

**HARVESTING ENERGY**  
*from renewable sources*

**Boosting the Green Transition – Obtain more Energy by Integrating Green Technologies**

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**AGENDA:**

- 1. *Aalborg CSP Introduction***
- 2. *Integrated Energy Systems – Solar Thermal & Heat Pump & Storage***
- 3. *Long-term (seasonal), Pit Thermal Energy Storage (PTES)***
- 4. *Engineering services, EPC / EPC-M, Owners Engineering***

# ***1. Aalborg CSP Introduction & Selected References***

## CHANGING ENERGY

### Our vision

To accelerate the world's renewable energy transition by making more competitive green energy solutions.



21

operational, commercial plants



5

projects under development

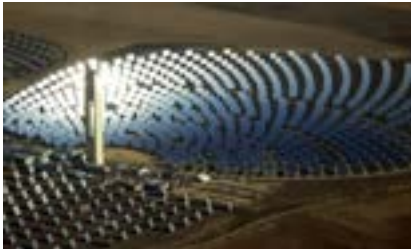


## BUSINESS AREAS



## SELECTED REFERENCES

**20MWe Direct steam solar tower receiver**



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

**10MWe Direct steam solar tower receiver**



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

**50MWe steam generation system**



Customer: Lauren  
Location: Rajasthan, India  
Plant Type: Parabolic Trough  
Capacity: 50 MWe  
Scope: Turnkey steam Generator System  
Status: Operational

**36.6MWth CSP Integrated Energy System**



Customer: Sundrop Farms  
Location: Port Augusta, AU  
Plant Type: Solar tower  
Capacity: 36.6 MWth  
Scope: Turnkey system  
Status: Operational

**6.8MWth combination plant**



Customer: Taars Varmerørk  
Location: Taars, DK  
Plant Type: Parabolic Trough + Flat panels  
Capacity: 6.8 MWth  
Scope: Turnkey delivery  
Status: Operational since

**16.6 MWth combined CSP and ORC plant**



Customer: Brønderslev Forsyning  
Location: Brønderslev, DK  
Plant Type: Parabolic Trough  
Capacity: 16.6 MWth  
Scope: Turnkey parabolic trough system  
Status: Operational

**8 MWth solar district heating system**



Customer: SK Forsyning  
Location: Halskov, DK  
Plant Type: Flat solar panels  
Capacity: 8 MWth  
Scope: Turnkey system  
Status: Operational

**3x200 Mwe thermal oil steam generator**



End user: DEWA  
Location: Dubai, UAE  
Plant Type: Parabolic trough with Thermal Oil  
Capacity: 3 x 200MWe  
Scope: Turnkey system  
Status: Under construction

**2.5 MWth integrated heat pump system**



Customer: Ørum Varmerørk  
Location: Ørum, Denmark  
Plant Type: Electrical air-to-water heat pump  
Capacity: 2.5 MWth  
Scope: Turnkey system  
Status: Operational

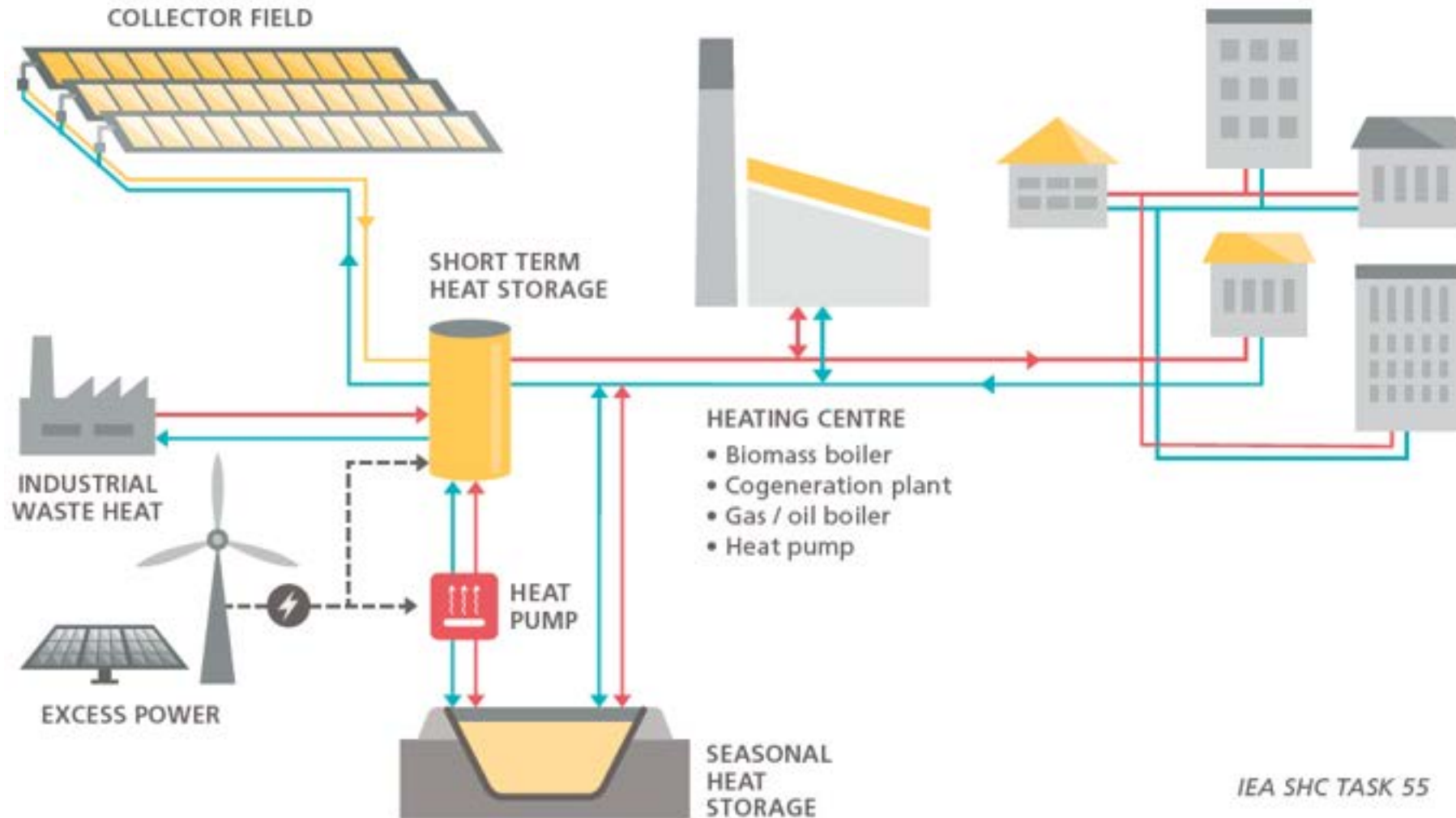
**10,000 m2 lid solution for PTES**



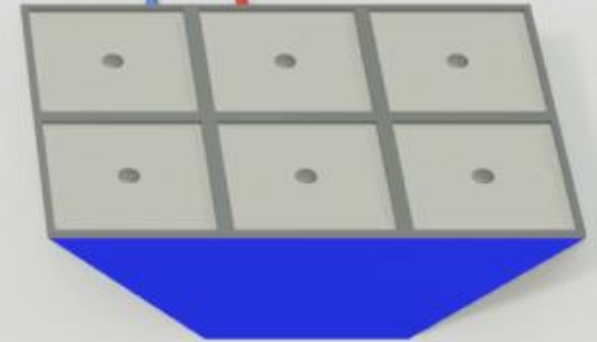
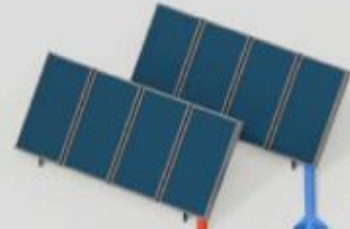
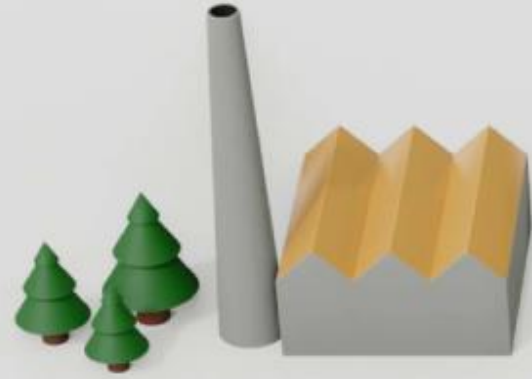
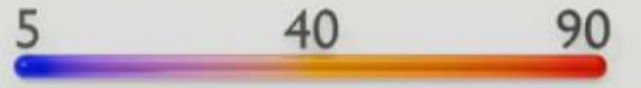
Customer: Dronninglund Fjernvarme  
Location: Dronninglund, Denmark  
Plant Type: Pit Thermal Energy Storage (PTES)  
Capacity:  
Scope: 10,000 m2 insulating lid for 70,000 m3 PTES  
Status: Under construction

## *2. Integrated Energy Systems – Solar Thermal & Heat Pump & Storage*

## Efficient, cost-effective and flexible heat delivery







Summer

**AALBORG CSP**  
- Changing Energy

## 2.5MW INTEGRATED HEAT PUMP SYSTEM

Ørum Varmeværk, Ørum, Denmark








Integrating a heat pump system into the energy supply allowed the Danish district heating plant Ørum Varmeværk to reduce the energy costs by lowering the gas consumption and by making the energy production more flexible.

The system from Aalborg CSP is integrated with an existing 6,376 m<sup>2</sup> solar field boosting its efficiency and enabling a higher level of renewable energy in the plant's energy supply.

**Location:** Ørum, Denmark **Client:** Ørum Varmeværk **Status:** Operational



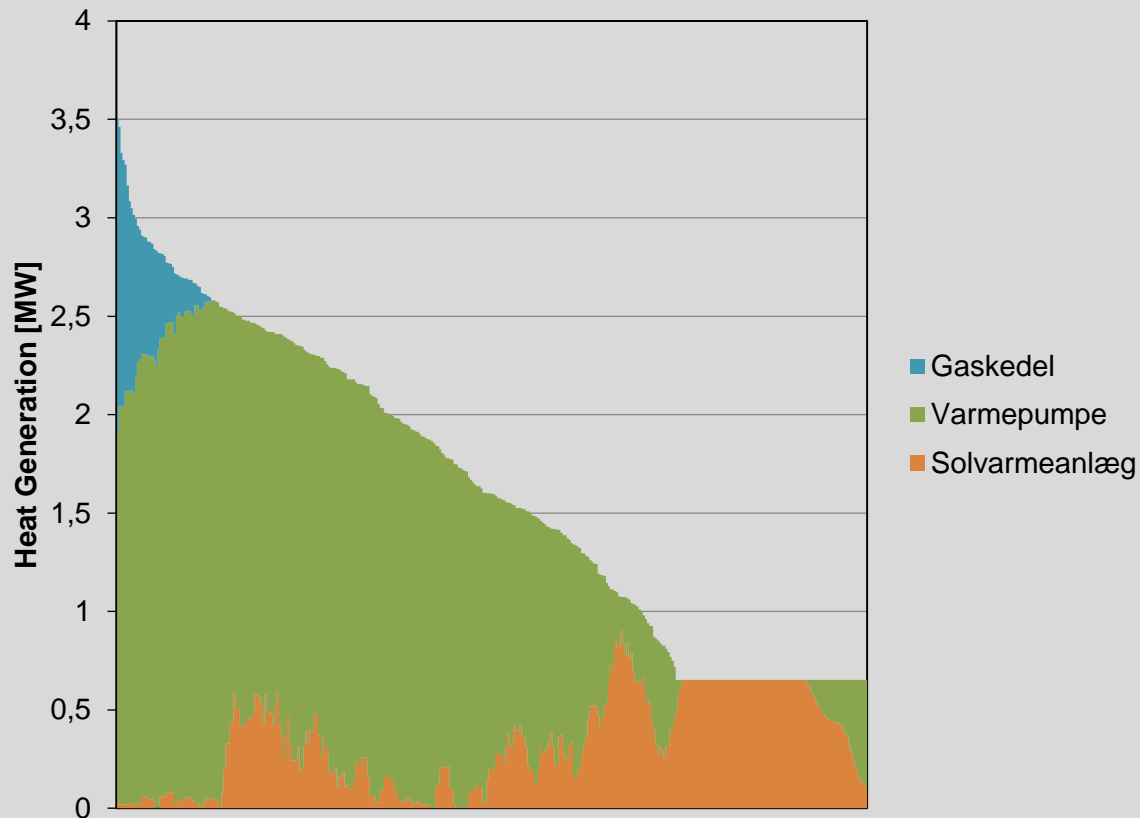
### PROJECT FACTS:

-  Refrigerant: 3,000kg ammonia
-  COP >3
-  Solar heat integration
-  Capacity: 2MW at 0°C outdoor temperature
-  End users: 696

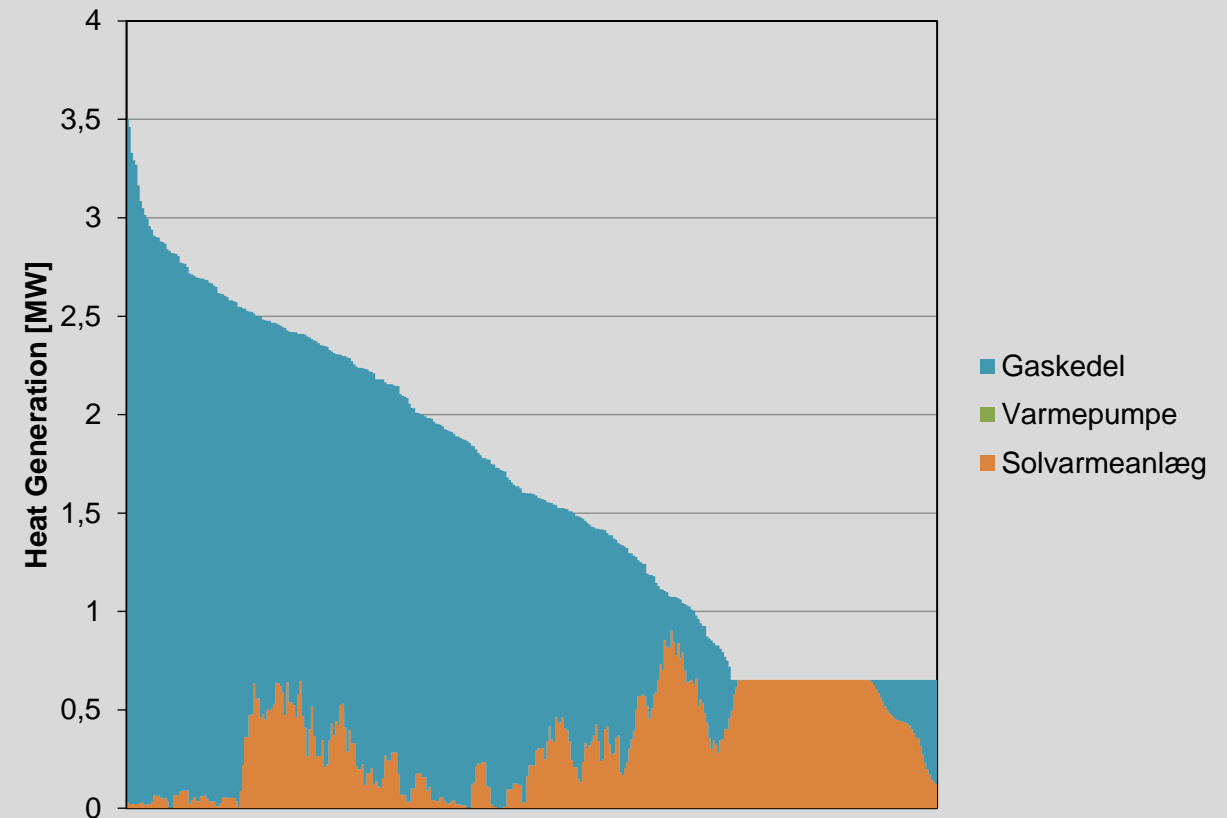


# Heat Production in Ørum, DK

Load Curve with Heat Pump

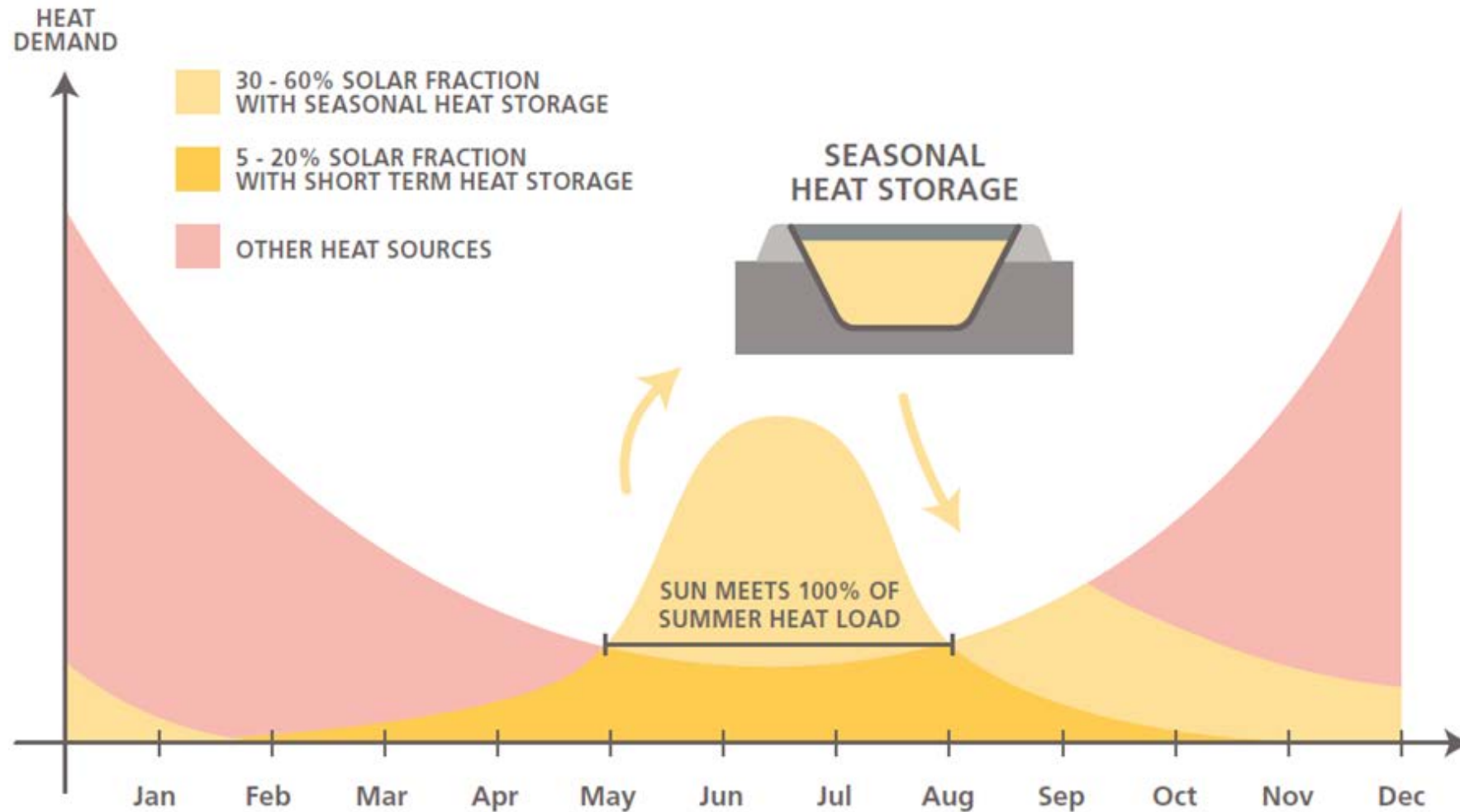


Load Curve without Heat Pump



### *3. Long-term (seasonal), Pit Thermal Energy Storage (PTES)*

## PTES - TECHNOLOGY AND FUNCTIONALITY



IEA SHC TASK 55

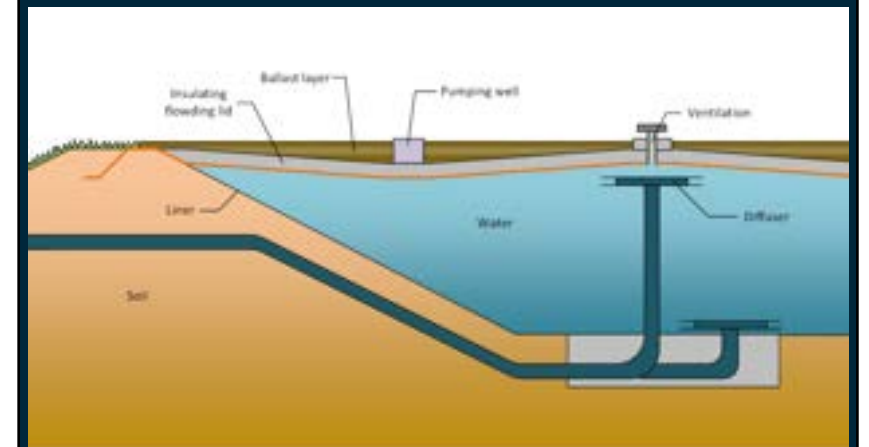
## PTES - TECHNOLOGY AND FUNCTIONALITY

### Key benefits of Aalborg CSPs Pit Thermal Energy Storage solution

- ✓ Improved efficiency of heat production as the PTES makes it possible to store excess energy produced during peak hours for later use, when there is no or limited energy generation from the sun or other fluctuating renewable energy sources.  
e.g., Excess solar heat produced and stored during summer can be released during winter
- ✓ Increased flexibility of the heat production
- ✓ Unique lid design that prevents the accumulation of moisture and allows vapour to diffuse out from the lid construction rather than accumulate inside the insulation. This helps minimize heat loss thus improving the efficiency and reliability of the storage.
- ✓ Sectionized lid design optimized for low operation and maintenance costs.
- ✓ Cost-efficient way of storing excess thermal energy as water is a cheap storage medium with a high heat capacity.
- ✓ Balance between supply and demand



Pit Thermal Energy Storage in Marstal



Principle drawing of Aalborg CSP Pit Thermal Energy Storage

***4. Engineering services, EPC / EPC-M, Owners Engineering***

# ENGINEERING SERVICES

## Feasibility studies

- ✓ Thermal performance modelling (heat and mass balance)
- ✓ System integration e.g. Thermal energy storage integration
- ✓ Conceptual design and process flow diagrams (PFD)
- ✓ Bill of materials (BoM)
- ✓ Process and instrumentation diagrams (P&ID)
- ✓ Technical specifications (pipes, valves, pumps, heat exchangers etc.)

## Pre-engineering

- ✓ Balance of plant (BoP)
- ✓ Pipe dimensioning
- ✓ Pressure drop calculations
- ✓ 3D Drawings and modelling
- ✓ Thermal stress analysis (flex calculations)
- ✓ CE-marking

## Detailed engineering

- ✓ Control and operational philosophy
- ✓ EN, ASME, PED etc. design compliance
- ✓ Project management
- ✓ Consultant services
- ✓ Feasibility studies
- ✓ Site supervision
- ✓ After sales and legal maintenance



## ENGINEERING SERVICES

### Key benefits of the Engineering Competences of Aalborg CSP

- ✓ Experience in project execution world-wide
- ✓ Leading technology integrator
- ✓ Own developed performance tool, for system integration and flexibility
- ✓ We know how success look like...



*THANK YOU FOR YOUR ATTENTION*

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