NIC Project UKPNEN03 Deliverable D7

Appendix 3
Third party analysis based on project data

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Optimise Prime

HITACHI Inspire the Next · Uber · Scottish & Southern Electricity Networks · centrica · Royal Mail · UK Power Networks

1 Introduction

Optimise Prime invited third-party organisations to submit proposals for how they could utilise the data collected from the trials to carry out additional analysis that would complement that being carried out as part of the project's experiments.

Following a tender process, the project commissioned CK Delta to further develop the impact of the existing learnings from the project and deliver additional insights. The data from the Home and Depot trials was provided to CK Delta, who supplemented it with low voltage (LV) network load profiles from UK Power Networks' Envision innovation project. In the Envision project, demand from 68,000 meter point administration numbers (MPANs) was modelled. CK Delta also used proprietary mobility data based on usage of mobile telecoms networks.

Several hypotheses were tested, the results of which are presented in the sections below.

2 Workstream 1 – Home charging

2.1 Hypothesis 1:

Analysis of mobility datasets and LV Envision load profiles can be utilised to improve understanding of residential EV load profile and estimate peak load times and geographically extend the project learnings to the whole of UK Power Networks' network (and potentially UK-wide).

CK Delta found that analysis of mobility data from mobile telecom networks, together with Envision LV load profiles can be used to identify the times that people return home and how far they have travelled. The research was able to pick out specific journey types that may represent commercial use, such as journeys of less than 50 miles that make several stops before returning to home, 5% of the total trip population made such a journey with four stops and 2% made five stops.

Importantly, the analysis is more accurate in identifying commercial journeys from sites where the site is not in a high-density population area. In more urban areas, the analysis would likely pick up significant activity from surrounding areas not related to the site.

2.2 Hypothesis 2:

Analysis of mobility datasets and LV Envision load profiles can help identifying specific priority LV substations at risk of being overloaded.

CK Delta identified the LV transformers in the London region with less than 10% capacity available and identified 820 ground mounted transformer across the UK Power Networks licensee areas with less than 10% capacity available.

Mobility data helped understand the loads on the transformers – the greater the mobility in the area (a measure of number of occupants, arrivals and departures of people using mobile network services), the higher the transformer load. Telco-driven mobility data was shown to be a good indicator of residential electricity demand profiles and peaks. Coupled with the Envision project predictive model, transformers at risk of overload can be identified earlier.

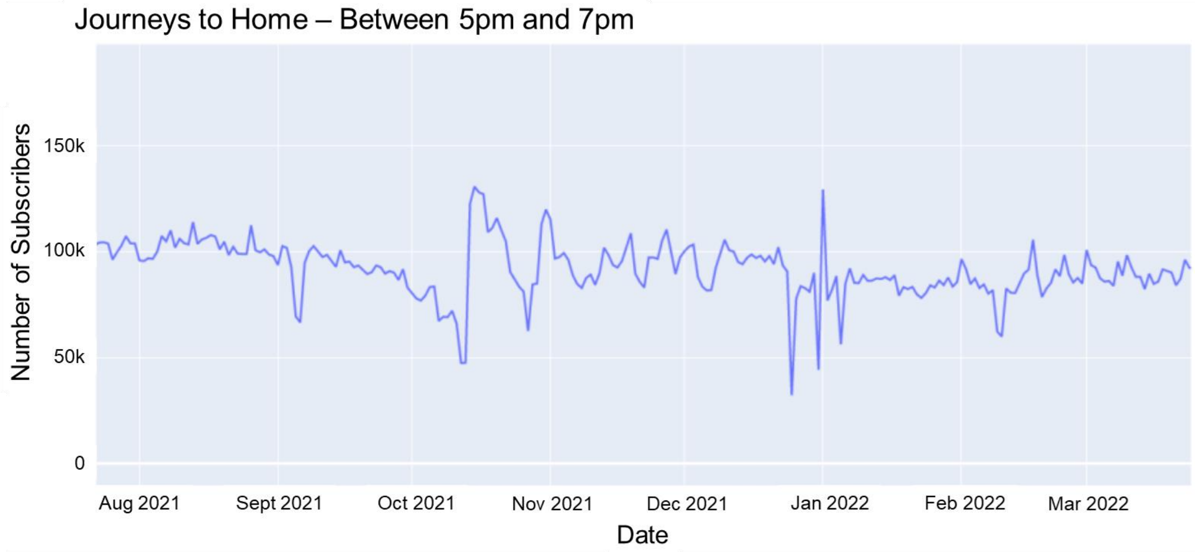
2.3 *Hypothesis 3:*

Evaluate and research the potential to predicting higher granularity insights around vehicle charging windows/charging sessions to adapt smart charging strategies and optimise displacement of load in time.
Research and identify potential additional elements to the seasonal variation of residential EV demand.

The research confirmed that mobile data can be used to predict times of peak load which should allow the DNO to plan flexible services tenders with fleets for smart charging.

A weekly seasonality can be identified in the mobility data. In addition, the analysis confirmed effects around holiday periods – for example a decrease in mobility was identified during the middle of October, which is likely related to schools' half term breaks, and at the end of December, and there are spikes in mobility at the end of holiday periods, as shown in Figure 1. The Envision project observed positive correlation between demand and mobility behaviour.

Figure 1 – Pattern of subscriber journeys during evening peak times throughout the year



3 Workstream 2 – Depot charging

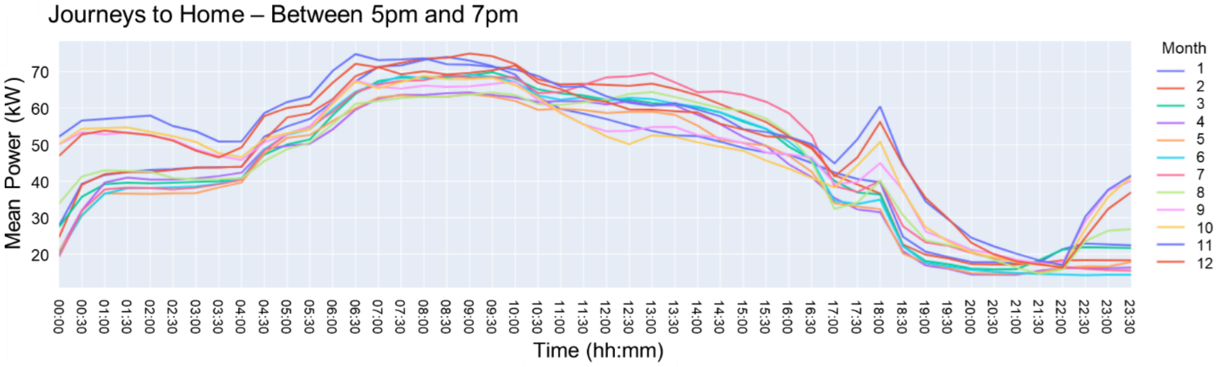
3.1 *Hypothesis 1:*

Research the possibility to identify existing commercial/industrial customers onto UK Power Networks network (beyond the depot sites included in the Optimise Prime trials) where deployment of profiled connections/control of EV charging would be beneficial to the DNO and the customer

CK Delta confirmed that it is possible to identify which transformers are most likely to require reinforcement if a depot with a large amount of EV charging was to be connected to them. If 100 EVs connected to each transformer were to charge simultaneously at 7.3kW, out of 8,373 LV transformers in the London Power Networks (LPN) region where monitoring data was available 3,650 would require reinforcement.

CK Delta analysed which depots had a standard behaviour (based on average power, maximum power and power range at one of the Royal Mail depots, an example of which is shown in Figure 2), and was able to identify 60 similar customers on UK Power Networks' distribution network, by segmenting the MPANs which had similar characteristics.

Figure 2 – Pattern of demand from Envision for an electrified Royal Mail site



This was expanded further by a search algorithm that identified MPANs where trends in demand and power profiles at specific times are observed. This allowed transformers where profiled connections would be most effective in controlling and balancing low voltage load to be prioritised, thereby reducing need for reinforcements.

3.2 Hypothesis 2:

Analyse and test whether matching estimated substation load forecasts with available telematics data could unlock higher accuracy when determining optimal profiles

CK Delta analysis of data from the Optimise Prime trials and Envision data using statistical methodologies showed that the probability of specific depots of vehicles charging at the same time, the impact of these events on transformers and the potential impact of mitigating solutions, such as smart charging can be modelled.

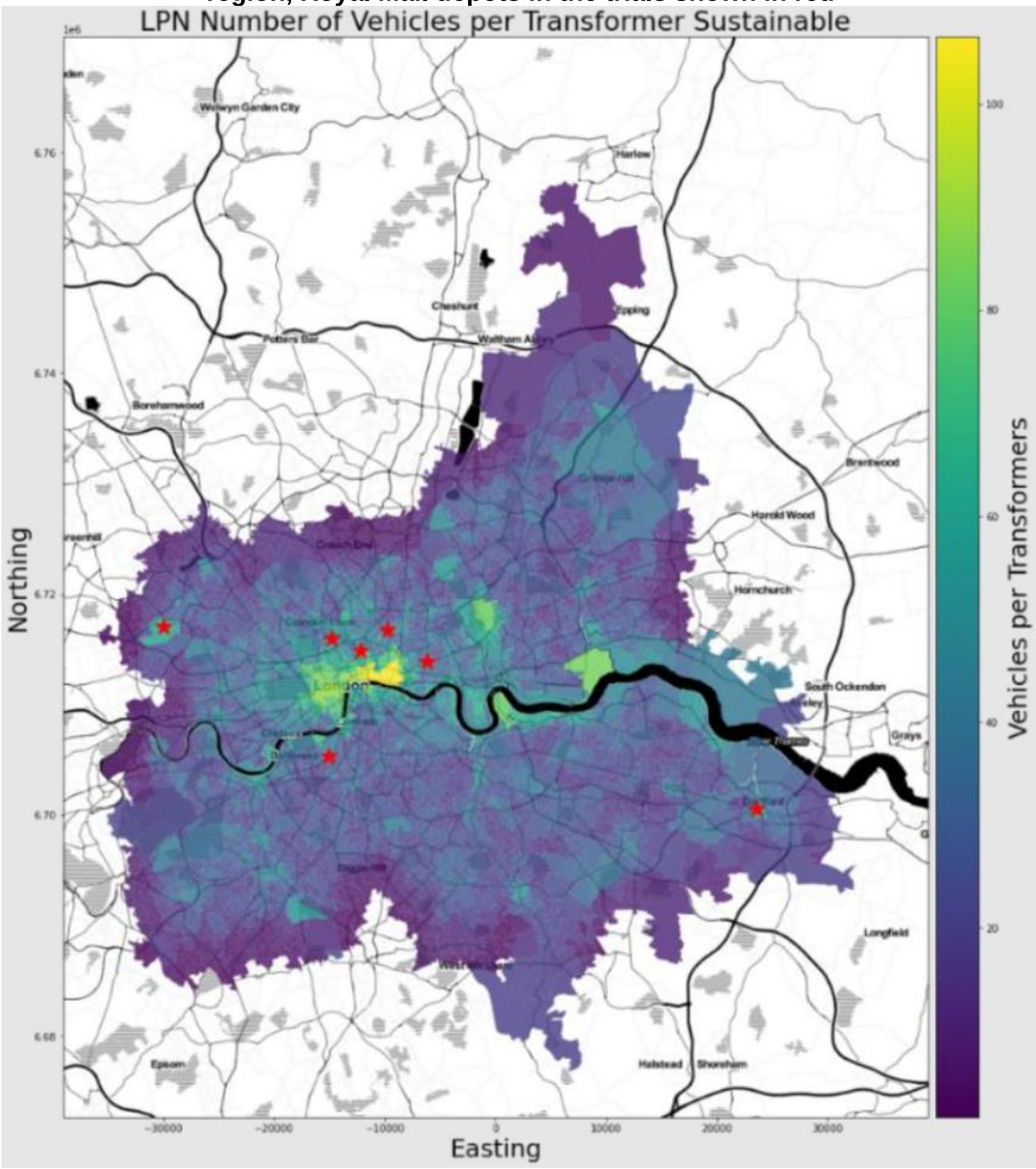
For example, it was possible to model the predicted proportion of LV substations in the London area that would be overloaded if a fleet of 50,100 or 150 EVs were connected to them and charged either in an un-managed or smart charging scenario. The result of this analysis is shown in Table 1 and is illustrated geographically in Figure 3.

Table 1 – Proportion of LV substations that are predicted to become overloaded if different sizes of EV depot were connected

Fleet size	50	100	150
Overload (un-managed)	3.8%	43.6%	75.4%
Overload (smart charging)	0.1%	27.5%	52.7%

When extrapolated across the LPN region, the benefits of smart charging are estimated at between 48 and 385 MW (0.5% and 4% of LPN headroom for 500-1000kVA transformers).

Figure 3 – Illustration of the number of vehicles each transformer could support in the LPN region, Royal Mail depots in the trials shown in red



4 Conclusions

For home-based fleets, an estimate of the residential EV charging load can be produced from mobility data, which could help DNOs plan their mitigation strategies.

For depot-based fleets, it is possible to identify journeys from a particular site where the site is not in a high-density population area: this type of analysis is only suitable for commercial sites located outside of major towns and cities.

Depot load data can be used as a proxy for other MPANs with similar load patterns, such as significant peaks in demand at the end of a working day, on different transformers. This can help prioritise transformers where most of the capacity has been used and where profiled connections may provide the most value.

This may be particularly useful for DNOs when designing the flexibility services product offering for home and depot-based fleets and dynamic connections with depot-based fleets.