A successful Energiewende needs multi-modal approaches for industrial energy management

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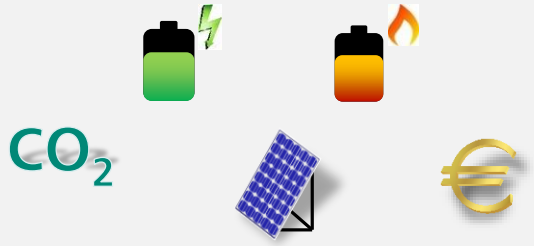
Initial situation

- Flexibilization of the energy demand is the key to a successful Energiewende
  - ➢ Only achievable in consideration of all different forms of energy – multi-modal approach (e.g. power-to-heat)
- Therefore an increase of transparency of multi-modal energy systems is absolutely necessary
- Besides this, the use and conversion of energy should be as renewable as possible, thereby climaneutral as possible at minimal costs



Research topic

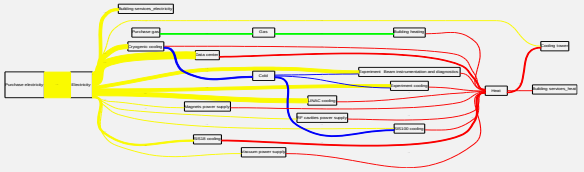
Development and optimization of detailed digital replica of complex multi-modal energy related systems and processes with our own energy system modelling and optimization tool (similar to OSeMOSYS or oemof)

Challenges:

- get or develop necessary system information (production and demand), such as
  - Entire dedicated components incl. operating parameters
  - Time series for each component (e.g. generation & storage schedules, production planning)
  - Calculate CO_2 intensity for each commodity at any time
- Define system constraints, e.g.
  - Technology availability
  - Energy or emission limits
  - Load and renewable patterns

Research objective

- Increasing comprehension of industrial energy systems due to full scale multi-modal modelling, simulating and optimization via LP and MILP
  - **Establish** the method of the "**digital twin**" in context of digitization of energy systems
  - **Optimizing** the system setup to minimize cost and emissions by adding new technologies or re-arranging the use of available ones
  - **Uncertainty quantification** (to obtain ±XX% cost and/or CO2 emission)
  - Development of a **sensitivity analysis** for small system constraint changes



Energy flow diagrams (Source: own research)