Solar Foods

Development of a solar thermal branch concept for the food industry based on case studies

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Overview

- **Introduction**
- **Objectives and methodology**
- **Process optimisation and heat recovery**
- **Integration of solar thermal**
- **Concepts based on case studies**
- **Conclusions and outlook**

Introduction (1)

- **EU-targets by 2020 (20-20-20):**
  - ⇨ Reduction of emissions by 20%
  - ⇨ Increase of energy efficiencies by 20%
  - ⇨ Increase of the use of renewable energies up to 20%
- **Energy demand in the Austrian tobacco, food and indulgence food industry (NACE 15,16)**
  - ⇨ 1995: 20,000 TJ
  - ⇨ 2007: 26,000 TJ
  - ⇨ **Increase by 30%**
- **Need and potential for improvement**

Introduction (2)

- **Unit operations in the food industry with the highest thermal energy demand**
  - ⇨ Concentration of e.g. milk, whey, fruit and vegetable juice
  - ⇨ Drying in the production of e.g. powder, dried fruits and instant products
- **High potential for solar thermal in the food industry due to**
  - ⇨ Thermal energy demand in the range between 30°C and 150°C
  - ⇨ Hours of operation (mostly during day) and mostly constant load over the year

→ **motivation for the development of a branch concept**

Objectives

- **Development of practical concepts for the integration of solar thermal in sub-branches of the food industry**
- **Close cooperation with companies and branch representatives**
- **Consideration of**
  - ⇨ energy efficiency measures,
  - ⇨ heat integration and
  - ⇨ other renewables
- **Development of a solar roadmap 2020/2030 for the food industry**

Methodology (1)

- **Survey of the status-quo of the energy and resource demand in the Austrian food industry based on data of companies**
- **Development of a balancing tool**
- **Display of framework conditions of the sub-branches**
- **Integration of solar heat based on the case studies and development of implementation concepts for the companies evaluated**
- **Development of a solar roadmap 2020/2030**
- **Development of the branch concept**
  - ⇨ Planning and implementation tool, guideline for the integration of solar thermal and the roadmap

Methodology (2)

- **10 companies from the food industry**
  - ⇨ Meat processing industry including slaughter (3)
  - ⇨ Vegetables and fruit processing (3)
  - ⇨ Production of fruit juice concentrate (1)
  - ⇨ Production of bakery products (1)
  - ⇨ Dairies (2)
- **Evaluation of all relevant process data and parameters**
  - ⇨ Mass and energy balances
  - ⇨ Load profiles
  - ⇨ Demand and supply side (heat, cold, power)

Process optimisation

- **All technologies and processes were evaluated**
  - ⇨ State of the art
  - ⇨ Process parameters
    - **Temperatures**
    - **Operational mode**
    - **Losses**
  - ⇨ Supply system
    - **Steam**
    - **Warm/hot water**
  - ⇨ Alternative technologies

→ **identification of optimisation potential and discussion with the company owners**

Heat recovery

- **Before the integration of solar thermal available waste heat streams should be integrated**
- **Design of a heat recovery network**
  - ⇨ Pinch analyses
  - ⇨ Streams with heating and cooling demand (hot and cold streams)
  - ⇨ Process streams
  - ⇨ Heat supply
  - ⇨ Cold supply
- **Based on the remaining heating demand after this step the integration of solar thermal can be evaluated**

Solar thermal integration

- **Based on load profiles of remaining heating demand**
  - ⇨ Performance of simulations implementing
    - **Location**
    - **Solar radiation**
    - **Processes**
    - **Temperatures of the heating demand**
  - ⇨ Technical and economic evaluation of the solar thermal integration
  - ⇨ Choose of the collector type and area necessary

Case studies (1)

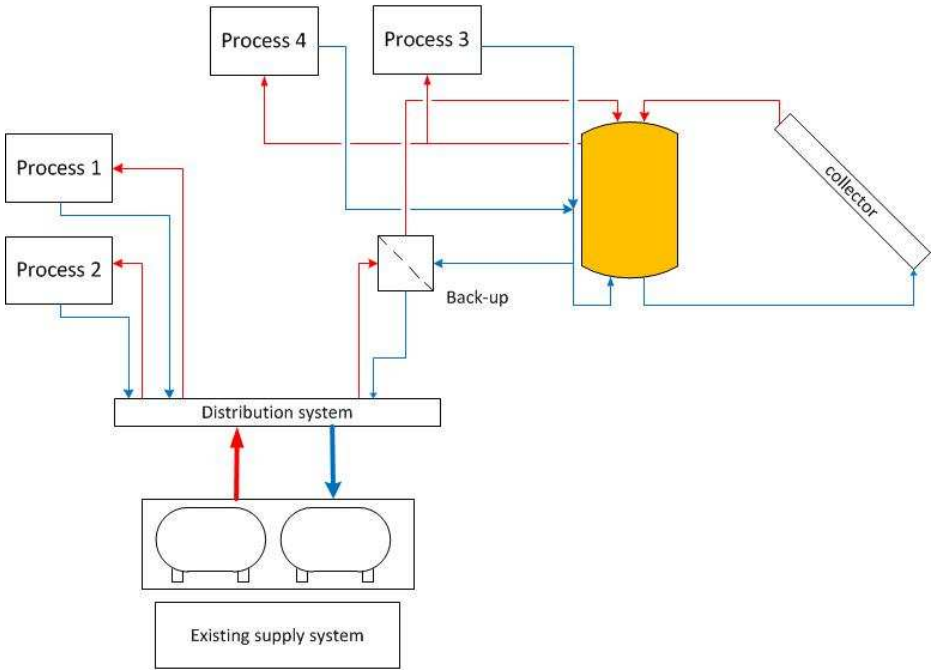
- **Process optimisation**
- **Heat integration**
- **Potential for solar thermal integration**
  - ⇨ Process temperatures between 30°C and 150°C
- **Optimisation of the overall efficiency of the production process**
- **Optimisation of the solar fraction**
- **Minimization of specific costs**
- **Depending on sub-branches different concepts for the solar integration have been detected**

Case studies (2)

- **Influences on solar thermal integration potential**
  - ⇨ Existing structure of heat and cold supply (old?)
  - ⇨ Already implemented heat recovery esp. from cold storages
  - ⇨ Heat supply system: steam, hot/warm water
- **Depending on sub-branches different concepts/potentials for the solar integration have been detected**
  1. Solar thermal integration for processes heat
  2. Solar thermal as heat source for new technologies identified
  3. Solar thermal as heat source for service water (cleaning, hygienic)
  4. Heat recovery from cold storages vs. solar thermal integration

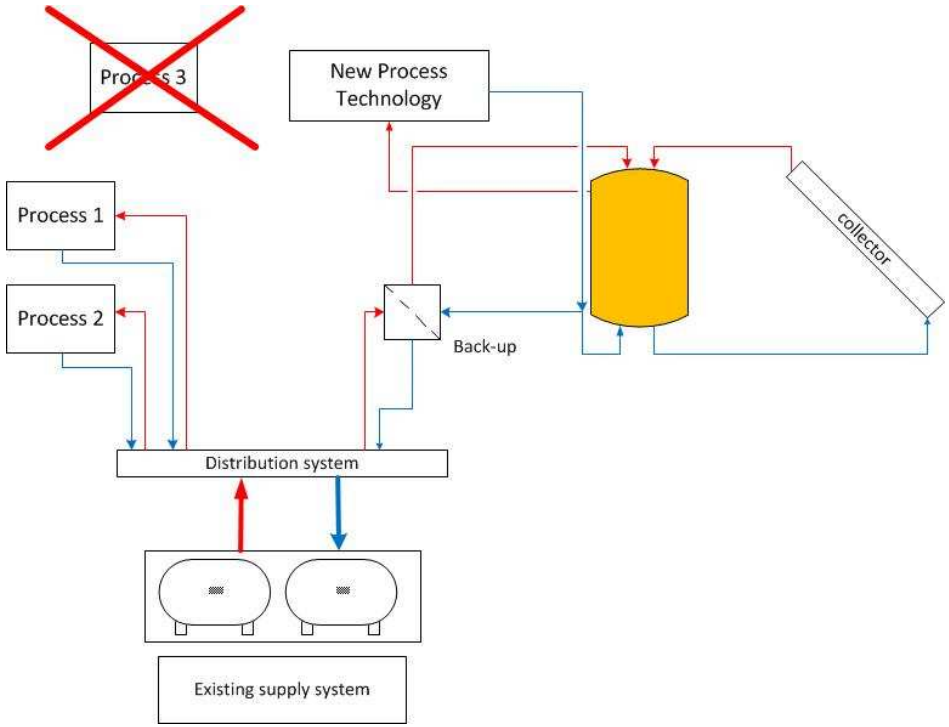
Concepts (1)

- **Solar thermal as process heat**
  - ⇨ Heating demand between 30°C and 150°C
    - **Pasteurisation, cooking, etc**
  - ⇨ Constant load profiles
  - ⇨ Implementation of storages
  - ⇨ High solar fraction and economic implementation
    - **Dairies**
    - **Meat processing industry**
    - **Fruit and vegetable processing industry with constant loads**



Concepts (2)

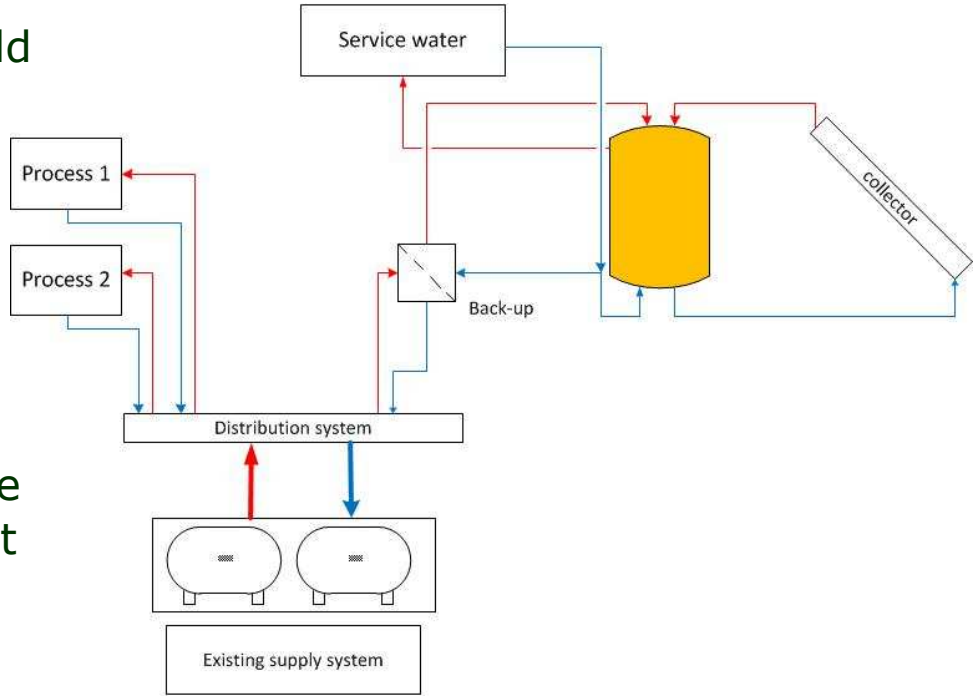
- **Solar thermal for new process technologies / PI**
  - ⇨ Based on technology evaluation a process change has been suggested
    - **Change in heat supply temperature**
    - **Substitution of fossil fuels**
    - **Integration of solar thermal**
  - ⇨ Test of technology switch will be done within the next year
  - ⇨ All sub-branches



Concepts (3)

➢ Solar thermal for service water

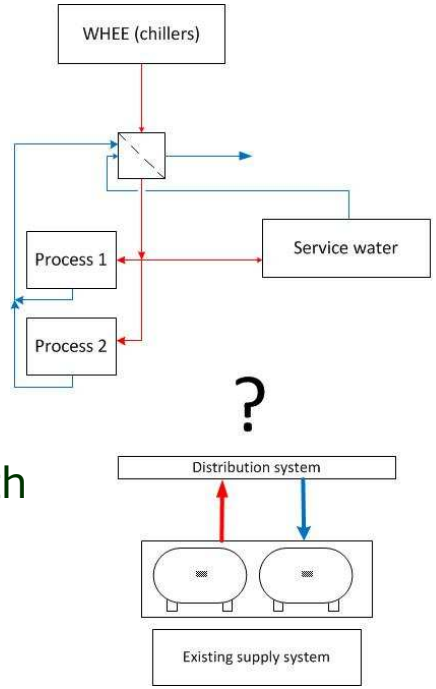
- ⇨ Process heat supply with steam / electric power
- ⇨ Change in the supply system would be necessary
  → hard for small companies
- ⇨ Big demand of service water
- ⇨ Partly done with cold water and a change will be necessary anyway due to hygienic demands
- ⇨ After integration of available waste heat a high potential for solar heat integration has been detected
- ⇨ All sub-branches esp. small companies

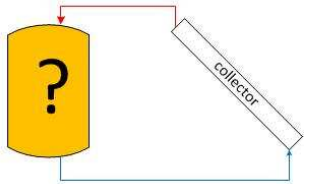


Concepts (4)

➢ Solar thermal vs. waste heat

- ⇨ Process heat supply with steam / electric power
- ⇨ Change in the technology is not possible due to
  - **Small size of company**
  - **Manufacturers of the technology**
- ⇨ Huge amount of waste heat available from cold storages and deep-freezing
- ⇨ Waste heat can be perfectly combined with cleaning processes (not yet implemented)
- ⇨ In companies with low process heat demand (partly only cleaning) a huge amount of the energy demand can be covered by heat recovery
- ⇨ Fruit and vegetable and meat processing companies





Conclusions

- **Potential for solar thermal integration in sub-branches of the food industry has been verified**
- **Heating demand at temperatures between 30°C and 150°C**
- **Steps before solar integration**
  - ⇨ Evaluation of technologies used
    → change possible or necessary?
  - ⇨ Integration of waste heat esp. where cold storages and deep-freezing is necessary
  - ⇨ Optimised integration of solar thermal as
    - **Process heat**
    - **Supply for new technologies / PI**
    - **Heat source for cleaning and general service water**

Outlook

- **Finalisation of the development of the Solar Foods branch concept**
- **Implementation of branch specific guidelines**
- **Availability of the tool for companies, energy mangers, energy auditors…**
- **Development of the roadmap 2020/2030**
- **Realisation of concepts suggested as demonstration plants for future projects**

Project partners

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