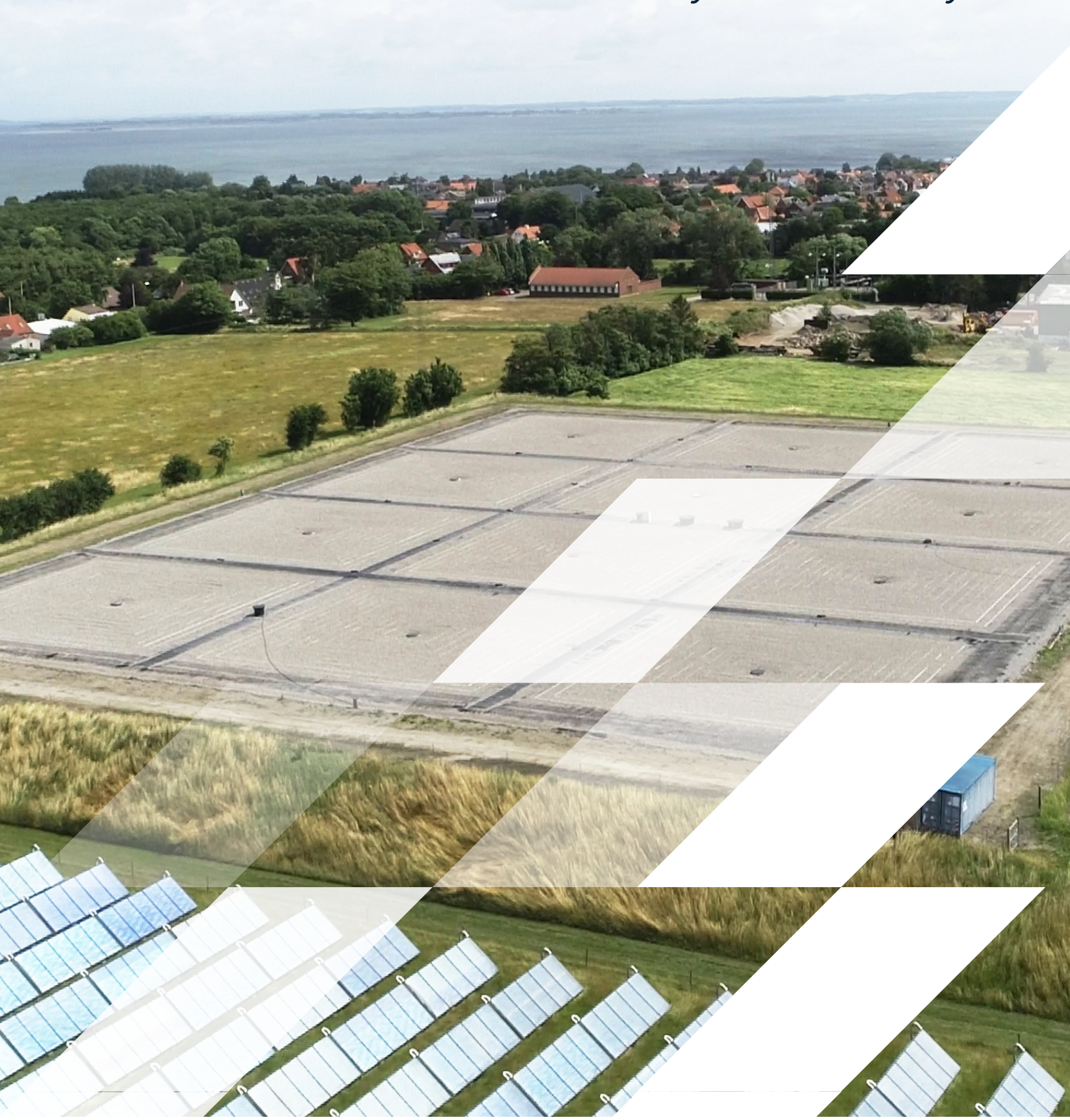


# ***PIT THERMAL ENERGY STORAGE***

*for increased efficiency and flexibility*



# INCREASED SYSTEM FLEXIBILITY

## with Pit Thermal Energy Storage

A Pit Thermal Energy Storage (PTES) is a cost-efficient way of storing excess thermal energy, as water - in addition to being a cheap storage medium - possess a high heat capacity. By integrating a PTES in the district heating supply, district heating plants and utility companies are able to collect and utilize excess energy and heat that would otherwise go to waste. This includes, among other things, excess heat from solar heating- and biomass plants or industrial processes as well as excess energy from PV (Photovoltaic) panels and wind turbines. By utilizing excess heat, the energy utilization is optimized significantly, while the system-flexibility is likewise improved. Moreover, PTES systems can decouple production and demand and thereby stabilize the energy system and minimize the expensive peak load production.

With a PTES solution from Aalborg CSP, district heating plants and utility companies will benefit from a cost-efficient energy storage as well as a durable and operationally stable lid technology, which ensures a minimum of heat loss.

PTES is a commercially proven technology, which is both scalable and cheap compared to other Power-to-X (PTX) alternatives on the market. Aalborg CSP offers supply and installation of both key components - such as PTES lids - as well as unique turnkey solutions.



Excess heat from solar heating- or biomass plants and industrial processes as well as excess energy from wind turbines and PV panels can be stored in a PTES for optimum energy utilization and increased system flexibility

Both solutions are customized to fit individual energy needs and requirements to obtain most efficient and reliable heat storage.

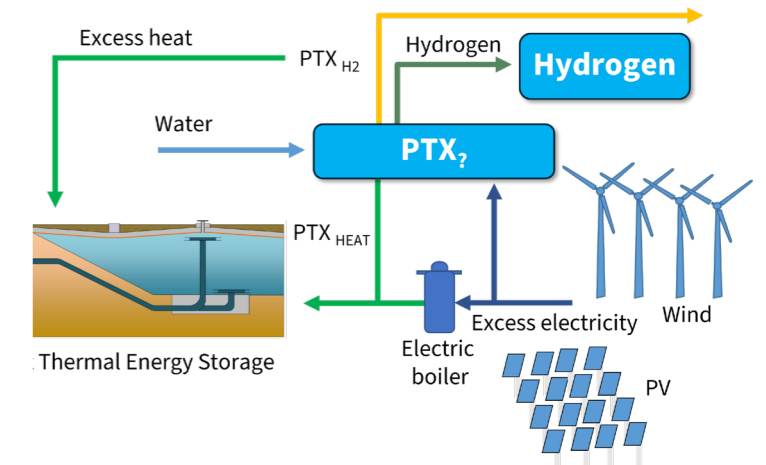
# PTX<sub>HEAT</sub> AND ENERGY STORAGE

## for efficient sector coupling

PTX with sector coupling of e.g. electricity and district heating by means of energy storage is considered one of the keys to the sustainable energy system of the future.

PTX is the general term for electricity conversion, energy storage, and reconversion pathways that use excess electricity - typically during peak periods where fluctuating renewable energy generation exceed the capacity or demand of the market. To utilize the excess electricity generated and thereby balance the grid, the renewable electricity can be converted into hydrogen - PTX<sub>H<sub>2</sub></sub> - or heat - PTX<sub>HEAT</sub>. In this connection, PTES is an ideal technology.

PTX<sub>HEAT</sub> can utilize excess heat from electrolysis in PTX<sub>H<sub>2</sub></sub> or can be integrated with energy sources such as solar, heat pumps and biomass boilers. Moreover, a PTES system can with great benefit be integrated with energy systems already containing an electric boiler. The boiler uses excess electricity from wind turbines and PV-panels to heat up water for district heating purposes and the heated water is stored in a PTES. When the electricity price is low, cooled water is extracted from the storage and heated by means of the electric boiler. Afterwards, the water is stored in the PTES once again for later use, when the demand increases. It is hereby possible to convert excess electricity to district heating - PTX<sub>HEAT</sub> - and thus utilize the fluctuations in electricity prices to achieve optimum system flexibility.



Principle diagram of PTX in combination with a PTES system

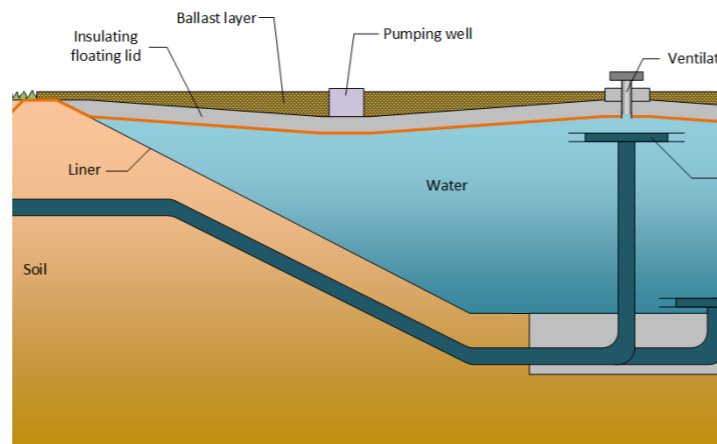
# OPTIMUM ENERGY UTILIZATION

## through storage of excess heat

A Pit Thermal Energy storage is a large water reservoir used for storing thermal energy. The reservoir is lined with a water-proof plastic lining to retain heat and prevent water from leaking out into the surrounding soil. The top of the storage is covered by a floating insulating cover used for retaining the heat and keeping rainwater from entering the storage.

Excess heat from solar heating- and biomass plants and industrial processes as well as energy from wind turbines and PV-panels can be used for heating up the water inside the PTES to approx. 80-90 °C. When the heat demand increases, cooled return-water from the district heating network is lead into the bottom of the storage, while the heated water from the top is sent out to the consumers. Heat is thus stored, when the production price is low and supplied to the consumers, when it is expensive to produce. Hereby, an optimal utilization of the energy is achieved.

A significant optimization of the energy utilization can be achieved by combining a PTES system with other energy technologies. PTES systems are therefore ideal in co-operation with other renewable heat sources such as solar heating plants, biomass boilers and heat pumps.



Principle diagram of Aalborg CSP's PTES solution

### BENEFITS OF PTES INTEGRATION

- Utilization of excess heat and energy
- Increased system flexibility
- Cost-efficient energy storage
- Can be integrated with heat sources such as: excess heat, solar-, biomass- and heat pump technologies
- Can be used as both cold- and heat storage

# STABLE AND DURABLE LID

## for PTES systems

The purpose of Aalborg CSP's unique, certified lid solution is to address and solve problems and challenges while minimizing the risks typically experienced during the installation and operation of a PTES.

The durable and operationally stable lid technology prevents accumulation of air, water and moisture inside the insulation in an efficient way and is furthermore designed as a diffusion open construction. This allows for any vapor that might pass through the floating liner from the upper water levels of the PTES to diffuse out through the insulated construction. This design feature prevents vapor from accumulating and condensing inside the insulation. By making the lid a diffusion open construction, the insulation capacity of the storage is greatly improved, and the heat loss is reduced.

The lid is furthermore divided into sections for improved rainfall handling. The lid sectioning enables safe and efficient dewatering of the surface of the lid with a minimum of maintenance required. A draining system in each section of the lid leads the water to a pumping well, where the water is pumped away. Each section is designed with an inward fall toward the centre of the section, which allows for rainwater to be led away from the surface.

The inward fall is present both on top of and underneath the sections, which furthermore prevents air pockets, that would otherwise develop underneath the lid construction, from occurring. In the summer of 2021, Aalborg CSP received a Technology Qualification Certificate from Lloyd's Register declaring that the unique lid technology for PTES meets all necessary requirements in terms of design and functionality as well as sustainability. This includes a minimum lifetime of 25 years, a minimum energy loss and an availability factor of 100% without risk of stoppages. Moreover, a minimum of 90% of all materials used in a PTES are recyclable.

The certified lid design differs from other designs on the market in terms of both quality and reliability and thereby ensures lower heating prices for the consumers.

### BENEFITS OF CERTIFIED LID FROM AALBORG CSP

- Certified by Lloyd's
- Long durability
- Stable operation
- Cost-efficient
- Scalable

# CHANGING ENERGY

## *around the world*

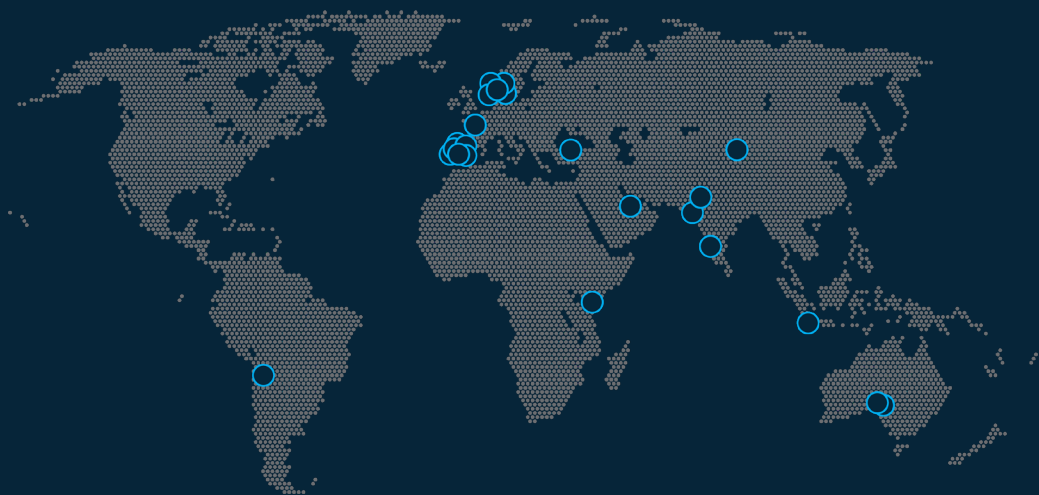
Aalborg CSP A/S is a leading developer and supplier of innovative, renewable technologies with the vision Changing Energy aiming at changing the way energy is produced and stored today. We design and supply green solutions and integrated energy systems based on solar power, energy storage within power-to-X (PTX<sub>HEAT</sub> and PTX<sub>SALT</sub>), heat exchange and much more for industries and power plants worldwide.

Since 1988, Aalborg CSP has utilized its immense expertise within design and delivery of boilers, complex systems, renewable energy technologies and energy storage. Thereby, we have a deep understanding of individual energy needs, technology- and system integration as well as optimization with key competences such as performance modelling and system design.

Aalborg CSP A/S places strong focus on R&D activities and works both internally within the company and externally with Danish and international knowledge-based companies and institutions in continuously creating innovative and sustainable technologies.

Aalborg CSP offers a wide variety of renewable energy solutions including high- and low temperature energy storage, solar panels, heat pumps, boilers, integrated energy systems as well as customized Power-to-X solutions. We match individual energy needs with the right systems and technologies and integrates and combines solutions to achieve synergies between both sectors and technologies. We do so in order to create optimum value for our clients, while also optimizing the utilization of the world's energy sources aiming for a CO<sub>2</sub> neutral future.

Headquartered in Aalborg (Denmark) and with a sales & service office in Spain, Aalborg CSP A/S has realized cost-effective green energy solutions worldwide.



**AALBORG CSP**  
- Changing Energy

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