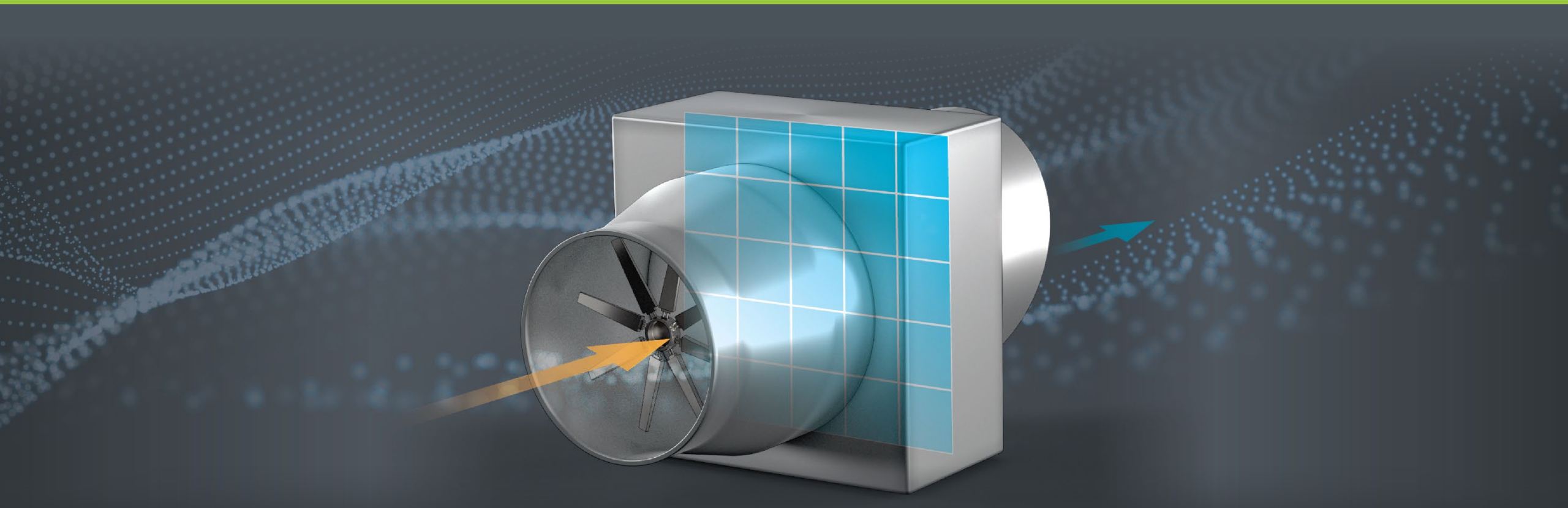


NETL Direct Air Capture (DAC) Center



Ron Breault, Thermal Science Team Supervisor



Aug 15-18, 2022

DAC Center Overview

- ✓ \$20M budgeted for NETL to create a National DAC Test Center, with \$25M authorized
- ✓ Test capture materials, integrate capture and regeneration processes, advance developer skids
- ✓ Integrated experimental and modeling facility to rapidly advance DAC technologies from TRL 2 to 6
- ✓ Capture data → test in model → test commercially viable processes



CAPABILITIES

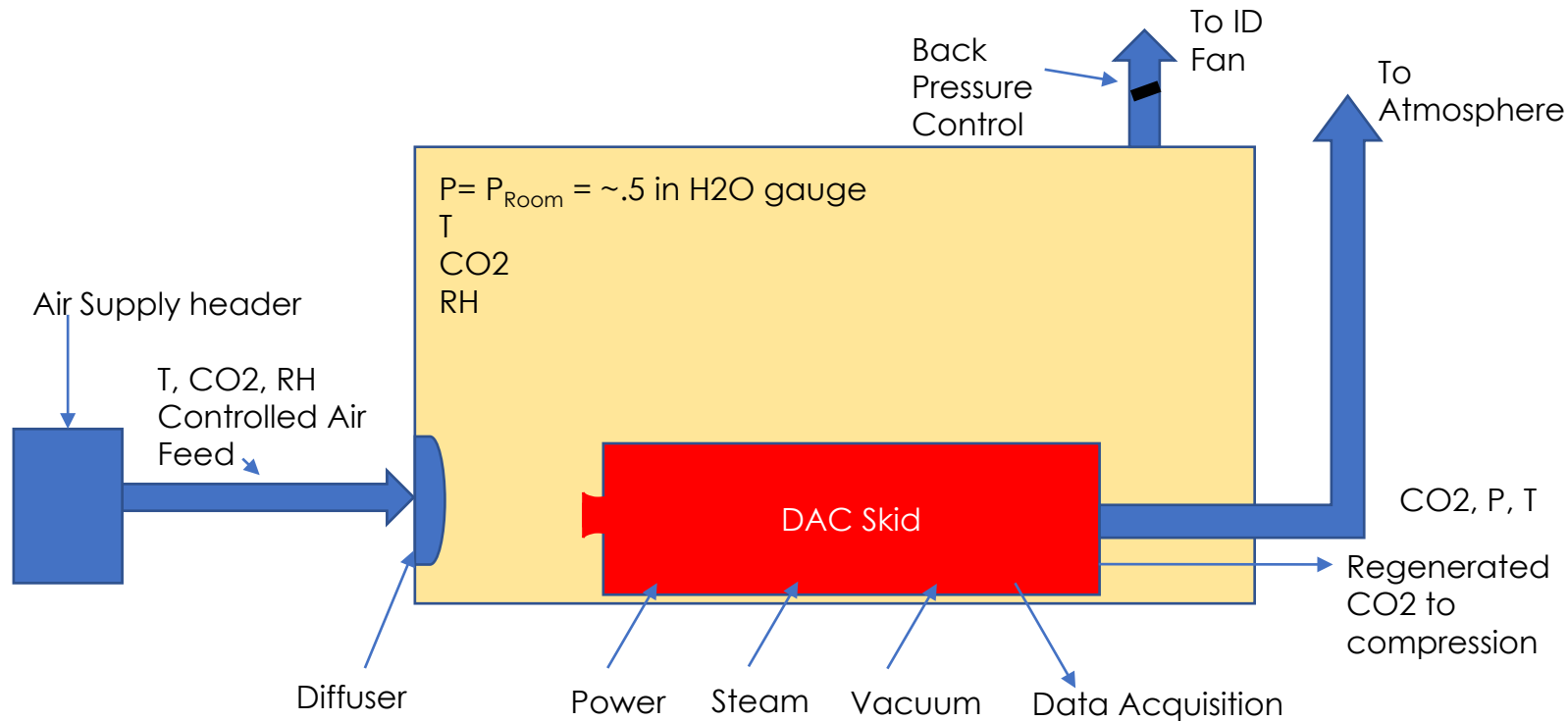
3-4 batch reactors for novel solvent and sorbent material development	2-3 reconfigurable test beds with flexible reactor designs	2 full test cells for evaluating developer-built DAC skids	Advanced instrumentation with remote and autonomous operation	Air feed with a wide variety of environmental conditions	Compression and storage equipment for reuse of captured CO ₂ at NETL
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DAC Center Test Capabilities

Skid Rooms and Developmental Reactors

- Nominal air feed – 2000 to 3000 scfm
- Concentration– 400 to 600 ppm of CO₂
- Humidity – RH= 20% to ~98 %
- Temperature – T = -10C to 40C
- CO₂ exit conditions – 50% to 90% reduction
- Utilities
 - Power
 - Steam
 - Vacuum
- Instrumentation and Controls
 - CO₂, Temperature, Pressure (feed, effluent and numerous locations within the process loops)
 - Remote access for operational control
 - 24/7 operation

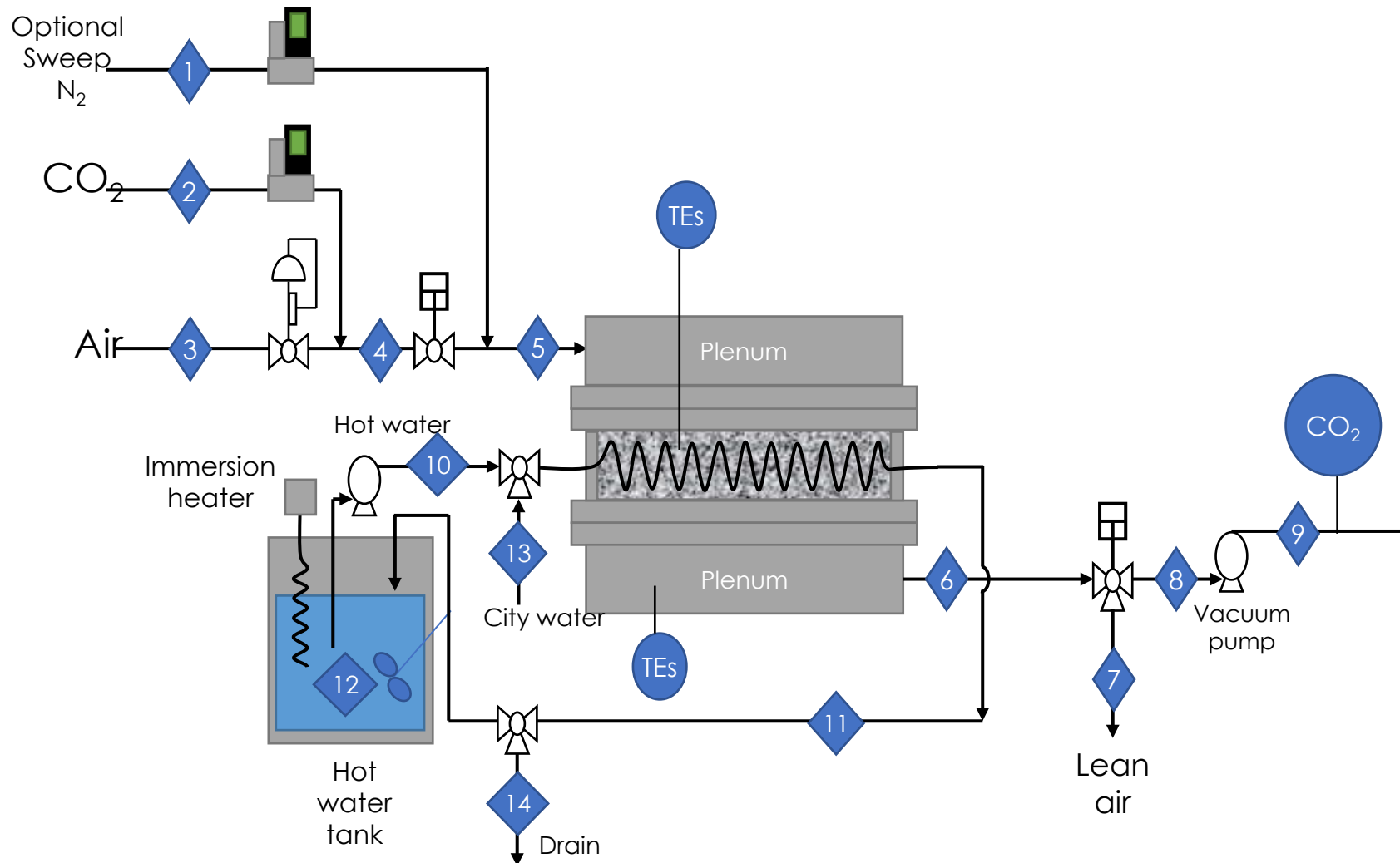
DAC Skid Test Cell



Features:

- Two identical test rooms
- Test cell supplied with 3000+ scfm of CO2, temperature and RH controlled air
- Cell maintained at 0.5 in water while feeding test skid at up to 3000 scfm of air to treat
- Power, steam, vacuum and data acquisition provided
- Private control room
- 24/7 operation with remote operator access and control

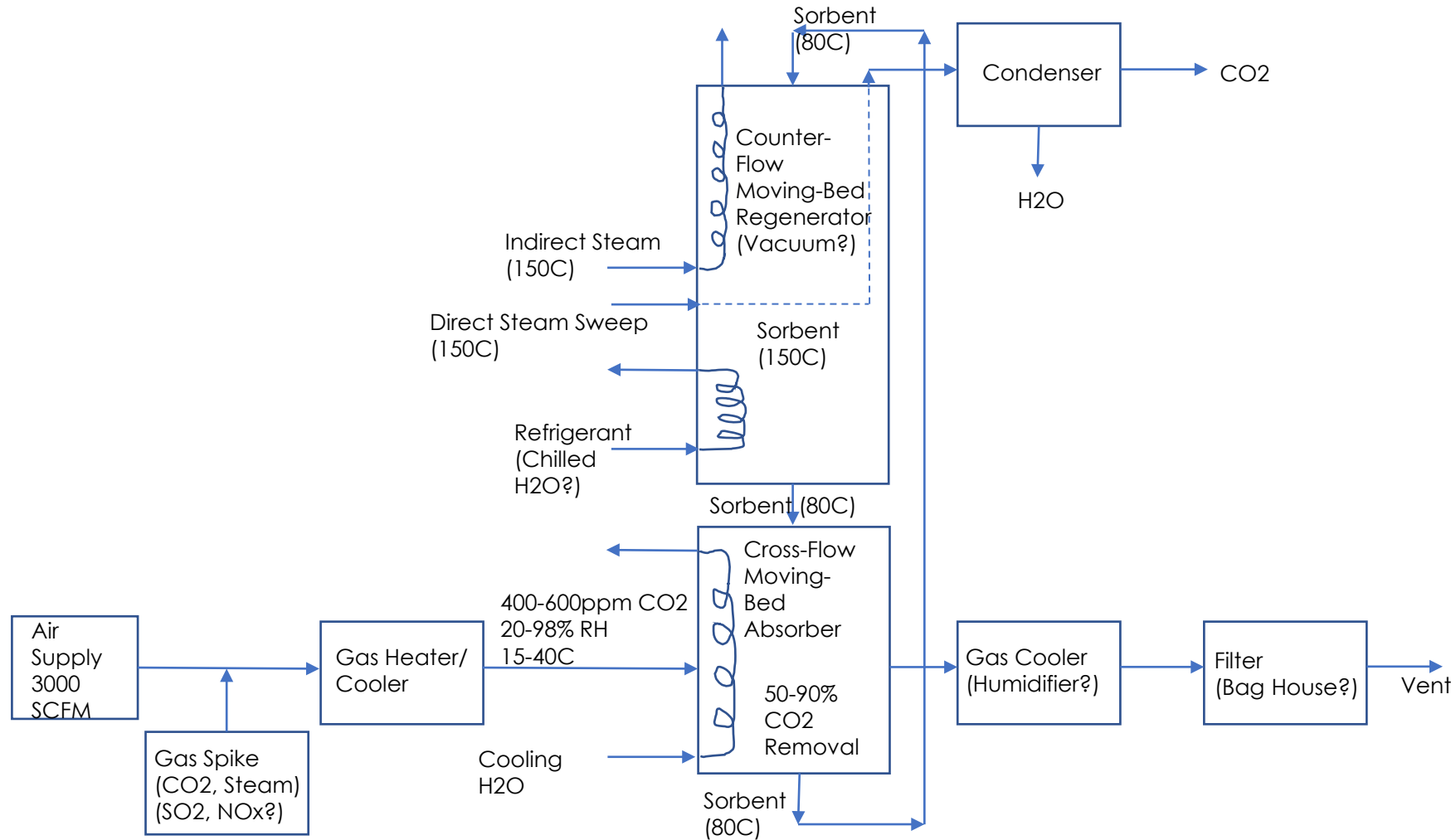
Reconfigurable Cyclic Test Bed



Features:

- Test bed supplied with up to 3000 scfm of CO₂, temperature and RH controlled air
- Power, steam, vacuum and data acquisition available
- 24/7 operation with remote operator access
- Bed expandable from 6 inches to 36 inches
- Bed can be monolith, particles, or fiber mats
- In bed cooling and heating
- Ability for steam sweep

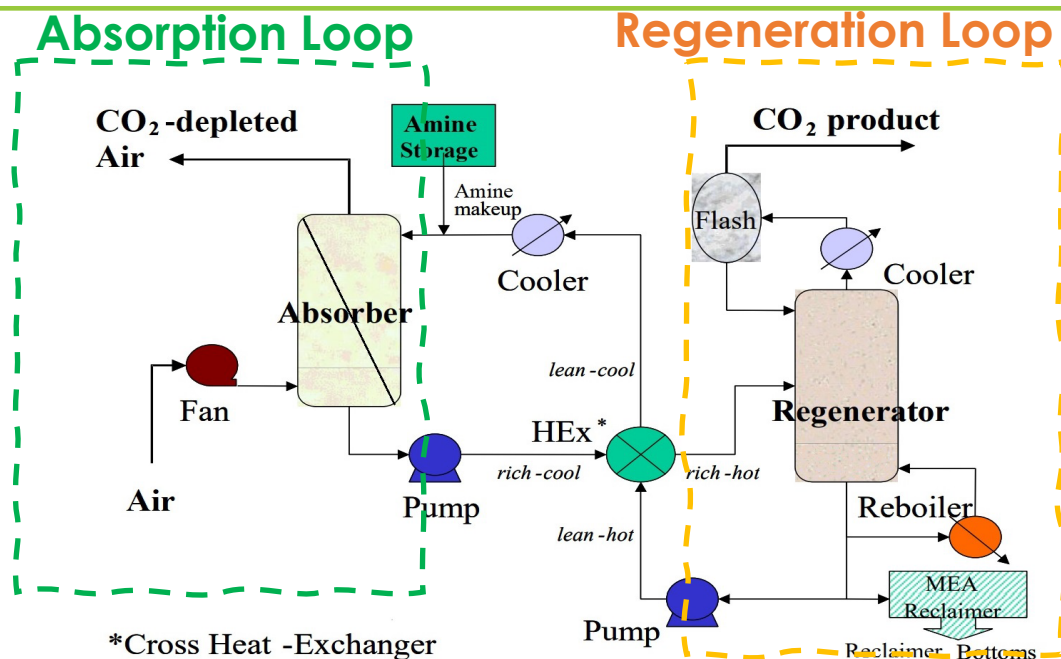
Moving Bed Cross Flow Reactor for Continuous Removal



Features:

- Test bed supplied with up to 3000 scfm of CO2, temperature and RH controlled air
- Power, steam, vacuum and data acquisition available
- 24/7 operation with remote operator access
- Bed expandable from 6 inches to 36 inches
- Various size sorbent particle capability
- In bed cooling and heating
- Ability for steam sweep

Reconfigurable Solvent Based Systems

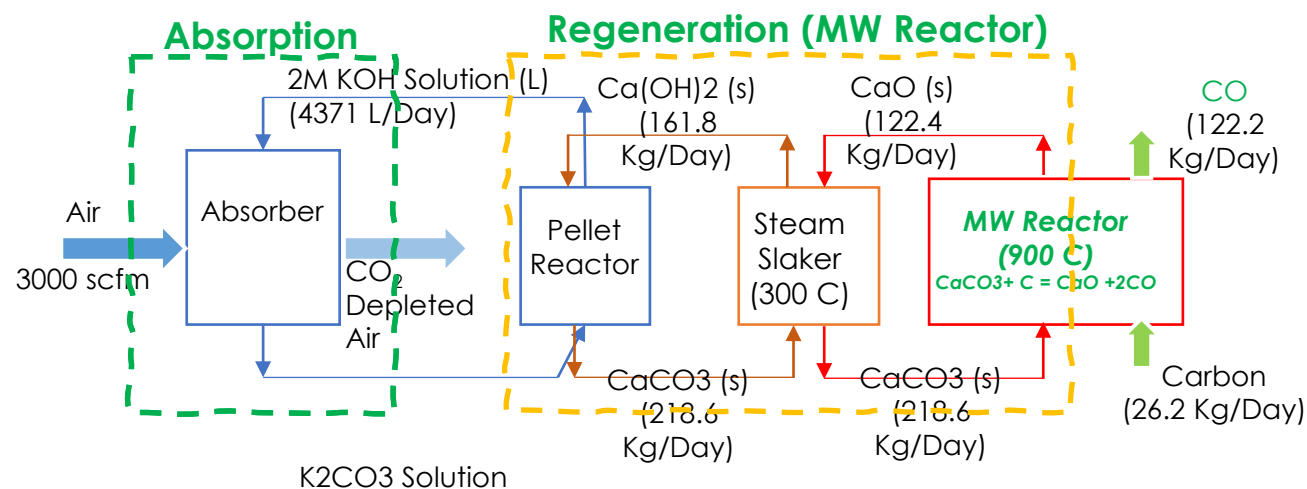


Features:

- Absorber supplied with up to 3000 scfm of CO₂, temperature and RH controlled air
- Power, steam, vacuum and data acquisition available
- 24/7 operation with remote operator access
- Low temperature amine regeneration

Features:

- Absorber with up to 3000 scfm of CO₂, temperature and RH controlled air
- Power, steam, vacuum and data acquisition available
- 24/7 operation with remote operator access
- Novel microwave regenerator



Candidate Sites

Option 1:

- Renovation/utilization of Building 84 high bay (PGH)

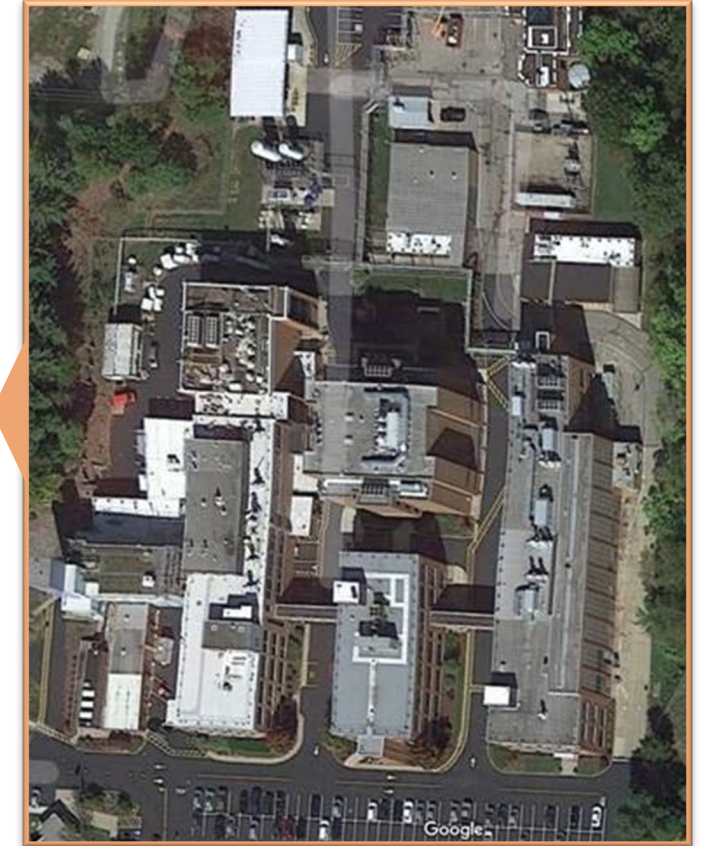
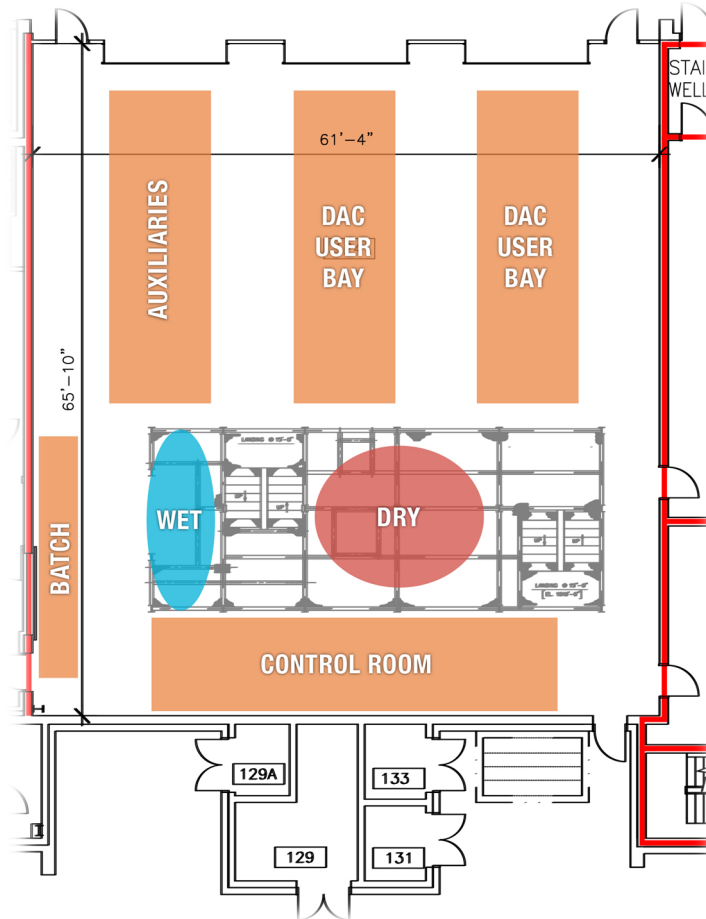


Option 2:

- New Building east of the East Parking Area (MGN)

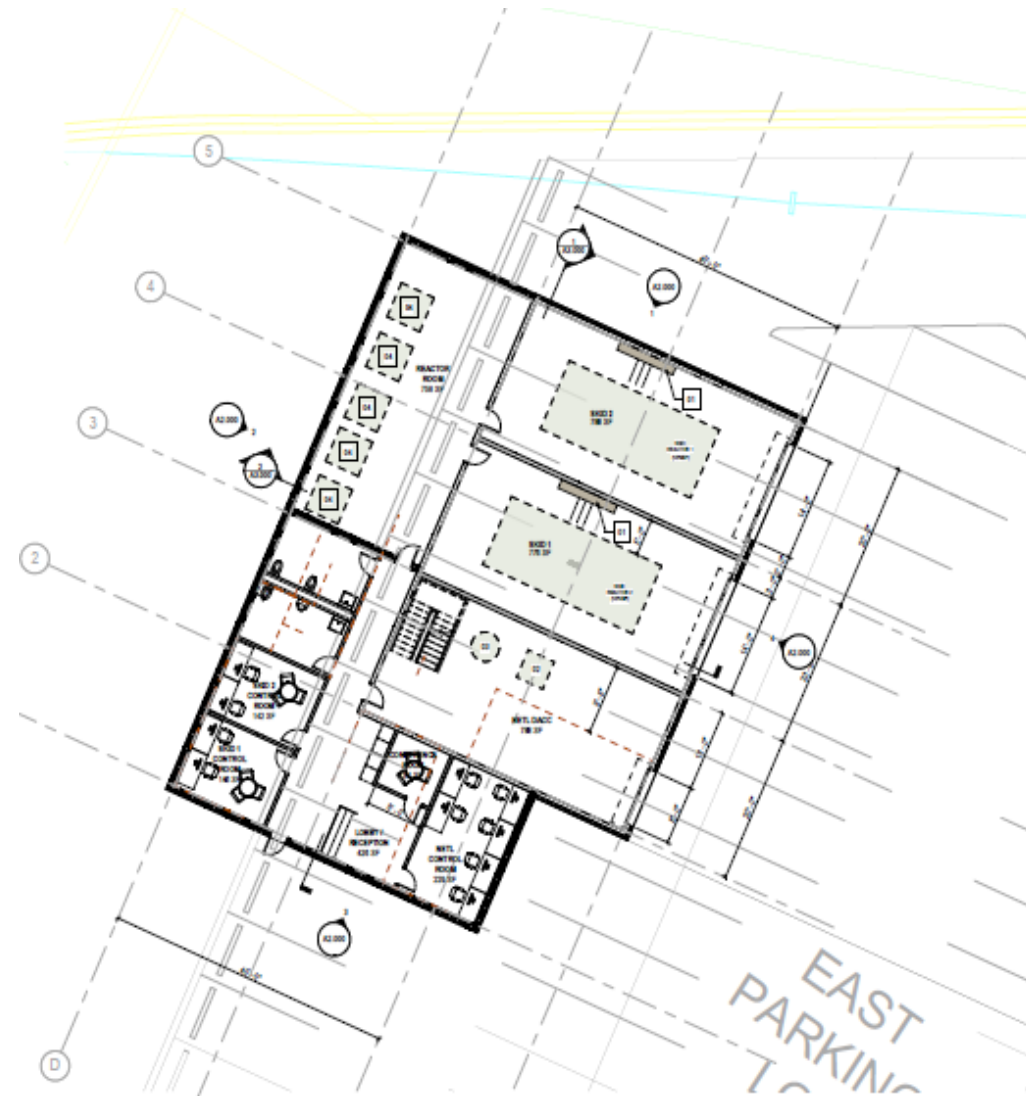
B84 High Bay

- 64ft x 60ft
- Can accommodate the dry and wet reactors
- Space for 2 user bays
- Sufficient space for facility auxiliaries

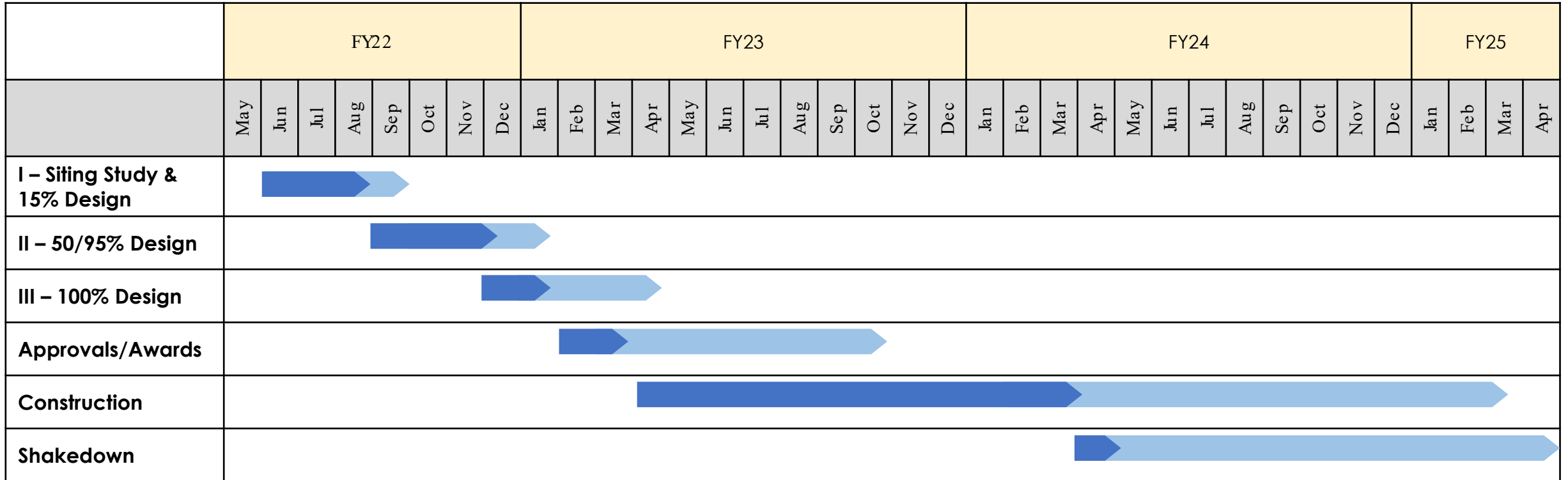


New Facility Morgantown

- Better Layout
- Easier Access
- Fewer constraints on skids
- Built to size plus potential expansion

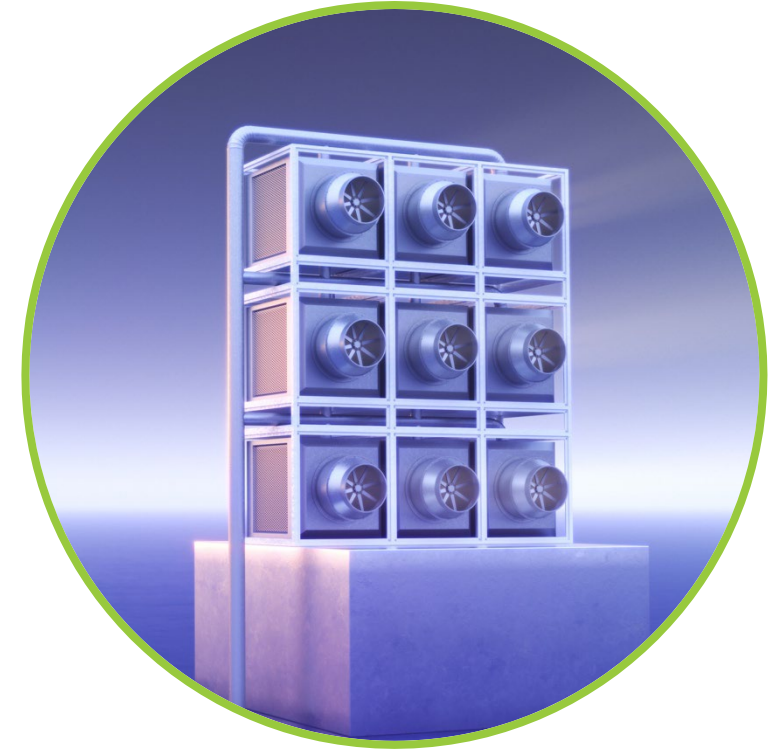


Schedule for DAC Center

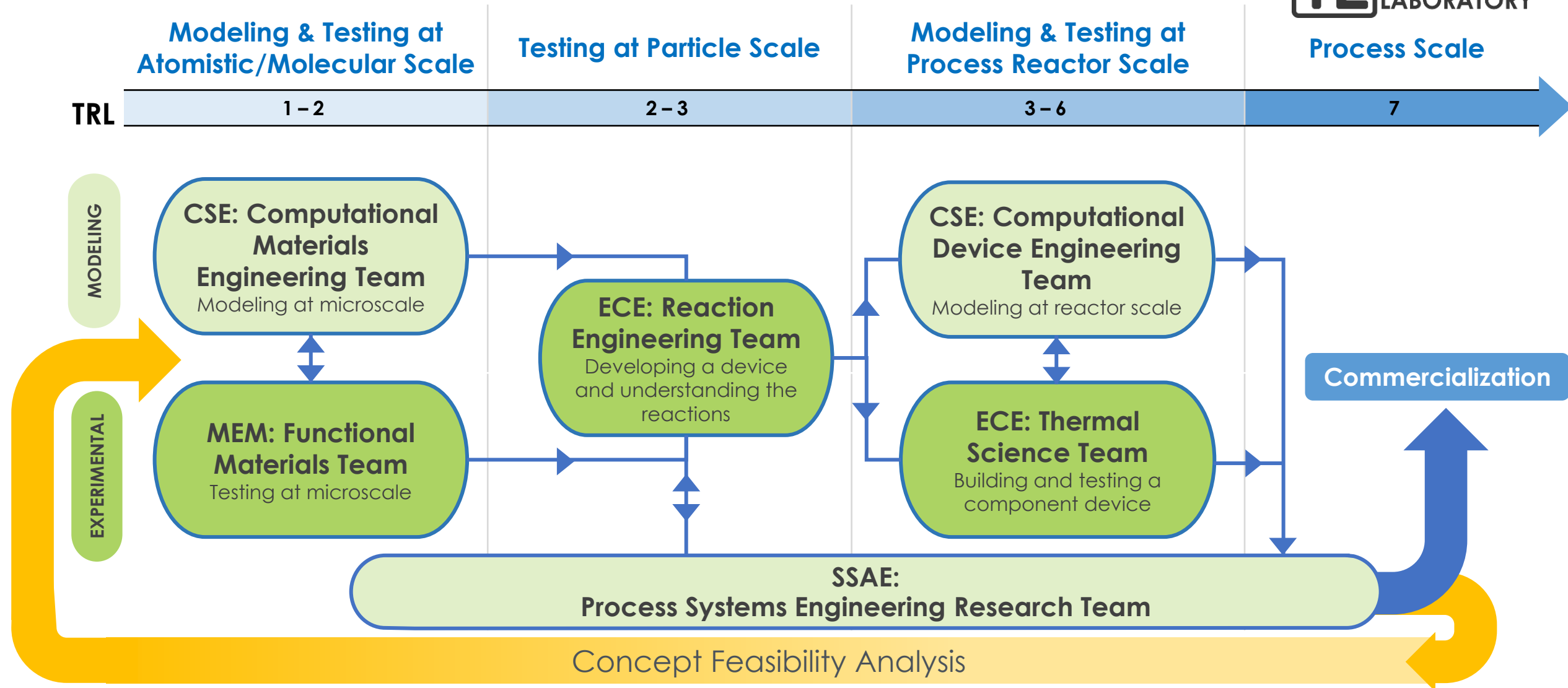


15% Design Schedule Status

- ✓ Contract signed
- ✓ Kick-off meeting held early June
- ✓ Completion expected late August



Collaboration to Achieve Commercialization



- NETL is building a user-friendly DAC test center
- It will have 2 test cells for evaluating user developed test skids for a wide variety of climate conditions (Summers in Miami – winters in Chicago)
- It will have 3 user developmental test facilities for testing cyclic and continuous designs for a variety of sorbents from liquid solvents to solid monoliths.
- It will have between 4 to 5 (liter sized) batch reactor test facilities for developing new and novel sorbents and accessing sorbent life.
- It is expected to be operational in May of 2024
- NETL will have interim testing capability at the 3000scfm scale for testing cyclic systems as early as the summer of 2023.

Acknowledgements

- A special thank is extended to Fan Shi, Jim Hoffman and Sam Bayham for taking the lead on the design of the reconfigurable test units as well as many, many others at NETL helping to make this center a success