 min	5320
14	Apr-25	646680	Anantapur	Highway	570	60	DC	40 min	5400
15	May-25	646680	Anantapur	Highway	780	60	DC	40 min	5430
16	Jun-25	646680	Anantapur	Highway	810	60	DC	40 min	5450
17	Jul-25	646680	Anantapur	Highway	540	60	DC	40 min	5456
18	Aug-25	646680	Anantapur	Highway	600	60	DC	40 min	5467
19	Sep-25	646680	Anantapur	Highway	750	60	DC	40 min	5478
20	Oct-25	646680	Anantapur	Highway	620	60	DC	40 min	5498
21	Nov-25	646680	Anantapur	Highway	700	60	DC	40 min	5520
22	Dec-25	646680	Anantapur	Highway	630	60	DC	40 min	5600
23	Jan-26	646680	Anantapur	Highway	700	60	DC	40 min	5620
24	Feb-26	646680	Anantapur	Highway	760	60	DC	40 min	5643

[26 rows x 10 columns]

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2. MONTH WISE REGRESSION ANALYSIS FOR EV COUNT

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.979490932
R Square	0.959402486
Adjusted R Square	0.919402486
Standard Error	123.2596015
Observations	26

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	8976001.766	8976002	590.8012574	2.05589E-18
Residual	25	379823.2339	15192.93		
Total	26	9355825			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Month	0.012858096	0.000529	24.3064	6.50418E-19	0.011768599	0.013947593	0.011768599	0.013947593

INTERPRETATION:

- The regression results indicate a clear and strong connection between the progression of months and the demand for EV charging services. The Multiple R value of 0.979 shows that the two variables move very closely together, suggesting that demand tends to rise as time passes.
- The R Square value of 0.959 means that nearly 96% of the variation in EV charging

demand is explained by the month variable, showing that time is an important factor influencing demand patterns. The Adjusted R Square value of 0.919 further supports the reliability of the model after considering the number of observations used in the analysis

- ANOVA results strengthen this conclusion, as the F-statistic of 590.80 and the extremely small significance value of 2.05×10^{-18} indicate that the model is statistically meaningful and the relationship observed is unlikely to occur randomly.
- Overall, the findings suggest a consistent upward trend in EV charging demand over time, and the regression model provides a dependable basis for examining patterns and predicting future demand for EV charging station.

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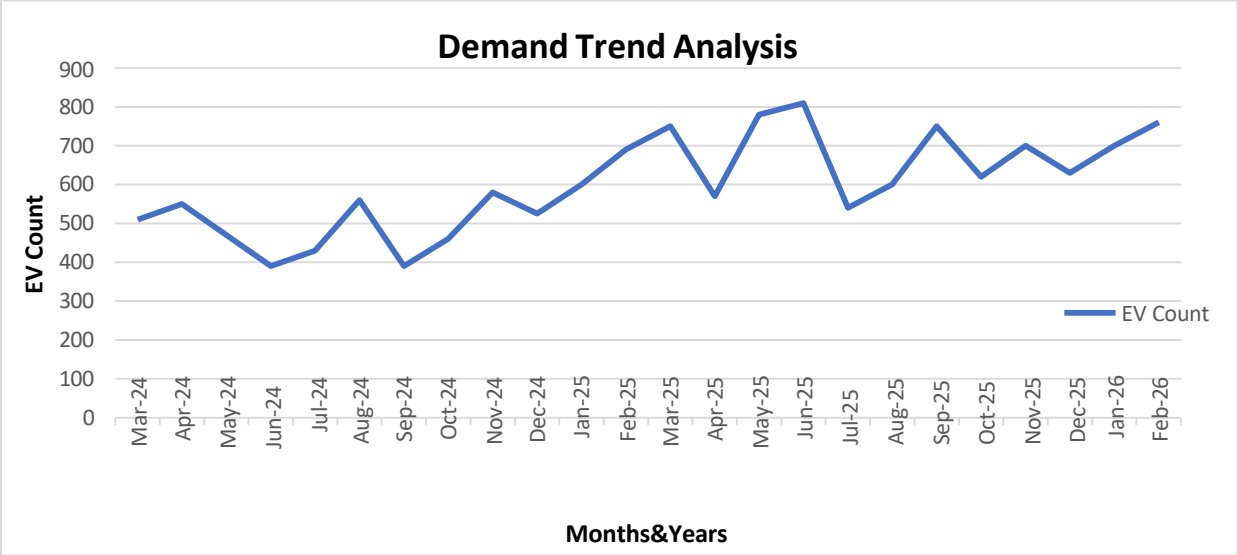
3. DEMAND ANALYSIS FOR EV COUNT OVER MONTHS TREND LINE



INTERPRETATION:

1. **Overall Increasing Demand:**

The graph shows a general upward movement in EV charging demand from early 2024 to early 2026, indicating that the number of electric vehicles using charging stations is gradually rising over time.

2. **Short-Term Fluctuations:**

Although the overall trend is increasing, the demand does not grow steadily every month. There are several increases and decreases during the period, suggesting that usage levels vary due to temporary factors such as travel patterns, weather conditions, or local EV activity.

3. **Overall Increasing Demand:**

The graph shows a general upward movement in EV charging demand from early 2024 to early 2026, indicating that the number of electric vehicles using charging stations is gradually rising over time.

4. **Short-Term Fluctuations:**

Although the overall trend is increasing, the demand does not grow steadily every month.

There are several increases and decreases during the period, suggesting that usage levels vary due to temporary factors such as travel patterns, weather conditions, or local EV activity.

5. **Peak Demand Periods:**

The highest demand appears around the middle of 2025, where EV charging usage reaches its maximum level of around 800 units. This suggests a period when EV adoption or charging activity was particularly high.

6. Sustained Growth Toward 2026:

Despite occasional drops, the final months in the graph show demand remaining higher than the earlier months. This indicates that EV charging infrastructure is likely experiencing long-term growth and may require expansion to meet future demand.

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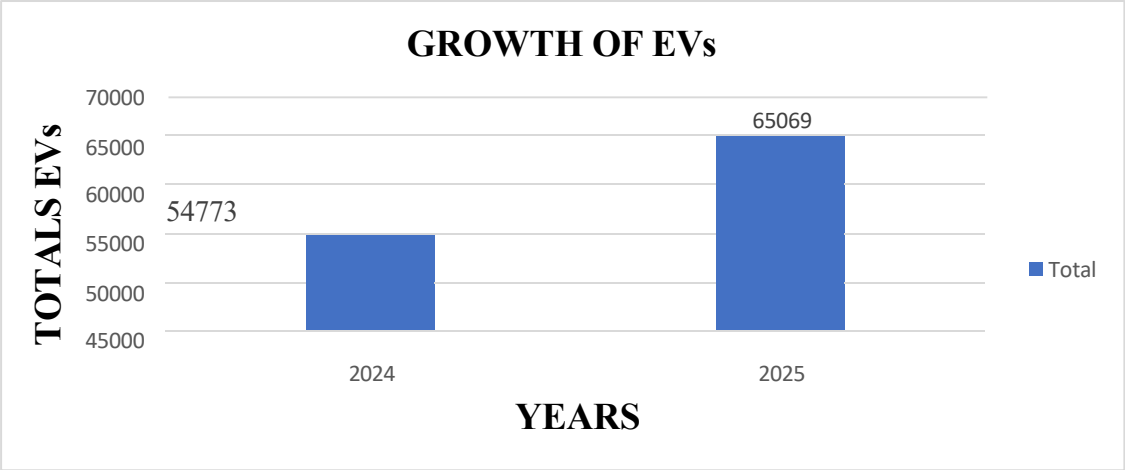
4. Year-wise Growth of Total Electric Vehicles (EVs) – 2024 vs 2025

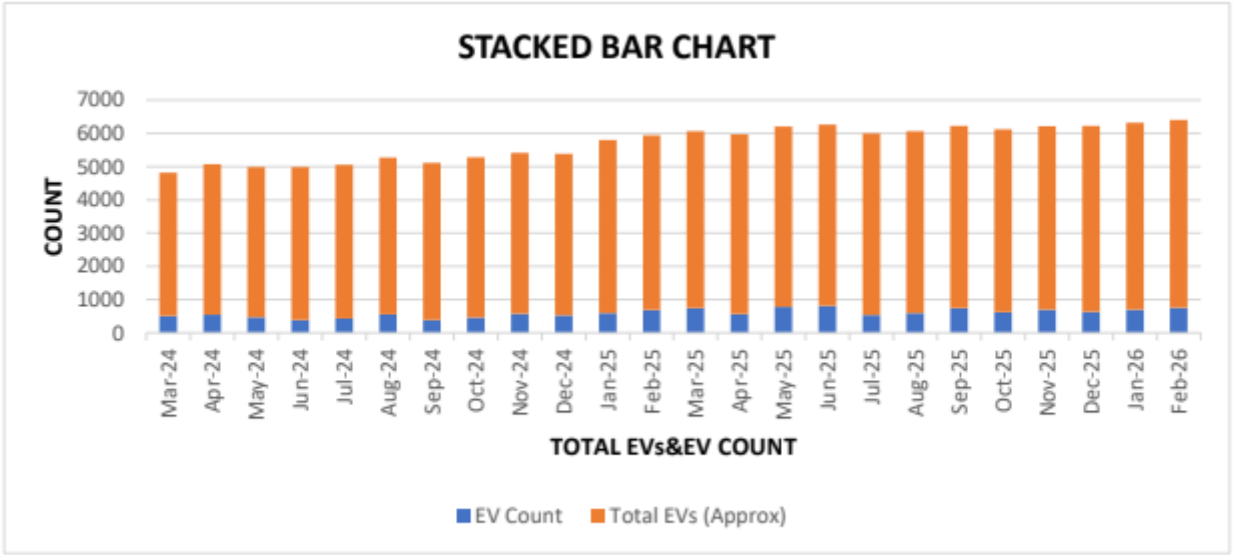
Row Labels	Sum of Total EVs (Approx)
2024	54773
2025	65069
Grand Total	**119842**



Interpretation:

- The chart shows that the total number of electric vehicles increased from **54,773 in 2024** to **65,069 in 2025**, indicating a clear rise in EV adoption within one year.
- The difference of **10,296 vehicles** between the two years highlights a strong upward trend. This growth suggests that more consumers are shifting towards electric mobility
- The rising number of EVs indicates a growing demand for **EV charging stations and related infrastructure**, making demand forecasting important for future planning and efficient resource allocation

5. STACKED BAR CHART OF EVs CHARGING STATIONS AND TOTAL EVs BY CATEGORY



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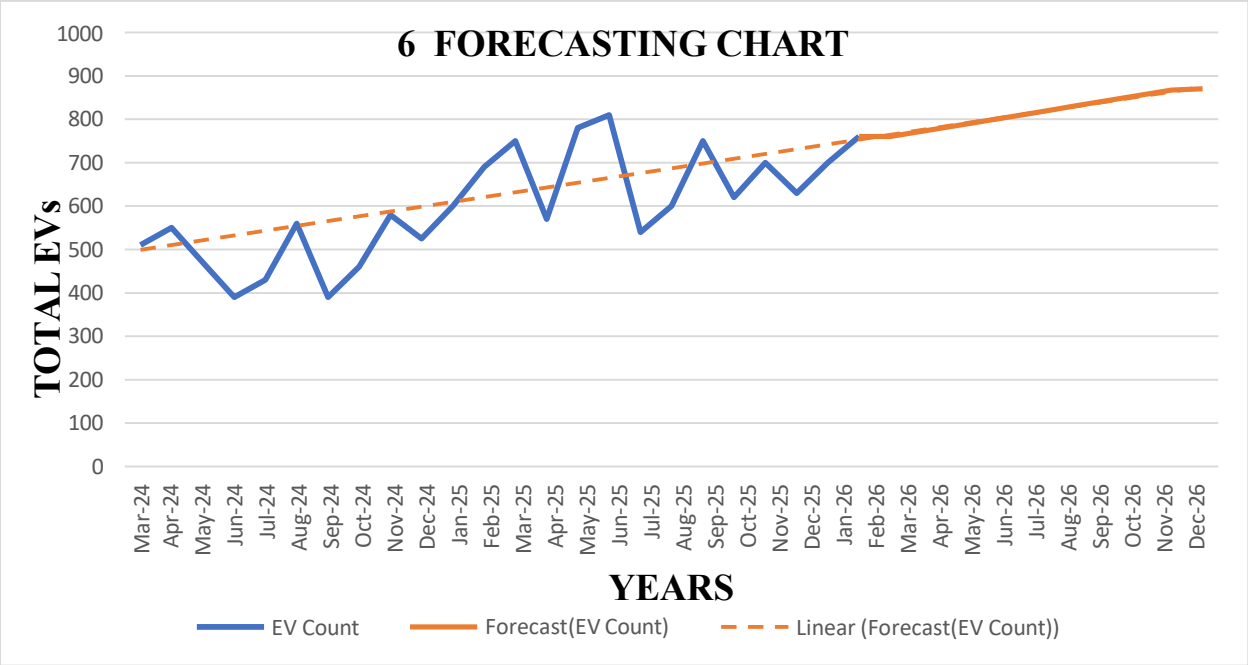
INTERPRETATION:

• Total EVs grew from ~4,310 (Mar 2024) to ~6,400 (Mar 2026) — a ~42% increase over 24 months. The steepest gains occurred between Jan–May 2025, pointing to a likely catalyst such as policy support or new model launches.

• The blue (EV Count) segment doubled from roughly 200–300 units early on to 600–700 by early 2026. This proportional growth shows that individual EV ownership is expanding in step with fleet-level totals — not lagging behind.

• From July 2025 onward, bar heights plateau in the 6,000–6,400 range. Rather than a decline, this likely reflects a healthy transition from rapid early adoption into steady, mainstream integration of EVs.23

6. FORECASTING EV VEHICLES CHARGING STATIONS IN ANANTAPUR



INTERPRETATION:

• This line chart 4.1.4 tracks the actual count of EV charging stations alongside a forecast projection, spanning from **March 2024 through January 2027** — a three-year analytical window. Three data series are plotted: the actual EV Count (blue), the Forecast line (orange), and a Linear Trend line (dashed orange).

• overall growth is clear and positive the EV charging station count is projected to nearly double from its January 2024 starting point by early 2027.

• Short-term volatility should be expected based on historical behavior, even though the forecast presents a smooth curve.

• The alignment between the forecast and linear trend suggests the underlying growth is well expansion.

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6. FORECASTING EV VEHICLES CHARGING STATIONS IN ANANTAPUR

Month	EV Count	Forecast(EV Count)
Mar-24	510	
Apr-24	550	
May-24	470	
Jun-24	390	
Jul-24	430	
Aug-24	560	
Sep-24	390	
Oct-24	460	
Nov-24	580	
Dec-24	525	
Jan-25	600	
Feb-25	690	
Mar-25	750	
Apr-25	570	
May-25	780	
Jun-25	810	
Jul-25	540	
Aug-25	600	
Sep-25	750	
Oct-25	620	
Nov-25	700	
Dec-25	630	
Jan-26	700	
Feb-26	760	760
Mar-26		750.9816055
Apr-26		762.858527
May-26		774.7354484
Jun-26		786.6123699
Jul-26		798.4892914
Aug-26		810.3662128
Sep-26		822.2431343
Oct-26		834.1200558
Nov-26		845.9969772
Dec-26		857.8738987
Jan-27		860.9389107

INTERPRETATION:

• This line chart 4.1.4 tracks the actual count of EV charging stations alongside a forecast projection, spanning from **March 2024 through January 2027** — a three-year analytical window. Three data series are plotted: the actual EV Count (blue), the Forecast line (orange), and a Linear Trend line (dashed orange).

• overall growth is clear and positive the EV charging station count is projected to nearly double from its March 2024 starting point by early 2027.

• Short-term volatility should be expected based on historical behavior, even though the forecast presents a smooth curve.

• The alignment between the forecast and linear trend suggests the underlying growth is well-approximated by a straight-line model, implying a relatively stable and predictable rate of expansion.

FINDINGS OF THE STUDY

1. The monthly EV charging count increased significantly during the study period. Early 2024 values were around 390–560 vehicles, while by early 2026 the demand rose to about 700–760 vehicles, showing a consistent increase in charging activity.
2. Regression analysis shows a very strong relationship between months and EV charging demand (R = 0.979). This indicates that as time progresses, the demand for charging services continues to rise steadily.
3. The R^2 value of 0.959 means that about 95.9% of the variation in EV charging demand is explained by the time variable, suggesting that the forecasting model is highly reliable for predicting future charging demand.
4. The total number of EVs increased from 54,773 in 2024 to 65,069 in 2025, reflecting a growth of 10,296 vehicles within one year. This growth directly increases the demand for charging infrastructure.
5. Some months in 2025 showed peak demand levels (750–810 EVs), indicating periods when EV charging stations experienced heavy usage.
6. Forecasting results predict that EV charging demand may reach around 860–870 vehicles per month by the end of 2026, showing steady expansion of EV adoption.

CONCLUSION

The Conclusion says that the demand patterns for electric vehicle charging stations in Anantapur using historical monthly data and regression-based forecasting techniques. The analysis clearly indicates that EV charging demand has been rising consistently during the study period. The statistical results demonstrate a strong relationship between time and charging demand, suggesting that the increasing adoption of electric vehicles is gradually intensifying the need for charging infrastructure. The forecasting results further indicate that this upward trend is expected to continue in the near future. These findings highlight the importance of effective demand forecasting for EV charging networks. Accurate forecasting helps infrastructure providers and policymakers plan charging facilities, allocate resources efficiently, and ensure that the growing number of electric vehicles can be supported without operational constraints. Overall, the study confirms that EV charging demand in this region is12expanding steadily and that strategic planning will be necessary to accommodate future growth.

SUGGESTIONS OF THE STUDY

1. Additional charging stations should be installed in areas with high vehicle movement such as highways, commercial zones, and urban centres to accommodate increasing demand.
2. Introducing higher-capacity fast chargers can reduce charging time and improve service efficiency, thereby supporting a larger number of vehicles.

3. Charging station operators should maintain systematic records of charging sessions, energy consumption, and vehicle usage patterns. Such data can improve the accuracy of future forecasting models.

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