



Pumped Thermal Energy Storage (PTES)

Low-cost, safe and environmentally-responsible electrical energy storage anywhere

From Concept to Prototype: ARPA-E DAYS Program



Low-Temperature Reservoir (LTR)



CO₂ heat pump
& power cycle

~200 kWth system, including both charging and generating cycles

High-Temperature Reservoir (HTR)

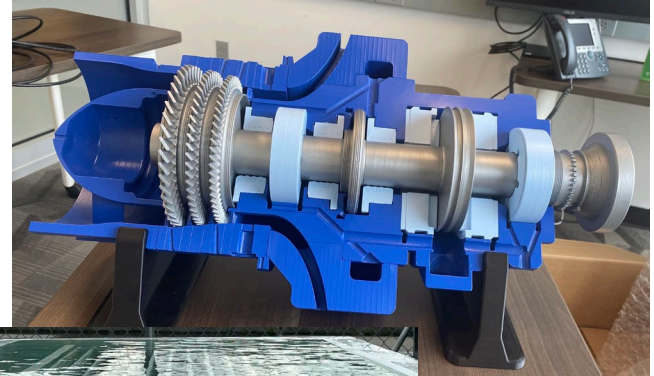


First-round testing completed with HTF reservoir

Second-round test with sand reservoir starting imminently

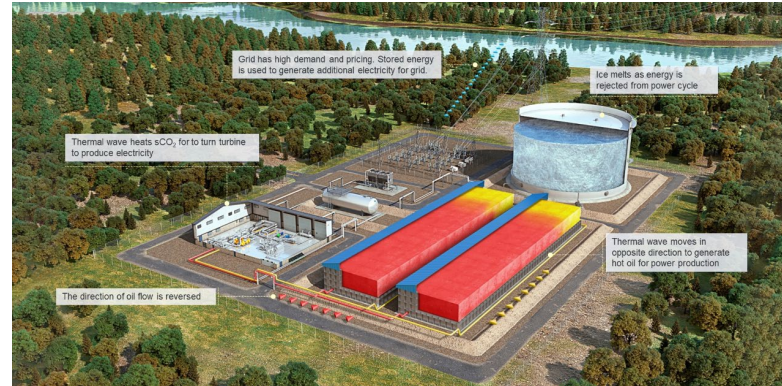
Other ongoing development programs

- Large-scale charge compressor (UC, UND)
- Low-temperature expander (SwRI, Flowserve)
- Direct ice-on-CO₂ coil and passive ice/water slurry (AES, SPF)
- Concrete/HTF high-temperature reservoir (Westinghouse)
- 100 MW, 10-hour pre-FEED study (EPRI, Advisian/Worley, Southern Company)



Commercialization progress

Westinghouse to Build 2GWh Pumped Heat Storage in Bulgaria Based on Echogen Technology



Bulgaria and Singapore 100 MW/10 hr projects (with Westinghouse)



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