

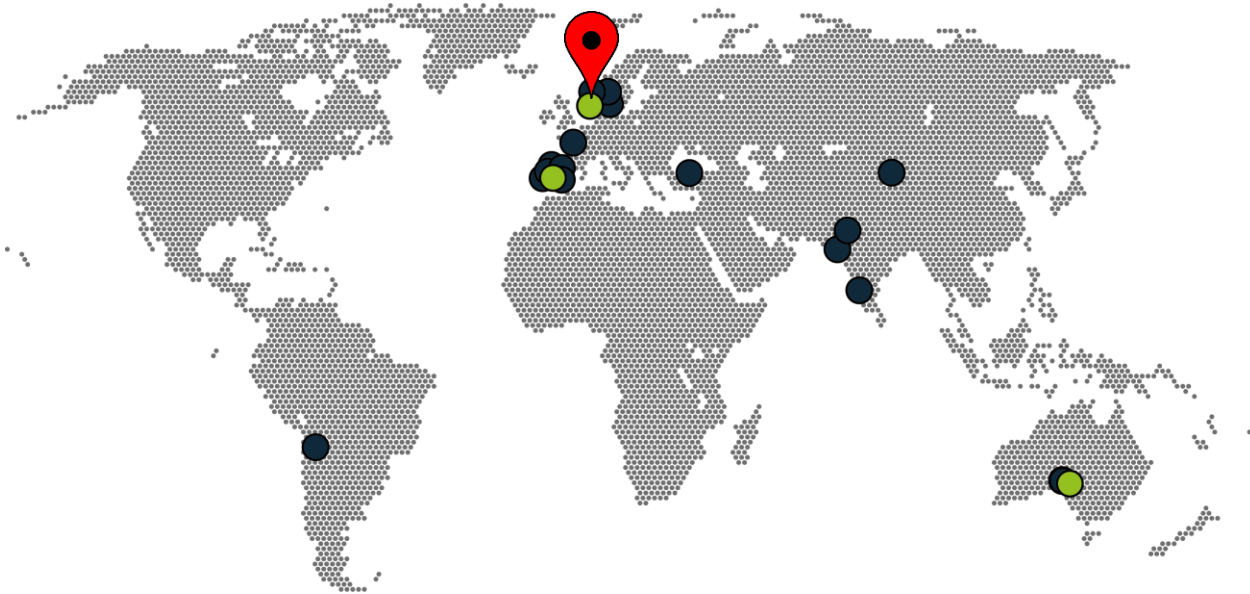
Harvesting energy
FROM THE SUN

CSP combined with flat solar panels - Optimal use of the sun

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GLOBAL REACH

Leading developer and supplier of innovative
RENEWABLE ENERGY TECHNOLOGIES
aiming to change the way energy is produced today.



Our company

- 1** headquarters in Aalborg (Denmark)
- 3** sales & service locations worldwide

Our projects

- 8** countries of the world
- >1,700 MWth** solar installations globally

VISION & MISSION

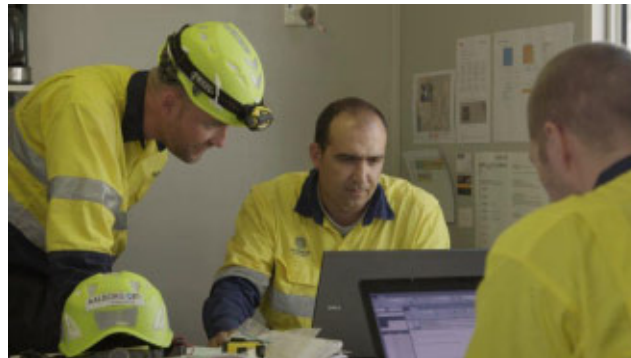
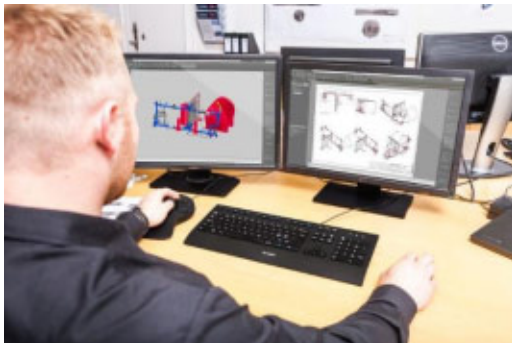
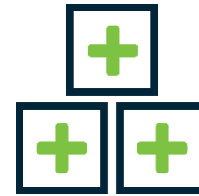
Our Vision

Changing Energy
accelerating the world's renewable energy
transition by making more competitive
green energy solutions.

Our Mission

to **develop** and **supply**
green technologies
and integrated energy solutions
to lower the cost of energy
for our customers.

FROM IDEA TO REALITY



FROM BOILERS TO CSP & CSH



1988
Traditional boiler design and delivery



2007
Entry to the CSP market with solar boilers: 5x50MWe steam generators, 20+10MWe central receivers, Spain



2011
CSP for district heating optimized for local conditions, Denmark



2013
50MWe and 25MWe steam generators, India



2014
Development of different thermal energy storage technologies begins



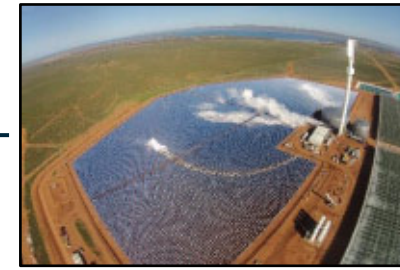
2017
Molten salt solar boiler project in China



2017
Different district heating projects with flat solar panels, Denmark



2016
CSP combined with biomass-ORC, Denmark

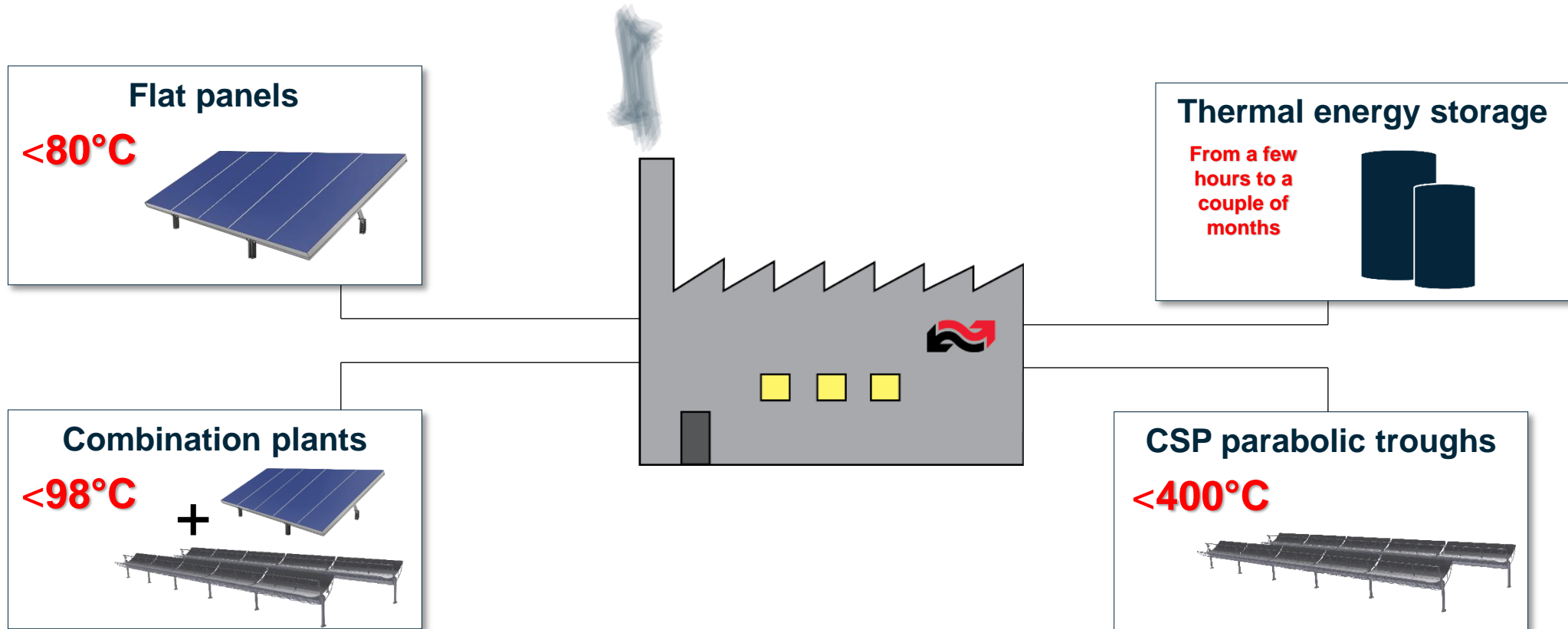


2016
The first integrated energy system based on CSP in the world, Australia

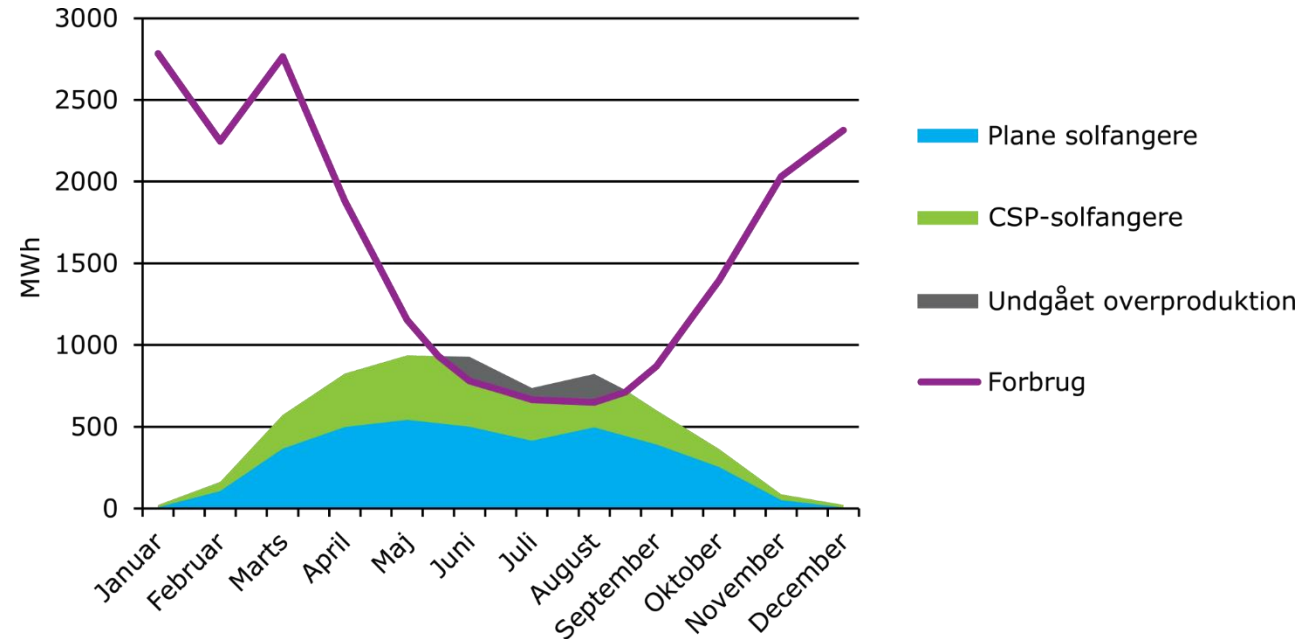
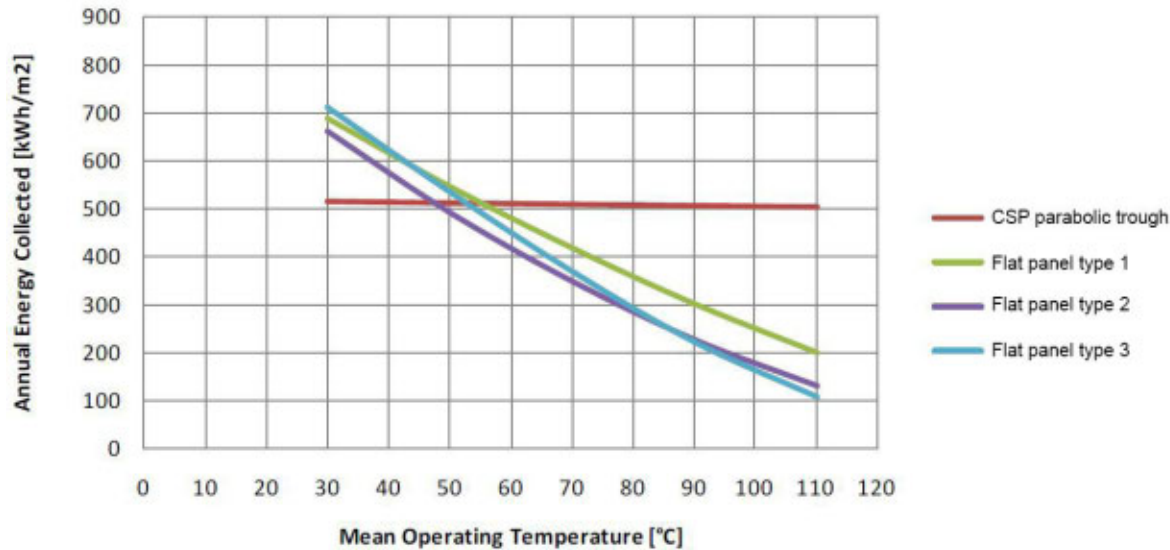


2015
CSP combined with flat panels for district heating, Denmark

SOLUTIONS FOR ALL TEMPERATURE RANGES



Plant description, Combined solar field

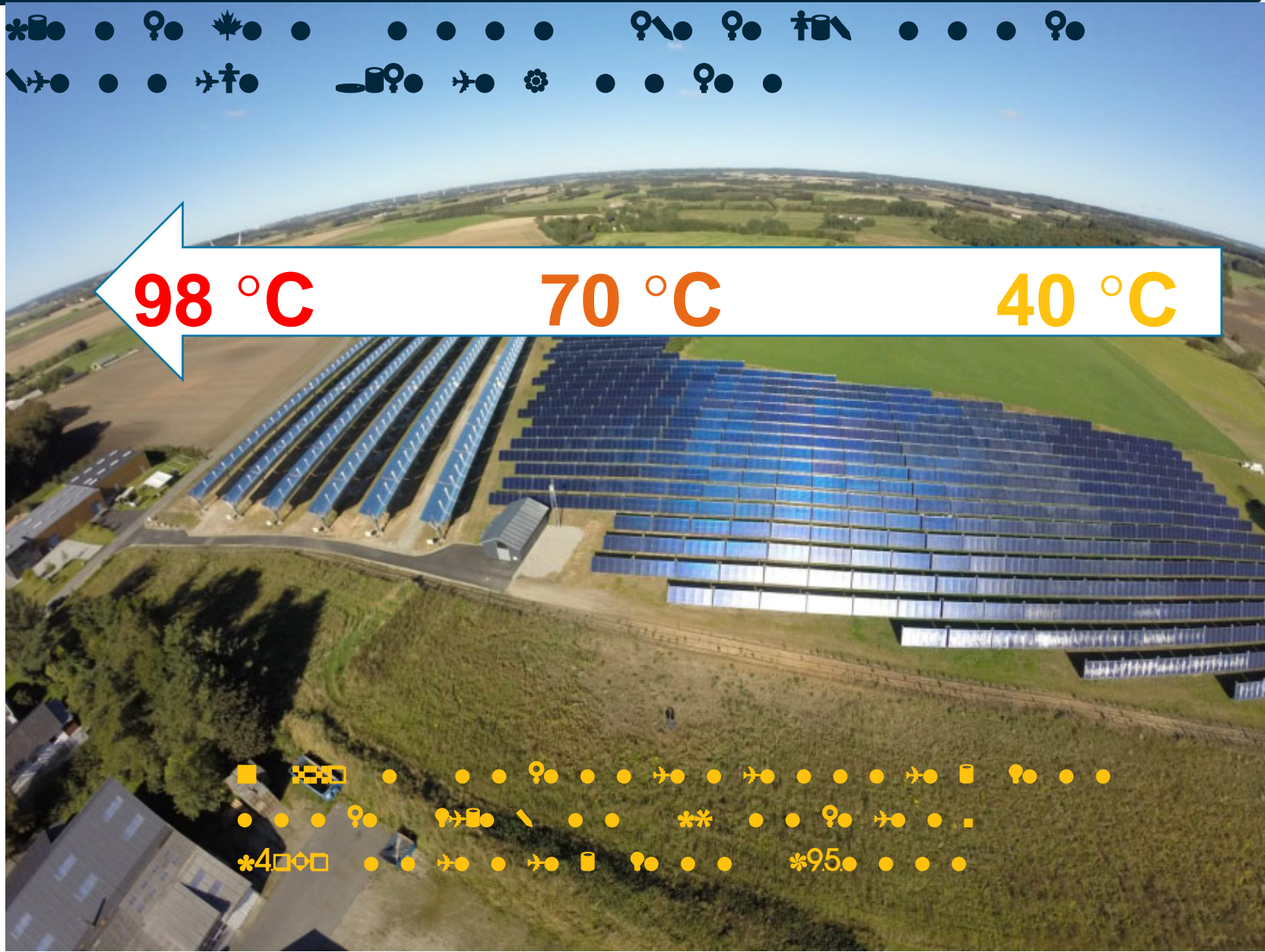


Combining the two technologies allows the district heating plant to obtain the perfect match by having the two subfields to deliver the most energy they can.

The flat plate collectors preheat the water and thereafter the CSP field "boosts" the temperature.

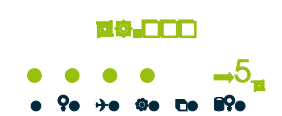
Benefits of the combination plant

- The flat panels are cheaper and good at producing heat at low temperatures.
- The CSP plant minimizes the heat losses for the flat panels and for the system.
- The CSP plant can be defocused in order to avoid overheating.
- The flat panels are installed with a tilt of 50°, which partly moves the production from summer to spring/autumn months.
- By implementing the CSP plant, the operational hours early in the morning and late in the afternoon are increased.

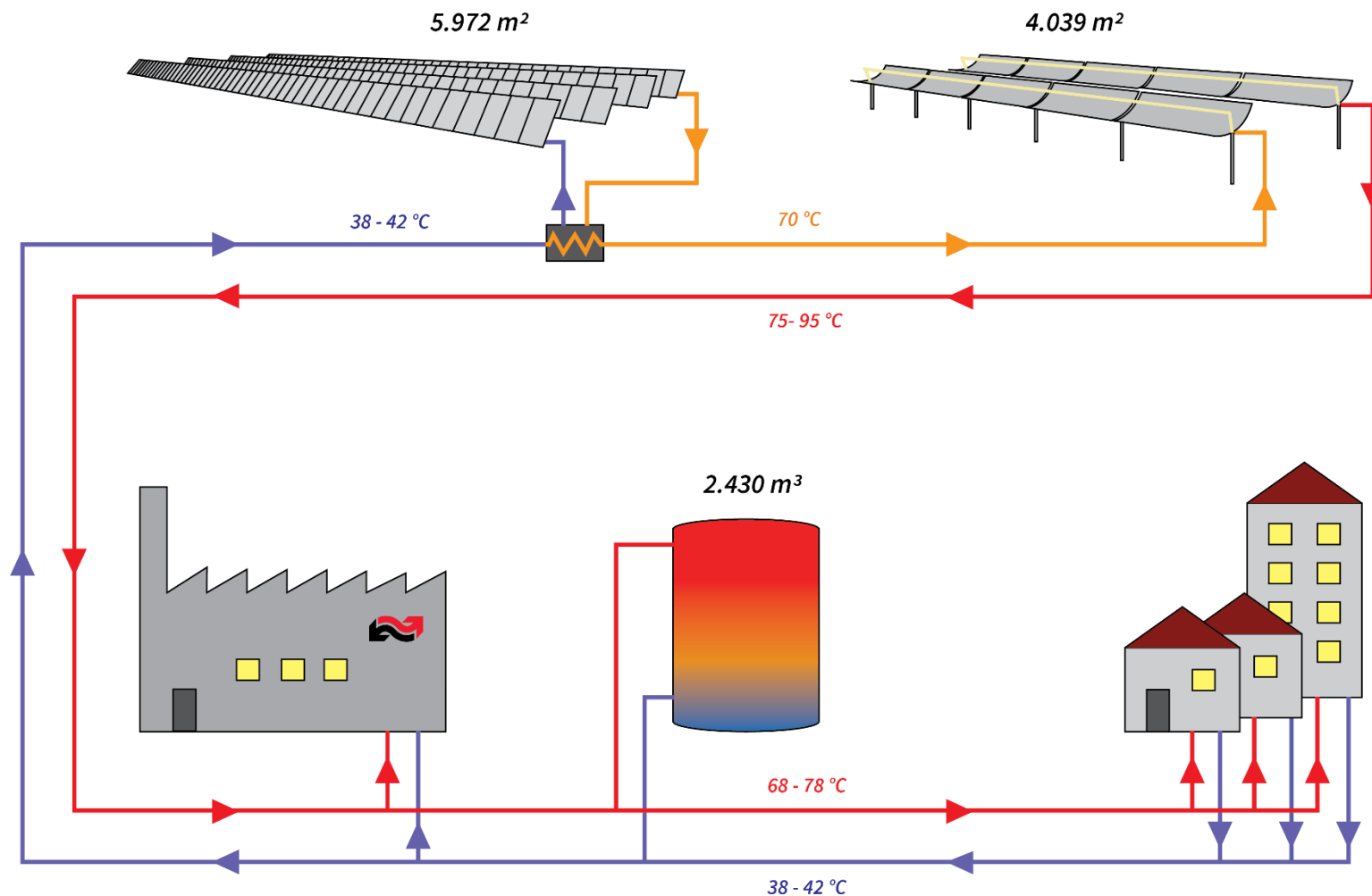


AALBORG CSP

- Changing Energy



System Flow Chart



Tårs Varmeværk

Gas Motor: Rolls-Royce B35:40 V12 11,9 MW

Heat Production $5,1 \text{ MW}_t$
Electricity production $4,9 \text{ MW}_{el}$

Gas fired boiler 1: 6 MW_t
Gas fired boiler 2: $3,1 \text{ MW}_t$

HTF CSP: District Heating Water
HTF flat plate collectors: Glycol/Water
Operation temperature after solar field: $90 - 95^\circ\text{C}$

Heat exchanger between the city and the district heating station.

Up to 30% of heat production covered by solar energy

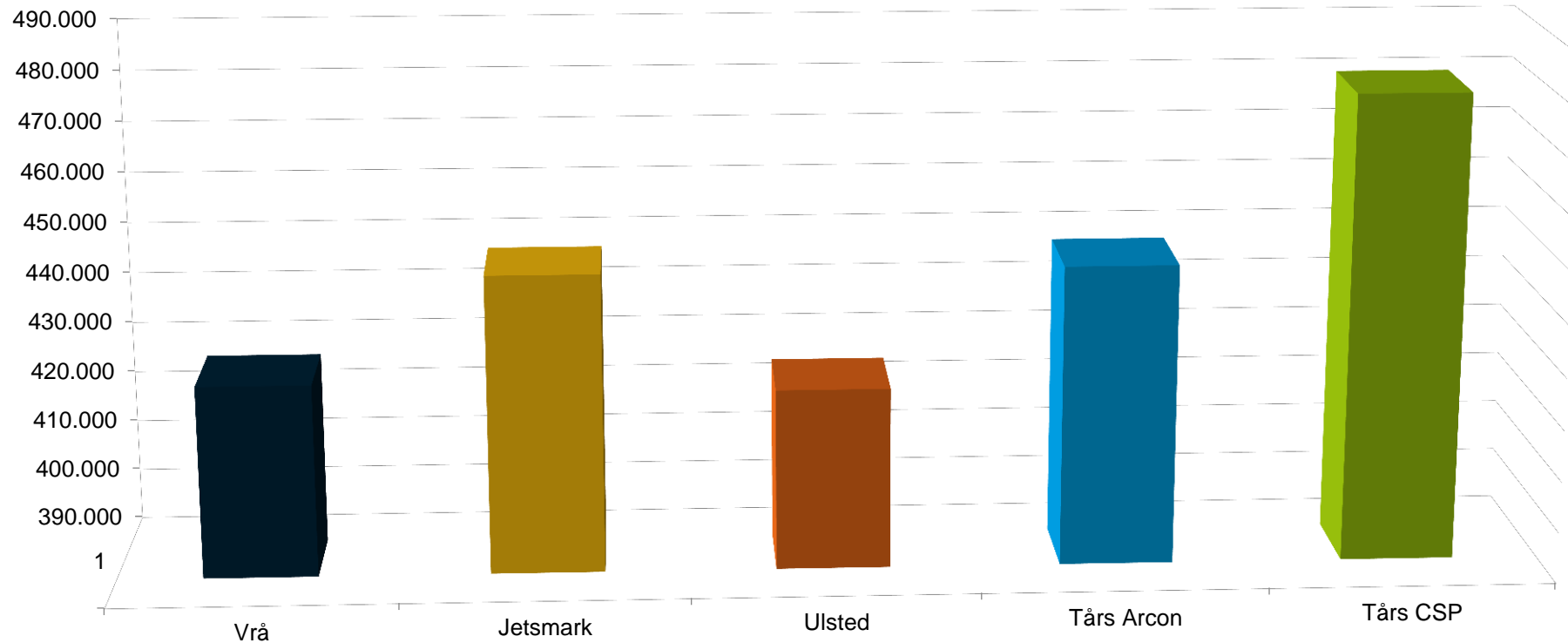


6,082 MWh annually

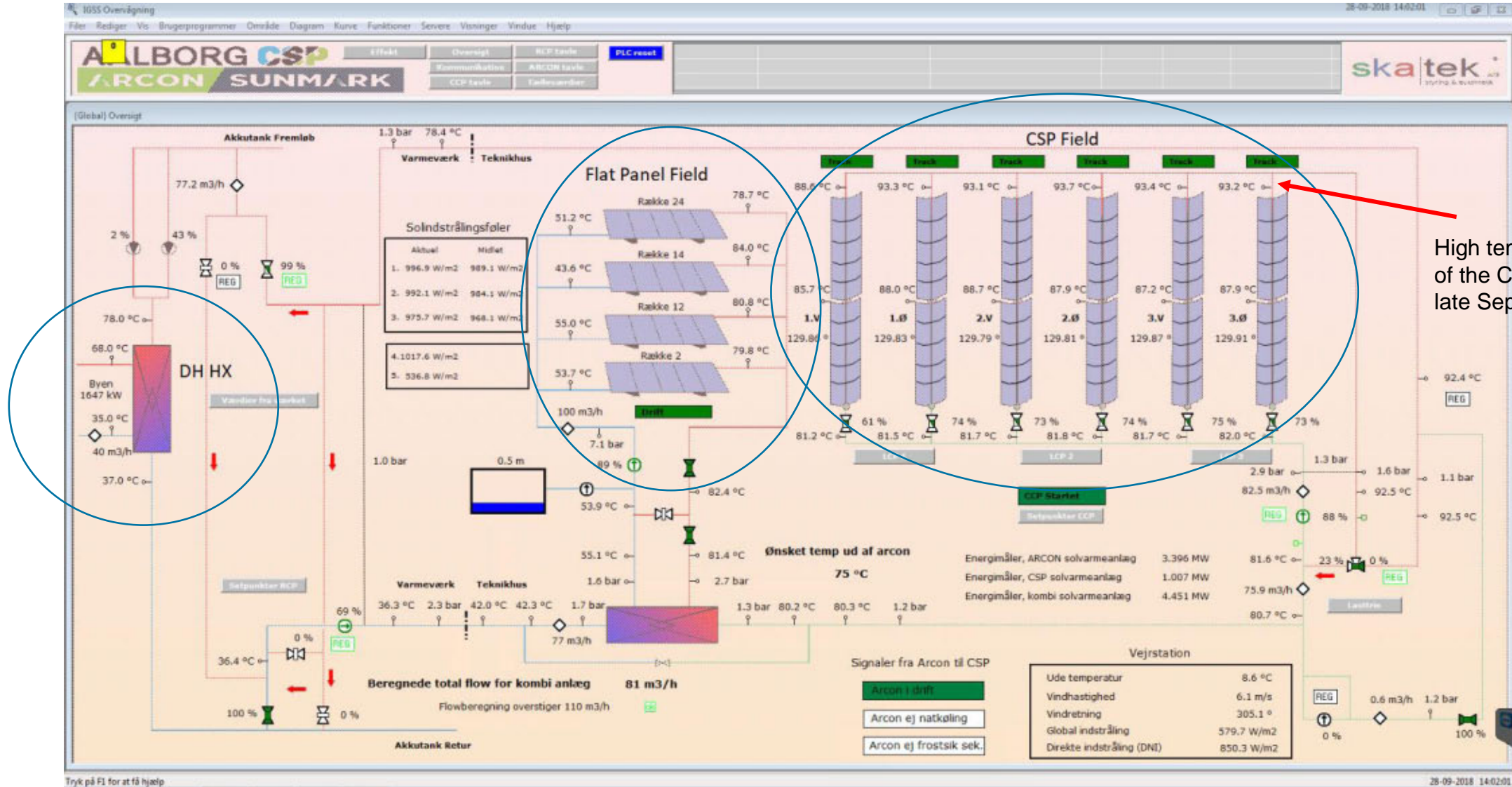


6*8*583 → 4* → 536 → 8*954

Annual output W/m²

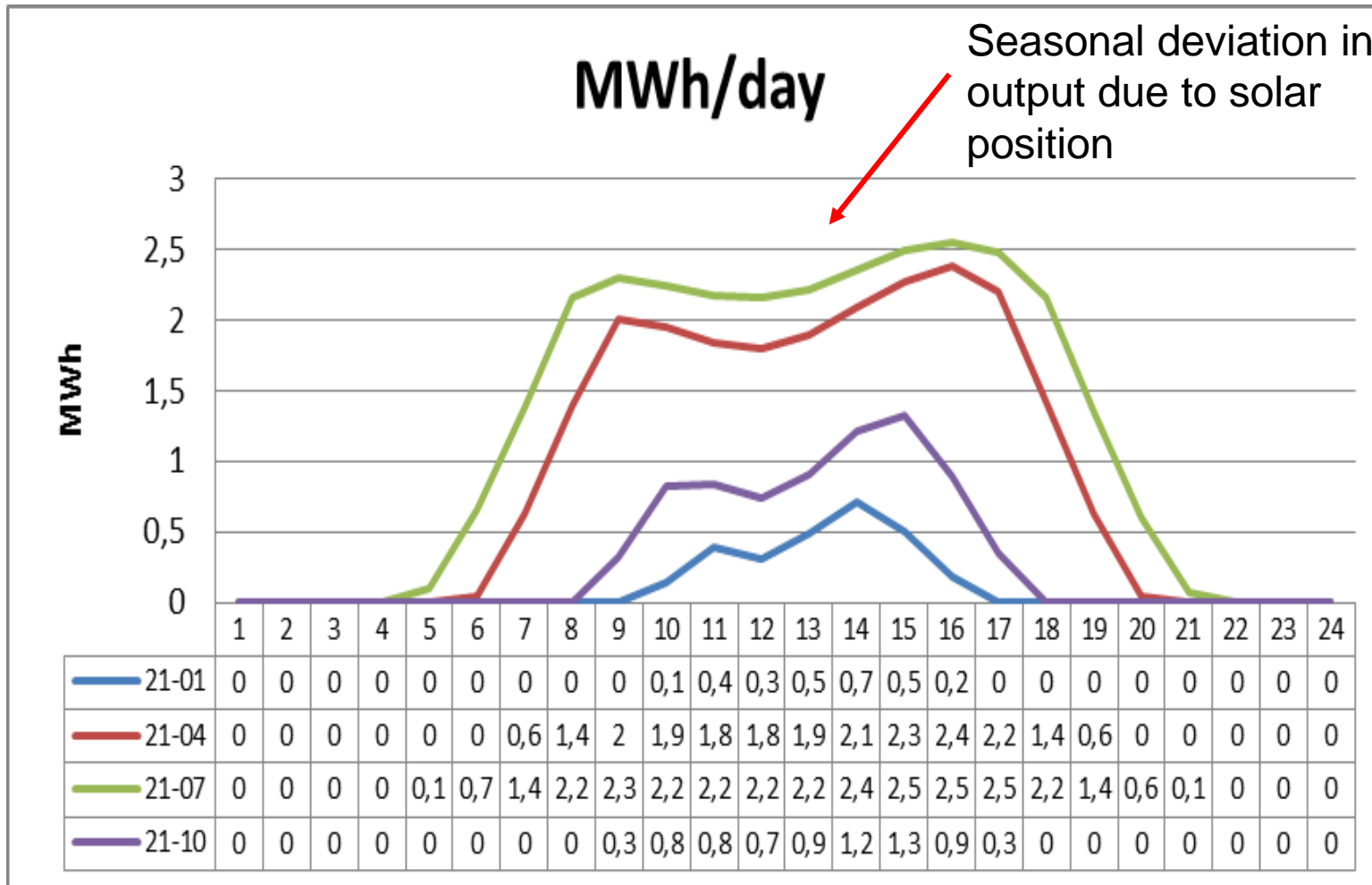


Control of Solar Field – 28/09/2018



High temperatures out of the CSP even in late September!

CSP field thermal production in different seasons

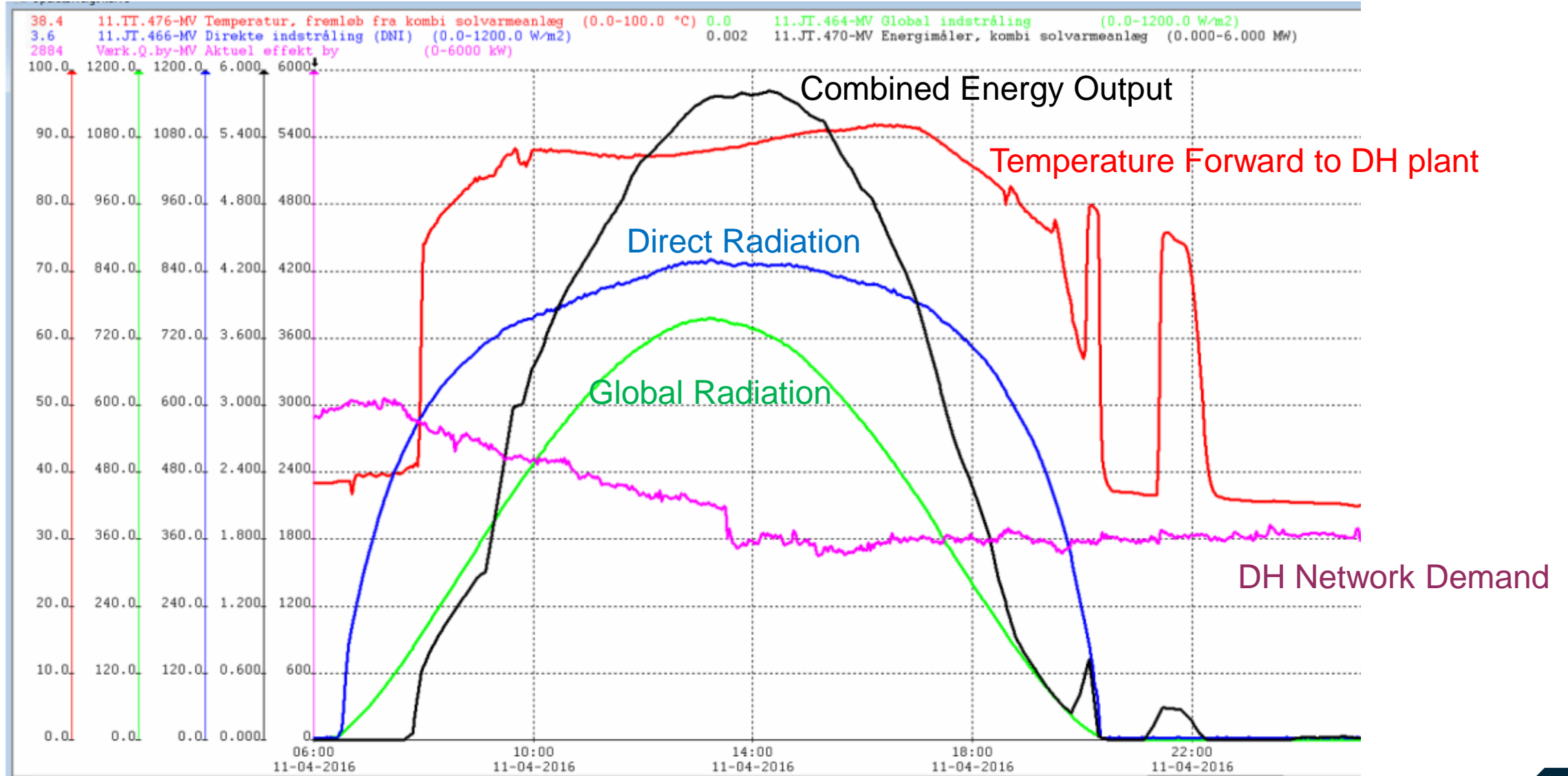


Expected thermal production on a clear day:

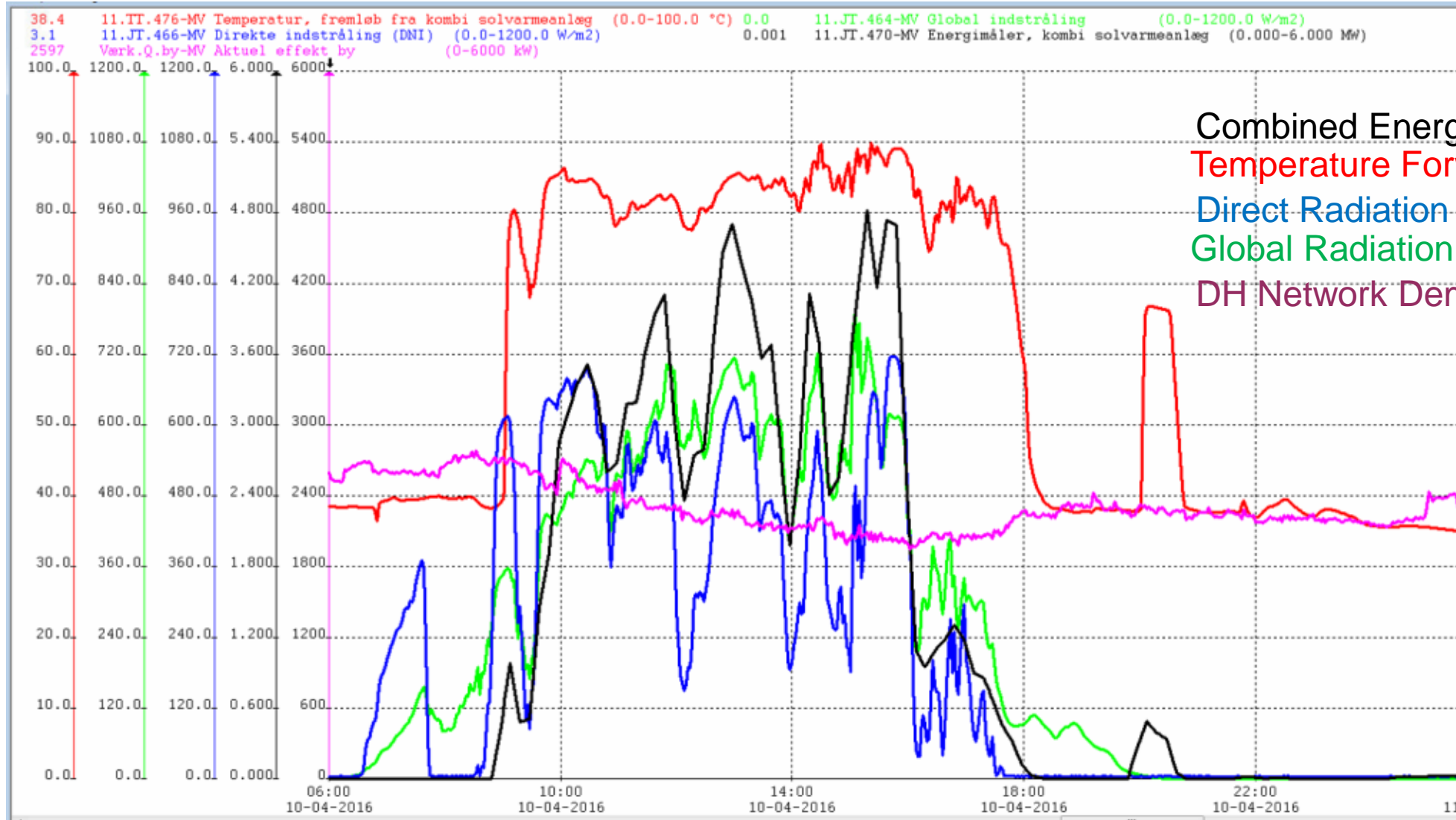
- 21 January:** 1,5 MWh
- 21 April:** 22,4 MWh
- 21 July:** 29,7 MWh
- 21 October:** 7,2 MWh

The angle of orientation of the CSP rows towards the west in relation to the North/South Axis, causes the production to be greater during afternoon hours.

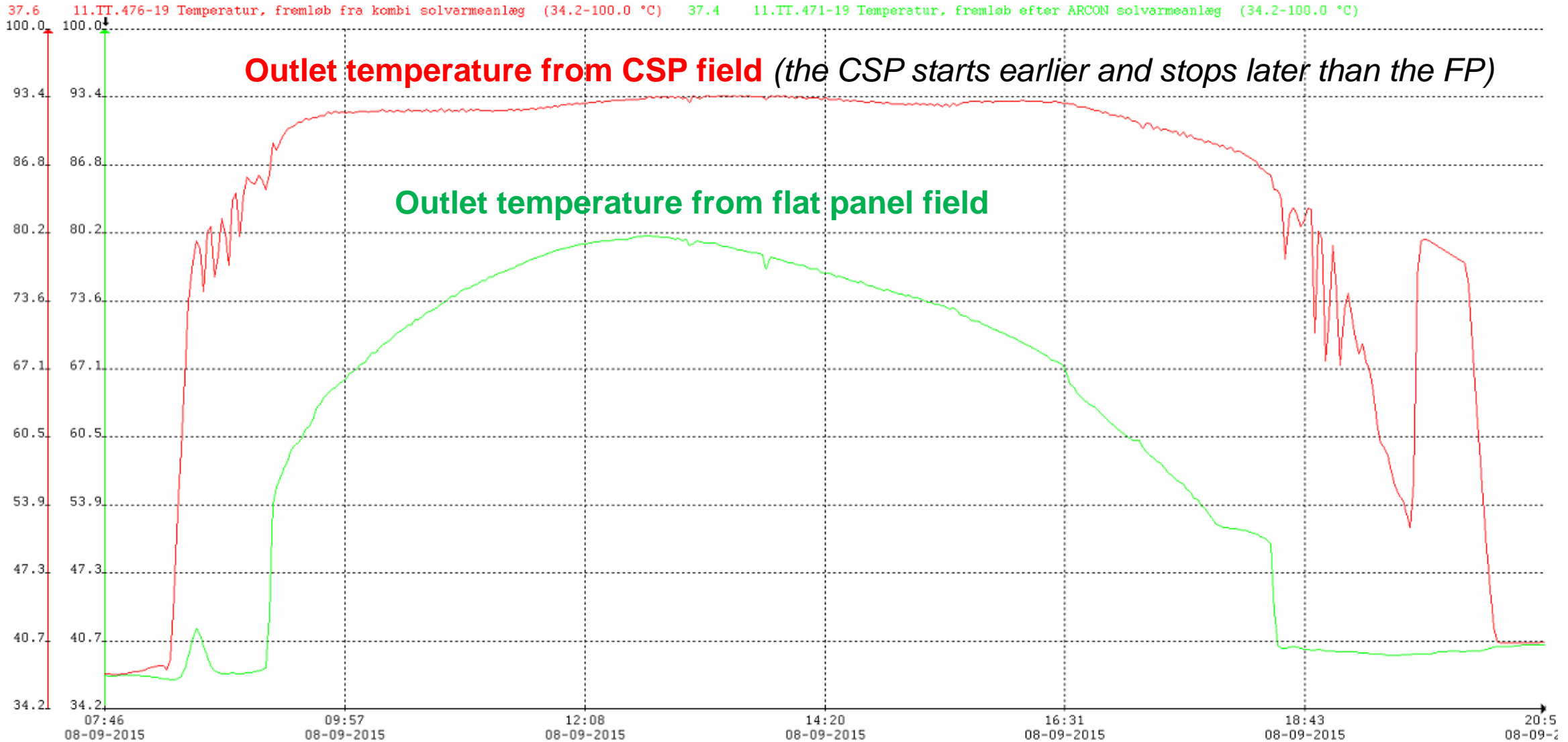
Trend curves - Tårs



Trend curves - Tårs



Temperature Profiles, °C after CSP and Flat Plate field



THANK YOU FOR YOUR ATTENTION

VISIT OUR STAND

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