**Pumped Thermal Energy Storage (PTES)**

Engineered to Fill the LDES Gap to Enable the Global Energy Transition.

- **Low cost** — Offers a lower levelized cost than currently available technology – CapEx, OpEx and end-of-life.
- **Scalable** — No topographical or geologic dependencies; can be built anywhere with a fully domestic supply chain.
- **Flexible** — Modular solution that can uniquely serve high power needs at both medium and longer GWh durations. Provides grid inertia and other ancillary services.
- **Longest asset life** — Unlike lithium or chemical batteries, power generation equipment has no loss in capacity or capability over time.
- **Sustainable** — No chemical, fire or safety risks; Long asset operational lifespan (50 years+); low carbon footprint and fully recyclable at end-of-life.

**Innovative Design Coupled With Tested Technology**

**Advanced Supercritical Carbon Dioxide (sCO₂) Technology**
- Efficient heat pump and heat engine cycle
- Echogen is a world leader developing sCO₂ systems for power generation

**Unique, Patented Thermal Storage Solution**
- Engineered concrete thermal batteries
- Low-cost materials

**Proven Components**
- Power turbine and low-temperature compressor are derivatives of existing designs
- Heat exchangers, piping, valves, controls are of similar design to existing sCO₂ systems
- Printed Circuit Heat Exchangers (PCHE)

**Proven Technology Currently Being Deployed in First Commercial Applications**

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Proven Technology

Leveraging Existing Equipment and Known Components

Thermodynamic cycles transform energy between electricity and heat

Charging Cycle (Heat Pump)
- Supercritical CO₂ heat pump (refrigeration) cycle
- Uses electrical power to move heat from a cold reservoir to a hot reservoir
- Creates stored energy as both “heat” and “cold”

Generating Cycle (Heat Engine)
- Supercritical CO₂ heat engine (power) cycle
- Uses heat stored in hot reservoir to generate electrical power

Application Example