

Transformational Energy Storage Leadership – Efficiency, Independence, Low Emissions, Resilience

Dr. Halle Cheeseman – ARPA-E (DOE – Early-Stage
R&D)

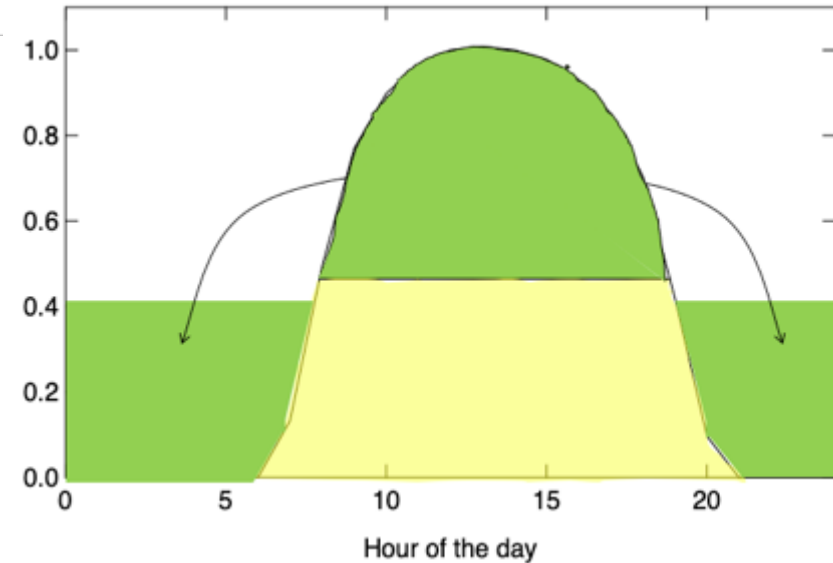
ARPA-E Long Duration **DAYS** program – 2018



Duration Addition to Electricity Storage

Key Parameters Objectives & Assumptions

- 10–100 hours Duration
- LCOS – \$0.05/kWh (+\$0.025/kWh - Renewable Energy Electricity Cost)
- \$37MM funding for 11 projects (+ 4 projects from OPEN Solicitation)
- Low energy efficiency (e.g., 40%) can work with low capital cost (e.g., \$20/kWh)
- Early Demonstrations 1–500kWh; eventual deployment multi-MWh



The DAYS technical portfolio

Thermochemical energy storage



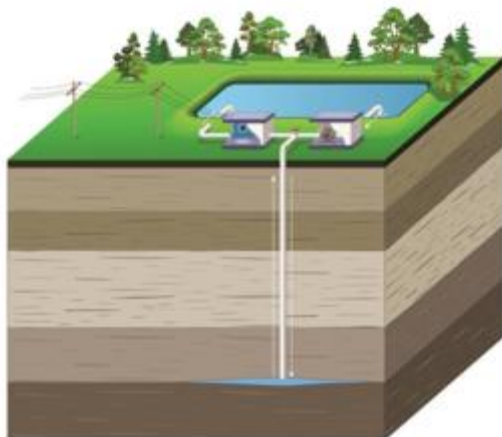
1 Project

Thermophotovoltaic (TPV) storage



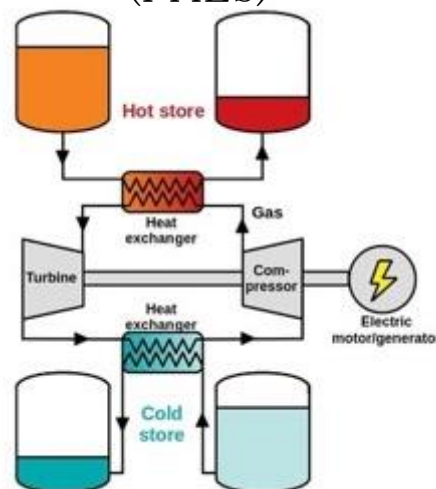
2 Projects

Geomechanical storage



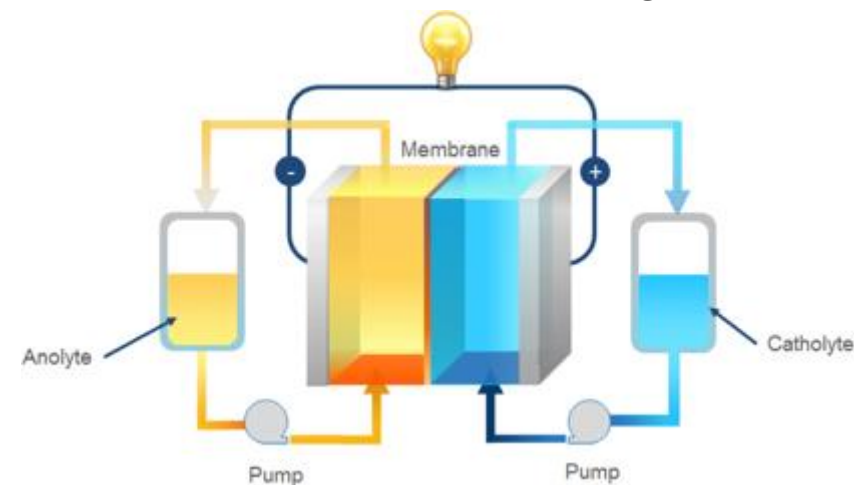
1 Project

Pumped heat energy storage (PHES)



4 Projects

Electrochemical storage



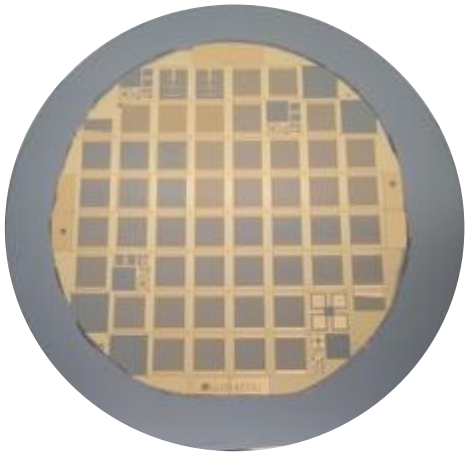
7 Projects

Antora Prototype being commissioned in Fresno, CA

With TPV Panel



TPV Cell

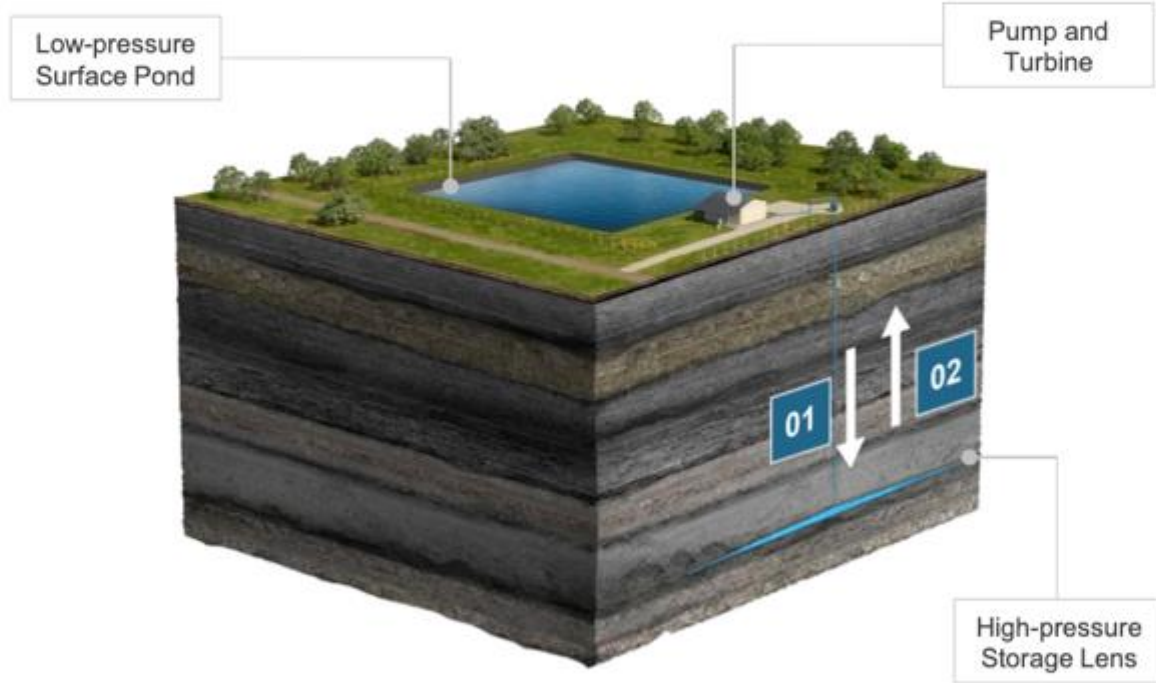


A new kind of energy storage: Geomechanical pumped hydro

Low-cost, long-duration, widely-applicable long duration energy storage



How it Works



01 Charge. Water pumped down the well into high-pressure storage lens

02 Discharge. High-pressure water flows up the well to drive a turbine



Heat Based Energy Storage Systems

South-West Research Institute



Pumped Heat Energy Storage
- Control System

Echogen



Super-critical CO₂
Working Fluid

RedoxBlox



Thermochemical
100kWh ESS

Key Learning from DAYS

- \$0.05/kWh for LCOS is the right number and has become the standard
- Storing heat is cheap. Converting it cost effectively to electricity requires scale
- There is a strong early market for PHES for industrial/process heat. This may detract companies from longer-term innovation.
- Maximizing early profitability will require close anticipation of curtailment opportunities and lucrative demand pricing
- Can a combined clean energy heat and power ESS beat a low-cost simple PHES plus LFP battery?

Following the Success of DAYS, we are contemplating a **WE**

Seasonal
Energy
Storage



Fill up in Spring/Fall
Use in Summer/Winter

Mobile
Disaster
Relief or
Arbitrage



Strategically located emergency response
or demand amelioration

Strategic
Energy
Reserve



Does all the oil go away? How much will be
replaced?
Equivalent 240 gallons per household.

Thank you for Listening

