Executive Summary – Electric Vehicle Support Infrastructure

The required data to analyse the trends in annual mileage of motor vehicles was sourced from the Road Traffic dataset (Department of Transport, 2021). The dataset required basic cleaning to identify key pieces of data such as the AADF of each vehicle type (by body shape) the link length of each count point (unique road identifier), and road type (major or minor). The AADFs of major roads were then multiplied by the link lengths of their respective roads for 365 days (Department for Transport, 2019), to obtain the expected annual mileage. The methodology to calculate annual mileage for minor roads required the changes in total minor road length per year and the weights of each vehicle type as a percentage out of total motor vehicles. The following formula was used to estimate annual mileage for minor roads: **Annual Mileage** (Current Year) = **Change in Minor Road length** x **Vehicle Type Weight** x **Annual Mileage Estimate** (Previous Year). The estimated annual mileage for minor roads was then summed with the annual mileage for major roads to produce expected annual mileages for all roads per year. The dataset was then grouped by region and vehicle type according to the specification. Line plots and bar plots were produced to identify trends in the data per vehicle type and region respectively. Both plots showed that there was a gradual increase in annual mileage up to 2019, but due to the lockdown measures established to inhibit the spread of COVID-19 (Department of Transport, 2020), annual mileage in 2020 had dropped significantly by approximately 20%.

A variety of regression techniques were used to predict annual mileages of motor vehicles from 2020 to 2050. These techniques include linear least-squares regression, ARIMA and SARIMA forecasts. Least-squares regression failed to capture the trends in the data so was swapped in favour of ARIMA forecasts. Whilst ARIMA fit the training data accurately, it was unable to simulate the seasonality in the data, so ultimately a SARIMA model was used with seasonal periods of m = 10. The parameters P, D, and Q were chosen optimally using a grid search algorithm that identified parameters with the lowest AIC. The SARIMA model was then used to forecast annual mileages for each vehicle type (including all motor vehicles) and predicted total annual mileage to be approximately 400 billion miles in 2050 which matches results published online (GoCompare, 2021). From the predictions, it is evident that the expected increase in annual mileage is largely contributed by Light Goods Vehicles and Cars/Taxis. It is important to note that these estimates are limited by a lack of accurate data on minor roads and are also not representative of external factors such as pandemics which may cause significant drops in annual mileage.

The UK is planning the mass adoption of electric vehicles in efforts to become more environmentally friendly. In order to successfully carry out this large-scale project, the Government need to ensure that the National Grid is capable of supplying enough energy to meet the surge in electricity consumption due to electric vehicles. By predicting the number of electric vehicles from 2020 to 2050 through fitting a curvilinear regression to electric vehicle registration data, I have estimated that by 2050 approximately 65% of all vehicles will be electric. I have estimated the additional electricity to supply these vehicles to be roughly 78TWh by multiplying the share of electric vehicles by the estimated annual mileages from 2020 to 2050. These estimates were then compared with those published by Ofgem's claims of electric vehicles requiring additional electricity in the range of 60-100 TWh annually (Ofgem, 2021).

I have researched appropriate generation technologies to generate the additional electricity required by electric vehicles. I determined that the National Grid was comfortably capable of handling the increased demand due to EVs because of the government's plans to create mass offshore wind farms (National Grid, 2020). The arrival of new technology such as 'Smart Charging' and 'V2G' (vehicle-to-grid; Pickett et al., 2022) will ensure that the national grid can handle the charging of EVs even during peak charging hours. I propose that to cover the additional electricity required by EVs, the government should focus on renewable energy sources, mainly offshore wind farms and some solar power stations. By multiplying the projected annual Watt-hours of electricity required to run electric vehicles with the GBP/MWh levelised costs of the renewable energy sources, I estimated that by 2050 electricity generation for EVs will cost around 3 billion GBP annually.

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