



Battery Energy Storage Systems

# Cooling for a sustainable future

Thermal Management for Battery Energy Storage Systems

# Why Thermal Management makes Battery Energy Storage more efficient



Energy storage plays an important role in the transition towards a carbon-neutral society. Balancing energy production and consumption offers positive means for integrating renewable energy sources into electricity systems while improving overall energy efficiency. Mismatch between production and demand can easily be compensated by drawing on Battery Energy Storage Systems.

## The challenge of battery's heat generation

Ideas for new technologies are being developed every day. Nevertheless Lithium-Ion batteries continue to dominate energy storage systems due to falling battery costs and increased performance with less weight and space requirements giving better energy density compared to other battery types such as lead acid batteries. The critical factor in their use is large heat generated during operation.

## The right cooling solves the problem

Thermal management is vital to achieving efficient, durable and safe operation. The choice of the correct solution is influenced by the C-rate, the rate at which level the battery is providing energy.

Higher C-rate, more frequent cycling causes increased heat dissipation therefore an effective cooling concept is mandatory. Thermal stability is crucial for battery performance and durability - battery degradation and damage will be reduced and downtime minimized. Battery safety must be prioritized.

## Battery lifetime could be increased

Research shows that an ambient temperature of about 20°C or slightly below is ideal for Lithium-Ion batteries. If a battery operates at 30°C instead of a more moderate lower room temperature, lifetime is reduced by 20 percent. At 40°C, the losses in lifetime can be near 40 percent and if batteries are charged and discharged at 45°C, the lifetime is only half of what can be expected if used at 20°C.

## The right cooling has many advantages

### Cost savings



Up to 40% longer lifetime reduces costs

### Availability



No downtimes due to overheating

### Safety



Risk of battery damage will be reduced



# Pfannenberg Solutions

The Pfannenberg Battery Cooling Solutions maintain battery packs at an optimum average temperature. They are suitable for ambient temperatures from -30 to 55° C and thus applicable for most applications. The Pfannenberg Battery Cooling Portfolio is based on a flexible modular conception. It includes air cooled products as well as liquid cooled solutions and covers front-of meter, commercial or industrial applications.

## Customized Solutions to meet your special requirements

Additionally, Pfannenberg is able to leverage 60 years product engineering knowledge to deliver solutions bespoke to your requirements. From our advanced product range we provide a wide range of customizable cooling solutions that allow tailored temperature control of the batteries for the Energy Storage System. The C-rate will be considered so the solution operates with maximum efficiency while completely protecting your equipment.



## Perfect fit of our existing portfolio

Depending on the application and C-rate, the available range of special Pfannenberg products start from Filter Fans for small applications ranging to Chiller's liquid-cooling solutions for in-front-of-the meter applications. The Pfannenberg product portfolio is characterized by high energy efficiency, reliability and robustness.

### Small Applications C-rate low

### Large Applications C-rate high



Filter Fans

Air/Air Heat  
Exchangers

Cooling Units

Air/Water Heat  
Exchangers

Chiller

- Highly efficient
- IP 55 protection
- EMC variants

- Energy friendly
- Robustness
- Easy to install

- For -40° to +60°C
- IP 56 protection
- NEMA Type 4/4X

- Door mounted
- High air flow
- Robustness

- Customized
- Energy friendly
- Connectivity

# Pfannenberg Your Thermal Management Partner for Energy Storage Systems

- Over 60 years dedication in Thermal Management and Liquid Cooling
- Specialized portfolio tailored to the requirements of battery cooling
- Capability and flexibility to develop bespoke solutions in partnership with customers
- Global footprint with multiple own production facilities
- Experience how to maintain and support projects all over the world



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