CM50266 – Applied Data Science
Case Study 2 Executive Summary: Electric Vehicle Support Infrastructure

Basic Analysis

After reencoding the data from the original dataset [1] so as to include the corresponding region names and removing the missing values due to minor roads, it was possible to derive the mileage for each region and vehicle type for the period 2000-2020. In particular, across this entire period, cars and taxis were observed to have the highest total mileage whereas pedal cycles had the lowest. Similarly, South East regions had the highest total mileage whereas the North East had the lowest. There are two notable decreases in the overall increasing trend of the total annual mileage for the UK on the whole. Between 2007 and 2010 there is a noticeable decrease in mileage, most likely owing to the spike in average UK petrol prices which persisted during that same period [2]. Lastly, a significant decrease in mileage is observed in 2020, this of which is due to the COVID-19 pandemic; with considerations such as quarantined individuals and lockdowns, there would have been less persons on the roadways and hence, less vehicles recorded.

Regression

Before running the regression model, I tested for any outliers in the data due to the two decreases as noted above. In particular, 2020 data ended up being an outlier and hence, was removed from the data for the regression analysis. I used an ARIMA model as it is one of the most widely implemented techniques with regards to time series forecasting; ease of use also makes the approach attractive as historical data (in our case, mileage) is utilised as the only explanatory variable. The predicted linear increase in mileage is seen to result in an estimated value of approximately 290.5 billion vehicle miles by 2050. However, the ARIMA approach might be limited as it is unable to consider external factors, such as fluctuations in petrol prices, these of which clearly have an impact on mileage outcomes.

Research

Estimates provided by the UK Department for Transport , under the Shift to Zero Emission Vehicles initiative, state that approximately 97% of miles are expected to be travelled by electric vehicles by 2050 [3]. This, along with the average energy consumption of 314 Wh/mi for electric vehicles [4], as well as historical considerations of the UK's supply and demand of electricity [5], were used to estimate the total number of electric miles expected by 2050 and additional energy required to accommodate for this. In particular, by 2050, approximately 281.5 billion vehicle miles will be produced by electric vehicles, this of which requires approximately 85.2 TWh of additional energy. An independent estimate of 80 – 90 TWh of additional required energy provided by Regen [6] adds a degree of validation to this estimate.

Recommendation

Considerations of levelised technology cost estimates [7] and EV charging peak times [8] were used to formulate the recommendation of 30% offshore wind, 25% onshore wind, 15% solar energy, 15% CCGT + CCS post combustion and 15% CCGT H Class technology investment to meet the additional energy demands at the lowest overall cost. This was decision was optimised under the consideration of region-specific energy requirements and characteristics, as well as UK meteorological tendencies. Overall, regions should expect to spend between £133.8 to £672.5 million pounds, with the North East expecting to spend the least and the South East the most.

Bibliography

[1] U. D. f. Transport. "Road traffic bulk downloads." https://roadtraffic.dft.gov.uk/downloads (accessed 4th April, 2022).

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[4] E. V. Database. "Energy consumption of electric vehicles." https://ev-database.uk/cheatsheet/energy-consumption-electric-car (accessed 27th April, 2022).

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[7] E. I. S. UK Department for Business. "BEIS Electricity Generation Costs (2020)." https://www.gov.uk/government/publications/beis-electricity-generation-costs-2020 (accessed 27th April, 2022).

[8] B. L. Chris Vlahoplus. "Charging up: A review of electric vehicle workplace charging." https://www.greenbiz.com/article/charging-review-electric-vehicle-workplace-charging-sponsored (accessed 27th April, 2022).