Carbon Capture and Separations for Energy Applications

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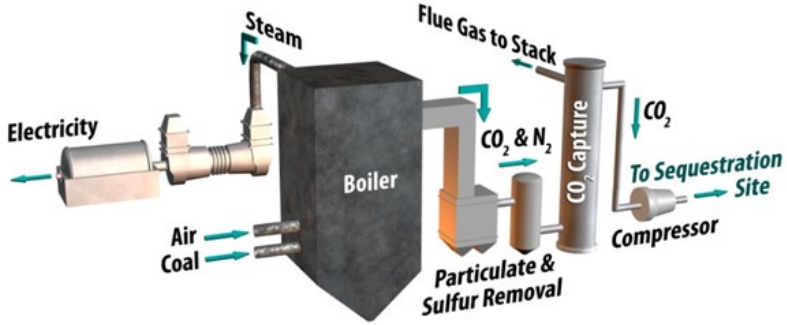
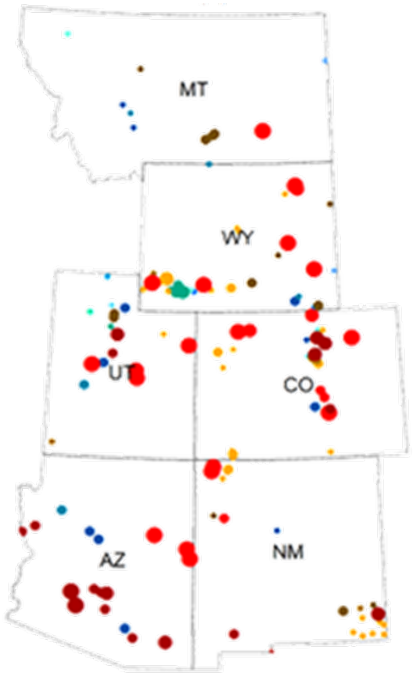
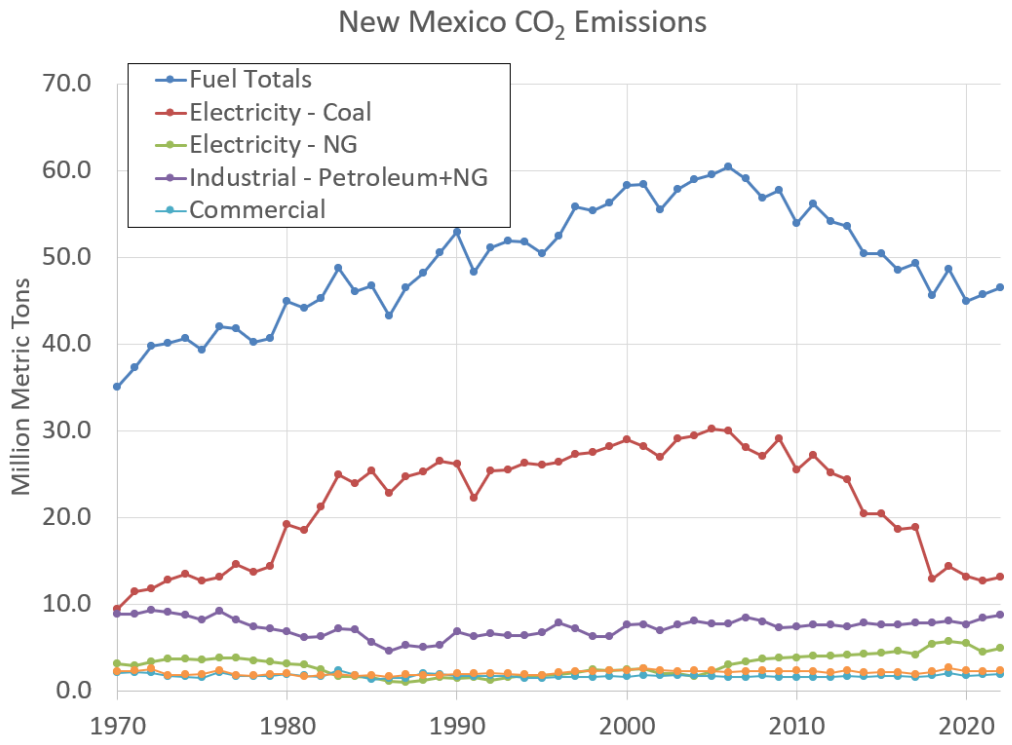
Carbon Capture from Point Sources

- **Continued reliance on fossil fuel for energy makes CO_2 capture and sequestration or reuse an essential requirement**
  - NM CO_2 emissions predominantly from power & industrial sector



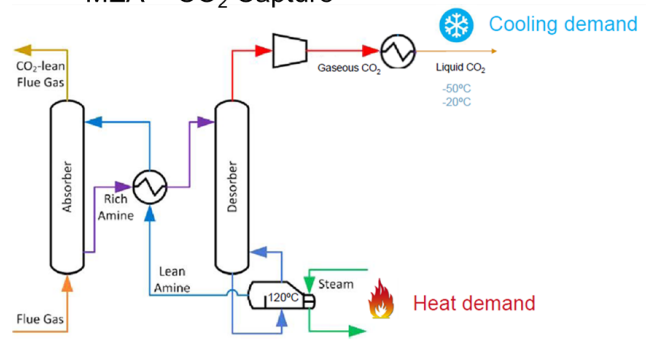
45Q-eligible point sources



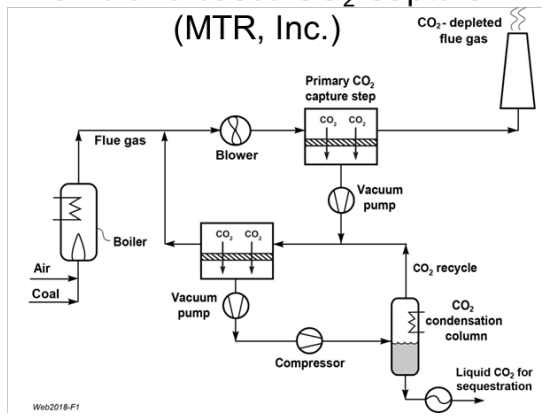


Source: EIA

MEA™ CO_2 Capture



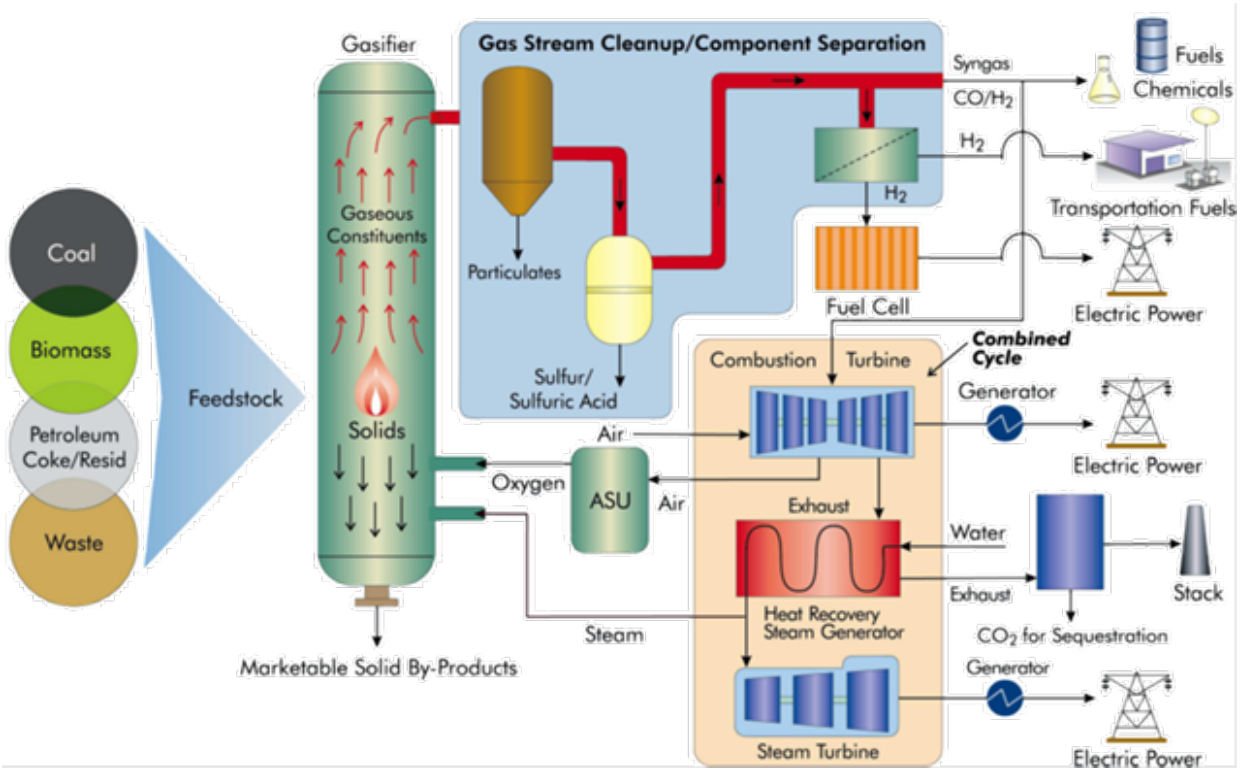
Membrane-based CO_2 Capture (MTR, Inc.)

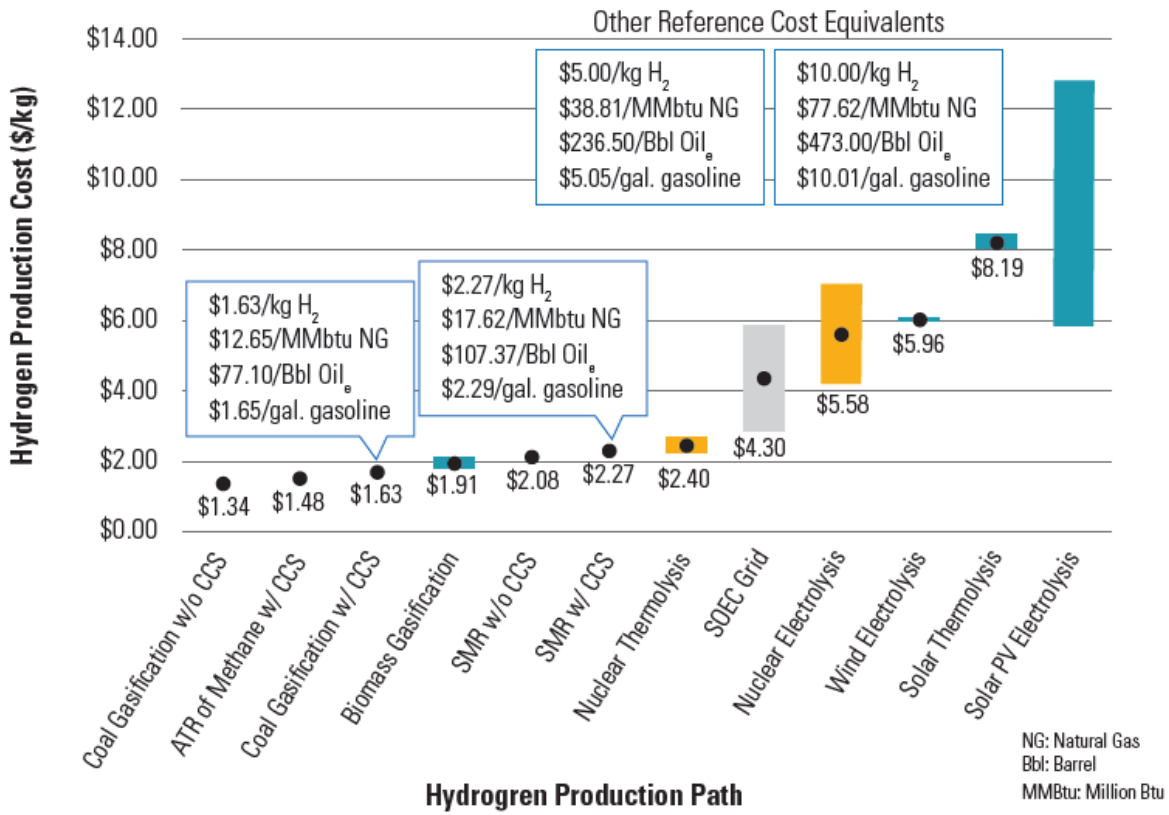


H_2 production with Carbon Management

Gasification Systems

- Reduce the cost and increase efficiency exploiting Radically Engineered Modular Systems (REMS) concepts for gasification system

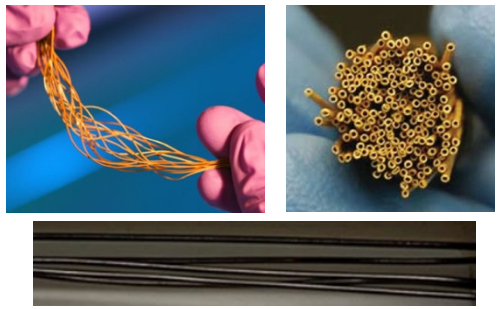




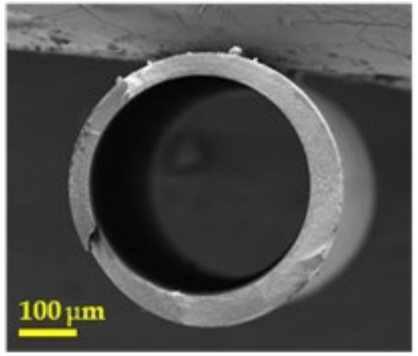
Source: DOE-FE/NETL

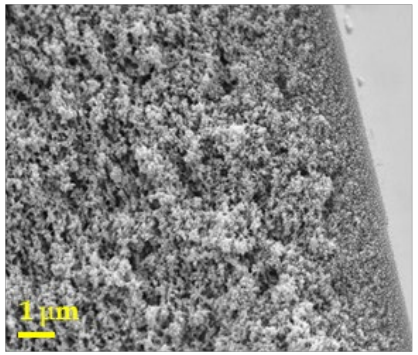
H_2 Production with Integrated Carbon Capture

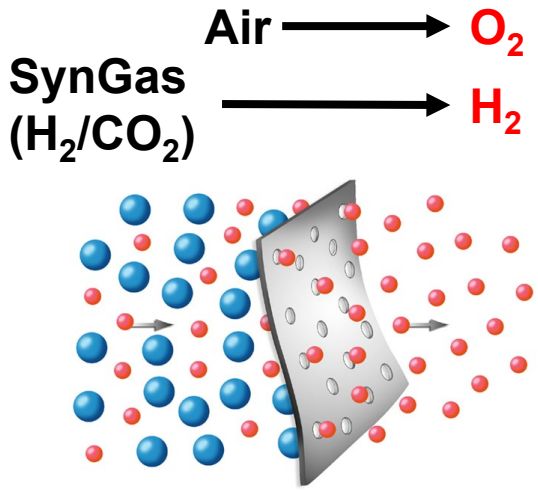
- Advanced membranes for modular gas separations

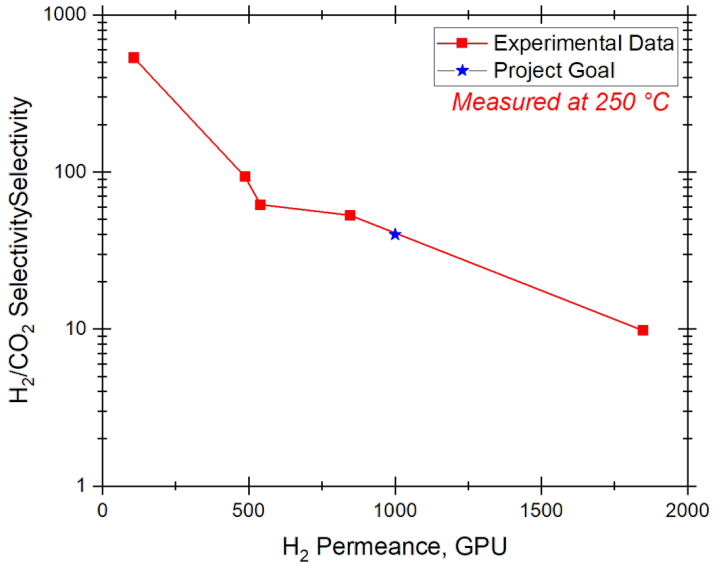


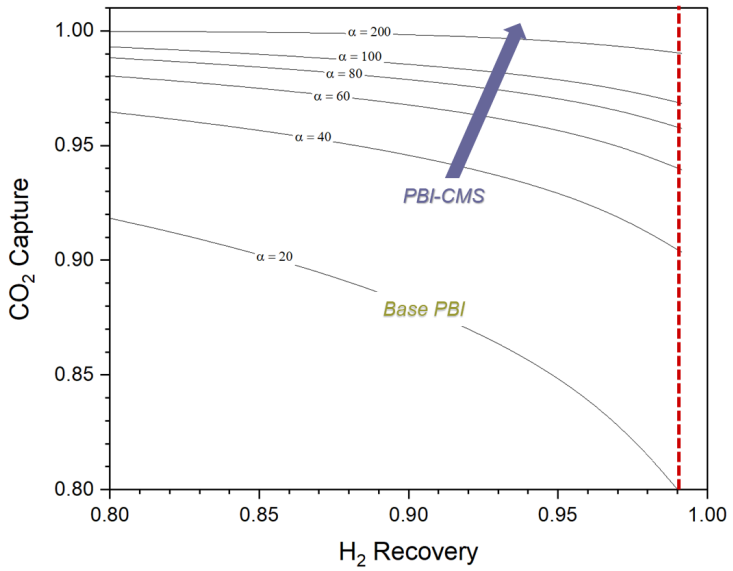
Industrial Platform Development (Hollow Fiber Membranes)

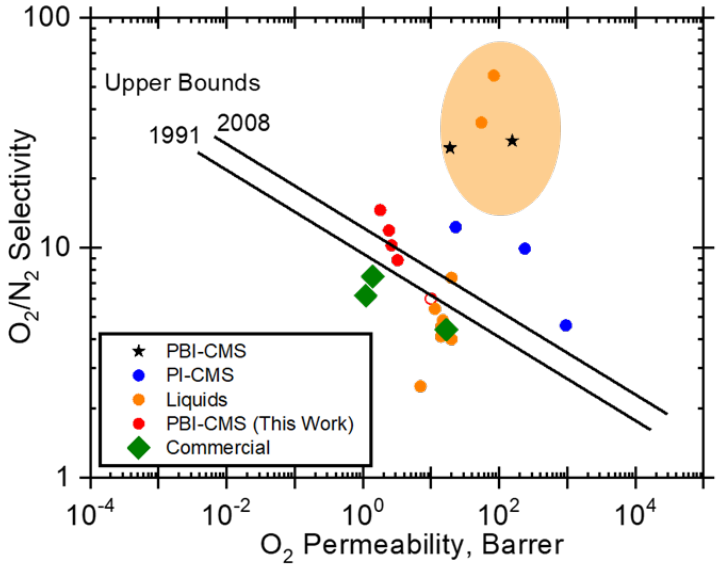








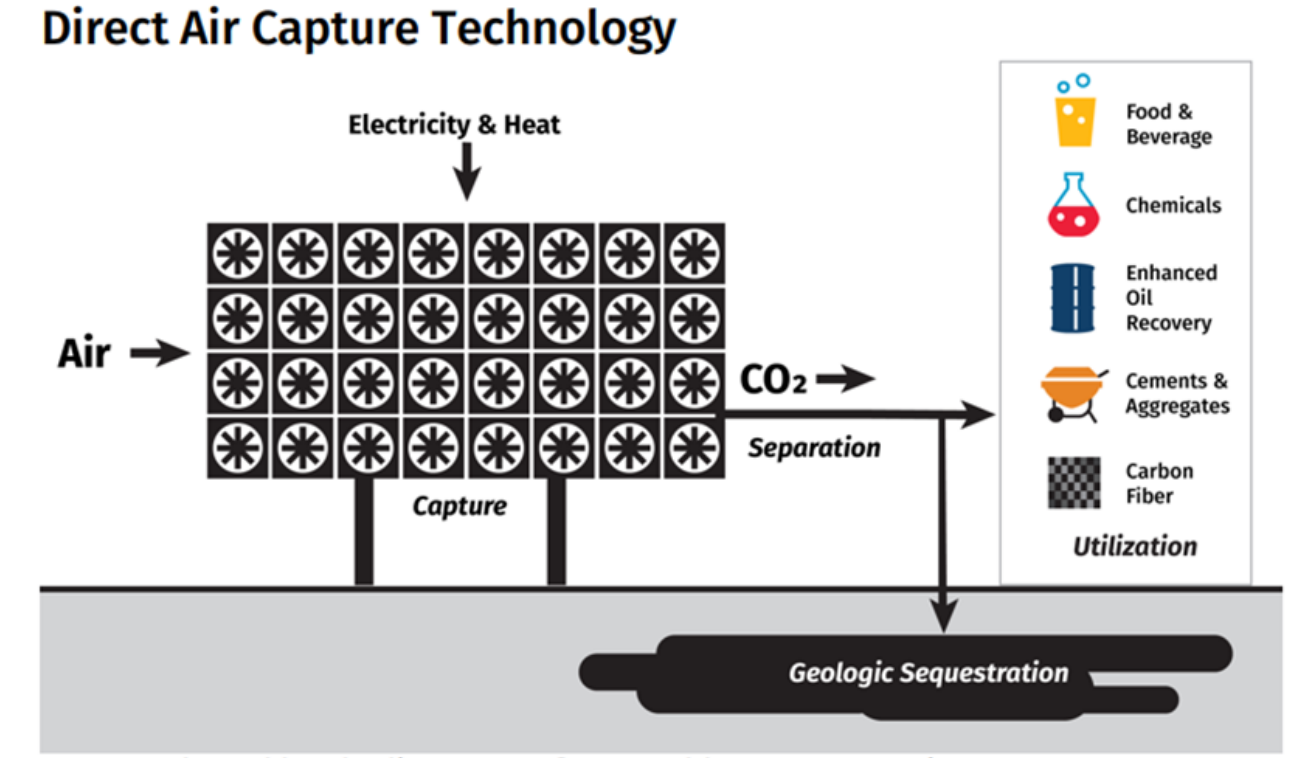




Elevated Temperature post-WGS H_2/CO_2 Separations

Direct Air Capture of Carbon Dioxide

- **Net zero carbon economy requires both CO_2 emissions reduction and CO_2 removal (CDR) from atmosphere**
- **DAC of CO_2 estimated scale (EIA)**
  - 85 million tons by 2030
  - 980 million tons by 2050
  - Current deployment – 0.01 $MtCO_2$
  - Cost – $100 to 700/ton CO_2
- **DAC CO_2 a climate-neutral feedstock for chemicals to fuel production**
  - 350 Mt of air captured CO_2 for synthetic fuel



Source – Rhodium Group

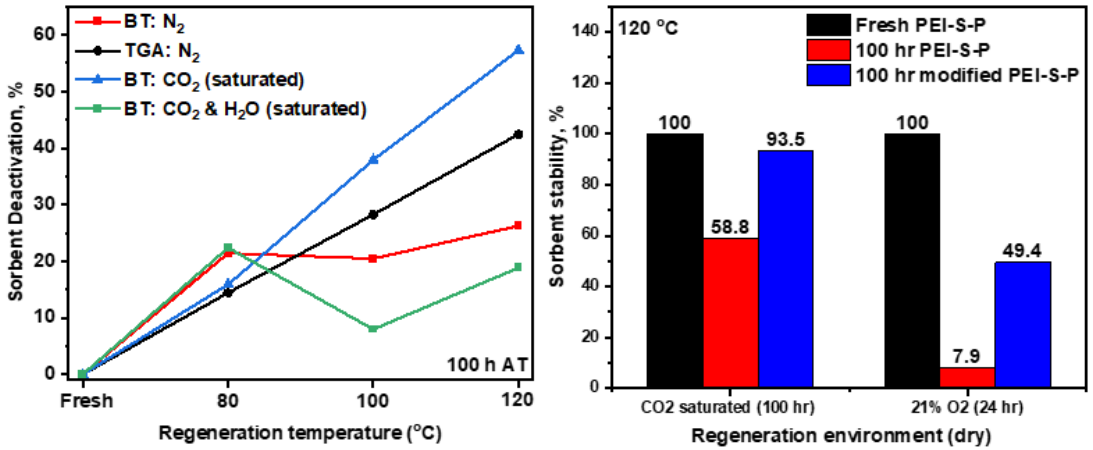
Advanced DAC Materials

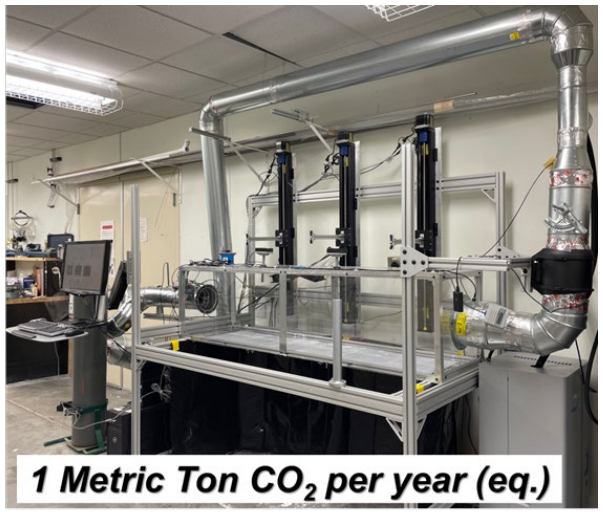
LDRD LABORATORY DIRECTED RESEARCH & DEVELOPMENT

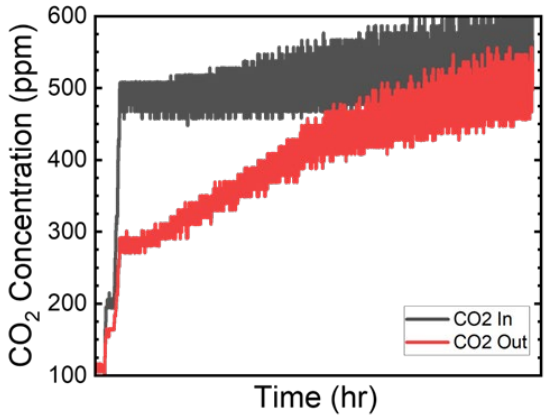
Research needs:

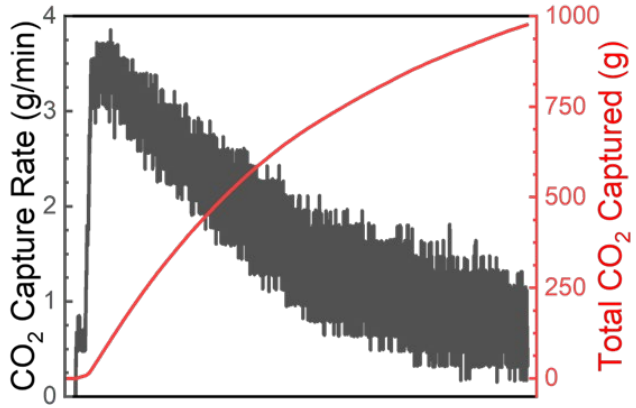
Novel thermo-chemically robust materials with long lifetime ⟷ **Testbed capabilities for performance benchmarking and process development**

PEI-silica pellets (PEI-S-P)









- Precise understanding of amine-based material degradation
- Developing new CO_2 reactive materials with lower heat of regeneration
- Materials for reactive CO_2 conversion

Closed-loop, variable-scale, humidity-controlled, variable air-speed (0 - 8.1 m^3/min), CO_2 concentration control (200 to 2000 ppm), and automated data recording