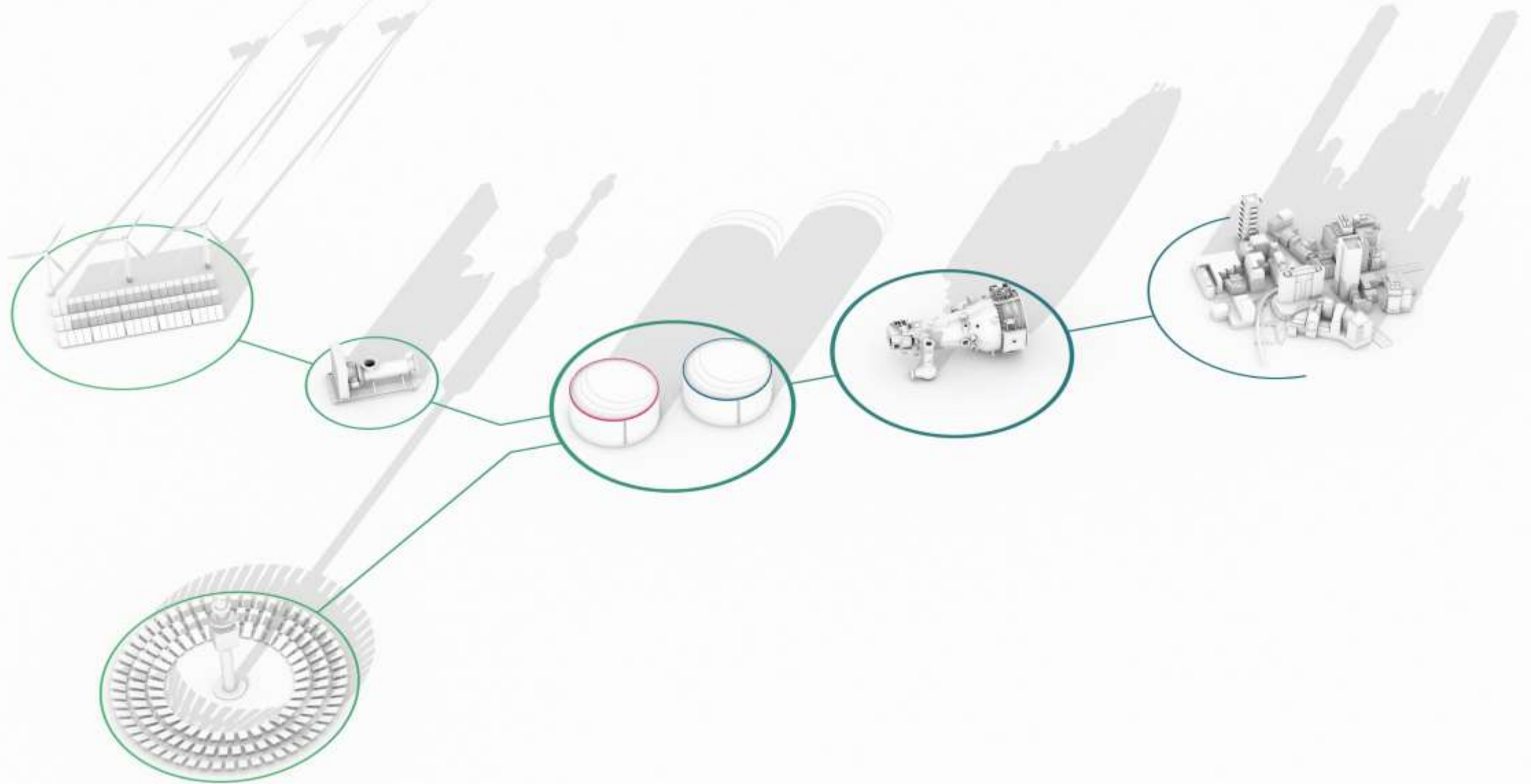


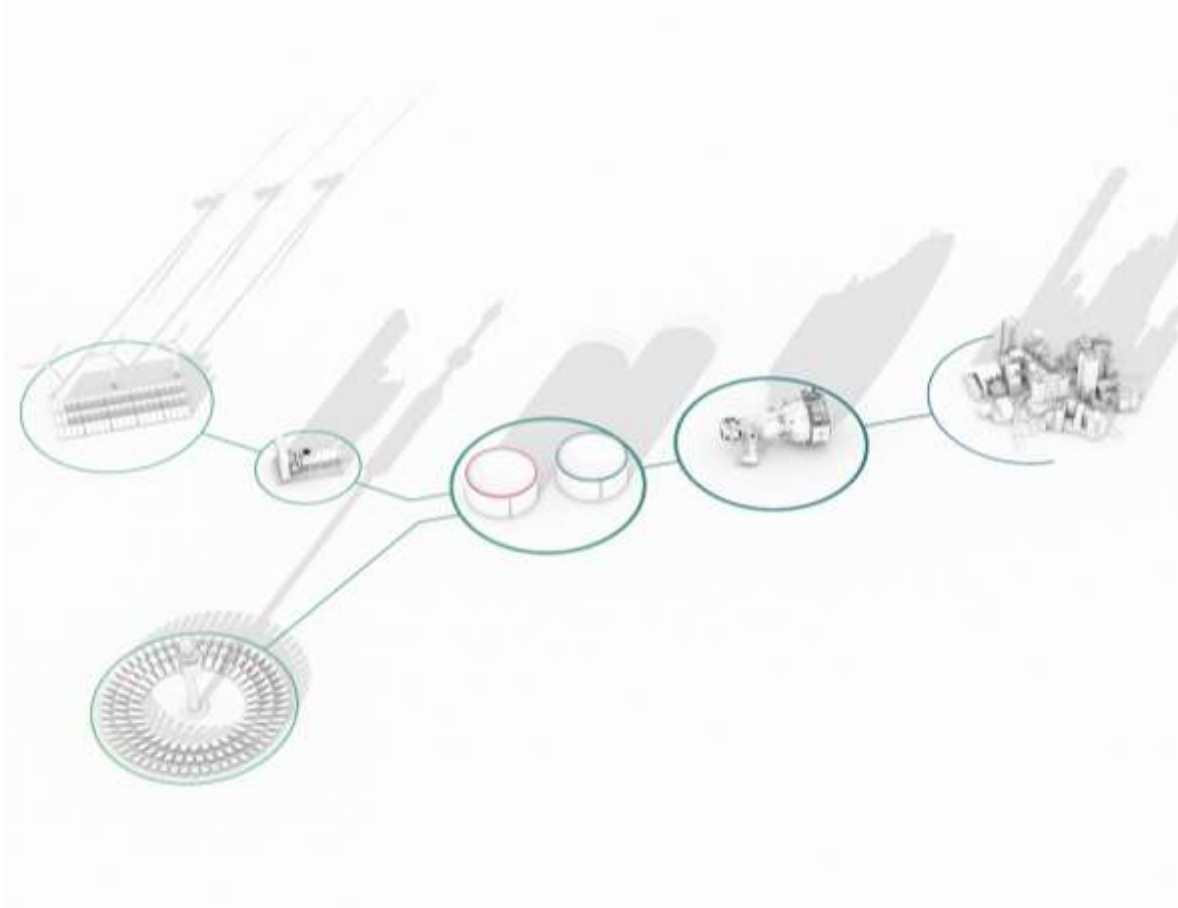
MAN MOSAS

Molten Salt Energy Storage

MAN molten salt energy storage (MOSAS)



MAN MOSAS – flexible and economic storage solution for multiple applications



- Retrofitting coal-fired power plants, for example, is possible in order to produce a sustainable energy system including a stable grid
- Peak shaving of volatile electricity through conversion into heat and time-dependent reconversion into electricity
- Molten salt is used as a heat transfer medium due to its high operating temperature and resulting high efficiency
- Steam production with molten salt via heat exchanger, and usage in steam turbine to produce electricity
- MAN MOSAS is also used for concentrated solar power (CSP) to make solar energy storable

MAN MOSAS for retrofit of conventional plants

Applications (1/3)



Description

- The energy system must **retain its dispatchability** and thus it is necessary to store fluctuating energies
- Molten salt storage is suitable to **retrofit, e.g., coal-fired power plants** by electrical heaters or heat pumps in combination with storage tanks and salt heat exchangers for the steam generation

Benefits

- Further **use of existing power plant infrastructure**, e.g., turbine & generator remains part of the system
- **Reduced investment costs** of the entire system

MAN MOSAS for Concentrated Power Plants

Applications (2/3)



Application

- Molten salt can be used direct as **heat transfer media** in linear and point focusing concentrated power plants.
- By **storing molten salt in tanks**, steam and therefore electricity can be generated also at times where the sun is not shining

Benefits

- **Low levelized costs of electricity** (LCOE) in the sun belt region
- **Dispatchable power generation** from renewable sources
- **Higher thermal efficiencies** due to higher steam parameters

MAN MOSAS for Energy Recovery

Applications (3/3)



Application

- Due to transferring the flue gas energy of industrial batch processes to the molten salt storage the fluctuation is compensated and a continuous energy source is generated

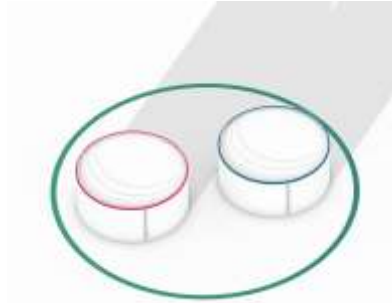
Benefits

- **Optimize the efficiency of industrial batch processes** where high flue gas temperatures are occurring (e.g. steel industry)
- **Reduce own costs** of the process

The technology behind MAN MOSAS (1/2)



Molten salt is heated via electrical heaters powered by renewable energy...



Thermal energy is stored in a hot storage tank
The storage time can be controlled by the salt tank volume and is customized

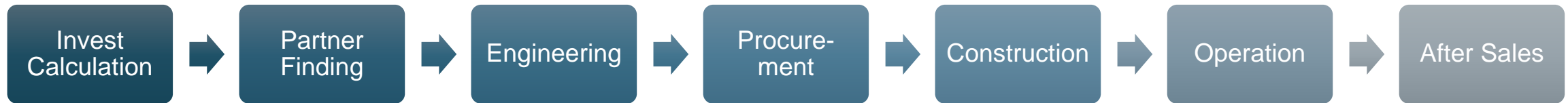


Hot molten salt produce superheated steam to drive the turbine
Cold salt is kept liquid in an insulated storage tank



...or directly via a concentrated solar power plant (CSP)

MAN providing complete solutions based on molten salt energy storage



- 60 years experience in molten salt technologies
- 100 years experience in turbo equipment
- > 100 years EPC experience in power plant projects



Comprehensive scope of supply



Renewable Energy

- Wind or solar energy providing the power for this kind of plant



Electrical Heaters

- Electrical heaters transform electricity into heat stored in molten salt

Heat Pumps

- Increased efficiency in combination with heat pumps



Molten Salt Storage

- Hot and cold tanks store the energy – capacity adjusted by tank volume



Molten Salt Heat Exchangers

- Efficient and proven way to transfer the heat stored by molten salt to steam

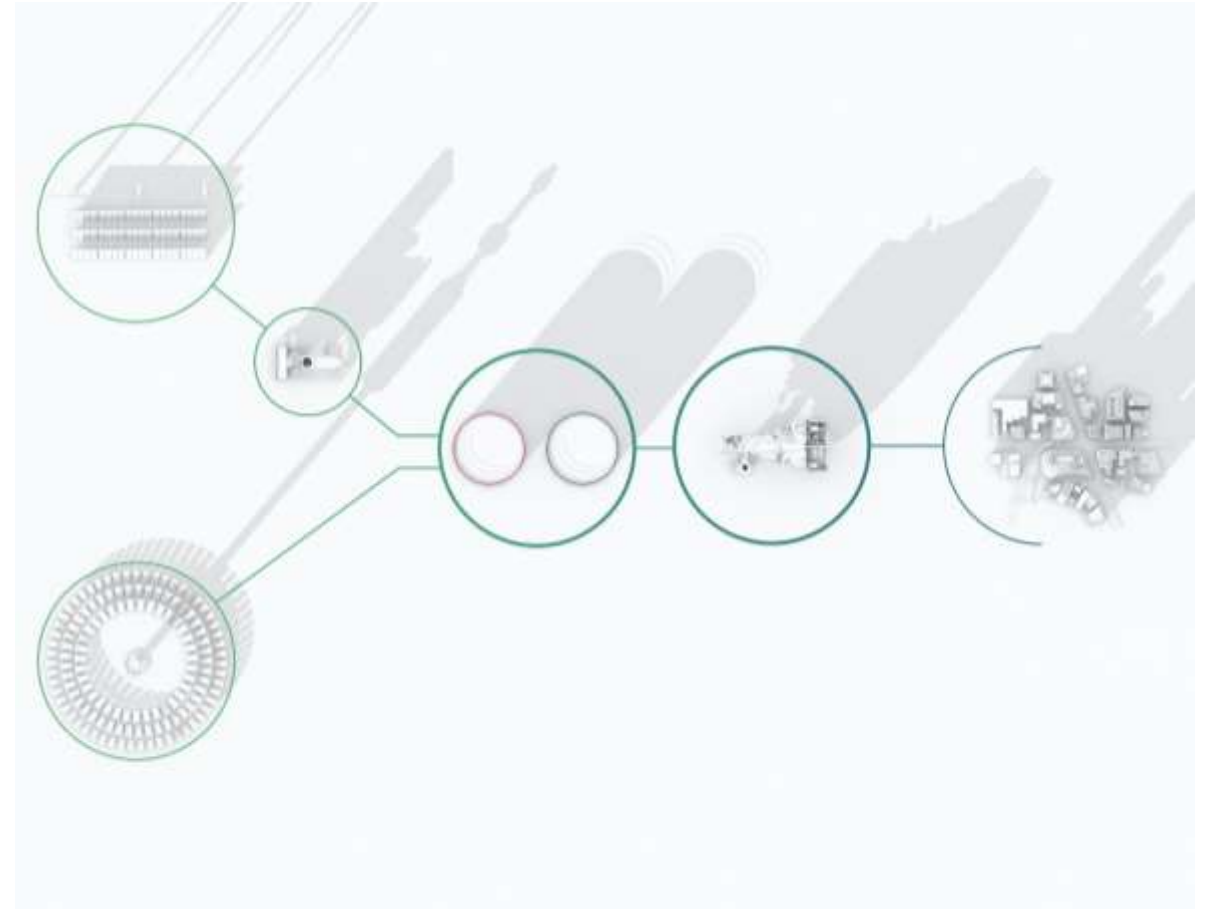


Steam Turbines

- Steam turbines transform the stored heat back into electricity when needed

Summary

- Storage solution which can be used in several power generation applications (CSP, retrofitting of fossil power plants, etc.)
- Temperature levels (150 °C – 600 °C) are ideal for steam generation
- Higher operating temperature of molten salt compared to thermal oil, for example, leads to higher efficiency
- Long-term experience of using molten salt as a heat transfer medium in the chemical industry
- MAN provides the molten salt system as a single solution
- Low safety requirements (not flammable)



An aerial photograph of a solar tower power plant. The central receiver is a large, white, cylindrical structure. It is surrounded by a vast field of heliostats (mirrors) that reflect sunlight onto the receiver. The heliostats are arranged in concentric circles, creating a dense pattern of blue and white. In the foreground, there are several rectangular structures, likely part of the molten salt storage system, which are filled with a bright orange-red liquid. The entire plant is situated in a desert environment with sandy ground.

Stabilize your grid when using volatile renewable energy sources.

▶ Molten salt technology makes fluctuating solar power storable.

Thank you very much!