Predicting effects of electric vehicles on the electricity grid

Recent research suggests that increasing the number of private electric vehicles would have very little impact on electricity consumption in Milan, Italy. However, unless there are suitable regulations, the daily demand for power to recharge the vehicles at peak times could overload the capacity of the electric supply system.

Greater use of electric vehicles would have a positive impact on human health and the environment, particularly in urban areas. It would also improve the security of the European energy supply, whilst transporting people and goods as necessary for modern economic development.

This study, conducted by the European Commission’s Joint Research Centre, investigated the possible impact of increasing the numbers of electric vehicles on the European power grid, using Milan, Italy, as a case study. CO₂ emissions reductions were also evaluated.

Different numbers of electric vehicles in the market share in 2030 were estimated, taking into account the technical features of electric vehicles and the potential uptake of such vehicles by consumers.

The calculations suggest that, in 2030, the total annual energy requirement for electric vehicles with a 3 per cent share of private vehicles will be 78 GWh (Giga (10⁹) watt Hours). This is estimated to be less than 0.3 per cent of the projected energy consumption in the Province of Milan for that year. Even if electric vehicles achieve a 30 per cent market share, energy demand would only be 2.5 per cent of the projected total annual energy consumption. This implies that the impact of electric vehicles on total energy consumption would be minimal.

In addition, in 2030, the average daily power demanded by electric vehicles for recharging for all scenarios, was estimated to be a relatively small percentage (varying between 0.4 to 8 per cent) of the overall daily power demand from the grid. However, this assumes that not all vehicles have to recharge their batteries at the same time.

If the market share of electric vehicles was 15 per cent or more, and if all these vehicles had to be recharged in the evening on the same day, the peak power demanded would be high (over 15 per cent of daily total power demand).

Strategies are therefore needed to avoid potentially damaging the grid with increasing numbers of electric vehicles. These include: infrastructure improvements; creating an “intelligent” grid which decides when to provide power to batteries; and using vehicles to store electricity and supply on demand when they are connected to the grid (the “Vehicile to Grid (V2G) concept).

Estimates of CO₂ emissions potentially saved by the increased use of electric vehicles depend on the mix of energy sources that feed the grid and the share of electric vehicles in the private fleet. Assuming 81 per cent of the national energy mix is sourced from non-renewable sources, the study suggests, for example, that to reach a 20 per cent reduction in global emissions of CO₂ by 2030, about 25 per cent of the private fleet should consist of electric vehicles.


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