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**Press release**

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## MAN and ABB introduce unique Energy Storage Solution

### MAN Energy Solutions partners with ABB to develop and commercialize new energy-storage system

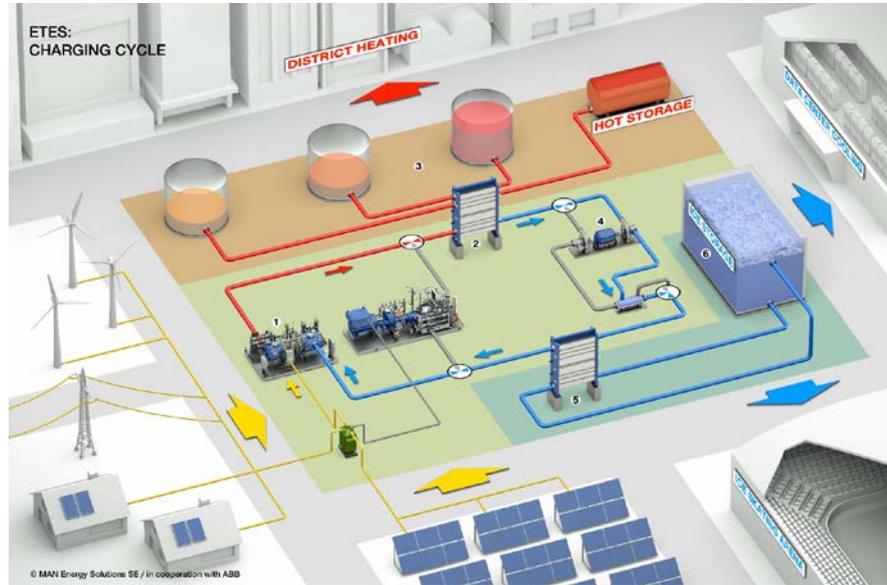
MAN Energy Solutions Schweiz AG has signed a cooperation agreement with ABB Switzerland for the development, production and commercialization of a three-way energy-storage system. The new Electro-Thermal Energy Storage system (ETES) stores large-scale electricity, heat and cold for distribution to consumers.

ETES uses surplus renewable-electricity to generate heat and cold for storage in insulated reservoirs during a so-called 'charging cycle'. The heat and cold can be converted back into electrical energy on demand. Moreover, it is possible to distribute the stored cold and heat to different types of consumers. For instance, heat can be transferred to district heating, the food-processing industry, laundry facilities, etc., whereas applications for the cold include cooling data-centers, ice-hockey arenas or air-conditioning for skyscrapers. The system is location-independent and designed to suit various boundary conditions.

Dr. Uwe Lauber, CEO of MAN Energy Solutions, said: "The biggest challenge in building stable, climate-neutral energy systems is the intermittency of renewable energy in power generation and supply. To match an increasing consumer demand for energy with a fluctuating supply, the world needs reliable energy-storage systems." Lauber added: "At MAN Energy Solutions we have made it our mission to drive the transition towards a carbon-neutral world. Together with our partner, ABB, we now offer a complete solution for the storage, use and distribution of electrical and thermal energy that is groundbreaking."

Prof. Dr. Hans Gut, Managing Director of MAN Energy Solutions Schweiz AG, said: "ETES is the only storage system able to store electricity, heat and cold at the same time and also distribute them to consumers, which makes it unique." He continued: "Due to the high overall efficiency, the modular character of the system and its low impact on the environment, ETES is a sustainable energy-storage solution that is suitable for a wide range of applications worldwide."

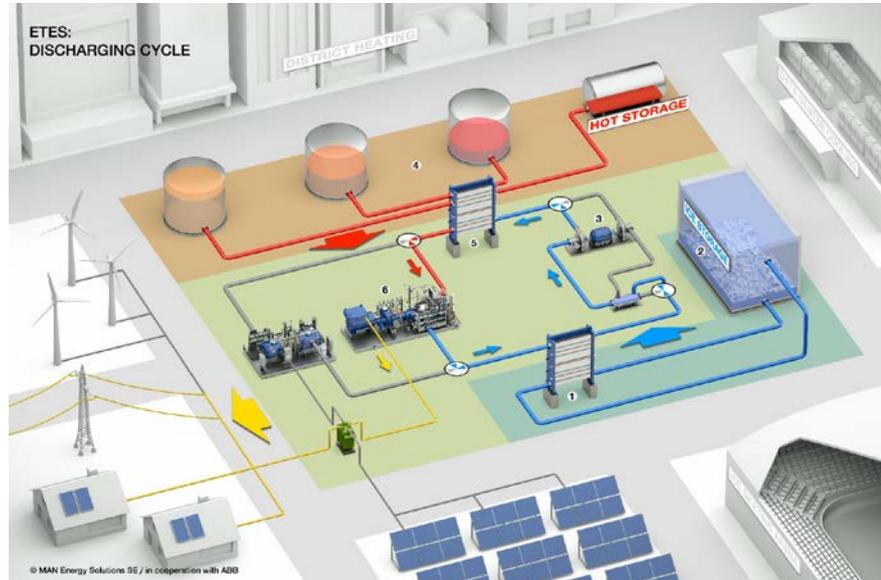
The turbomachinery technology and the process design of the charging and discharging cycle are the key elements of this energy-storage system and reflect MAN Energy Solutions' core competences. ETES features MAN's hermetically-sealed turbo compressor HOFIM™ within the charging cycle to compress the CO<sub>2</sub> working fluid to its supercritical state at typically 140 bar and ca. 120°C.



**Charging Cycle:**

- (1) The HOFIM™ turbo-compressor runs on surplus energy from renewable resources, compressing CO<sub>2</sub> in the cycle, which is heated to 120°C.
- (2) The CO<sub>2</sub> is fed into a heat exchanger and heats the water.
- (3) The hot water is stored in isolated tanks, each one at a separately-defined temperature level.
- (4) Still under high pressure, the CO<sub>2</sub> is fed into an expander, which reduces the pressure – the CO<sub>2</sub> is liquefied and cooled.
- (5/6) The liquefied CO<sub>2</sub> is again pumped through a heat-exchange system, this time on the cold side of the system. Heat is taken from the surrounding water and ice is formed in the ice storage tank.

There are numerous uses for the stored heat, for instance within the food-processing industry or for district heating. Among other possible applications, the cold can be used to cool data centers, for cold storage or the air-conditioning of buildings.



### *Discharging Cycle:*

*(1/2) Gaseous CO<sub>2</sub> enters the heat exchanger on the cold side of the system where it condenses because of the cold from the ice-storage tank. The ice in the tank melts.*

*(3) The pump increases the pressure of the CO<sub>2</sub> again.*

*(4/5) The CO<sub>2</sub> passes through the heat exchanger and is heated by the water in the hot-water storage tanks.*

*(6) The heat from the heated CO<sub>2</sub> is fed into the power turbine where it is converted back into electrical energy via a coupled generator. The electricity flows into the grid and is distributed to consumers.*

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MAN Energy Solutions enables its customers to achieve sustainable value creation in the transition towards a carbon neutral future. Addressing tomorrow's challenges within the marine, energy and industrial sectors, we improve efficiency and performance at a systemic level. Leading the way in advanced engineering for more than 250 years, we provide a unique portfolio of technologies. Headquartered in Germany, MAN Energy Solutions employs some 14,000 people at over 120 sites globally. Our after-sales brand, MAN PrimeServ, offers a vast network of service centres to our customers all over the world.