

Manchester areas to target for emissions reduction from fossil fuelled vehicles

1.0 INTRODUCTION

Air pollution causes health problems with respiratory diseases including COPD. Scientists agree that climate change is being caused by the emission of greenhouse gases, like carbon dioxide, from the burning of fossil fuels. In order to tackle climate change we must reduce our carbon emissions. One way we can do this is by powering vehicles with electricity generated from renewable energy rather than with fossil fuels (petrol or diesel).

For this assignment I have chosen to answer the question 'how much of Manchester's private electric car charging demand could be met by rooftop solar on supermarkets in the area?'. This is an interesting question because Manchester in the UK is not known for its sunshine. It's a valuable question because solar panels can be installed on roofs relatively quickly (compared to building wind turbines). And for a densely packed city it's the main (if not only) solution for local electricity generation. With regards to the supermarket element of the question, even in a lockdown the majority of the population still go to supermarkets, on average on a weekly basis. Supermarkets are usually large flat roofed buildings which present an ideal area for the installation of solar panels.

1.1 Audience/Interest

The answer to this question 'which areas of Manchester should be targeted for emissions reductions from fossil fuelled vehicles', may be of interest to:

- Policy makers and or Local Authorities - to set targets and incentives for three ideas laid out on the previous slide,
- Community interest groups - to campaign for the rollout of local charging points.

2.0 DATA

The following data will be used in the project:

- 1) CSV of Manchester postcodes showing districts and wards by latitude and longitude, Source: <https://www.doogal.co.uk/UKPostcodes.php?Search=M> (June, 2020)
- 2) Data on Accidents and on Health (COPD admissions and Respiratory Disease Deaths) by Manchester ward, different sheets within an .xlsx file, Source:

<https://dashboards.instantatlas.com/viewer/report?appid=962615537fc24dda8a0a29dc86bd4e37> (June, 2020)

- 3) Geojson file of Manchester wards, Source:
https://martinjc.github.io/UK-GeoJSON/json/eng/wards_by_lad/E08000003.json (June, 2020)
- 4) Foursquare API supermarket venue search (June, 2020)

The first data source also includes the 'distance to a station' for each postcode and the average income for each postcode.

The last two data sources are self-explanatory.

2.1 Data cleaning

Of the 47 fields available in the Manchester postcodes CSV the 5 fields were selected for use (as shown below), these fields were fully populated.

	Ward	Latitude	Longitude	Distance to station	Average Income
0	Ancoats & Beswick	53.481207	-2.213571	0.922572	36448.469388
1	Ardwick	53.465806	-2.216967	0.877121	28371.785714
2	Baguley	53.391012	-2.284313	2.852126	33244.086022
3	Brooklands	53.406493	-2.296415	3.291382	36283.419689
4	Burnage	53.431516	-2.203527	0.589623	36351.463415
5	Charlestown	53.524126	-2.190979	1.414367	33480.731707
6	Cheetham	53.501020	-2.241741	1.561111	34973.262032
7	Chorlton	53.442847	-2.279975	2.473974	48407.339450
8	Chorlton Park	53.435098	-2.267336	3.187115	47054.272517
9	Clayton & Openshaw	53.478961	-2.176137	1.130757	29672.712146
10	Crumpsall	53.515799	-2.238195	3.218195	32701.212121

Figure: Table extract for cleaned Manchester ward data.

The Foursquare API search for supermarkets yielded duplicates in the same place (where multiple shops may be in the same building for example), these had to be removed.

MoneySupermarket Supermarket also came up, so anything that referenced Money also had to be removed.

3.0 METHODOLOGY

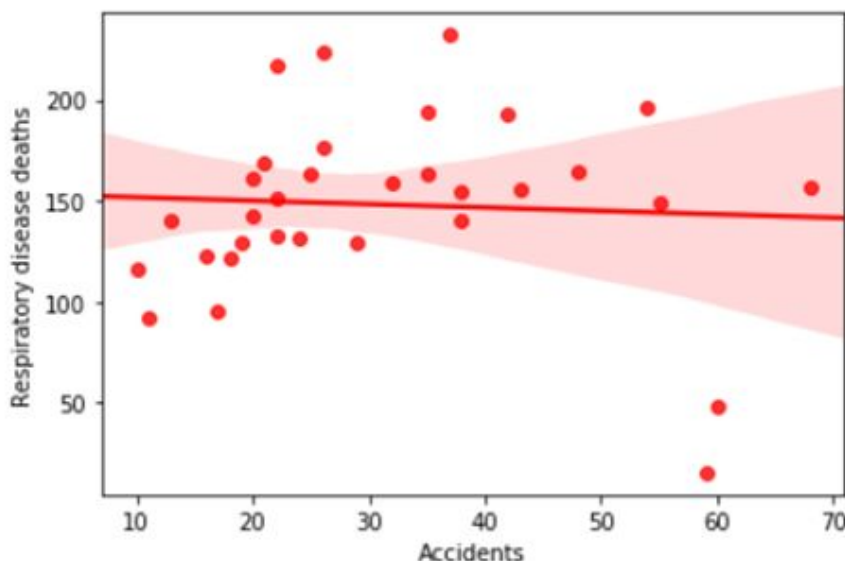
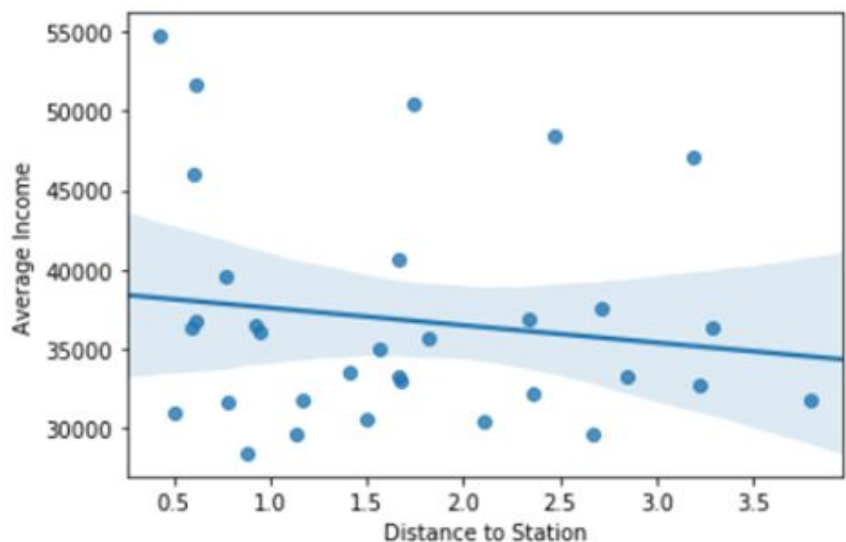
Data exploration - Regression plots to test correlations

It is thought that a higher income means increased likelihood of using private transport and in particular an electric car. Also the further from a station the higher the need for private transport. To test whether there is a relationship between 'Distance to Station' and 'Average Income' of a ward a scatter plot was drawn.

The scatter plot shows slight negative correlation. The `.corr()` reveals a correlation score of -0.149.

A hypothesis could be that houses close to amenities (like a station) cost more so those with higher incomes can better afford these.

Wards appearing on the top right hand corner of this graph are hypothesised to be the best candidate locations for chargepoint installations.



Is there a link between the number of accidents and the number of respiratory disease deaths? The scatter plot suggests no correlation between 'Accidents' and 'Respiratory disease deaths'.

There are many influencing factors in accidents that are not related to the number of vehicles in an area (and respiratory diseases are also caused by factors other than vehicle air pollution).

4.0 RESULTS

To find out the worst the numbers in each column are normalised so they can be added together. The stacked horizontal bar chart shows the results of this exercise.

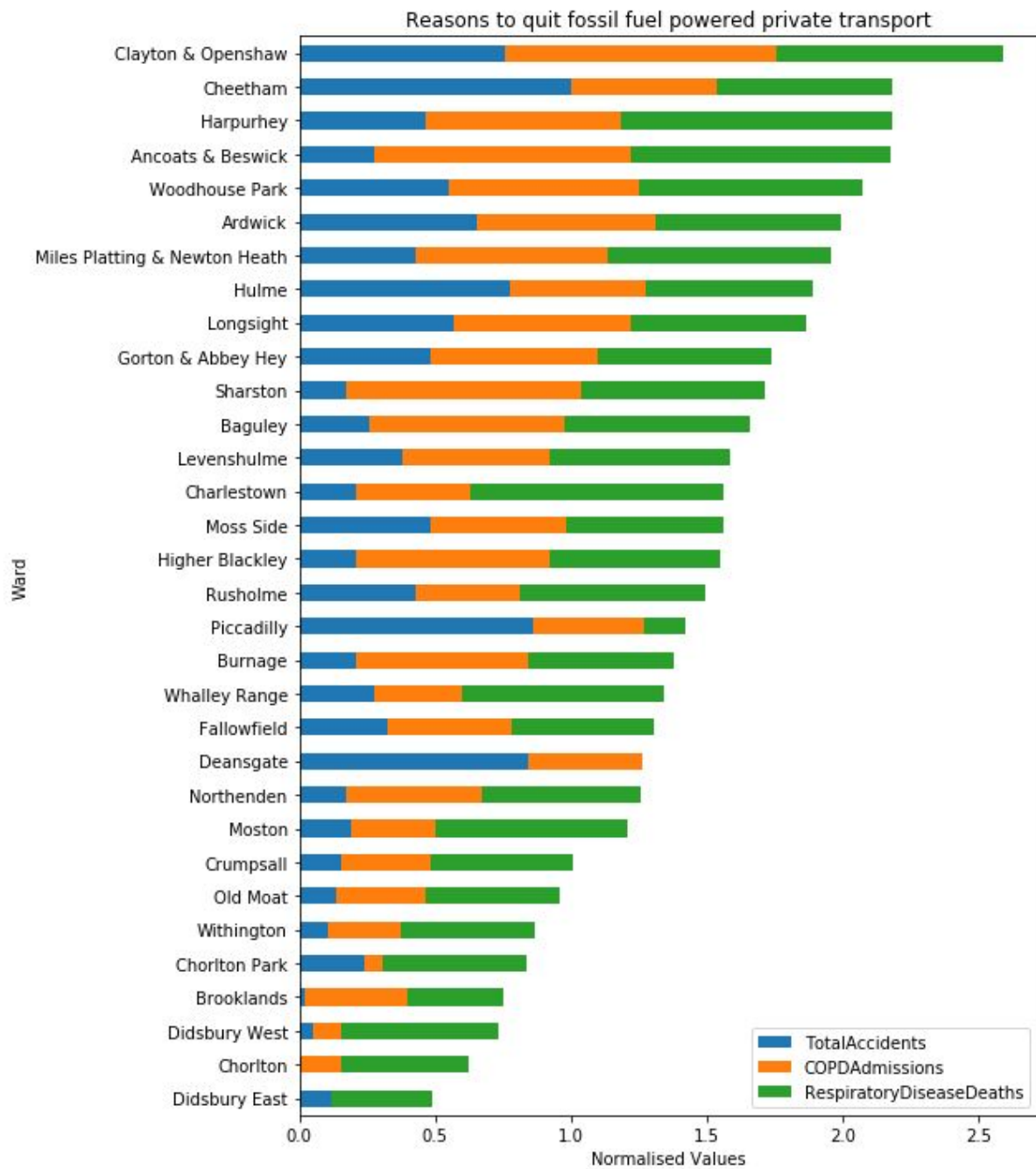


Figure: Stacked horizontal bar chart showing normalised values of the factors that would benefit from reduction in fossil fuel powered private vehicle transport within the ward.

The top 5 wards, with the worst total cases of respiratory disease deaths, COPD admissions and accidents, are plotted on a choropleth map with the 'distance to the station' shown on a scale. The blue markers have a popover with the top 5 ward names.

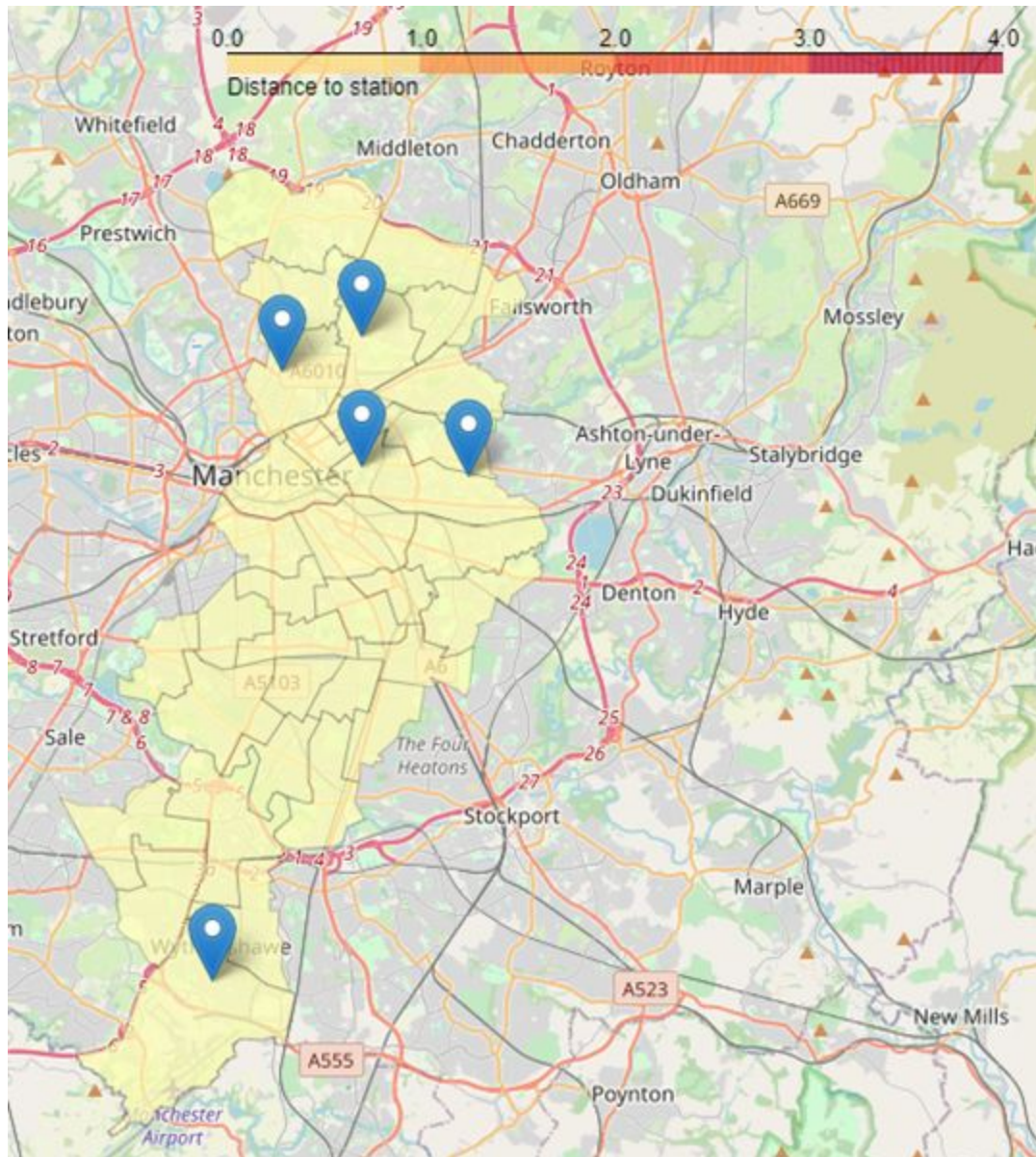


Figure: Choropleth map showing blue markers for the 5 Manchester wards that have most to gain from emissions reductions.

When zooming in the ward that is far outside the city centre is identified to be close to Manchester International Airport (an additional source for air pollution that leads to respiratory

health conditions).

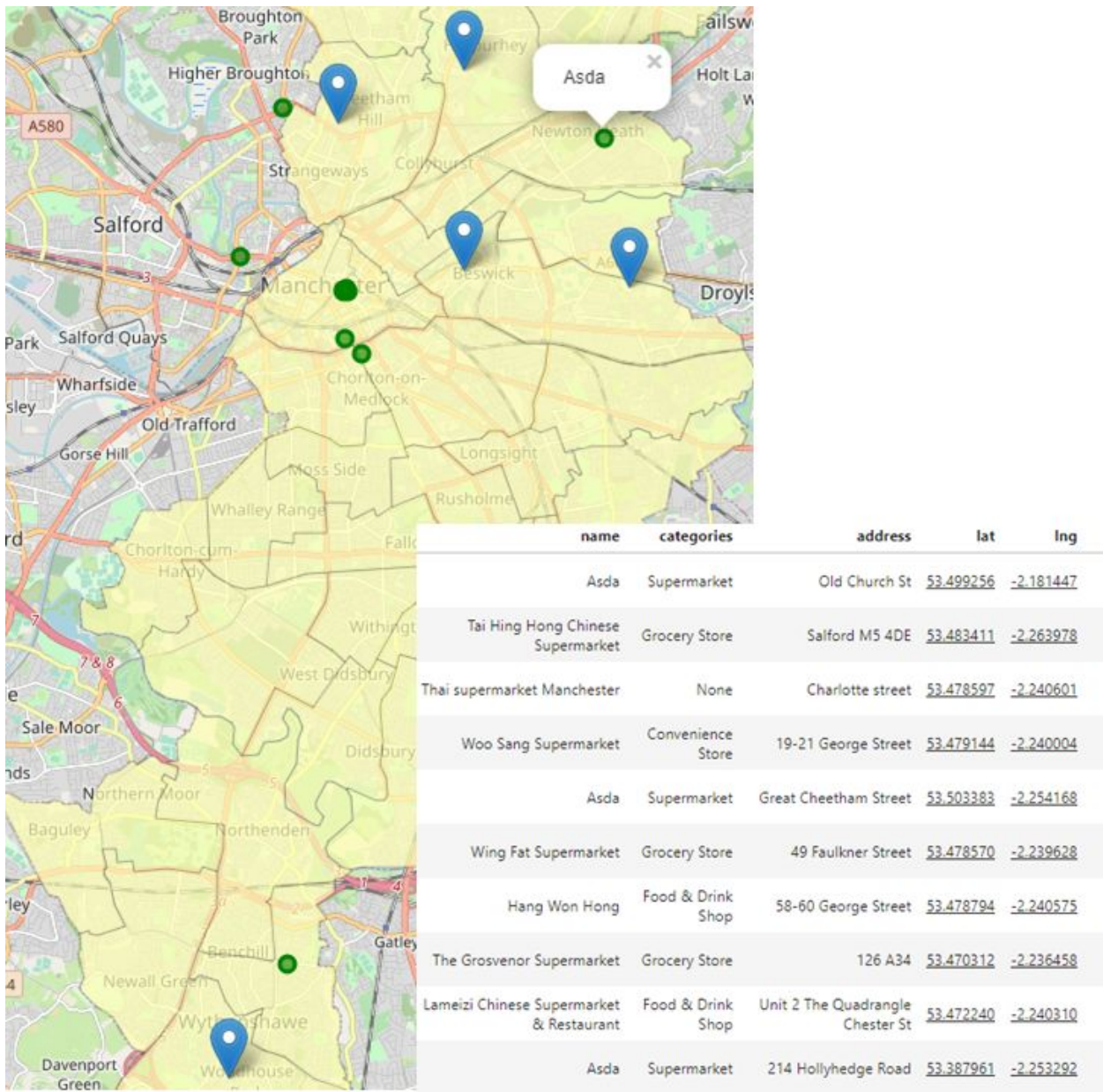


Figure: Choropleth map showing blue markers for the 5 Manchester wards that have most to gain from emissions reductions and the supermarkets (green circles) within 2km of ward centre). Inlay - dataframe extract showing list of identified supermarkets.

5.0 DISCUSSION

Because the normalised accidents data seems to be proportion to the normalised respiratory disease deaths and COPD admissions data we have made an assumption that there is a correlation with the number of fossil fuel powered private vehicles with these factors. It would be interesting to get data about the number of cars driving in/through a ward on an average day/year (or something similar), could the link to the respiratory disease be because of age of car rather than quantity of car? Could accidents be down to the average speed limit within a ward or some road

design features? Could the respiratory diseases be due to polluting industry in the area or a high rate of smoking? We need more data to investigate these.

What other sites could be good for EV chargepoints/car share scheme bases? Some residential areas with on street parking, perhaps gyms and sports centres? Perhaps a public opinion survey could help.

Other matters that need to be explored include, the hypothesis of whether those wards that are further from a station use private transport more needs to be assessed. It would be helpful to have data on public transport use for people in these wards.

6.0 CONCLUSION

The top five wards that would benefit the most from reducing private, fossil fuel powered transport are: Clayton & Openshaw, Cheetham, Harpurhey, Ancoats & Beswick, Woodhouse Park be targeted for ways to reduce air pollution. A list of potential sites (supermarkets) for EV charging points and EV car sharing schemes within 2km of the centres of these wards have been found.

Some further investigation could be carried out with additional dataset to ensure the assumptions made in this project are reasonable. The next stage after that would be to verify whether the supermarkets identified are viable locations for EV chargepoints and car sharing schemes and also whether other factors show a demand for this change from private fossil fuel powered vehicles to shared electric vehicles. A bonus would be to find other viable places for public charging infrastructure or car share scheme locations to help the removal of fossil fuel powered vehicle emissions causing pollution leading to health problems (and death) and climate change.