



U.S. DEPARTMENT OF  
**ENERGY**



# Retrofittable Advanced Combined Cycle Integration for Flexible Decarbonized Generation

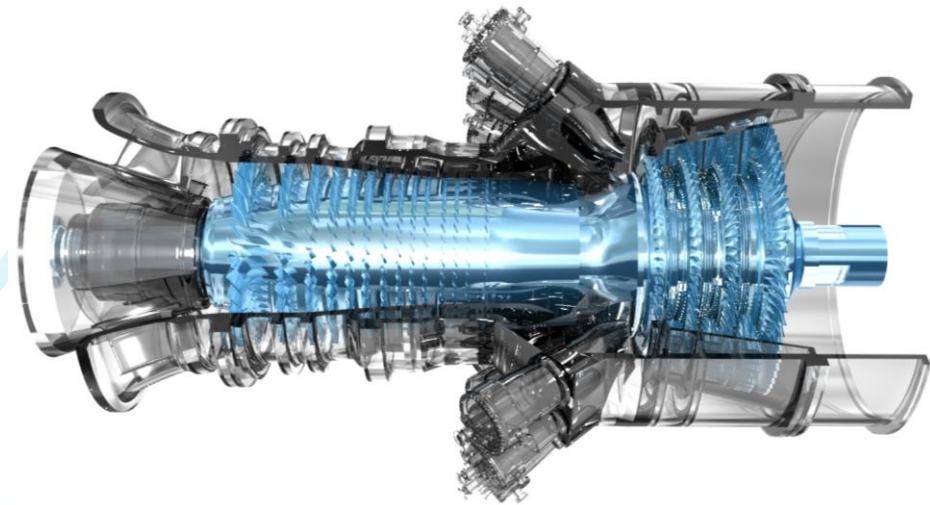
2022 Carbon Management Review Meeting

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# BUILDING TOWARDS ZERO... A ZOOM ON CCUS



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## DOE AWARD FOR CCS FEED STUDY

### “Retrofittable Advanced Combined Cycle Integration for Flexible Decarbonized Generation”

- FEED study to integrate carbon capture storage with an existing NGCC plant (2x1 7F.04 Plant Barry 6 in Bucks AL)
- GE led team to focus on minimizing capture impacts via advanced integration & controls to preserve the NGCC attributes of operability & flexibility
- Template for lowering CO<sub>2</sub> emissions for the largest gas turbine fleet

Award Prime Recipient: GE Gas Power  
Sub recipients: Linde, Southern Company  
Major Vendor: Kiewit



## 2 INTEGRATION

Maintain NGCC operability & flexibility for better integration with future renewable led grid

## 3 IMPROVED CO<sub>2</sub> EXHAUST INTENSITY FEASIBILITY

 Alabama Power

 Southern Company

## 1 95% CARBON CAPTURE

   
We create chemistry

 Kiewit



# Project Overview

## Problem Statement:

Current State of the Art CCS designs have not explored integration into NGCC plants, missing major technical risks to operation of NGCC plants and major opportunities to improve and enhance the technical and economic viability of CCS in a modern NGCC plant.

## Objectives

GEGP will investigate integration concepts leading to a single NGCC/CCS configuration and conclude with a detailed design, TEA, and LCA focused on integration of CCS with the NGCC power plant. Milestones have been identified to track progress on improving CCS economic viability thru the course of the Project.



## GEGP will focus on 2 primary Objectives to be completed thru the execution of this CCS FEED Study:

- Identify CCS integration and operation risks and recommend solutions to eliminate or manage Risks
- Identify GT, ST, HRSG, and Plant CCS integration concepts that lead to improved CCS economic viability

# Project Objectives & Technical Approach

## Overall Objective

- **Objective** The Recipient (GEGP) will design and integrate a “Gen2” post-combustion 95% Carbon Capture System (CCS) system into an existing domestic Natural Gas Combined Cycle (NGCC) power plant with emphasis on optimized plant integration and performance, reduced CCS cost, and increased operability/flexibility to accommodate and complement renewable power sources.

## Technical Approach – Multiple Phases to Technical Work

### Phase 1 –

#### Down-select Best Configuration

- GT Improved CO<sub>2</sub> Exhaust Intensity
- Other GT Modifications to maximize CCS utilization
- HRSG tie-in to CCS
- Steam Turbine Modifications for tie-in to CCS

✓ Does the Modification Create unmanageable Risk?

✓ Does the Modification Reduce Existing Risk?

✓ Does the Modification Significantly Improve CCS Success Criteria?

### Phase 2 -

#### Detailed Design

- GT, HRSG, ST Modifications Design
- ISBL (Core CCS) Detailed Design
- OSBL (ISBL interface with Plant)
- Modification of Existing BOP systems

### Phase 3 -

#### Detailed Costing

- GT, HRSG, ST Modifications
- ISBL (Core CCS)
- OSBL (ISBL interface with Plant)
- Modification of Existing BOP systems
- Construction and Commissioning
- Total Plant Cost Roll-up (-20%/+30%)

### Phase 4 -

#### Post Design Assessments

- Detailed LCOE/TEA
- EH&S Risk Assessment
- Operability and Startup/Shutdown
- Environmental Justice
- Jobs Impact
- Project Final Report

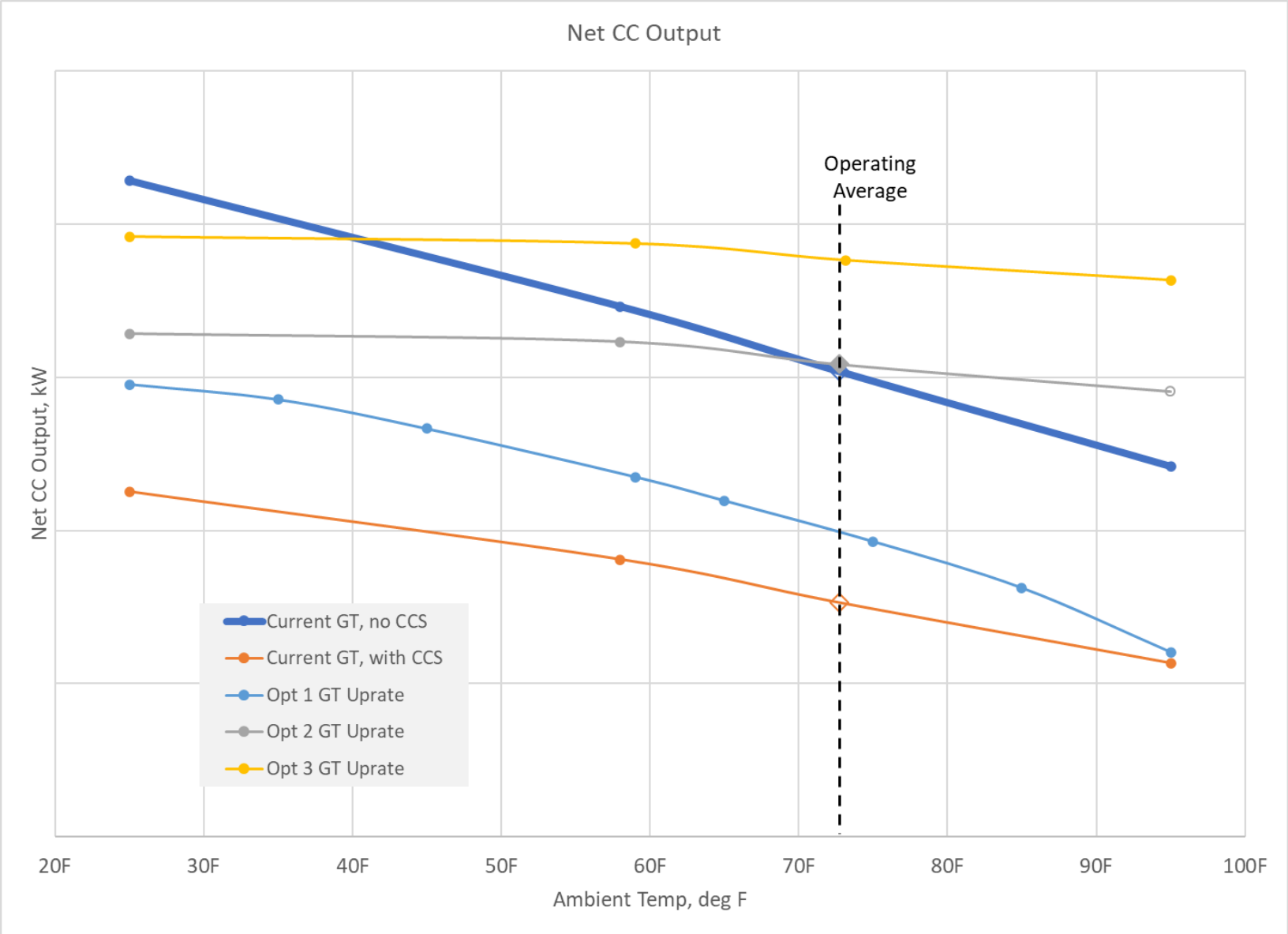
**Periodic Milestones: CC Net Efficiency, LCOE, Break Even CO<sub>2</sub> Sales Price**



# Progress to Date:

## Performance

Performance run across ambient operating space  
Performance run for current GT (with and without CCS),  
and several GT Uprates  
Based on expected Operating Profile, CC Net  
performance drops ~12-16% MW due to CCS, from both  
the reduced ST Generator output (caused by large CCS  
steam extraction) and the large new CCS Aux Loads



# Progress to Date (continued):

## **Improved CO<sub>2</sub> Exhaust Intensity**

Focused on Elevated CO<sub>2</sub> design

- Design work progressing on selected configuration
- Combustion recommends future Lab test
- Will require significant combustor operability
- Will require tightly integrated GT controls to manage operability and GT combustion dynamics
- Drives significant reduction in CCS vessel count, footprint and installed cost

## **GT, ST, and HRSG Upgrades**

GT:

- Inlet Filter House and Combustor mods for Elevated CO<sub>2</sub>
- Optional GT upgrades to recover some or all of 'lost' CC output

ST:

- Modified LP steam path (reduced flow capacity)
- New Butterfly Crossover Control Valve
- Distributed steam supply to limit section pressure ratios
- Review Impacts of Optional GT upgrades

HRSG:

- LP SH – direct integration to CCS
- Stack tie-ins for CCS
- Review Impacts of Optional GT upgrades



Thank You



Questions?