

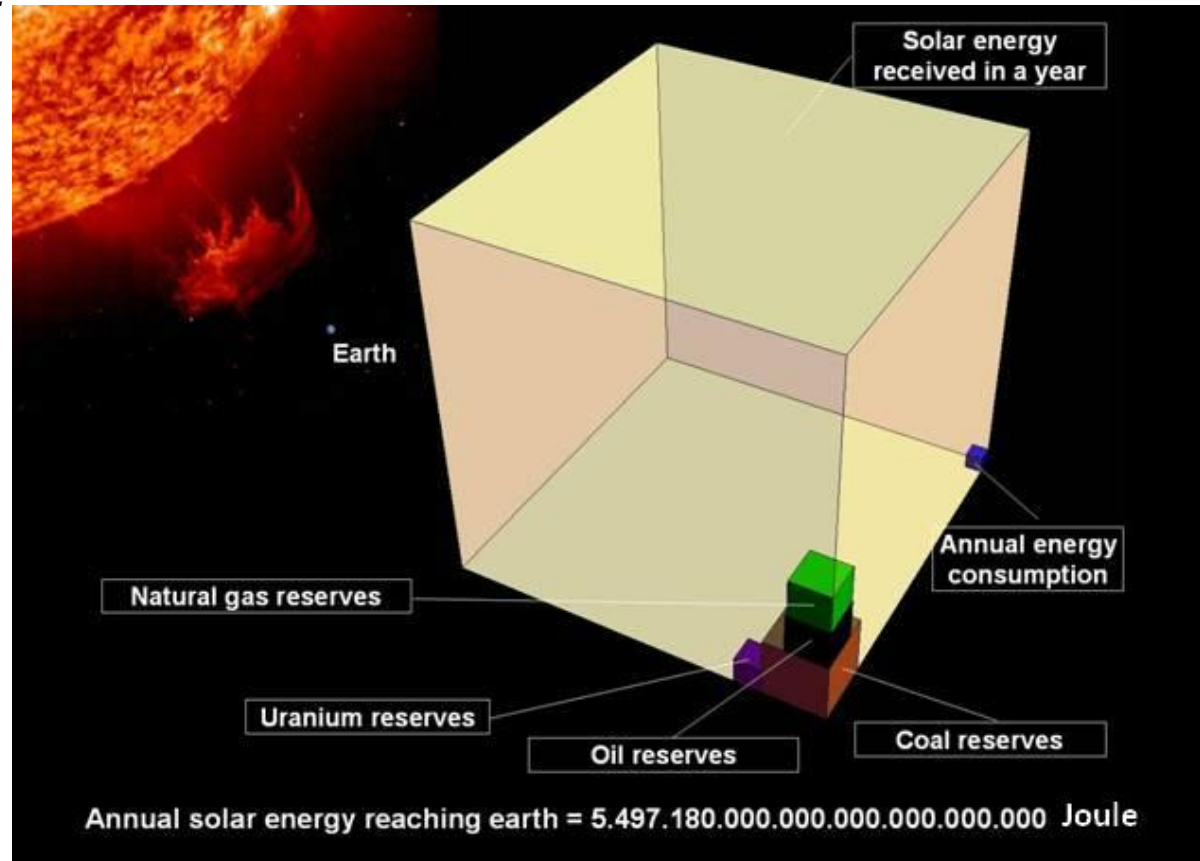
Harvesting energy
FROM THE SUN

Aalborg CSP - Commercially Viable CSH Solutions

Changing Energy for a Greener Future

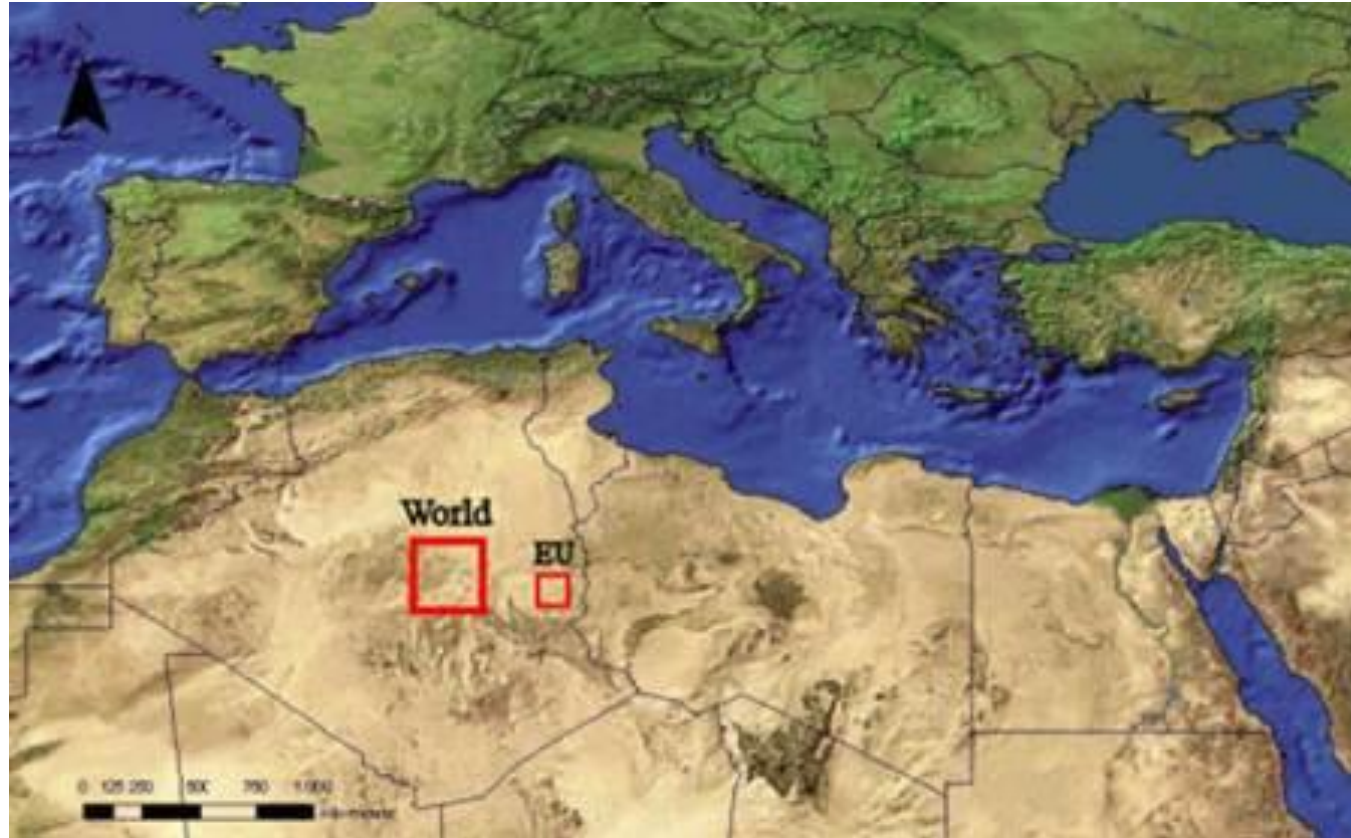
Why Solar Energy?

An abundant resource...



Why Solar Energy?

CSP in Sahara to cover global electricity demands?



VISION & MISSION

Changing energy = lowering cost for a greener future

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.

BUSINESS AREAS & TECHNOLOGIES

Claim market leadership by pursuing "cost & performance leadership position" through partnerships



CSP power plant technologies

- DSG Solar tower receiver (direct steam)
- MSR Solar tower receiver (molten salt)
- Steam generator system (thermal oil)
- Steam generator system (molten salt)
- Fresnel steam island



Integrated Energy Systems

Novel configuration of renewable technologies with CSP acting as focal point of the system to holistically satisfy multiple energy demands:

- ✓ heating
- ✓ clean water
- ✓ electricity
- ✓ process steam
- ✓ cooling



Solar district heating

- CSP troughs
- Flat panels
- Combination plants
- Accumulation tank



Thermal Energy Storage (TES)

- MSR technology
- Oil-To-Salt HX
- Direct-steam-to/from-concrete storage
- Storage for CSP plants with thermal oil
- R&D – Next Gen Thermal storage technologies



Industrial CSP solutions

- Sun-powered process steam production
- Sun-powered hot water production
- Solar electricity
- Solar desalination
- Solar cooling

Strategic driver past 5 years – CSP industry – in transformation – no-growth stage.

Aalborg invests all available capital in new technologies, market diversification - and build partnerships for both for solar technology, and for integration of storage and associated technologies – eg. like desalination or cooling based on thermal energy.

Integrated solutions & asset-light business-model ready for high-growth stage.

MSR

SGS /HX

Industrial solar & energy storage technologies in Aalborg

Integrated Energy System & District Heating & Industrial Solar Boilers

***Technology platforms ready for
renewable market growth***

***Now require financing structures similar
to PV/LED for eg. operational lease/HPAs***



INTEGRATED ENERGY SYSTEM FOR DESERT-FARMING

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In October 2016, the world's first Integrated Energy System based on CSP - designed and delivered by Aalborg CSP - went into operation to secure sustainable operation of Sundrop Farms' greenhouse facilities in the Australian desert.

Location: Port Augusta, Australia

End user: Sundrop Farms

Status: operational

Capacity: 36 MWth

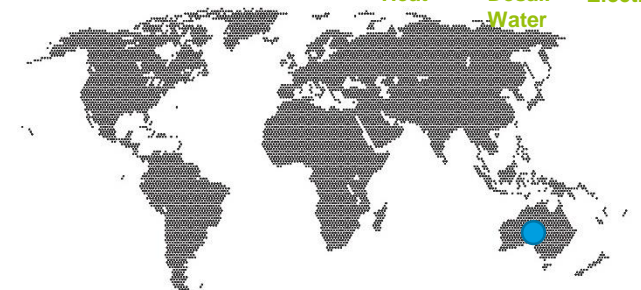
Greenhouses: 200,000 m²

Tomatoes produced: 17,000 tons / year

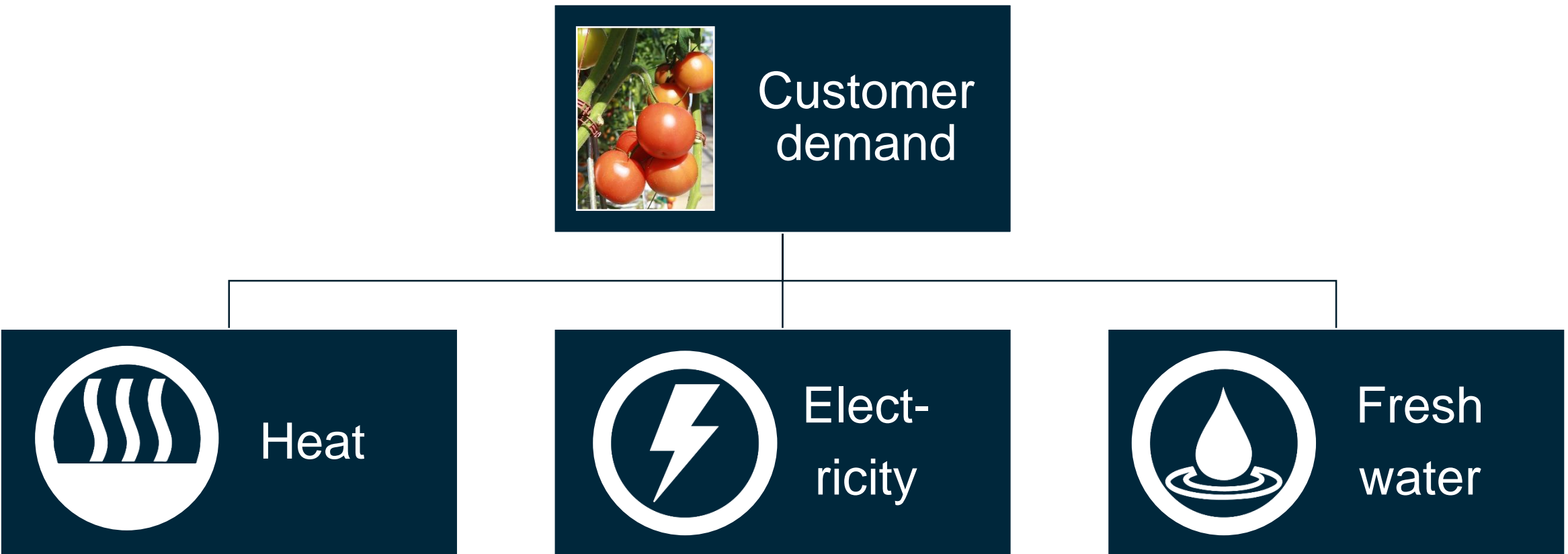
CO₂ savings: 16,000 tons / year

Final energy output:

- Heat
- Desal. Water
- Electricity

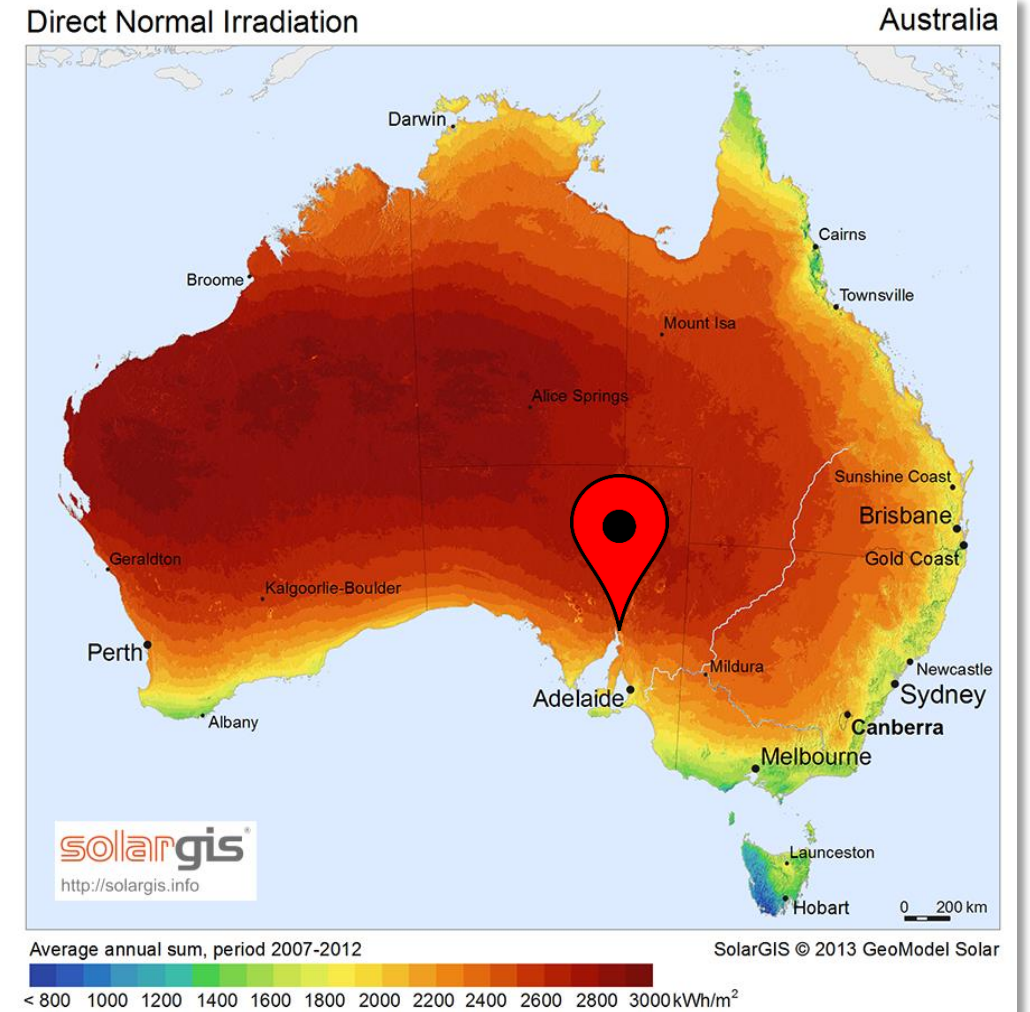
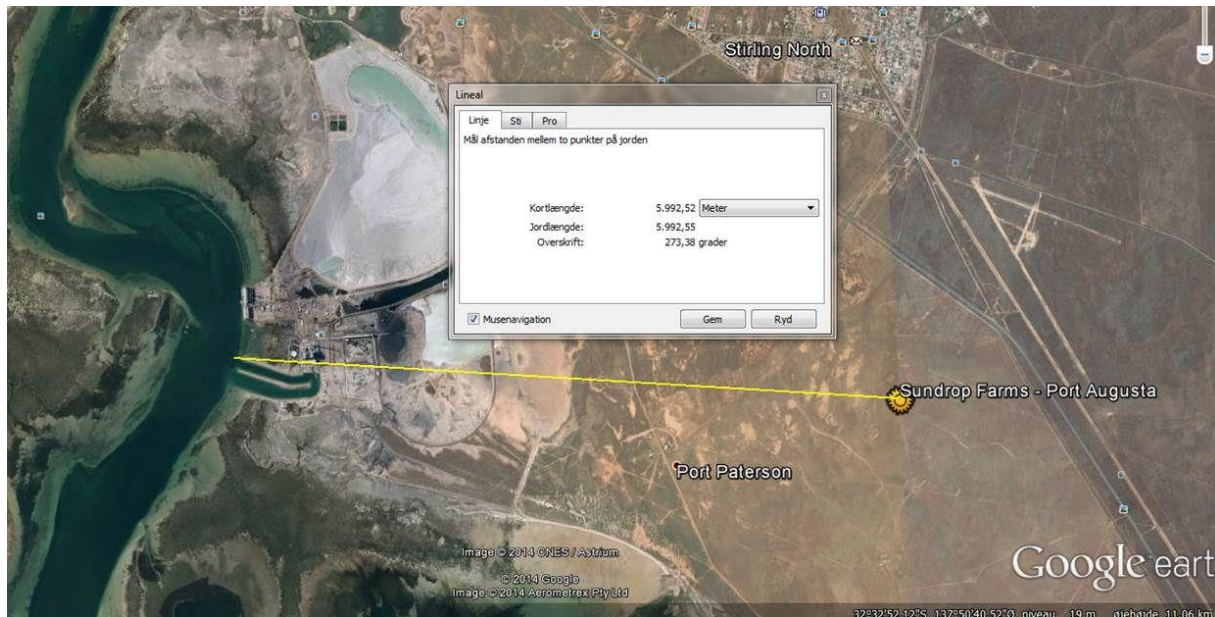


Desert farming in Australia – From idea to realization

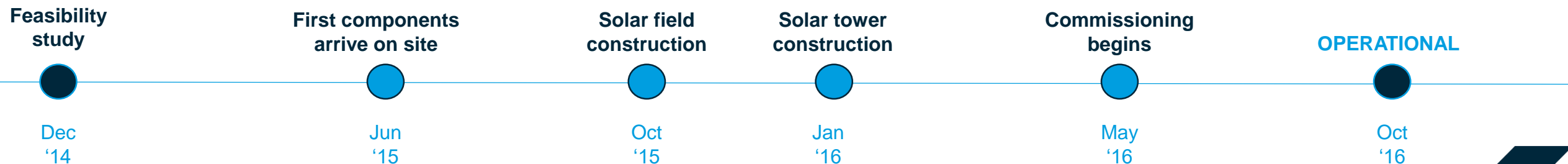
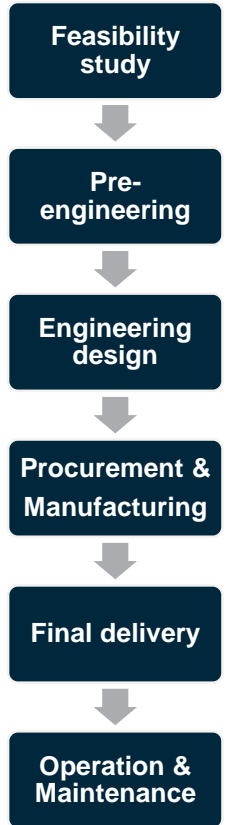


Resources to work with

- **Location:** Port Augusta, AU
- **Solar resources:** excellent DNI
- **Seawater:** 3km from site

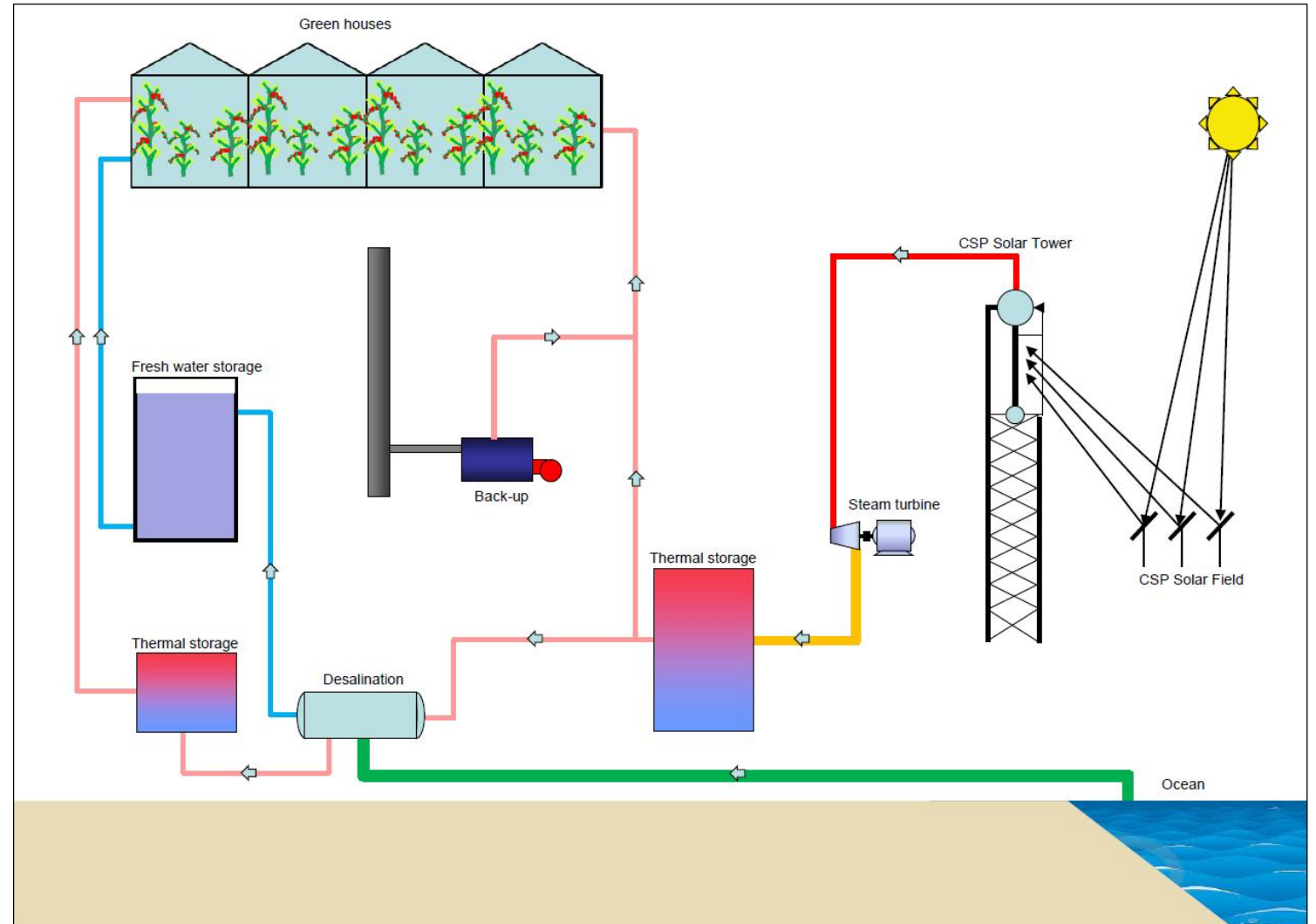


From idea to reality – in 22 months



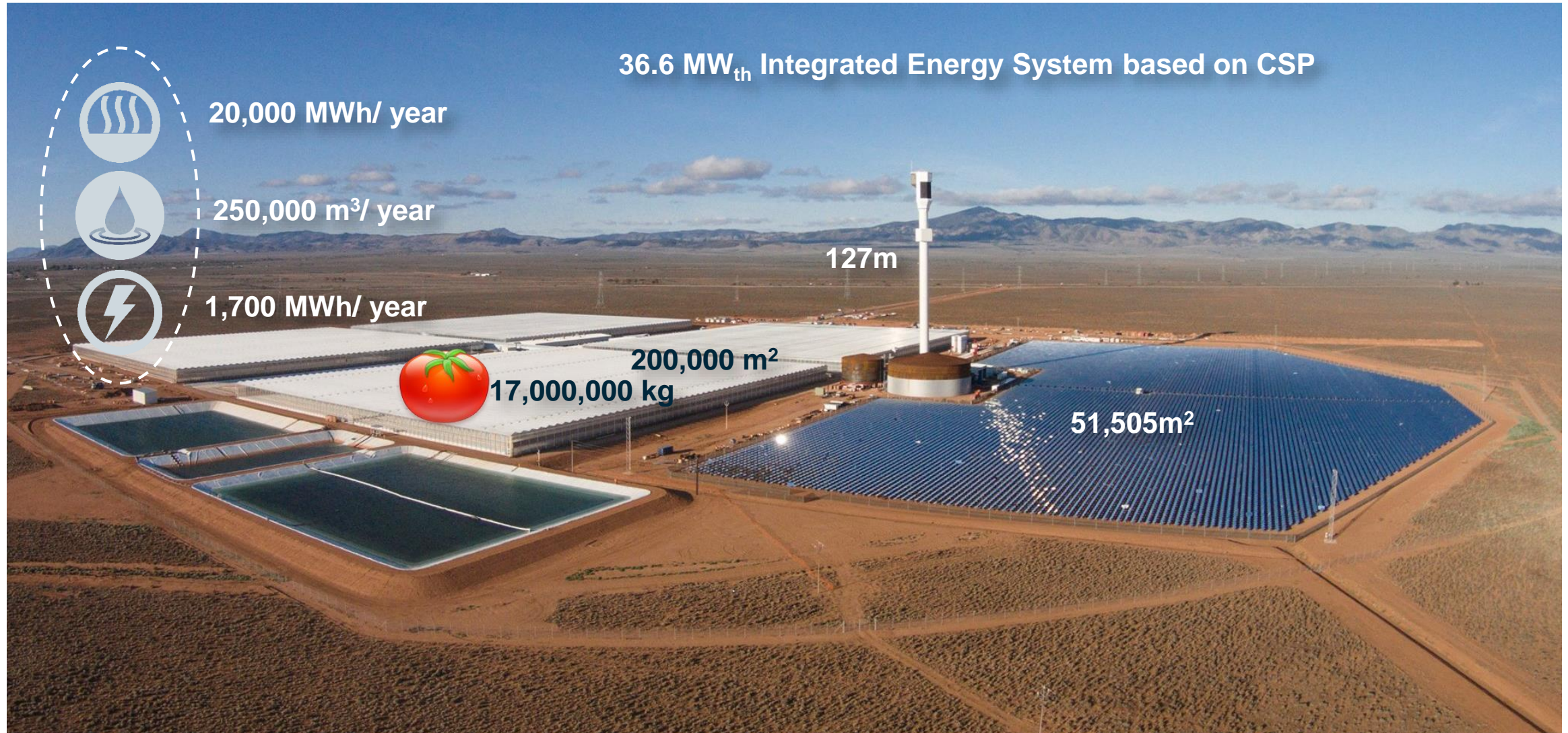
Schematic layout

- Solar field
- Tower
- Receiver and steam drum
- Steam turbine
- Thermal storages
- Desalination
- Heating for greenhouses
- Backup boiler





Operational since October 2016



CSP FOR COMBINED HEAT AND POWER

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Aalborg CSP designed and delivered a CSP system to be integrated with a biomass-organic rankine cycle (ORC) plant for combined heat and power generation – the first one in the world to combine these two technologies in a large-scale setting.

Location: Brønderslev, North of Denmark

Client: Brønderselev Forsyning

Status: operational

Capacity: 16.6 MWth

CSP aperture area: 26,929 m²

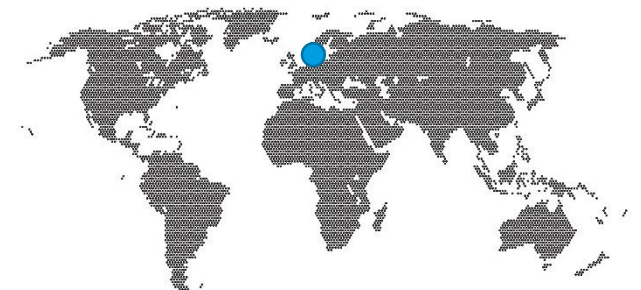
Final energy output:



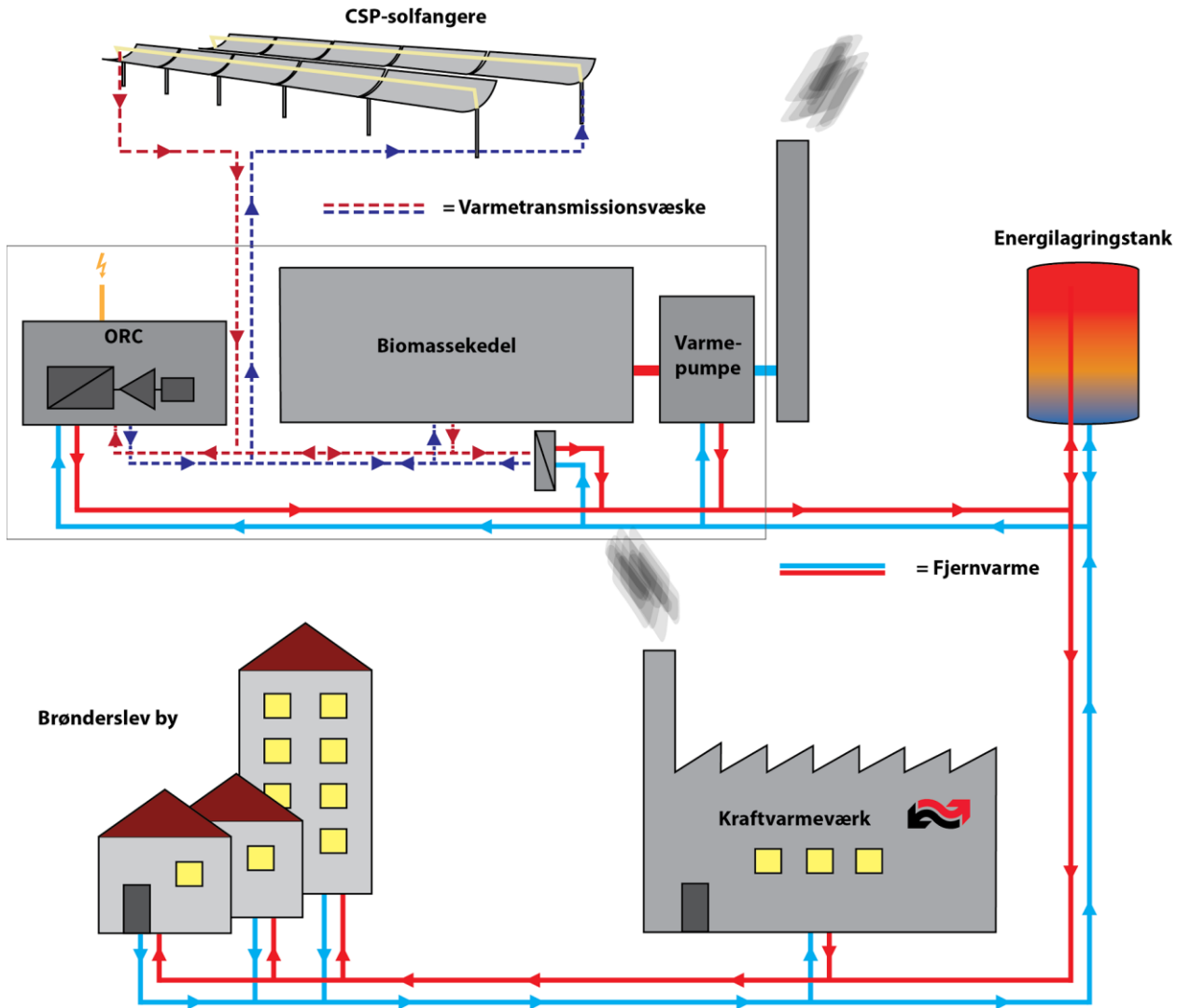
Heat



Electricity



Overview of the plant



Biomass: 2 x Euroterm
ORC: Turboden
CSP solfield:
HTF:
Operation temperature:

10 MWth
4 Mwe
16.6 MWth
Therminol 66
up to 312 °C



HYBRID – SOLAR DISTRICT HEATING

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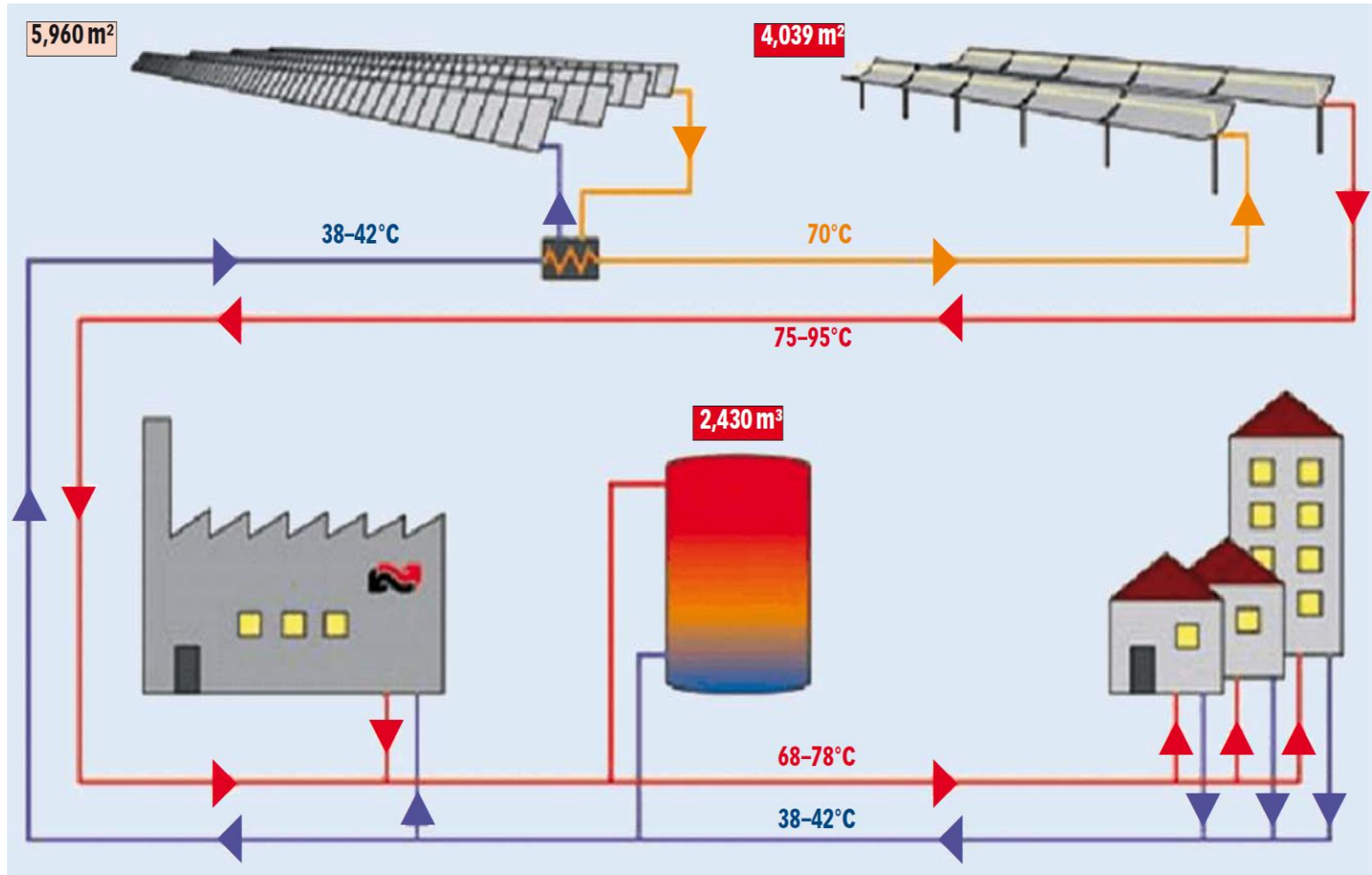
Aalborg CSP designed and delivered a Hybrid CSP system. Globally unique as it combines CSP and Flat plate collectors.

Location: Tårs, North of Denmark
Client: Tårs Forsyning
Status: Operational
Capacity: 6.8 MWth
CSP aperture area: 4,039 m²
Flat panel aperture area: 5,960 m²

Final energy output: 
Heat



Schematic overview



Tårs Forsyning

Medie CSP:	Distric heating water
Medie Flate plate collector:	30%Glycol/Water
Operation temperature:	90 - 95 °C

Up to 30% of heat production covered by solar energy



6,082 MWh annually



DISTRICT HEATING WITH FLAT PANELS



In order to reduce a Danish district heating plant's natural gas dependency as well as to stabilize energy prices, Aalborg CSP supplied a flat panel system.

Location: Havdrup, South of Denmark

Client: Solrød Fjernvarme a.m.b.a.

Status: commissioning

Capacity: 1.9 MWth

Annual heat production: 1,226 MWh

Solar energy share: 28%

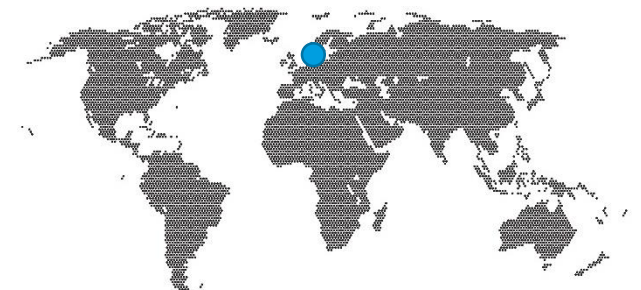
No. of households: 350

CO₂ savings: 233 tons / year

Final energy output:



Heat



THANK YOU FOR YOUR ATTENTION

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