Integration of Pumped Heat Energy Storage with a Fossil-Fired Power Plant

Award No. DE-FE0032031

DE-FOA-0002332, *Energy Storage for Fossil Power Generation*

AOI 1B, Phase 1 Feasibility Study

Southwest Research Institute
Applied R&D Institution

Benefiting government, industry and the public through innovative science and technology

Prime recipient

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Malta Inc.
Energy Storage Technology Developer

Meet the Future of Energy Storage

Sub-recipient

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Luminant Generation Company LLC
Fossil Asset Owner

Powered by people generating safe, reliable, and cleaner electricity for today.

Sub-recipient

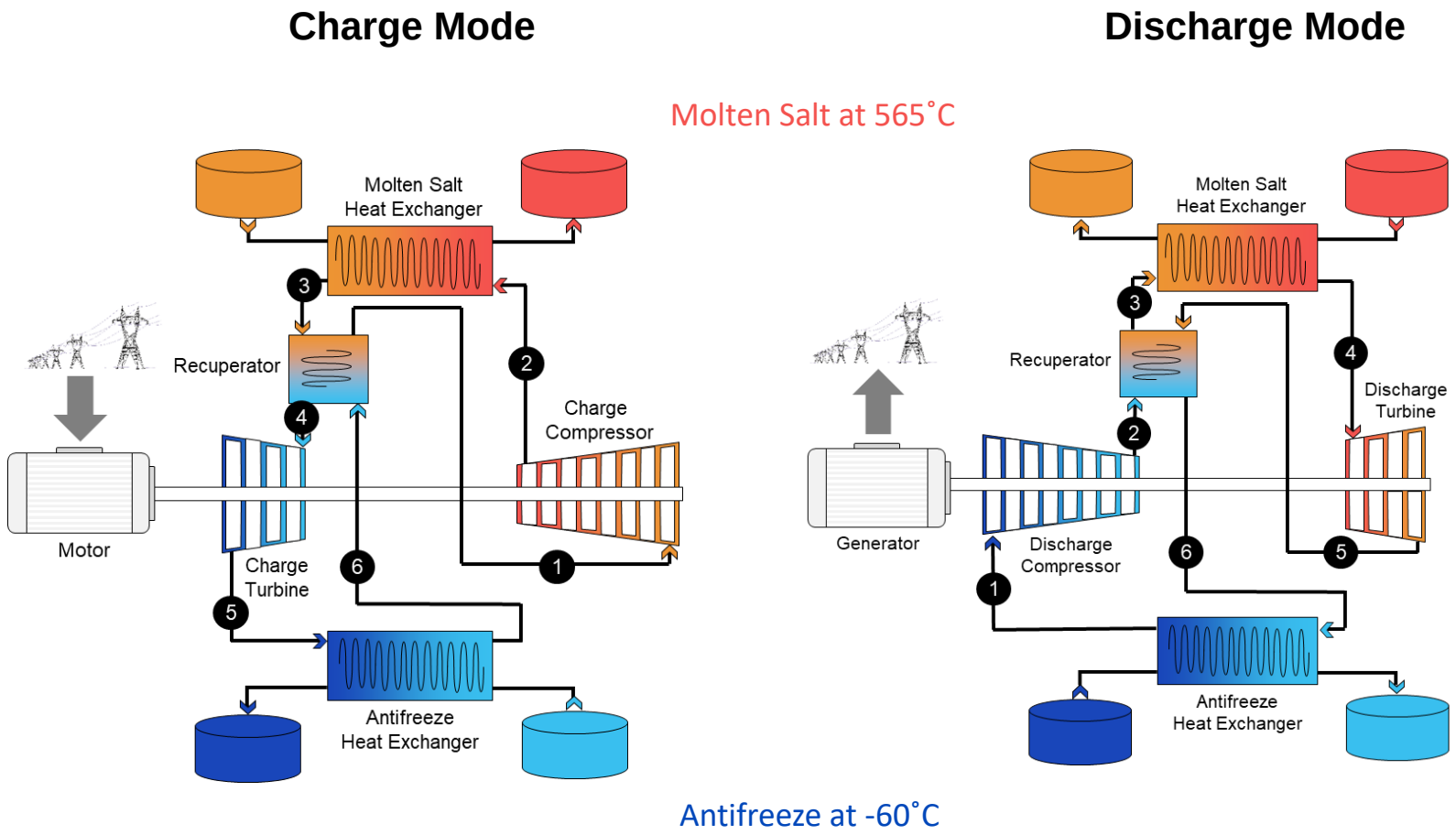
Matt Ballew

Pumped Heat Energy Storage (MPHES)

Technology:
MPHES is a long-duration, molten-salt-energy storage technology that uses turbomachinery and heat exchangers to transfer energy to and from thermal storage media

Synergy with Fossil:
Uses hardware components, workforce personnel, and skillsets similar to those used by fossil EGUs

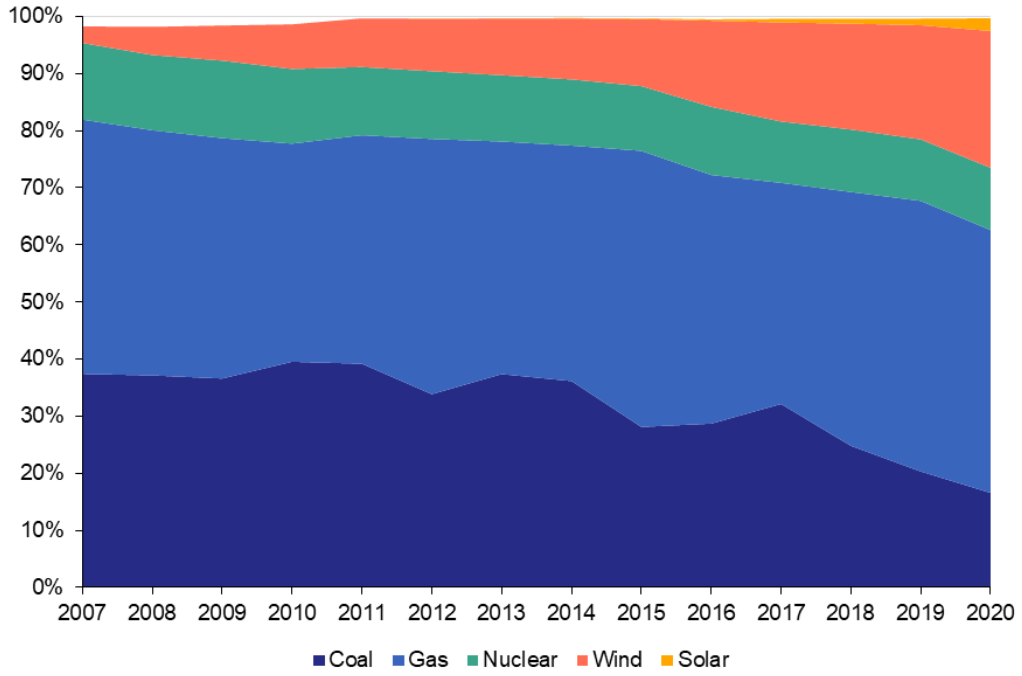
TRL & Development:
System leverages commercially available hardware



Integration with Luminant Fossil EGU in ERCOT

ERCOT

- Beginning to see a significant shift in the generation mix, as of August 2020,
  - VRE makes up 26% of the ERCOT generation mix
  - Wind energy has seen continued growth
  - Solar energy has grown to a non-zero contribution
- Market with high wind penetration
  - In 2019, ramps due to wind were experienced at 12% total generation in one hour



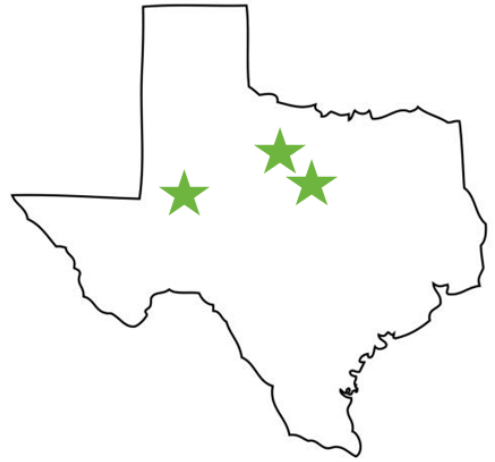
Luminant Site Selection

Three potential gas-fired power plants were identified during the proposal phase

- Two combined cycle natural gas plants with negative pricing at night
- A simple cycle peaker located near a variety of other assets

All based in North or West Texas where wind energy contributes to grid disturbances throughout the year

Site selection on-going as first major project task



Demonstrate potential value streams through a dispatching model using actual market data

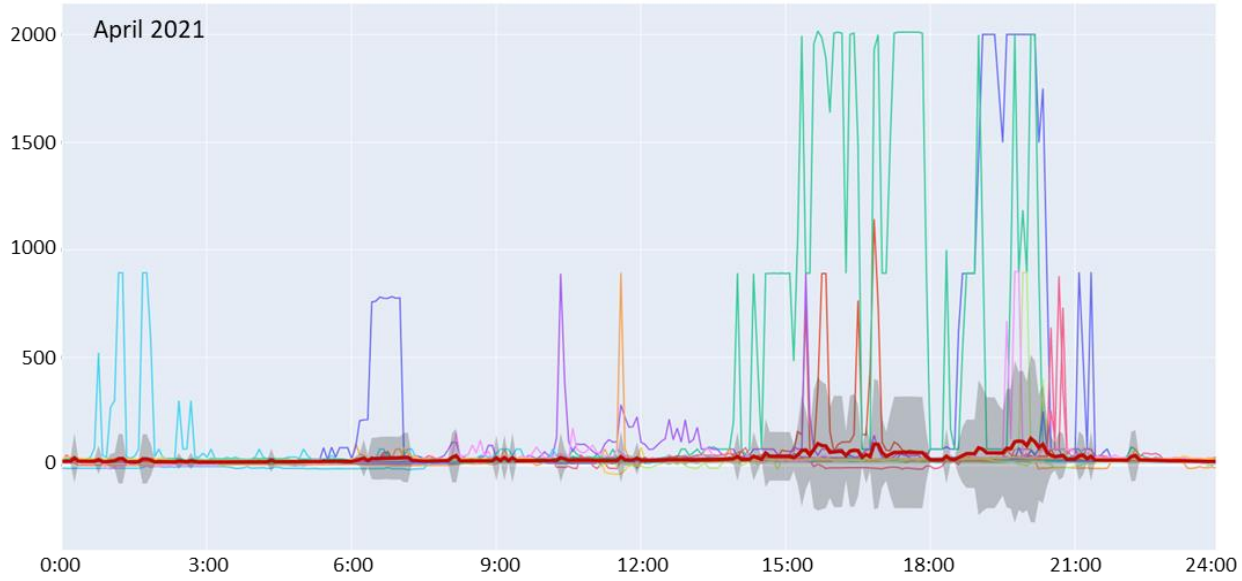
Objective: Feasibility study for the integration of a 100-MW, 10-hour Malta Pumped Heat Energy Storage (MPHES) system with a full-sized natural-gas-fired power plant

Desired Outcomes: Demonstrate potential benefits of the integrated MPHES-gas plant

- **Improved operational performance**: run with reduced cycling
- **Increased economic performance**: respond better to grid disturbances
- **Improved environmental performance**: better monitor emissions usage

Method:

Using ERCOT market pricing from the node of the selected plant, evaluating various market conditions and dispatching strategies of a MPHES integrated with the natural gas plant.



Small-Scale PHES Demonstration

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Small-Scale PHES Demo

Cycle Analysis | Facility Design | Procurement | Transient Analysis | Assembly | Commission | Test

Commission: Sept 2021

Test: Dec 2021

Objective: Demonstrate operation and ***verify control strategies of a closed air Brayton PHES*** at lab scale

Outcomes:

- Steady state and transient operation data to inform full-scale system design
  - Ambient effects
  - Sequencing considerations

- Dedicated energy storage test facility
  - Predicted RTE = 10%
  - Storage capacity for 1 hour steady state operation
  - 50 kWth
  - Discharge Mode generates 5 kW