

AN ANALYSE OF THE PORTUGUESE POWER SYSTEM OPERATION CONSIDERING ELECTRIC VEHICLES MASS ADOPTION

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Summary: In Portugal, recent predictions indicate that in the time horizons of 2030, 2040, and 2050 there will be mass adoption of EVs resulting from the support and incentive policies of the Portuguese government to contribute to the reduction of this dependence. This mass adoption will naturally have an impact on the power demand for the system. The main contribution will be the modelling and assessment of electric mobility in the Portuguese transmission system. To achieve this assessment, scenarios of power consumption and production will be studied at a substation level. Afterward, the transmission system will be modelled considering the most recent information and the network evolution perspectives. Based on power demand profiles, a security assessment analysis will be performed considering the impact of the voltages, congestion, and n-1 events. Considering the impact of electric mobility and renewables, new scheduling algorithms will be proposed. The Portuguese electrical system is modelled in the DPlan computational tool, where the analysis of safety restrictions related to voltages and currents will be carried out in the face of a possible contingency. The proposed methodology starts with the validation of the scenario of 2024, comparing the obtained results with the ones published by the Portuguese transmission system operator (REN). Afterward, new consumption and generation profiles will be defined for the coming years of 2030, 2040, and 2050. These scenarios include projections of the evolution of consumption, renewable energy sources, and EVs. The generation and consumption profiles were taken from REN's Data Hub in 01/26/2024, which served as a reference to estimate the profiles for the other years. This date represents the date on which the highest EE consumption was recorded in Portugal in the year 2024.

Since the intention is to carry out the analysis of the N-1 safety criterion to verify whether the electrical system of Portugal complies with this criterion in a context of massive EV adoption, it is crucial to carry out the analysis in the extreme cases that are defined here as being those where we have a lot of power consumption from the grid. In practice, in the winter scenario, naturally, there is a higher consumption of electricity compared to the summer, spring, and autumn scenarios. Therefore, for the simulation of the Portuguese electricity network model in DPlan, a day in the winter scenario was considered as a reference, in which the highest consumption of electricity was recorded in the year 2024.

Based on the results already obtained, it is possible to conclude that new strategies to manage EVs should be considered to avoid major investments in the transmission system until 2040. Considering the experiments, it was concluded that the most effective strategies are the ones that coordinate the management of EVs with the renewable generation. In the scenario of 2050, several investments will be needed to assure the targets defined by the Portuguese government.