

# Phase I: Natural Gas-Based Energy Storage at Abbott Power Plant



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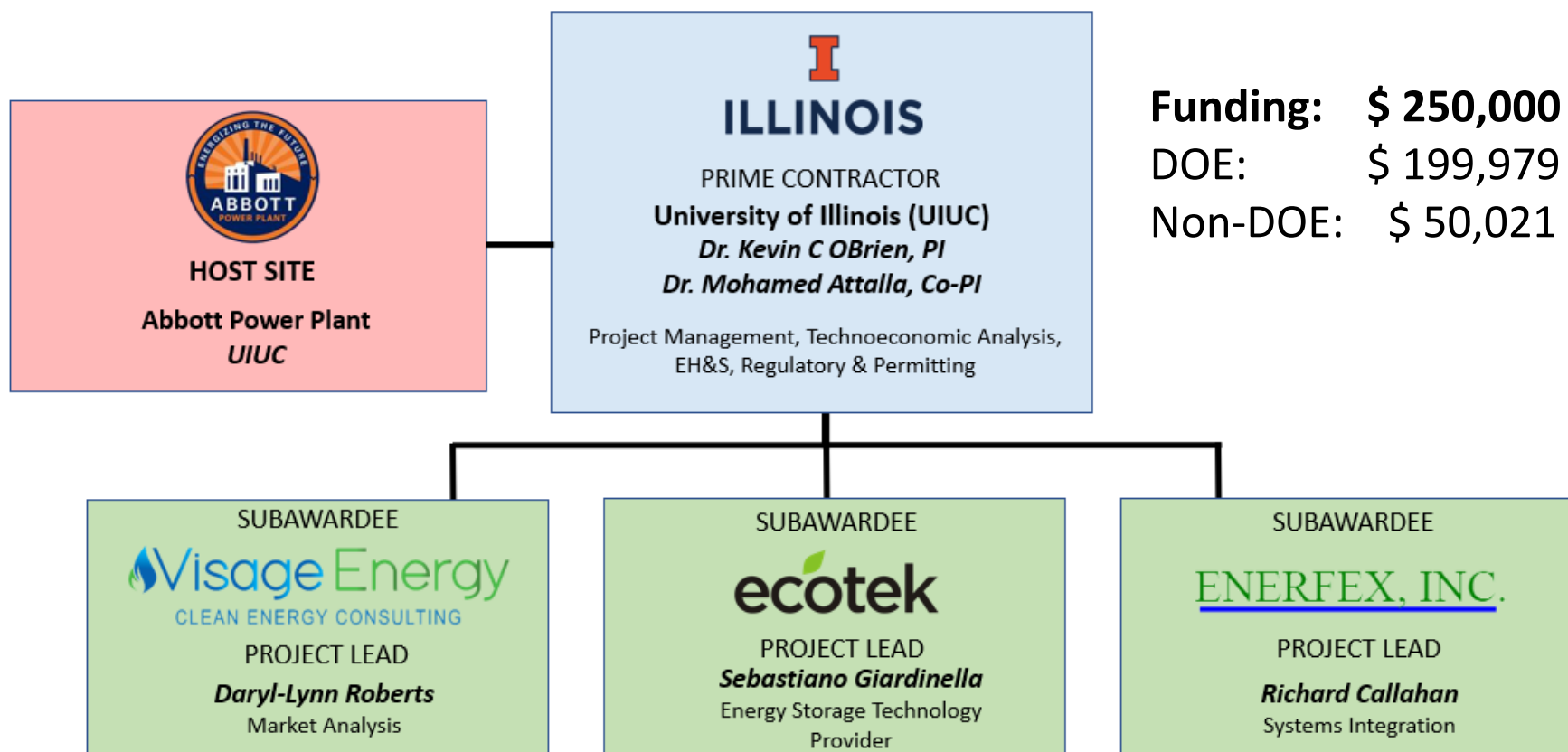
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# Project Team Management Structure

*Leverages the experience of team members*



# Program Goals and Project Objectives

*Utilize fossil assets and fossil fuels in a new manner*

## PROGRAM GOALS

- Advance energy storage technology (ES tech)
- Integrate ES tech with fossil assets
- Reduce barriers to wide-spread deployment of ES tech

## PROJECT OBJECTIVES

- Feasibility analysis for 10 MWh Compressed Natural Gas Energy Storage (CNGES) at Abbott Power Plant
- Develop results that will enable transition to Phase II (detailed design, build, operate) of a 10 MWh energy storage facility
- Demonstrate applicability to existing power plants and especially Combined Heat and Power (CHP) plants
- Evaluate techno-economics of CNGES and model its impact on a grid with increasing renewable energy assets

# Relevance and Outcomes / Impact

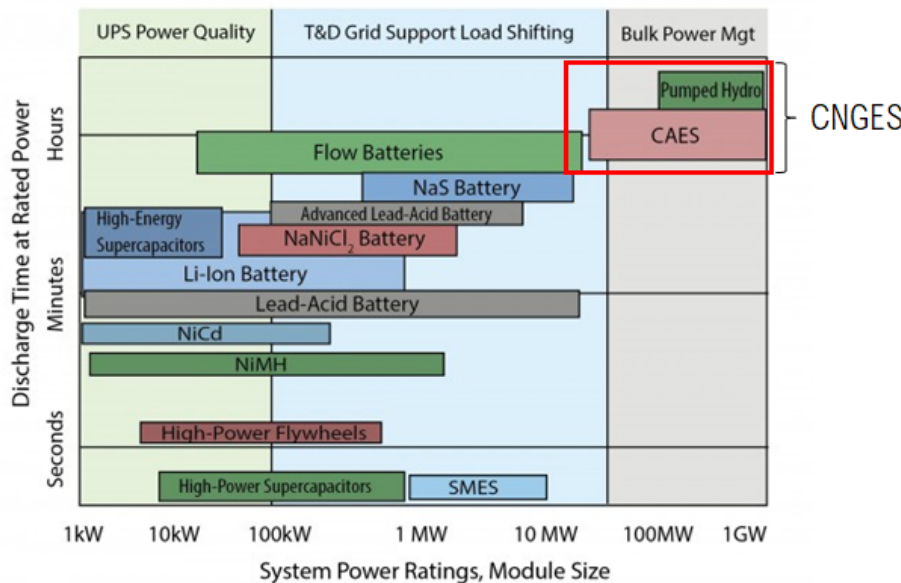
## *Utilize fossil assets and fossil fuels in a new manner*

- Co-locates energy storage technology with a fossil energy asset “within the fence line” (*future roles for fossil assets*)
- Existing natural gas pipeline provides a ready source for the required natural gas for CNGES
- Demonstrates means to utilize natural gas in a mode that does not result in combustion of the gas (*future applications of fossil fuels*)
- Use of existing “off-the-shelf” equipment and known d permitting requirements enables smooth transition to Phase II demo (*achieve 2025 demo target*)
- Demonstration of CNGES at Abbott Power Plant provides a means for other coal and nature gas plants to understand the advantages and challenges of integrating energy storage with their plant (*demonstration site for CNGES*)
- University setting enables ready forum to exchange information with large scale power plants



# Advantages of the Technology

## Benefits over other energy storage options



Source: Center for Sustainable Systems, University of Michigan. 2020. "U.S. Grid Energy Storage Factsheet." Pub. No. CSS15-17

### CAES

Runs on Air: Electricity prices pay for compression, storage and energy recovery.

Underground storage requires development of new fields (risk of failure due to lack of suitable locations – best locations may already be in use for natural gas storage)

Aboveground storage requires vessels designed and constructed for that purpose.

### CNGES

Runs on Natural Gas: Gas prices pay for compression and storage. Electricity prices pay for energy recovery.

Underground natural gas storage widely developed across U.S., in many cases close to key locations.

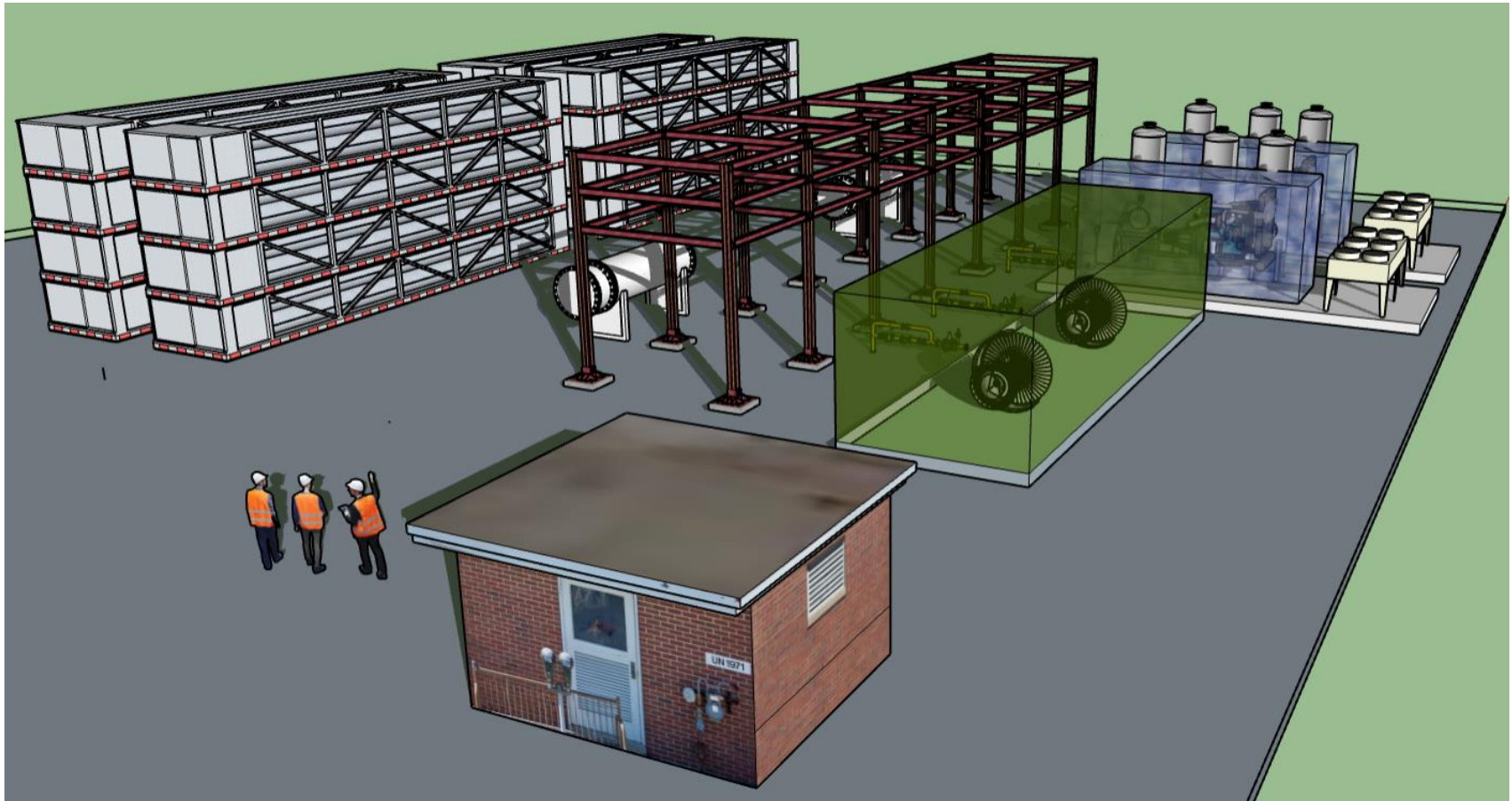
Existing pipelines (using linepack) or CNG trailers may be used for storage.

|                               | Li-ion Battery* | Pumped Hydro* | CAES*       | CNGES (estimate) |
|-------------------------------|-----------------|---------------|-------------|------------------|
| Capital cost, power (\$/kW)   | 1,570-2,322     | 1,700-3,200   | 1,050-2,544 | 600 – 2,100      |
| Capital cost, energy (\$/kWh) | 393-581         | 106-200       | 94-229      | 100-350          |
| Round-trip efficiency         | 0.86            | 0.80          | 0.52        | 0.55-0.65        |
| Cycles at 80%                 | 3,500           | 15,000        | 10,000      | 10,000           |
| Life (years)                  | 10              | >25           | 25          | 25               |

\*Data from Mongird, K., Viswanathan, V., Baldacci, P., Alam, J., Fotedar, V., Koritarov, V., & Hadjerioua, B. (2019). Energy Storage Technology and Cost Characterization Report (PNNL-28866) Pacific Northwest National Laboratory.

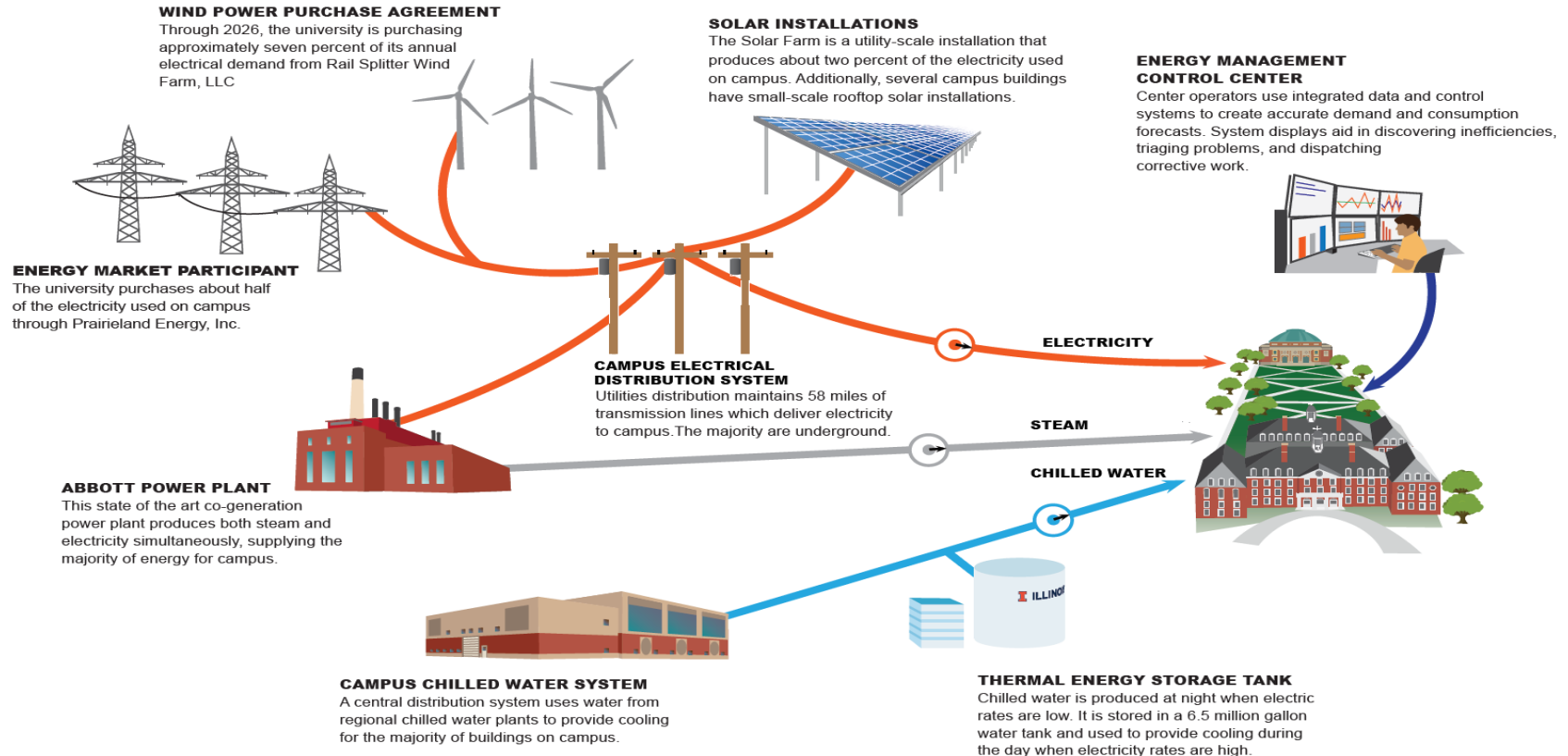
# Natural Gas Energy Storage

*3D Rendering of proposed on-site facility*



# Abbott Power Plant and University of Illinois Grid

*Excellent host site since combines renewables with coal and natural gas asset*

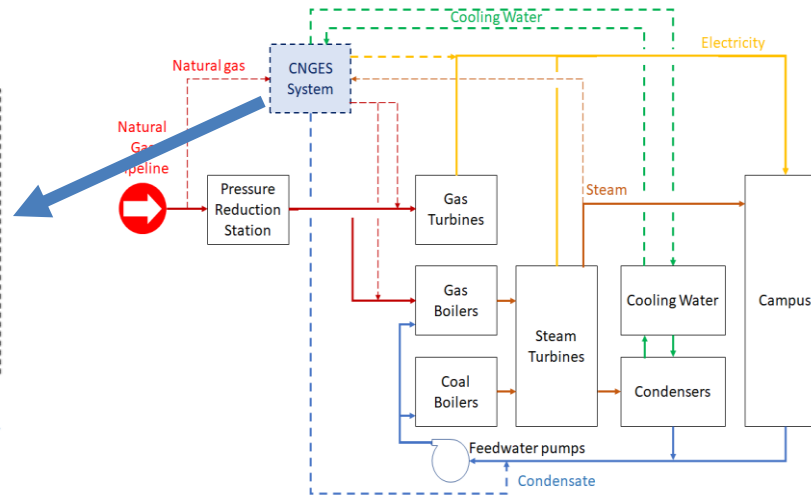
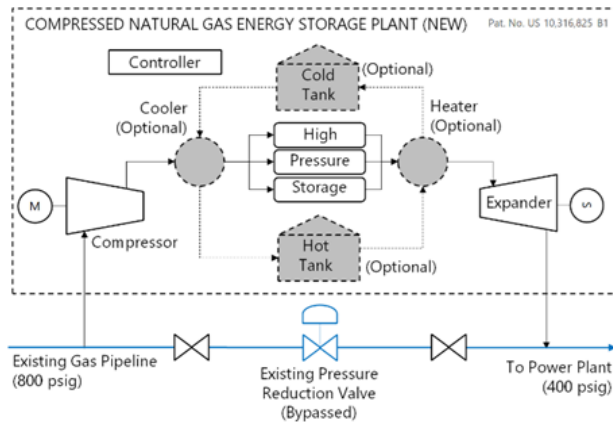


*University of Illinois has been modeling the impact of running the fossil plant in a load following mode to back up renewables*



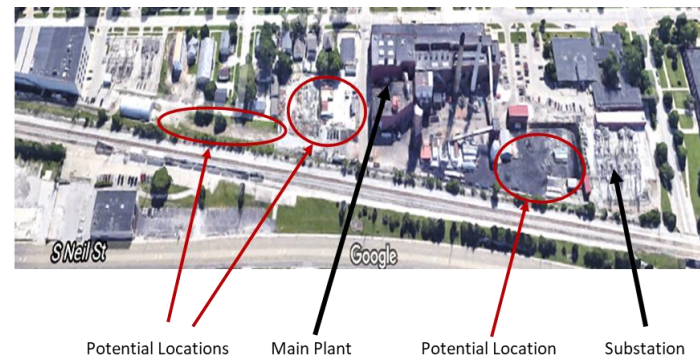
# CNGES and Its Integration with the Plant

## Preliminary analysis indicates feasibility



CNGES system  
Integrates well  
with Abbott  
Power Plant  
for both coal  
and natural  
gas side of  
plant

## Space available to locate the CNGES system



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

- Phase II should be designated as a design, build, operate with the pilot demo plant as a deliverable
- If executed properly, Phase I results should enable an easy transition to the Phase II listed above

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

- Traditional fossil assets and their associated infrastructure still have a vital role – though it may be different from past roles
- Fossil assets need to load follow as penetration of renewables increase
- Energy storage imparts grid resilience
- Centralizing energy storage facilities leverages existing infrastructure and capabilities
- Carbon Capture, Utilization and Storage (CCUS) MUST be part of this future

### **How can NETL help transition coal assets as they retire over the next 10-15 years?**

- Fund R&D that specifically addresses means to re-purpose / utilize these assets
- Fund R&D for “Hybrid” coal plant of the future that has CCUS and energy storage and considers renewables as part of the grid that it serves (e.g. Coal FIRST)

### **Is there a particular topic, issue, or area of need that NETL should be aware of?**

- R&D designed with the goal of deploying a demo is critical and must continue
- More work integrating fossil assets with renewables in a way to achieve net zero CO<sub>2</sub> emissions
- Energy-water nexus: need to specifically address

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