
De-Carbonizing the Campus: Planning, Tools & Technologies
CampusEnergy2023
February 27 – March 2, 2023
Gaylord Texan Resort & Convention Center | Grapevine, Texas
INTERNATIONAL
DISTRICT ENERGY
ASSOCIATION

District Heating Using Concentrated Solar Collectors - A Case Study -

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Phoenix Solar Thermal

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PHOENIX SOLAR THERMAL INC.

ABSOLICON SOLAR COLLECTORS

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Hogslatten Solar Thermal Park

- Härnösand Energi & Miljö AB (HEMAB) district heating supplier
- Located in HÄRNÖSAND, SWEDEN

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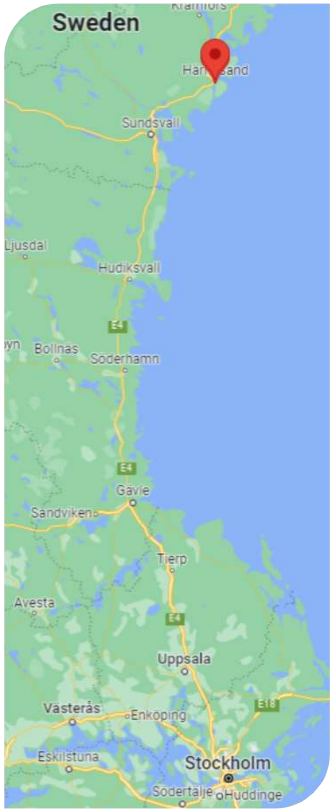
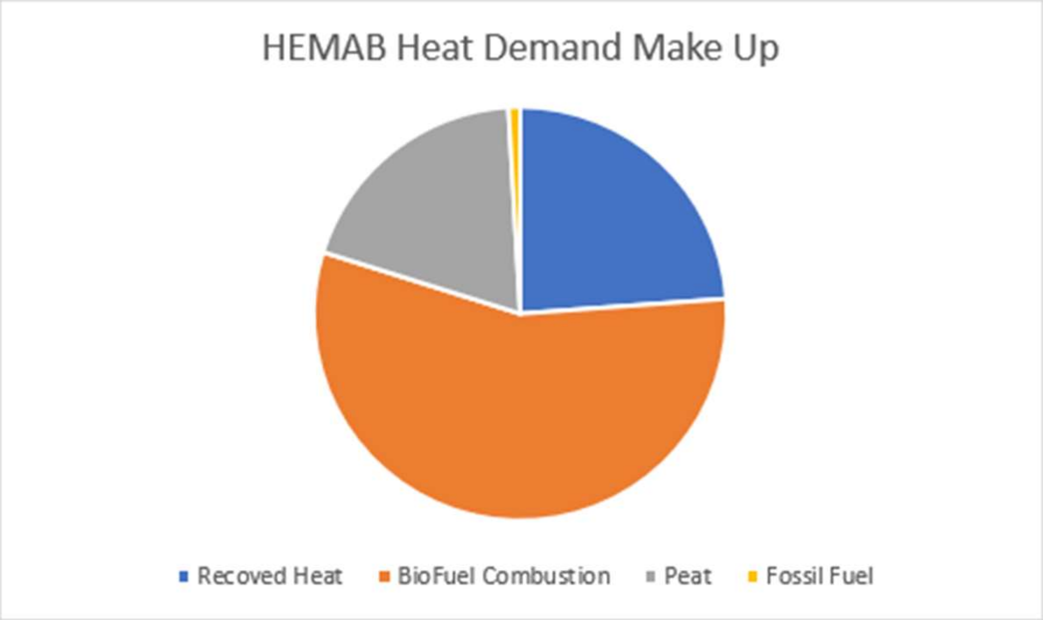
- Located in HÄRNÖSAND, SWEDEN
- HEMAB district energy system
  - Grid volume 2,155m^3
  - Total grid length 121 km
  - 2,022 grid connection points
  - 18,500 inhabitants
  - Annual heat load 200 GWh/year



Problem

- Reduce boiler biofuel combustion
- Meet up to 25% of the district heating network demand on summer days
  - (1.5MW of 6MW summer load)
- Demonstrate T160 parabolic solar collectors' effectiveness in energy production and operational durability
  - Third party audit: Research Institute of Sweden (RISE) and Umeå University



Solution

- 9,462m² solar field footprint
- 1.5 MW solar system
- To be delivered in two stages
- Delivering 73C to 120C hot water, fed directly into the city district heating network.

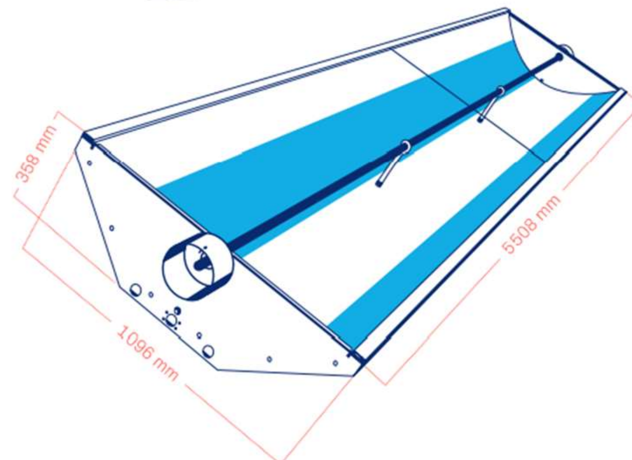
STAGE 1

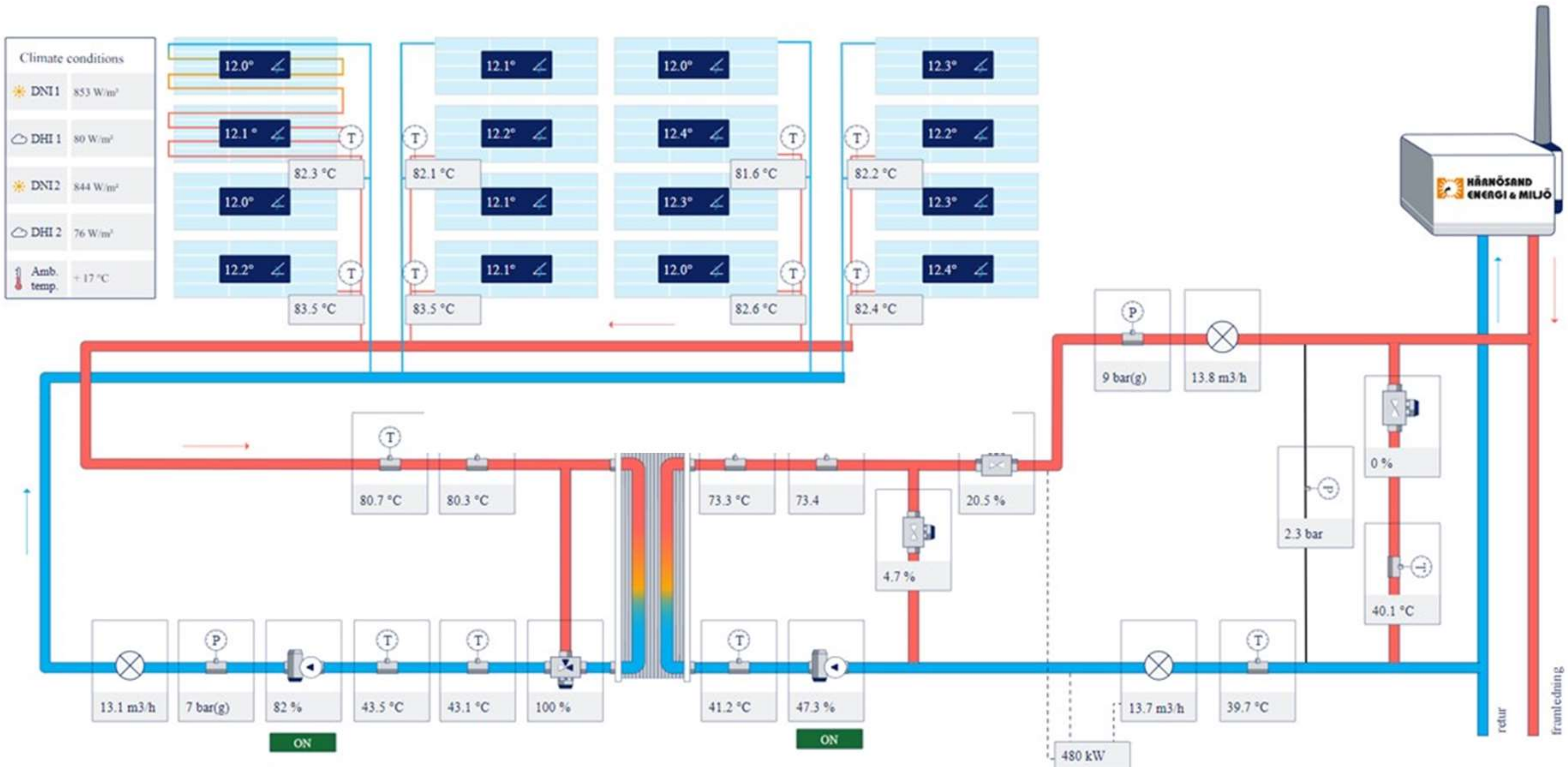
- 1,700 m² solar field footprint
- 1,056m² collector aperture
- 192 parabolic collectors
- 739 KW solar thermal system
- Commissioned September 2021
- Producing 357 kWh/m²

Solar central for district heating at 120°C

Solution

- 16 banks of 12 collectors
- 76.4% optical efficiency
- Follow the course of the sun for optimum energy transition
- Self cleaning glass surface
- Water glycol mix – solar field heat loop
- Direct tie into the district heating network
- Deliver 120^{o}C (248^{o}F)




Climate conditions
DNI1 853 W/m²
DHI 1 80 W/m²
DNI2 844 W/m²
DHI 2 76 W/m²
Amb. temp. +17 °C
82.3 °C
83.5 °C
82.1 °C
83.5 °C
81.6 °C
82.6 °C
82.2 °C
82.4 °C
9 bar(g)
13.8 m3/h
80.7 °C
80.3 °C
73.3 °C
73.4
20.5 %
4.7 %
0 %
2.3 bar
40.1 °C
13.1 m3/h
7 bar(g)
82 %
ON
43.5 °C
43.1 °C
100 %
41.2 °C
47.3 %
ON
13.7 m3/h
39.7 °C
480 kW
retur
framledning

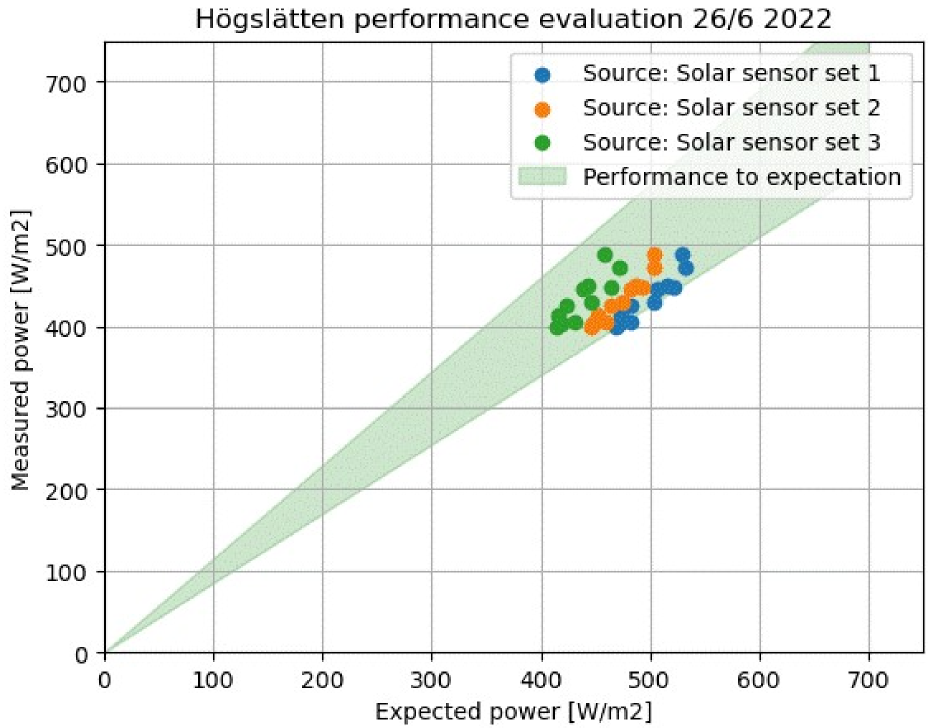
Solution - Results

✓Phase 1 judged a success.

- First year energy production 278,505.7 kWh
- Power produced 400 W/m^2 to 500 W/m^2

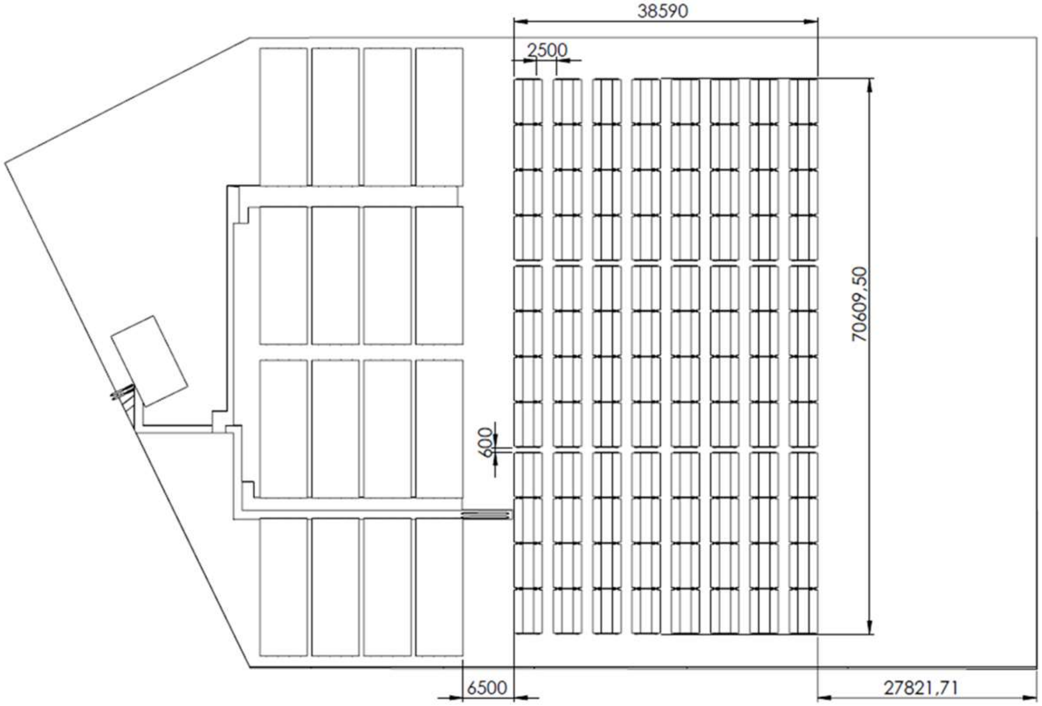
✓First full year of operation

- 0 alarms triggered
- 0 service calls required



Solution - Results

✓Phase 2 is underway. Commissioning timeline 2023 Q3



Phase 2 Expansion
Total 1.5 MW

When complete this will be Sweden's largest solar thermal field connected to District Energy in operation

Lessons Learned

- **Project Implementation**

- **Product Design**

Lessons Learned – Project Implementation

1. Inground Piping

Benefits
- Clean
- Ease of access for collector servicing

Lesson
- Ensure contractors take into account thermal cycles - temperature range & frequency
- Vertical sleeves (tee pipes) allowing 50 mm movement

Lessons Learned – Project Implementation

2. Field Configuration

Lesson - Have a clear view of your project goals

<u>Energy Production</u>

- Choice of Priority: Maximum energy production /solar field footprint OR maximum energy production / m^2
  - Phase 2 – plan for expanded distancing from 1.43m c-c to 2.5m c-c
- End result – reduce impact of collector shadowing
- Target – increase solar energy output per m^2 by 30% to 464 kWh/m^2

<u>Project Plan</u>

- Size the solar central for the final solar field size

Lessons Learned – Product Design

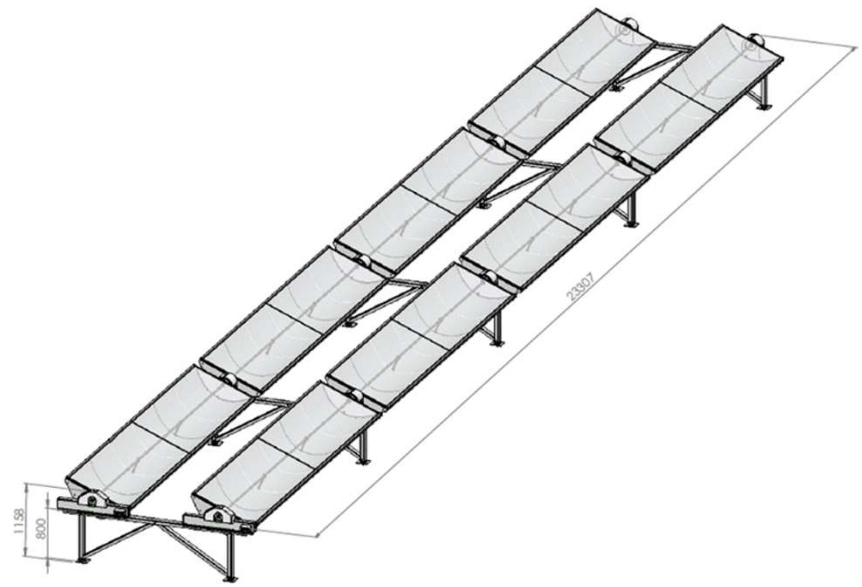
1. Collector Grouping

- Move to a 2-row configuration (vs. 3-row)
- Net result – less collectors driven/motor

Benefit

- Reduced wear and tear
- Increase equipment availablity
- Reduced motor sizing & burden (driving 4 versus 12 collectors)
- Enhanced track positioning accuracy
  - Improved efficiency (reduced heat losses)

Lessons Learned – Product Design



Lessons Learned – Product Design

2. Support Frame Redesign

- Reduce maximum beam length from 17m to 3m
- Position support legs at end

Benefits

- Lighter weight materials – no longer require crane for handling beams
- Simplify installation and shorten installation time
- Ease of access for installation, setup and maintenance
- Eliminate long length stablity issue
- Greater stability (eliminate risk of end sag)

Lessons Learned – Product Design

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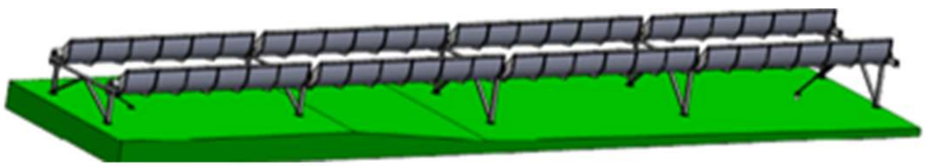

Lessons Learned – Product Design

3. Design New Modular End Tracking Units

Separate the drive mechanism from the support structure

- Tracking units adaptable for different leg configurations e.g. rooftop installation
- Improve access and serviceability of key components

Standardized mechanical packaging and wiring

- Ease to scale manufacture

Conclusion

Solar thermal technology is a reliable source for providing sustainable renewable heat energy supply

Energy security is an important key result

Other equally impactful considerations include:

- ✓ *Ease of installation*
  - ✓ *Modular construction*
  - ✓ *Minimum critical onsite requirements*
- ✓ *Repeatability of production and performance*
- ✓ *Simplicity of design for ease of operation*
- ✓ *Ease of integration into your process*

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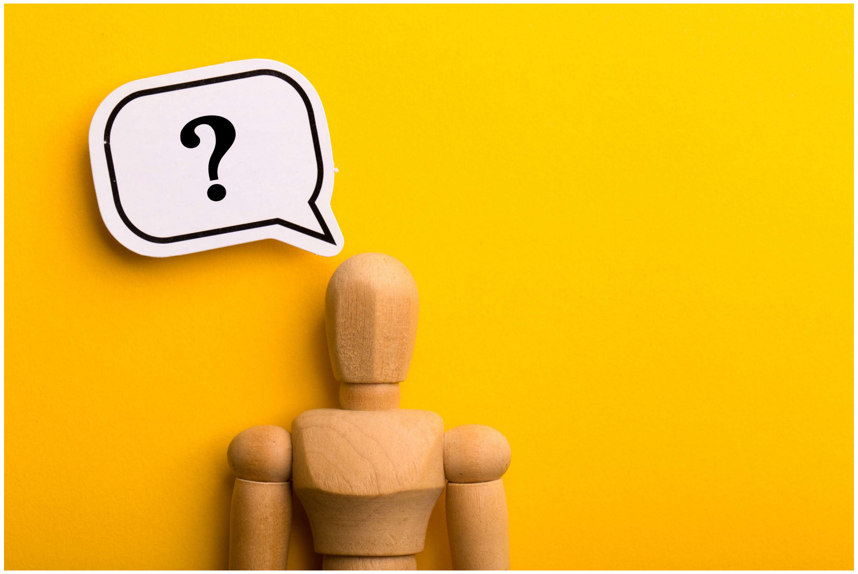
Questions



Thank You!

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