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Solar Power Forecasting for the Bidding Zones of the Italian Electricity Market with an Analog Ensemble Approach

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Abstract : The rapid increase of renewable energy in Italy is led by wind and solar installations. The 2017 Italian energy strategy foresees a further development of these sustainable technologies, especially solar. This fact has resulted in new opportunities, challenges, and different problems to deal with. The growth of renewables allows to meet the European requirements regarding energy and environmental policy, but these types of sources are difficult to manage because they are intermittent and non-programmable. Operationally, these characteristics can lead to instability on the voltage profile and increasing uncertainty on energy reserve scheduling. The increasing renewable production must be considered with more and more attention especially by the Transmission System Operator (TSO). The TSO, in fact, every day provides orders on energy dispatch, once the market outcome has been determined, on extended areas, defined mainly on the basis of power transmission limitations. In Italy, six market zone are defined: Northern-Italy, Central-Northern Italy, Central-Southern Italy, Southern Italy, Sardinia, and Sicily. An accurate hourly renewable power forecasting for the day-ahead on these extended areas brings an improvement both in terms of dispatching and reserve management. In this study, an operational forecasting tool of the hourly solar output for the six Italian market zones is presented, and the performance is analysed. The implementation is carried out by means of a numerical weather prediction model, coupled with a statistical post-processing in order to derive the power forecast on the basis of the meteorological projection. The weather forecast is obtained from the limited area model RAMS on the Italian territory, initialized with IFS-ECMWF boundary conditions. The post-processing calculates the solar power production with the Analog Ensemble technique (AN). This statistical approach forecasts the production using a probability distribution of the measured production registered in the past when the weather scenario looked very similar to the forecasted one. The similarity is evaluated for the components of the solar radiation: global (GHI), diffuse (DIF) and direct normal (DNI) irradiation, together with the corresponding azimuth and zenith solar angles. These are, in fact, the main factors that affect the solar production. Considering that the AN performance is strictly related to the length and quality of the historical data a training period of more than one year has been used. The training set is made by historical Numerical Weather Prediction (NWP) forecasts at 12 UTC for the GHI, DIF and DNI variables over the Italian territory together with corresponding hourly measured production for each of the six zones. The AN technique makes it possible to estimate the aggregate solar production in the area, without information about the technologic characteristics of the all solar parks present in each area. Besides, this information is often only partially available. Every day, the hourly solar power forecast for the six Italian market zones is made publicly available through a website.

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