

FlexEuro: Flexible and Smart Management Wins in the Energy Market

The manufacturing industry needs a lot of electricity. Energy and electricity usage are therefore often decisive cost factors in the industrial sector. At the same time, flexibility in the power supply system has become the slogan of the day. After all, those who respond smartly to fluctuations on the market and manage their power consumption benefit from it. In the BMWi-funded FlexEuro project, researchers from the “Financial Mathematics” and “Optimization” departments are developing models and methods for the optimal marketing of load flexibilities in various electricity markets.

So-called supply-dependent power generation was unimportant in the past for nuclear and coal-fired power plants, but is now crucial for the price in the electricity mix. This means that due to renewable energies, such as wind and solar power, electricity production is increasingly dependent on the weather and also fluctuates over the course of a day, sometimes every hour or even every second. However, it is not just generation that has an impact on markets and prices, but also varying levels of demand. Companies that respond to such flexibility when purchasing electricity are going to have decisive advantages in the future, especially energy-intensive companies. At the same time, they relieve the burden on the energy network.

Smart control of aluminum production

These industrial processes with particularly high energy consumption include, for example, the production of aluminum or, more precisely, aluminum electrolysis. TRIMET Aluminium is on board as an application partner in the FlexEuro project. Everything revolves around light metal products in the medium-sized family business. “At the kick-off to the project, we were also shown the impressive manufacturing processes in the electrolysis furnaces during a tour of the plant. That definitely increased our understanding. They have to run 24/7 so that in the end the output does not suffer,” says

Dr. Neele Leithäuser. That takes a lot of energy. Some of the furnaces are already designed to compensate for deviations in power input by controllable heat exchangers without interrupting production.

“TRIMET also calls these flexible furnaces a virtual battery,” explains the deputy head of the “Optimization – Operations Research” department. The special feature: In the converted cells, production can be ramped up and down depending on the weather. When the sun is shining and the wind is blowing, the furnaces can melt up to 25 percent more with surplus green electricity. If it is dark or there is no wind, they ramp down production by up to 25 percent. This is highly complex, because electrolysis requires a constant operating temperature of 960 °C. Even 10 degrees above or below that is not good for the end product. The aim of the project is to control electricity consumption in such a way that the electricity required on the market can be used as efficiently as possible.

Mathematics keeps an eye on short-term marketing options

“Here, we focus on short-term marketing options for flexibility,” explains Elias Röger, ITWM expert in financial mathematics. Röger cites the so-called day-ahead-market as an example. “Always at noon of each day, the stock

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Flexible electrolysis furnace at TRIMET Aluminium SE.

Short-term Marketing Options

- The balancing power market: Balancing power, also referred to as reserve power, ensures supply in the event of unforeseen events in the power grid. It is provided by certified market participants and remunerated by the grid operators.
- The day-ahead auction: trading of electricity for the following day. There is one price for each of the different delivery periods, which becomes known at the end of the auction.
- The intraday market: It refers to the continuous buying and selling of electricity that is delivered on the same day. Electricity can be traded back and forth until shortly before the delivery date, which allows speculation. Positions from the day-ahead auction can be changed again here.

market determines the electricity price for each hour of the following day. This result depends on the level of expected consumption and the forecast generation from renewable energy sources." The different characteristics and restrictions of the markets require an individual combination of mathematical models for each marketing option (see info box for differences between the markets). In TRIMET's practice, this can mean that the furnaces then use less electricity in a "more expensive hour" in the best case and continue to ramp up in less expensive hours. The project is now halfway completed and the researchers are drawing up an initial interim balance.

Leithäuser summarizes: "In the first one and a half years, we at ITWM dealt intensively with

marketing on the day-ahead-market. For this purpose, the possibility of flexible consumption was modeled as a multicriteria optimization problem. Mathematical forecasts were then used to calculate optimal load schedules for the coming day. Here we were able to show that flexibility is very profitable economically."

FlexEuro will run until August 2022 and the end result should be specific recommendations for practical action. The plan is to bring the developed models and methods into use as software prototypes at the project partner.

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