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Distributed control with multi-agent systems: the case of intermittency reduction for wind energy

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Distributed control with multi-agent systems: the case of intermittency reduction for wind energy

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Topic:
1. **Power balancing solutions for wind power variability and unpredictability**
2. **IT technology for large-scale integration of wind power**

Multi-agent technology is state of the art IT. It is not yet widely applied in power control systems. However, it has a large potential for bottom-up, distributed control of RES and DER in future power systems. At least two major European R&D projects (MicroGrids and CRISP) have investigated its potential. Both grid-related as well as market-related applications have been studied. This paper focuses on the application of multi-agent technology in a commercial setting, i.e. by reducing the need for balancing power in the case of intermittent energy sources, like wind energy.

Wind power supply is subject to the risk of over- and underproduction, causing imbalance in a commercial portfolio. As a result, it has a poor market position. In order to overcome the portfolio imbalance of wind power we have built an 'Imbalance Reduction System' (IRS) and performed a real-world field test with it, in which imbalance is minimized within a real-time electricity market portfolio, making use of the flexibility of demand and supply of additional industrial and residential consumers and producers (CHP for district heating; residential heat pumps; industrial cold stores; an emergency generator).

The IRS field test applies the PowerMatcher concept (http://www.powermatcher.net/), in which software agents act as representatives of the power producing and/or consuming installations. Via market algorithms a strategy is determined that coordinates the devices' operational schemes so as to reduce real-time market portfolio imbalance. The algorithms in the PowerMatcher use a bottom-up electronic market mechanism. Building such a system, controlling primary user processes on the one hand, assuring local autonomy, and operating on the electricity market on the other hand, appears to be feasible with mainstream IT components. The IRS demonstrates the opportunities to embed variable

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output DER-RES generators more smoothly in the portfolio. Imbalance reduction rates of over 40% have been achieved, and with a properly tailored portfolio even larger rates appear to be possible.

We will describe the context and operation of the Imbalance Reduction System and discuss a number of results from the field test, which has run now for over one year.