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Modeling Feasibility of a Proposed Renewable Energy System with Wind and Solar Resources and Hydro Storage in Complex Terrain

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High temporal and spatial variability in wind and solar power brings difficulties in integrating these resources into an electricity grid. These difficulties are even more emphasized in areas with complex topography due to complicated flow patterns and cloudiness evolution. This study investigates the feasibility and efficiency of a proposed renewable energy system with wind and solar resources and hydro storages in western Nevada, U.S.A. The state-of-the-art Weather Research and Forecasting (WRF) model was used for the prediction of wind fields and incoming solar radiation at the ground surface. Forecast winds and solar radiation were evaluated with observational data from four wind masts and four meteorological towers in two months, July 2007 and January 2010.

Based on a hypothetical wind farm and an assumed neighboring solar power plant both located near the hydro storage facility, as well as considering local power demand, the efficiency of the renewable energy system is projected. One of the main questions was how to optimize a schedule of activating pump storages according to the characteristics of several available hydro pumps, and wind and/or solar power predictions. The results show that segmentation of the pump-storage channel provides improved efficiency of the entire system. This modeled renewable energy system shows promise for possible applications and grid integration.