Sand Thermal Energy Storage (SandTES) Pilot Design

- **DE-FE0032024**

Prime Recipient: Electric Power Research Institute, Inc. (EPRI)

PI: Dr. Andrew Maxson

Sub-Recipients: Technische Universität Wien (TUW); Louis Perry Group, a CDM Smith Company; Southern Company

Location: Alabama Power's Plant Gaston, AL

DOE: $199,999
Non-DOE: $50,000

Total: $249,999

Objectives

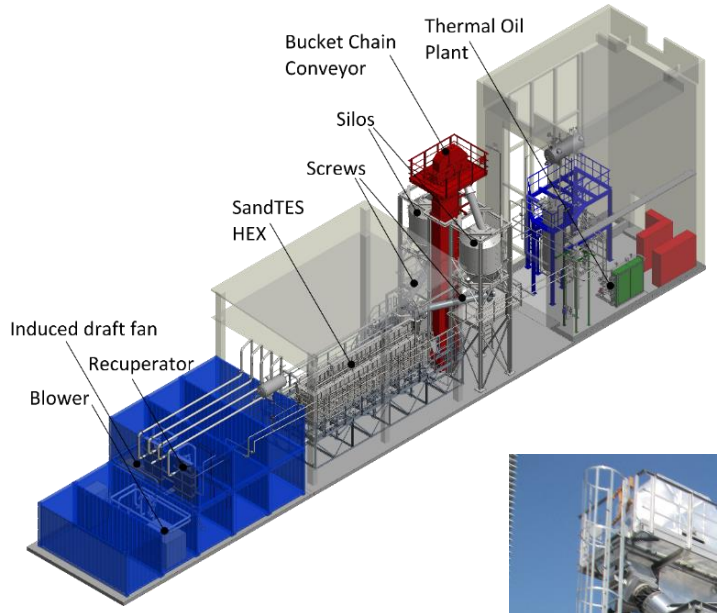
Perform a Phase I feasibility study on the integration of a SandTES system to Southern's coal-fired Plant Gaston, in preparation for a Phase II project in which a pre-front-end engineering and design (pre-FEED) would be performed for a 10 MWhe pilot. The effort serves to advance a near-term, fossil asset-integrated, energy storage solution toward commercial deployment.

Relevance and Outcomes/Impact

- Development of a workable concept that can readily be turned into a pre-FEED design, leading to a pilot demo
- Updated cost and performance for the commercial-scale SandTES integrated with a fossil power plant
- Review and assessment of potential technology gaps and a plan on how to overcome them
- Better understanding and layout of commercial plans for advancing SandTES to various markets

SandTES Overview

- SandTES developed by TUW
- Ultra low-cost material with high availability: $46/tonne
- Heat transferred to and from sand in counter-current bubbling bed heat exchanger
- Sand stored at temperature in silos to provide large storage capacity and minimize heat losses
- Significant testing on a 280-kWth pilot plant
- Potential to be a low-cost energy storage system at longer durations ~ $30/kWhe



280-kWth pilot plant

Courtesy of Technische Universität Wien

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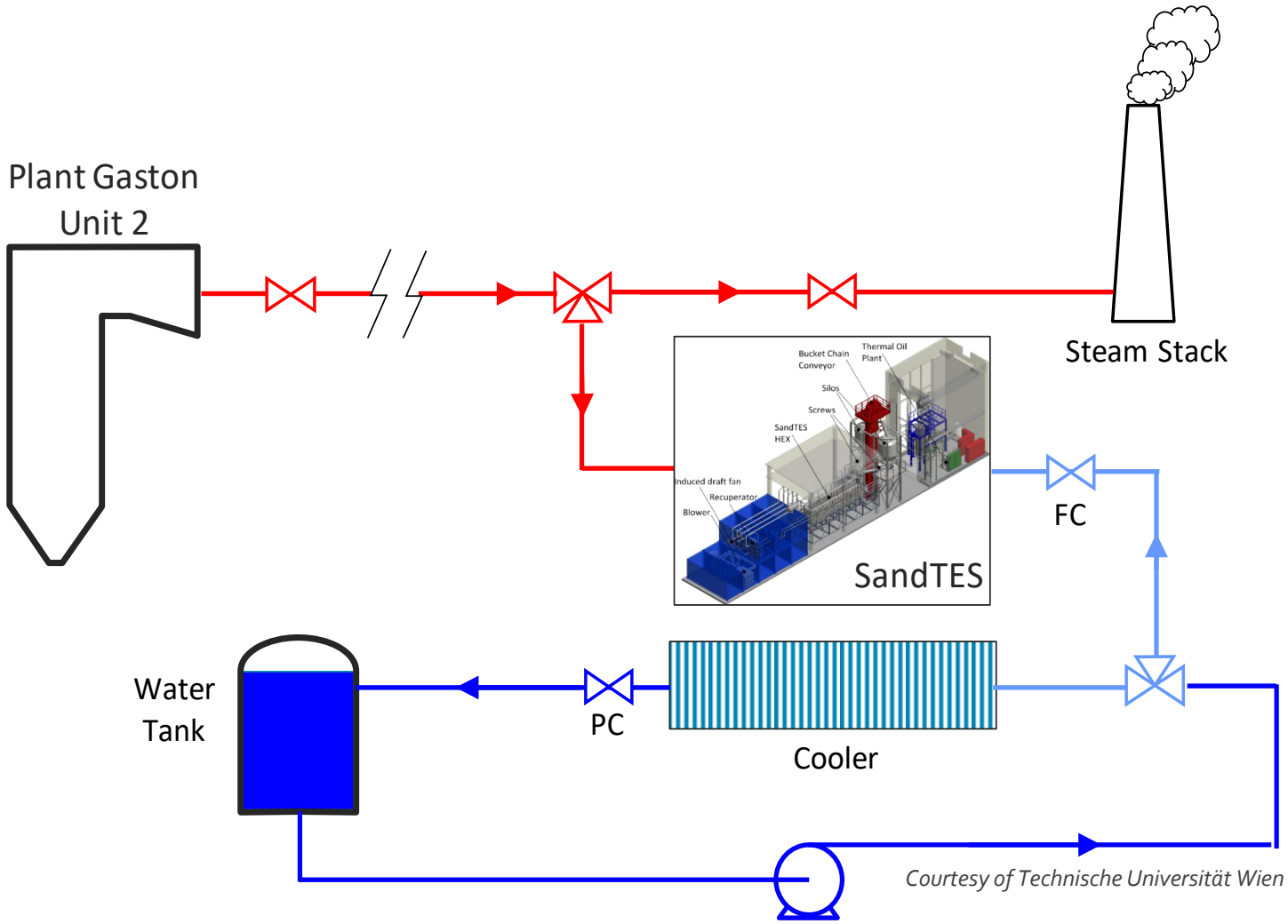
  - Integration directly into the coal-fired Plant Gaston Unit 2
  - Supercritical steam is provided for heating the sand; the sand in turn can create supercritical steam for power
  - Significant infrastructure will already be in place, reducing costs and risk



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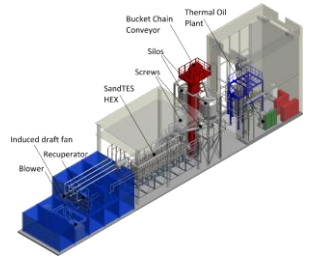

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  - Present information on how the project objectives relate to the program goals.

The objectives are aligned towards doing a pilot at 10 MWhe scale by 2025 to position SandTES to be commercially ready at 100s of MWhe scales by 2030.

  - Include quantifiable metrics that will be used to measure the success of the project (e.g., specific cost reductions or energy efficiency improvements over a baseline)

Primary metrics of interest are levelized cost of storage, capital costs, and AC-to-AC round-trip efficiency (RTE). Costs will be estimated in Phase I, and again in Phase II with more accuracy. RTE and other key operating characteristics will be measured during the proposed next-step pilot project using guidelines developed by EPRI.

  - Include the motivation for and/or meaning behind the metrics (i.e., are they derived from end user requirements? Do they relate to some documented pain-point in the industry?).

RTE and costs have been identified by the power industry as critical metrics that impact the potential benefits of energy storage systems. Other operating characteristics (e.g., startup time) will be reviewed with industry to assess their relative importance.

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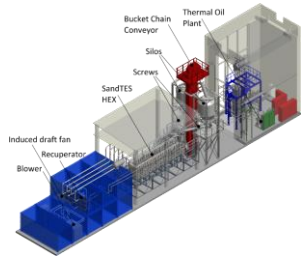

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1) Describe the use case / application for your technology.

SandTES can be applied to any thermal power plant (biomass, fossil, nuclear, and solar thermal) or use electrically-generated heat. Costs are lowered if an existing power system can be used. The facility can provide bulk energy with system inertia serving both energy and ancillary markets.

2) What is the target size/scale of the energy storage technology/module/system? What is the target for storage duration? (e.g., 4h, 10h, 24h+)

This system is intended to provide GWhs of storage at durations up to 24 hours.

3) What is the approach for addressing any outstanding or current gaps/challenges over the rest of the project?

Operational testing at the 10 MWhe scale including significant cycling will assess the operational reliability of the system and data from the pilot will improve modeling to optimize the design.

4) Are there any key commercialization/market considerations for the energy storage technology?

Obtaining power industry feedback will be critical towards better understanding the benefit case.

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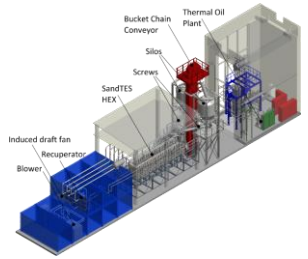

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1) What is needed to be able to pilot **a demo plant by 2025?**

SandTES has been tested at 285 kWth scale and is ready to progress to the next-step 10 MWhe scale. The site at Plant Gaston will already have existing infrastructure in place to integrate SandTES to a coal unit based on a prior DOE project, reducing risk. If the proposed pilot project receives DOE funding in the 2023 timeframe, the 10 MWhe demo can be implemented by 2025 and set the stage for a next-step commercial plant by 2030.

2) What does NETL need to consider regarding a **low-carbon future**?

Energy storage is a key enabler for a low-carbon future. As more variable renewable energy (VRE) is installed and fossil is displaced, energy storage will be needed to provide grid stability and reliability. As VRE grows, its impact on the grid, which needs to be protected from intermittency and lack of inertia, will change the demands on energy storage, largely in size and duration and potentially operating characteristics. Systems with longer duration that provide inertia will be key.

3) How can NETL help **transition coal assets** as they retire over the next 10–15 years?

SandTES integrated to a coal asset can utilize heat from coal combustion to drive the steam power island, then continue to utilize the power island through heat generated from electricity (via added electrical heaters) off the grid after the coal is retired.

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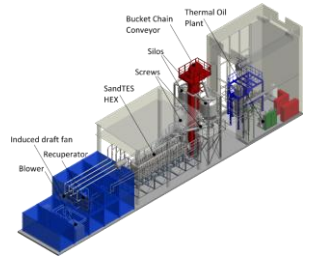

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Discussion:

1) What is the value of longer-duration energy storage and what must happen in the markets for these systems to be viable?
2) Will owners invest in operating fossil power plants?
3) Will there be a need for multiple types and durations of energy storage in a portfolio? Is there a play outside of batteries and hydrogen?

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Contact Information

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