

Integration of Renewable Generation into the Portuguese Power System: The Impact of Different Hydrological Regimes

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Abstract

The Portuguese power system has experienced an increasing integration of renewable energy sources during the last years and is still applying a considerable effort in increasing its share of renewable energy. The geographical characteristics of the country allow the exploitation of several renewable energy sources, like wind, hydro, photovoltaics, waves and biomass.

The main challenges associated to the integration of renewable energy into the power systems derives from their availability, uncertainty and variability. The non-dispatchable nature of some renewable energy sources, like wind power, induces particular difficulties in balancing the power demand and generation, emerging as a possible cause of some power system instability.

Unbalances between power demand and generation are likely to occur, particularly during the off-peak periods, when the demand is lower. That potential to the power unbalances occurrence tends to increase during the years of higher rainfall, especially in power systems with considerable installed hydro power.

Power systems, like the Portuguese one, equipped with significant pumping-hydro installed capacity should be able to deal with the power balancing issue induced by the integration of larger amounts of wind power. The ability of those hydro power-plants to operate as an energy storage system allows the absorption of the potential power unbalances, enabling a time shift of the power generation.

Pumping-hydro plants installed in Portugal are integrated in river courses and are operated in a perspective of being hydro power-plants with pumping capacity, in opposition to the perspective of pure pumping-hydro power-plants. This particularity introduces some restrictions to their operation, especially related to the compromise of simultaneously generate power, using the upper reservoir river inflows, and contributing to avoid the power unbalances that results from the variability of the wind power generation. Those operation constraints tend to increase as the rainfall tends to be higher.

Regarding the restrictions of the pumping-hydro when subjected to different rainfall conditions, the present paper intends to study the consequences of different hydrological regimes in the ability of the Portuguese power system to integrate the renewable generation.