Karlsruher Institut für Technologie

Heat | Hydrogen | Resilience

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Master Thesis

System modeling and thermodynamic control of a grid-compatible heat pump

The heat pump is a central pillar of the energy transition and opens up the development of low-temperature heat. It serves as a bridge between the heat and electricity sectors, as the use of medium and high capacity heat pumps in particular must take into account issues of grid serviceability and grid dynamics, issues of heat supply and the specific business models of customers.

In the MSc thesis, in cooperation with a well-known industrial partner, an exemplary system is to be set up using a system modeling code (Ebsilon or Dymola) and examined and evaluated with regard to various control mechanisms. The focus is on influencing the start-up process and partial load operation by means of control in the thermodynamic cycle (e.g. bypass, inlet guide vanes, control of the heat flow).

As part of the work, requirements are first to be defined together with a customer. The central components of the heat pumps are the compressor and expander together with the corresponding drive motor. In high performance classes, the latter is used for energy recovery. The efficient coupling of the components and their grid-friendly control (partial load behavior and dynamics) is to be investigated and evaluated in this work using specific scenarios. A promising approach is the thermodynamic and fluid-dynamic coupling and control of the heat pump instead of speed control, which is to be investigated in this thesis.

The work includes in detail
- Literature research
- Familiarization with the modeling software Ebsilon or Dymola
- Creation of a heat pump model
- Carrying out transient or steady-state calculations for various operating cases
- Summarizing, interpreting and evaluating the results
- documentation

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