NETL Carbon Utilization Project Review Meeting

# Carbon Utilization and the National Carbon Capture Center

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U.S. DEPARTMENT OF ENERGY | NATIONAL ENERGY TECHNOLOGY LABORATORY

NATIONAL CARBON CAPTURE CENTER

# National Carbon Capture Center

- **Sponsors:** U.S. Department of Energy and its National Energy Technology Laboratory
  - DOE's primary carbon capture research facility since 2009
- **Partners:** Electric Power Research Institute, power/energy industry leaders
- **Managed/operated by:** Southern Company
- **Location:** Wilsonville, Alabama
- **Infrastructure:** Real-world power plant operating conditions – coal and natural gas
- **Expertise:** Technical staff for design, installation, testing support and analysis
- **International collaboration:** Co-founder of International Test Center Network

# Major Accomplishments and Future Scope

- 110,000+ test hours of testing over last decade
- 60+ technologies tested / developers from 7 countries
- Post-combustion accomplishments:
  - ✓ Continuous expansion – alternative regeneration, gas injection, analytical support
  - ✓ Advanced solvents, membranes, solid sorbents
    - 16 technologies in queue to test / 7 technologies scaled up (or ready) to 10+ MW

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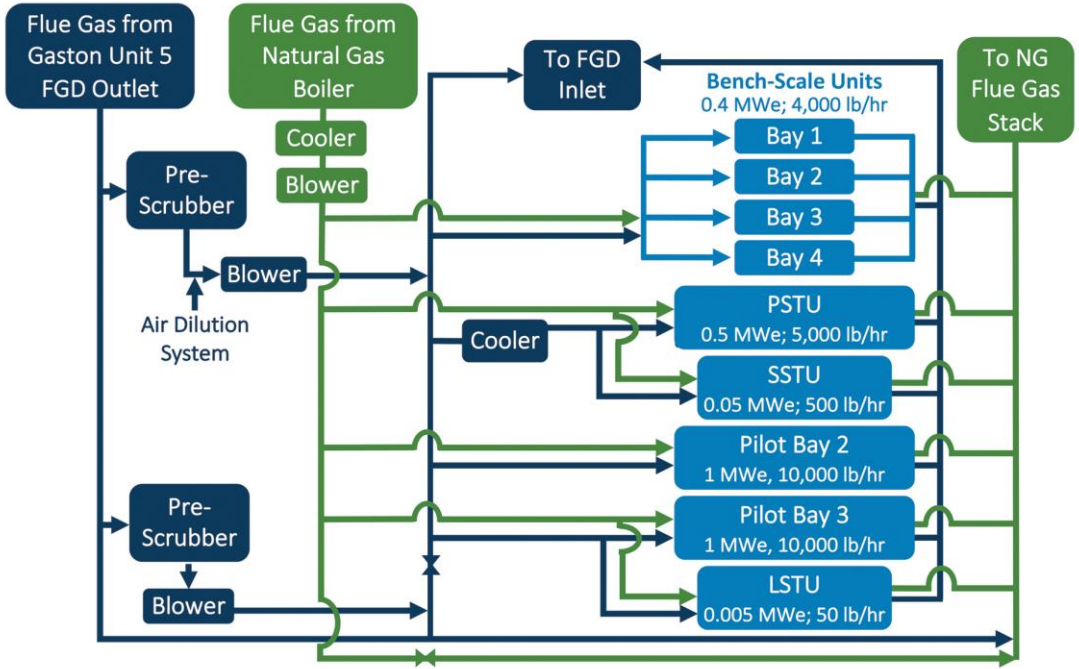
**Reduced cost of $CO_2$ capture from fossil generation by 1/3**

**Oct. 1, 2020 – 5-Year Agreement Renewal / $140 Million**

Expanding scope to $CO_2$ capture for natural gas power, $CO_2$ utilization, direct air capture

# Utilization Capabilities

## Test Bay Configuration




## Test Bays

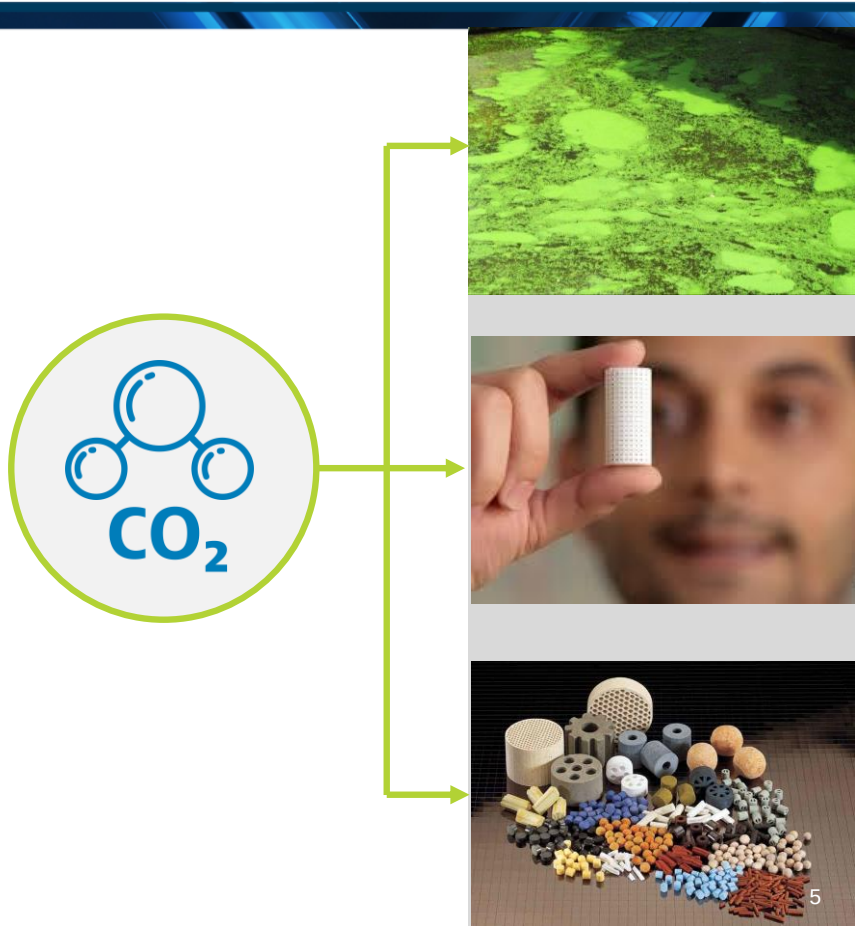
**Lab-Scale**
Indoor, tabletop-size units

**Bench-Scale**
Outdoor units up to ~15’ x 25’

**Pilot-Scale**
Outdoor units up to 50’ x 75’

# Exploring $CO_2$ Utilization Technologies at NCCC

- NCCC is a preferred host site for DOE utilization research funding opportunities
- NCCC is engaging developers in a variety of utilization technology areas
  - $CO_2$ conversion to biomass via agriculture/ aquaculture
  - Synthesis of fuels and organic chemicals
  - Conversion of $CO_2$ to inorganic products, i.e., construction materials
  - Synthesis of inorganic materials and chemicals
  - $CO_2$ as working fluid for EOR and as solvents and refrigerants



# Potential $CO_2$ Utilization Infrastructure Additions

- Three possible scopes:
  1. Captured $CO_2$ header
  2. Captured $CO_2$ header with $CO_2$ gas storage
  3. Captured $CO_2$ header with $CO_2$ liquid storage
- Scopes 1-3 increase flexibility of $CO_2$ supply for utilization projects, but obviously increase cost as well
- Also evaluating possibilities of pairing capture and utilization projects that have synergies

# Current $CO_2$ Utilization Demonstration Projects at NCCC

| Southern Research | Carbon Upcycling UCLA | Helios-NRG |
|---|---|---|
| **Ethylene production using coal-fired flue gas** | **$CO_2$ mineralization to produce concrete** | **Algae technology to utilize $CO_2$ for value-added products** |
| • Thermo-catalytic process<br>• Uses nanoengineered low-cost catalyst<br>• Advantages over commercial steam<br>• Co-production of CO-rich syngas | • Convert waste gas into pre-cast concrete building components<br>• Potential for utilization of off-spec fly ashes<br>• $CO_2$ utilization into concrete without $CO_2$ capture step<br>• Carbon XPRIZE finalist | • Grow dense populations of algae quickly while capturing 70%+ of $CO_2$<br>• Utilize algae products to reduce overall $CO_2$ capture cost<br>• Advance DeAqua technology for dewatering<br>• Validate capture efficiency |
| SR SOUTHERN RESEARCH | UCLA | Helios-NRG, LLC |

# Potential Benefits of Testing DAC Technologies at NCCC

- Existing balance of plant infrastructure, i.e., steam/heat, cooling water, electricity, etc.
- Existing analytical support and equipment
- Existing permitting in place
- Capability to test both DAC and capture from concentrated sources (or hybrid concepts)
- Experienced design, engineering, O&M and support personnel to assist in technology scale-up, process and infrastructure modifications, test operations, troubleshooting, and evaluation.

# Thank You

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