

Changing energy

with the most efficient harvesting of the sun

Company overview and case studies
Brisbane 2016

Peter Badstue Jensen - 37 years of working experience

- Director – R&D – IES Sales – Stakeholder Member of the Board of Directors
- Project Manager International large power projects Aalborg Industries A/S
- Technical director in PT. Aalborg Indonesia, Jakarta, building a boiler workshop
- Commissioning engineer Aalborg Boilers
- Marine engineer in Dansih Navy and commercial fleet
- Boiler Smith.

My way to CSP

Welding Boilers
Operating Boilers
Selling Boilers
Designing Boilers
Selling Steam Turbines
Designing unique energy systems
Managing Power projects
Managing Boiler Companies
Founding the company

VISION & MISSION

AALBORG CSP
- Changing Energy

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 cost of energy
for our customers.



BUSINESS AREAS



CSP power plant technologies

- Solar tower receiver (direct steam)
- 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 needs for:
- ✓ heating
 - ✓ clean water
 - ✓ electricity
 - ✓ process steam
 - ✓ cooling
 - ✓ mechanical power



Solar district heating

- Solar heating
- Solar cooling



Thermal Energy Storage (TES)

- Direct-steam-to/from-concrete storage
- Storage for CSP plants with thermal oil

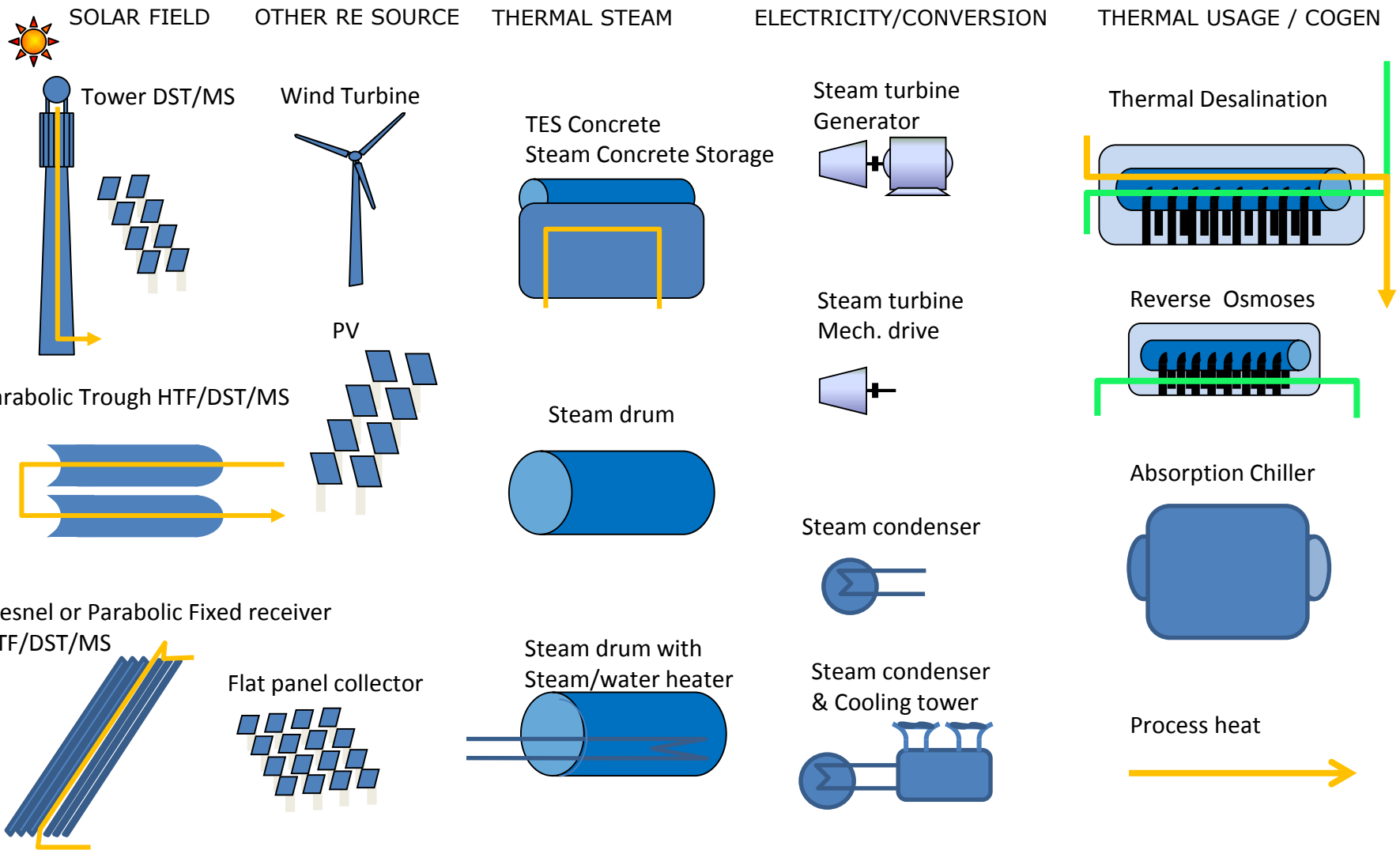
In collaboration with:



Industrial CSP solutions

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

CHANGING ENERGY



Harvesting the sun in the most efficient way

...**integrating** technologies

...to achieve **lowest possible cost** of energy

CASE 1:

The world's first Integrated Energy System based on CSP

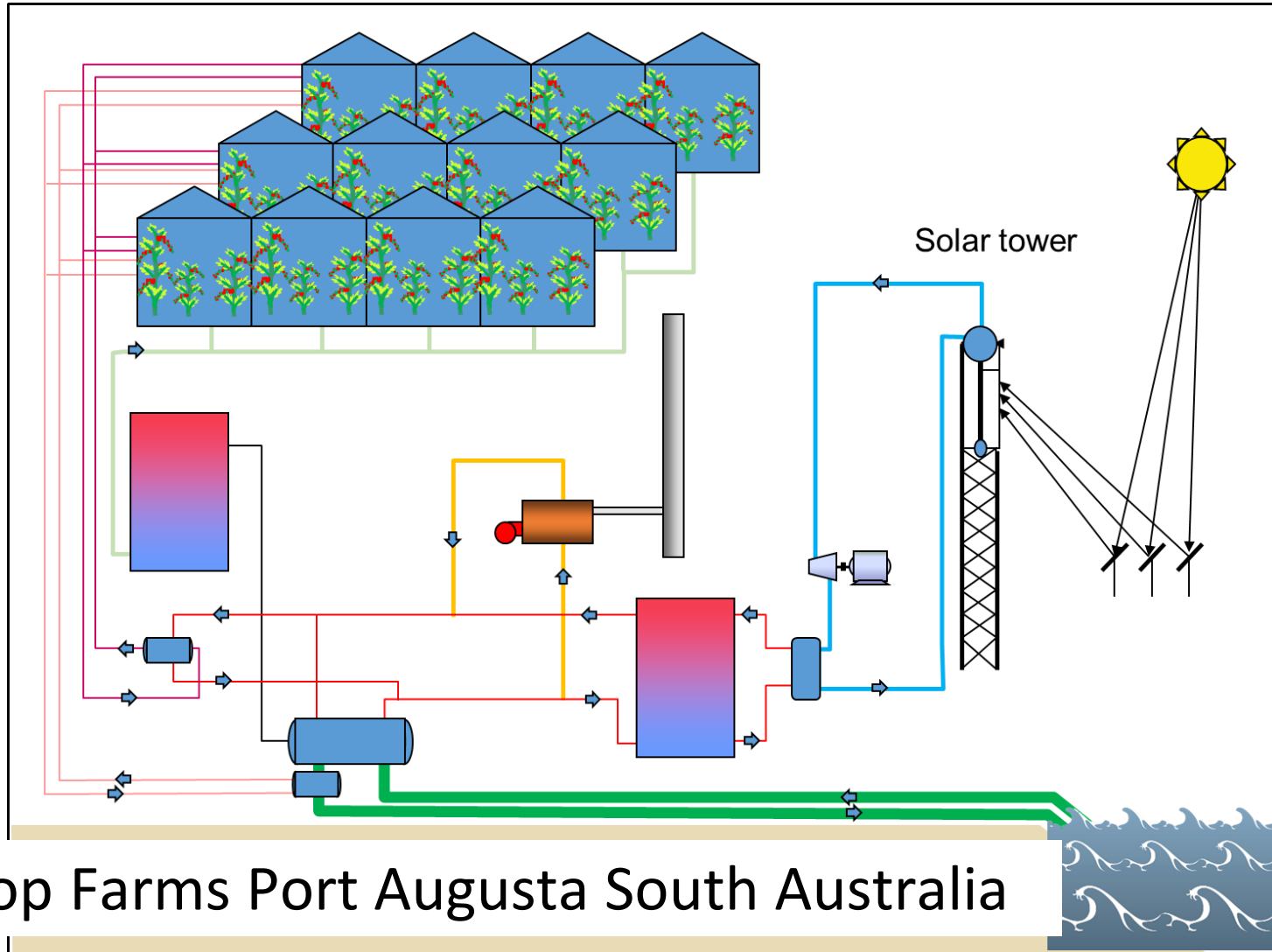


CASE 2:

Denmark's most advanced solar district heating system



CASE 1. SUNDROP FARMS



Sundrop Farms Port Augusta South Australia

CASE 1.

The world's first Integrated Energy System based on CSP

The client:

Sundrop Farms is a leader in sustainable horticulture for the arid world; growing high-value crops using seawater and sunlight



Assignment:

Sundrop Farms has contacted Aalborg CSP to develop and supply a renewable energy system based on the concentrated solar power technology to enable sustainable operation of 200.000m² greenhouses for the production of 15.000 tons of tomatoes annually in the South-Australian desert.



200.000 m²
greenhouses



15.000
tons / year

Resources to work with:

- Sun
- Seawater



Great solar resources



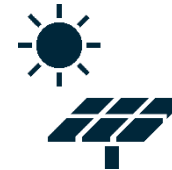
Seawater from Spencer Bay
(5km from the location)

CASE 1.

The world's first Integrated Energy System based on CSP

Pre-engineering:

- **Study:** determined technical and economical viability of the project and the scope of the system
- **Chosen technology:** CSP tower technology for direct steam generation



140.000 m²
energy system from which 51,000
m² is the solar field

Value-adding engineering design:

- **Multiple energy streams:** thermal energy is used to provide heating, fresh water and electricity
- **Year-round operation:** seasonally balanced energy system to achieve reliable operation day and night, 365 days a year
- **Lowering energy costs:** up to 80% powered by solar energy



20.000
MWh / year

Heating the greenhouses
in wintertime and on cold
summer nights



250.000
m³ / year

Desalinated fresh
water for irrigation



1.700
MWh / year

Steam turbine
periodically
produces electricity

Turnkey delivery:

- As turnkey supplier, Aalborg CSP is responsible for complete design, component deliveries, construction as well as commissioning of the plant



CASE 1.

The world's first Integrated Energy System based on CSP

Status:

- Construction phase



Expected to go operational

- Second half of 2016



CASE 2.

Denmark's most advanced solar district heating system

Status:

- Operational since August 2015



CASE 2.

Denmark's most advanced solar district heating system

The client:

Located in the northern part of Denmark, Taars Varmeværk provides district heating for Tårs, a town with 1,900 citizens.



Assignment:

Aalborg CSP was contacted by Taars Varmeværk's engineering consultant to suggest the best solar district heating system for a town with 840 households. The aim was to find the most optimal solar heating system in terms of performance and economy.



840

households

Resources to work with:

- Sun



CASE 2.

Denmark's most advanced solar district heating system

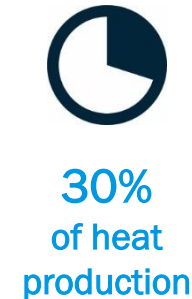
Pre-engineering:

- **Study:** determined technical and economical viability of the project and the scope of the system
- **Chosen technology:** CSP parabolic trough combined with flat panels



Value-adding engineering design:

- **Perfect match of technologies:** flat collectors preheat the water which is thereafter boosted by the CSP technology to achieve the final temperature of 98 °C.
- 30% is the highest DK city coverage by the sun.
- **No need for seasonal storage**



Turnkey delivery:

- As turnkey supplier, Aalborg CSP was responsible for complete design, component deliveries, construction as well as commissioning of the plant



SELECTED REFERENCES



PS20 Tower

Customer: undisclosed
Location, Seville, Spain
Plant Type: Tower with saturated steam
Capacity: 20 MWe
Scope: Receiver panels, Steam Drum, Installation



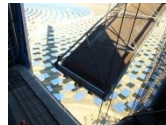
HE 1

Customer: undisclosed
Location, Ecija, Spain
Plant Type: Parabolic Trough
Capacity: 50 MWe
Scope: Steam Generator System, Turnkey installation



HE 2

Customer: undisclosed
Location, Ecija, Spain
Plant Type: Parabolic Trough
Capacity: 50 MWe
Scope: Steam Generator System, Turnkey installation



PS10 Tower

Customer: undisclosed
Location, Seville, Spain
Plant Type: Tower with saturated steam
Capacity: 11 MWe
Scope: Receiver panels, retrofit Installation



MS 4,2 MW

Customer: undisclosed
Location, Seville, Spain
Plant Type: Molten Salt Steam generator
Capacity: 4,2 MW
Scope: Steam generator system, turnkey installation



Cargo Solar Power

Customer: Gujarat
Location, India
Plant Type: Parabolic Trough
Capacity: 25 MWe
Scope: Steam Generator System,



Sundrop Farms Integrated Energy System

Customer: Sundrop Farms
Location: Australia
Plant Type: Solar tower
Capacity: 36 MWt
Scope: Turnkey system

2009

2010

2011

2012

2013

2014

2015



S1

Customer: undisclosed
Location: Seville, Spain
Plant Type: Parabolic Trough
Capacity: 50 MWe
Scope: Steam Generator System, Turnkey install.



S3

Customer: undisclosed
Location, Seville, Spain
Plant Type: Parabolic Trough
Capacity: 50 MWe
Scope: Steam Generator System, Turnkey installation



S4

Customer: undisclosed
Location, Seville, Spain
Plant Type: Parabolic Trough
Capacity: 50 MWe
Scope: Steam Generator System, Turnkey installation



Greenway Tower

Customer: Greenway CSP
Location, Mersin, Turkey
Plant Type: Tower with superheated steam
Capacity: 4 MWth
Scope: Receiver panels, steam system, engineering



Godawari

Customer: Lauren
Location, Godawari, India
Plant Type: Parabolic Trough
Capacity: 50 MWe
Scope: Steam Generator System,



Taars District Heating

Customer: Taars FV
Location, Taars, DK
Plant Type: Parabolic Trough + Flat panels
Capacity: 2,5 MW
Scope: Parabolic trough system



Brønderslev District Heating

Customer: Brønderslev FV
Location, Brønderslev, DK
Plant Type: 800Kw Parabolic Trough
Capacity: MWe
Scope: Parabolic trough system

GLOBAL PRESENCE

AALBORG CSP
- Changing Energy



Headquarters:

Denmark
Hjulgagervej 55,
Aalborg
9000

Other sales and service locations:

Spain
The United States
Kenya
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Australia

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Feasibility studies

R&D in Aalborg CSP

Concrete Storage Steam and Thermal oil
Foil Heliostats lowering cost
Molten Salt receivers and storage
Standardization and ESCO models
Parabolic Troughs
Integration of flat panels
Storing and retrieving electricity as
thermal energy.