ENDURING System: *Long-Duration Electricity Storage by Low-Cost Thermal Energy Storage and High-Efficiency Power Generation*

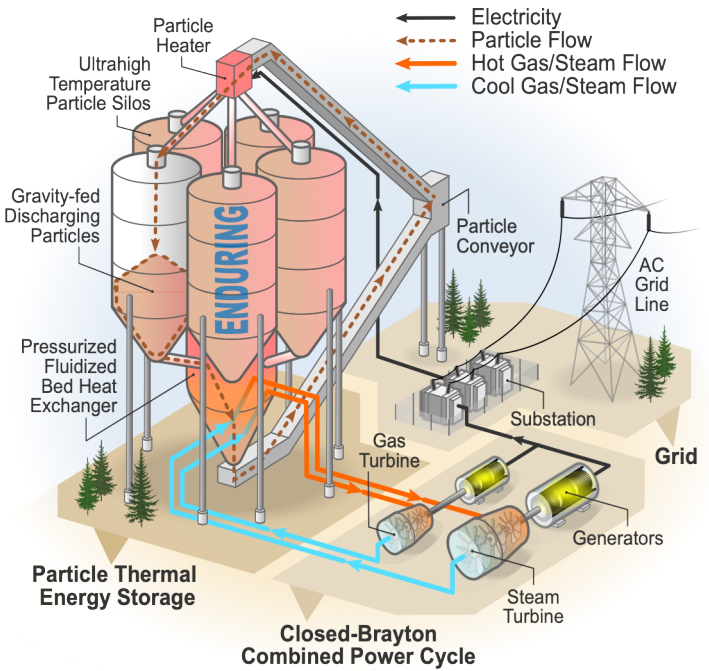
3-year | $2.79M in funding from the U.S. Dept. of Energy

Objective

Develop the ENDURING system and components for long-duration energy storage (LDES) capable of **10–100 hours** storage duration, **50–400 MWe** power capacity.

Significance

- Potential to achieve **grid-scale energy storage** at a fraction of the cost of conventional chemical battery technologies.
- The ability to provide **base-load power for several days** allows for continued grid integration of intermittent renewable sources.



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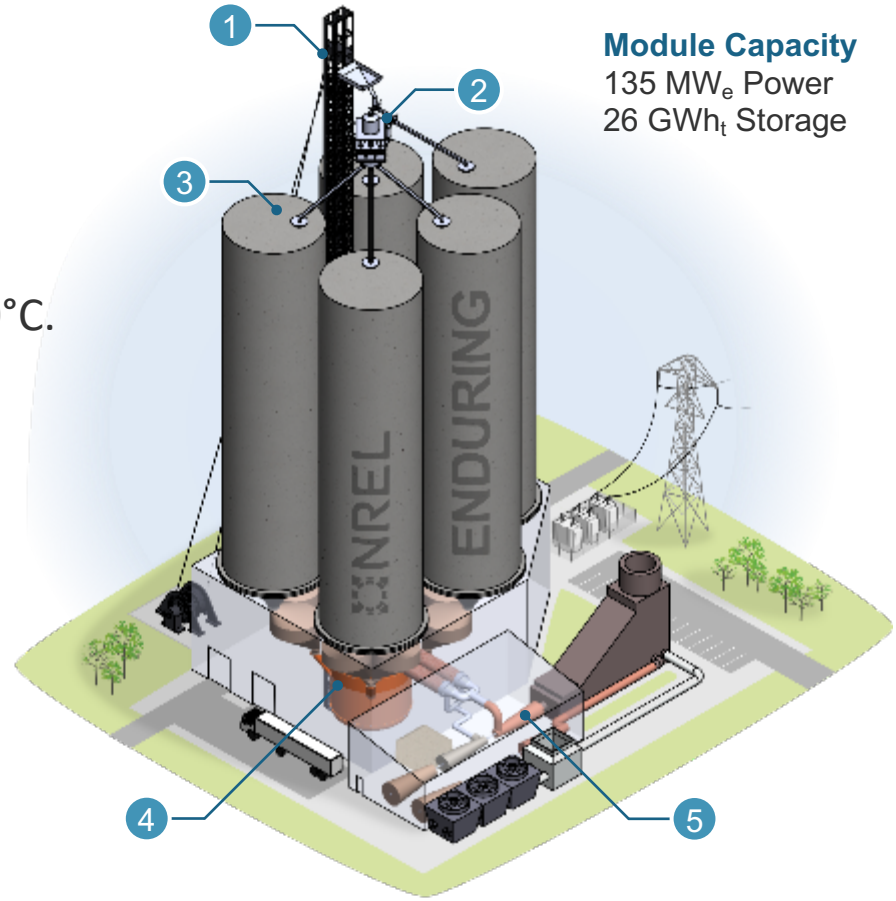
System Overview

1. **Particle lifting** by skip hoist.
2. **Electric particle heater** for *charging*.
   - Load following capability.
3. **Thermal energy storage** (TES) at 1,200°C.
   - 900°C ΔT increases storage density.
   - Silica sand at $30-40/ton.
   - Low-cost containment.
   - Storage cost of ~$2/kWht.
4. *Discharging* **Fluidized bed heat exchanger**.
   - Direct particle/gas contact.
5. **Power generation**
   - GE 7E.03 combined cycle

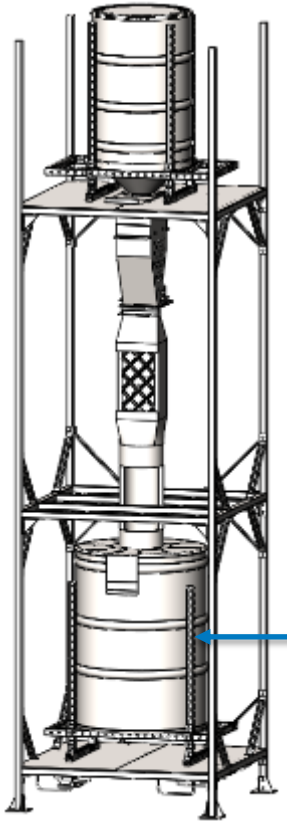


Module Capacity
135 MW_e Power
26 GWh_t Storage

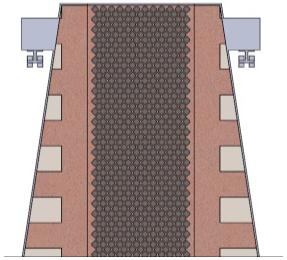
Scalable for 0.5- 80 GWh_t storage, 50-400 MW_e generation

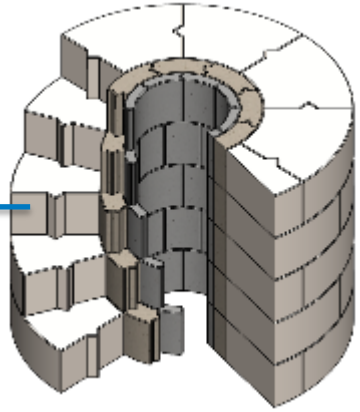
Material/Prototype Development and Testing

Screened and tested materials

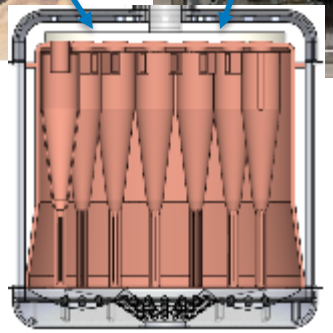


Testing charging heater and storage prototype





Testing cold/hot prototypes for discharging heat exchanger



Product fluidized bed heat exchanger design

Working with industry partners on components and system

Remaining gaps, challenges, and R&D

- Four patent applications are filed on component and system designs.
- The ENDURING thermal energy storage can be initially deployed on an existing thermal power plant.
- Need pilot demonstration at 1–5 MW scale to verify commercial potentials:
  - Develop product-relevant prototype design, fabrication, and operation for charging heater, fluidized-bed heat exchanger, particle handling, and TES containment.
  - A 60-meter-tall particle lift structure near NREL can be a test site for the pilot demonstration.

Seek partner and support to develop pilot and product path.