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# Model-based design and control of $CO_2$-neutral energy systems

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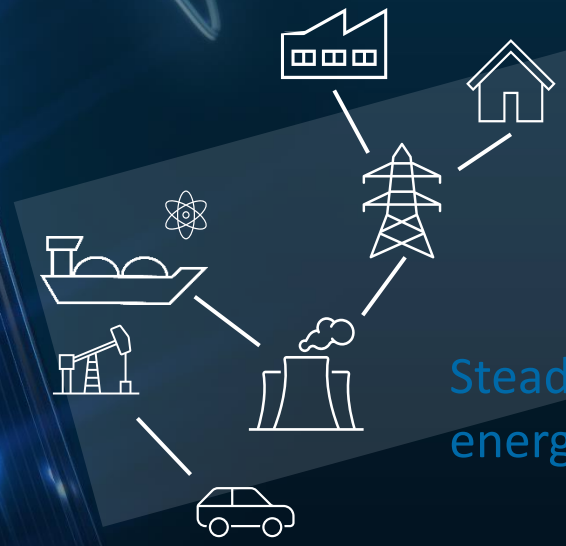
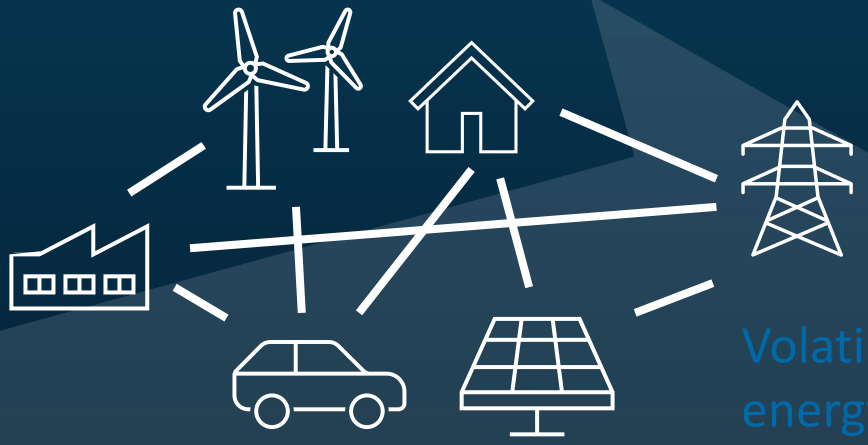
Quelle: shutterstock | Gorodenkoff

# Principle of subsidiarity



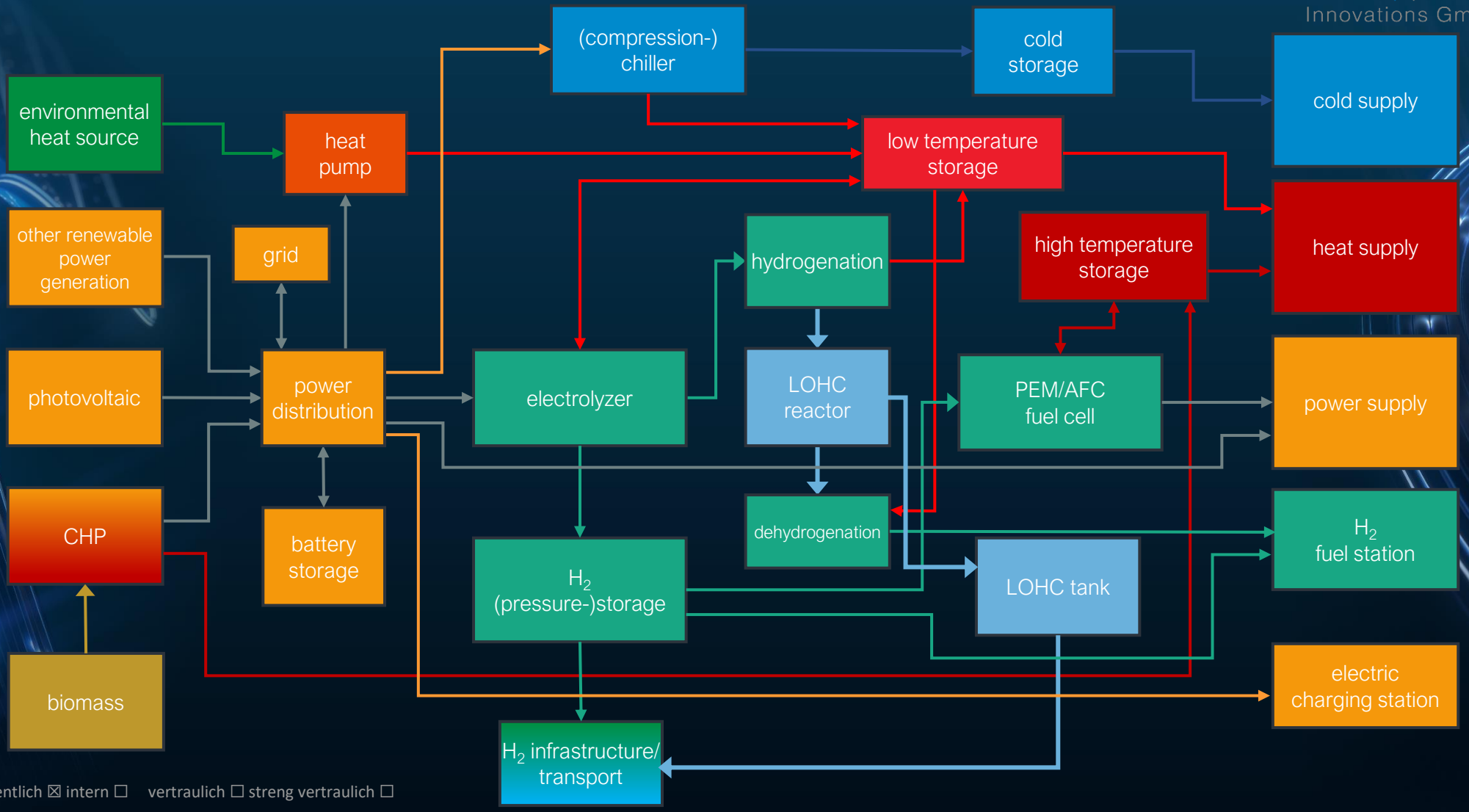
Steady traditional energy system



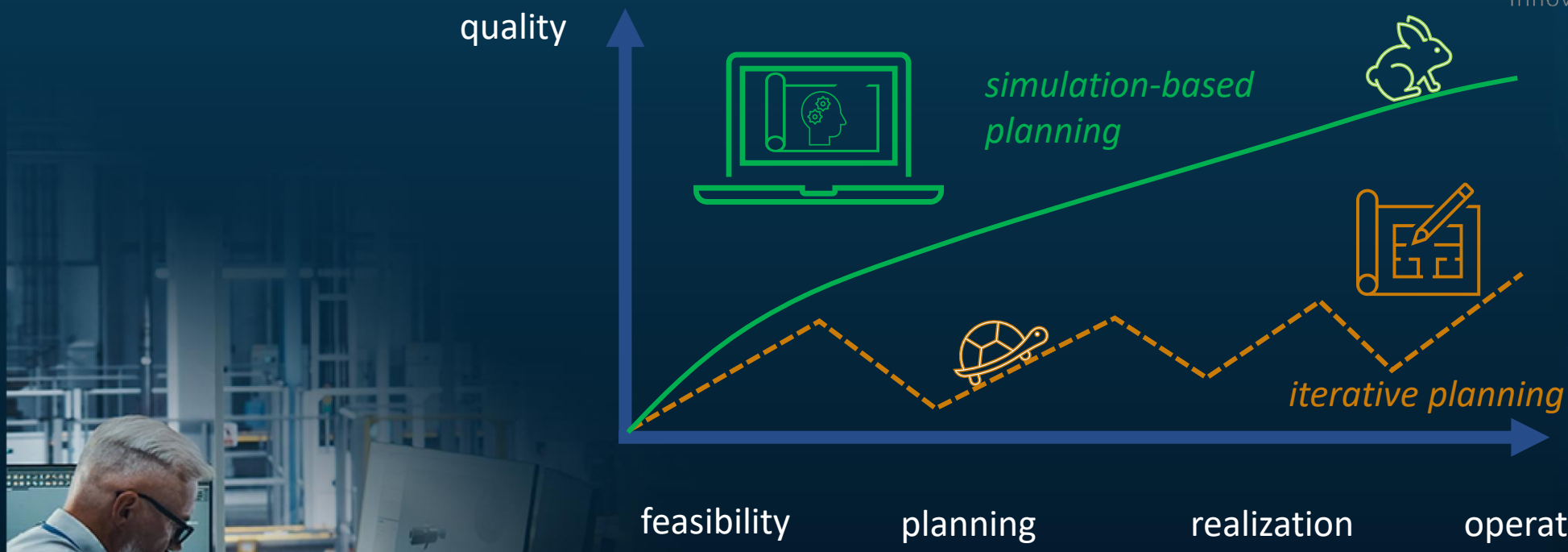
Volatile novel energy system

- decentralized generation
- self consumption
- sector coupling
- grid services

# Hydrogen-based hybrid power plant



# More quality and speed with the help of simulation




- optimal design
- virtual commissioning
- model-based energy management
- predictive maintenance

# HEITEC Innovations libraries

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OpenModelica

Modelica language

Dymola

fmi Functional Mock-up Interface


- dynamic
- manufacturer-independent
- flexible

- efficient planning
- $CO_2$-neutral production
- design of city districts

Quelle: iStock | Petmal

# Object-oriented modeling

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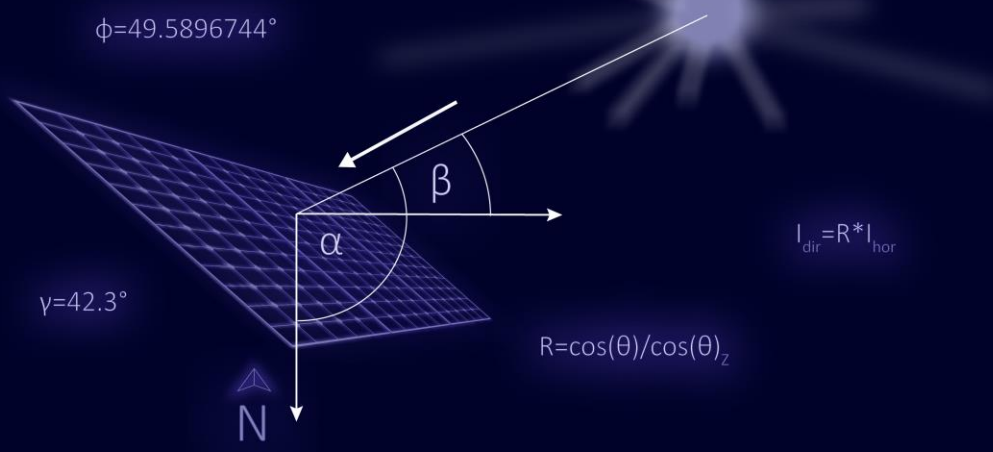
Modelica Language




$$\cos(\theta) = \sin(\beta) * \sin(\phi) * \cos(\gamma) - \sin(\beta) * \cos(\Phi) * \sin(\gamma) * \cos(\alpha) +$$
$$\cos(\beta) * \cos(\Phi) * \cos(\gamma) * \cos(\tau) + \cos(\beta) * \sin(\Phi) * \sin(\gamma) * \cos(\alpha) * \cos(\tau)$$

- platform independent
- scalable

- collaborative
- knowledge stored in the model

# Better results thanks to physical simulation

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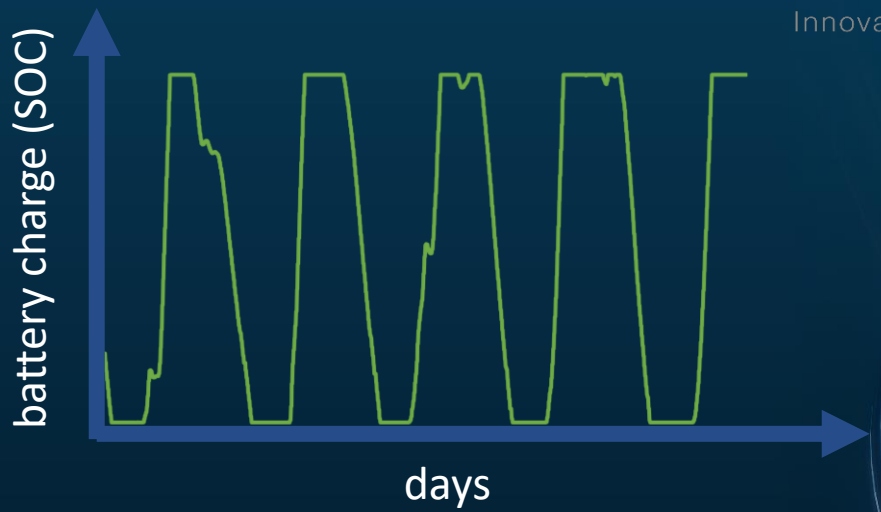
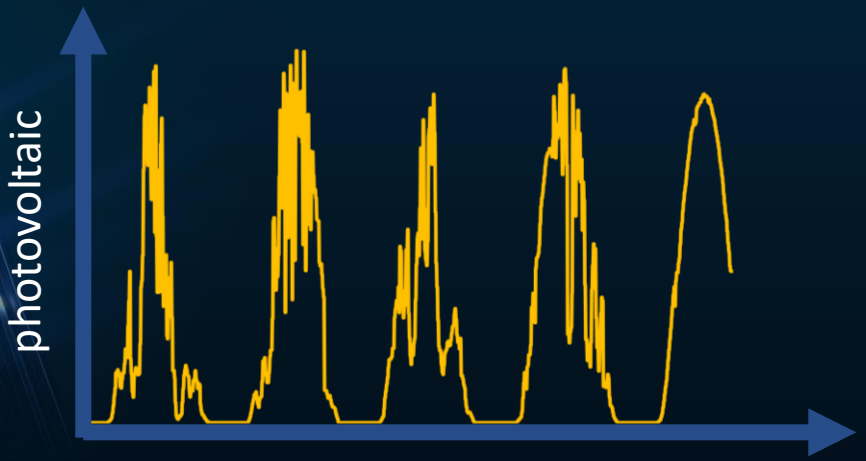
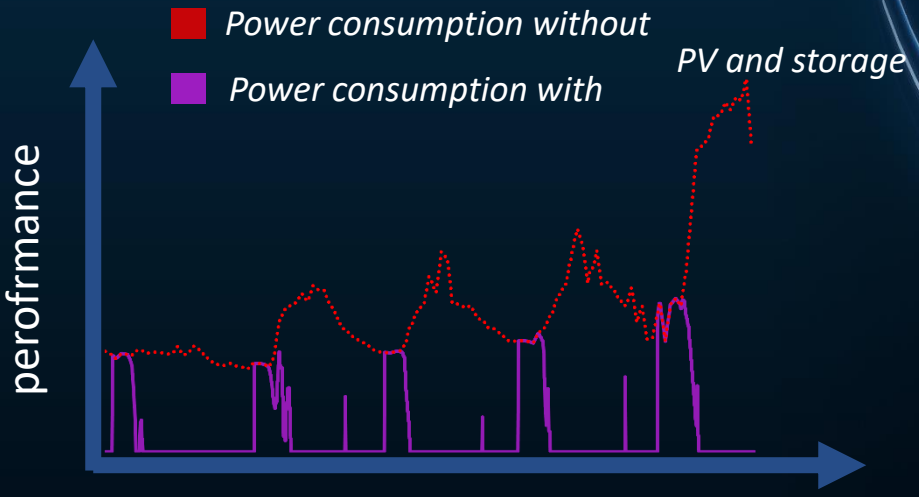
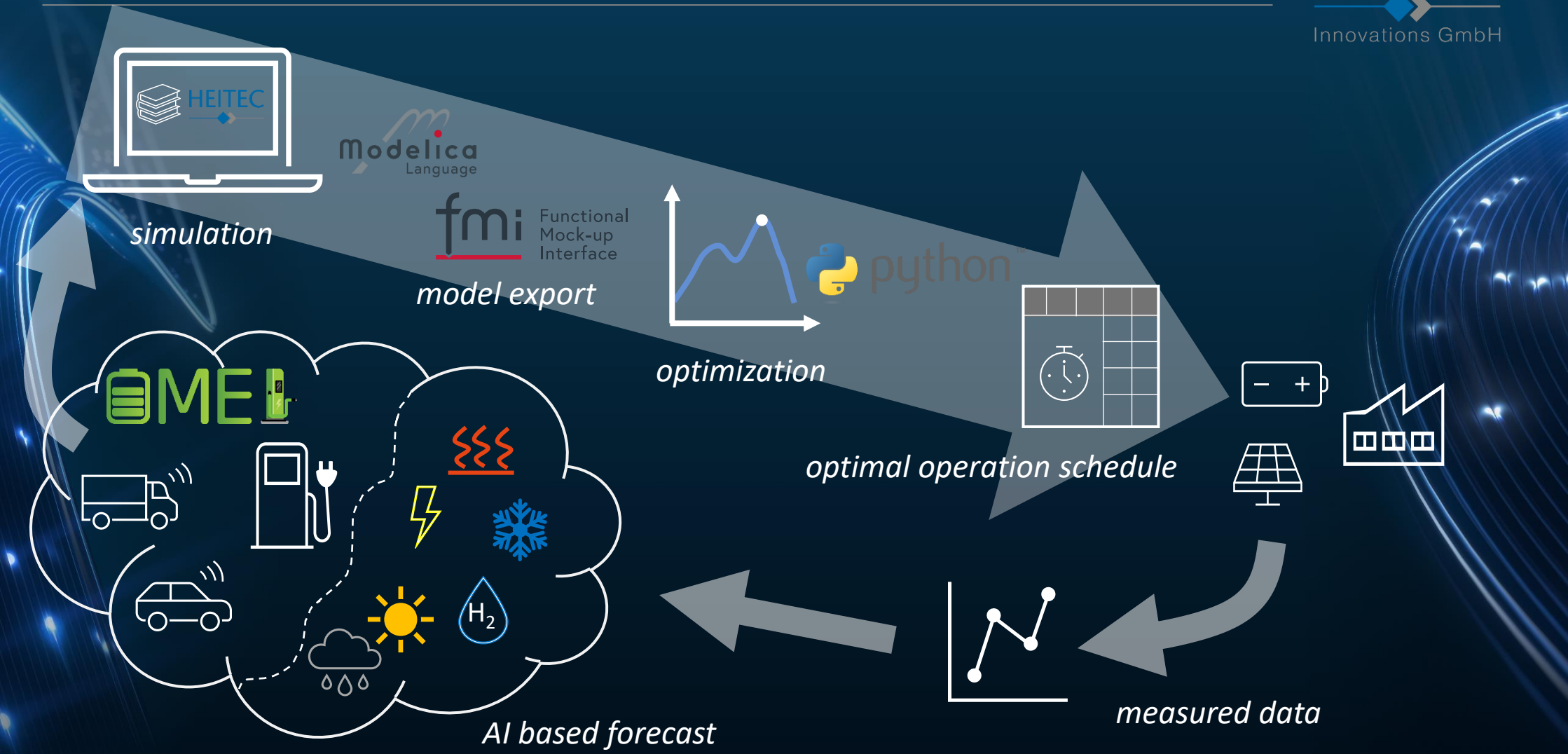
- precise
- time-resolved
- cross-sectoral



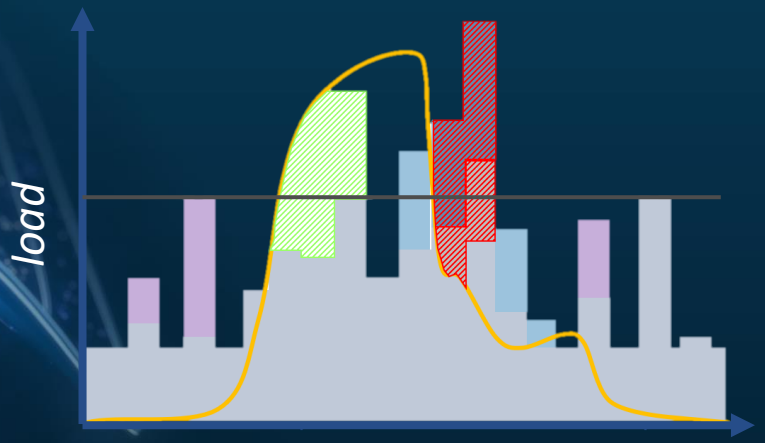



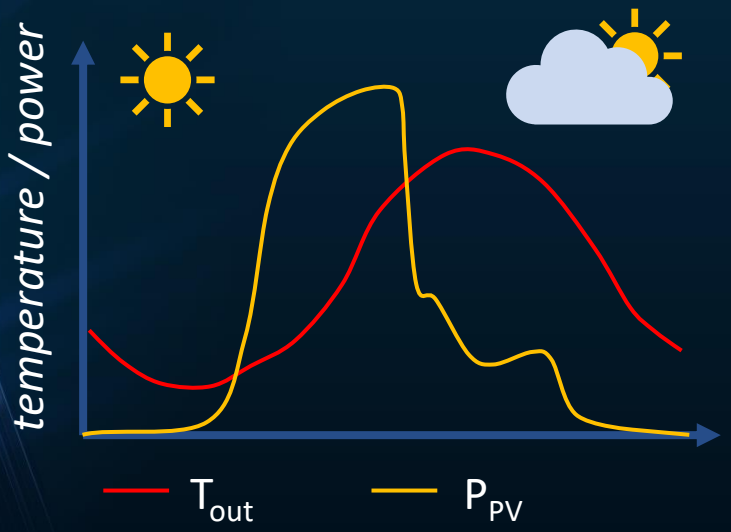



# Model based operation optimization



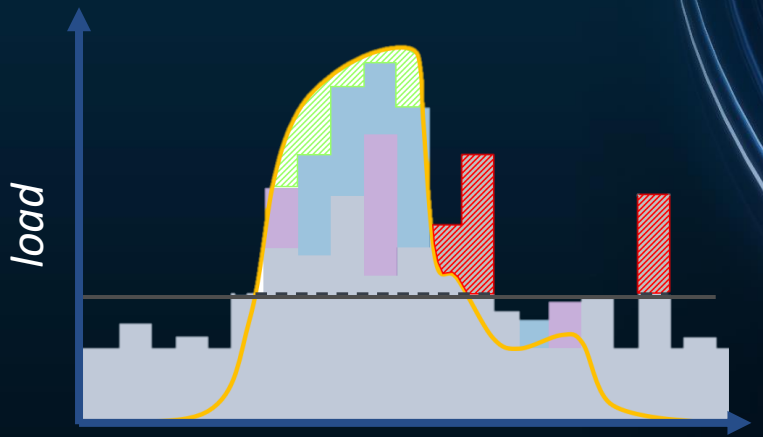
# Model predictive energy management system: planning instead of reacting



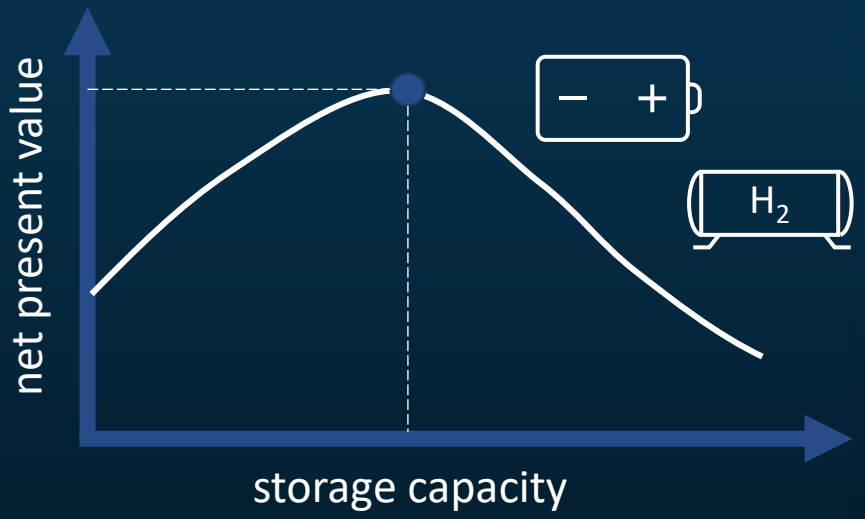




optimization

- discharging battery
- charging battery
- controllable loads
- non-controllable loads
- refrigeration machines



# Optimized economic efficiency and non-monetary effects


- $CO_2$ neutrality as a corporate strategy
- supplier status & publicity
- employer attractiveness
- long-term energy costs & security of supply

# Thank you for your attention

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