Electric vehicle charge point placement optimisation

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Project Background

There is increasing demand for plug-in and hybrid vehicles in the UK as they are becoming more affordable due to decreased battery costs and lower manufacturing costs. In order for the growth in electric vehicles to continue, consumers need to be reassured that there is adequate charging provision, with a recent survey showing almost half of UK consumers are worried that they would not be able to find an available, working or compatible charge point (CP). E.ON is an international, privately-owned energy supplier. As part of its sustainability programme, coupled with the increasing need to focus on the environment, E.ON is looking to assess the market for new public charging points across E.ON sites and the feasibility of incentivising its business customers to operate public charging stations.

Data and Methods

A regional-level optimisation model is considered for Great Britain, with a full analysis performed for the London and North East regions. Points of Interest (POIs) data are exploited in the analysis of CPs because they are potential locations where charging is needed, i.e. where people are likely to drive to and spend time. The number of POIs within walking distance of existing CPs have been used to rank the POI categories in terms of importance. Workplace population and night time population from the 2011 census, and traffic data and EV registration locations from the Department for Transport were also considered as potential demand indicators for CPs. The data for these variables was resampled to a 1 km grid so they could be joined with the POI data to build a box factor measure representing demand for CPs in a cell. The maximum coverage location problem was solved for the demand function to obtain candidate cells that maximise the total demand coverage such that the overall demand is covered in the most effective way. This was performed using the lpSolve package in R and displayed using ArcMap. A sensitivity analysis was then performed to determine the best variables at matching existing CPs.

Key Findings

From our statistical models, a positive correlation was found between workplace population and CP intensity, which is consistent with the theory that people are likely to charge their cars in places where lots of people work, as well as at their workplaces. The model combining workplace population and POI in the analysis, with the weighting two-thirds to one-third respectively, has shown to be quantitatively the best for the London region (Figure 1) and North East region. In both areas, the model selecting candidate sites appears to match the actual CP locations best in the area with highest workplace values, i.e. in the dense urban areas. In the suburbs of London the pattern is very similar but there is a poor match for the rural areas in the North East. A simple proximity analysis has shown that even in a dense, urban environment like London there are candidate cells that are nearly 3 km away from an existing public site.

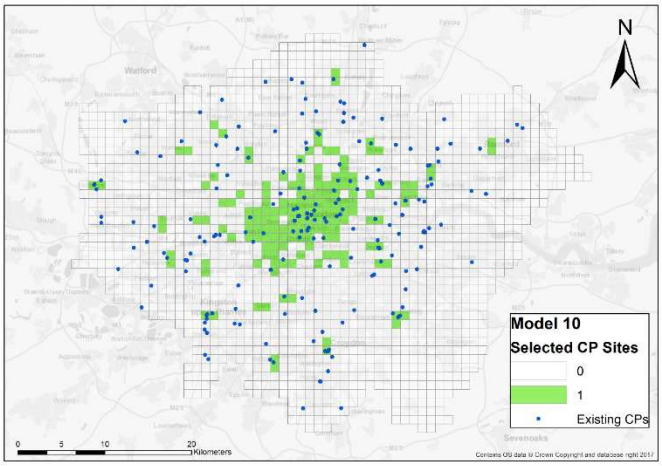

Figure 1. Optimised CP locations (green cells) and existing CP locations (blue points) in London.

Value of the Research

This study has successfully produced a proof-of-concept method for optimising the location of CPs at a regional level and builds upon previous work by including new datasets, such as EV registrations, in order to generate better insight. The methods presented in this study provide a way for E.ON to identify candidate B2B sites that are suitable for further local- and street-level investigation. This research also supports a major energy company in improving the future suitability of the UK infrastructure to electric vehicles and, therefore, supports carbon footprint reduction initiatives.