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HYDROSTOR

ADVANCED COMPRESSED AIR ENERGY STORAGE

CEC Business Meeting – 1/26/2022 (Agenda Item #5)

- ***Hydrostor & Advanced Compressed Air Energy Storage Overviews***
- ***Pecho Energy Storage Center – Project Overview***

About Hydrostor

Hydrostor is the global leader in Advanced Compressed Air Energy Storage (A-CAES)

Founded: 2010

Offices: Toronto, Canada (HQ), SF Bay Area, Adelaide, Australia (satellite)

Operating Facilities:
2 (Canada – Toronto Hydro; Canada – IESO)

Company Financing:
$250 M investment by Goldman Sachs – Jan. 2022

Project Pipeline:
900+ MW commercially bid in CA in 2020-21, 4 GW project pipeline (focused on U.S., Canada, Australia)

A-CAES is a breakthrough for long-duration energy storage:

- Uses only water, pressurized air and commercially proven equipment to provide long-duration, *emissions-free* storage.
- Provides similar characteristics to pumped hydro storage, but with the key advantage of being able to *flexibly site* where the grid needs it.

How Advanced-CAES Works (A-CAES)

A-CAES integrates <u>proven</u> technologies and construction approaches in innovative ways to produce a superior long-duration grid-scale energy storage solution

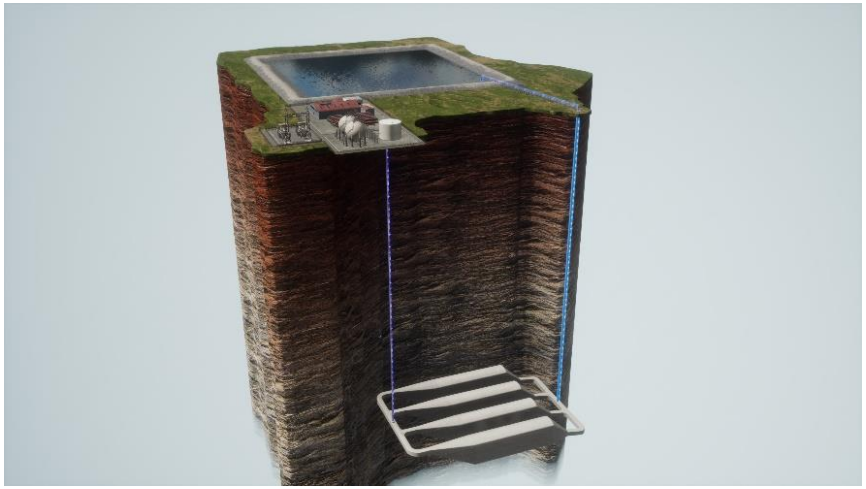
<u>STEP 1</u>
Compress air using electricity

Electricity runs a compressor to produce heated compressed air

Unique to Hydrostor

<u>STEP 2</u>
Capture heat in thermal Store

Heat is extracted from the air stream and stored in a proprietary thermal store



Unique to Hydrostor

<u>STEP 3</u>
Store compressed air in purpose-built cavern

Air is stored in a purpose built cavern using water to maintain constant pressure

<u>STEP 4</u>

Convert the air to Electricity

Water forces air to the surface where recombined with heat and expanded through a turbine

- ***<u>Major Equipment</u>:*** Utilize off-the-shelf, commercially proven power generating equipment, including air compressors, turbo-expanders, generators and heat exchangers
- ***<u>Underground Storage Caverns</u>:*** Purpose-built underground cavern construction using industry standard and well-proven mining techniques
- **<u>Efficiency:</u>** Round Trip Efficiencies (RTE) of the A-CAES process are approximately **60%**

Long Duration Energy Storage Attributes

	**Fossil Plant Replacement**	• Provides synchronous dispatchable generation with fast ramp rates • Projects can be flexibly sited in areas of highest benefit to the grid • Commercially attractive alternative to new and existing natural gas plants (no emissions and lower permitting hurdles) • Can leverage existing transmission infrastructure while minimizing land use and related environmental impacts
	**Transmission Deferral**	• Non-wires alternative to defer transmission system & network investments • Long-duration alleviates grid congestion during peak periods, and enables transmission alternatives requiring longer-term outage management • Projects can be flexibly and strategically sited near critical load pockets and infrastructure
	**Renewable Integration**	• Provide dispatchable or baseload renewables at rates ~$60-120/MWh • Optimize large solar/wind project utilization and economics through time-shifting of generation to reduce curtailments

***Pecho*: 400 Megawatts (MW) for 8 hours = 3,200 MWh**

***Gem*: 500 Megawatts (MW) for 8 hours = 4,000 MWh**

Statewide Benefits of A-CAES LD Energy Storage

- ***Provides 500 MW (Gem) and 400 MW (Pecho) of new quick-starting synchronous generation with fast ramp up/down capabilities***
- ***Projects support California Climate Policies and Renewable Portfolio Standards (RPS) by maximizing renewable generation and integration***
- ***No fossil fuel use during operations – no combustion emissions***
- ***A-CAES Technology produces fresh water from ambient air during operation***
- ***Displaces older and less efficient generation with carbon-free generation***
- ***Flexible capacity with minimal response time: local and regional voltage support and primary frequency response***
  - ***Fossil fuel-free and emissions-free spinning reserve***
  - ***Flexible capacity with minimal start time***
  - ***Peaking energy for local contingencies***
  - ***Voltage support & primary frequency response***
  - ***Long duration generation capacity to assist with prolonged system contingencies***

Pecho Energy Storage Center - SLO County, CA

***Project Capacity*: 400 MW**
***Storage Duration*: 8 Hours (3,200 MWh)**
***POI*: PG&E Morro Bay Switchyard (230 kV)**
***Target Commercial Operation Date*: Q1 2027**

Pecho Energy Storage Center - Vicinity Map

Local Benefits of Pecho Energy Storage Center

- ***Repurposes existing San Luis Obispo County electrical infrastructure including the CAISO-controlled Morro Bay Switching Station***
- ***Helps replace the loss of generation from Diablo Canyon Nuclear Power Plant decommissioning***
- ***Facilitates the efficient integration of onshore and offshore renewable energy development***
- ***Total Installed Cost: $750 million to $900 million***
- ***Construction Jobs:***
  - ***Average Construction Workforce: ~200 over 4+ years***
  - ***Peak Construction Workforce: ~450***
  - ***Total Construction Labor: ~1.6 million man-hours***
- ***Operations & Maintenance Jobs: 25-40 Full-time equivalent positions***
- ***Fiscal Benefits: Over $500 million in Regional Direct & Indirect Economic impacts***
- ***Hydrostor will work closely with San Luis Obispo County to establish a Community Benefits Program in connection with the project***

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