Solar Thermal
Innovative technology and essential energy source in smart energy systems

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Solar thermal – essential energy source in smart energy systems

Euroheat & Power, www.4dh.eu
Solar thermal
– Technology, projects and markets

1. The collector
   - Savosolar solar thermal technology
   - Solar field design

2. The energy system of which the solar plant is part
   - Reference projects

3. Organization and planning
   - Solar district heating experience in Denmark
   - Market approach

- Absorbers – profile with optimal heat transfer and coating
- Collector design – minimise heat loss (internal hoses)
- Solar field design – shared foundations, double stanchions
- DH and industrial applications – optimizing solution
- Local partners – maximizing local benefits
Unique technological advantage

- **Absorber strips** made from aluminium profiles as used in automotive heat exchangers
- One-of-a-kind **coating** technology, which makes it possible to coat entire absorbers after assembly
- Has resulted in the **market’s most efficient** large area collector

**Traditional production**
- Welded strip
- Heat transfer to fluid

**Savosolar**
- Thin-walled profile with Direct Flow heat transfer
- **Minimal thermal losses**
- Optimized heat transfer
Absorber

Actual absorber size compared to person
Further advantages

• Awarded with the Intersolar Award 2011 for “the biggest absorber development in the industry the last 30 years”
• Double glazed collectors with superior glass insulation
• Solar Keymark certified and ISO 9001 certified
• Only producer of large area collectors with PED module II certification according to directive 97/23/EG of the European Parliament
• Mounting solutions for both fields and roofs – fields preferred
• Etched (as opposed to coated) anti-reflective glass treatment without deterioration over time
• Several large scale district heating solar fields – up to 20,000 m² in size
Minimal thermal losses in connections

- Integrated connection hoses (patent pending)
  - Minimizes thermal losses in the connections
  - Allows for mounting with only 40 mm distance between panels
  - Reduces shadowing effects compared to traditional connections
  - Protects the connection hoses from external wear from weathering and bird attacks
Maximum use of available land – heat density

• Shared collector foundations (patent pending)
  • **Minimises** the number of foundations
  • Ensures that collectors are **aligned** with each other
  • Offers a **visually** pleasing result which is less noticeable in the landscape
Foundations below the collectors
Space for driving a vehicle
Few foundations
Leveling of land not required
Danish record for production: 4.97 kWh/m² in one day

Double stanchions

Jelling Varmeværk, Jelling, Denmark – 15,300 m² (+4,800 in 2019) Savosolar
Saving of:
- Piping cost
- Heat loss
- Excavation cost
- Welding cost
- Land requirement
Løgumkloster Fjernvarme, Løgumkloster, Denmark – 15,300 m²

- Savosolar solar fields 15,000 m²
- Energy storage
- Exchange station
- Wood pellet boiler
- Heat pump

Future solar field extension 35,000 m²
Future energy storage of 150,000 m³
Combination of single-glazed (SG) and double-glazed (DG)
SG and DG
Double stanchions

Very wet land area – high heat density was important to meet customers requirements
High heat density also important for roof installations
Solar thermal plant – turnkey

- Savosolar work with local partners
  - Local economy
  - Local competences
- The whole solar thermal system, comprising:
  - Collector field
  - Piping (solar field and transmission)
  - Pumps
  - Heat exchanger
  - Control
  - Heat storage (tank)
  - Building
  - Ground works
Solar thermal plant – initial design

- Savosolar has own energy calculation tool
  - Location and weather data (Meteonorm)
  - Temperatures (requirements from customer, design for piping, heat exchanger)
  - Collector parameters (tilt angle, row distance)
  - Field design – double stanchion, row length (flow rate is limiting parameter)
  - Tank storage calculation

- Interface to customer
  - Data input and report
  - Hour (calculations), month, year, solar fraction (presentation)

- Efficiency values
  - Solar keymark

- Design parameters can include
  - Summer load (DH)
  - Area restriction
  - Other heat production technology
  - Heat storage

Lower supply temperature implies higher efficiency (thus lower energy cost)

Consequently: reduce the temperature in (part of) the DH system, before designing and implementing a solar thermal plant

Or e.g. combination with heat pump
Savosolar winning market concept

Solution Excellence

Winning Customer & Community Prosperity

Product Superiority

Local Partnering
Solar district heating in Denmark

- Phases of a solar thermal system
  - Preparation and planning
  - Establishing
  - Commissioning
  - Operation and maintenance
- Target groups
  - Boards
  - Municipalities
  - Operators
- Six examples of solar district heating systems
  - Based on interviews
- Links to more information
  - E.g. www.solarheatdata.eu

http://task55.iea-shc.org/publications
Solar district heating in Denmark

- Reduced CHP-production – different production structure
- Central – decentral
- Diversified systems
- Solar thermal is modular; easy to expand and combine with other technologies
- Reduction of heat price primary driver for substituting natural gas with biomass
- Increased use of biomass - Environment?

Solar district heating plants in Denmark
Solar area and number of plants in operation and planned

- Solar thermal is renewable and local
Complementary technologies

• Biomass boiler
  • Saving lifetime of biomass boiler when low/no summer load
  • Reducing operation costs (low for solar thermal)
  • Solar thermal more efficient at lower output temperatures
  • Biomass boiler more stable and efficient operation with heat storage

• Heat pump:
  • Higher efficiencies: lower output temperature from solar thermal, higher input temperature for heat pump
  • Flexible operation – matches variable (efficient) production from solar thermal (consider correlation between parameters – e.g. solar irradiation and electricity prices) – storage required.
Heat storage – enabling diversification

- Heat storage is always required for solar thermal
- Diurnal or seasonal – different technologies
  - Diurnal – tank storage, 20-35 % solar fraction
  - Seasonal – e.g. pit thermal heat storage, 50-70 % solar fraction
- Storage enables optimization of electricity production as well as heat production
  - E.g. electrical heat pumps
  - Enabling lower output temperature (higher efficiency) – supplemented by e.g. heat pumps
  - Also possible without storage, but probably not feasible
Solar thermal plant – pros and cons

Advantages include:

• Stable energy price
  • No fuel costs
  • Tax (?)
  • Low operation costs
  • Same high yield – also after 20 years

• Local resource
  • No transportation costs

• Environment
  • E.g. utilize old landfill sites (synergy with city planning)
  • No noise or visual impact

• Green energy
  • No emissions

Challenges include:

• Sensitive to availability of long term financing

• Requires coordination with city planning (land use), long term

• Control system of energy plant may be more complicated
  • “A boiler you cannot stop”
  • Requirements for operation of the plant
The sun rises in the North!

SAVOSOLAR - solar thermal technology taken to the next level

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Please visit www.savosolar.com