

# Advanced Carbon Capture Testing at the National Carbon Capture Center (FE0022596)

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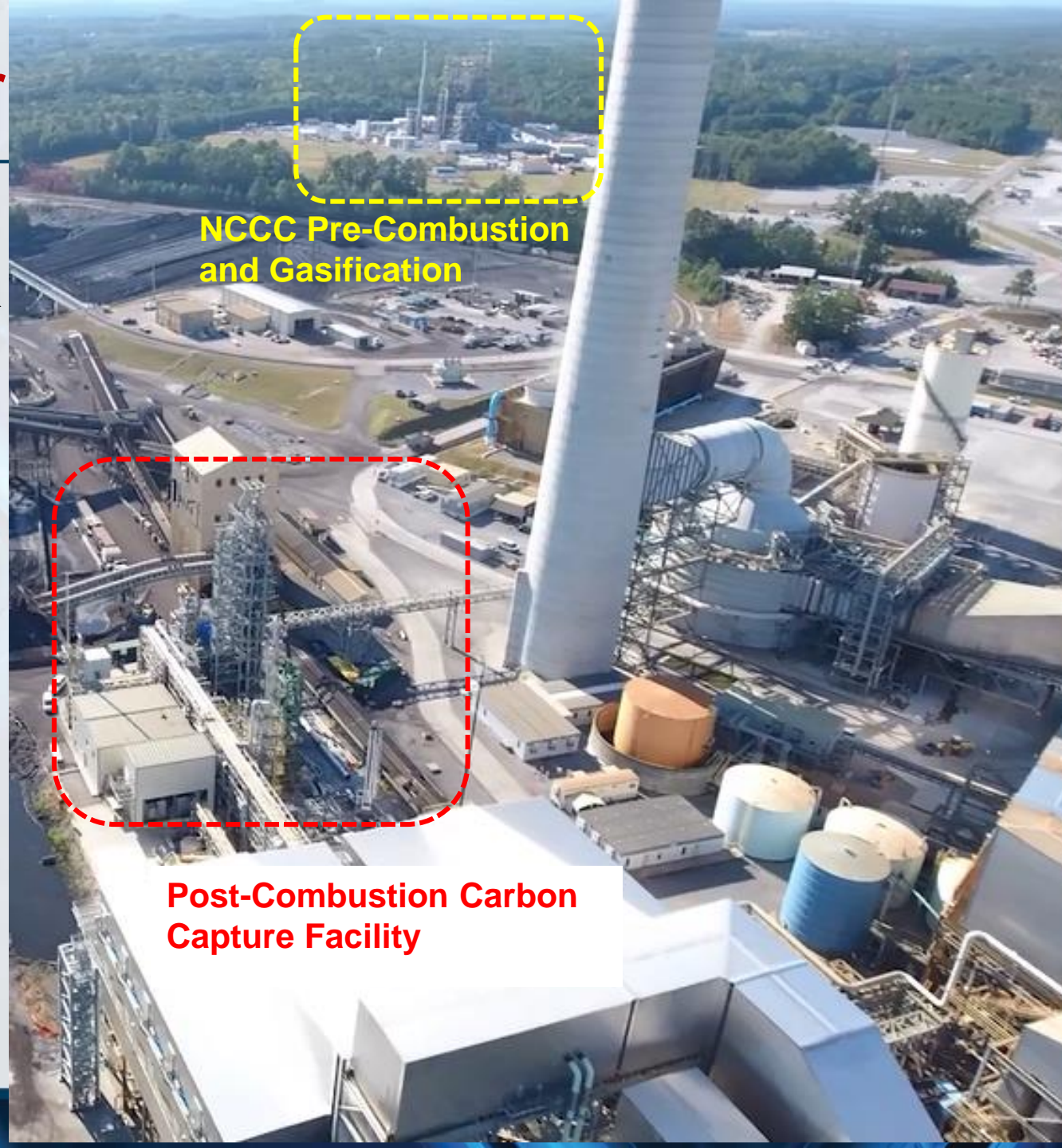
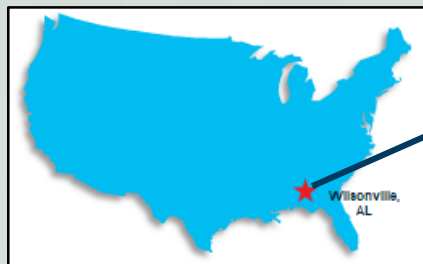
2019 NETL Carbon Capture, Utilization and Storage, and  
Oil and Gas Technologies Integrated Review Meeting  
Pittsburgh, PA



U.S. DEPARTMENT OF  
**ENERGY**



# National Carbon Capture Center



NCCC Pre-Combustion and Gasification

Post-Combustion Carbon Capture Facility

Alabama Power Plant E.C. Gaston



CLEARPATH



ELECTRIC POWER RESEARCH INSTITUTE

ExxonMobil



Peabody



2014 -  
2020

DOE & Industrial Sponsors  
80/20 \$187.5 million

- Continue CO<sub>2</sub> Capture R&D for Cost Reduction



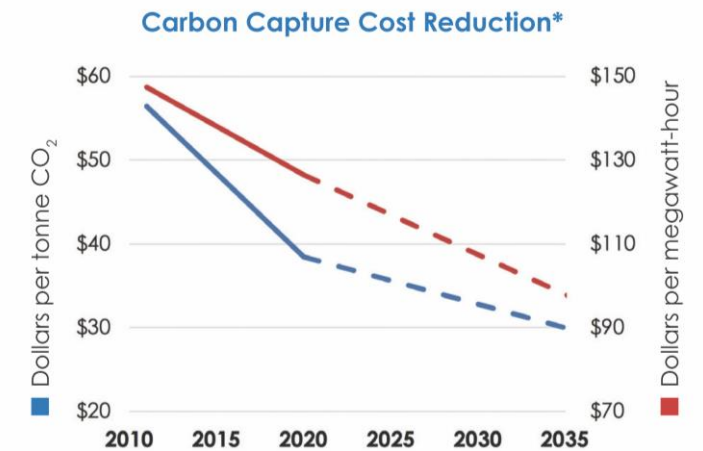


# National Carbon Capture Center



- Celebrated 10 years of technology development at NCCC totaling over 110,000 hours technology testing
- More than 60 technologies tested
- Developers from U.S. and 6 other countries

*Already reduced  
projected cost of  
carbon capture  
from fossil  
generation by 1/3*



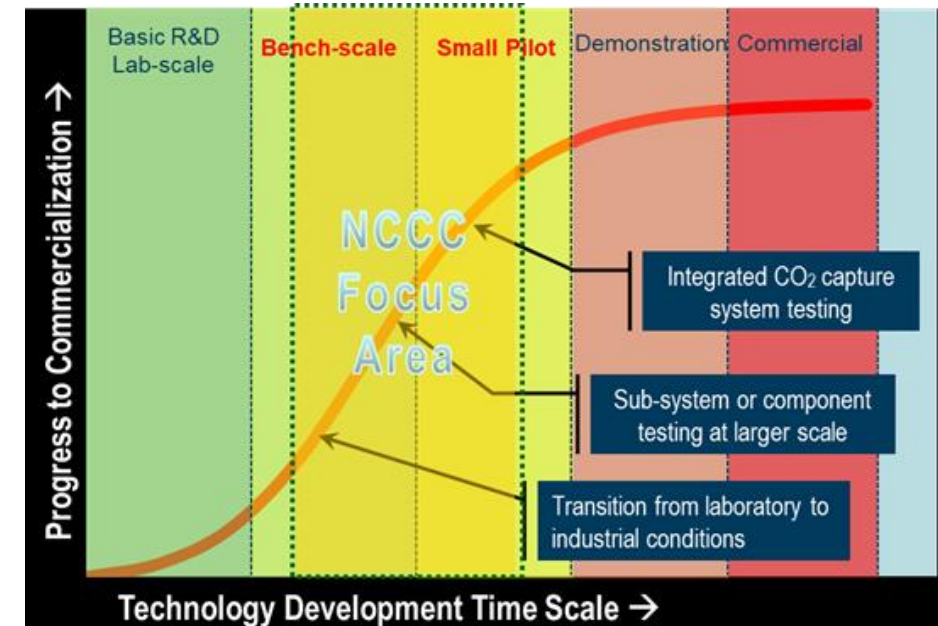
\* Supercritical pulverized coal 2011 dollars; Source: NETL / CURC-EPRI

Infrastructure expansion broadening testing of carbon capture technologies for natural gas power plants

# Advantages of the NCCC

## Cost-efficient test site with infrastructure for numerous technology developers

- Real-world conditions with coal-derived flue gas and future expansion for natural gas testing
- Flexibility for testing at multiple scales and on-site scale-ups
- Technical staff for design, installation and testing support
- High-quality data acquisition and gas/liquid sampling and analysis





# International Collaboration

- Support DOE goal of international cooperation
- Broad effort in China, India, Middle East, Korea, Japan, EU, Australia, Canada, Norway
- Multiple paths for NCCC involvement
  - Partners, developers, network members, consulting services and workshops
- ITCN shares knowledge on operating test facilities
- Broad benefits of ITCN
  - CCS support is inconsistent, ITCN attenuates swings
  - Share knowledge and partnerships for scale-up
  - Technologies more robust with broad requirements
  - Encourage passionate participants to stay in the field

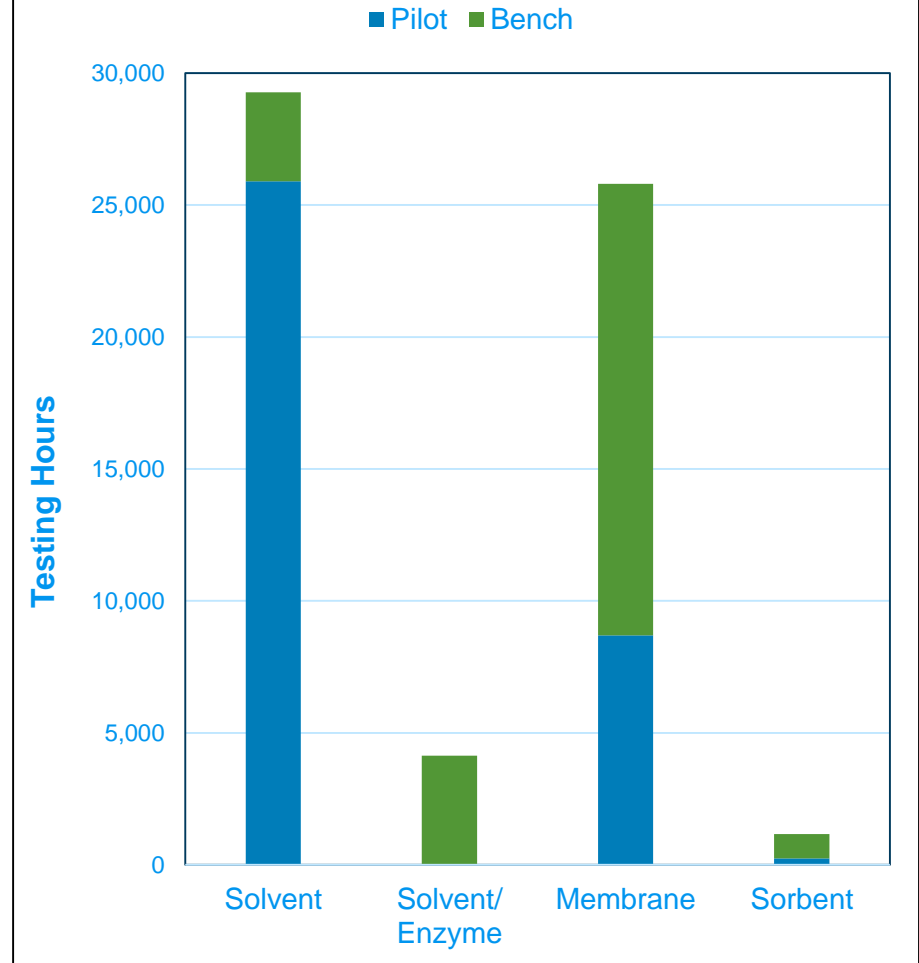


# Post-Combustion Testing Accomplishments Since Inception

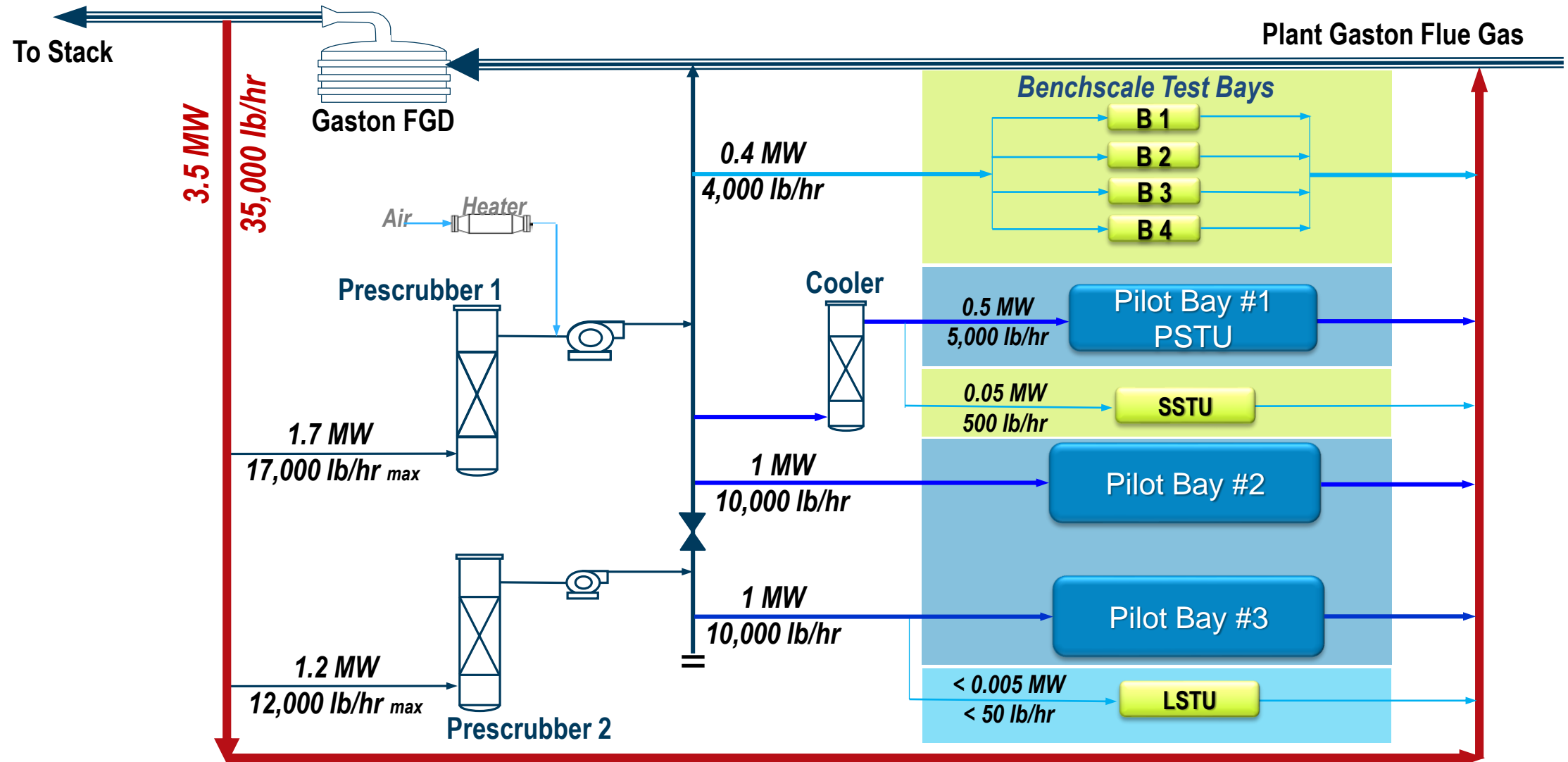
- **60,000+** hours of performance data collected
- **37 technologies** from **25 developers** tested
- **8 technologies** scaled up (or ready to) to 10+ MW

Aker, Carbon Clean Solutions, ION Engineering, Linde, MTR, RTI, Shell Cansolv, and Hitachi

Post Combustion Since 2011

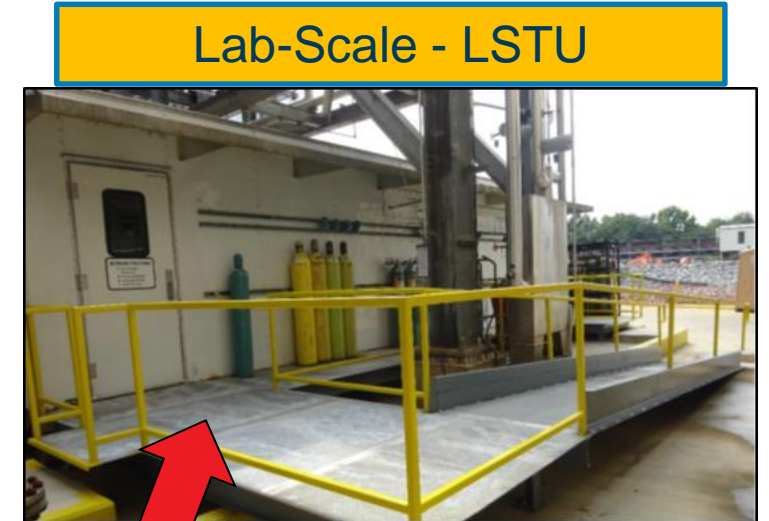
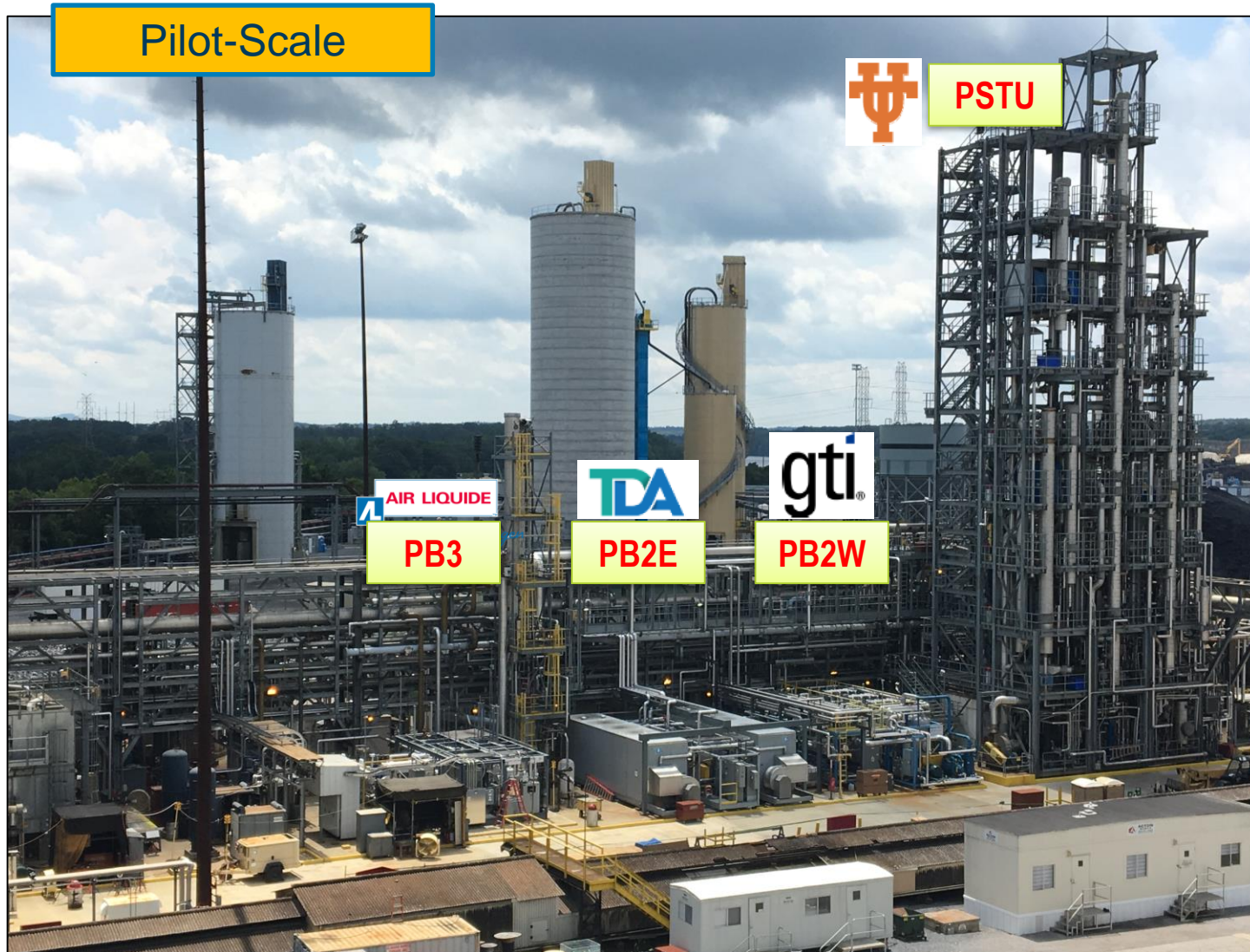


# Post-Combustion Carbon Capture Facility Configuration





# Current Pilot- and Lab/Bench-Scale Tests





# Current Test Campaign

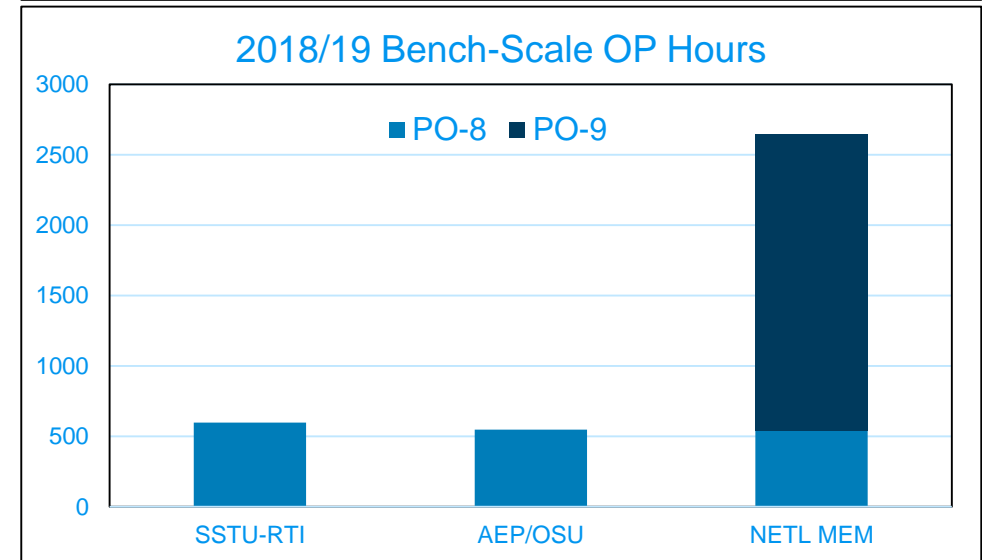
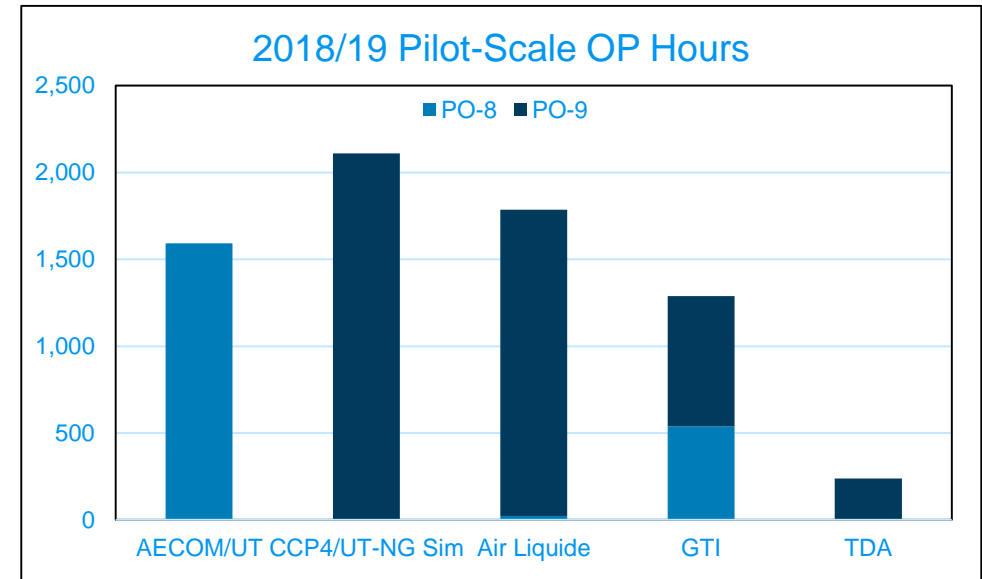
- **PO-9 (January– Current 2019)**
  - Pilot-Scale 4,862 hours

Location	Developer	Technology
PSTU	CCP4/ UT-Austin	Advanced Flash Stripper, NG Sim.
Pilot Bay 2 East	TDA	Alkalized Alumina Sorbent
Pilot Bay 2 West	GTI	aMDEA/Membrane Contactor
Pilot Bay 3	Air Liquide	Cold Membrane

- Bench-Scale 2,597 hours

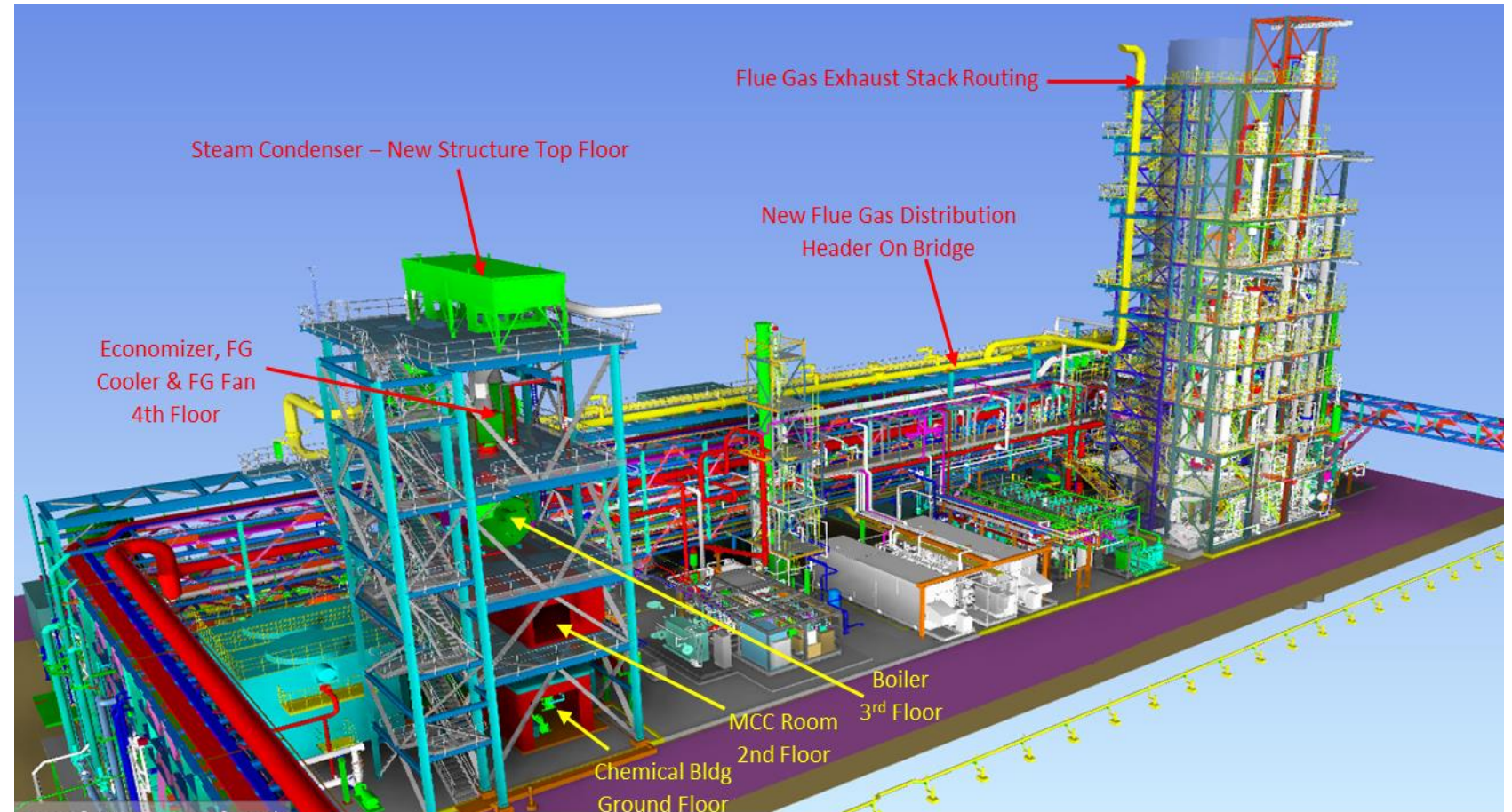
Location	Developer	Technology
LSTU	NETL	Membranes

PO-8 (4/18-8/18); PO-9 (1/19-Current)



# Natural Gas Infrastructure – Benefits of Addition

- Create operational independence from host coal unit, allowing expanded testing windows
- Provide contaminant-free flue gas source for technology commissioning and start-up
- Increase operational flexibility while leveraging existing carbon capture infrastructure
- Create a single site where technologies can test on both natural gas- and coal- derived flue gas
- Utilize experience of highly specialized staff





# Natural Gas Infrastructure – Project Update

## Detailed Design

- ✓ **Major equipment selection**
- ✓ **Civil/Structural Design**
  - ✓ Foundation
  - ✓ Structure
  - ✓ Stack support
  - ✓ Pipe bridge additions
- ❑ **Mechanical Design**
  - ✓ Instrument Air
  - ✓ Demineralized Water
  - ✓ Natural gas tie-in (at Gaston)
  - ✓ Natural gas supply line
  - ❑ Equipment interconnections (in progress)
- ❑ **Instrumentation, Controls, Electrical Design**
  - ✓ Natural gas line
  - ❑ Equipment interconnections (in progress)

## Construction

- ✓ **Foundation**
  - ✓ Demolition
  - ✓ Reconstruction
    - ✓ Micropiles
    - ✓ Pile Caps & Grade Beams
    - ✓ Backfill
    - ✓ Slab-on-grade
- ❑ **Structure**
  - ✓ Instrument Air
- ❑ **Natural Gas**
  - ✓ Tie-in
  - ❑ Supply line (in progress)
- ❑ **Flue Gas** (fabrication complete, pending installation)
- ❑ **Utilities** (fabrication in progress)

# Natural Gas Infrastructure - Progress

Delivery of Steam Condenser



Delivery of Package Boiler



Concrete removal in progress



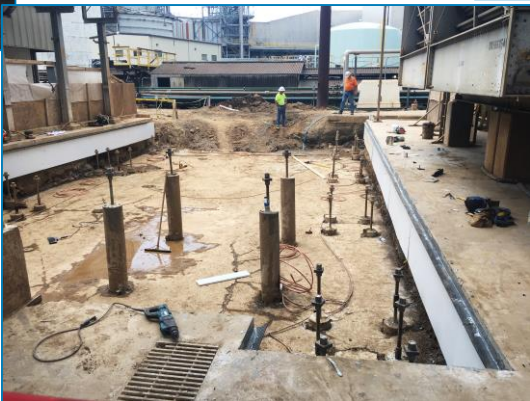
Concrete demolition complete



Natural gas line tie-in at Plant Gaston



Flue gas header piping staged



Completed micropile system



Pile caps and grade beams poured



# Future Developers at the NCCC

Developer	Technology Description	Technology	Scale
Huaneng CERI	Blended amine solvent (HNC series)	Solvent	Pilot-PSTU
ION Engineering	Validation of Transformational CO <sub>2</sub> Capture Solvent Technology	Solvent	Pilot-PSTU
GTI	Rotating Packed Bed Solvent (ROTA-CAP)	Solvent	Bench
GTI	Graphene Oxide (GO) Membrane	Membrane	Bench
MTR	Self-assembly Isoporous Supports Polymeric Membrane	Membrane	Bench
OSU	Novel Transformational Membranes and Process	Membrane	Bench
SUNY Buffalo	Rational Development of Novel Metal-Organic Polyhedra-Based Membranes for CO <sub>2</sub> Capture	Membrane	Bench
PCI	High Capacity MOF Nanosorbents	Sorbent	Bench
LBNL/Inventys	Inventys Sorbents and LBNL amine-appended MOFs Sorbents	Sorbent	Bench
Rensselaer Polytechnic Institute	Transformational Molecular Layer Deposition Tailor-Made Size-Sieving Sorbents	Sorbent	Bench
CO <sub>2</sub> Utilization Developer	Technology Description	Product	Scale
Southern Research	Thermocatalytic Ethylene Production Process Using Ethane and Coal-Fired Flue Gas CO <sub>2</sub>	Ethylene	Bench
UCLA	Upcycled CO <sub>2</sub> -Negative Concrete	Concrete	Bench
Helios-NRG	Novel Algae Technology to Utilize CO <sub>2</sub> for Value-Added Products	Algae	Bench

# Acknowledgements



## Special Thanks

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For more information: [nationalcarboncapturecenter.com](http://nationalcarboncapturecenter.com)

