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OPTIMIZATION OF ENERGY AND WATER SUPPLY SYSTEMS IN S. VICENTE, CAPE VERDE

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S. Vicente is an island of the Cape Verde archipelago with significant problems regarding the electricity and water supply systems. The island has important wind resources that are difficult to integrate in the electricity grid because of the wind intermittency. In addition, this island does not have any source of fresh water and all water that is provided to the population is desalinated seawater. The penetration of the wind power in the electricity supply system depends on the dynamic penetration limit that is usually applied for grid stability. This limit is the maximum wind power directly supplied to the electricity grid at each hour; it is expressed as a percentage of the hourly load and should not surpass 30%. The excess wind power is the one that cannot be injected in the electricity grid due to that limit. If this wind power is not stored or used to desalinate seawater, it will be curtailed. This work evaluates the possibility of using the excess wind power to produce fresh water that is stored in a lower reservoir of a pumped hydro system. The remaining wind power can be stored in this energy storage system. The objective is to minimize the curtailed wind power that will be a function of the dynamic penetration limit of the grid and of the characteristics of the pumped hydro system, namely its operational strategy. This paper proposes a methodology to optimize the operation of this system, minimizing the curtailed wind power, hence minimizing the annualized costs. To solve this optimization problem two algorithms were used: a recent method for global optimization GLODS (Global and Local Optimization using Direct Search) and a multi-objective optimization method DMS (Direct Multisearch Method). GLODS was used to determine the initial solutions for the DMS.