

Adiabatic Compressed Air Energy Storage



Your challenges

- Absorbing renewable energy that might otherwise be curtailed
- Regulatory requirements of black-start capabilities, resulting in bound capital and resources
- Balancing load with new mix of generating assets and end client expectations
- Volatile fossil prices cause increase in OPEX






Our storage systems enable

- Energy and ancillary services without CO₂ and NO_x emissions
- Increased grid capacity utilization, balancing and reserve services
- Decarbonization by high utilization of renewable energy sources
- Flexible cycling operations by independent operation for compression and expansion train
- District heating and process heat supply

Our offerings

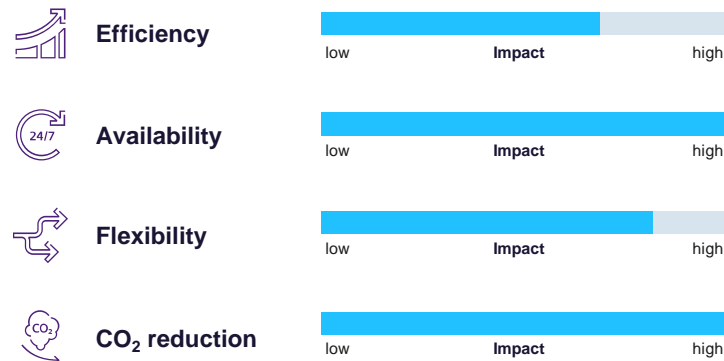
- Entire surface plant scope including CAES cycle, balance of plant, and construction
- Future-ready design: Deep decarbonization by unlocking synergies between thermal storage and traditional compressed air energy storage
- GWh-scale energy storage solution
- Proven components coupling together for unlocking a new market

Typical properties

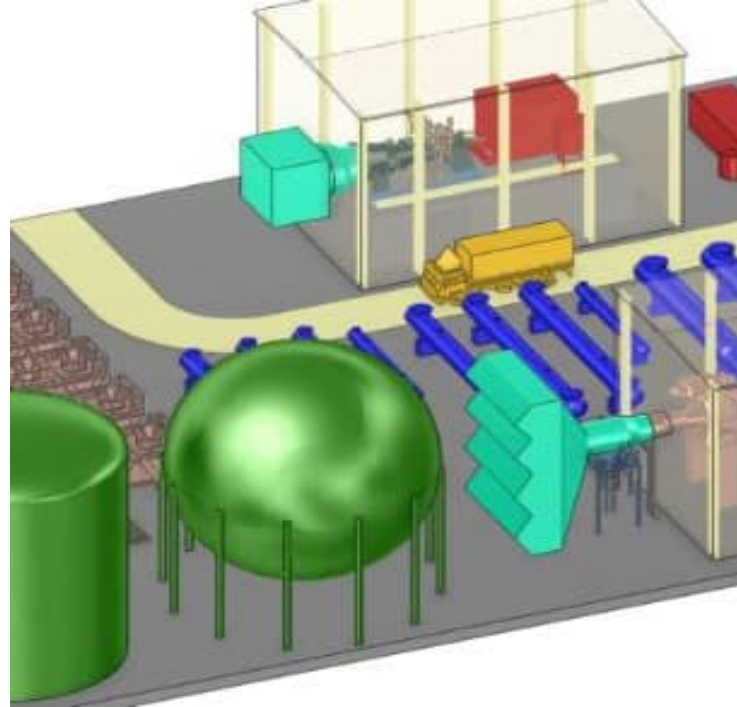
	Power range	50 – 350 MW_{el} ¹ per Unit
	Discharge time	>24 h , limit depending on Cavern Volume
	Reaction time	<7 min
	Storage size	>8,000 MWh_{el} per Unit limit depending on Cavern
	Storage period	Multiple days/weeks

¹ Power range is per expansion train | Please contact us [here](#)






Benefits



Adiabatic Compressed Air Energy Storage Smart

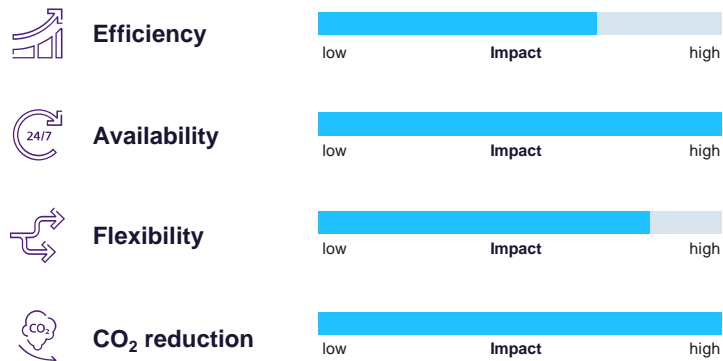


Typical properties

	Power range	5 – 50 MW _{el} ¹ per Unit
	Discharge time	up to 10+ hours
	Reaction time	<7 min
	Storage size	up to 500 MWh _{el} per Unit
	Storage period	Multiple days/weeks

¹ Power range is per expansion train | Please contact us [here](#)

Benefits



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Our storage systems enable

- Energy and ancillary services without CO₂ and NO_x emissions
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- Flexible cycling operations by independent operation for compression and expansion train
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Our offerings

- Entire surface plant scope including CAES cycle, balance of plant, and construction
- Future-ready design: Deep decarbonization by unlocking synergies between thermal storage and traditional compressed air energy storage
- GWh-scale energy storage solution
- Proven components coupling together for unlocking a new market

Diabatic Compressed Air Energy Storage



Your challenges

- Absorbing renewable energy that might otherwise be curtailed
- Long duration energy storage for supporting load management
- Balancing load with new mix of generating assets and end client expectations
- Regulatory requirements of black-start capabilities, resulting in bound capital and resources






Our storage systems enable

- Energy and ancillary services with low fuel consumption
- Increased grid capacity utilization, balancing and reserve services
- High flexible operating modes, including simultaneous charging and discharging
- Excellent load-following capacity and part-load efficiency
- Decarbonization by high utilization of renewable energy sources

Our offerings

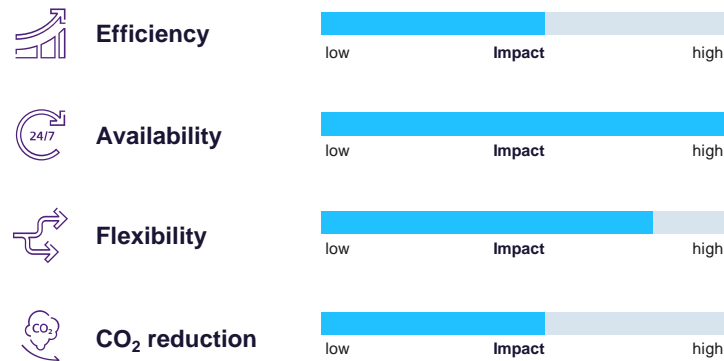
- Entire surface plant scope including CAES cycle, balance of plant, and construction
- Future-ready design: Further CO₂ reduction via co-firing with H₂ based fuels
- GWh-scale energy storage solution
- Proven components coupling together for unlocking a new market

Typical properties

	Power range	140 – 165 MW_{el}¹ per Unit
	Discharge time	>48 h, limit depending on Cavern Volume
	Reaction time	<10 min
	Storage size	>8,000 MWh_{el} per Unit limit depending on Cavern
	Storage period	Multiple days/weeks

¹ Power range is per expansion train | Please contact us [here](#)

Benefits



A-CAES Power Plant

Characteristics

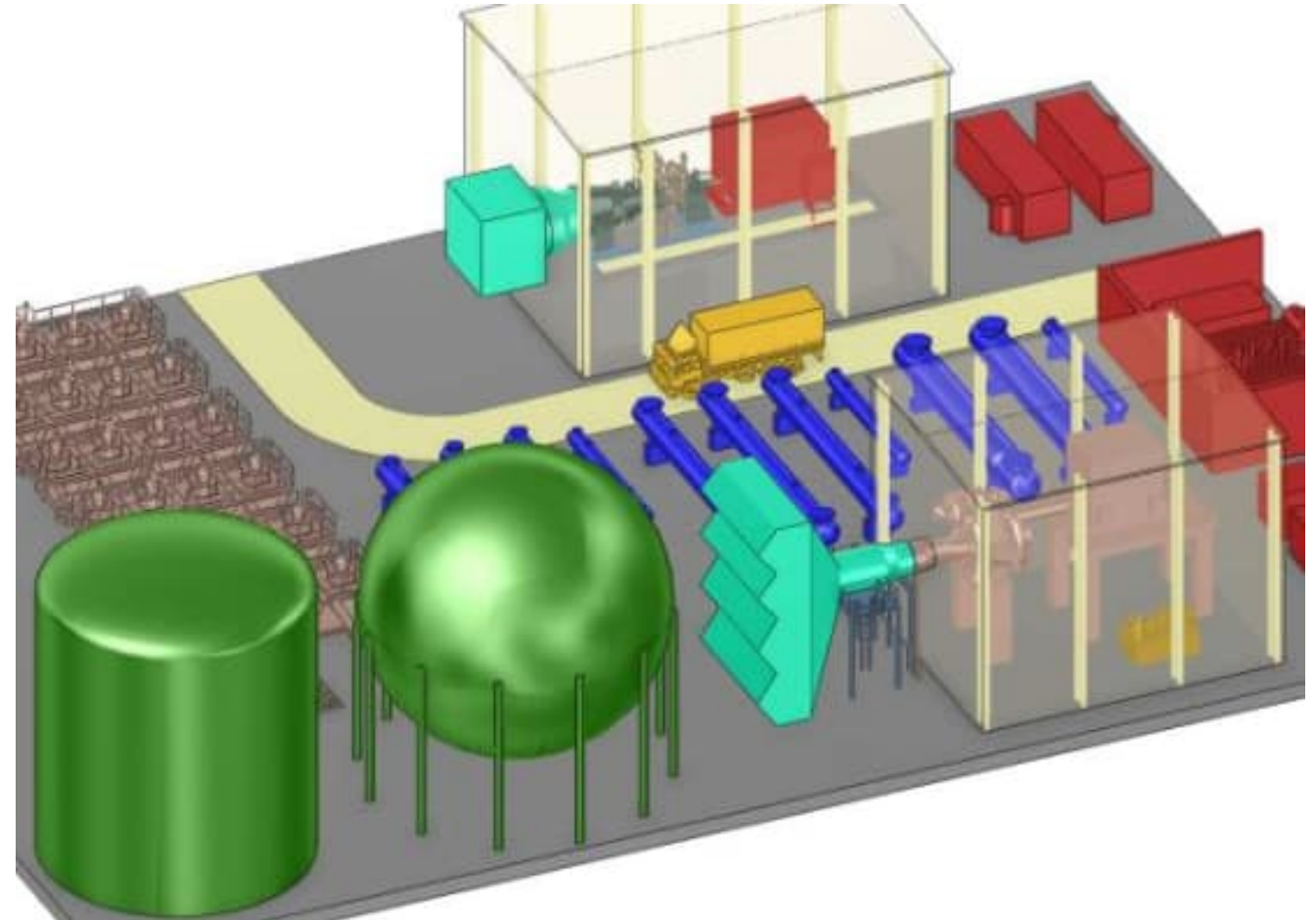
- Round trip efficiency up to 65 to >70% (Power to Power)
- Approx. 150 – 250 €/kWh depending on the discharge time (incl. civil, excluding air storage, no fuel needed)
- Train size 50 to 350 MW, multiple trains possible
- Discharge duration as per customer request (modular system)
- ZERO Green House Gas emission → No NO_x and no CO₂
- < 25 years expected useful life
- 10,000+ cycles
- Negligible annual degradation
- No commodity risk
- operation at high/cold ambient temperature
- Frequency response, reactive power, voltage management
- Rotating inertia/short circuit power
- Black start capability
- District heat application possible



A-CAES Smart Power Plant

Characteristics

- Round trip efficiency up to 65 to >70% (Power to Power)
- Approx. 250 – 400 €/kWh depending on the discharge time (incl. civil and including air storage, no fuel needed)
- Train size approx. 50 MW, multiple trains possible
- Discharge duration as per customer request (modular system)
- ZERO Green House Gas emission → No NO_x and no CO₂
- 25 years expected useful life
- 10,000+ cycles
- Negligible annual degradation
- No commodity risk
- operation at high/cold ambient temperature
- Frequency response, reactive power, voltage management
- Rotating inertia/short circuit power
- Black start capability
- District heat application possible



D-CAES Power Plant

Characteristics

- Round trip efficiency up to approx. 60% (Power to Power)
- Approx. 50 – 150 €/kWh depending on the discharge time (incl. civil, excluding air storage, excl. fuel)
- Typical power train size up to 165 MW, multiple trains possible
- Discharge duration as per customer request (modular system)
- No CO₂ emission when operation with H₂
- 25 years expected useful life
- 10,000+ cycles
- Negligible annual degradation
- commodity risk
- operation at high/cold ambient temperature
- Frequency response, reactive power, voltage management
- Rotating inertia/short circuit power
- Black start capability
- Continuous/parallel operation can be specified (no storage!)

