Hybrid Energy System Modeling in Modelica

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In this paper, a Hybrid Energy System (HES) configuration is modeled in Modelica. Hybrid Energy Systems (HES) have as their defining characteristic the use of one or more energy inputs, combined with the potential for multiple energy outputs. Compared to traditional energy systems, HES provide additional operational flexibility so that high variability in both energy production and consumption levels can be absorbed more effectively. This is particularly important when including renewable energy sources, whose output levels are inherently variable, determined by nature.

The specific HES configuration modeled in this paper include two energy inputs: a nuclear plant, and a series of wind turbines. In addition, the system produces two energy outputs: electricity and synthetic fuel. The models are verified through simulations of the individual components, and the system as a whole. The simulations are performed for a range of component sizes, operating conditions, and control schemes.

Keywords: hybrid energy system; Modelica; multiple-input; multiple-output; renewable power; optimization