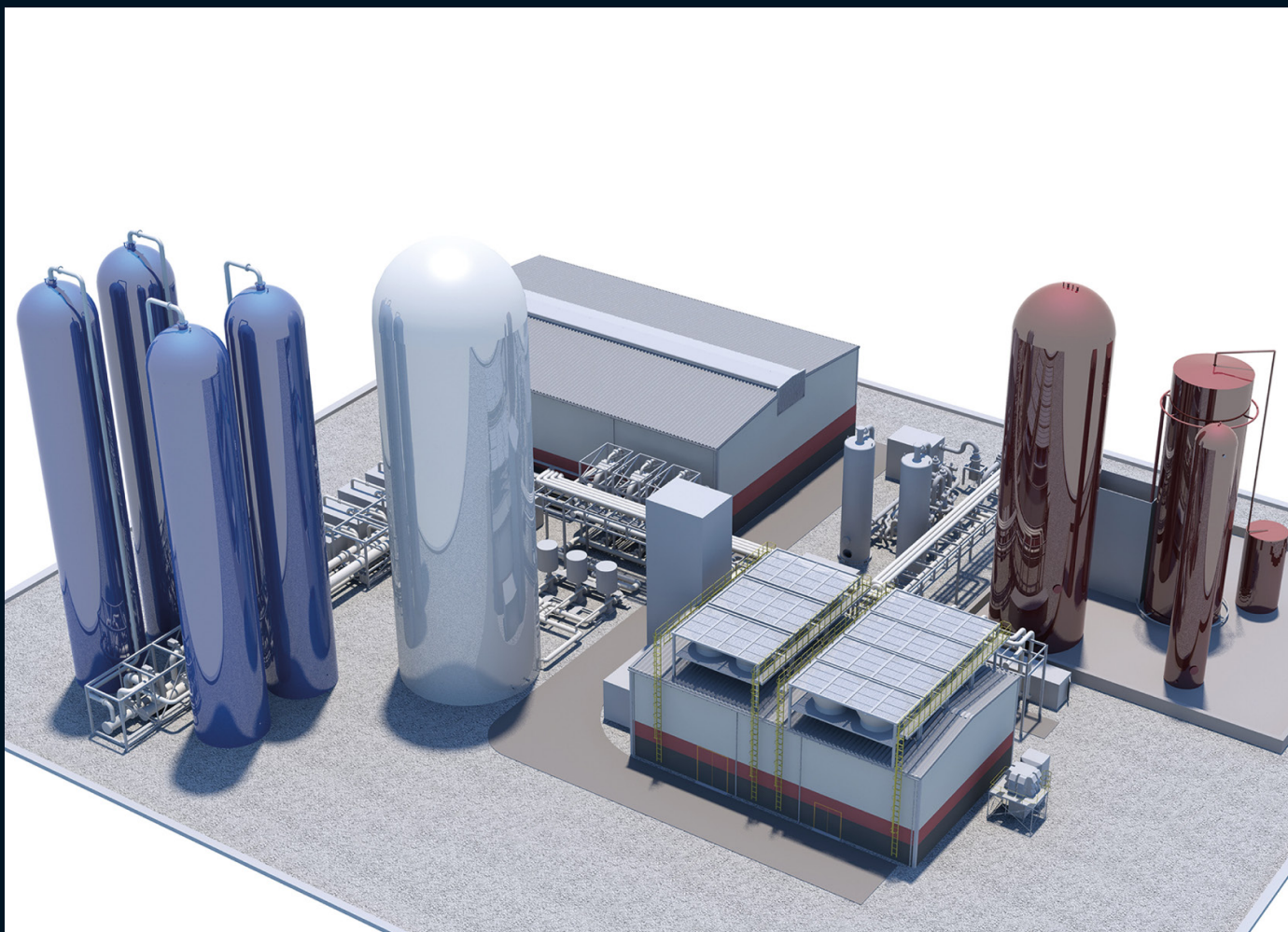


Powering a decarbonized  
world for everyone

# Liquid Air Energy Storage



# Long Duration Energy Storage solution enabling a decarbonized power system

## Key differentiators:

- 30 years lifetime
- Negligible capacity degradation
- Decoupled charge and discharge power ratings
- Location agnostic
- Scalable and suitable for bulk energy storage
- Intra-day, inter-day and weekly storage capabilities
- Low supply chain risks
- Integration with external sources of heat or cold
- Established end of life recycling processes
- Rotational inertia support to the grid
- Mature technology
- Energy density which is 1-2 orders of magnitude higher than other storage technologies

## Liquid Air Energy Storage

There is a global push to increase the contribution of renewable energy sources (RESs) to the energy mix. With a significant expansion in the installed capacity of RESs, grid operators across the world are grappling with emerging challenges such as the intermittent nature of RESs, grid congestion and the economic curtailment of RES generation. In this context, energy storage systems have become essential to increase the absorption of RESs in the power system and minimize any economic curtailment. Specifically, numerous independent studies have identified long duration energy storage (LDES) systems as the missing link to realizing 100% RES-based power systems.

Liquid Air Energy Storage (LAES) is a game changing technology which can unlock the full potential of renewable energy by making it as reliable and dispatchable as energy from conventional sources.

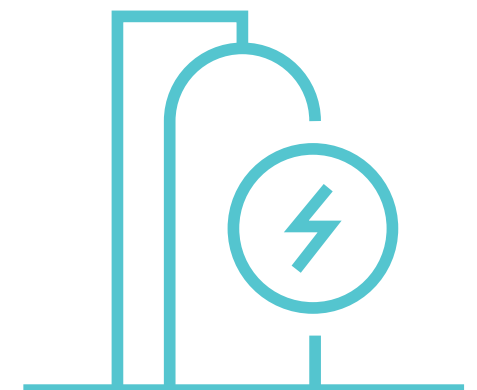
Sumitomo SHI FW will lead the LAES business, applying our technology development, engineering, and global project delivery capabilities to help our customers in their energy transition and net-zero journeys. LAES harnesses a freely available resource—air, to provide a reliable, flexible, and sustainable energy storage solution.

LAES is the only LDES technology available on the market today that offers multiple GWh of storage, is scalable with no size or geographic constraints, and produces zero emissions. LAES is ultra-flexible, durable, cost-competitive and free from the capacity degradation issues observed in some conventional energy storage technologies.

The discharge power of a LAES system typically ranges from 25MW to over 100MW while the storage capacity typically ranges from 200MWh to 2.5GWh. With the charge power, discharge power and storage capacity being decoupled, the LAES is well-suited for long duration storage and bulk energy shifting applications.

LAES is particularly effective when it is combined with variable RESs. A LAES system can be charged during periods of high RES generation and discharged over long durations during periods of low RES generation. The versatility of the LAES system makes it capable of serving every level of the electrical power system. The LAES system can provide a range of services including but not limited to:

- 24x7 firm and dispatchable renewable energy
- ancillary services which can be monetized depending on the specific energy market
- rotational inertia support to RES dominated power grids
- reactive power support, short circuit capacity and black start support



# How does LAES work?

LAES systems are designed based on established processes in the turbo machinery, power generation and industrial gas sectors. Similar to other energy storage technologies, the operation of a LAES system comprises charge, storage and discharge processes

## Stage 1. Charging the system

Excess renewable energy is used to run a compressor which draws in ambient air. The air is pressurized and cleaned using an air purification unit. The air is then cooled to cryogenic temperatures until it liquefies. 700 litres of ambient air are required to produce 1 litre of liquid air. The heat emitted during the compression process is stored in two heat storage tanks and used during the discharge phase. The cold energy stored in the cold storage tank during the discharging process is used to liquefy the air during the charging process.

## Stage 2. Liquid air storage

The liquid air is stored in insulated tanks which function as the energy reservoir. The self-discharge is minimal owing to the highly insulated nature of the tanks. The storage capacity (MWh rating) of the LAES system can be increased by simply increasing the number of tanks. The additional capital expenditure required for increasing the number of tanks is minimal.

## Stage 3. Power recovery / Discharging the system

During the discharge process, the air is pressurized. The heat stored in the heat storage tanks during the charging process is applied to the liquid air via heat exchangers. During this evaporation process, the cold energy emitted is stored in a cold storage tank. This stored cold energy is reused to liquefy the air during the charging process. The high-pressure and superheated gaseous air is expanded through a multi-stage turbine to generate electricity.

Figure 1. Simplified LAES process schematic

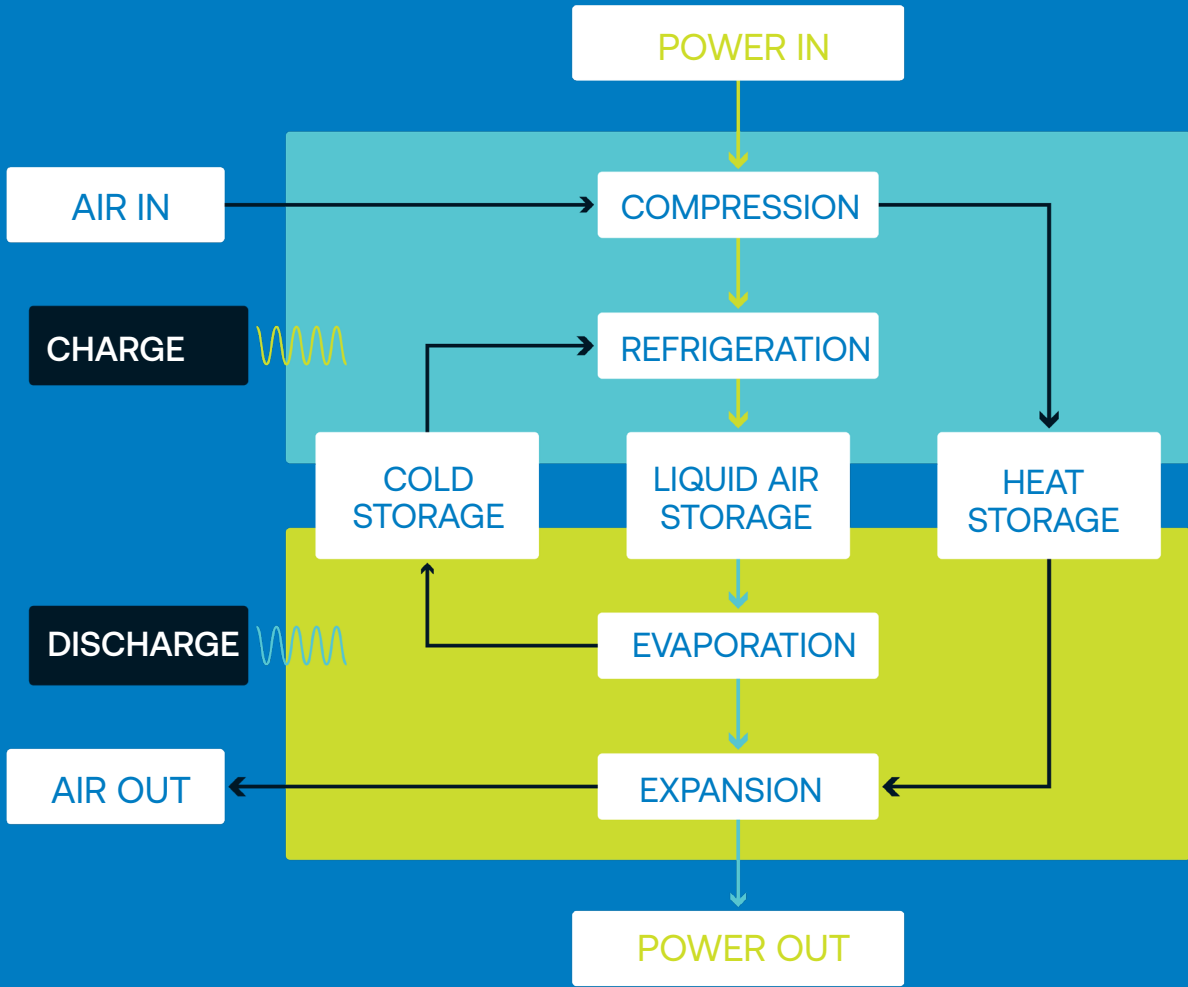
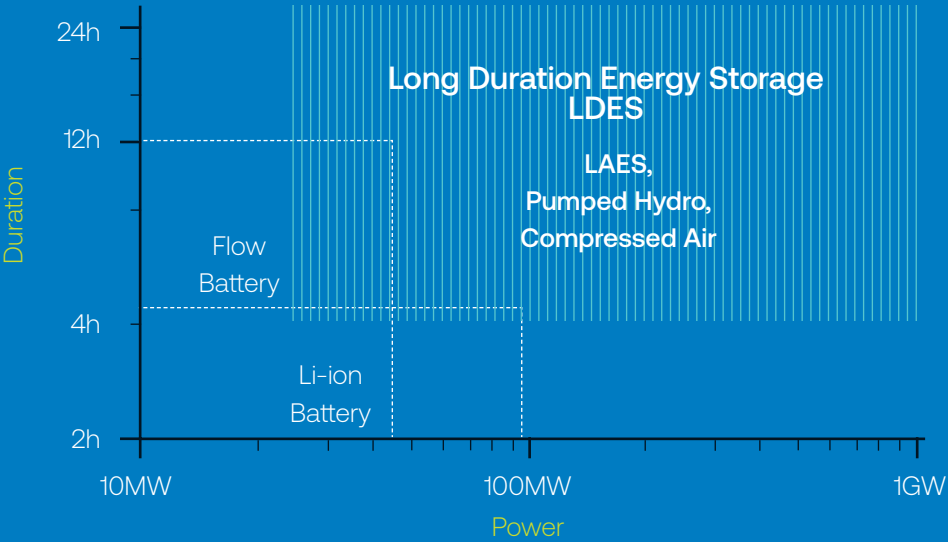


Figure 1. Typical applications for different storage technologies in terms of output power and storage duration



Liquid Air Energy Storage enables 24x7 dispatchable renewable energy



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## About us

Since 1891, Sumitomo SHI FW have developed and delivered the highest quality technology solutions within the everchanging energy market. Now the transition to a net zero world is reshaping industries and economies to improve our impact on our environment.

We work in partnership with our customers, cultivating a deep understanding of their businesses, to deliver integrated energy solutions.

We want to be a life-cycle partner, bringing complementary expertise and working closely with our customers across the entire process. This is from customer value creation to design, scope, installation, execution, maintenance, and operations.

We partner with a diverse array of experts to meet rapidly evolving customer needs. With our unique knowledge, proven expertise, leading

technology, and global reach, we go further, together. By working closely with our customers, we enhance customer value and can reach decarbonization goals faster.

Whatever the customer challenge, we endeavor to find the solutions.

**Powering a decarbonized world  
for everyone.**