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Forecasting Consumption

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Dieselstrasse Energy Park from Energieversorgung Halle can store around 2,000 MWh of thermal energy with its 'Energy and Future Storage'. Image: Kappa Agency, 2018

For more than 50 years, Energieversorgung Halle GmbH (EVH) has been generating district heating and electricity from environmentally-friendly cogeneration. Economical power plant optimization requires highly accurate predictions of the amount of heat required and, simultaneously, the amount of electricity that can be generated. Bachmann provides the solution for dynamic heat consumption forecasting.

Around 74,000 apartments, public buildings and commercial enterprises in Halle are supplied with district heating from EVH. The district heating network extends more than 200 km throughout the entire city. Heat is generated in two energy centers, which also produce electricity via environmentally friendly cogeneration, currently based on natural gas. In 2020, more than 440 GWh of electrical energy was fed into the public grid.

Tricky Operational Planning

Economical optimization relies on precise knowledge of future demand for heat. This is the only way to optimize power plant usage, primary energy purchasing, and market sale of electrical energy. Essentially, plant deployment planning is based on heat demand. At the same time, however, it must be matched as closely as possible to the quantities of electricity offered and committed to the market: any shortfalls or surpluses can significantly reduce economic efficiency.

In the past, demand for district heating was determined largely from weather data. Considering the forecasted electricity prices on the spot market and technical data on plant availability, an optimization model was used to determine, largely manually, power plant input for the next day. These settings were only adjusted during the day in the event of a plant failure or a massive change in heat demand.

Challenges in the Energy Market

However, the energy market is now subject to significant changes, presenting suppliers with entirely new challenges and requiring enormous flexibility and agility. The increasing use of renewable energies, and the associated volatility of supply, lead to considerable price fluctuations on the electricity market, especially during the day.

To be able to operate economically and take advantage of any market opportunities, EV Halle has enacted radical organizational and procedural process changes for plant deployment planning, operation, and marketing. A key focus was the dynamic optimization of the operation of the energy park. Heat demand must always be met, but in future, power plant flexibilities and real-time market prices must also be considered.

AI for Better Forecasting

The most important control variable is still the most accurate possible forecast of heat demand from connected consumers. Bachmann Monitoring and its team, led by Prof. Michael Schulz, redesigned the consumption forecasting process. Data from EVH's own weather measurements; forecasts from weather services; and existing measured values for flow and return temperatures, volume flows, and outside temperatures at the heat transfer stations in the network are now recorded every 15 minutes and imported into the software. At the same time, it has access to the entire data history along with the power plant production data. Using these inputs, a dynamic algorithm forecasts the heat demand using various sub-algorithms and compares the results of the forecasts with the actual values for the same period. The 'best' sub-algorithm in each case is then applied in turn for the subsequent calculation, and all others are modified according to their miscalculations. These AI methods enable the algorithm to learn constantly, dynamically adapting its rules and structure to the current situation.

In a nod to Darwin's theory of evolution, these self-evolving procedures that constantly reshape and select according to temporal accuracy, are referred to as 'genetic algorithms'. These procedures form a class of their own within AI methods and have proven effective in areas such space travel.

Subsequently, trends with various forecast horizons are generated for all operating parameters, according to customer requirements. EVH uses 3 horizons: One, with 1 1/2 days for optimal electricity. Another with a longer forecast period of 14 days for primary energy procurement on the commodities market. And a third horizon of around 12 hours is used to

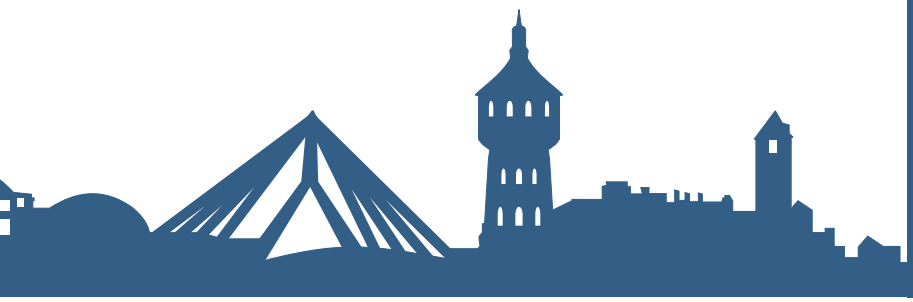
organize shift operations. There is a strong benefit for network operations: Because transfer stations and power generation plants are now monitored, operations personnel receive feedback on network operating parameters at least four times per hour. Any heat losses are thus identified more quickly, improving operational reliability.

Added Flexibility

Three years ago, as part of the modernization of its plant park, EVH also built a huge, large-scale heat storage facility, the Energy and Future Storage Facility, often affectionately referred to in Halle as 'Germany's largest thermos'. With a volume of 50,000 m^3, the facility can store around 2,000 MWh of thermal energy – enough to supply every EVH customer with heat for two days. Crucially, the storage facility decouples heat production from electricity production as far as possible, making it possible to run plants much more flexibly: Necessary 'must-run' situations due to a demand for heat can be reduced and production can be shifted to times of more economical operation. "Today, electricity is traded on the intraday electricity market, and purchase prices vary considerably throughout the day," explains Mathias Hocke, Head of Portfolio Management/ Procurement at EVH. This is also supported by an additional power plant unit, which can be started up and shut down at short notice, reacting flexibly to market price signals. "With the thermal storage unit as a buffer, we can now offer electricity at the best possible prices."

Optimal Automation in the Future

With the technical upgrade of production facilities, the heat storage system and the dynamic forecasting of demand, EV Halle has successfully migrated from a demand-driven and manually controlled operation to a revenue-oriented mode of operation with a high degree of automation. "Together with Bachmann Monitoring, we are currently examining further possibilities to further refine the forecast," says Mathias Hocke. In this context, changes in the network, triggered by faults or local maintenance, for example, will be automatically recorded and will help to make the software even more realistic. Hocke is pleased: "This will enable us to further improve the quality of our forecasts and expand our ongoing process of digitization."



»With automated and more accurate forecasting we can more easily track electricity market volatility.«

Mathias Hocke
Head of Portfolio Management/Procurement
at Energieversorgung Halle (EVH)

ENERGIEVERSORGUNG HALLE GMBH (EVH)

– Employs around 320 people

– Supplies electricity, natural gas and district heating to the city of Halle an der Saale, Germany, with a population of around 250,000

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