

Innovations for energy systems in industry - Modeling - Components - Operation

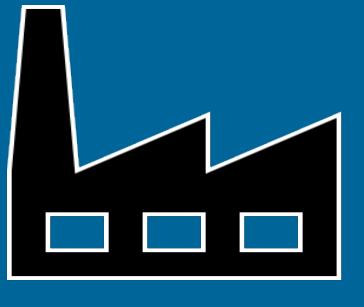
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Institute of Energy Systems and Thermodynamics

Innovations for Energy Systems in Industry

... 1/3 of world energy consumption is needed by industry
this share can be reduced significantly ...





Questions to be answered ... Industry

Systemic

- Demand for renewable generation / Sectoral Coupling Gas, Electricity, Heat / Need for flexibility

Technology

- Storage tanks, heat pumps, etc. / New production processes / Network technologies (e.g. DC)

Market

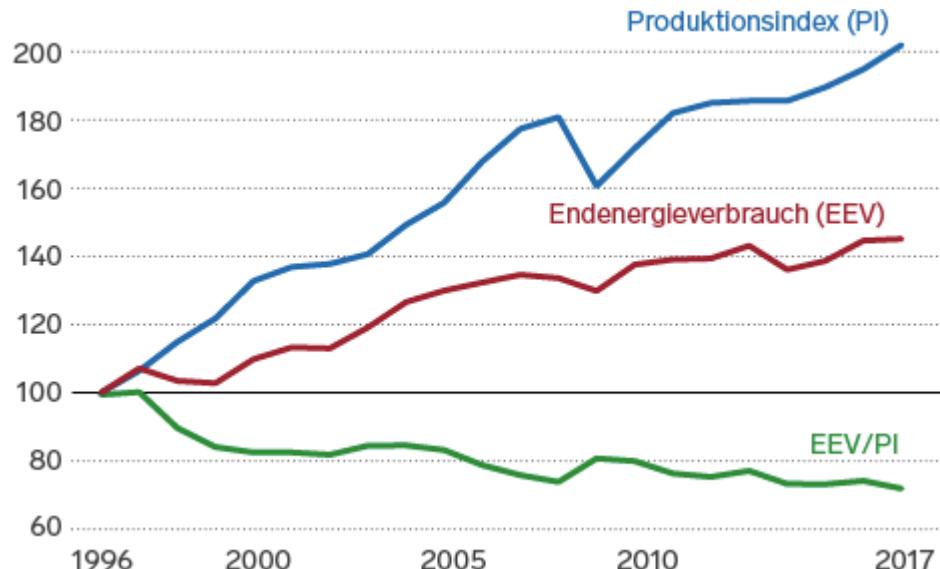
- Which market design? / What is the object of markets? / Where are the boundaries of local energy communities? / New business models

Infrastructure

- Energy networks (gas, electricity, heat) / Industrial energy infrastructure / Production processes and plants

Content Source: (15)

Industry needs 1/3 of Austria's Energy Demand ...



- Industry approx. 30% energy consumption in Austria
- 60% energy-intensive industry
- Energy intensity -1.6% p.a. (1996– 2017)
- Strong dependence on energy imports



Source: Österreichische Energieagentur

Energy productivity → Production index rises stronger than energy consumption of industry.

Content Source: Energie in Österreich 2018, <https://www.bmvt.gv.at/service/publikationen/energie/energie-in-oesterreich-2018.html> bmvt; (16) - www.nefi.at

Goals and Tasks

1. Current situation/outlook for 2050 of renewable generation (industrial) primary energy demand.
2. Identify / quantify key industrial processes load shifting potential.
3. Comparison of existing with necessary flexibility options
4. Presentation of current el. grids /market designs requirements for 2050.

Project

Three-part
discussion paper

Two stakeholder
workshops

Technology
policy
recommendation



Strategic
research agenda

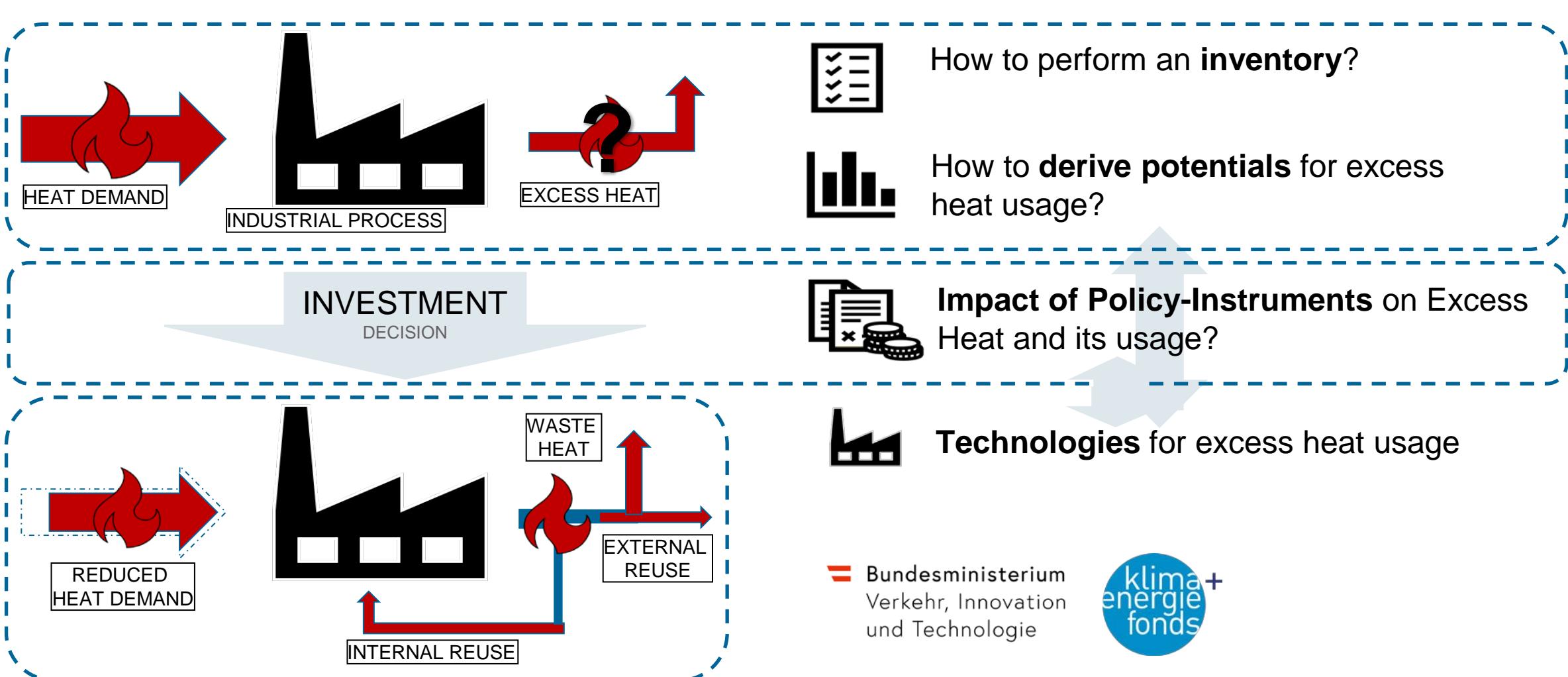
Results

Actual situation /outlook renewable energy requirements

- ✓ Today's domestic demand cannot be covered with the entire Austrian, technical renewable potentials!
- ✓ Energetically industry could be supplied exclusively with renewable electricity.
- ✓ Capacities show a large demand for daily and annual storage facilities.

Decarbonization pathways application of renewable electricity, gases, thermal and biogenic fuels, increasing primary and final energy efficiency

CONCLUSION: there is not "the" single path



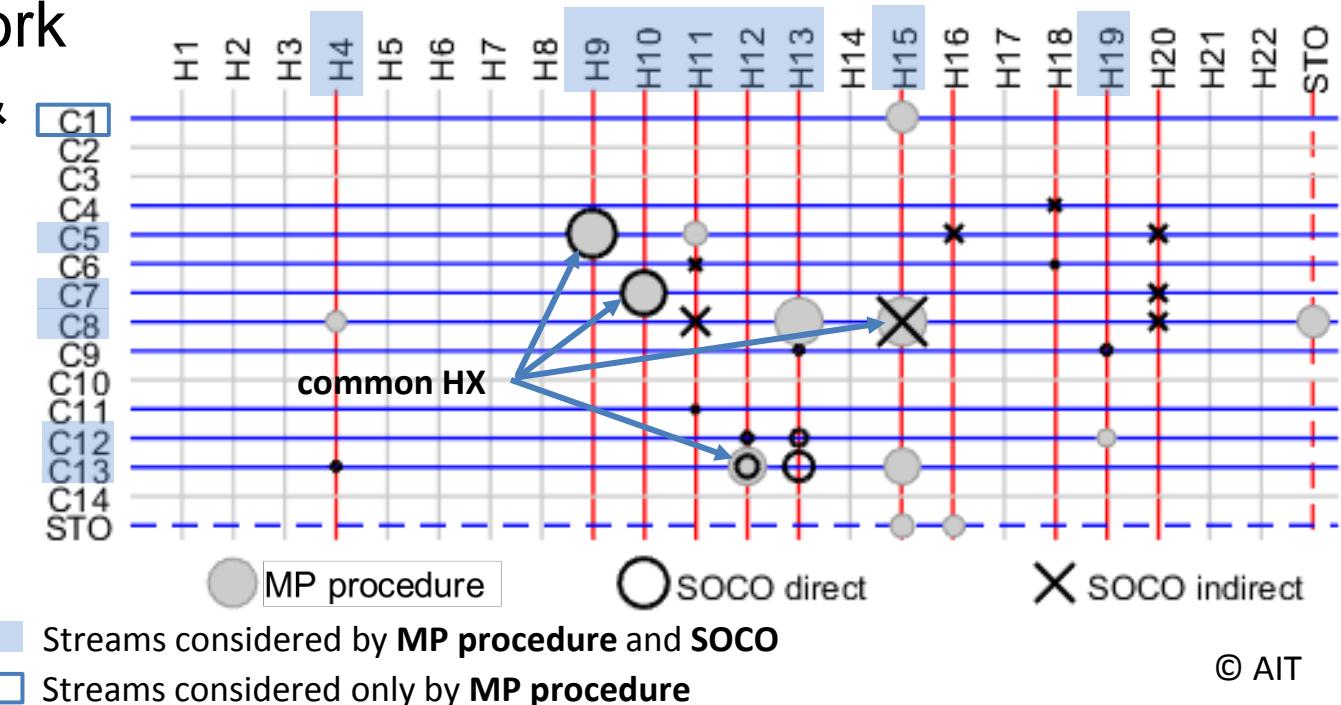


How to **derive potentials** for excess heat usage?

Example: Dairy Factory (AEE INTEC)

Comparison of AIT PI Framework
(Mathematical Programming) &
(Solar)SOCO

- 37 Process streams
- Changing operating states
- Stream data for 3 weeks
- Storage integration
- Heat exchanger network synthesis



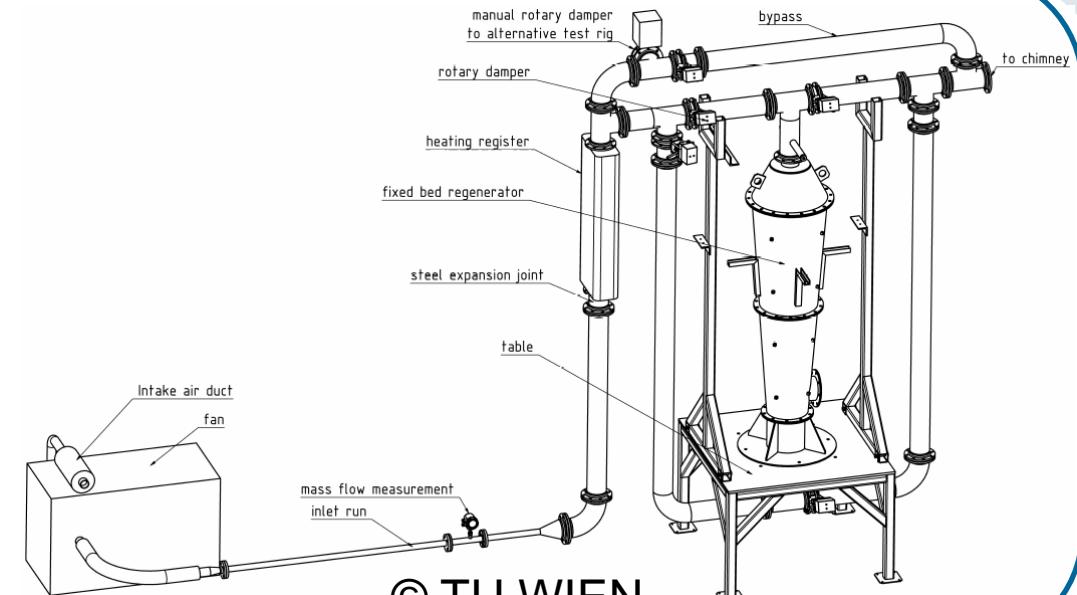
© AIT

Thermal Energy Storage Technologies



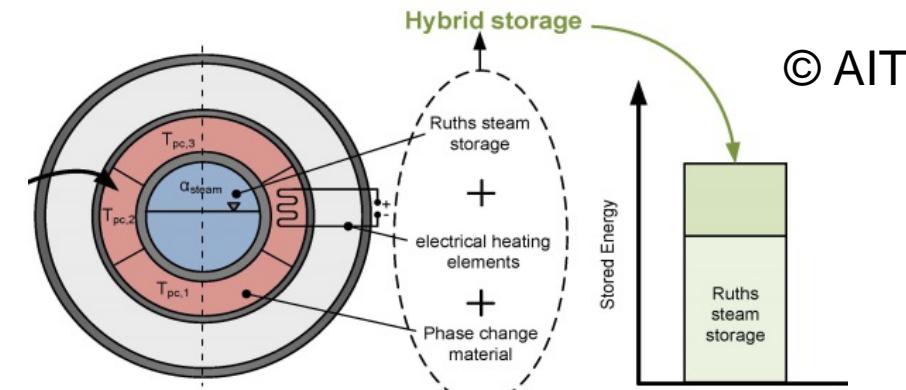
Active and Passive Regenerators

P=15 kWth
Tmax = 300 °C
Vmax = 100 m³/h



Hybrid Energy Steam Storage

Up to 30% more stored energy
in the hybrid storage
compared to Ruth's steam accumulator



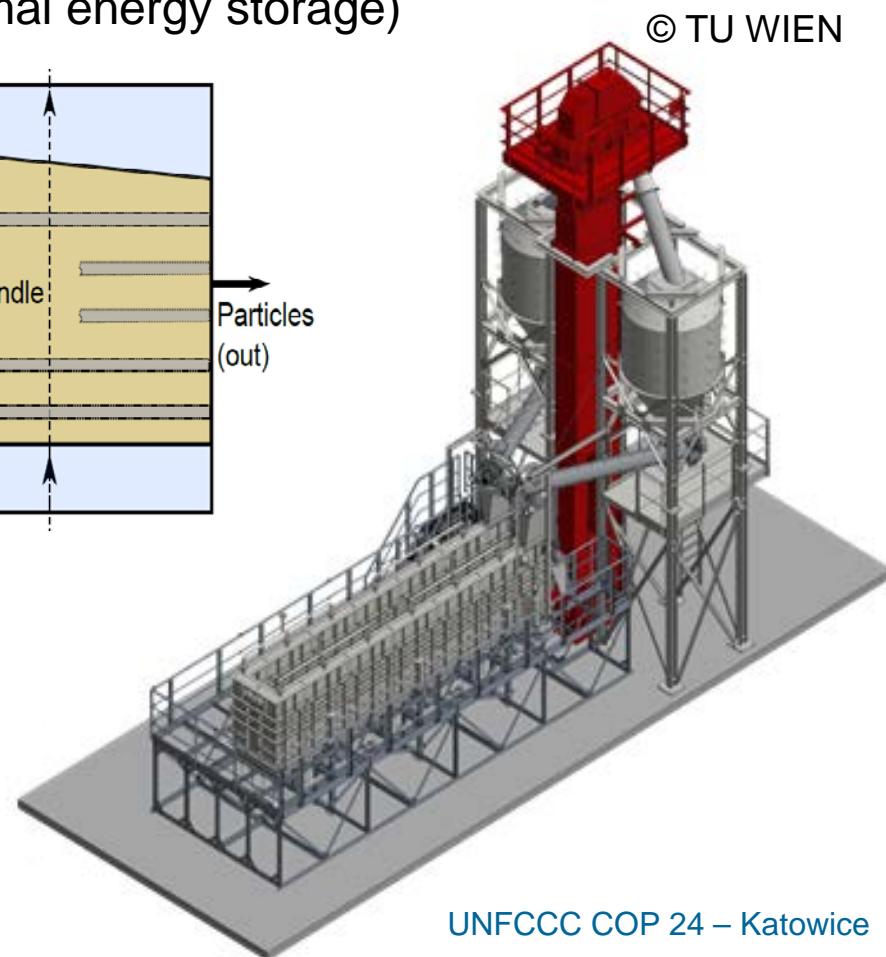
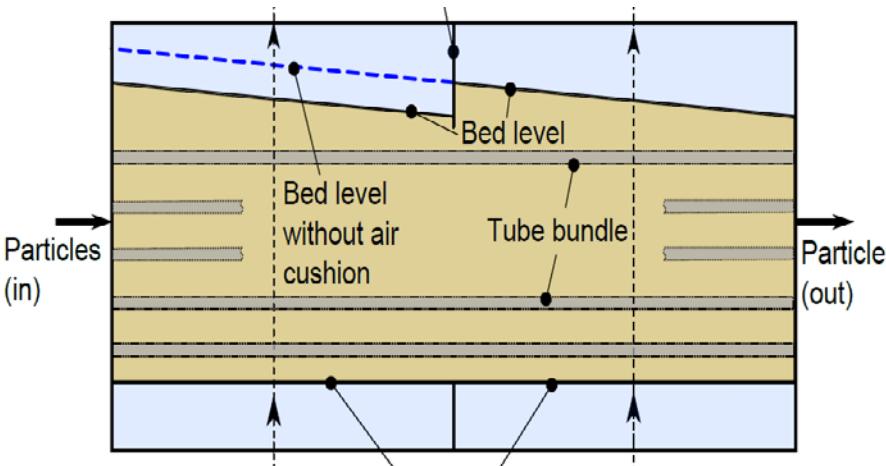
Content Source: (25) – (29)



SeLaTES = Sensible and latent thermal energy storage for industrial waste heat utilisation

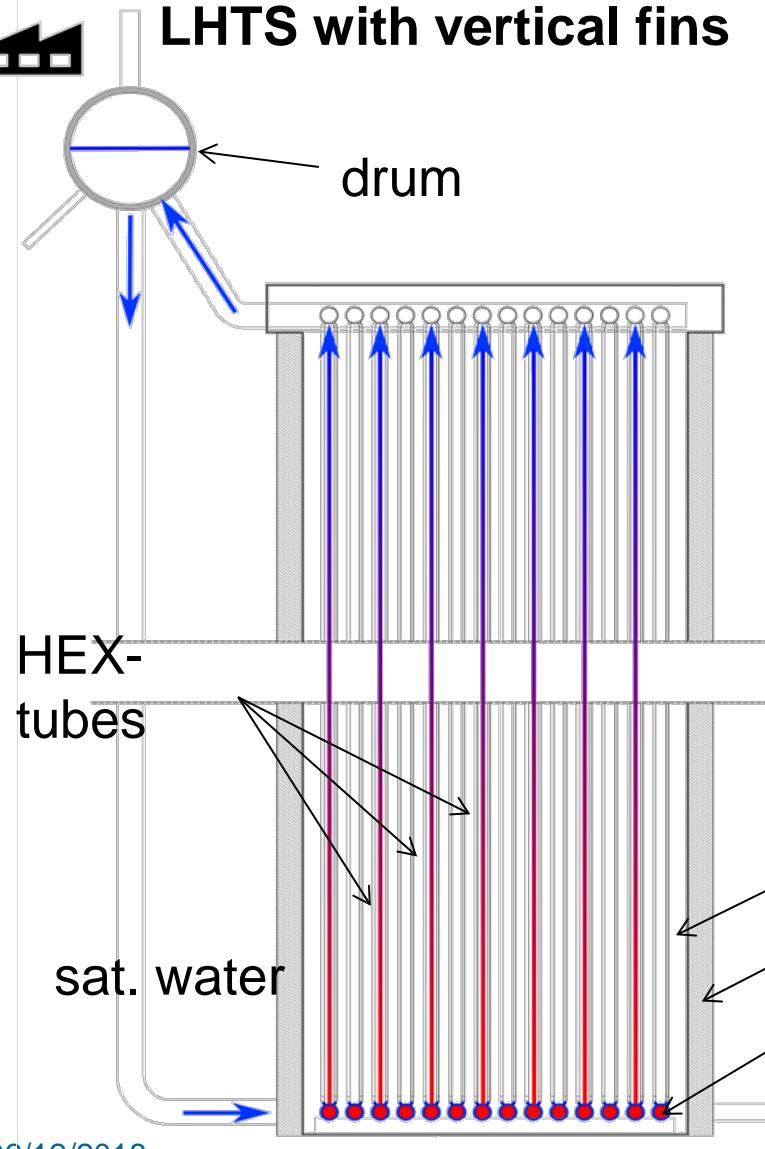
sandTES

(Active particle thermal energy storage)



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**LHTS with vertical fins**

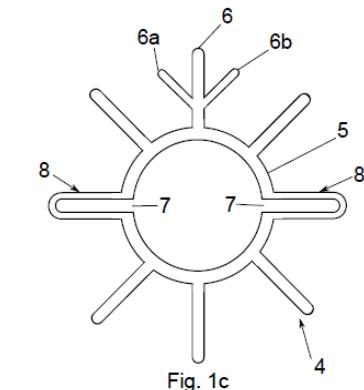
Particularly suitable for steam storage at higher pressures and longer storage periods

PCM with Steel/Alu- finned tubes**Finned -tubes**

- ✓ NaNO₃
- ✓ Alu
- ✓ Steel

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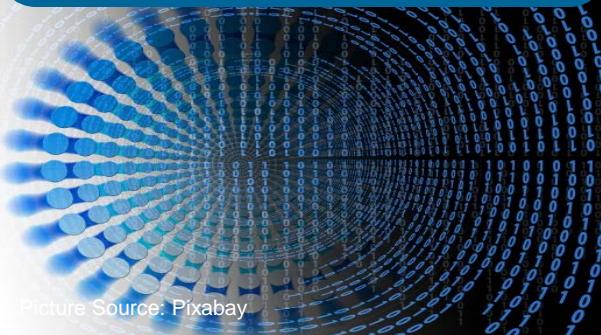
UNFCCC COP 24 – Katowice



Digital Transformation of the Industrial Energy Supply



Data handling and treatment

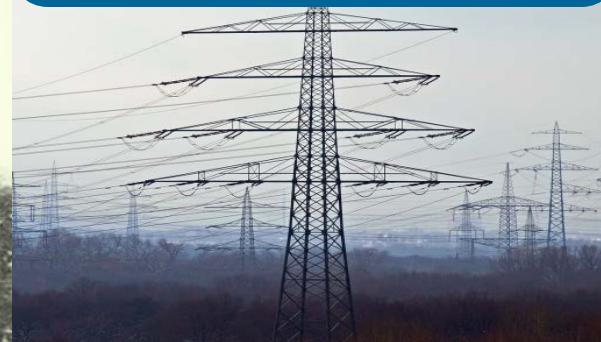


Picture Source: Pixabay

Design optimization and planning



Power Market and sector coupling



Operational optimization



Picture Source: Pixabay



Smart Industrial Concept!

Cooperation Doctoral School

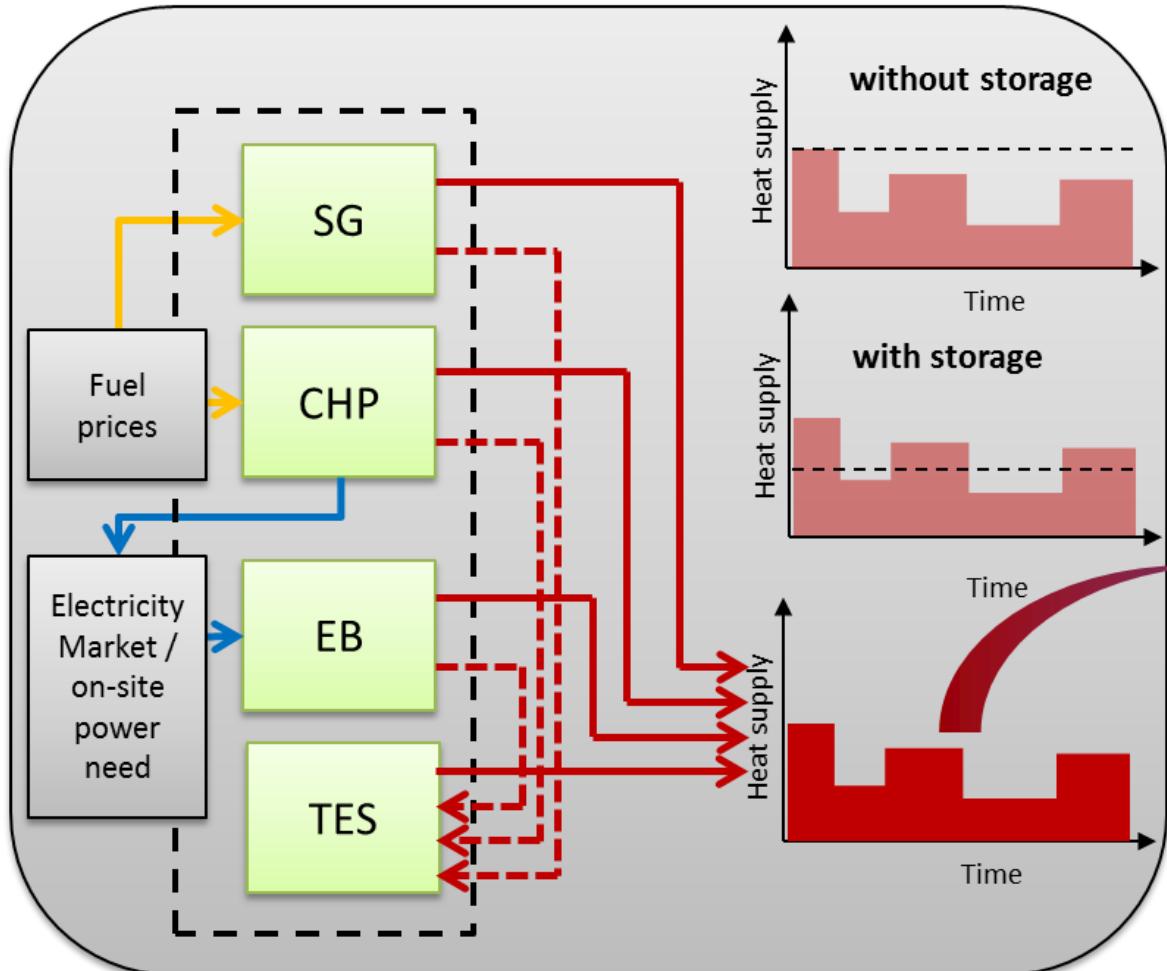
Holistic Approach with Digitalization of Industrial Processes and Applications for 2050 and beyond



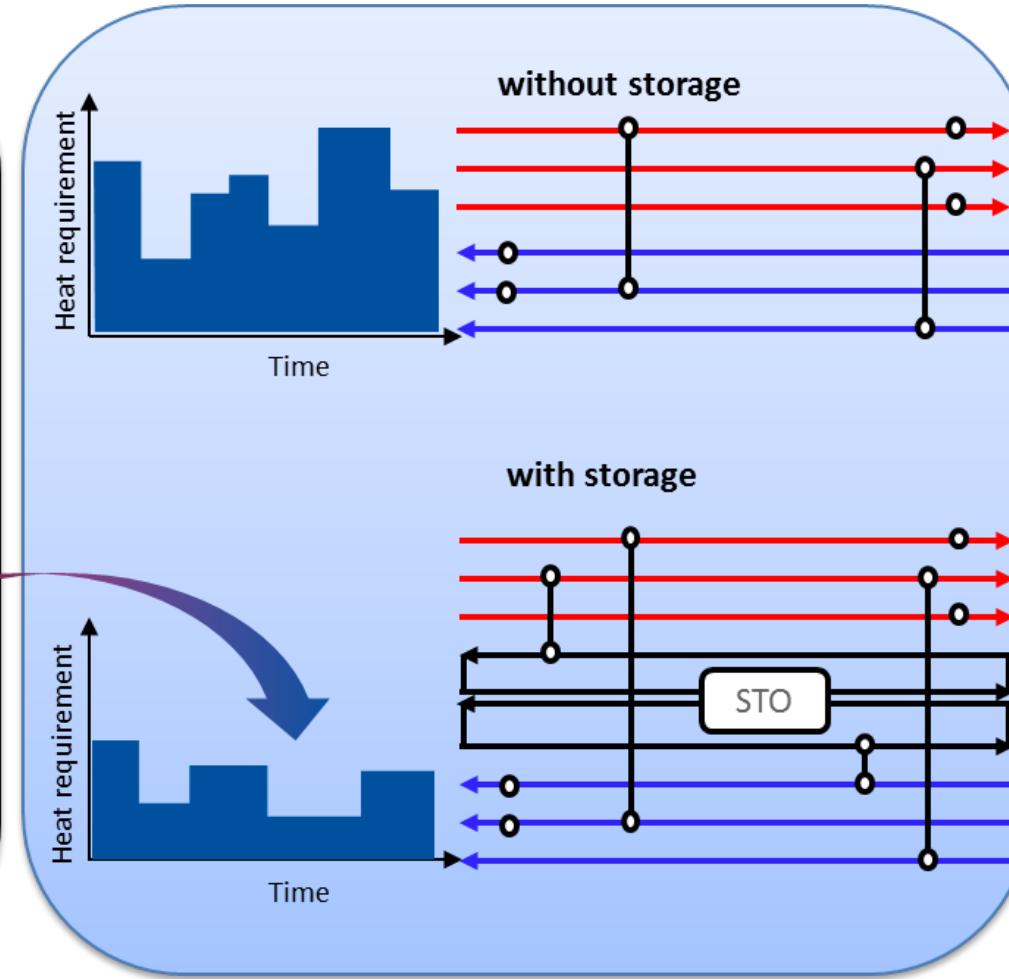
- ✓ Added value through specific use of data
- ✓ Development of methods for energy-optimized operation of industrial plants
- ✓ Optimum system design for future environment
- ✓ Consideration of mutual interaction industry ↔ energy networks



Energy Supply System



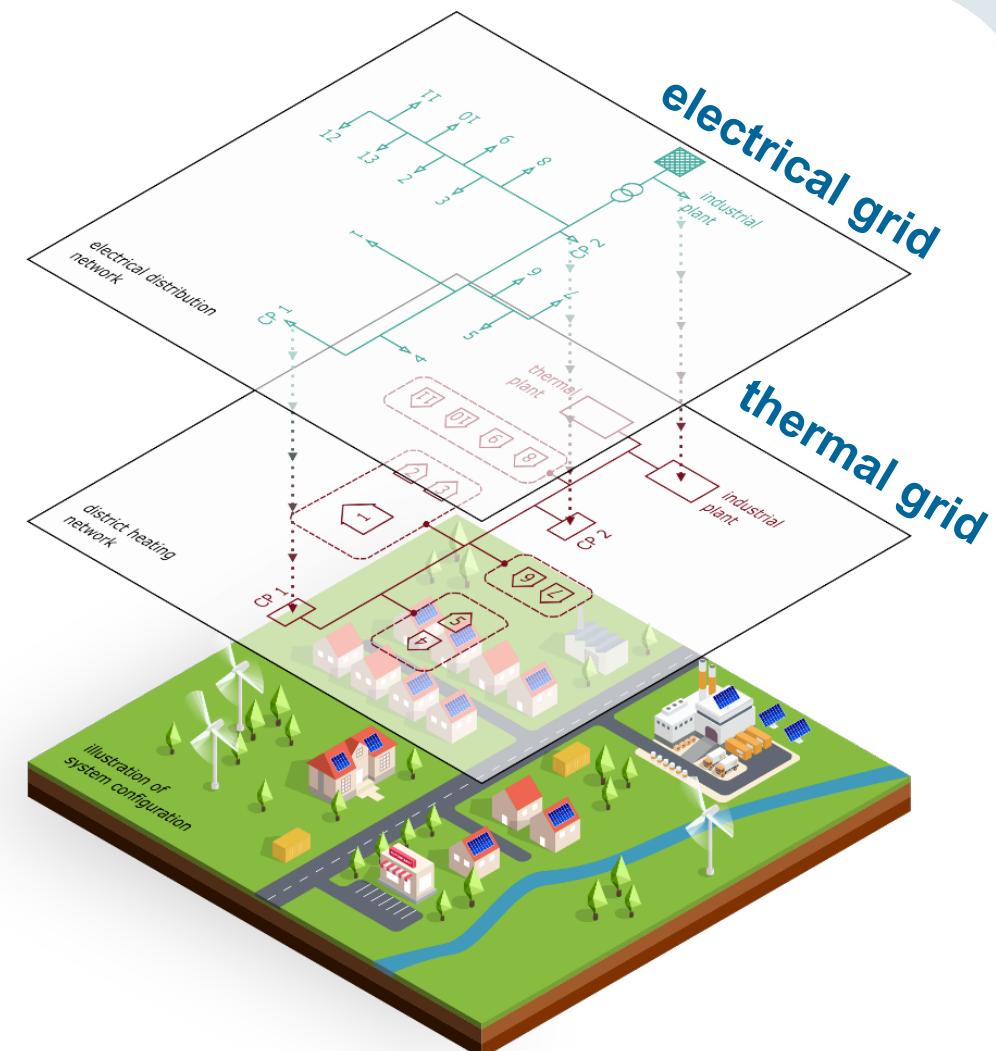
Industrial Process





Planning and operation of intelligent coupled district heating and electricity distribution networks

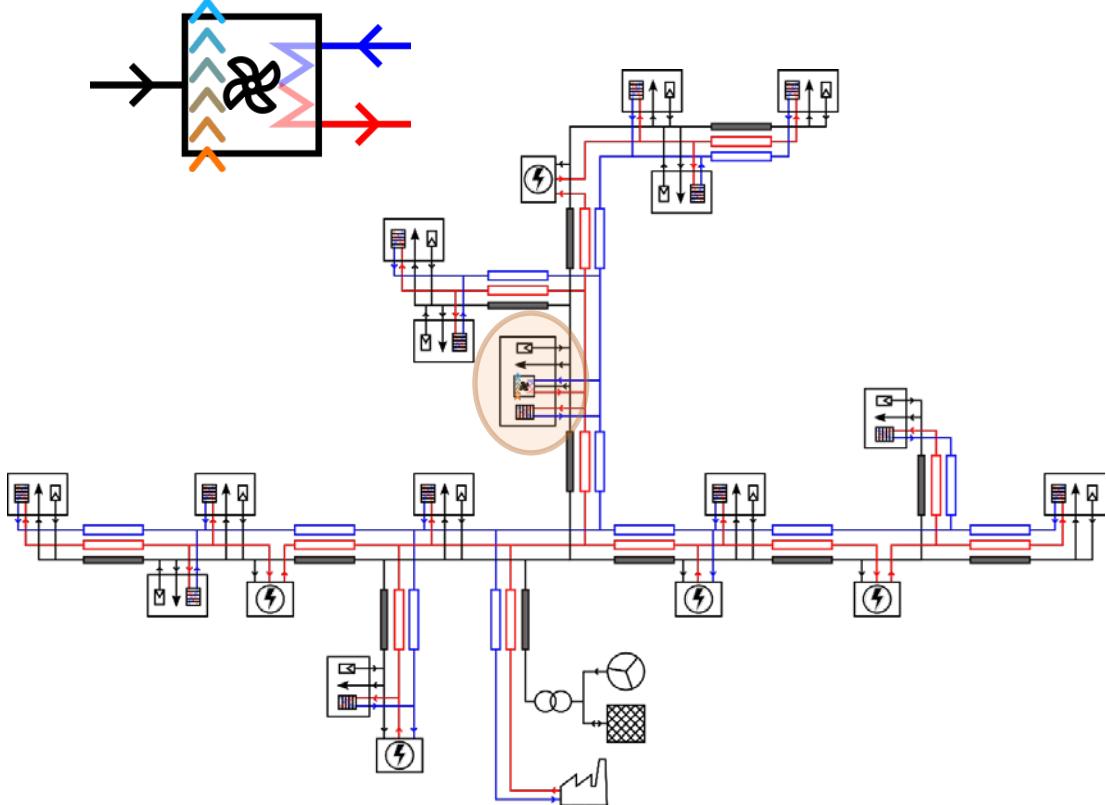
- ✓ Increasing share of volatile renewables in electric grid
- ✓ Need for decarbonization of heating sector
- ✓ Trend towards smart energy networks and energy communities
- ✓ Decentralized prosumers and storages
- ✓ Exploiting hitherto unused synergies between networks



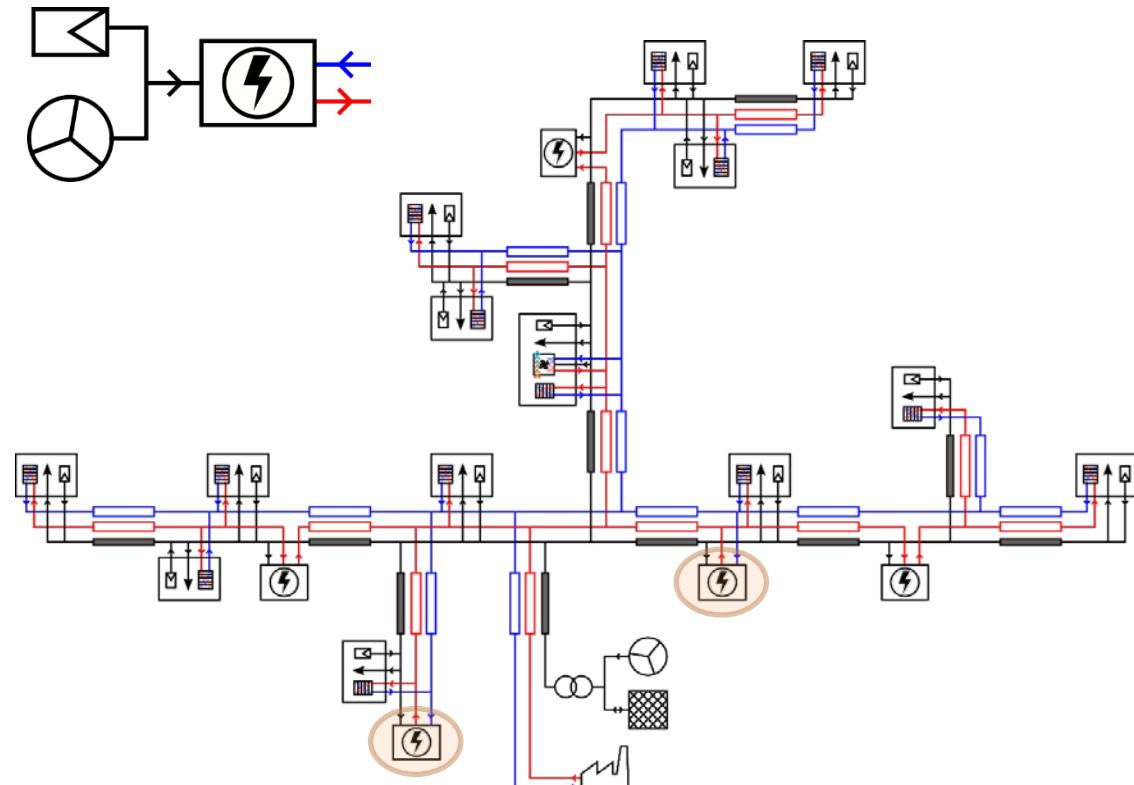


Case Study: Coupling points

Heat pump utilizing waste heat



Electric heater integrating surplus wind and PV



Content Source: (12)

- ✓ **Holistic optimization approach** for the energy supply of industrial plants taking into account production-process-related fluctuations and energy markets
- ✓ **Potential of storage** for load shifting and peak shaving in industrial processes is high, but always a question of economy.
- ✓ **Process integration requires** a very good understanding of both the technology and the process side.
- ✓ **Modeling of storage technologies** to understand transient thermal problems and applications

✓ **Design optimization**
✓ **Operational optimization**

Instruments for load flexibilization in industrial processes.

Thank you for your attention

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