Electric vehicles: A new model to reduce time wasted at charging points

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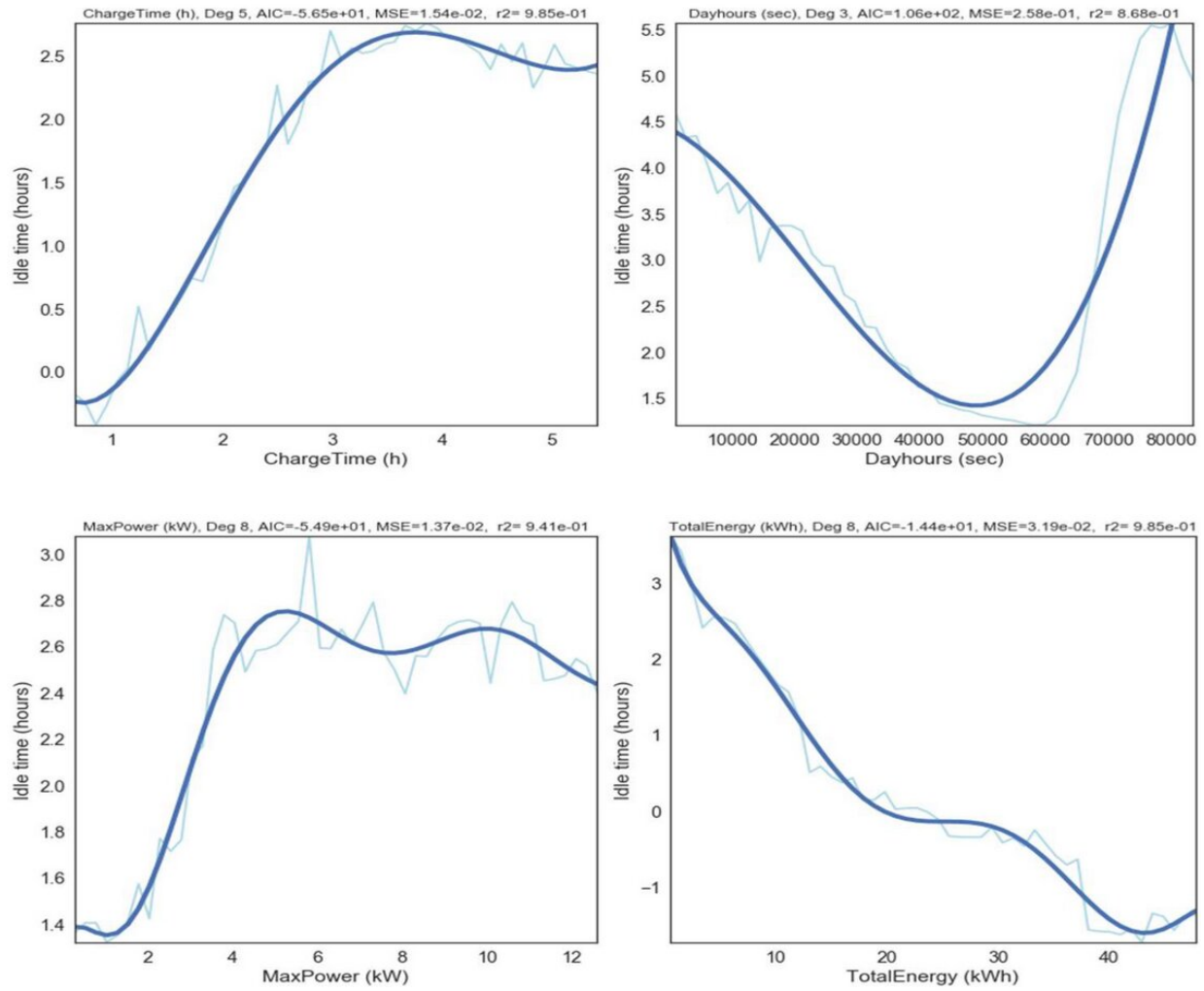

Factors influencing idle time included charge time, max power, total energy, and hour of the day the car is first plugged in. Credit: European Commission, Joint Research Centre (JRC)

Over half the time (61.4 percent) that electric vehicles spend connected to public charging stations, they're idly occupying a space that another car could use, according to a JRC-led study of e-vehicle charging times in the Netherlands.

This 'idle time' occurs when the car has been fully charged but is left plugged in. High idle time obviously reduces the availability of chargers, but it also provides an opportunity for grid operators to balance the grid.

Using data from 1.8 million e-vehicle charging observations in the Netherlands over a 6-year period, the study analyses the factors affecting idle time, providing a methodology to plan effective future charging infrastructures. The study authors also recommend building new charging points in the centre and at the outskirts of the cities that they looked at.

Based on the factors identified, the study provides a model that can estimate, at the beginning of its charging session, how long an e-vehicle is likely to be left idle after charging is completed.

As the number of e-vehicles on the road increases and puts pressure on existing charging infrastructure, there's a danger that drivers might struggle to find a free charging spot before their car runs out of juice. At the same time, fully charged but plugged-in vehicles could be used to feed the wider power grid with energy at times when demand is high. And charging stations can be managed to take advantage of this idle time by shifting charging to a time when demand is higher.

All of this of course depends on a solid understanding of the factors that affect idle time. For the study, JRC scientists partnered with ElaadNL, the Netherlands' knowledge and innovation centre for charging infrastructure, to identify these factors and investigate their impact.

The factors influencing idle times

The three factors found to have the highest influence are:

- The time of day that the car is first plugged in: while there is no single 'peak moment' in terms of number of cars idling, the scientists found that cars that start charging first thing in the morning or late in the evening tend to have higher idle times. This could be because people leave their car to charge before going to work and picking it up at the end of the day, or after leaving the office before going home to sleep and picking it up again in the morning;
- The amount of energy supplied to the vehicle during the charging period: the less charge left in the battery before it is plugged in, the higher the idle time after it has finished charging. Those that allow their car battery to run lower before plugging in are more likely to leave the car idling for a longer period than those who do a quick top up of their car battery. This is also reflected in the positive correlation between total charging time and level of idle time after the car is finished charging;
- The maximum power supplied to the electric vehicle. Each vehicle has a maximum charge power which affects its ability to be recharged at a certain speed. The scientists found the highest idling time for cars with a maximum charging power between 4 and 6 kilowatts, which roughly corresponds to the average slow charge power of e-cars currently on the market.

The scientists also made some more specific observations. For example, while taxi drivers are among the highest users of public charging points, they also tend to leave their vehicles idling for less time.

Infrastructure strategies and behavioural change

The transition to a low-carbon economy is a key political priority for the EU. To make this a reality, one of the ambitions is the widespread take-up of low- and zero-emission vehicles over the next decade. A big challenge for future planning is to have a correct ratio of chargers available for these vehicles: drivers must be confident they will be able to charge their car when needed. The scientists recommend using their methodology to plan deployment of future chargers based on areas with 'high vulnerability scores'– those areas where there's likely to be a higher demand for charging points than what is available.

Several municipalities in the Netherlands have adopted policies granting EV-users the right to have public chargers installed near their homes such that these 'public' chargers become semi-private chargers. This has a major impact on the idle time of these chargers.

Looking beyond the study, the scientists also recognise that charging station owners can take actions to influence behaviour: they could start charging a fee for parking time once the vehicle is fully charged, for example. An app could also give drivers an estimation of the time until their car will be fully charged, sending them an alert when this is nearly finished. Users could also possibly find out through the app when an occupied charger will next be free, with the option to 'reserve' the charger for a set period.

Background

Public policies are taken at both regional and city levels targeting both electric vehicle adoption and charging infrastructure management. Over the years, idle time (the time an electric vehicle is connected without charging) is increasing, with direct impacts for the sizing of the infrastructure, its cost and its availability.

This study applies supervised machine learning to a dataset on idle time

from the Netherlands, identifying the main influencing parameters on idle time and the most accurate algorithm to use to estimate the time that an electric vehicle will remain parked after charging. The model developed provides useful information for electric vehicle users and policy makers—as well as to network owners, who can improve network management by targeting specific variables.

More information: Alexandre Lucas et al. EV Idle Time Estimation on Charging Infrastructure, Comparing Supervised Machine Learning Regressions, *Energies* (2019). DOI: 10.3390/en12020269

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