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Verification of Renewable Energy Forecasts at Transformer Stations of the German Transmission Grid

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The growing generation of renewable energies fed-in into the German electrical grid leads to a weather-dependent fluctuating power production, which must be integrated into the electrical grid. While previously the balance of power generation and load was the major aim of the transmission system operators (TSOs), the importance of the spatial distribution of the decentral produced power grew within the last years. To guarantee a reliable grid operation TSOs are generating grid congestion forecasts for different lead times. To be able to calculate the load flows within the transmission grid each TSO has to know the temporal characteristics or schedules of all loads and generators directly connected to the transmission grid. Moreover, they have to consider the load flows to or from the underlying distribution grid. These so called vertical grid loads reflect the load and generation landscape within the distribution grids. To be able to estimate redispatch potentials and other grid safety measures TSOs need reliable forecasts about the composition of the vertical grid load at all transformers in each substation, i.e. the proportions of the load, the conventional electricity generation, and renewable energy.

In Germany about 80 GW of wind farms and photovoltaic (PV) stations are connected to the distribution grid, which has a major impact on the vertical grid load. In general, there are several substations connecting each distribution grid with the transmission grid. However, since most distribution grids are meshed and grid topology is not static, forecasting the components induced by wind and PV at each substation is not trivial. In addition, it should be noted that only the total vertical grid load is measured at each transformer, which is why the target values of the required wind and PV power forecasts are not available. Consequently, statistic or machine learning based models cannot be applied to forecast the wind and PV based load flows directly. Moreover, a common verification by comparing a forecast with the corresponding measurement is not possible at this point.

Within this study, we will give a brief overview about the model approaches that we have used to forecast the wind and PV power induced proportion of the vertical grid loads at all German substations between transmission and distribution grid. Furthermore, we will show our current verification strategy including different error-measures and approaches to separate the vertical load flows into its components.