Solar Thermal system integration in existing District Heating grid.

Experience form Salaspils Siltums project

Leo Holm
Manager Technical Sales
ARCON-SUNMARK A/S IN HEADLINES

- 1974 Foundation of Arcon Solar A/S
- 1988 First large scale solar plant in combination with District heating
- 2007 Incorporation of Arcon Solar A/S in VKR Holding
- 2015 Merger of Arcon Solar A/S and Sunmark Solutions to Arcon-Sunmark A/S.
WE ARE THE WORLD’S LEADING SPECIALISTS

WE DELIVER HIGH QUALITY, AT LOW COST

Arcon-Sunmark is a Danish company with a global footprint. Design, development and our production is based in Denmark.

WE CAN PROVE IT

Arcon-Sunmark is behind the largest solar thermal installation for industrial process heating. In addition, we have installed more than 80% of the largest plants in Europe.

WE ARE HERE TO STAY

We are as solid and future-proof as can be. Arcon-Sunmark is owned by VKR Holding. In total, VKR Holding’s companies employ some 14,000 people in more than 40 countries. VKR Holding owns companies which bring daylight, fresh air and a better environment into people’s everyday life.
Arcon-Sunmark and FILTER AS established in 2019 a sales collaboration agreement which aims to offer large-scale solar heating systems for the Baltic market and in Bulgaria, Russia and Belarus.
UN GOALS NO. 7: AFFORDABLE AND CLEAN ENERGY

7.1 Modern energy
Clean and affordable energy

7.2 Renewable energy
Be part of the renewable energy transition

7.3 Efficient energy
Solar thermal shows highest energy yield per square metre

7.4 Clean energy
Solar thermal production is CO₂ free

7.5 Global energy
Renewable energy for everyone
BENEFITS OF DISTRICT HEATING AND SOLAR THERMAL
STABLE HEAT PRICE, INDEPENDENT FROM FOSSIL FUELS, CO2 FREE ENERGY PRODUCTION
WHY SOLAR THERMAL?

IT CAN BE STORED, TRANSPORTED AND IT WORKS EVEN IF IT IS CLOUDY
WHY SOLAR THERMAL?

IT’S THE MOST LAND SAVING RENEWABLE ENERGY SOURCE

Annual energy yield in kWh per m² of land

Source: Per Alex Sørensen, Planenergi: “Experience with solar thermal in Denmark”, Jan. 2014
WHY SOLAR THERMAL?
SOLAR THERMAL SHOWS HIGHEST ENERGY YIELD PER SQUARE METRE

3 times as many kWh as PV
43 times as many kWh per m² as biomass

Sources: Frauenhofer ISE, PlanEnergi and Chalmers University, Submitted by Bärbel Epp, solarthermalword.org, July 31, 2017
BENEFITS OF BIOMASS AND SOLAR

STABLE HEAT PRICE
The DH-plant can reduce it’s vulnerability to increasing fuel prices

PLAN SERVICE AND MAINTENANCE
Many plants enjoy a long period of up to 4 months of total shutdown of their boiler, where service and maintenance can be performed

PROLONG THE LIFETIME OF BOILER > 25%
Shutting down the boiler in the summer, keeps it from operating at low efficiency

BECOME INDEPENDENT FROM FOSSIL FUELS
A combination of biomass and solar is the perfect way to avoid using fossil fuels

CO$_2$ – NEUTRAL ENERGY PRODUCTION
With biomass and solar heating, the production of district heat can become 100% green, to benefit environment and economy
Why solar energy?

Low operation and maintenance’s cost
• The operation and maintenance is app. 1 – 1.5 Euro/MWh heat produced.
• The electricity consumption is app 4 to 6 kwh electricity to produce 1 MWh solar.

Easy in operation and maintenance
• Easy to operate and could run 24 hours unmanned, and could be remotely controlled.
• Maintenance is very limited - cleaning filters and pump inspections

Solar heating is a perfect match to other sources of energy.
• A solar system can be installed in conjunction with any type of heating plant.
• The system is always extendable.
Why solar energy?

CO2-neutral
• Solar energy is a good alternative to replace fossil fuel, and reduce the companies carbon footprint.
• With biomass and solar the production of district heat can become 100% green, to benefit environment and economy.

Stable heat price
• The District heating plant can reduce it’s vulnerability to increasing fuel prices
• The price of fuel fluctuates, the price of harvesting the sun will always be the same low price in +25 year. Hence, the larger the part of energy covered by solar heating, the better for the customers.
Why solar energy?

Integration into existing system

- Gives a better efficiency of the total plant (solar water for the city shunt instead of return water).
- 50-60 °C from the solar thermal could be used for the city shunt or preheating of condensation heat recovery of a boiler’s exhaust air.
- Preheat the water for the boiler, in periods where there is low solar radiation.
- It could be 70-80 °C if the solar heat is directly connected to the flow pipe of the DH network (depending of course on the DH network supply temperature).
- It could be 90 °C for charging a heat storage. However – depending on the storage – it might also be possible to charge the storage at different temperature.
Thermal solar collector

Arcon-Sunmark collectors

**Data**
- Outer dimensions: 2,27 x 5,97 x 0,14 m
- Gross area: 13,57 m²
- Aperture area: 12,60 m²
- Weight, without liquid: 250 kg
- Fluid content: 11 liter

**Casing features**
- Welded aluminum frame and back plate
- Air vents to reduce moisture accumulation

**Insulation**
- Back side: 75 mm mineral wool
- Side: 30 mm mineral wool
30 YEARS OF EXPERIENCE
WE DELIVER HIGH QUALITY AT LOW COSTS

From interest to decision

From decision to green ownership

From ownership to operator

Analyses
2 – 4 weeks

Feasibility study
2 – 4 weeks

Design & dimensioning
2 weeks

Construction of installation
10 – 24 weeks

Commissioning
2 – 4 weeks

Full scale operation
1 – 2 weeks

Service of installation
ongoing

Development with the customer
Energy calculation

Information needed for energy calculation – Energy demand form

1. General information

[Table: General Information]

2. Fuel information

Information about current type of fuel:

[Table: Fuel Information]

If only the consumed quantity of current type of fuel is known, please provide following information for the existing unit:

[Table: Additional Fuel Information]

3. Energy consumption

[Table: Energy Consumption]

4. Solar

[Table: Solar Information]

5. Other

The are interested in following estimate:

1. Efficiency of collectors (kWh/Wh)
2. Investment costs
3. Plant's annual output (kWh)
4. Solar heat coverage % of energy amount
5. Area/land necessary for solar plant
6. Roof design volume m³
The temperature in and out the solar panels is a very important parameter that has a major influence on the solar production.

Especial the forward and return temperature is very important for the solar production, for each 1 °C temperature changes, the efficiency of the solar panels, will change 0.5 %.
## Energy calculation

**Arcon-Sunmark calculation tool**

### Plant data

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**Total** 34252 4556 17

### Heat consumption and performance

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<th>Heat consumption [MWh]</th>
<th>Performance [MWh]</th>
<th>Coverages</th>
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<td>5880</td>
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<td><strong>Total</strong></td>
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Energy calculation

Arcon-Sunmark calculation tool
Installation

Maximum possible prefabrication of the pipe network in the plant allows reduced installation costs on site and high quality / safety.
Installation of the Collectors
Steel Profiles or Concrete Foundations

Steel Profiles
The steel profile is manufactured from structural steel S355 with a material thickness of 4 mm and is hot dip galvanized at Arcon-Sunmark's minimum requirement of 80 μm. The solar collectors are mounted on 4 hot-dip galvanized steel profiles which are cut to a depth of 130-160 cm, depending on the characteristics of the ground. The profiles must be placed with an accuracy of +/- 5 mm in order to assure the necessary strength and stability. Steel profiles, in contrast to the traditional concrete foundations, allow unevenness of the terrain up to +/- 150 mm. Alternatively, they enable the solar collectors to adapt to the natural course of the landscape.

Concrete Foundations
The concrete foundation is made of reinforced concrete and has a length of 2.6 m. The concrete foundations are used on ground surfaces where the hammering in the ground is not possible or allowed. For example abandoned garbage depots.
Installation of the Collectors
Efficient and proven installation of the collector field

Brædstrup 1 (2007), 5.6 MW, 8.012 m²

Brædstrup 2 (2011), 7.4 MW, 10.604 m²
Solar field layout
Solar field layout

Brædstrup 1 (2007), 5.6 MW, 8.012m²

Brædstrup 2 (2011), 7.4 MW, 10.604m²
FROM 1.000 – 156.700 M²
MORE THAN 1.6 MILLION SOLAR COLLECTORS INSTALLED WORLDWIDE SINCE 1988
The world’s largest solar thermal plant
Silkeborg, Denmark – 156,700 m².

Silkeborg, DK:
Solar system: 110 MW, 156,700 m² aperture area
Temperatures: 80 - 110°C
Max flow: 2,700 m³/h
Yearly yield: 80,000 MWh ➔ 20% solar coverage of town demand!
CHP as balancing and reserve power only
THE FIFTH WORLD’S LARGEST SOLAR HEATING PLANT, MARSTAL (DK)

32.943 m² solar panels and 75,000 m³ thermal pit storage (2012)
10,000 m³ thermal pit storage (2002)
Langkazi, Tibet
On the roof of the world (4,700 m above sea level)
Langkazi, Tibet
On the roof of the world (4,700 m above sea level)
ENERGY STORAGE

PREVENT ENERGY WASTE – USE THE ENERGY ON DEMAND

- Energy demand met by secondary sources
- Energy demand met by primary energy source
- Surplus primary energy production for storing
- Energy demand met by stored energy
- Energy demand met by secondary sources
Storage
Pressure less steel tank as short-term storage to compensate for irradiation and demand (1-4 days)
Seasonal Storage

75,000 M3 Pit Heat storage in Marstal
INTEGRATION

INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT

• Analysis of existing plant
INTEGRATION

INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT

• Simple integration
INTEGRATION

INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT

• High performance & flexibility
INTEGRATION UTENA

INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT
INTEGRATION UTENA

INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT
Salaspils District Heating built the first solar plant in Baltic
Heat production, transportation and distribution

Installed heat capacity 34.68 MW

Heat networks -20.6 km

The amount of sold heat:
60 000 MWh/year

>160 customer
Solar collector system 21,672 m²
Planned to produce 12,000 MWh per year
Calculated peak capacity 14.5 MW
Accumulation tank 8,000 m³
3 MW woodchip boiler with flue gas condenser
Costs

Total: ~7,26 mil EUR

- 40% EU funding: 2,73 milj. EUR
- LTD «Salaspils Siltums»: 1,78 milj. EUR
- SEB Bank Loan: 2,75 milj. EUR
2016

Planētā gāze

Šķeldas katls 3 MW
Šķeldas katls 7 MW
Kondensators 3 MW
Kondensators 7 MW
Gāze

Salaspils Siltums

20.02.2020
Diversification of fuels

**till 2012**
- CHP 41%
- Natural gas 59%

**2018**
- Woodchip 47%
- Natural gas 44%
- Condenser 9%

**After project**
- Natural gas 9%
- Condenser 10%
- Solar 20%
- Woodchip 61%

100% fossil fuel

>90% RES
Solar radiation 724 w/m²  Solar production 374 w/m²  Efficiency 52 %
REMEMBER!
There is an end to our resources.
THANK YOU
CONTROL SYSTEM

SOLAR OPERATION

• Basic solar operation scenarios

- Standby – no heat production
- Preheating
- Low temperature operation
- High temperature operation
- Efficiency reduction
- Condensation protection
- Night cooling
- Frost protection without heat
- Frost protection with heat