Federal Ministry
for Economic Affairs
and Energy

MITTELSTAND
GLOBAL
EXPORTINITIATIVE ENERGIE

Energy Efficiency for the Industry – Solutions Made in Germany

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07.05.2019

Manila, Philippines

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Agenda

- Presentation of upp
- Methodology of Energy Efficiency
- Steam Substitution
- Integration of Solar Thermal Energy
- Heat Recovery
- Cooling and Air Conditioning

Sustainable Products and Processes (upp)

Research focus

1. Climate, energy and resource efficient production
2. Collection, evaluation and benchmarking of energy data
3. Flexible energy supply and load management
4. Energy concepts and energy services for commercial facilities

Lectures

- Life Cycle Engineering
- Measurement of energy and material flows
- Energy efficient production
- Energy management systems
- Simulation und controlling of production and energy systems

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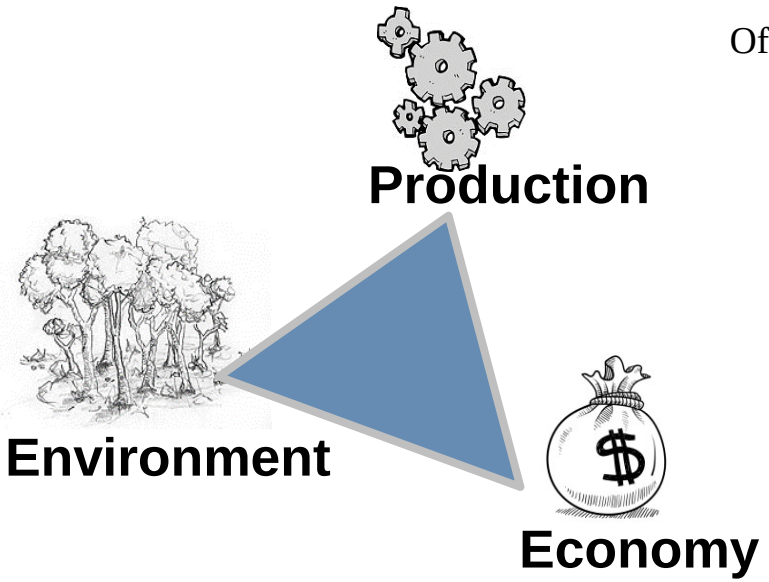
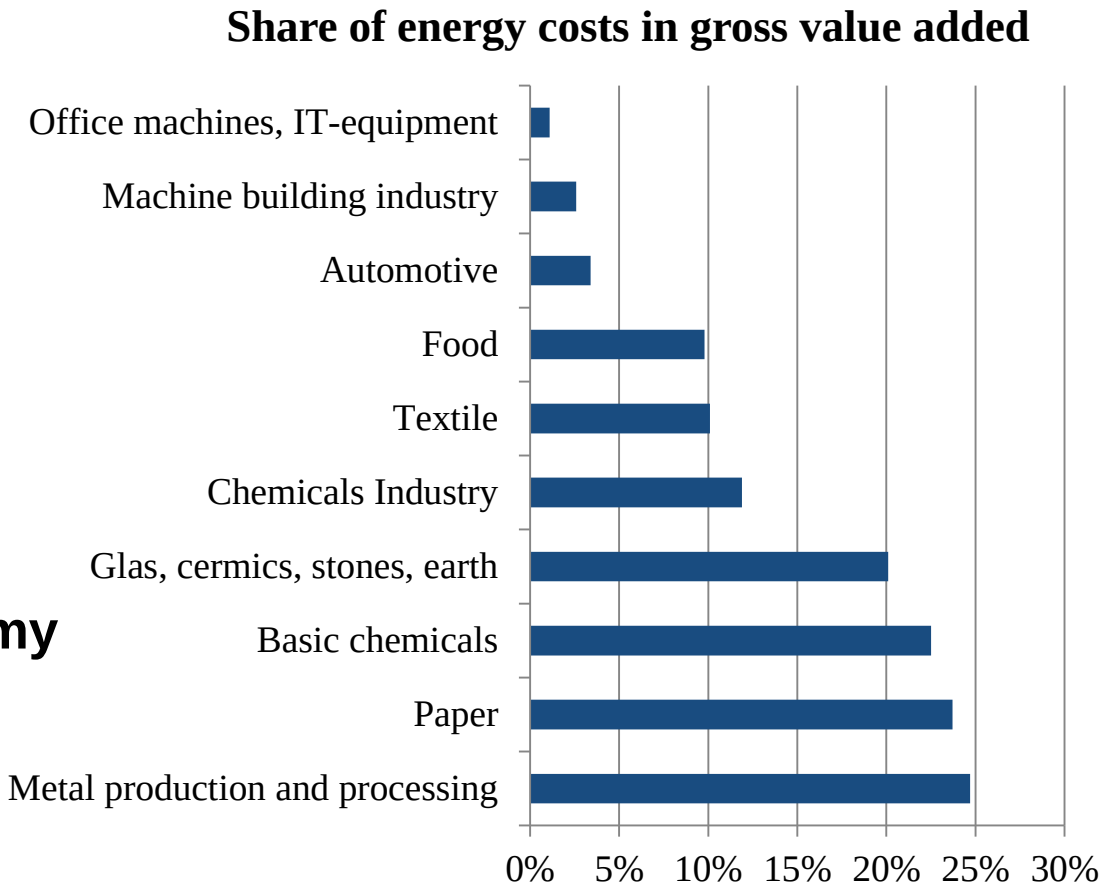
Increasing Energy Efficiency – Reducing Energy Costs





Own illustration from: VCI, VIK, BDEW, Thomson Reuters

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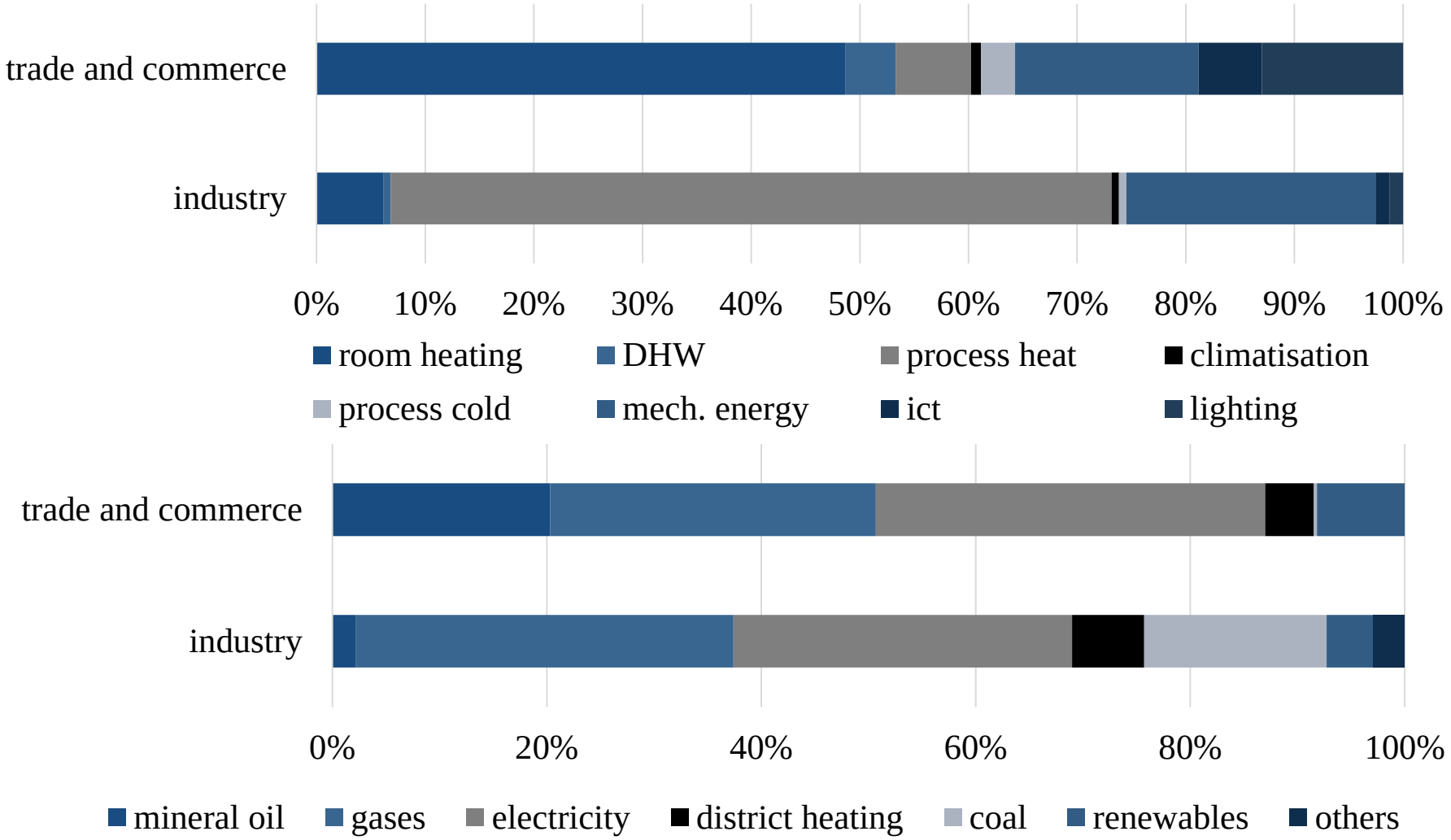
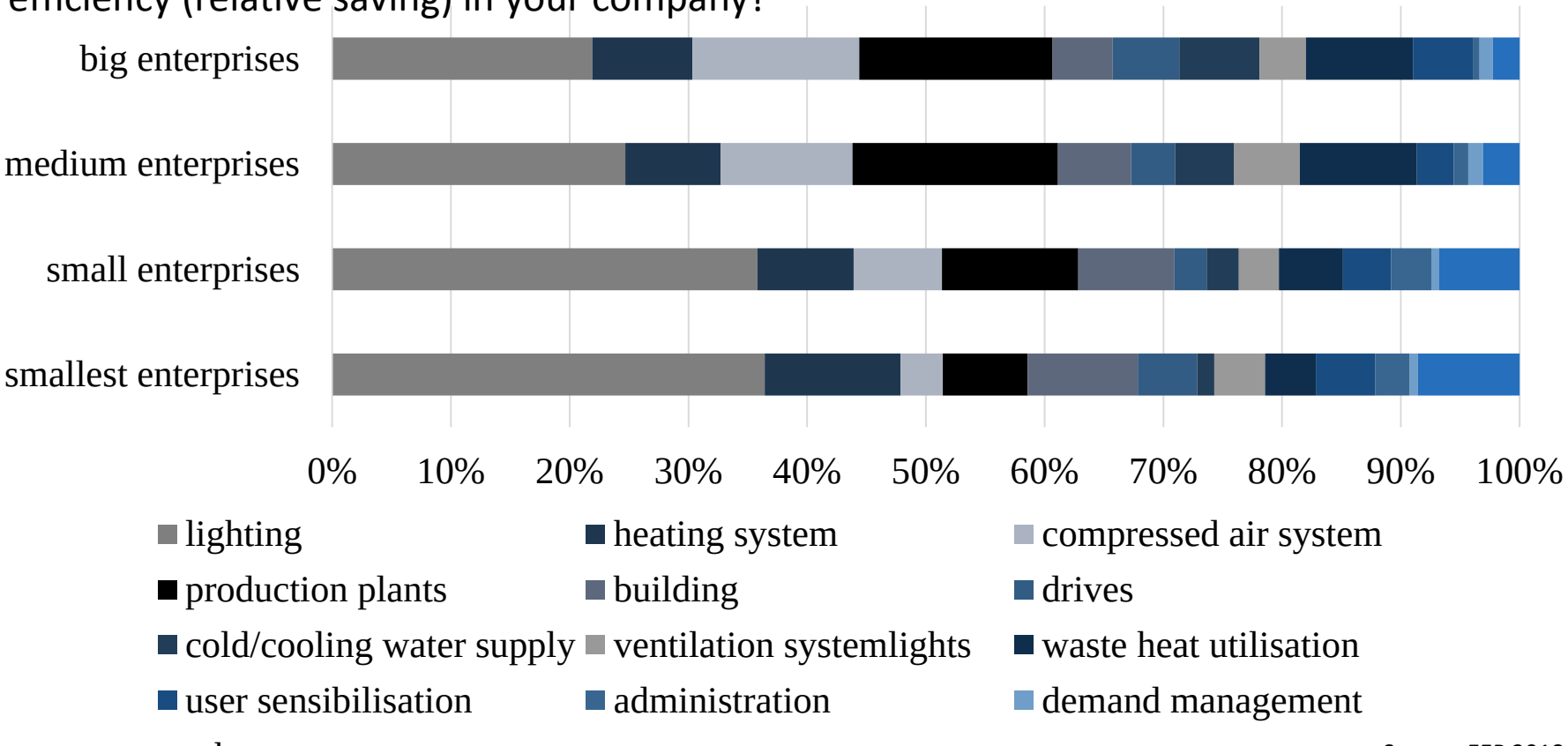
End energy use in the German Industry 2016



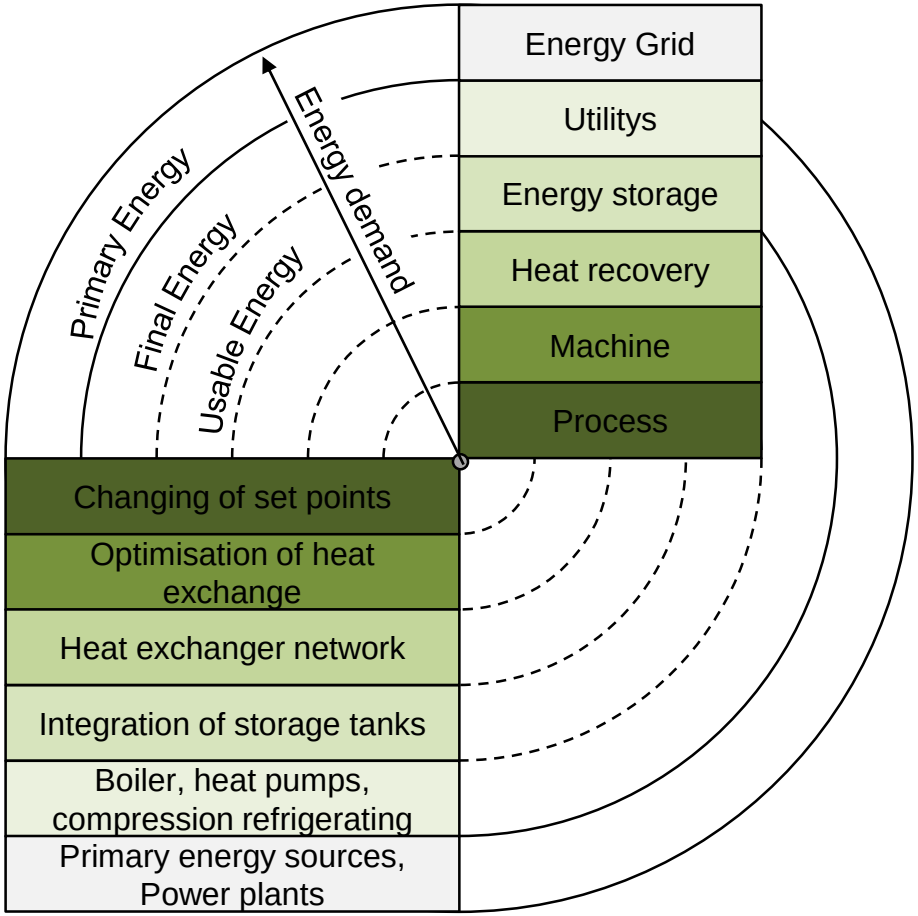
Energy efficiency potential in cross-sectional technologies II

In which area have energy efficiency measures led to the greatest increase in energy efficiency (relative saving) in your company?



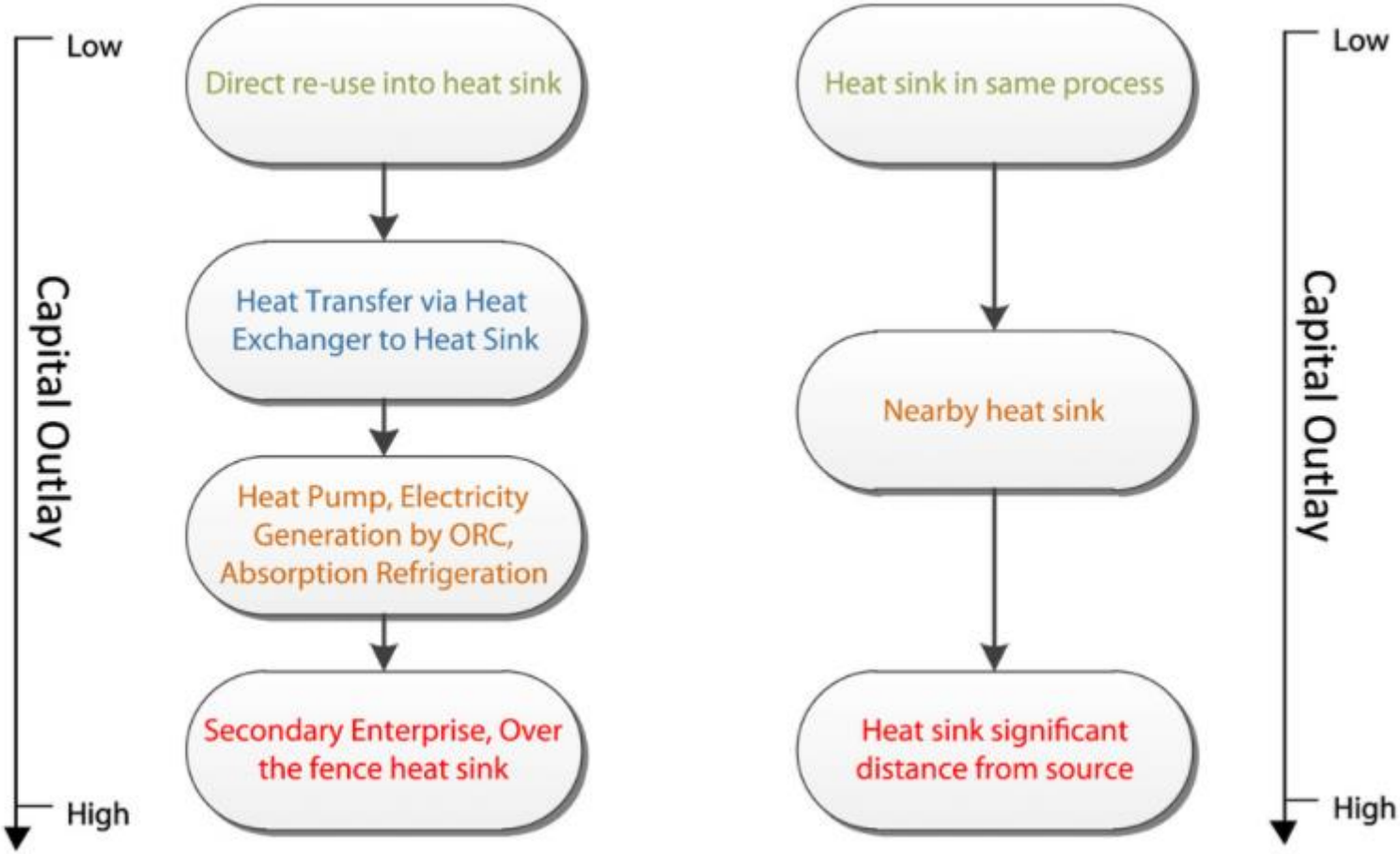
Source: EEP 2018

Methodology of Energy Efficiency Actions



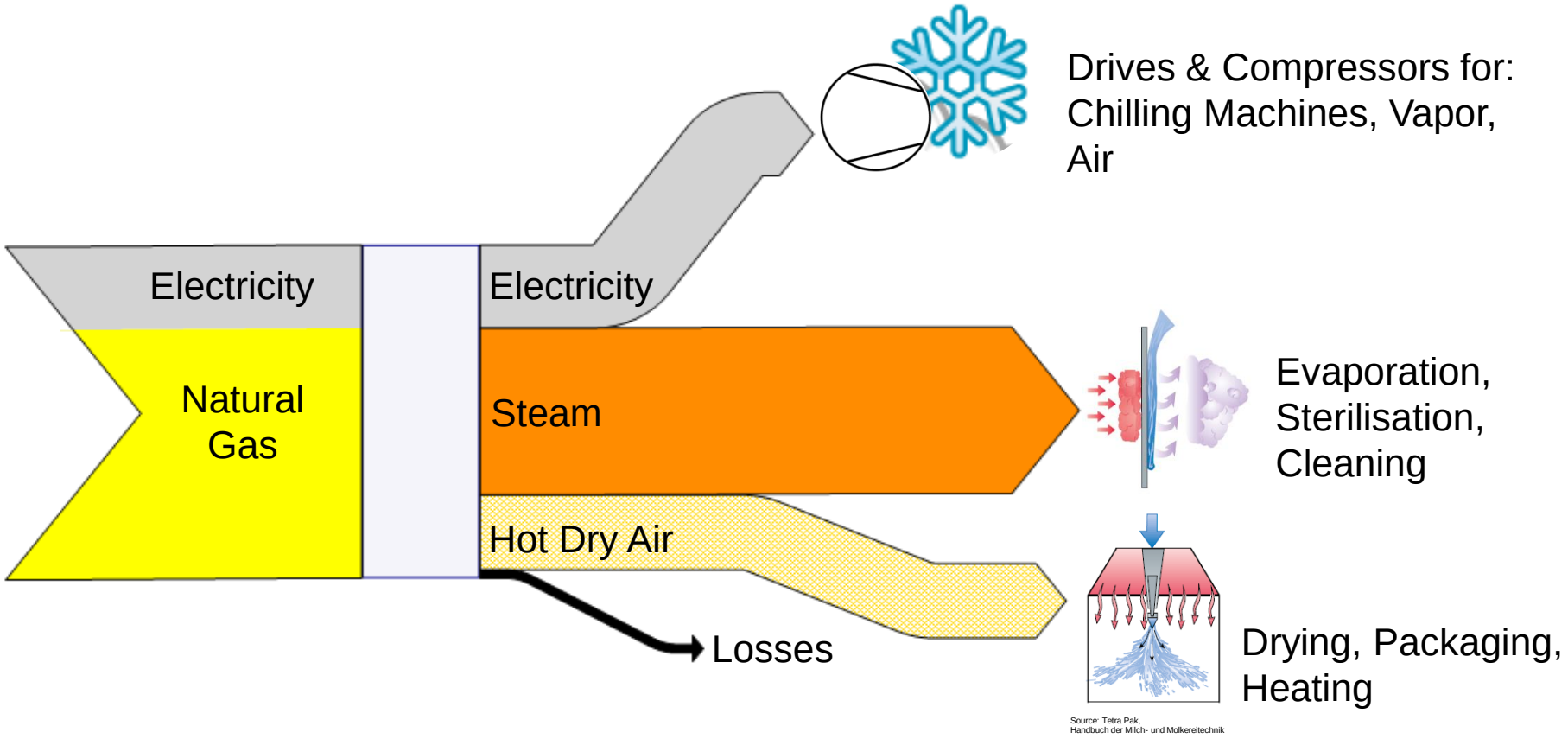
Source: Hesselbach 2012, Kemp 2005

Costs of Energy Efficiency Actions



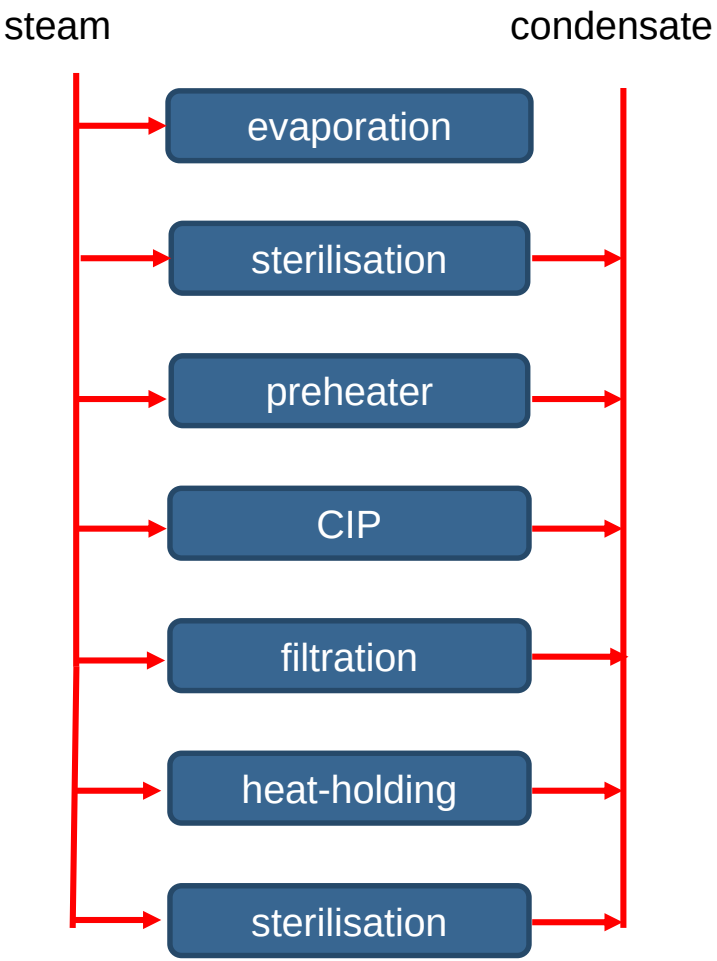
Source: Law, Harvey & Reay 2012

Steam Substitution – Energy Profile

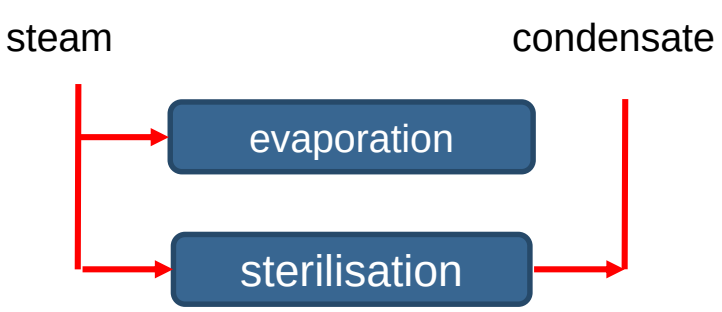


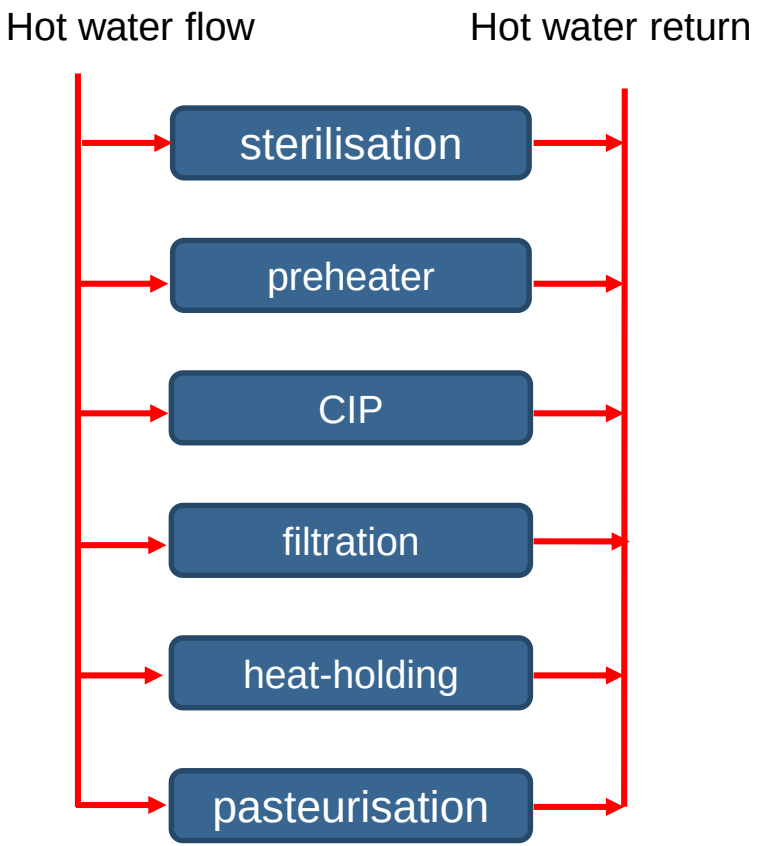
difficult to integrate solar thermal energy or combined heat and power

Analysis of Steam Consumers



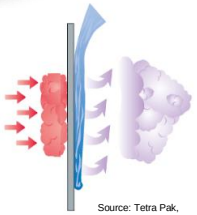
Steam Substitution





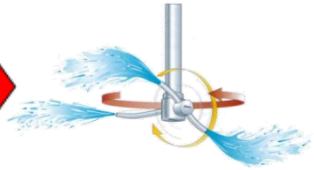
Steam Substitution – New Energy Profile

Compressors for:
Chilling Machines, Vapor, Air

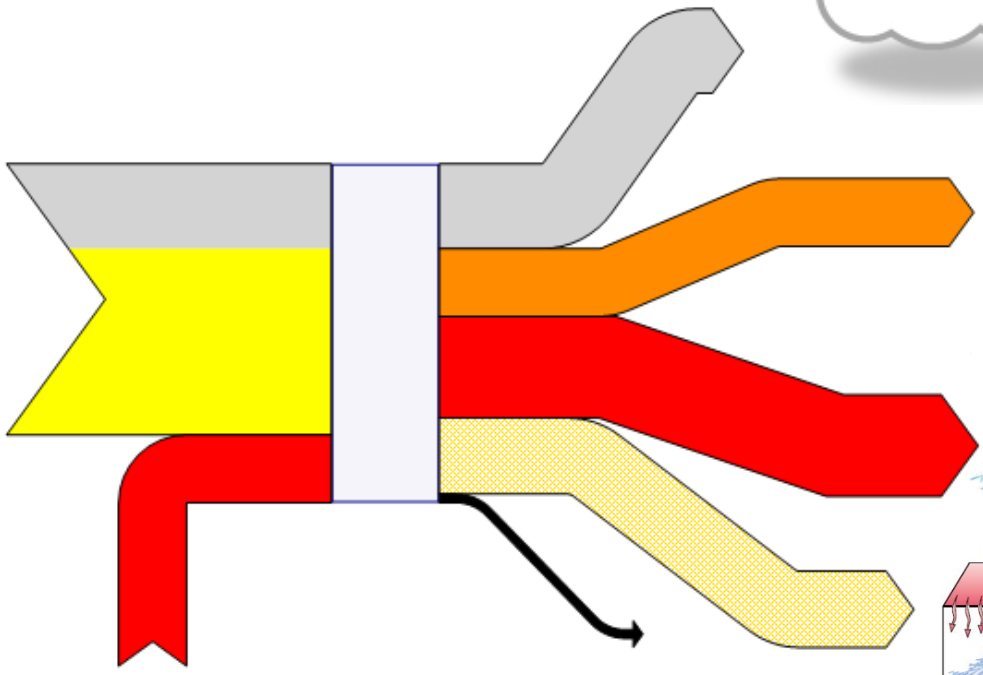


Source: Tetra Pak, Handbuch der Milch- und Molkereitechnik

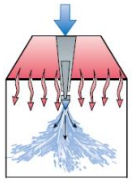
Evaporators, Sterilisation



CIPs, Heating



waste heat recovery



Source: Tetra Pak, Handbuch der Milch- und Molkereitechnik

Drying, Packaging

Good profile for solar thermal energy and combined heat and power

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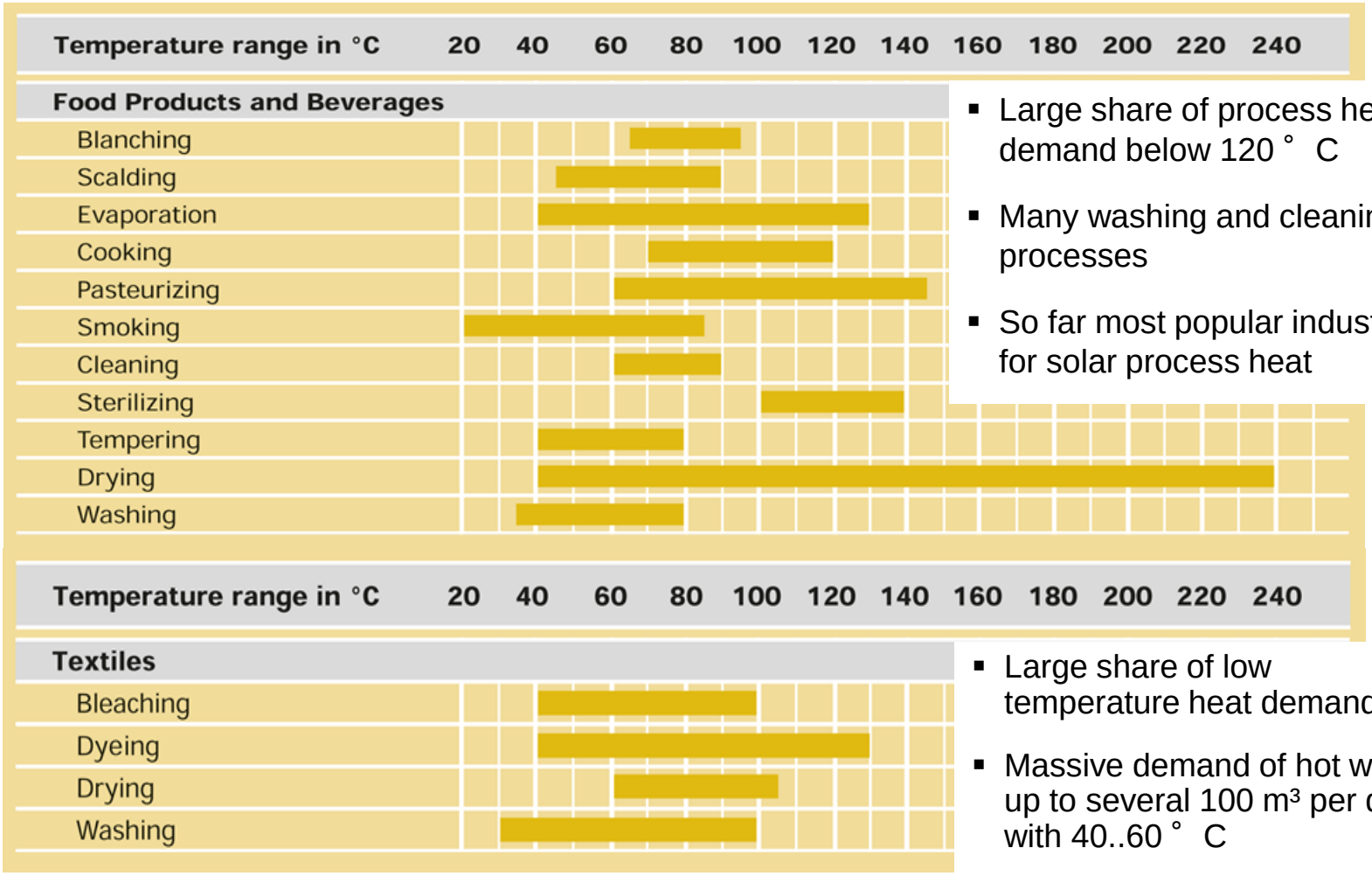
Low Temperature Heat Integration



- Large share of process heat demand below 120 ° C
- Many washing and cleaning processes
- So far most popular industry sector for solar process heat

- Large share of low temperature heat demand
- Massive demand of hot water up to several 100 m³ per day with 40..60 ° C
- Heated baths

Source: http://www.solare-prozesswärme.info/

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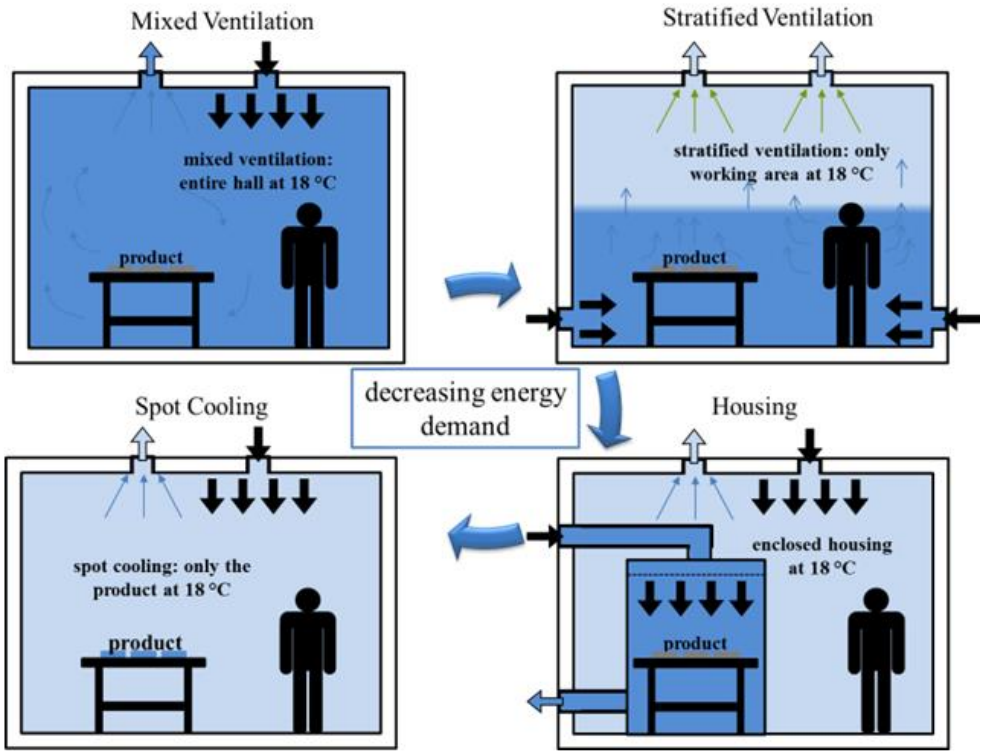
Improved air conditioning



Source: Wagner 2014

Spot cooling

Housing with diffusers

Localised cooling and air-conditioning saves up to 50 % of the energy

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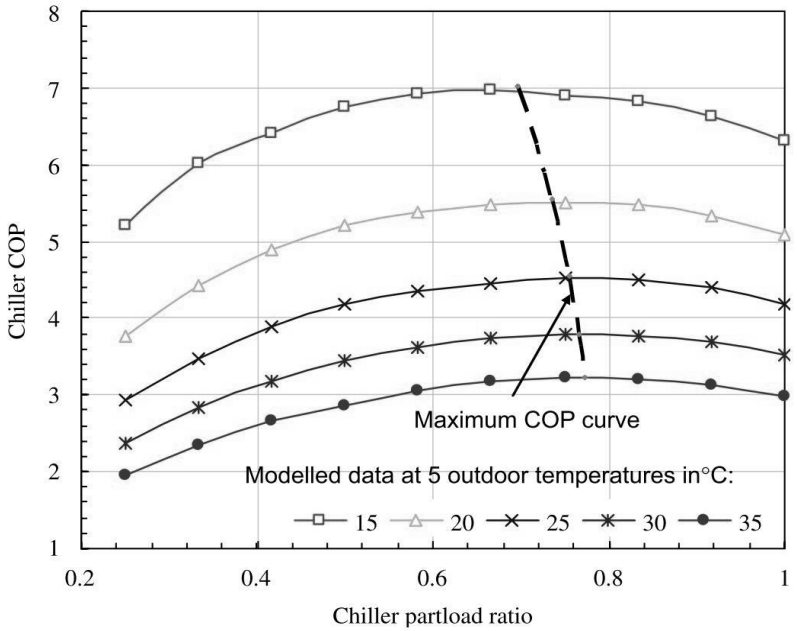
Efficiency gains of reduced condensation tempeature

- Rule of the thumb
- 1 K lower condensing temperature = 1 - 3 % energy savings
- Proportional to a decreasing condensation pressure the cooling capacity rises
- Proportional to a decreasing condensation pressure the power consumption of the compressor decreases

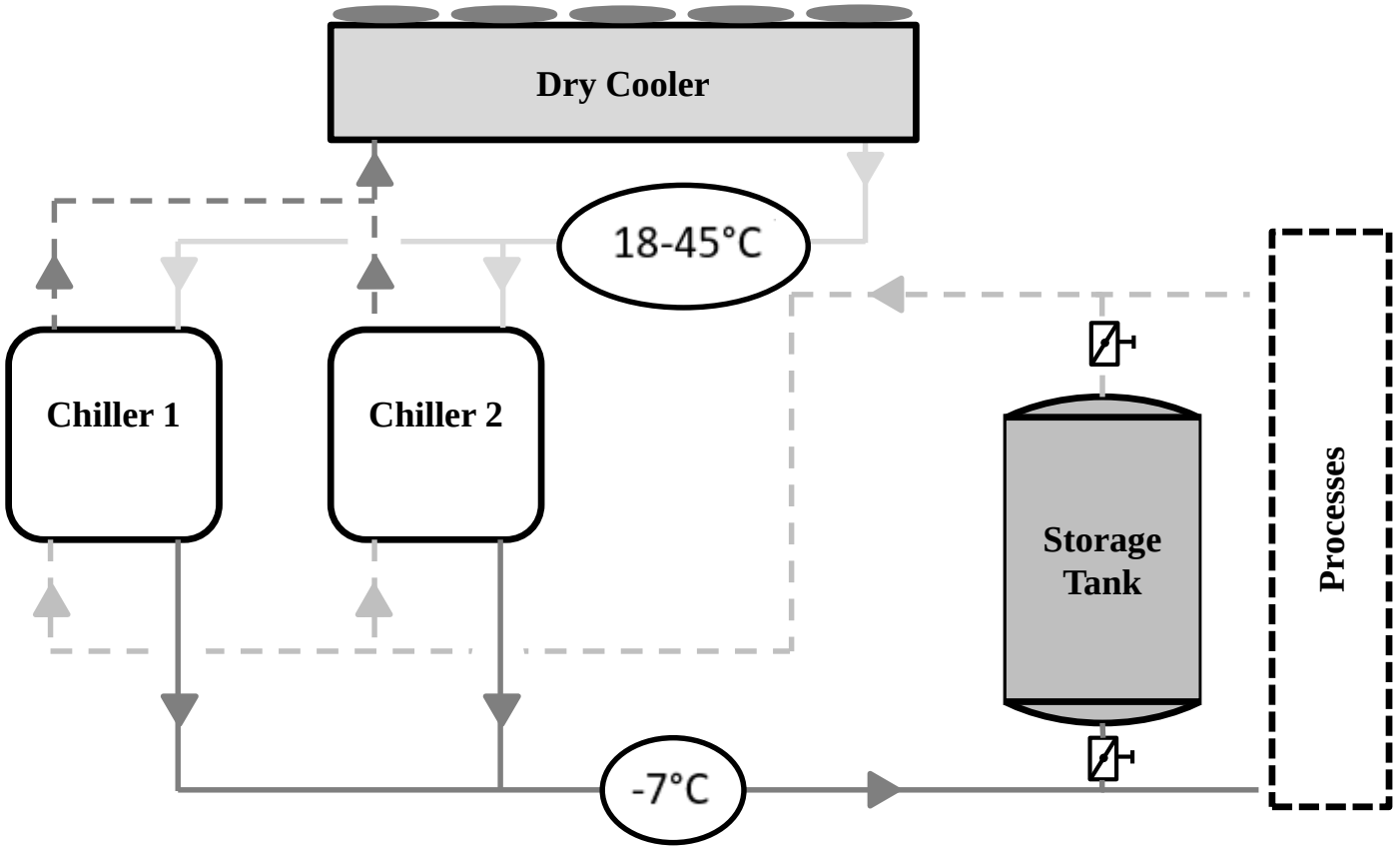


Efficiency gains of increased evaporation temperature

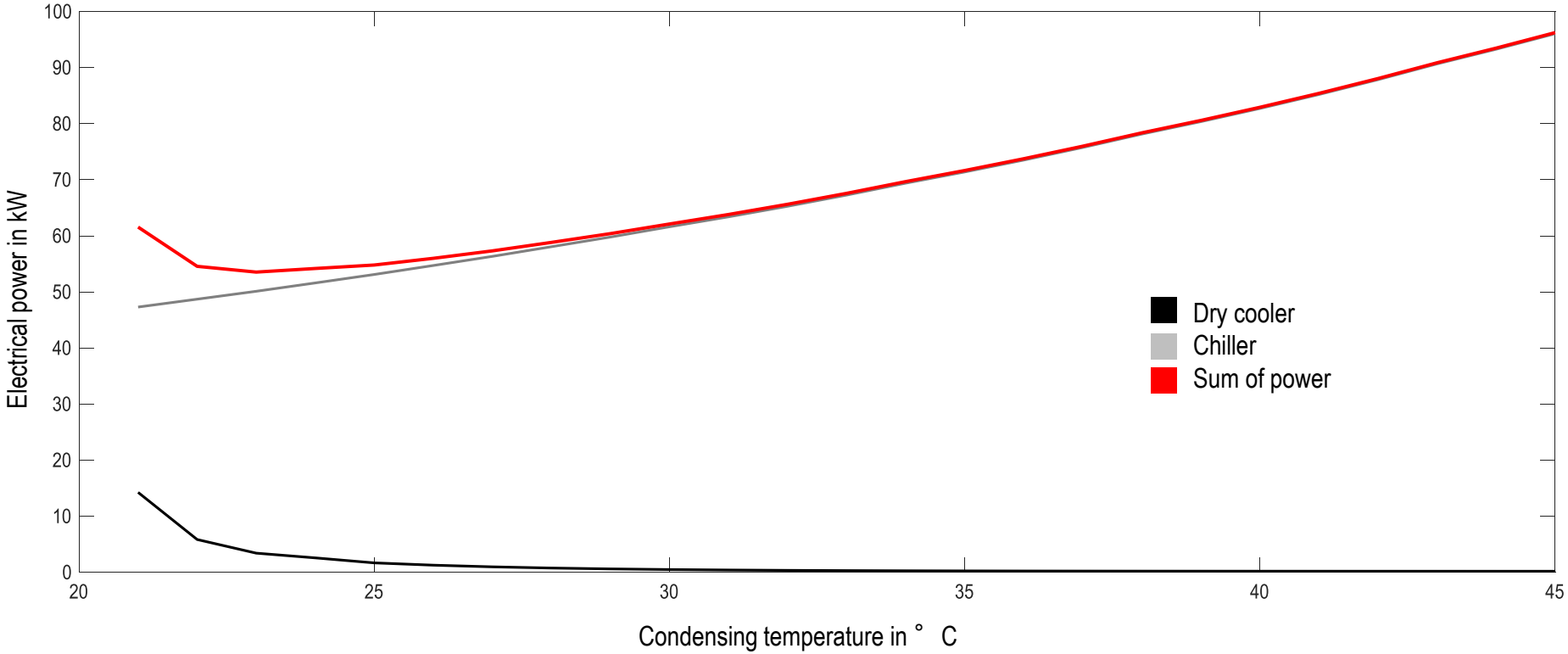
- Rule of the thumb
  - 1 K higher evaporation temperature = 3-4% energy savings
- Rising of cooling capacity by 3 – 4.5 % per 1 K higher evaporation temperature
- Rising of electrical power for compressor by 1 - 1.5 per 1 K higher evaporation temperature

Refrigerant	R134a	R404A
Cooling capacity	+ 5 %	+ 4 %
Compressor power	+ 1.5 – 2.0 %	+ 1.0– 1.5 %

Use Case – Food Processing Industry



Tradeoff between Dry Cooler and Performance of Chiller



- Cooling load: 100 %
- Ambient temperature: 18°C

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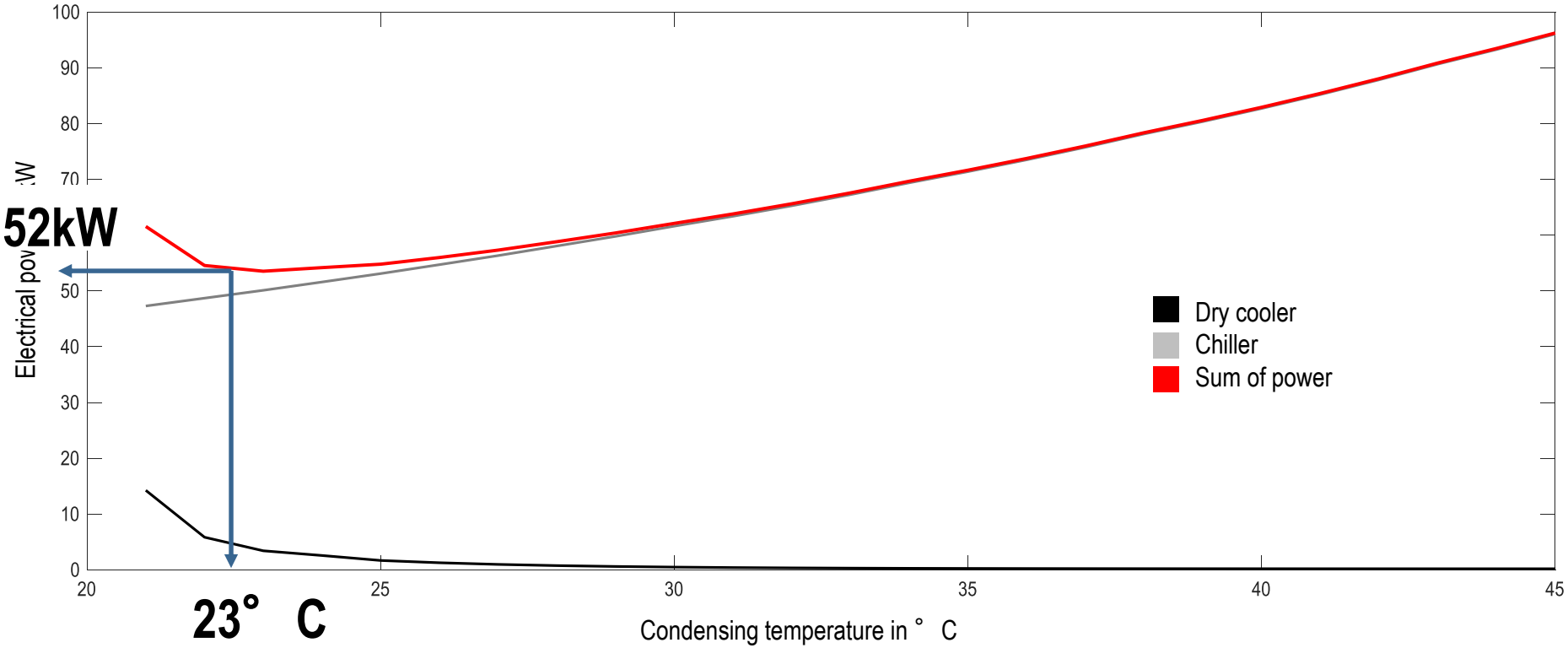
Tradeoff between Dry Cooler and Performance of Chiller



- Cooling load: 100 %
- Ambient temperature: 18°C

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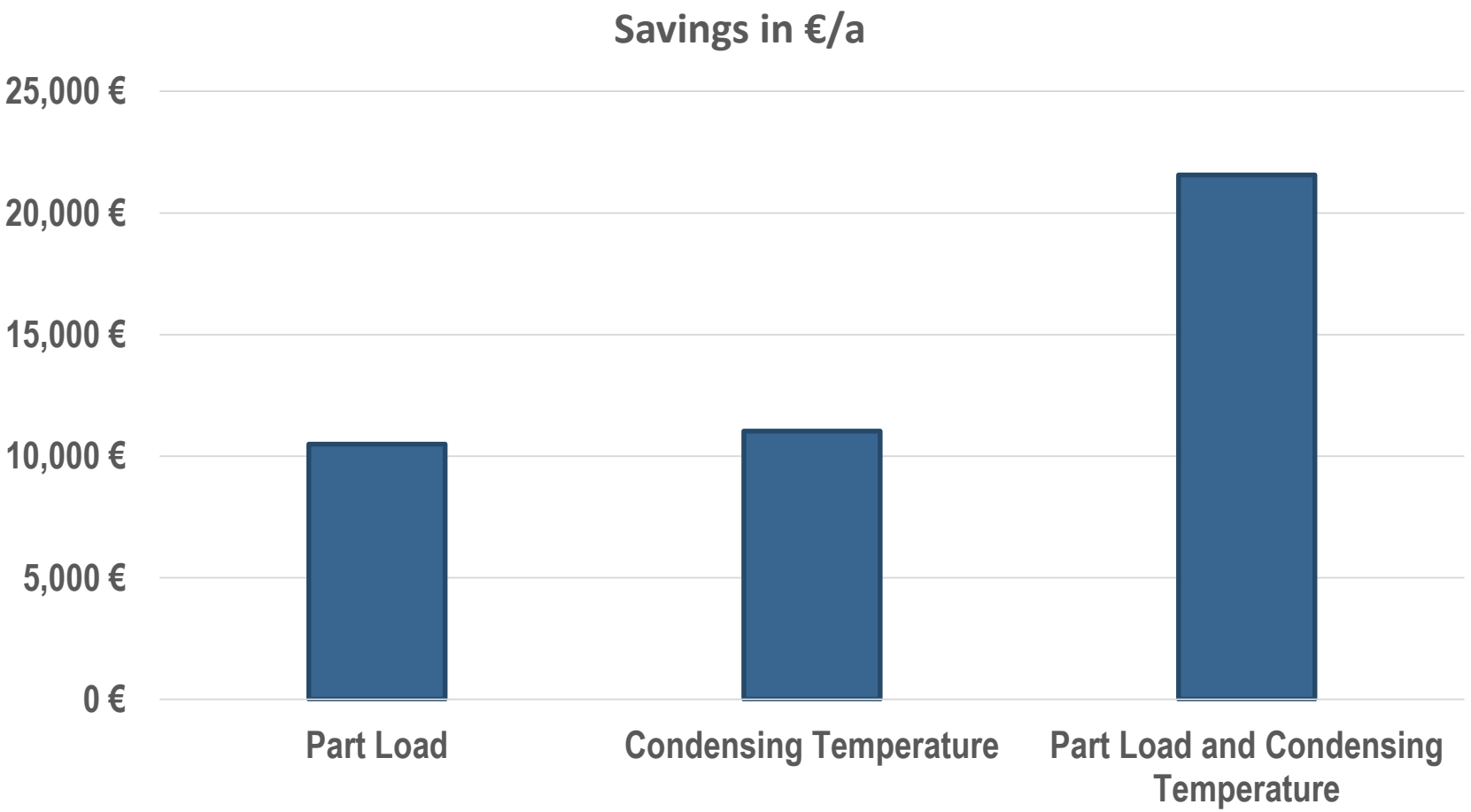
Monetary Savings – Use Case



Electricity price 16 ct/kWh

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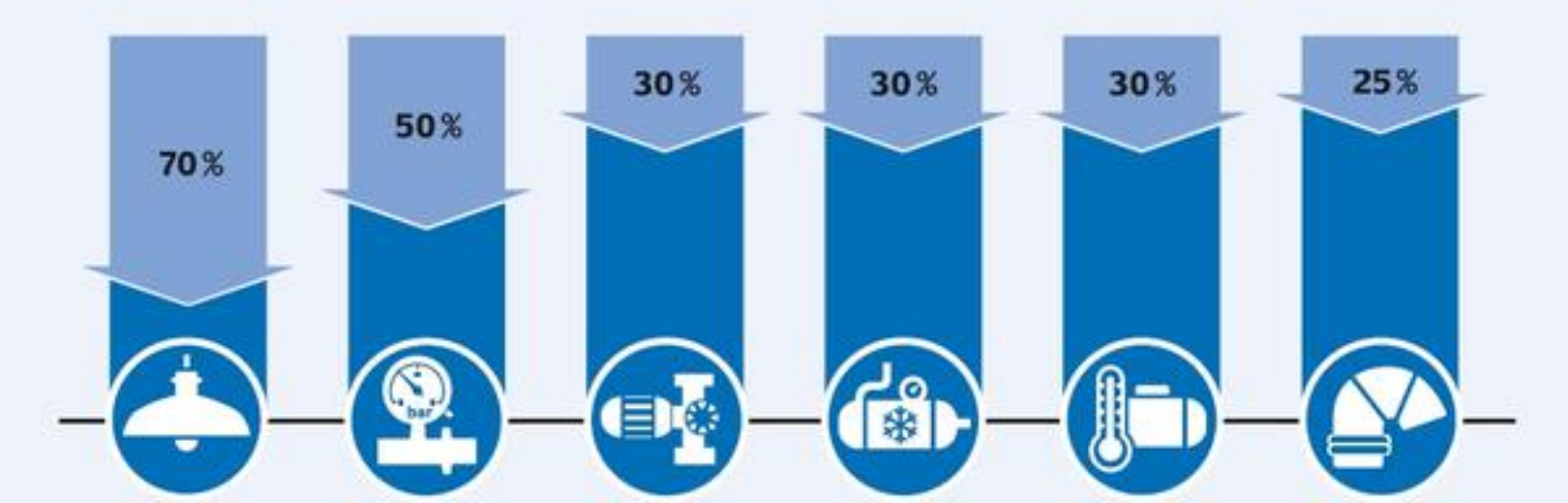
Backup

Enery Efficiency Potential of Cross-Sectional Technologies



Comparison Steam Substitution

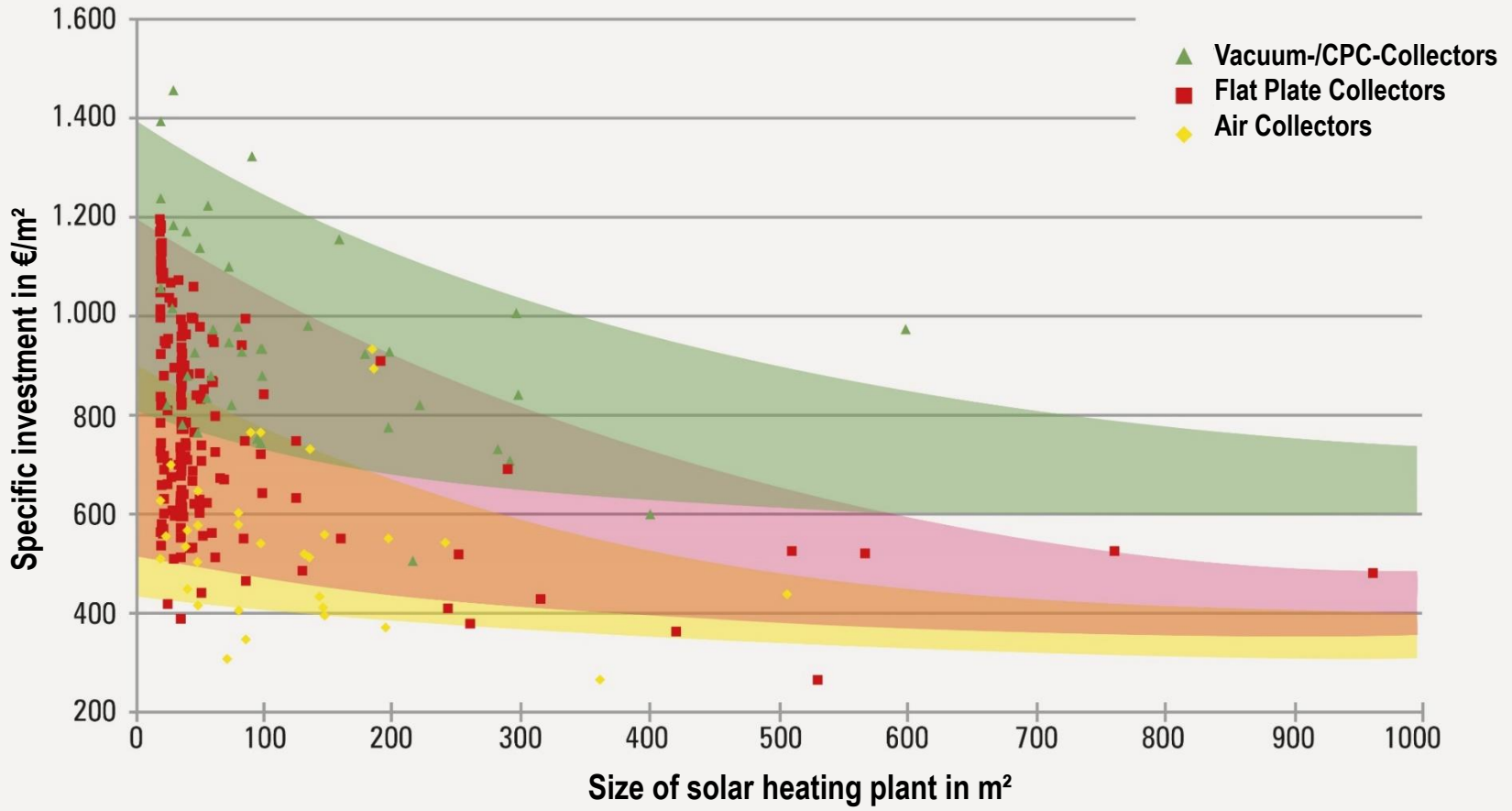
Benefits

- one system serves all
- high target temperatures
- high energy density
- high transmission power at a constant temperature
- smaller heat transfer surfaces
- no pumps are required in flow
- smaller pipes (cross sections)

Disadvantages

- maintenance
- condensate return system with holding tanks, flash steam losses
- wastewater
- feed water treatment complex and expensive
- threat
- leakage losses
- heat losses in pipes
- exergy losses in valves and HEX
- pressure drops

Costs of Solar Process Heat



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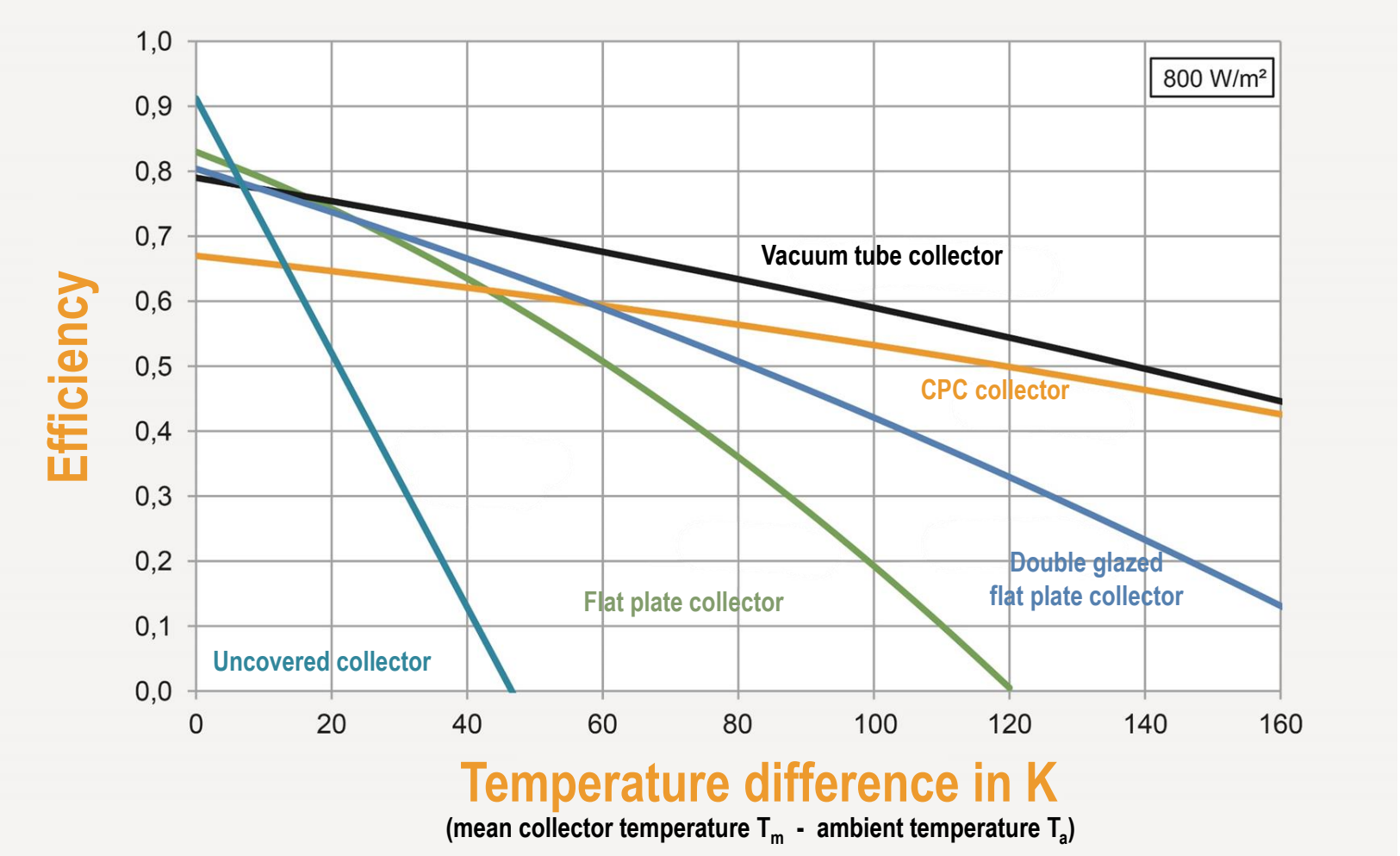
Source: University of Kassel, Schmitt 2017

Performance of Solar Collectors



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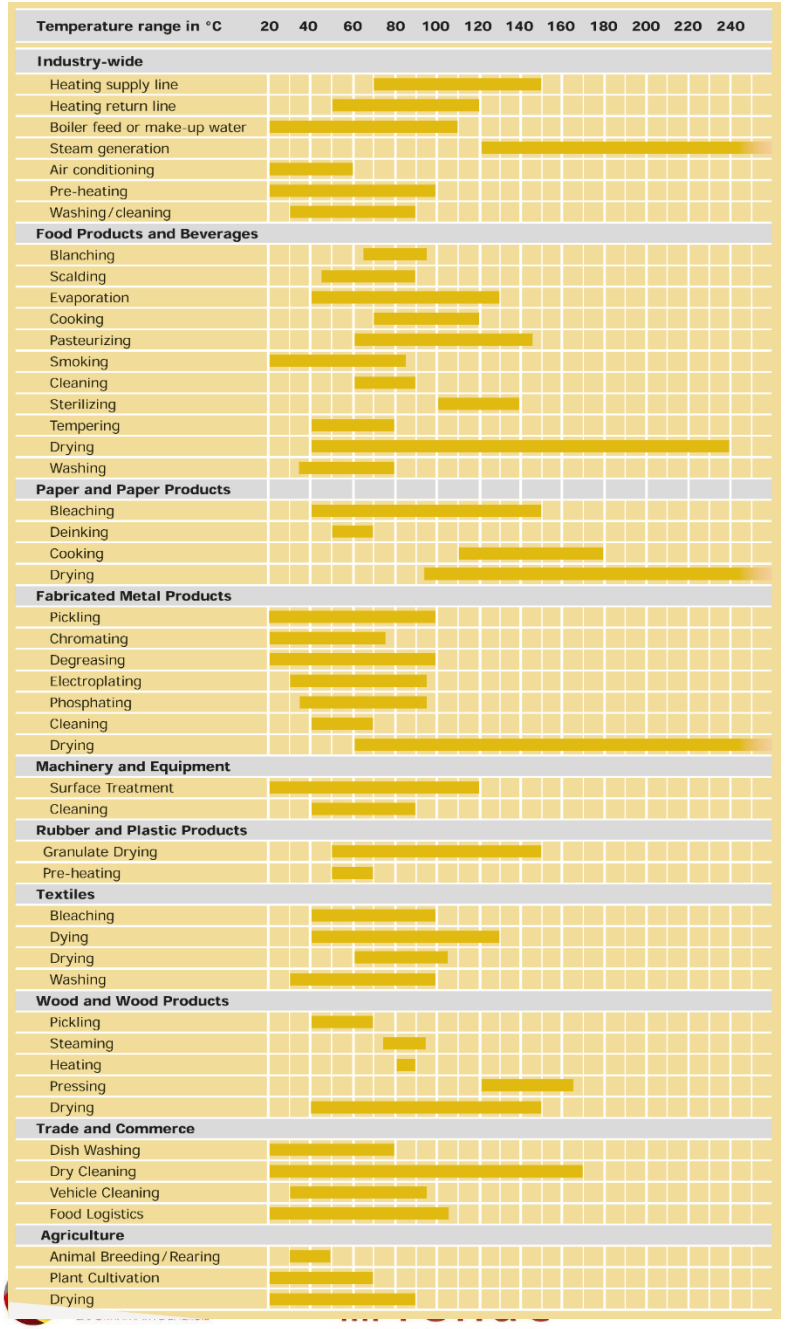

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