POLLUTION DUE TO TRANSPORTATION IN INDIA

ABSTRACT

Transport is a fundamental requirement of modern life, but the traditional combustion engine is quickly becoming outdated. Petrol or diesel vehicles are highly polluting and should be quickly replaced by fully electric vehicles. Fully electric vehicles (EV) have zero tailpipe emissions and are much better for the environment. There is a rise in vehicular population per annum in India which has a positive impact on the Indian economy but an adverse effect on the environment . Factor like usage of private transport which is affecting pollution especially in air pollution.

BACKGROUND: We collected pollution and pollutants dataset from the time span from 1998 till 2019 of India.Our aim to study vehicular pollution impact on environment.

KEY WORDS:

Pollution, Pollutants, PM2.5, Vehicles,Electric vehicles

INTRODUCTION

Air pollution is one of the serious environmental concerns of urban Asian cities including India, where the majority of the population is exposed to poor air quality. It causes health related problems such as respiratory disease, risk of developing cancer and other serious ailments etc. and also contributes to tremendous economic loss especially in the sense of financial resources that are required for giving medical assistance to the affected people. Most of the Indian cities are also experiencing rapid urbanization and the majority of the country's population is expected to be living in cities within a span of next two decades.

Pollution is the introduction of harmful materials into the environment. These harmful materials are called pollutants. Pollutants can be natural, such as volcanic ash. They can also be created by human activity, such as trash or runoff produced by factories. Pollutants damage the quality of air, water, and land.

Pollutants produced by vehicle exhausts include carbon monoxide, hydrocarbons, nitrogen oxides, particles, volatile organic compounds and sulfur dioxide. Hydrocarbons and nitrogen oxides react with sunlight and warm temperatures to form ground-level ozone.Vehicle emissions contribute to the formation of ground level ozone (smog), which can trigger health problems such as aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses, including pneumonia and bronchitis.India today is the world's fourth most significant greenhouse gas (GHG) emitter – contributing 7.08 percent of all global emissions. It ranks third amongst countries with the world's worst air quality, and 13 of its North Indian cities are among 15 of the world's most polluted. Transportation plays a villainous role here.

PRIOR: Analysis of Vehicular Pollution on Environment

OBJECTIVES

- Pollution from vehicles
- forecasting the sales of vehicles
- implementation of EV (electric vehicles) and its impact on pollution
- to conclude on the thing that can be done to have a control on pollution

METHODOLOGY

The tools that have been used helped with analysis and prediction from the available dataset

TOOLS

1. **PYTHON**

    PACKAGES WE USED ARE:

    Matplotlib: Matplotlib is a cross-platform, data visualization and graphical plotting library for Python and its numerical extension NumPy.

    SEABORN: Seaborn is a Python data visualization library based on matplotlib. It provides a high-level interface for drawing attractive and informative statistical graphics.

    STATSMODELS: As its name implies, statsmodels is a Python library built specifically for statistics.

2. **POWER BI:**

Microsoft Power BI is used to find insights within the data

METHODS

- **GRAPHS**: Different type of graphs like bar graph ,line chart, pie chart helped us to get insights from our data set and also helped to reach better conclusions

    For example in Fig.1 we represented the effect of pollution from different sources and represented in the form of pie chart

- **REGRESSION**: Regression analysis involves identifying the relationship between a dependent variable and one or more independent variables

  In regression analysis we took dependent variable as pollution rate from vehicles and independent variable as total number of vehicles

- **TIME SERIES:** Time series analysis is a specific way of analyzing a sequence of data points collected over an interval of time. In time series analysis, analysts record data points at consistent intervals over a set period of time rather than just recording the data points intermittently or randomly.

  We used time series for forecasting the number of sales vehicles till 2040

- **STATISTICAL HYPOTHESIS :** A statement about the nature of a population. It is often stated in terms of a population parameter. Null hypothesis: A statistical hypothesis that is to be tested. Alternative hypothesis: The alternative to the null hypothesis.

  we used the test of hypothesis to analyse that is the implementation of electric vehicles are worth or not.

- **DISTRIBUTION**:

  Pollution rate at Delhi is positively skew which indicates that the pollution maintains average rate and a small number has high pollution

DATA COLLECTION

- For pollution data set

  https://timesofindia.indiatimes.com/india/pollution-news

- Electric vehicle data

  https://dazeinfo.com/2020/05/29/annual-electric-vehicle-sales-in-india-by-segment-graphfarm/

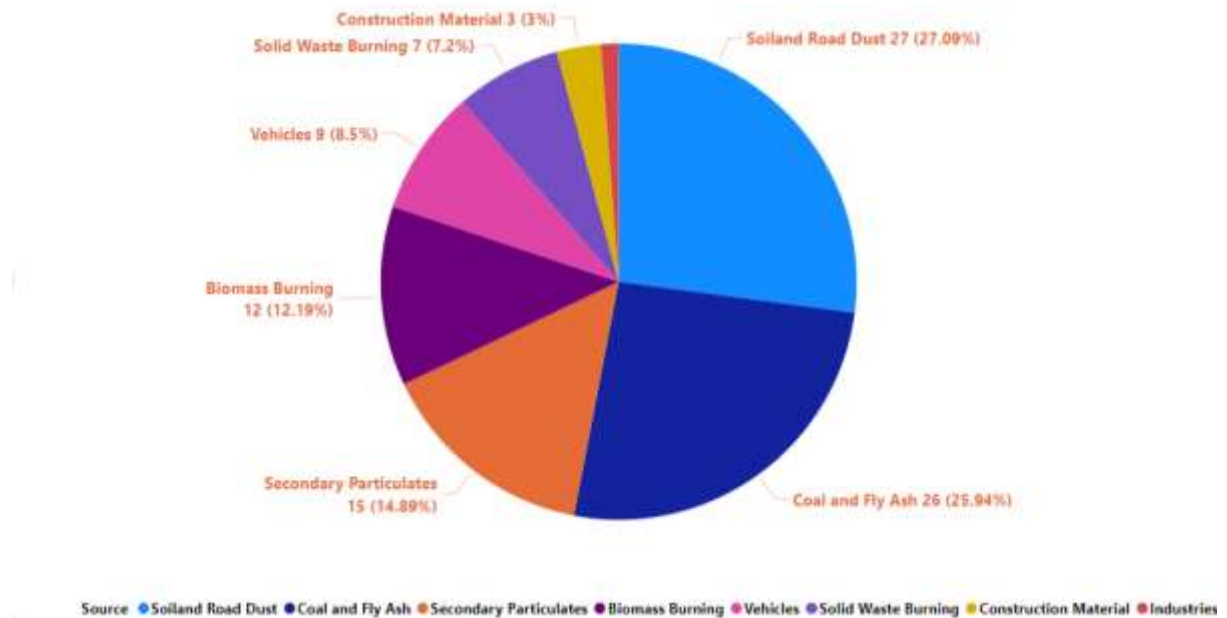# **POLLUTION FROM DIFFERENT SOURCES**

Fig.1

This pie-chart shows how various factors like soil and road dust, coal and fly ash, biomass burning, vehicles, solid waste burning and materials are affecting our environment. As we can see vehicles have a weightage of 8.5% of the total pollution.

VEHICULAR POLLUTION IN DIFFERENT STATES OF INDIA

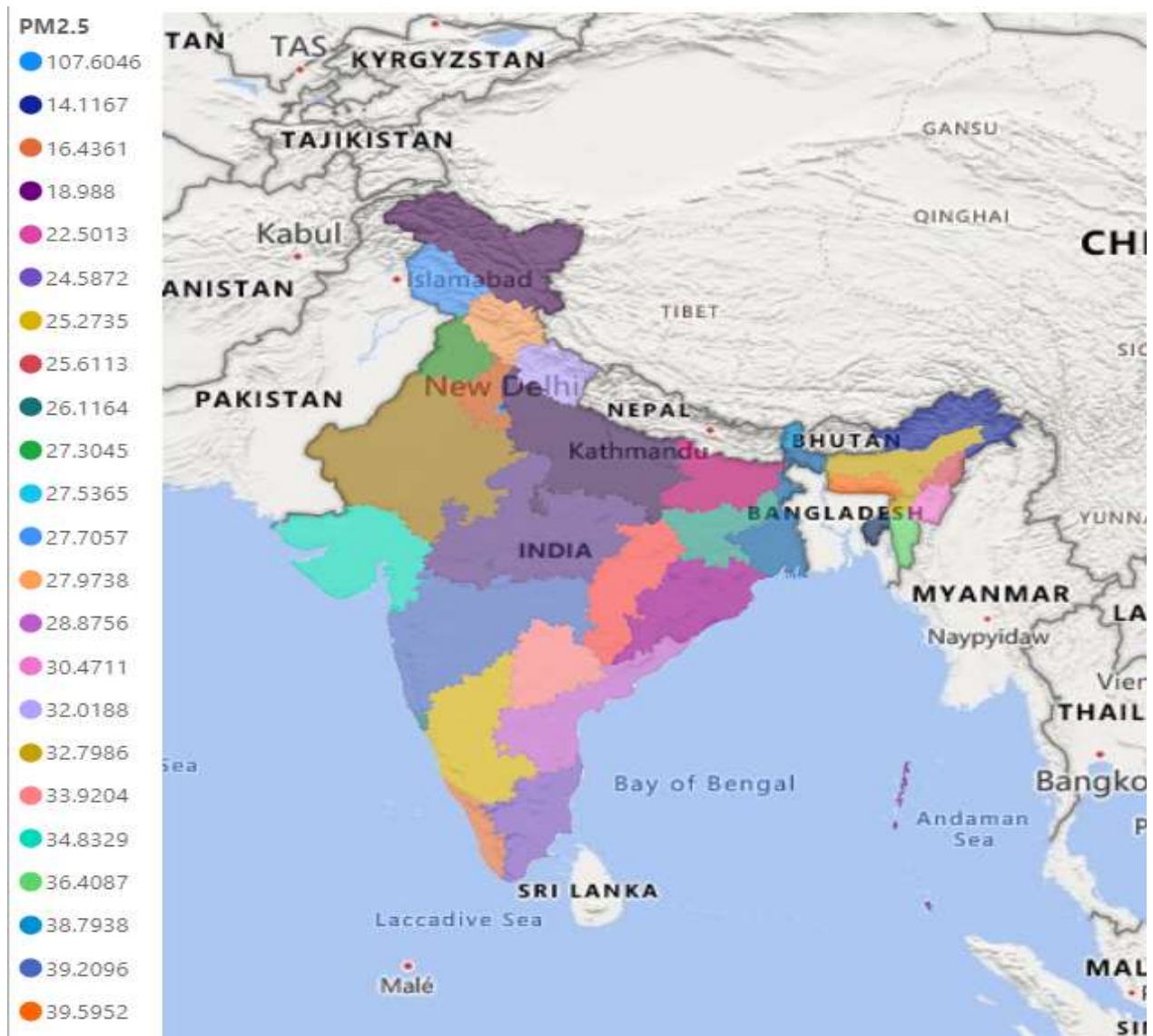● **India is today the world's second most polluted country**.

Fig.2

In the above Fig different colors are showing different pollution metrics due to vehicles. In different states of the country
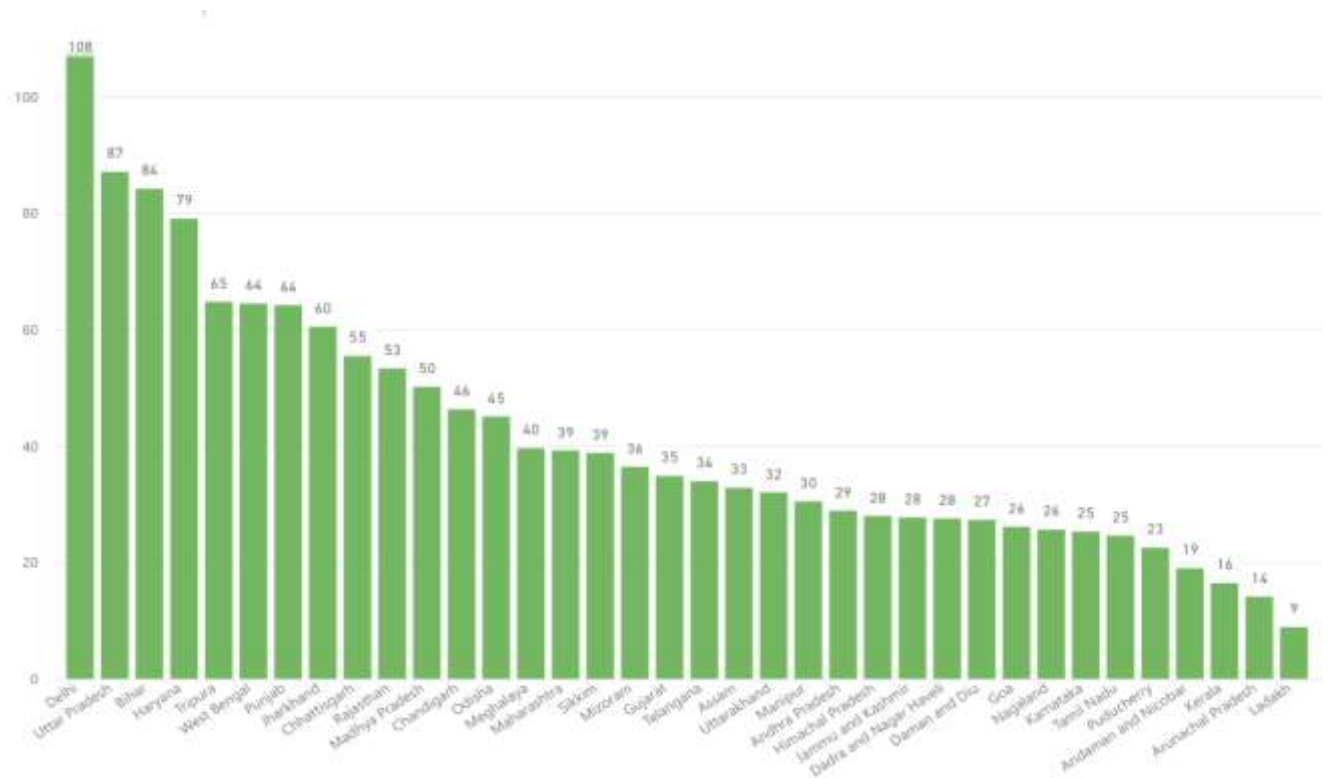
VISUALISATION

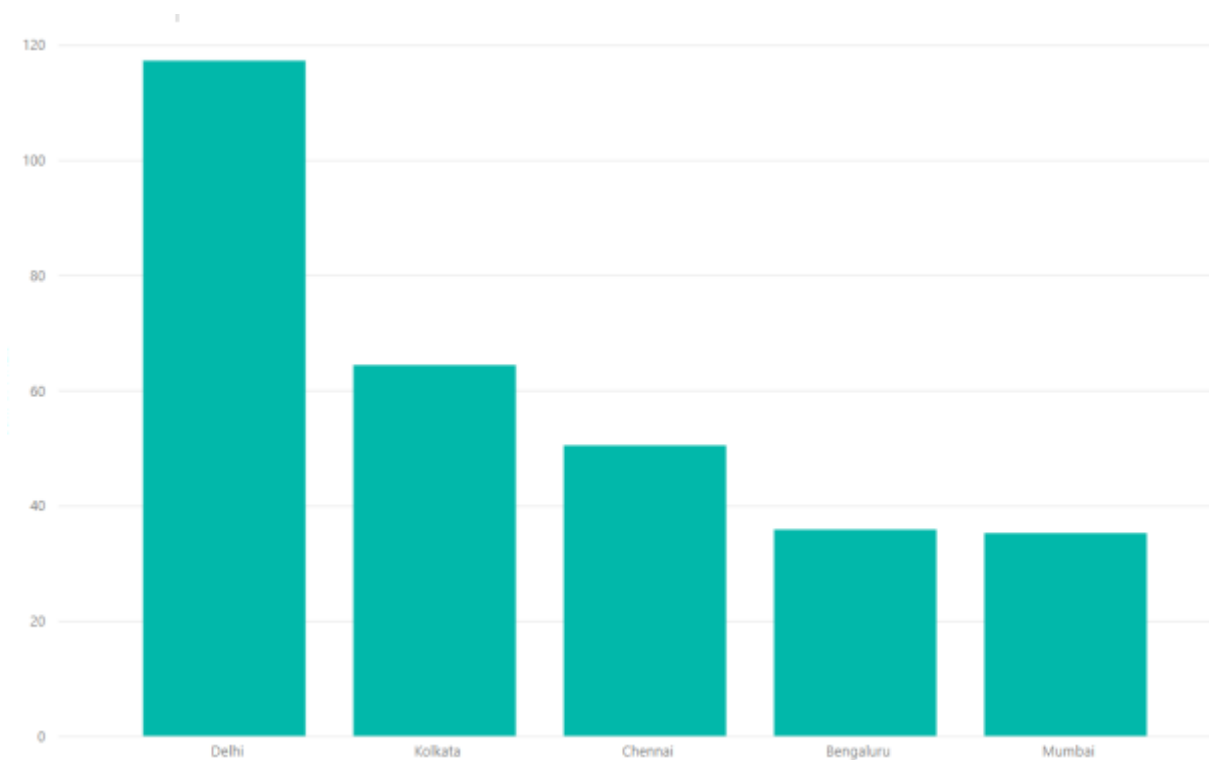Fig 3 -Graph showing vehicular pollution in different state of India

Fig.4 -Pollution in five metropolitan cities in India

From Fig3 and Fig.4 we can conclude that Delhi is the most polluted state in India with PM2.5 of 108 till 2020.The contribution of Delhi's own sources to pollution levels in the city was estimated to be around 32.9%, while the contribution from the NCR districts is likely to have been around 32.8% and biomass burning contributed around 9.5%.

- **Shapiro-Wilk normality test**

data: x

W = 0.8826, p-value = 0.09477

Conclusions:

Parameter	Value
P-value	0.09477
W	0.8826
Sample size (n)	12
Average (x̄)	318.6667
Median	319
Sample Standard Deviation (S)	121.3705
Sum of Squares	162038.6667
b	378.1838
Skewness	-0.3547
Skewness Shape	▲ Potentially **Symmetrical** (pval=0.578)
Excess kurtosis	-1.378
Kurtosis Shape	▲ Potentially **Mesokurtic**, normal like tails (pval=0.263)
Outlies	

Normal Distribution DELHI POLLUTION
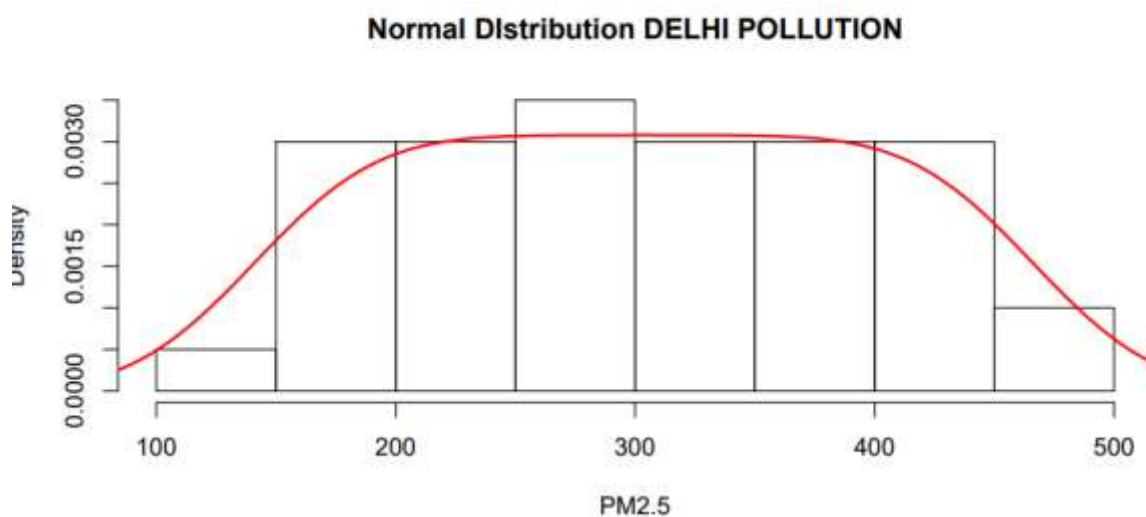
- Mesokurtic is **a statistical term used to describe the outlier characteristic of a probability distribution in which extreme events (or data that are rare) is close to zero**. A mesokurtic distribution has a similar extreme value character as a normal distribution.
- Contribution of vehicles in air pollution in Delhi is around **17% of the PM2. 5 concentration**.
- Compare to other metropolitan cities Delhi has highest pollution because Delhi is landlocked when compared to Mumbai and Kolkata so the level of pollution is more as the level of particulate matter and pollutants is not able to get discharged into the surrounding areas.
- Delhi government also implemented odd even rule under which private vehicles with registration plates ending in odd numbers could run on odd dates, and even numbers on even dates ,to reduce the pollution.
- Studies and research done on its impact in Delhi suggest positive results — from reduction in congestion to a slight drop in pollution levels and consequent improvement in air quality

VEHICULAR POPULATION

In India, the vehicle population is growing at the rate of over 9.2% per annum and vehicle population is approximately 295.8 million (2019),279.11 million (2020). Which is a good sign for the economy of our country but for the environment it's a dangerous effect. As there is a rise of vehicles there will be a rise of vehicular emissions which will lead to more pollution.
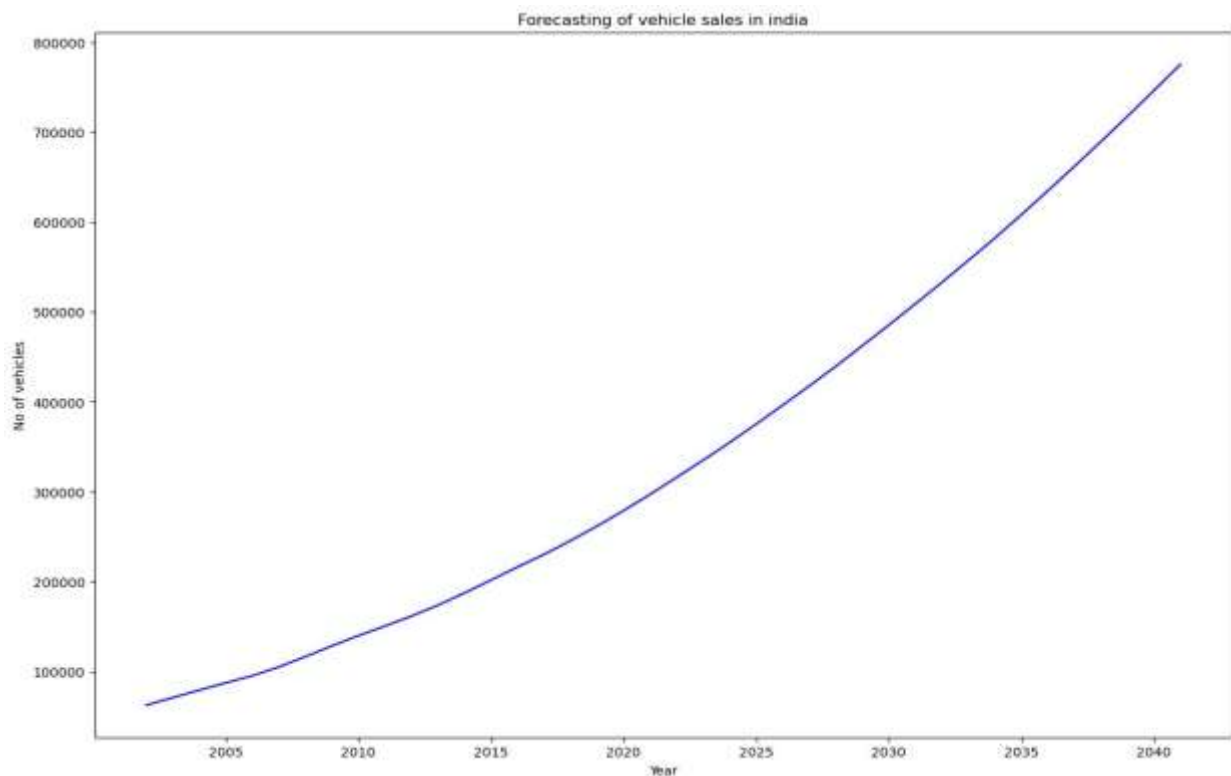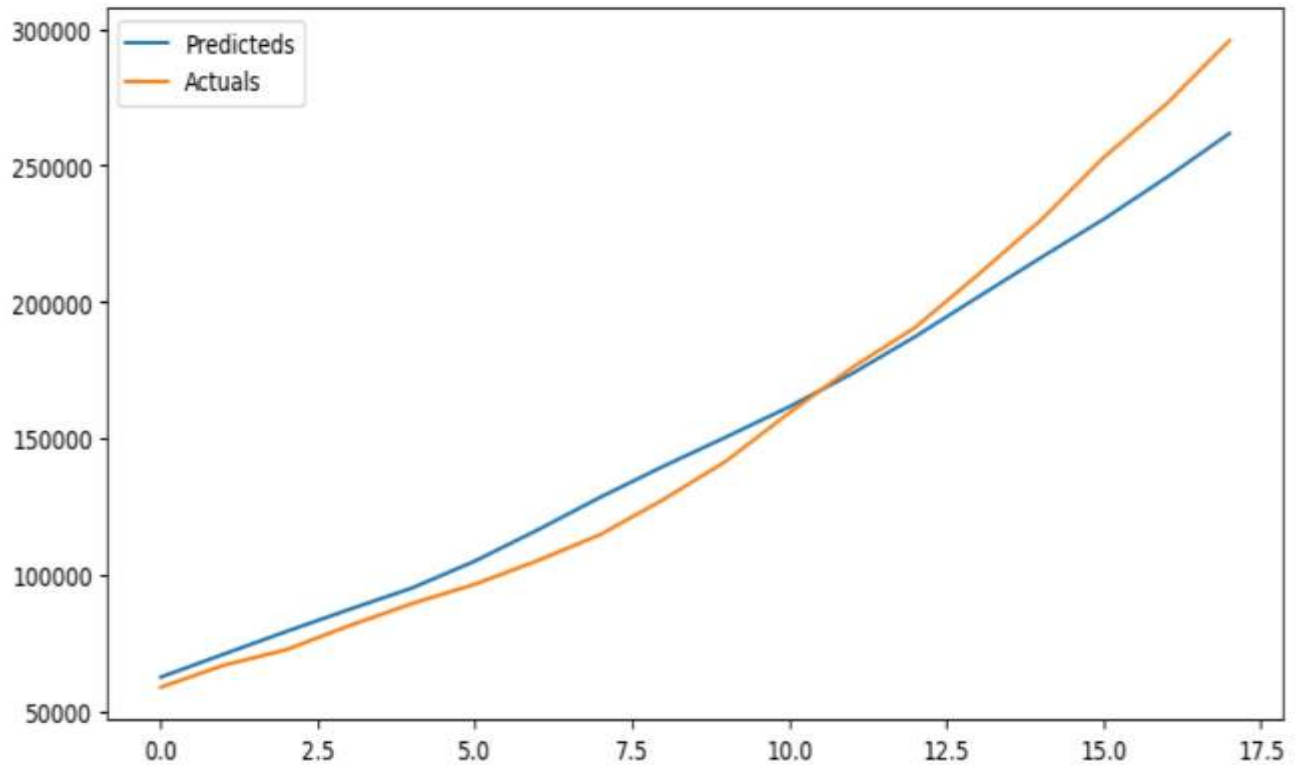
TIME SERIES ANALYSIS

Fig.5

Fig.6

We can infer from this time series graph that the annual number of automobiles sold out will rise exponentially.

POLYNOMIAL REGRESSION MODEL

The goal of regression analysis is to model the expected value of a dependent variable y in terms of the value of an independent variable (or vector of independent variables) x
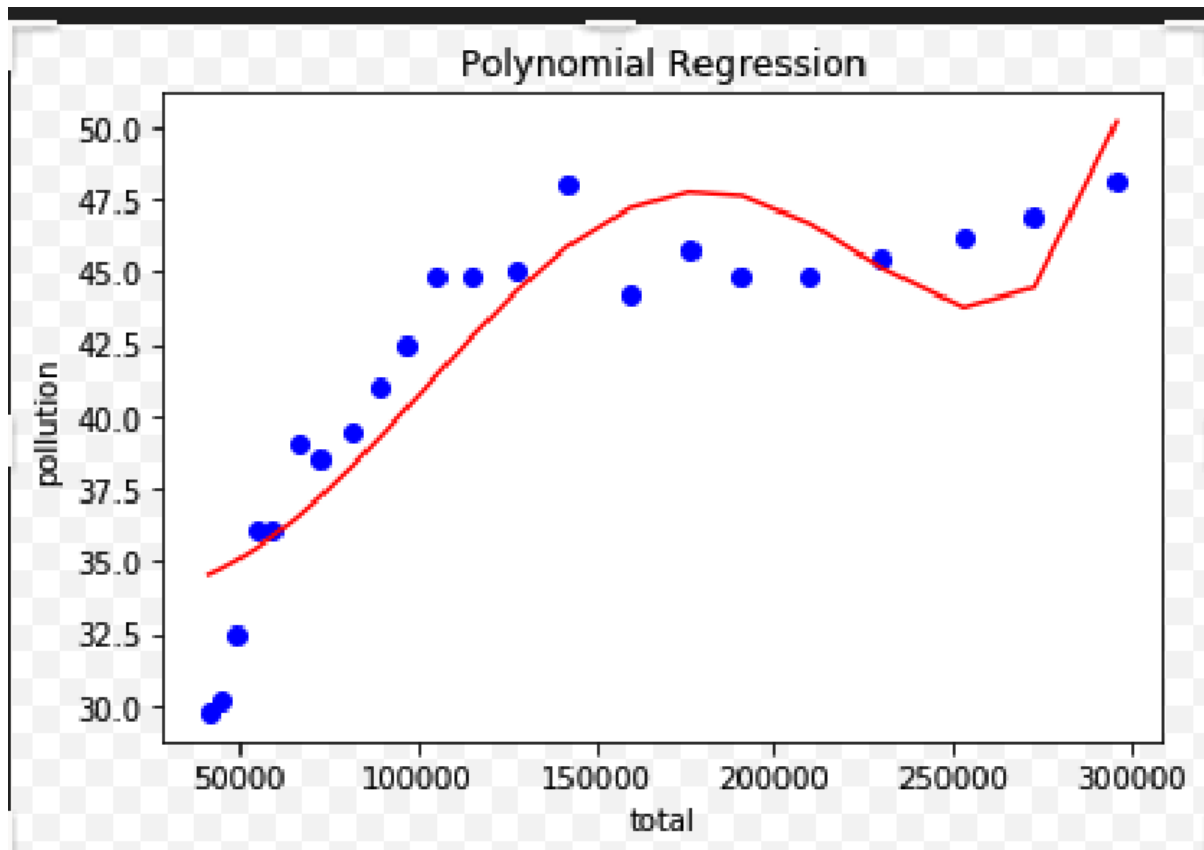
Fig.8

DEPENDENT VARIABLE: Pollution

INDEPENDENT VARIABLE: Total

Accuracy of our Model: 98.33%

```
In [5]:
from sklearn.metrics import r2_score
mymodel = np.poly1d(np.polyfit(x, y, 10))

score=r2_score(y, mymodel(x))

In [6]:
score*100

Out[6]:
98.33399747224418
```

Predicted value

year	Predicted pollution
2026	268.179
2027	397.42
2028	581.780

2029	845.323
2030	1200.182

If the vehicular pollution isn't controlled it might reach an adverse level of 1200.182mu/g which will lead to lot of environmental problems.

VEHICULAR POLLUTION

Emission from the road transport sector depends mainly on the fuel. Apart from type of combustion engine, emission mitigation techniques, maintenance procedures and vehicle age. Diesel is used as fuel in public transport and in cargo vehicles, cars and jeeps, used as gasoline. The major pollutants emitted from road transport are CO_2, CO, NO_x, N_2O, SO_2, VOC, PM, and HC.

PARTICULATE MATTER 2.5

 Vehicular emission contributes **to** particulate matter 2.5 (particles of size less than or equal to 2.5 micrometres). So, throughout our analysis we are only comparing with the pm2.5 metric.

CARBON MONOXIDE

Breathing air with a high concentration of CO reduces the amount of oxygen that can be transported in the blood stream to critical organs like the heart and brain. At very high levels, which are possible indoors or in other enclosed environments, CO can cause dizziness, confusion, unconsciousness and death
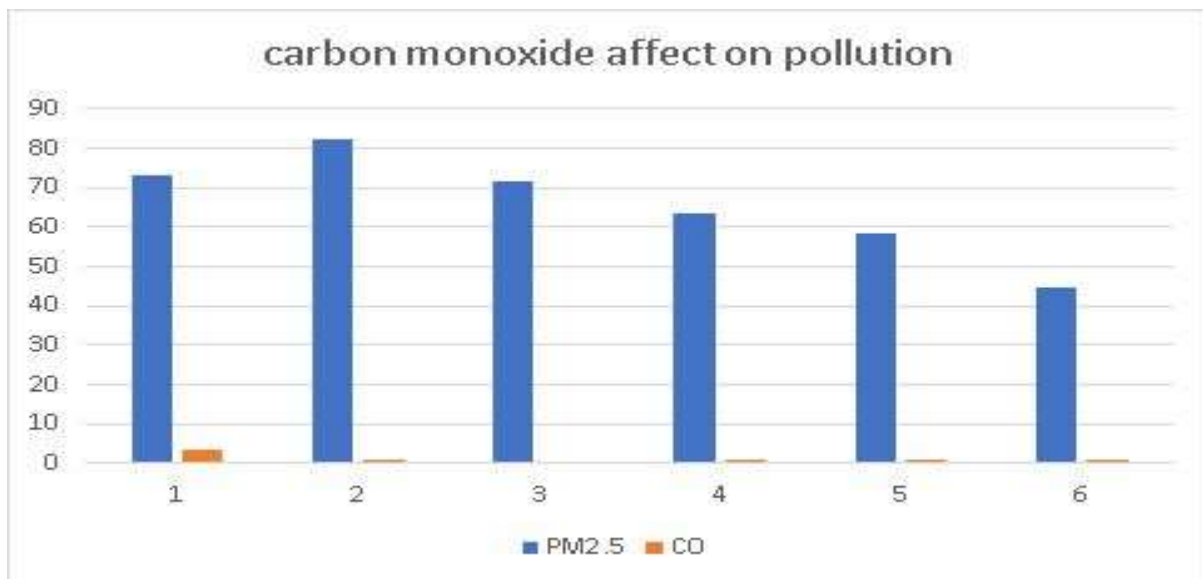

Fig.8

CARBON DIOXIDE

Carbon dioxide (CO2) is one of the primary constituent of vehicles emission. Today motor vehicles are estimated to contribute nearly 24 per cent of the Worlds direct CO2 emission. While these may not pose any immediate health hazards, their increasing build-up catalyses global warming, furthering climate change.

NITROUS OXIDE

Nitrous oxide (NOx) arises from the high-temperature combustion of fossil fuels and further contributes to ozone generation. Indian cities like New Delhi, Bangalore, Mumbai, and Kolkata have some of the highest sources of NOx in the country, linked exclusively to vehicular pollution. An excess amount of NOx gives rise to ground-level ozone. Although not directly emitted from
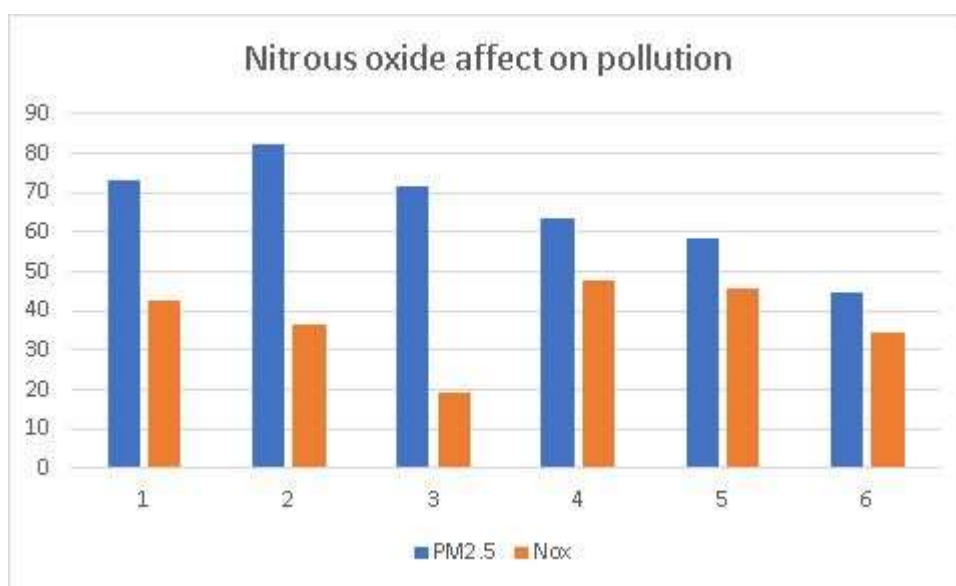

Fig.9

SULFUR DIOXIDE

When sulphur dioxide combines with water and air, it forms sulfuric acid, which is the main component of acid rain.
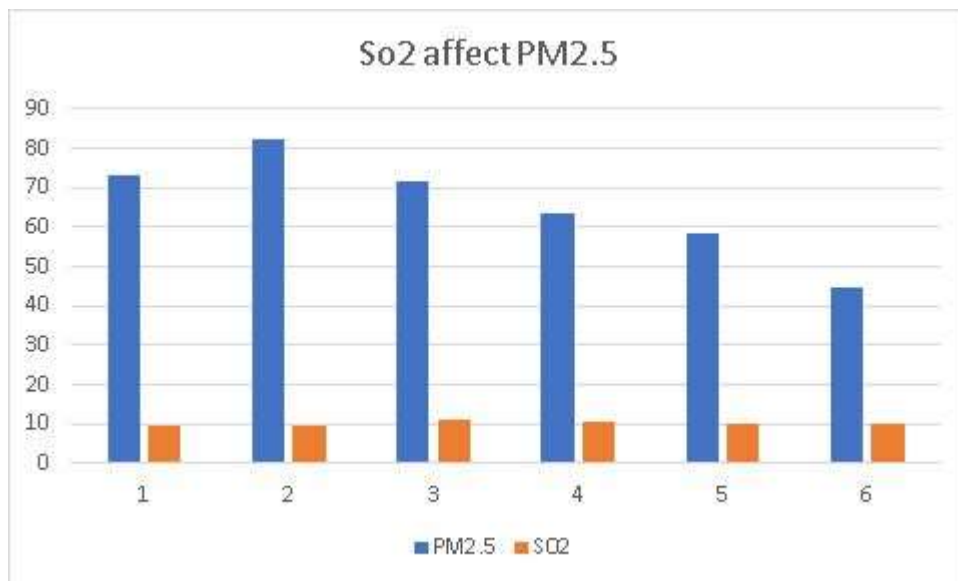
Fig.10

From the pollutants graph as we NO2 is the most harmful Pollutant as it has the higher amount of impact on PM2.5.

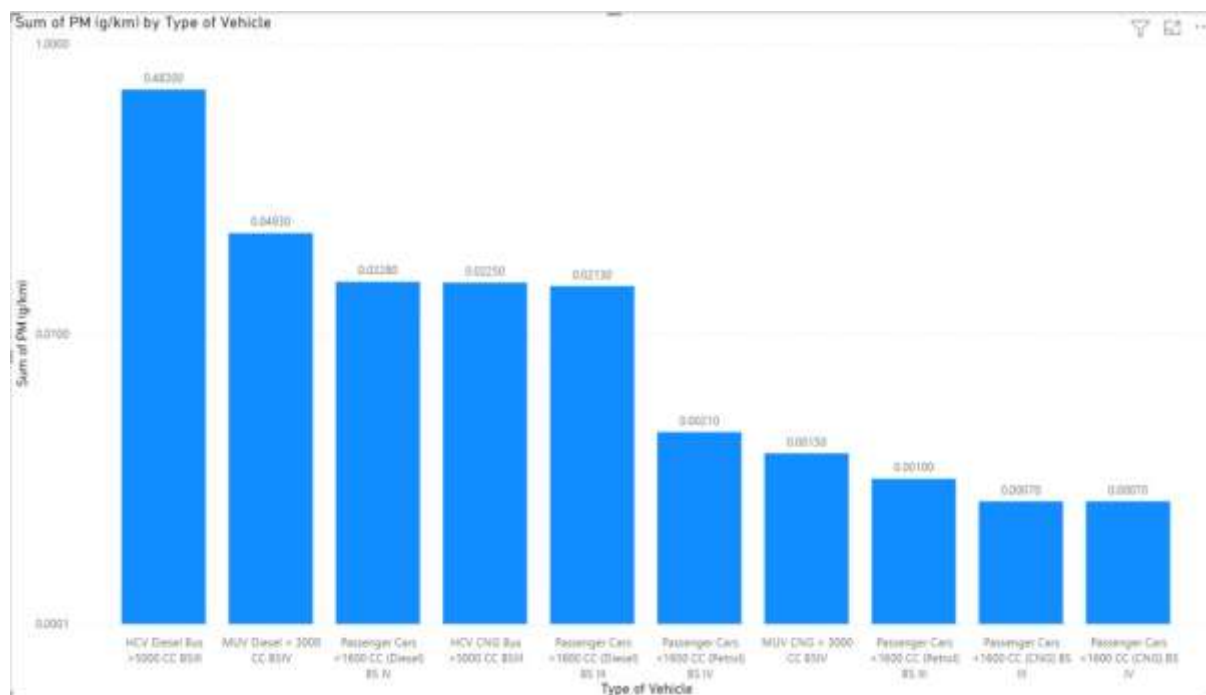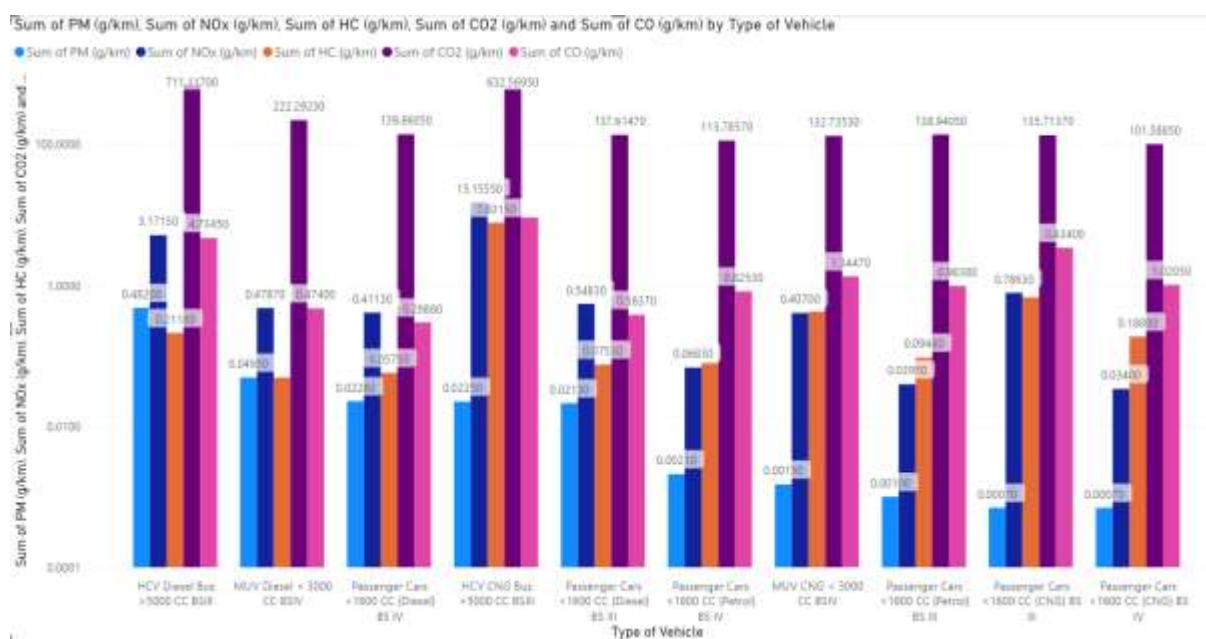**TYPES OF VEHICLES AND ITS HARMFUL EMISSIONS**

Fig.11

Fig.12

**From Fig 11 we can say that HCV(heavy commercial vehicles)
CNG AND DISEAL BUSES are the most harmful vehicles as we
can see from fig 12 that they also emit harmful gases as No2.**

BENEFITS OF ELECTRIC VEHICLES IN ENVIRONMENT

According to research, electric vehicles are more environmentally friendly. Compared to gasoline or diesel cars, they release fewer greenhouse gases and air pollutants. Additionally, this accounts for the electricity needed to maintain them through manufacturing.

Are electric vehicles more environmentally friendly?

The main advantage of electric vehicles is the improvement in air quality they may bring to urban areas. Pure electric vehicles emit no carbon dioxide when driving because they have no tailpipe. As a result, air pollution has greatly decreased.

So, the Indian Government implemented electric vehicles in the market to reduce pollution.

HYPOTHESIS TESTING

Null hypothesis: we expected an impact on pollution after electric vehicles came into picture.

Alternative hypothesis: We don't have an impact on pollution after using electric vehicle

Fig.13

REASON

    Two Sample t-test

data: x and y

x is number of electric vehicles

y is the pollution

t = 2.457, df= 16, p-value = 0.02581

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

  7559.313 102629.247

sample estimates:

  mean of x   mean of y

55140.22222   45.94189

there is a statistical difference between the two means that mean that there is a no impact of electric vehicles on pollution

Also, we can see from the graph, none of the other vehicles are less than the electric vehicles.

We are rejecting the null hypothesis, as we can see the rise of electric vehicles is not decreasing the pollution as there is a constant rise of other vehicles.

so, we reject null hypothesis.

Electric vehicles and the UK's Net Zero goal

The Mayor of London claims that about half of the air pollution in the city is caused by the transportation sector. It seems sense that the UK government and local governments would like to see more electric vehicles on the road. By 2040, the UK government wants to outlaw the sale of gasoline and diesel vehicles. Electric vehicles will play a significant role in the government's effort to decrease carbon emissions to zero by the year 2050.

PROJECT SUMMARY

- Vehicles are the reason for most harmful emissions of pollutants in the air.
- Delhi is the polluted state of India.
- Delhi pollution isn't controlled then there will be a rise in different types of diseases.
- Vehicular population is increasing annually, it declined during covid time but post covid it's increasing
- From our forecasting model we can see that there will be exponential growth in the sales of vehicles.
- No2, CO, CO2 are the most harmful pollutants that are being emitted from vehicles.
- Different types of vehicles have different types of emission, have cog and have diesel bus have the most harmful emission; it would be really helpful if we are able to find the alternative of these vehicles.
- Implementation of electric vehicles couldn't perform well as the number of other vehicles had more rise than the electric vehicle

CONCLUSION

Vehicular pollution is something that can't be controlled over a short period of time, it needs proper planning and implementation as there are a lot of factors that are affecting the pollution. Removing a certain type of vehicle will lead to different kinds of problems. Electric vehicles don't have many models so switching into it won't be an easy task.

Small things that can be done from which we can tend to control vehicular pollution are

- Switching to private transports, using a smaller number of cabs and two wheelers.
- Using cycles instead or motor vehicles at least for a smaller distance.
- Using fuels which emits a smaller number of pollutants.
- Avoid idling. That means don't waste fuels by burning it when you aren't moving.

BIBLIOGRAPHY

- Neeta (2017 December 12) AIR POLLUTION DUE TO ROAD TRANSPORTATION IN INDIA: A REVIEW OF ASSESSMENT AND REDUCTION STRATEGIES. ResearchGate. https://www.researchgate.net/publication/321747878_AIR_POLLUTION_DUE _TO_ROAD_TRANSPORTATION_IN_INDIA_A_REVIEW_OF_ASSESSMENT_AND _REDUCTION_STRATEGIES

- BENEFITS OF ELECTRIC VEHICLES (niti.gov.in)

- Pollution level in Delhi Today: Air Pollution Level and Air Quality Index in Delhi NCR (indiatimes.com)