THE ELECTRIFICATION OF TRANSPORTATION AND ITS IMPACT ON THE AUSTRIAN ELECTRICITY DEMAND CURVE WITH A SPECIAL EMPHASIS ON EUROPEAN RESOURCE ADEQUACY STUDIES

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In order to reduce greenhouse gas emissions and to be compliant with the EU's Paris Agreement commitments, the European power system is currently facing its largest transformation since it came into existence. More specifically, to reach climate neutrality until 2050, the European Commission suggests a reduction of greenhouse gas emissions by 2030 to at least 55% compared to the level of 1990 [1]. Therefore, power generation relying on fossil fuels (e.g. coal, lignite, oil) is gradually replaced by renewable generation assets, such as wind farms and photovoltaic plants, adding more volatility to the system. In addition, the demand side is undergoing drastic changes. New demand components such as heat pumps, electric vehicles or battery home storages are becoming more and more important and – through their characteristic behavior – reshape the overall demand curve. One of the key drivers of this development are electric vehicles (EVs). The evolution of EVs, their contribution to the Austrian electricity demand curve and consequently their impact on the security of supply is of high interest for Austrian Power Grid AG (APG) and thus constitute the main focus of this paper.

Motivation and Scope of the Paper

In order to assess security levels of supply, it is imperative for a Transmission System Operator (TSO) to have detailed information on the expected evolution of the demand curve. EVs do not only add extra load to the energy system, but can also provide additional flexibility (e.g. time shiftable load, vehicle-to-grid, etc.), making them to one of the main components in the currently ongoing transition of the power system.

Therefore, in order to provide well-founded estimates on how the ongoing electrification of transportation is going to affect Austria's future demand curve, APG together with the Austrian Institute of Technology (AIT) conducted a study. In this study, based on the best knowledge available and under consideration of political guidelines and goals, projections on size and structure of Austria's future EV fleet are derived and respective annual demand profiles are constructed. In a second step, the obtained data enters a test model, which is based on the official European Resource Adequacy Assessment (ERAA) 2021 model [2]. By this means, various assumptions on price sensitivity and load shifting behaviour of EVs and their corresponding impact on key adequacy metrics like Expected Energy not Served (EENS) and Loss of Load Expectation (LOLE) are analysed. Moreover, novel modelling approaches concerning EVs can be assessed and the findings may serve as valuable feedback for the ERAA model building stream.

Methodology

Since the input data for the European Resource Adequacy Assessment is of outmost importance, APG set up a test model in order to validate different extension levels on the generation side and to investigate

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various scenarios of demand additions. This test model is – compared to the full ERAA model – reduced in its geographical scope and specifically designed for studying different sensitivities on input data and modelling assumptions. Within this paper, special focus is drawn to the evolvement of EVs, whereas the following assessment is performed: different assumptions on the share of price sensitive EVs are implemented and their potential to shift load within a predefined time window is investigated. The impact of different EV scenarios on Austria's level of security of supply is assessed by means of the simulation outputs EENS and LOLE.

The test model is set up in the large scale Monte Carlo Simulator ANTARES [3], which is an open source software developed by the French Transmission System Operator RTE especially designed for adequacy simulations. For the sake of reflecting uncertainty related to various climate conditions (e.g. hydrological inflows, wind speed, irradiance), 35 different historic climate years (1982 to 2016) serve as basic input to build time series for renewable generation and demand. These time series are then randomly related with unplanned outages for generating units or interconnectors. Within this approach, each of the randomly created Monte Carlo Scenarios is assigned to a Unit Commitment and Economic Dispatch (UCED) problem, which is solved in an hourly granularity by ANTARES.

Results

Simulation results corresponding to different assumptions on the future Austrian EV fleet are presented and interpreted using visualization methods developed by APG. Special emphasis is given on the effect of the electrification of transportation being one of the future Power-to-X technologies offering flexibility options to the system.

Referenzen

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