1. In this presentation, we are going to talk about the UK’s electric vehicle support infrastructure and the required infrastructure to meet this demand.
2. For the basic analysis part of this case study, I have chosen “Regional traffic: by vehicle type”, which consists of 231 rows and 13 columns. As the data has already been pre-processed and checked, this does mean the dataset is ready to use and no more pre-processing is required.
3. I have created graphs to summarize the data within the dataset. The first graph plots the annual mileage driven by different vehicle types. As you can see, the mileage for all the vehicles types has decreased in 2020 except for pedal cycles, where it sees a 45.7% increase in mileage. Car traffics decreased by 24.7%, Van decreased by 9.1% and Lorry decreased by 5.7%
4. For all motor vehicles in every region, the South-East part of the UK remains the highest in mileage and the North-East remains the lowest. There is also a significant drop in mileage for all UK regions in 2020.
5. If we observed the region to region mileage for different types of vehicles in 2020, cars and taxis stand the highest in mileage in every region, with Large goods vehicles standing in 2nd place.
6. The fourth graph of this presentation is the annual mileage for all motor vehicles, where 280.5 billion miles were driven on UK roads in 2020, a 21.3% decrease compared to the previous year. The major factor that caused the decrease in traffics is due to the COVID-19 lockdowns.
7. There were several good models to choose from for forecasting the change in traffic. I had chosen to use Prophet as my model to predict and forecast the change in traffic. The reason being is that it is widely used by Facebook for generating accurate forecasts and by many data scientists in the past. It is also very easy to use, and setting the hyperparameter requires minimal effort to do so. The model itself is also suitable for univariate time series datasets, such as the dataset that I am using at the moment.
8. Prophet forecasts the change in traffic for the next 30 years to 2052. The blue line in the graph shows the general trendline, and the shaded part shows the confidence interval, which is set at 80%. I have abandoned the idea of different seasonality forecasts, due to the model fluctuating too much in predicting daily and weekly seasonality.
9. For the research part of this case study, I have been researching the government's plan of Shifting to Zero-Emission Vehicles, where the project plans to convert the entire fleet of vehicles in the UK to electric. The document mentions the possible implementation of government policies and grants, more reductions in EVs purchases and maintenance, and increase accessibility by increasing the number of charging ports in parking spaces etc.
10. By using the changes proposed in this document, it is possible to calculate and forecast the total millage that would be electric between the years 2022 to 2052.
11. Using this estimation, we can also estimate the energy required to power the electric vehicle fleet, assuming that the average energy consumption of 314 Wh/mile. The graph at the right shows the total energy consumption in TWh in the 30 years forecast
12. Looking at the supply and demand of the UK’s energy, the electricity margin lands between 5 TWh. Using this value, it is possible to calculate the additional energy required to power the fleet. The additional power requirement in the year 2052 peaks at 93 TWh
13. By comparing my forecast with independent estimates such as National Grid, it can be seen that the trend shares similar characteristics. However, National Grid predicts a lower demand across the years.
14. In the recommendation part of this case study to meet the electricity demand, I have studied the statistics provided by the Department for Business, Energy & Industrial Strategy and calculated the estimated pricing for implementing different power generating over the next 20 years.
15. By using the additional power demand in the year 2040 in every region and the predicted pricing in the BEIS forecast report for solar power, it is possible to find the region-to-region cost estimate of using fully solar power. The range of the cost is estimated to be from £120 million to £580 million per region.
16. For renewable energy, the weather condition significantly affects the energy generation of renewable energy. My recommendation for this problem is to observe the geology of the location before implementing renewable technology. For inland regions, it would be more suitable to use onshore wind and solar power. For seaside regions, offshore wind farms are recommended.
17. Looking into the time of day charging problem, the power grid should be able to withstand peak demands. The largest peak demand can be observed at around 10 pm. Due to the grid not having enough energy storage facilities, constant energy generation must be supplied to meet this demand
18. My recommendation on the proportion of technologies used to generate the additional energy requirements are 35% offshore wind power, 25% onshore wind power, 25% Combined Cycle Gas Turbine + Carbon Capture Storage post-combustion power and 15% Solar power. Using these percentages, the cost estimation of the recommendation is calculated. The average region cost ranges around £358 million.
19. Another recommendation that I wish to comment on is to increase the number of the implementation of renewable energy as it produces cheaper electricity. For peak demands, it would be more suitable to use more traditional and costly technologies. It is also recommended to combine both of these technologies for maximum effect in power generation, due to unstable weather in the UK.