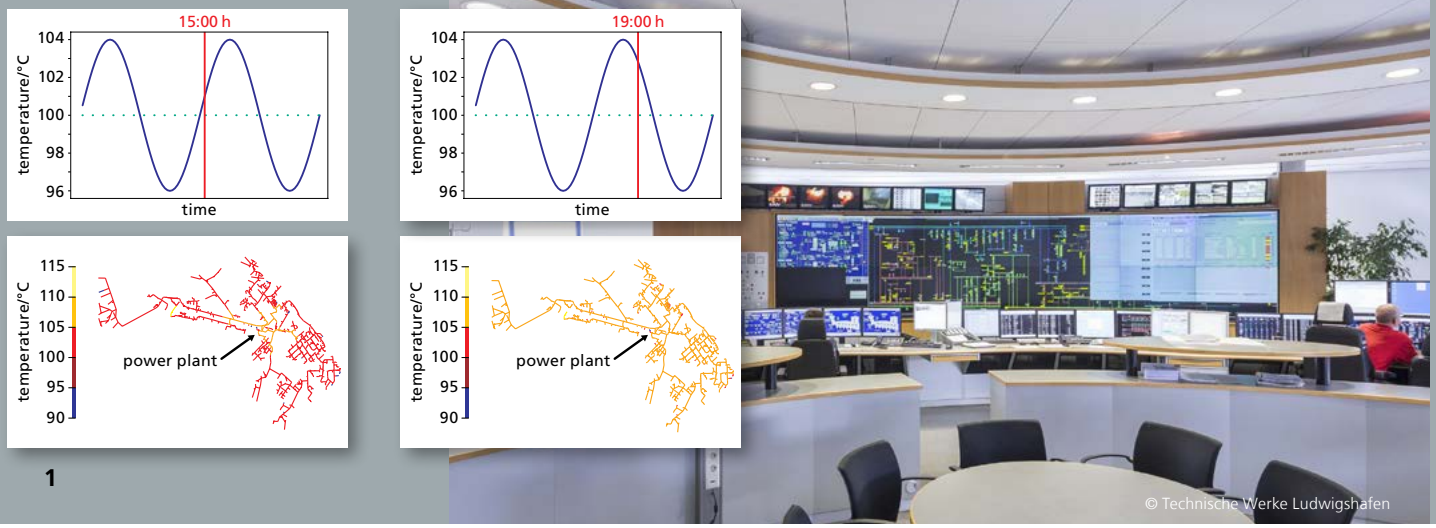

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DYNAMIC SIMULATION TO IMPROVE EFFICIENCY OF DISTRICT HEATING GRIDS

1 *Dynamic simulation of the sub-network in Ludwigshafen: feed-in temperature at the power plant (top), temperature in the district heating network (bottom)*

The project is sponsored by the Federal Ministry for Economic Affairs and Energy (BMWi) and implemented in cooperation with GEF (engineering company) and TWL (Technische Werke Ludwigshafen) with the aim of developing dynamic network simulations to improve the efficiency of district heating operations. The project has already developed and tested a software tool for network simulation, which TWL uses to optimize its operations.

District heating grids supply heat and warm water. The operators of district heating plants generate part of their revenues from the sale of electricity, generated in parallel at the combined heat and power (CHP) plants. The integration and dynamic control of the district heating grids as energy storage systems ensures efficient operation of the turbines and optimal use of the existing storage tanks.

Software models optimize grid operations at district heating power stations

The current software to support the operation of CHP plants focuses on either the optimal use of local resources, where the district heating network is managed as an unstructured sink, or on detailed models of the power grid and locally triggered hydrothermal conditions to ensure supply to all customers. However, this usually happens without having an integrated simulation of the overall picture with fluctuating operating conditions.

The dynamic simulation of district heating grids has huge advantages: using the software, the grid operator can read both the temperature and the flow conditions at any point in the district heating grid at all times. In doing so, the inlet temperatures provided at the power plant and mass flow fed into the grid can be controlled, which implies that the costs of switching on gas turbines for heat generation can be avoided.

Mathematics creates a digital twin behind the software

The traditional methods of solving the fluctuating thermohydraulic equations are too inaccurate or too expensive for use in proposing operational controls for district heating grids. This is the reason the project developed a new numerical method that does not need to further subdivide the lines. The software creates a digital image of the real district heating grid and an automated control center, which is more necessary than ever before considering the ongoing decentralization of input points. The optimization horizons over a few days can be mastered using model-predictive control and automatic differentiation.