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Utilizing Stored Hydrogen for Load-Following in Central Power Generation

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G. (Subbu) Subbaraman, Ph. D

Institute Fellow & Project Development Director

Hydrogen Technology Center, GTI Energy

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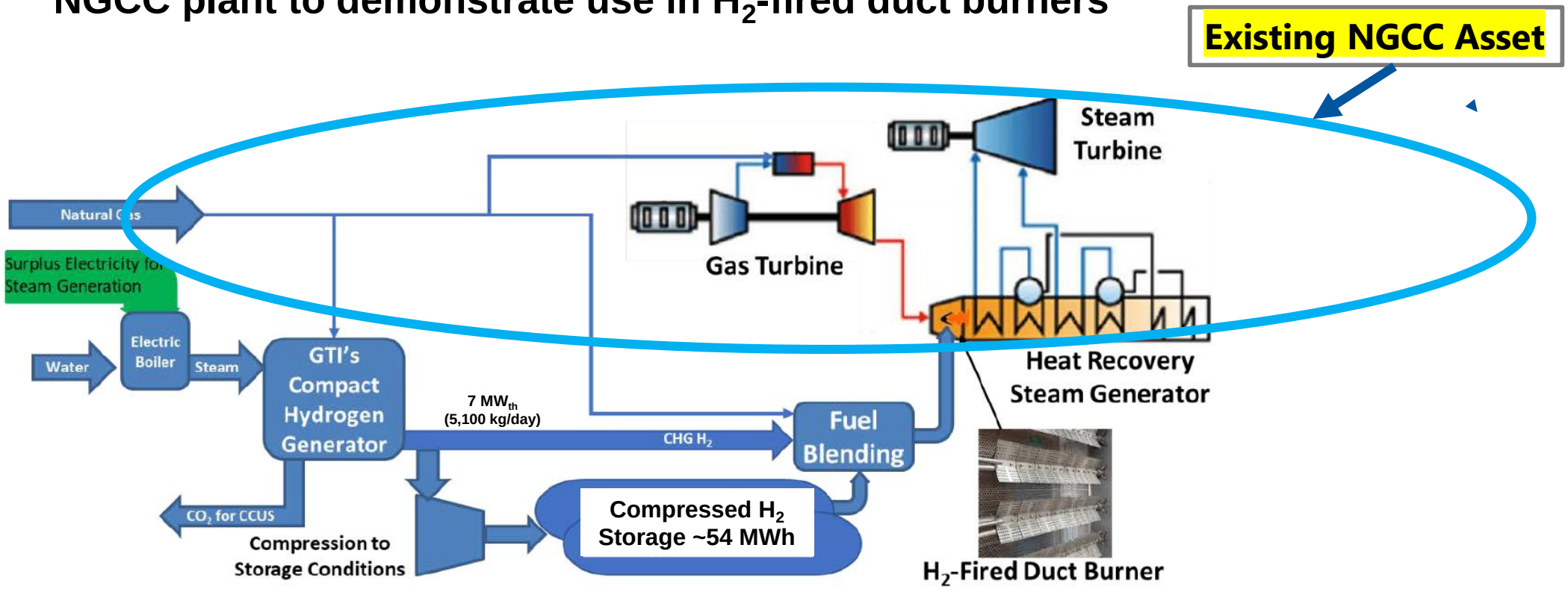
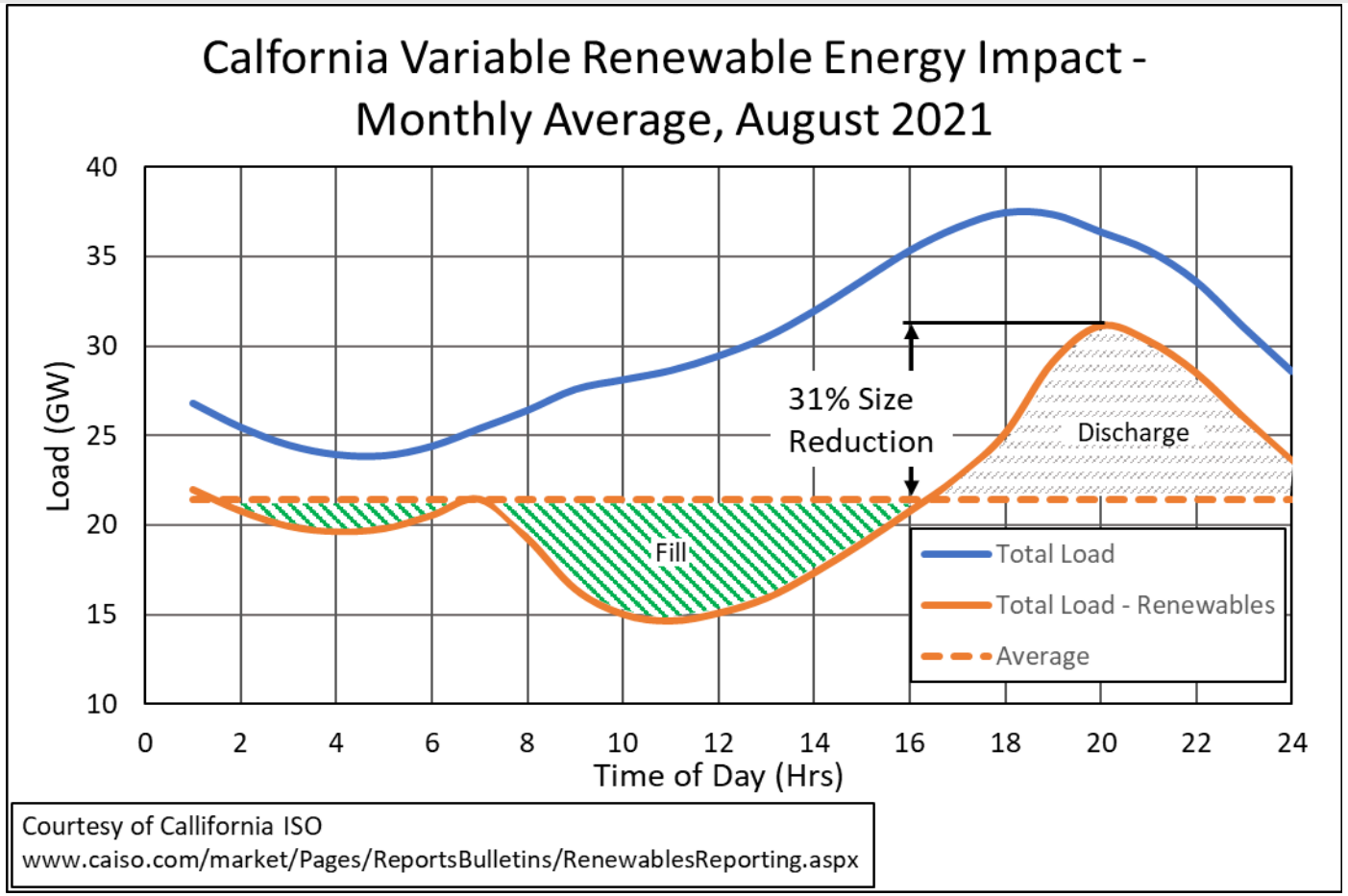
Hydrogen Storage for Load-Following and Clean Power

- Integration of on-site H_2 production and storage at an existing NGCC plant to demonstrate use in H_2-fired duct burners



H_2 Storage Benefits

- **H_2 storage minimizes the size of the hydrogen generation system by adding capacitance to the system.**
  - **Potentially lowering overall cost (plant size reduction vs. H_2 storage costs[1])**
  - **Favorable impact on utilization of existing fossil assets with increased Variable Renewable Energy (VRE)**
- **Further benefits include adding H_2 from other sources (e.g., from curtailed renewable electricity) and its use in other applications (vehicles, heating, etc.)**



[1] Reference: Ahluwalia, R. K., et. al., *System Level Analysis of Hydrogen Storage Options*, U.S. DOE Hydrogen and Fuel Cells Program 2019 Annual Merit Review and Peer Evaluation Meeting, Washington D.C. April 29-May1, 2019, Project ID: ST001

Existing Fossil for Integration of H_2-Fired Duct Burner System

- Southern Company Services' (SCS) Washington County Plant site selected
  - Co-generation plant
  - 1x1 natural gas combined cycle
  - GE 7EA gas turbine
  - Generating capacity of 122,579 kW
- Plant supplies steam to a neighboring customer
  - Same customer produces hydrogen utilized in the duct burner of the HRSG
  - Limits physical/procedural modifications required
- Barry plant is a backup

Planned Phase 2 (Pre-FEED) Project under DE-FE0032008

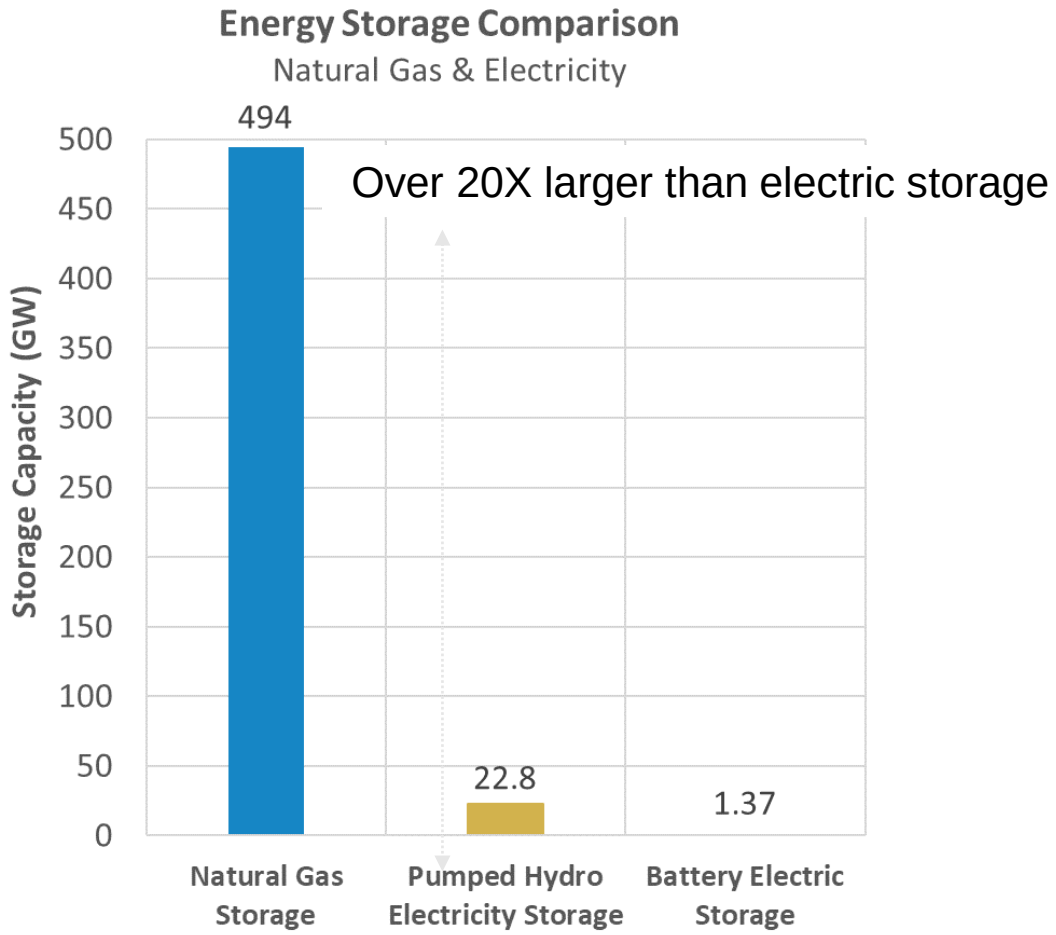
Project Partners

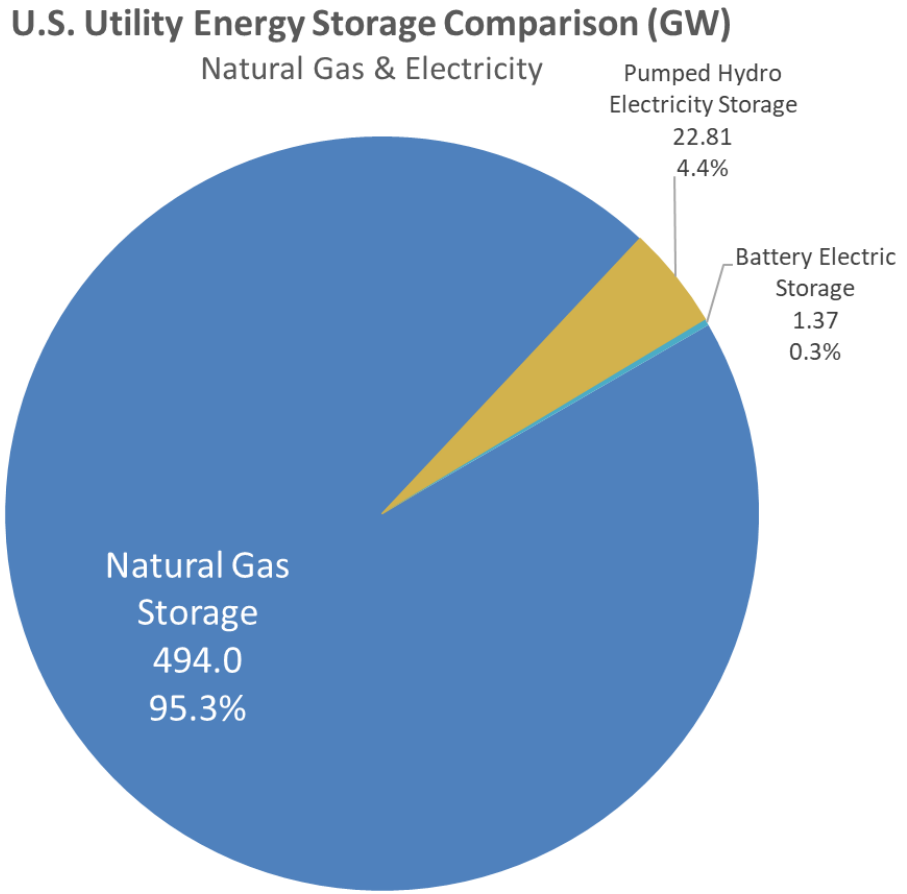
- **GTI Energy - Rich history in gas and energy supply, conversion, delivery, and utilization**
  - **Nearly 80 years of experience in managing energy research projects and has an annual research portfolio of over $150 million**
- **EPRI - Addresses challenges in the electricity sector including reliability, efficiency, affordability, health, safety, and environment**
  - **50 years of experience energy research and has portfolios of programs related to coal & natural gas power generation systems, renewables (including storage), distributed energy, and end use**
- **Southern Company - Premier energy company with 46,000 MW of generating capacity**
  - **Nearly 200,000 miles of electric transmission/distribution lines & 80,000 miles of natural gas pipeline**
  - **One of the very few U.S. utilities with a vertically integrated R&D organization including the National Carbon Capture Center (NCCC)**
- **PG&E - Gas and Electric Power groups are keen in decarbonizing their fleet**
  - **Provide utility perspective on hydrogen production and usage markets as it applies, in particular, in seasonal replenishment/makeup of their imported renewable power in their service region**
- **EPRI and GTI Energy have also developed the Low-Carbon Resources Initiative (LCRI), a five-year, collaborative effort supported by major electric and gas companies**
  - **Advance technologies needed for decarbonization so they can be deployed in 2030-2050**

Summary

- **Overall objective: Investigate feasibility of energy stored in the form of hydrogen for load-following at an existing NGCC asset**
  - **Hydrogen produced from natural gas and Variable Renewable Energy (VRE)**
- **Hydrogen charge/discharge/re-charge through duct burners to accommodate load demands with CO_2 emissions reductions**
- **Phase 1 Study results have defined subsystems capable of 54 MWh storage integrated with existing NGCC plant (higher than DOE target)**
- **Team has selected Southern Co. site and EPC and vendor for Pre-FEED**
- **Project is underway**

Food for Thought





Leverage Gas Infrastructure and Subsurface Geology for Affordable H_2 Storage @ Scale