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

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Innovations for Energy Systems in Industry

… 1/3 of world energy consumption is needed by industry this share can be reduced significantly …
Innovations for Energy Systems in Industry

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
- Strong dependence on energy imports

Source: Österreichische Energieagentur

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

Renewables 4 Industry

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.

Results

Three-part discussion paper
Two stakeholder workshops

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 perform an inventory?

How to derive potentials for excess heat usage?

Impact of Policy-Instruments on Excess Heat and its usage?

Technologies for excess heat usage

REDUCED HEAT DEMAND

EXTERNAL REUSE

INTERNAL REUSE

REduced heat demand

REDUCED HEAT DEMAND

EXTERNAL REUSE

INTERNAL REUSE

INDUSTRIAL PROCESS

INVESTMENT DECISION

WASTE HEAT

HEAT DEMAND

HEAT DEMAND

INDUSTRIAL PROCESS

EXCESS HEAT

EXCESS HEAT
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
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)
Thermal Energy Storage Technologies

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

sandTES
(Active particle thermal energy storage)
Thermal Energy Storage Technologies

LHTS with vertical fins

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

PCM with Steel/Alu- finned tubes

- NaNO3
- Alu
- Steel

Finned -tubes

- HEX-tubes
- drum
- sat. water
- heat insulation
- pipe-in-pipe mixer
- steam
Digital Transformation of the Industrial Energy Supply

Data handling and treatment

Design optimization and planning

Power Market and sector coupling

Operational optimization
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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
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
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Case Study: Coupling points

Heat pump utilizing waste heat

Electric heater integrating surplus wind and PV

Content Source: (12)
Conclusions

- 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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