Smart charging profiles for electric vehicles

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Abstract— Electric vehicles (EVs) can help decarbonise the transportation sector, which is responsible for a great share of greenhouse gas (GHG) emissions. Although different measures have been introduced to foster the penetration of EVs in the society, they have not been deployed at a large scale yet. Electric companies are concerned about the effects of introducing Evs into the grid, especially with a large amount. The charging pattern of Evs is the main factor that determines these effects. Unregulated charging (probably when returning home) would have undesirable consequences (e.g. increase in variable costs, emissions, reduction of reliability) for the system, it is therefore necessary to develop an "intelligent" charging strategy. These characteristics justify the existence of different smart charging profiles. It is also important to assess the effect of using day-ahead management systems instead of pre-set profiles.
This document compares different possible strategies for charging Evs and their consequences in the power system. The impact on variable costs, emissions and Renewable Energy Sources (RES) integration will be obtained using an operation planning model. The Spanish power system for 2020 is analysed under different EV penetration levels and charging strategies. The results show the benefits of using smart charging profiles instead of an unregulated profile, obtaining large cost reductions and maintaining system reliability levels. Moreover, the benefits of using a day-ahead management system are also evaluated, resulting in a small reduction of system variable cost compared to the use of pre-defined charging profiles.

Index Terms— Electric Vehicles, smart charging , RES integration, wind spillage, power system operation