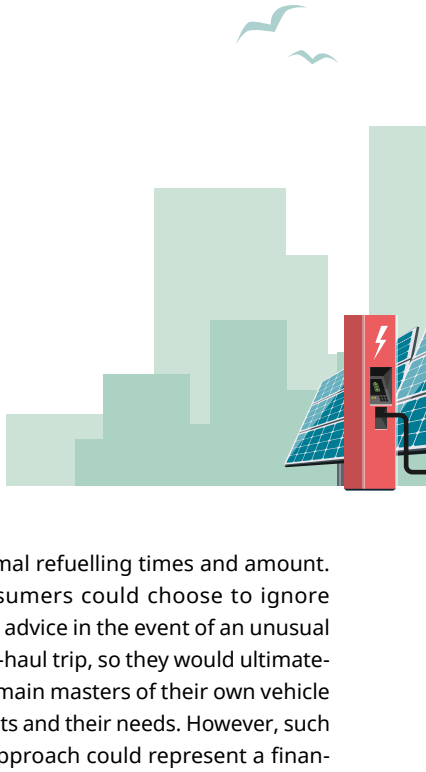
Stable energy: the road ahead for electric cars

By ***Konstantina Valogianni***

The adoption of electrically powered modes of transport continues apace. However, even in countries such as the Netherlands where a boom in the use of electric cars has been perceptible over the past four years, the problem remains the same – the high frequency of re-charging is expected to pose new strains on the grid due to the extra load coming from these vehicles.



However, an IT-based solution tested both mathematically and via simulations exists that could make the difference for grid operators, energy providers and vehicle users alike.

In the current climate, few would argue against the environmental interests of generating power via wind turbines and solar panels and encouraging consumers to switch from polluting petrol or diesel-powered cars to electric vehicles. The case of electric cars is an especially pertinent one. Once the logistical hurdle of providing sufficient recharging points has been overcome, there follows the issue of energy surges on the power grid at the most intense times of use.

Drivers of such vehicles typically use them for commuting, meaning that the peak points for plugging in come in the morning before work, during the day at work, and in the evening upon returning home. Energy providers cannot necessarily deal with such peaks, as underlined by the fact that recharging an electric car is often higher than a household's daily energy consumption. Changing consumer habits at attractive prices in order to space out their recharging times is key to the issue.

Taking the strain

One of the most obvious ways to counter the highest periods of demand is for additional power plants to be fired up to take the extra strain. But this option is both polluting for the environment and an expensive operation for energy providers. Grid stability has to be the goal, whilst keeping prices affordable. With electric vehicle usage expected to rise and rise, this would only represent a short-term solution at best.

The ideal approach would be to influence how and when such vehicles are charged and in order to do so two, if not three options are available. The question is one of responsibility – is it down to the consumer to choose the ideal time (both in terms of cost and available energy supply) to recharge or is it down to grid operators and energy providers to manage in a top-down way the right times to fill up? The answer is, ideally, both.

Consumer preferences

The decentralised, consumer-oriented approach involves installing on-board computer software in electric cars that would track consumers' typical use of their vehicles and inform them of the optimal refuelling times and amount. Consumers could choose to ignore such advice in the event of an unusual long-haul trip, so they would ultimately remain masters of their own vehicle and its and their needs. However, such an approach could represent a financial gain for all – for consumers who follow the advice given and charge accordingly and at cheaper times and for energy providers who could span out supplies more effectively.

Bidding for energy

The centralised, provider-driven approach would involve what is known as energy "auctioning", whereby central grid operators decide upon the best times for recharging to occur. In some cases, consumers could also plug in and sell back unused electricity to the benefit of fellow drivers in greater

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need. The challenge would be to keep all customers happy as, in some cases, delays would occur. Charging often occurs at a different rate, so the challenge confronted by providers and consumers alike is not just one of the amount of electricity required but also at what rate it can be supplied.

This dilemma could be overcome via IS technology in a mobile app form, meaning that consumers would be kept informed in real time of current energy prices, leaving them the option to either fill up right away when prices are higher or wait until the cost becomes more attractive at another point in the day. However, the ideal scenario would be to combine both approaches and offer varying prices and rates at different times in the day, giving drivers the chance to adapt their consumption habits accordingly and energy providers the opportunity to keep expansion investment costs down.

Testing the theory

A recent litmus test was carried out for the above theory via a complex set of mathematical modelling operations, statistical machine learning and simulations based upon electric car recharging in the Netherlands over 2013. Some 1,500 users and 231,995 charging transactions were under analysis, on the assumption that each household possessed one electric car only, could recharge at home or at work, and charged within the same region where different prices were available. Driving profiles were obtained via the Dutch Bureau of Statistics, whilst pricing information was drawn from EPEX SPOT data and the California-based ▸

also relieve the pressure on the grid and encourage more intelligent usage of recharging points by consumers. After all, the main objective in the current situation faced by consumers and suppliers is to incentivise the use of less polluting modes of transport whilst maintaining grid stability and attractive market prices. The ultimate "win-win" situation if ever there was one.

Time to road-test

By applying the algorithms devised as part of the recent study, it would be possible for intelligent software to be developed and installed in electric cars that would track consumers' usage, their household energy supply and, depending upon energy price variations during the day, inform drivers of the optimal time to recharge. Better still, it would also be capable of determining whether a given driver needed to only do a short commute in the morning, for example, thereby ensuring that sufficient power would be contained within the battery without recourse to additional expense and power surges through needless overcharging.

Within this ideal scenario, grid managers would not lose their level of control over demand. For supply and demand to dovetail, consumers cannot be the sole drivers of the system. This is precisely the beauty of the hybrid centralised/decentralised approach proposed. Consumers are duly informed of the right times to refill, the automotive industry can learn how to make recharging as smooth as possible, grid operators can be informed of how to set up their pricing schemes and, perhaps above all, the overall concept and reality of sustainable vehicle powering could be promoted on a broader scale.

The proposed model requires testing based upon different assumptions but one thing is clear – the way ahead for the electric car is to have consumers, grid operators and energy providers heading in the same direction, in order to keep prices down and supplies up. ■

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Time of Use scheme. The analysis was also based on the assumed peak charging times as being 9am, 2-3pm, and 7-8pm.

From the resultant algorithms produced, it was found that the coordinated, centralised/decentralised approach to managing consumer behaviour and grid stability could lead to an average 55 per cent reduction in the market price for electricity. Above all, it would

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