Industrial Drying:
DryFiciency as a research-to-market innovation using high temperature heat pumps

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**Challenge**

Drying & dehydration processes
- wide-spread in a number of industries
- primarily fossil-fired
- large volumes of low grade waste heat
- large potential to increase energy efficiency
Objectives

- develop and demonstrate heat pumps in three industrial drying processes with heat supply temperatures up to 160 °C
- two *closed loop heat pumps* for air drying processes
- one *open loop heat pump* for steam driven drying processes
AGRANA: Starch drying

Integrated wheat starch and bioethanol plant

http://www.agrana.com/fileadmin/inhalte/agrana_group/photos/Weizenstaerke_und_Bioethanolproduktion_ENGLISCH_END.jpg
AGRANA: Conventional dryer

Exhaust air
~200 t/h@52°C
(48% RH)

Steam

~200 t/h@158°C

Dry product

Flow stream dryer

Wet product

Water (HRC)
90°C

Drying agent (air)
~200 t/h
@30°C
70°C
AGRANA: Dryer with heat pump

- **Exhaust air**: ~200 t/h@52°C (48% RH)
- **Dry product**: ~200 t/h@158°C
- **Wet product**: ~200 t/h@30°C

**Diagram Components**:
- **Dryer**
- **Evaporator**: 90°C
- **Condenser**: 100°C
- **Intermediate circuit (Water)**
  - **Closed loop heat pump**: 140°C
- **Water (HRC)**: 90°C, 70°C
- **Drying agent (air)**

**Flow Streams**:
- **Steam**
- **Dry product**
- **Wet product**
- **Exhaust air**
Demo sites for the closed loop heat pumps

**STARCH**

AGRANA Stärke GmbH
Pischelsdorf (AUT)

**BRICKS**

Wienerberger AG
Uttendorf (AUT)

Integration and commissioning starts in May 2019
Key goals

- **ENERGY EFFICIENCY**: up to 80%
- **PRODUCTION COSTS**: up to 20%/kg
- **CO₂ EMISSION**: up to 75%
DryFiciency – vast market potential

Connolly et al. (2013). Heat Roadmap Europe 2: Second Pre-Study for the EU27. Department of Development and Planning, Aalborg University
Where to use heat pumps in industry?

Heat sources:
- waste heat from chillers: ca. 30°C
- waste heat from process cooling (cooling water): ca. 50°C
- waste water: 20 – 40°C, also contaminated
- off gas: 60 – 80°C, humidity, contaminated

Heat demand:
- process water: 50 – 80°C
- steam: 105 – 210°C
- hot air
- air preheating
- feed water preheating
- district heat: 60 – 120°C

Capacity:
- up to the MW range
Conclusions

- Industrial heat pumps turn waste heat into valuable process heat
- Increase on-site efficiency and contribute to decarbonization
- Solution of technological challenges for high temperature applications essential, such as
  - Suitable refrigerants
  - Temperature resistant materials and components
- Expectations of the industry
  - High availability and reliability
  - Short payback periods
- Industrial heat pumps allow for economic and environmental benefits
- Industrial heat pumps are in an early phase of market diffusion and there is a large application potential
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