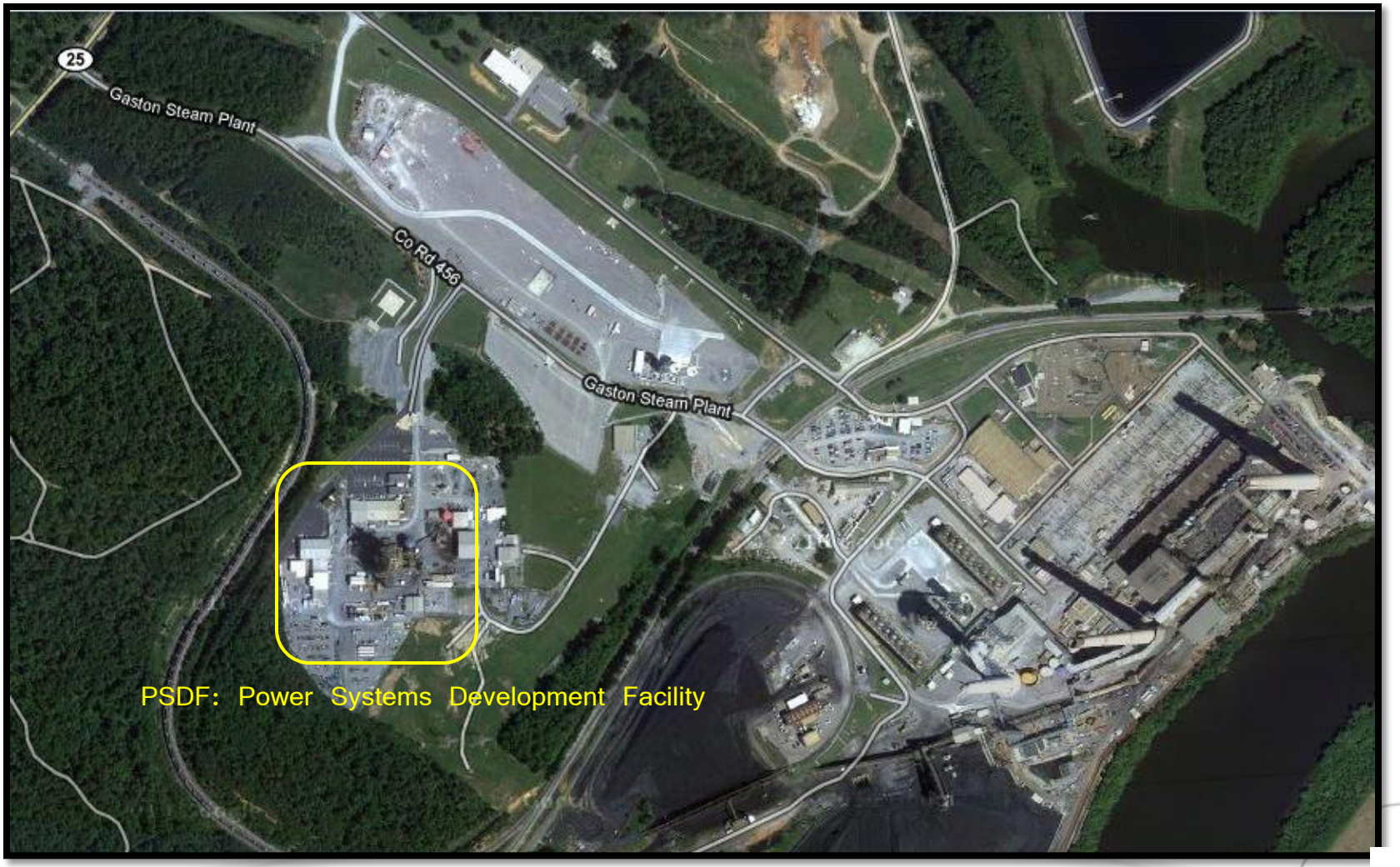
Pre-combustion CO_2 Capture @ National Carbon Capture Center (NCCC)

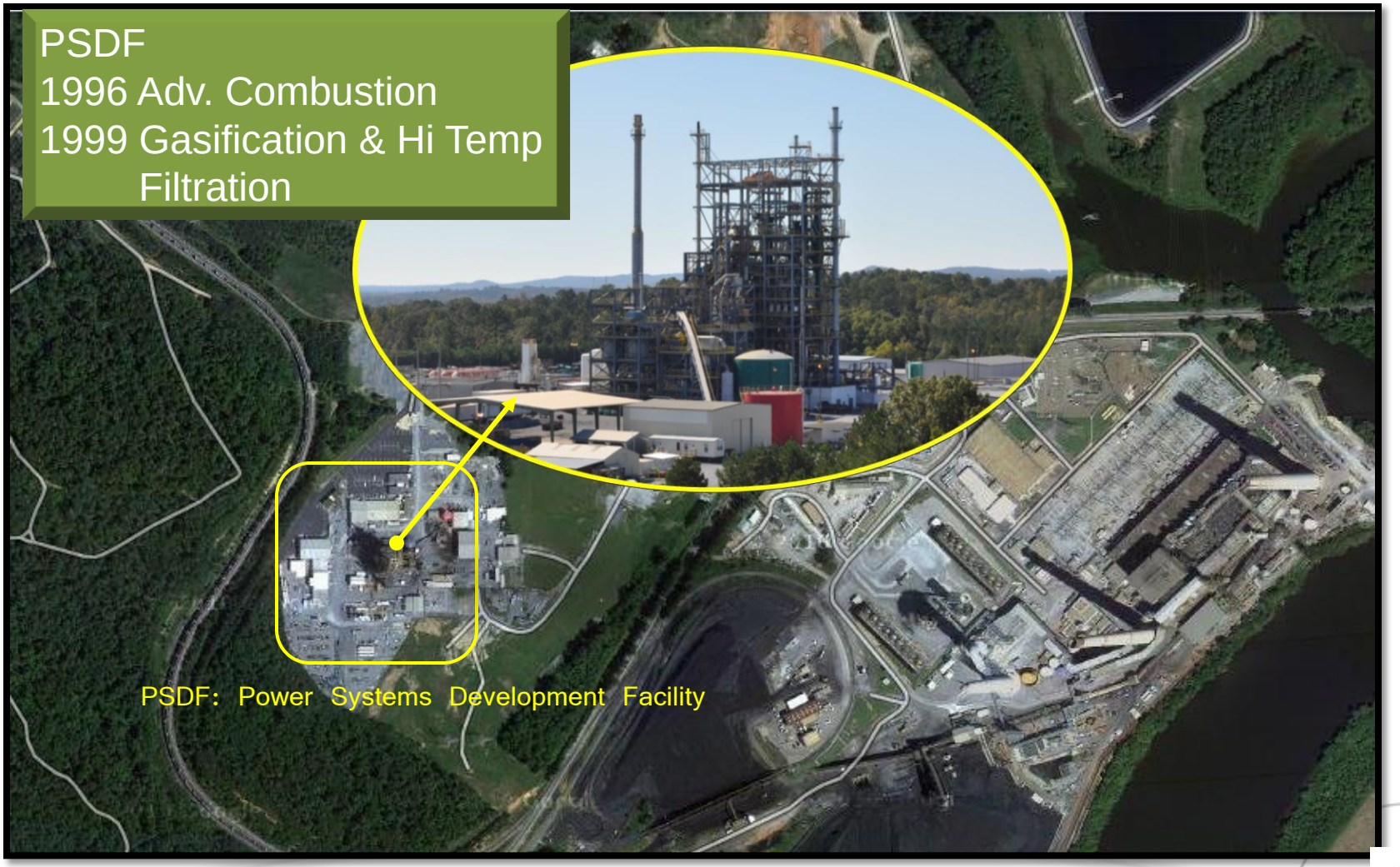
Tony Wu
Southern Company
July 10, 2013

2013 NETL CO_2 Capture Technology Meeting, Pittsburgh, PA

PSDF and NCCC



PSDF and NCCC

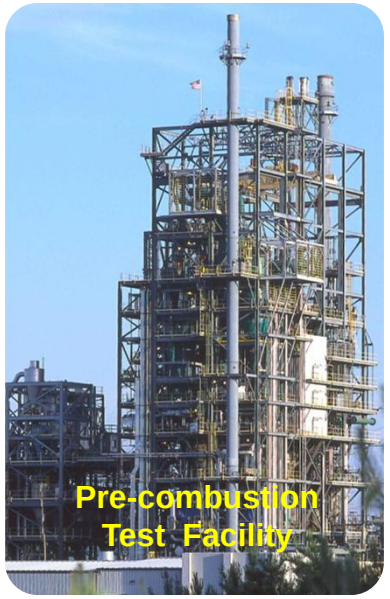


PSDF and NCCC

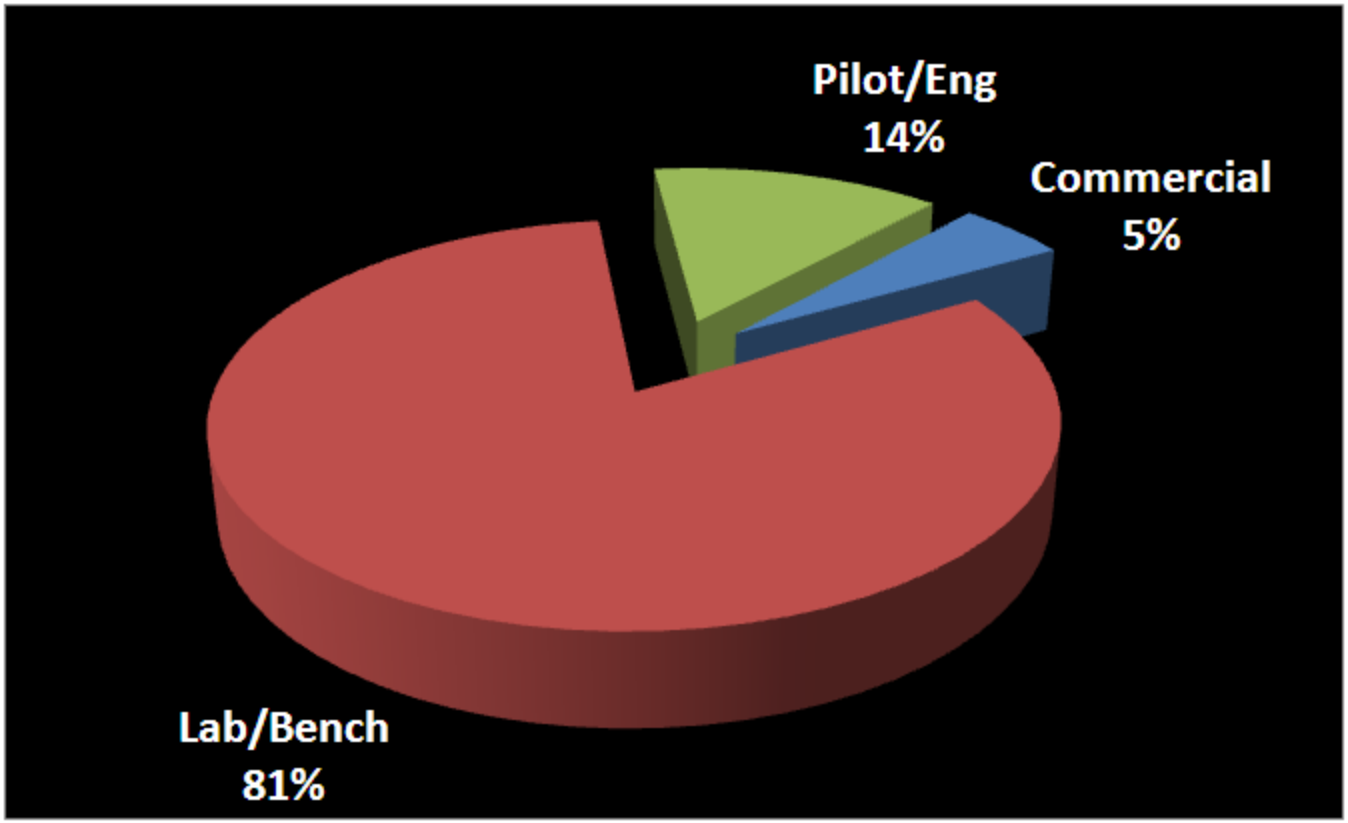
Benefits of NCCC

- Serve as centralized R&D testing facility
  - Capable of multiple testing simultaneously
  - ~8,000 gasifier run hrs produce 2.5X testing hrs
  - Effective performance comparison between technologies tested
- Make available realistic syngas for performance verification
  - Flexible in capacity & process conditions
- Leverage existing infrastructure and on-site expertise in power plant, process engineering and integration, design, and O&M areas
- Provide independent data acquisition and analysis for developers as needed

→ **Accelerating CO_2 capture technology commercialization**

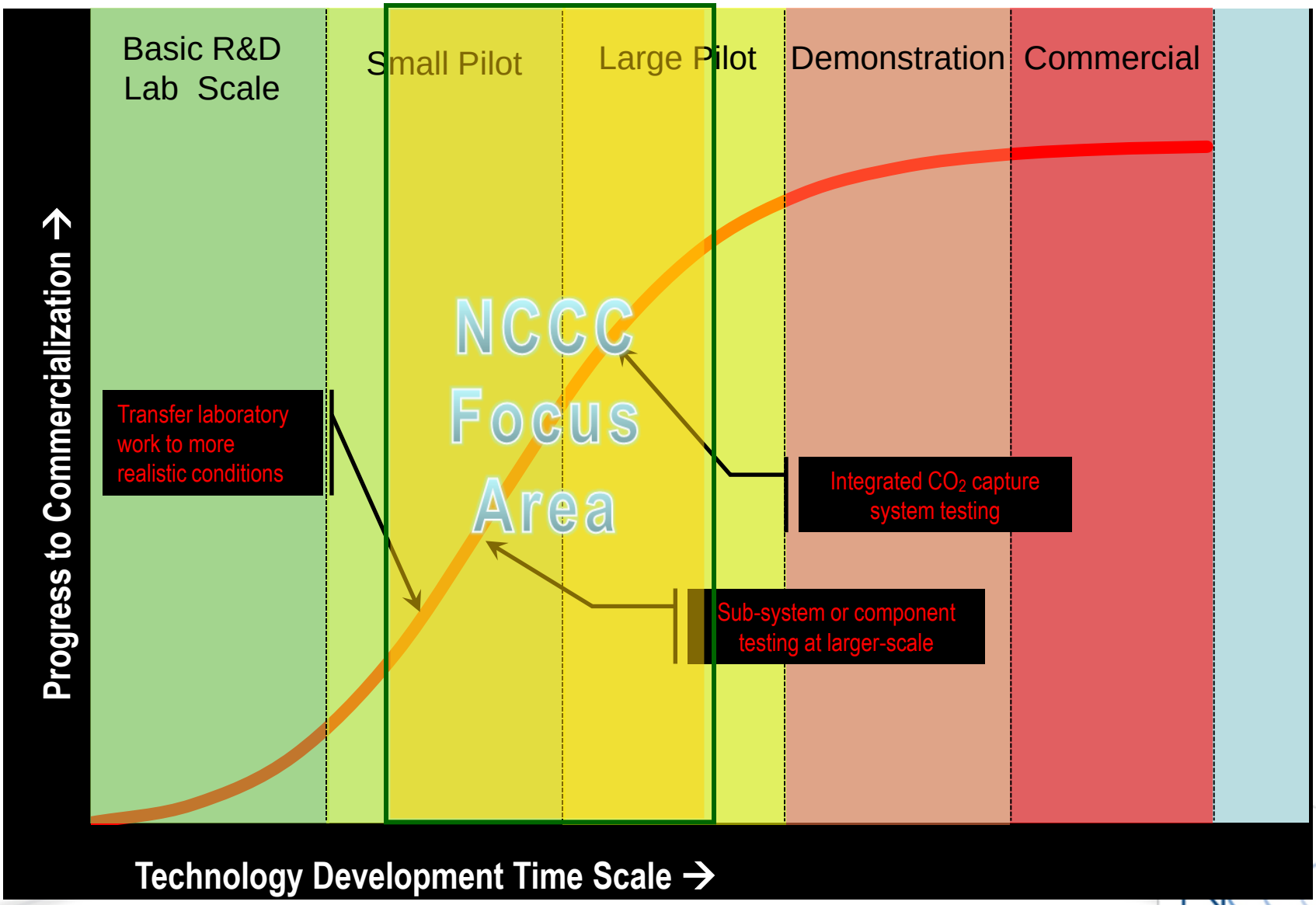


CO_2 Capture Technology Landscaping

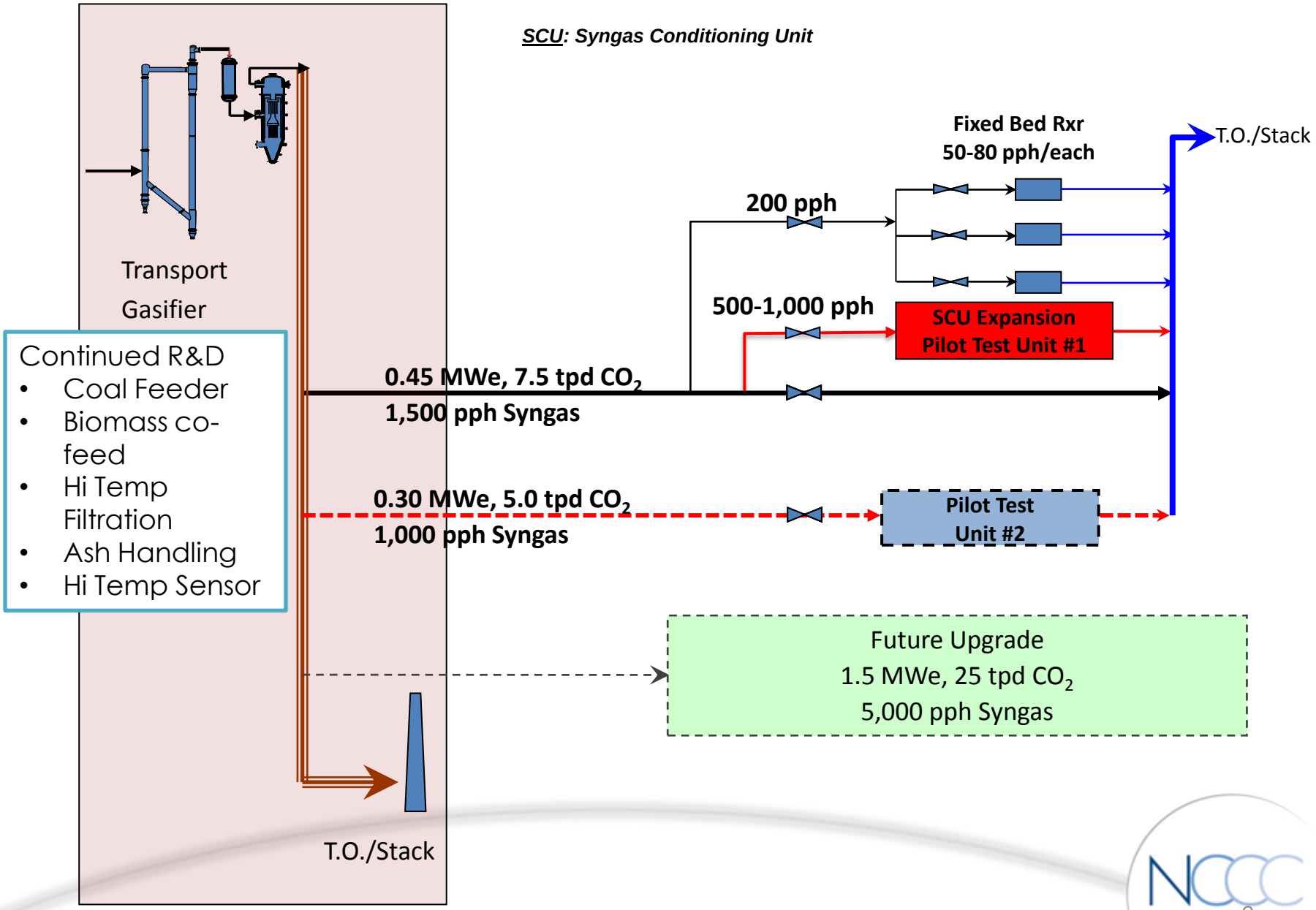


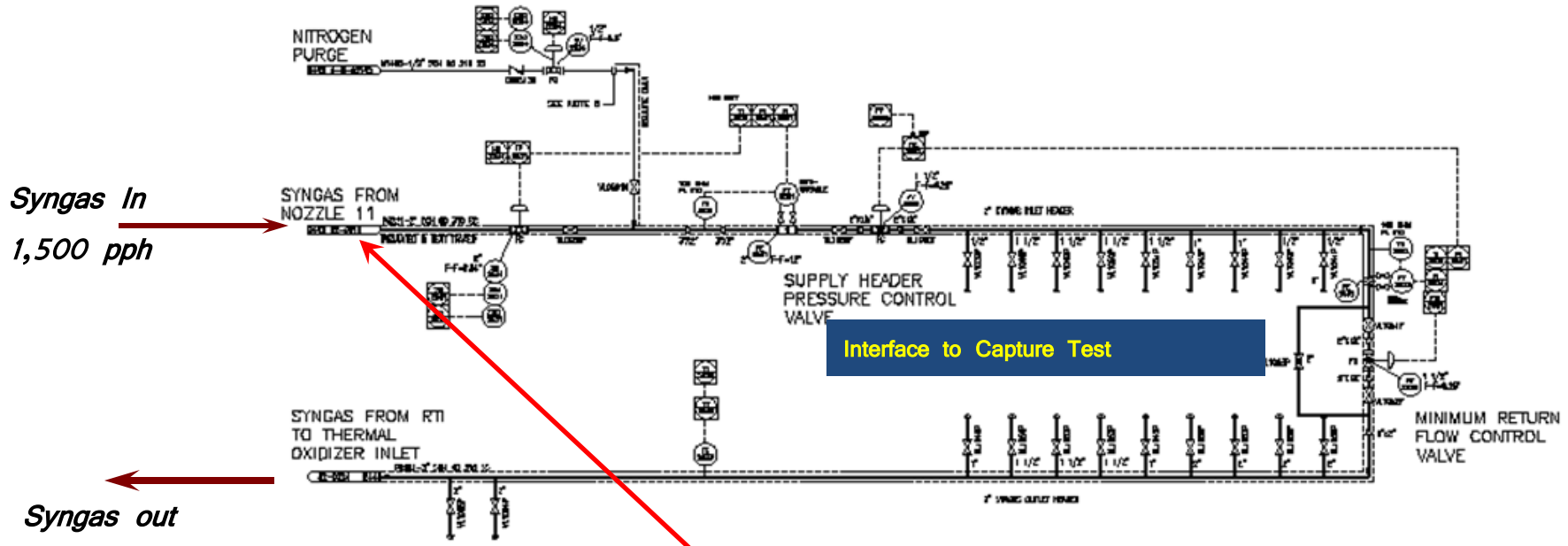
Based on NCCC's Technology Database

NCCC Program Focus



Simplified SCU Slipstream Schematic

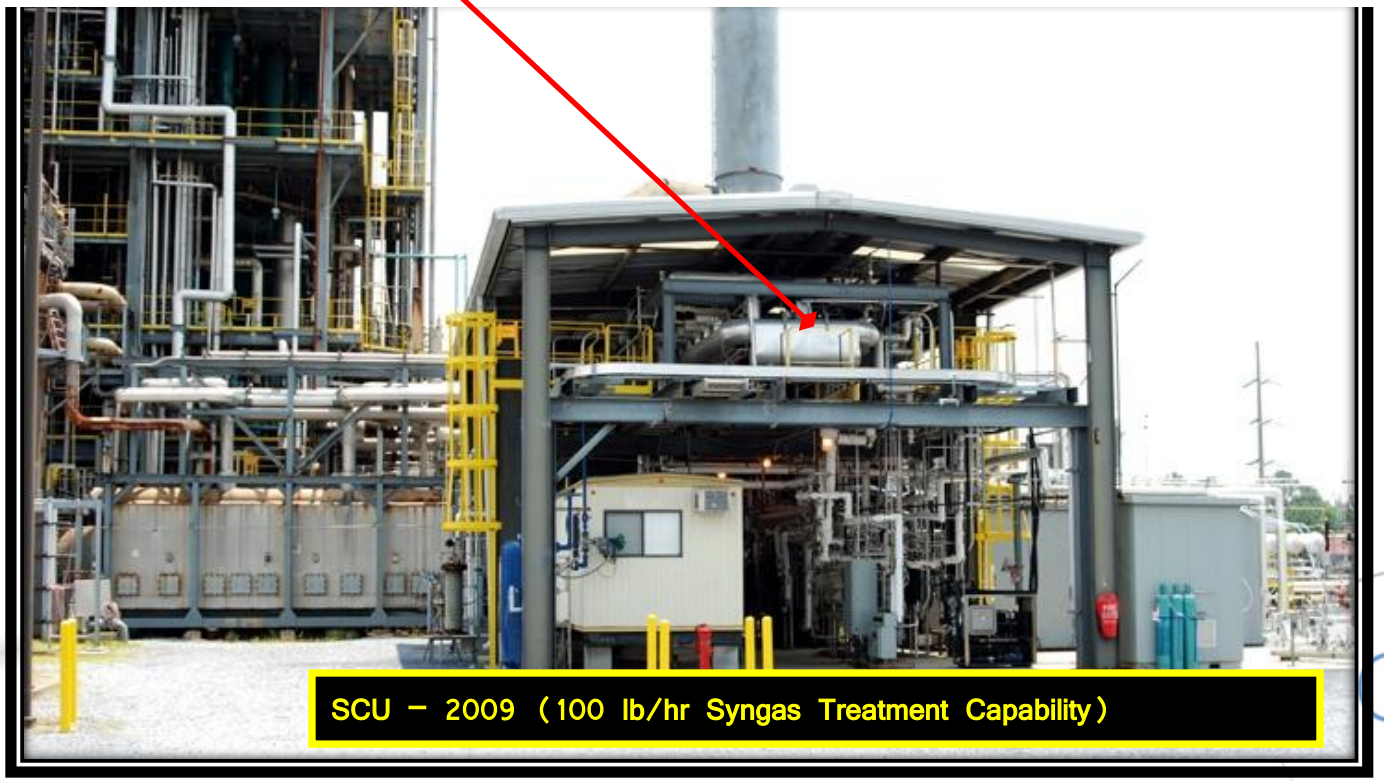




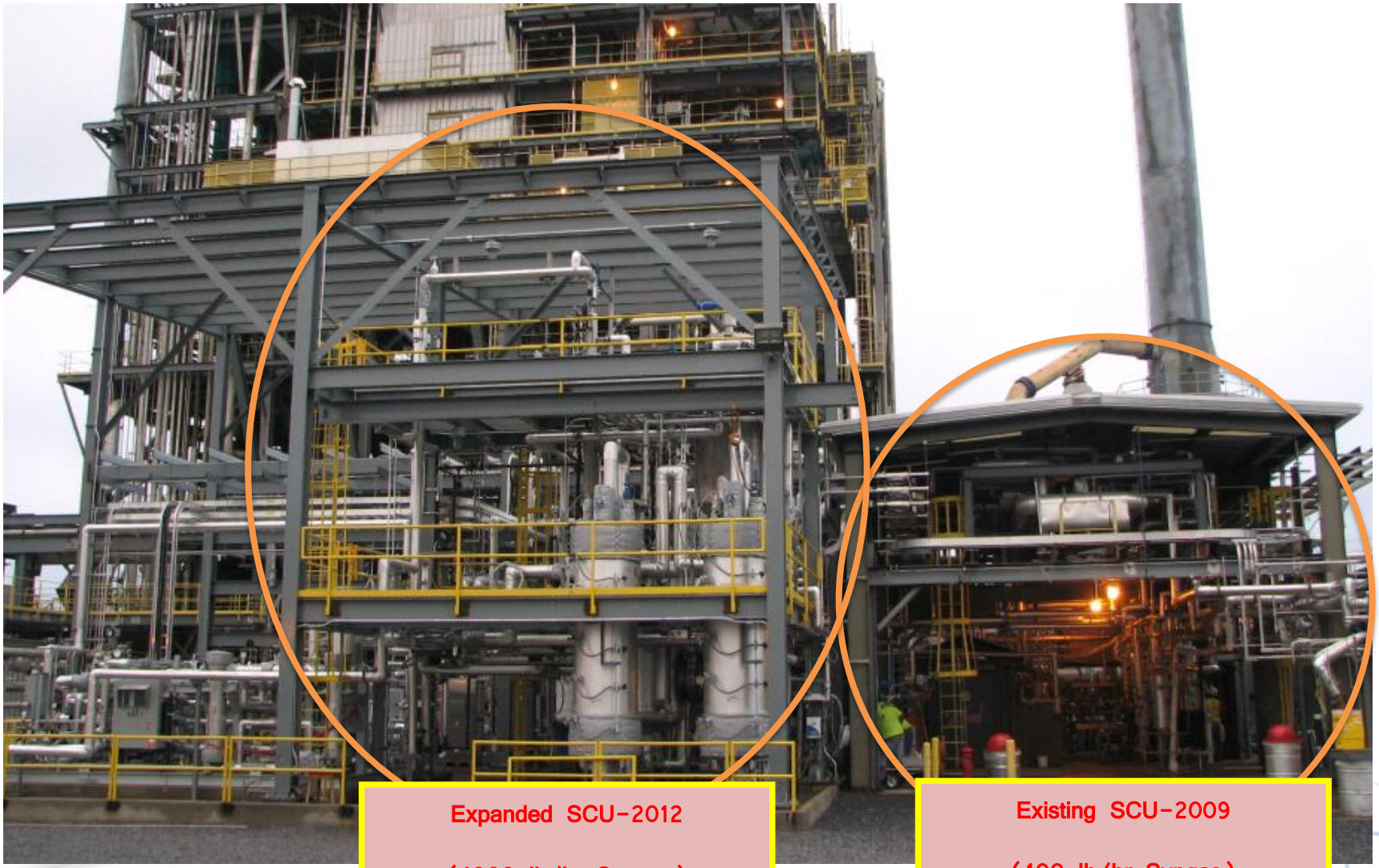
Syngas In

1,500 pph

Syngas out



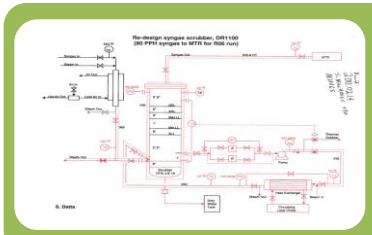
SCU Expansion 2012



NCCC Roles

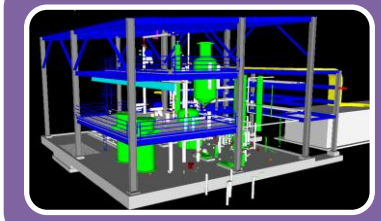
Civil/Construction

- Ground preparation
- Weather protection
- Skid installation
- Interconnecting interface piping & wiring



Process Development

- Develop PFD for syngas, N2, Air, cooling water
- Low temp gas cleanup process
- Warm gas cleanup process
- H_2 enrichment



Mechanic, Electric Design and I&C

- Design for syngas/N_2/Air/ cooling water supply
- Design for electrical supply, heat tracing
- Provide necessary instrumentation for process monitoring and alarm
- Vendor skid design review and recommendation for improvement and safe operation

Operation

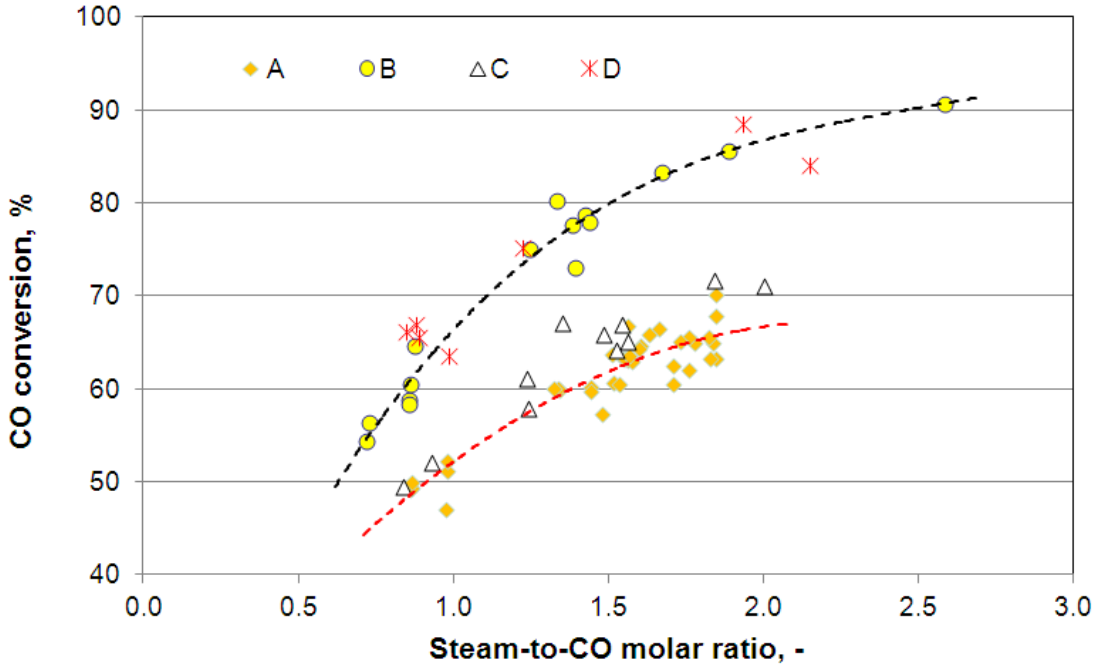
- 24x7 monitoring and operating
- Trouble-shoot field issues
- Component replacement
- Data logging and analytical support

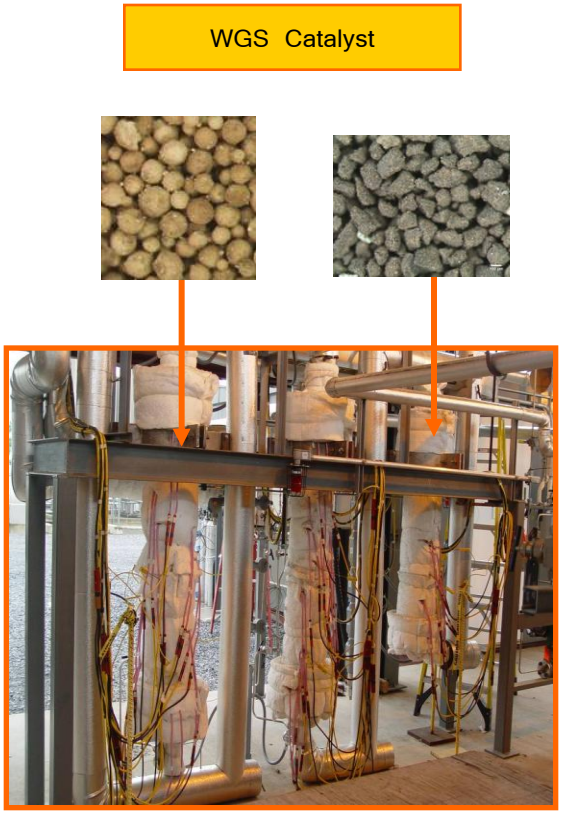
Current Technology Testing Scope

	WGCU (warm gas cleanup)	Catalyst	Solvent	Membrane	Sorbent	Chemical Looping
Bench	JM/NETL Hg Sorbent	WGS Southern Research F-T	NETL/ U of Pitt U of AL	H_2/CO_2 WPI MTR MPT Eltron	TDA	
Pilot (>500 lb/hr)			SRI International	MTR CO_2		OSU SCL

WGS Catalysts Evaluation

$CO + H_2O \rightarrow H_2 + CO_2$



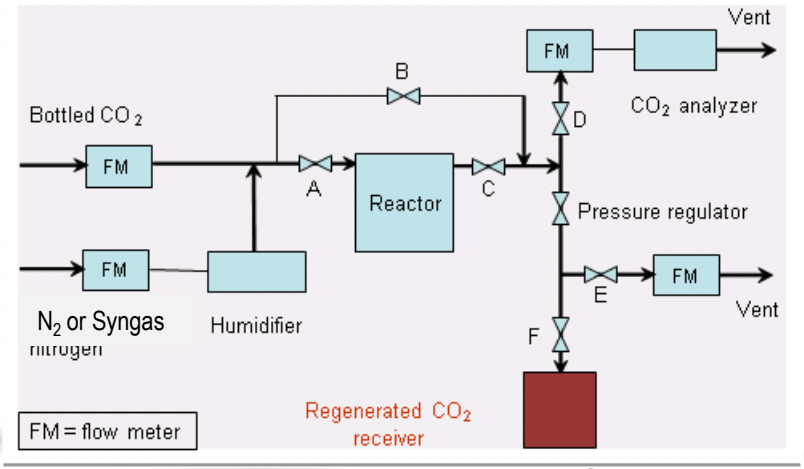


NETL May 2012

- 1.0 reduction ~ 40 MW gain (500 MW Plant)
- $275 MM saving over 30-year plant life
- Results implemented at Kemper County IGCC TRIG™ Project

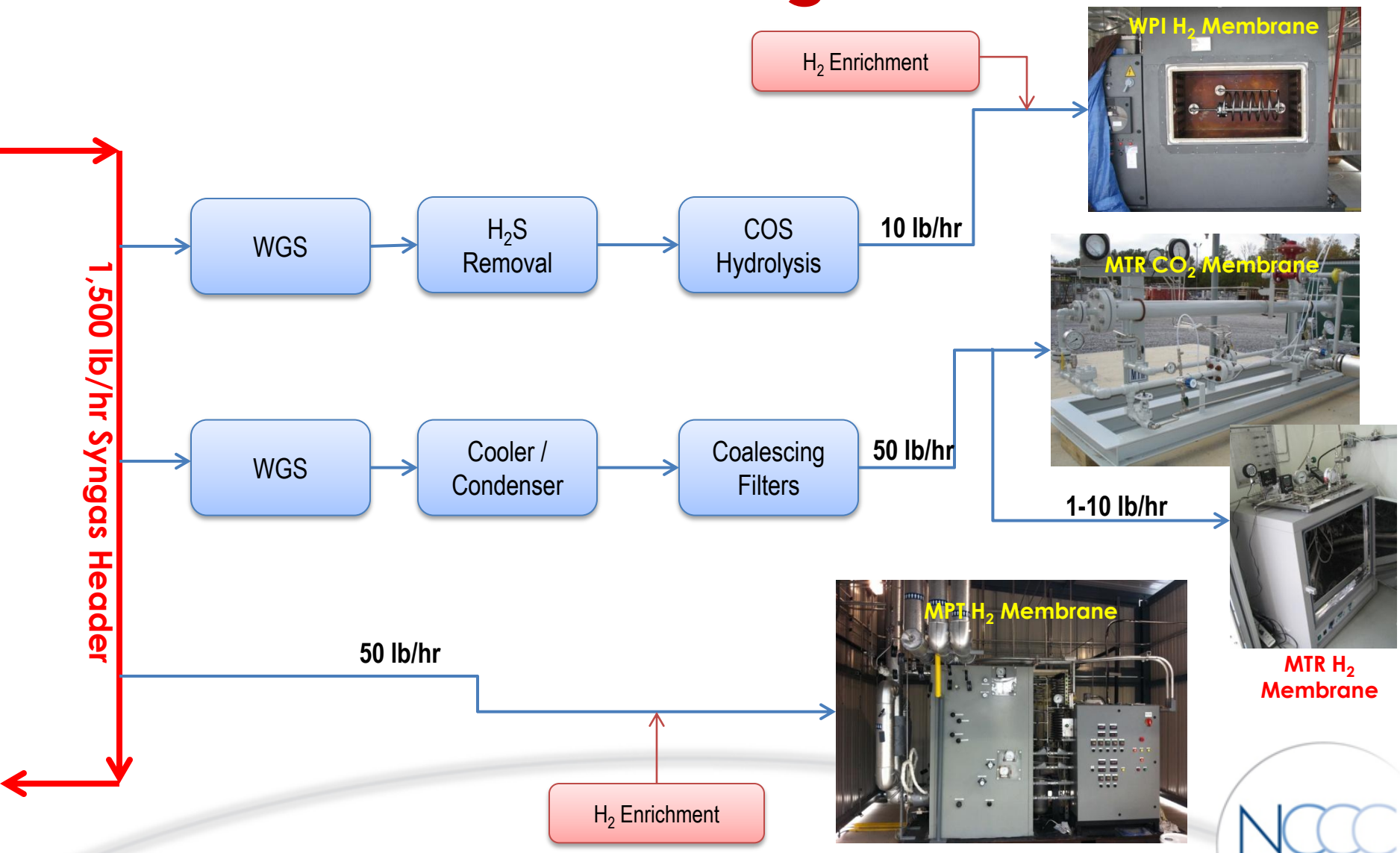
Solvent Characterization

- Parr Reactor
  - Flexible batch absorption and regeneration process
  - Capacity: 5 liter
  - Syngas and bottle gases
- Chemical Solvents
  - Ammonia-based solvent
  - Amino acid salts (potassium-prolinate)
  - Carbonates (K & Na)
- Physical Solvents
  - DEPG (dimethyl ether and polyethylene glycol)
  - PDMS (polydimethylsiloxane)
  - GTA (glycerol triacetate)
  - MEI(methylimidazoles)



Note: PDMS , GTA (U of Pitt/NETL) and MEI (U of AL)

Membrane Test Configuration



CO_2 Solid Sorbent (TDA)

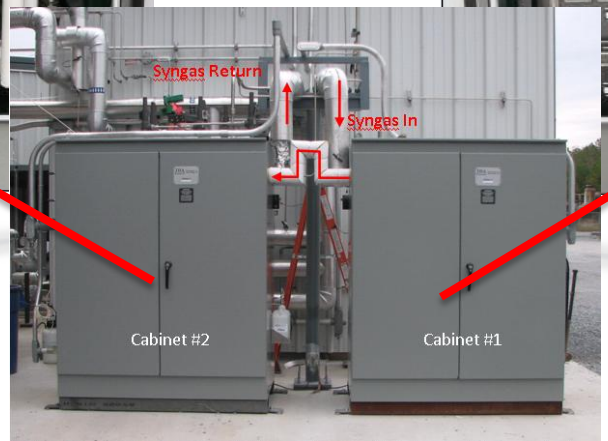
Cabinet #2- CO_2 Removal

Cabinet #1-Syngas Pre-treatment

Dry-Rite

Gas Analyzers

Chiller



Sorbent reactors (6.8 liter) w/ heating jackets (4)

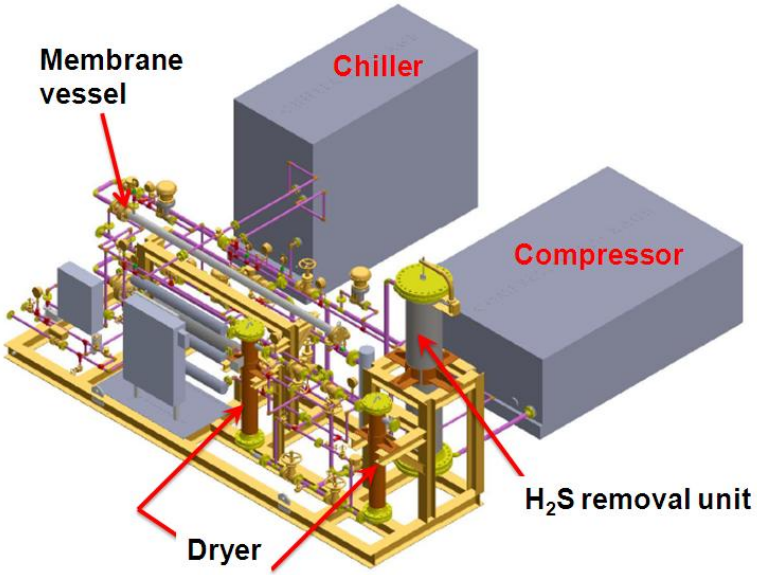
WGS/Heater

Sulfur guard beds (2)

Technology Scale Up

MTR CO_2 membranes

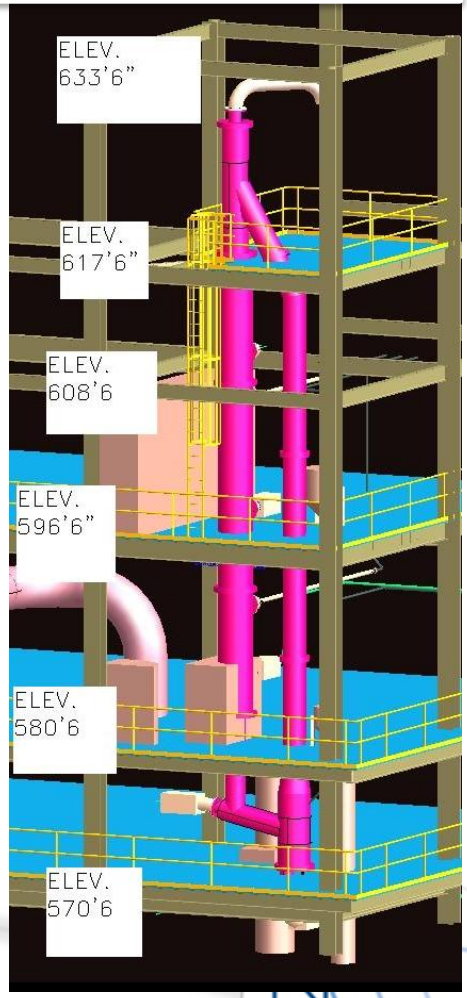
Field Small module, 50 lb/hr



Field Pilot Skid (500 lb/hr Syngas)

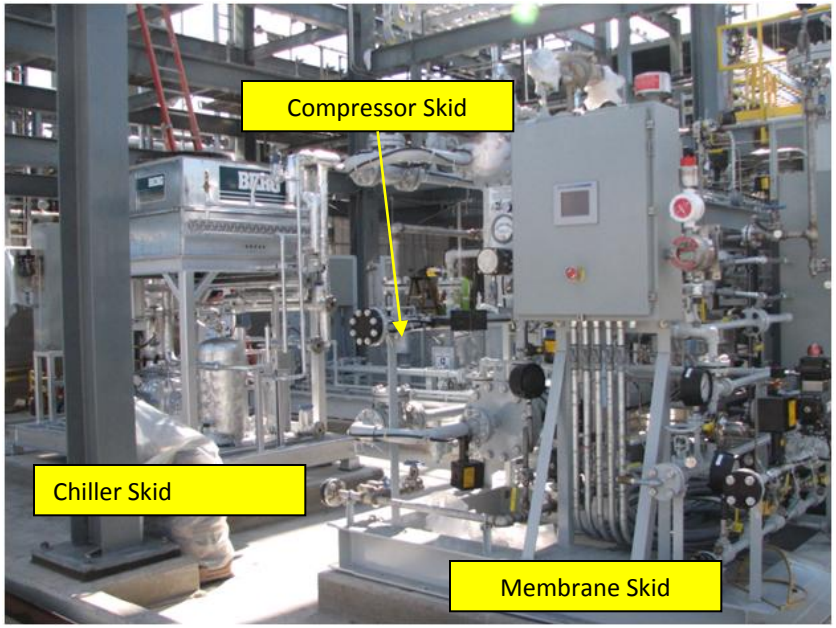
OSU SCL (Syngas Chemical Looping)

Lab 25 kW



Field Pilot Skid 260 kW, 880 lb/hr Syngas

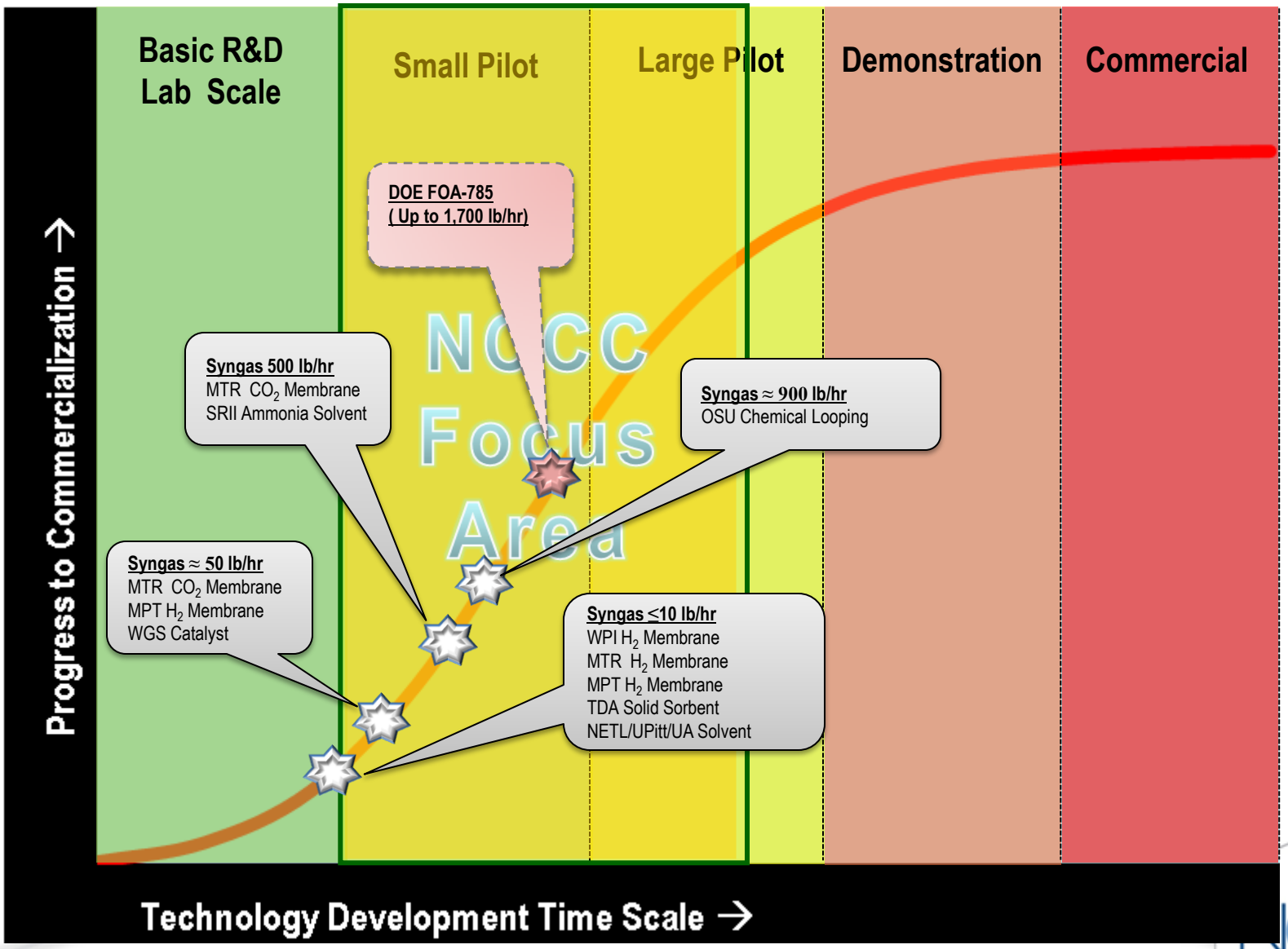
MTR CO_2 Membrane and OSU SCL



Integrated MTR CO2 Membrane System
Commissioned in Summer 2012

OSU SCL System
Plan for Commissioning in Fall 2013

Summary: NCCC Focus



Acknowledgements

- **DOE/NETL Sponsorship**
  - Mike Mosser, Project Manager, NETL
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  - Utility: AEP, Luminant, NRG,
  - Coal producer: Arch Coal, Peabody, Rio Tinto
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  - Eltron, JM, NETL, MPT, MTR, OSU, Southern Research, SRI International, Stanford U, TDA, UPitt, UA, WPI, WGS catalyst developers