



## Strategic Operation of Hydroelectric Power Plants in Energy Markets: A Model and a Study on the Hydro-Wind Balance

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### Summary

The European Union defined ambitious targets for the production of energy from renewable energy sources. Most European markets trade now high levels of variable renewable energy. Renewable generation increases the variability and uncertainty of the net-load (i.e., demand minus variable renewable energy). To a large extent, this variability and uncertainty can be compensated by hydroelectric power plants. Typically, hydro power producers consider the periods of time with low market prices (and normally low demand and/or high variable renewables production) to pump, and the periods with high market prices (and normally high demand and/or low variable renewables production) to produce energy. This article presents a model for hydro power plants and a study to analyse the hydro-wind balance in a real-world setting, namely a simplified version of the Portuguese power system, involving a significant penetration of hydro and wind power (more than 50%). The study is conducted with the help of the Multi-agent trading for Electricity Markets (MATREM) system. The results confirm (and rebut) the typical behavior of hydroelectric power plants (to produce energy, to pump water or to stay idle).

### Highlights

- Operational and economic models of hydroelectric power plants;
- Models that consider the economic and pumping values of water, and also accounts for unit performance curves;
- A study to "test" the model and analyze the hydro-wind balance in a real-world setting;
- During real-time operation, hydro plants respond to the deviations of variable generation (increase or decrease), thus compensating them and keeping power systems balanced.



The TradeRES project will develop and test innovative electricity market designs that can meet society's needs of a (near) 100% renewable power system. The market design will be tested in a sophisticated simulation environment in which real-world characteristics such as actors' limited foresight into the future and risk aversion are included.



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