THE OHIO STATE UNIVERSITY

Moving Beyond 90% Carbon Capture by Highly Selective Membranes and Processes

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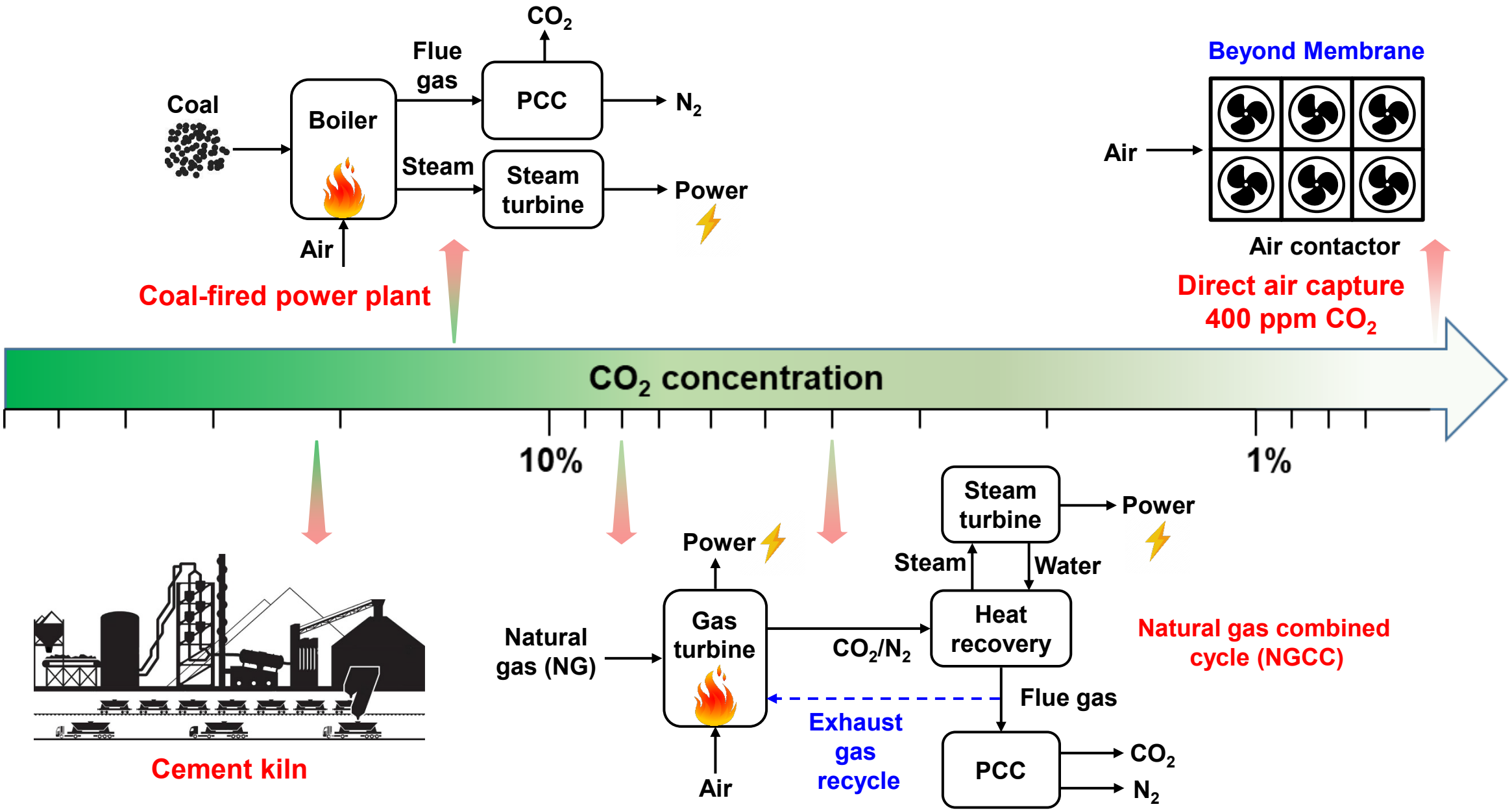
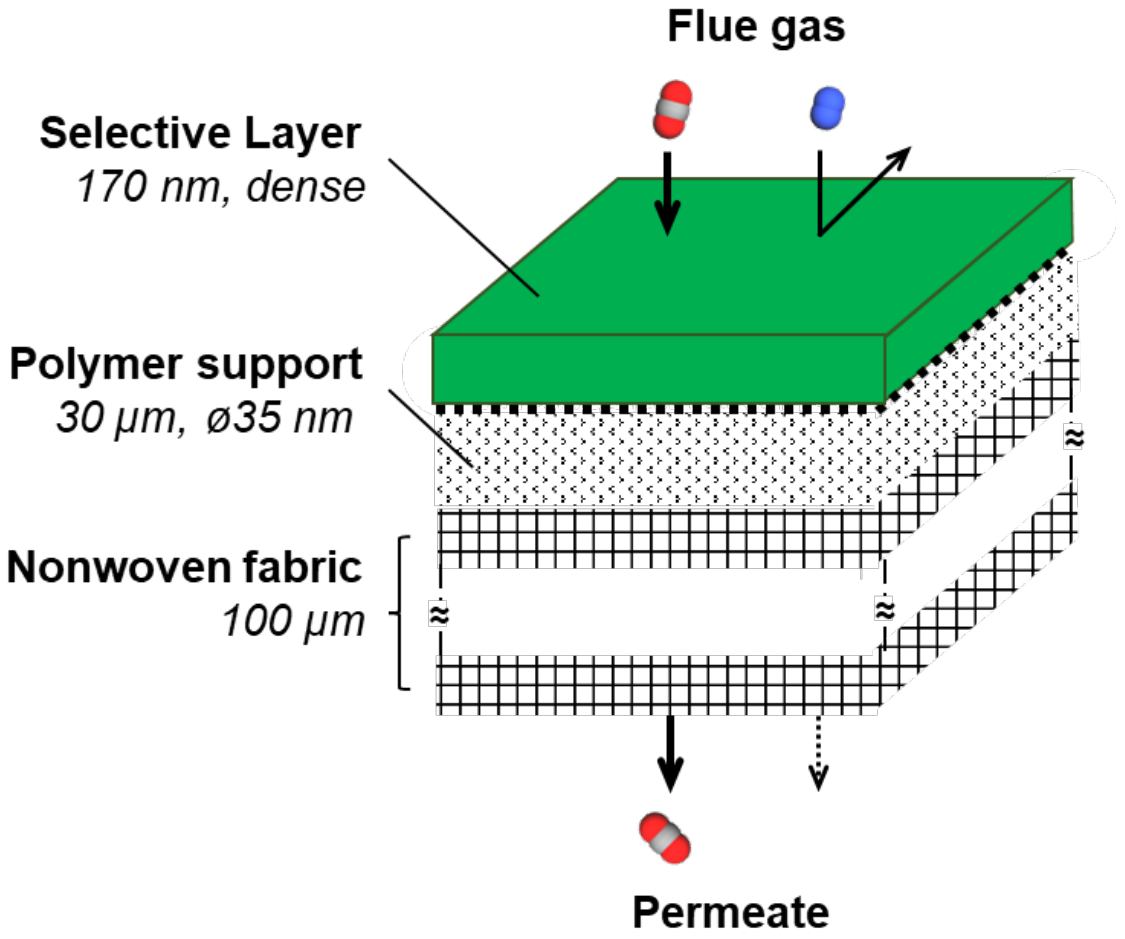
Post-Combustion Capture (PCC) from Stationary Sources



Facilitated Transport Membranes

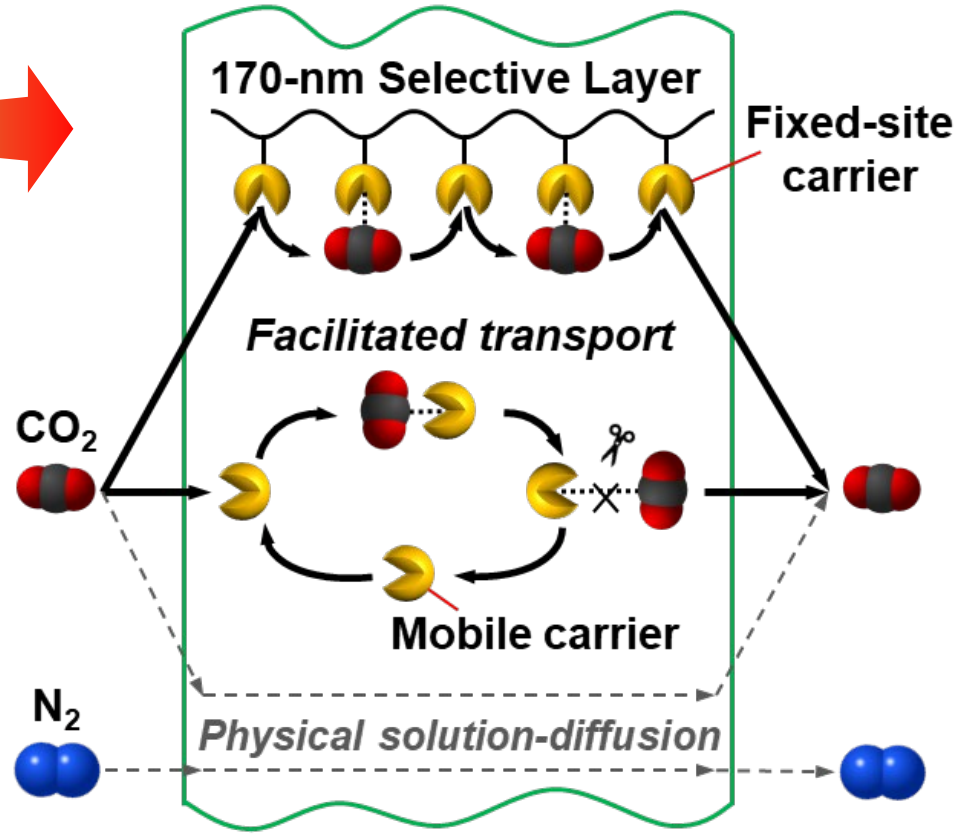
Thin-Film Composite (TFC) Membrane Structure: 3 Layers

Efficient and scalable membrane for low cost

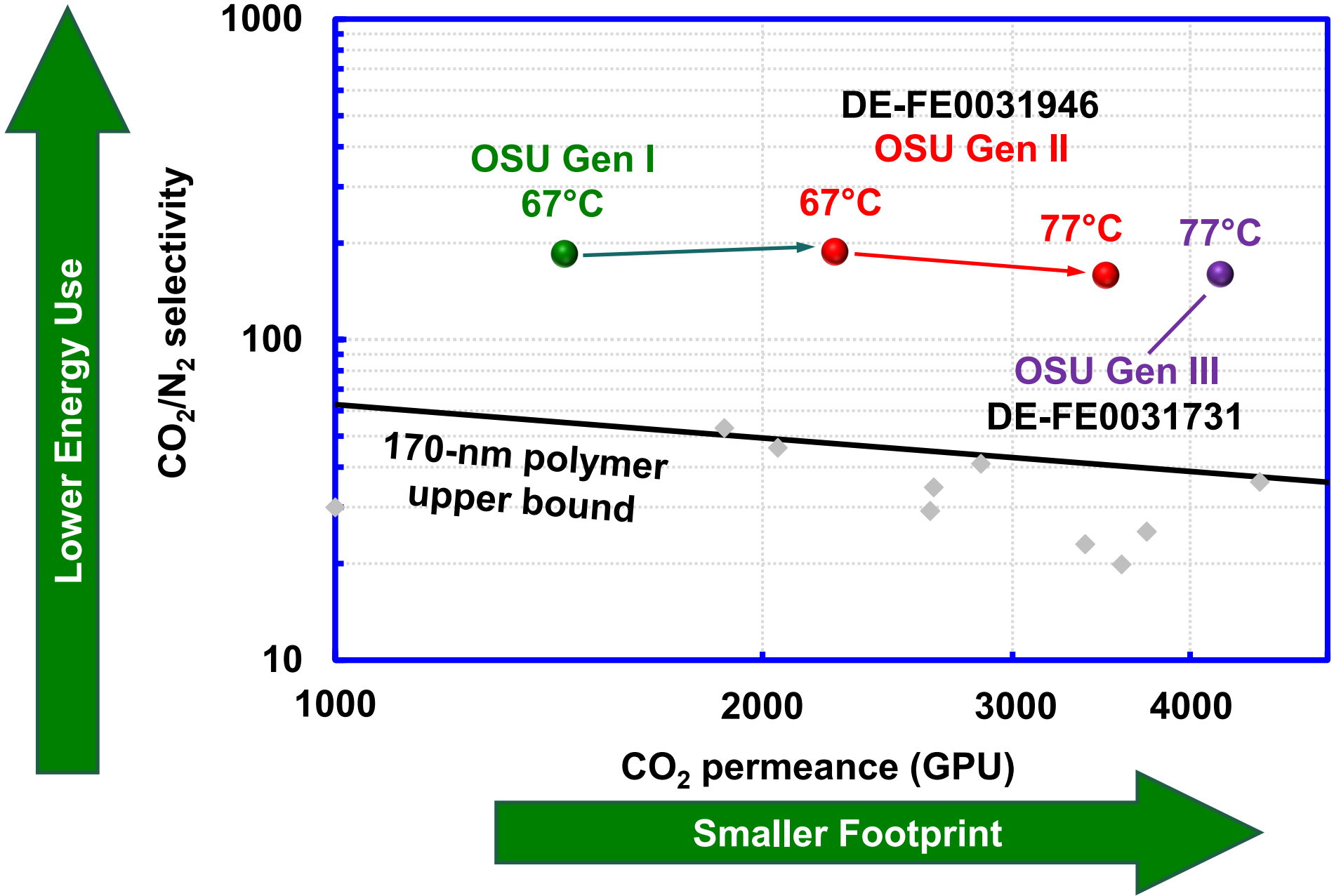


Amine-Based Facilitated Transport Membrane

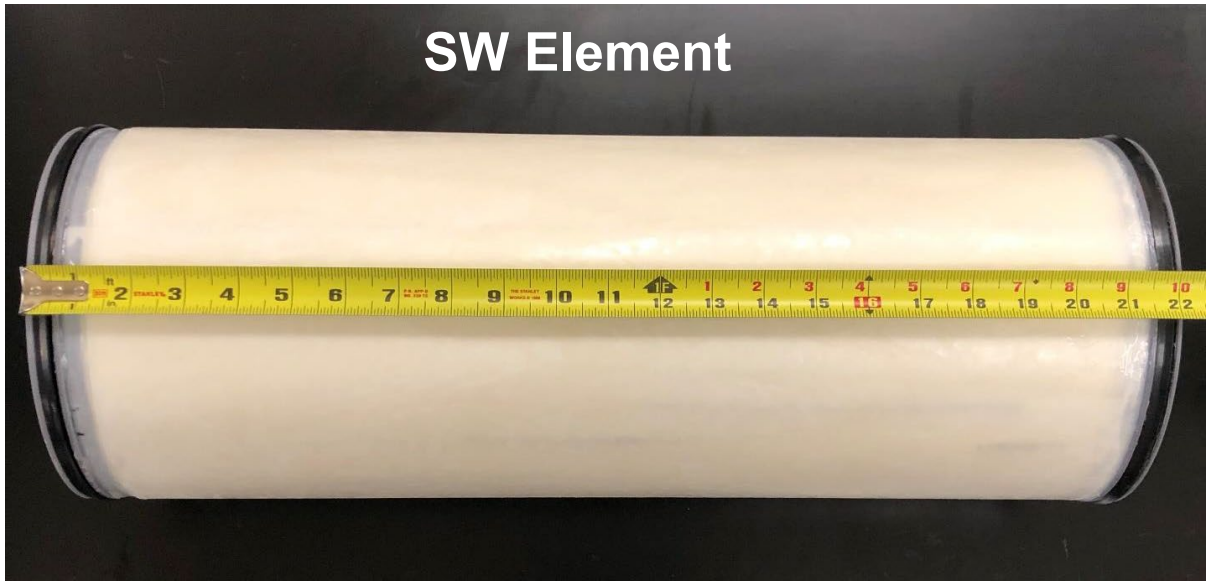
Highly selective CO_2 separation by reactive diffusion

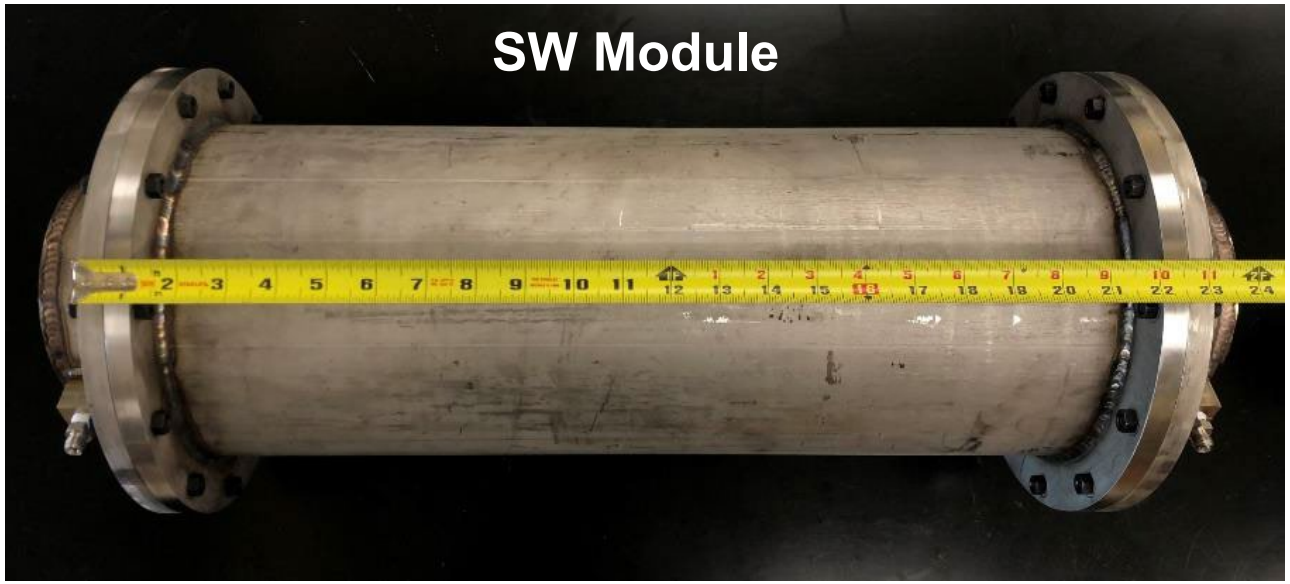


Evolution of OSU's Membrane Technology



Photos of ⌀8″ SW Element and Module

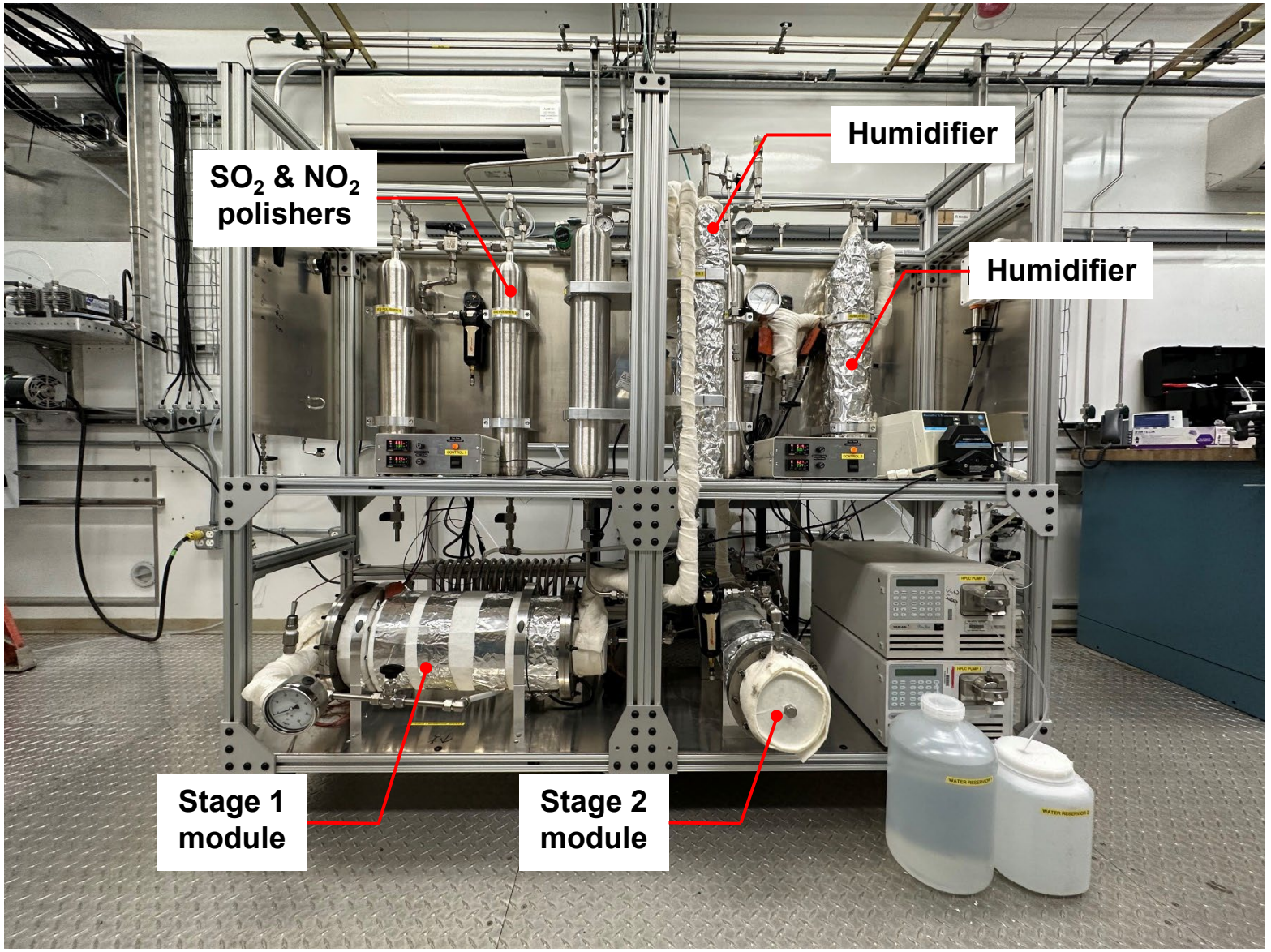


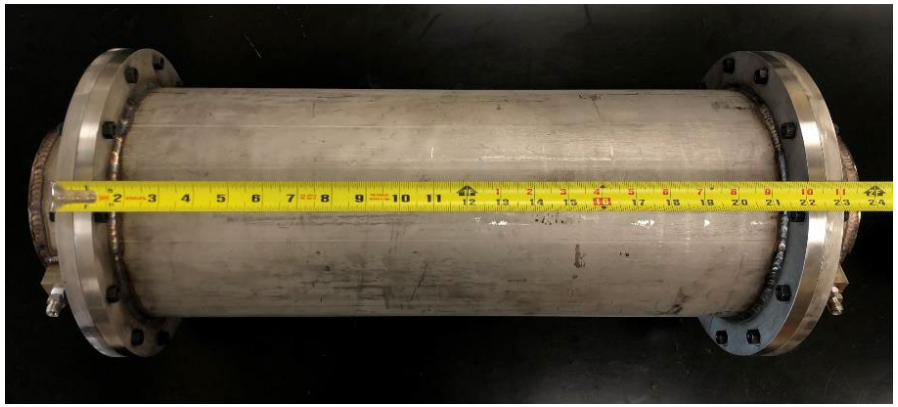


- **⌀8″ SW element**
  - Commercial diameter
  - Half of commercial length
  - 41 membrane leaves
  - 35 m^2 membrane area
  - 2000 m^2/m^3 packing density

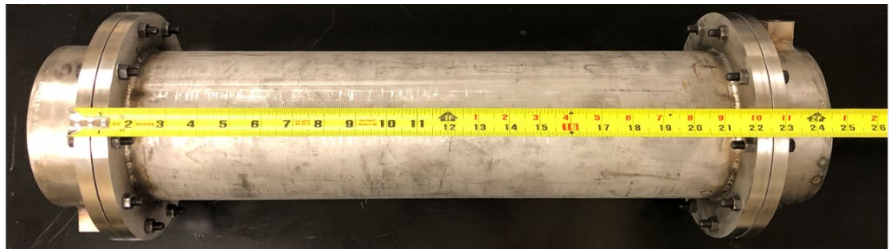
Yang et al., JMS, 696, 122520 (2024)

2-Stage Bench Skid at NCCC





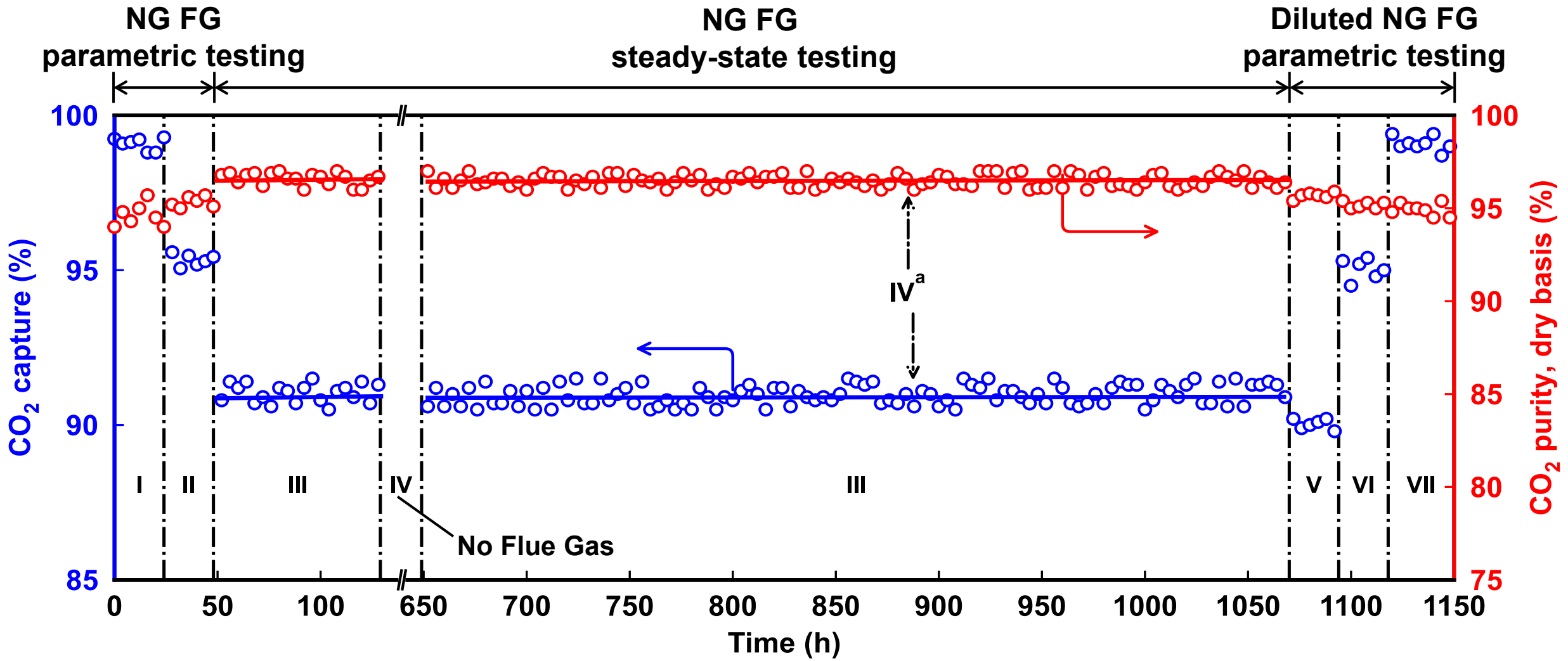
Stage 1 Module (⌀8″, 35 m²)



Stage 2 Module (⌀5″, 12 m²)

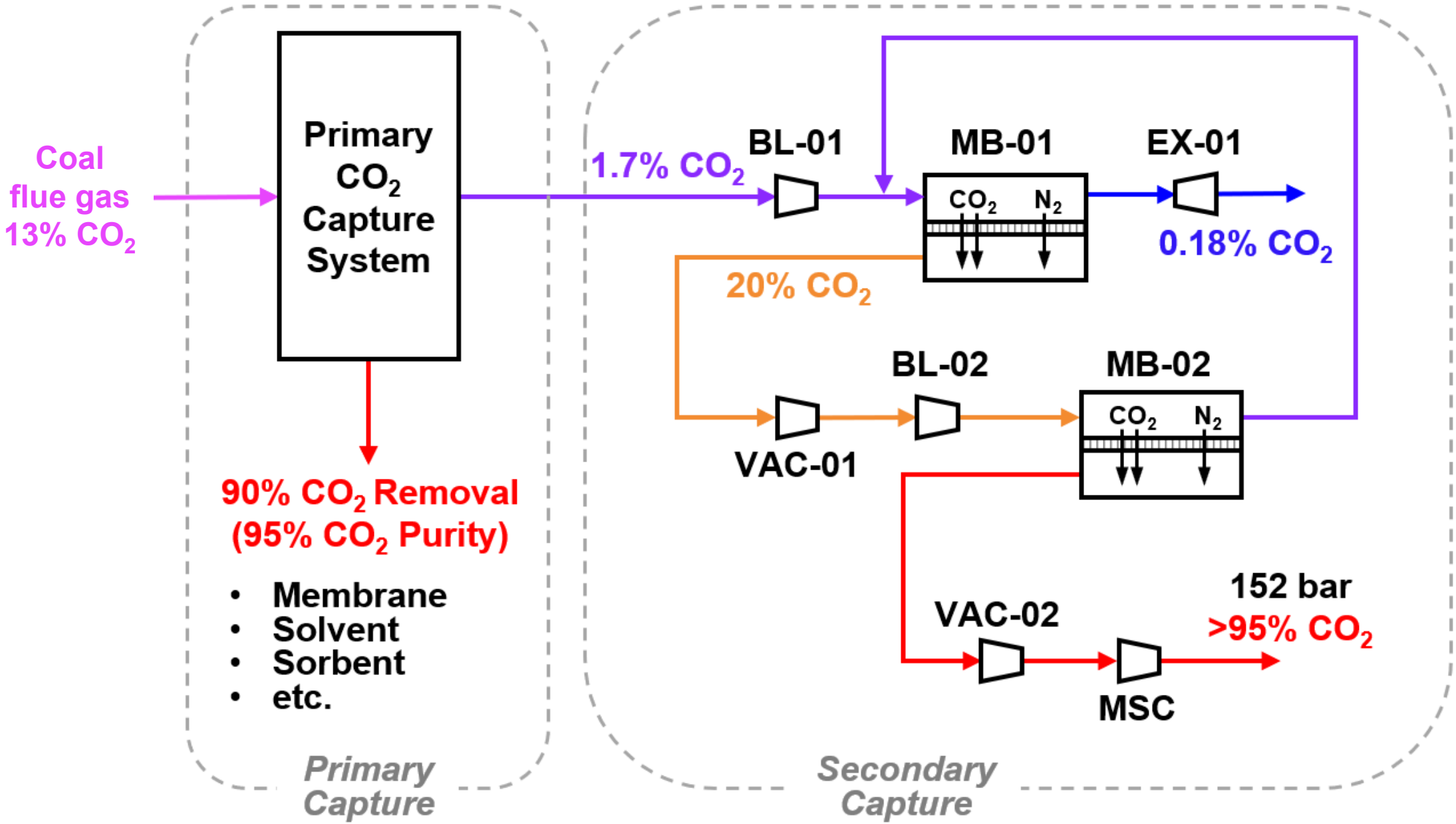
- NCCC = National Carbon Capture Center, Wilsonville, AL

Skid Testing with NG FG (8.6% CO_2) and Diluted NG FG (4.3% CO_2) at NCCC

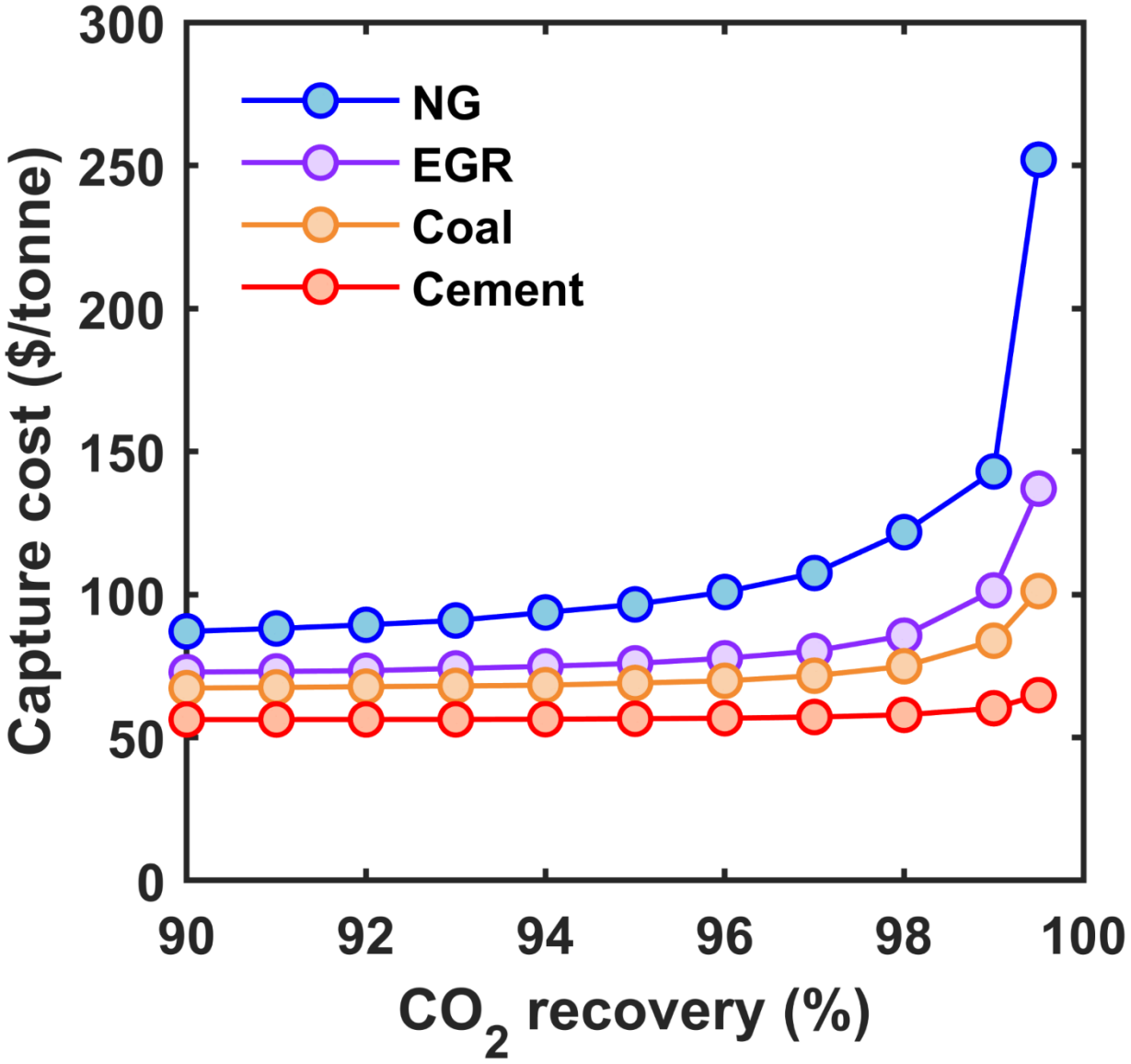


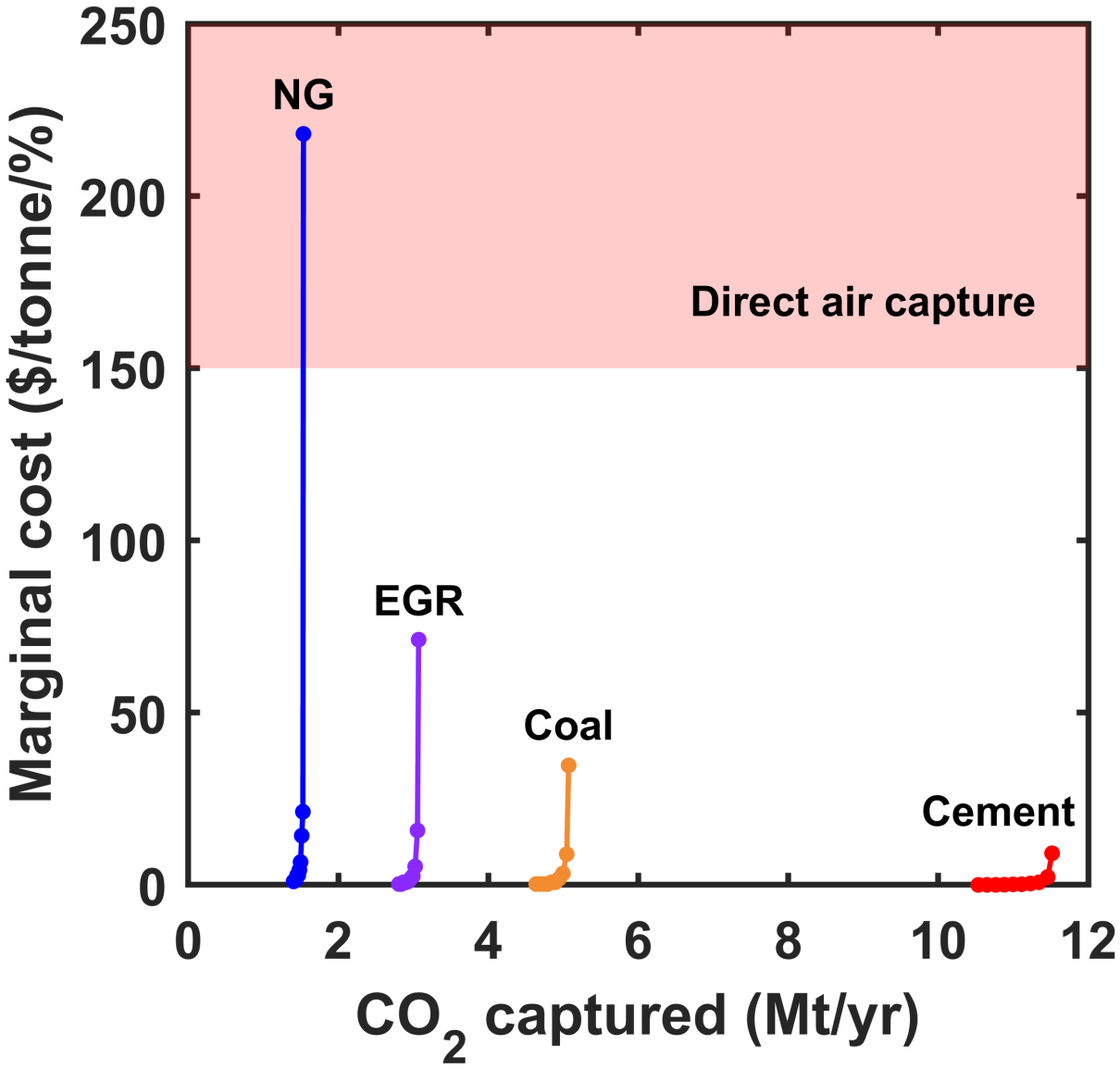
- 90–99% CO_2 capture degrees achieved for both CO_2 conc's, all with ≥95% CO_2 purity
- Good membrane module and process stabilities demonstrated at NCCC

Membrane as Secondary Capture Unit

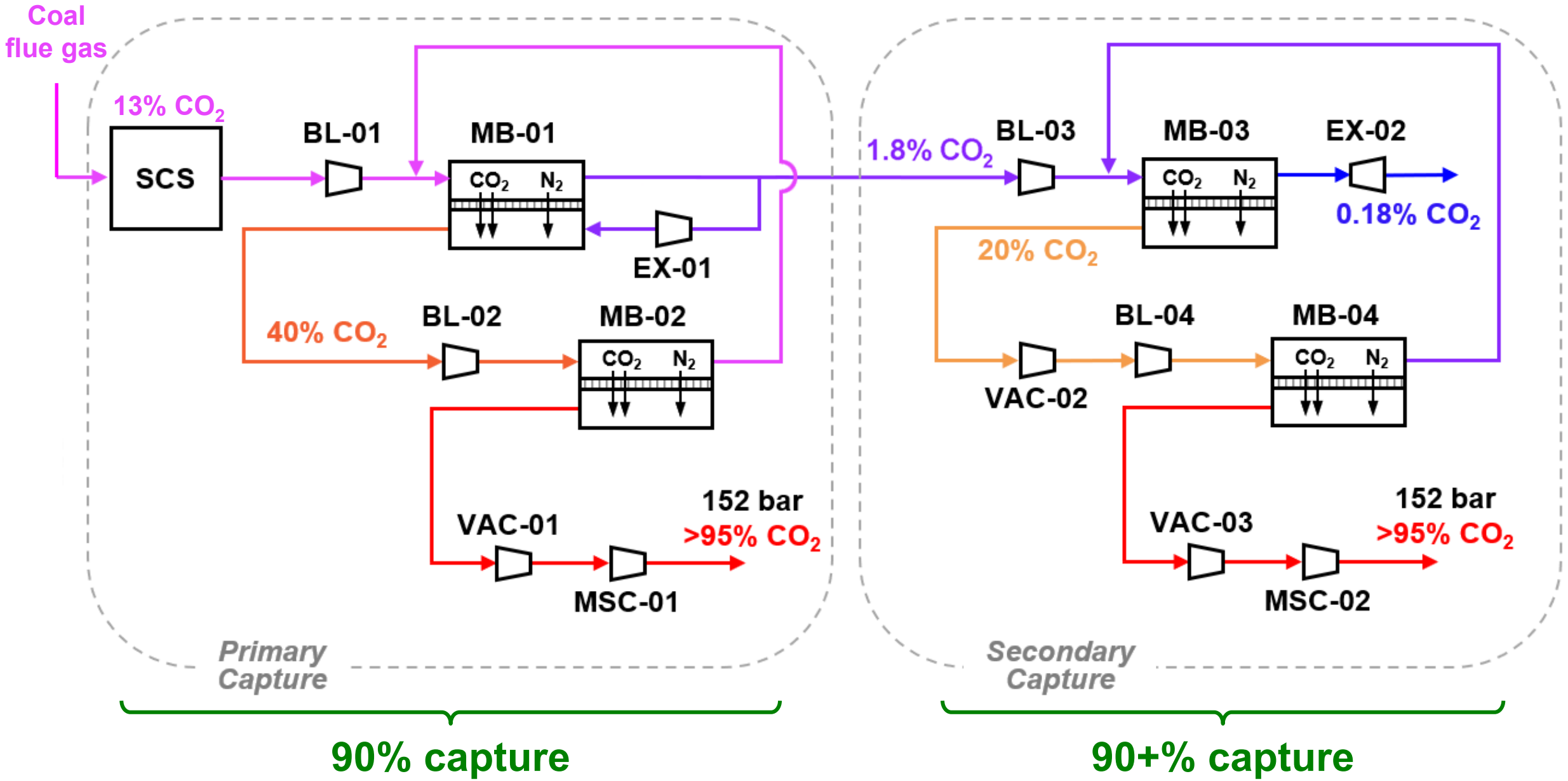


Effect of CO_2 Recovery

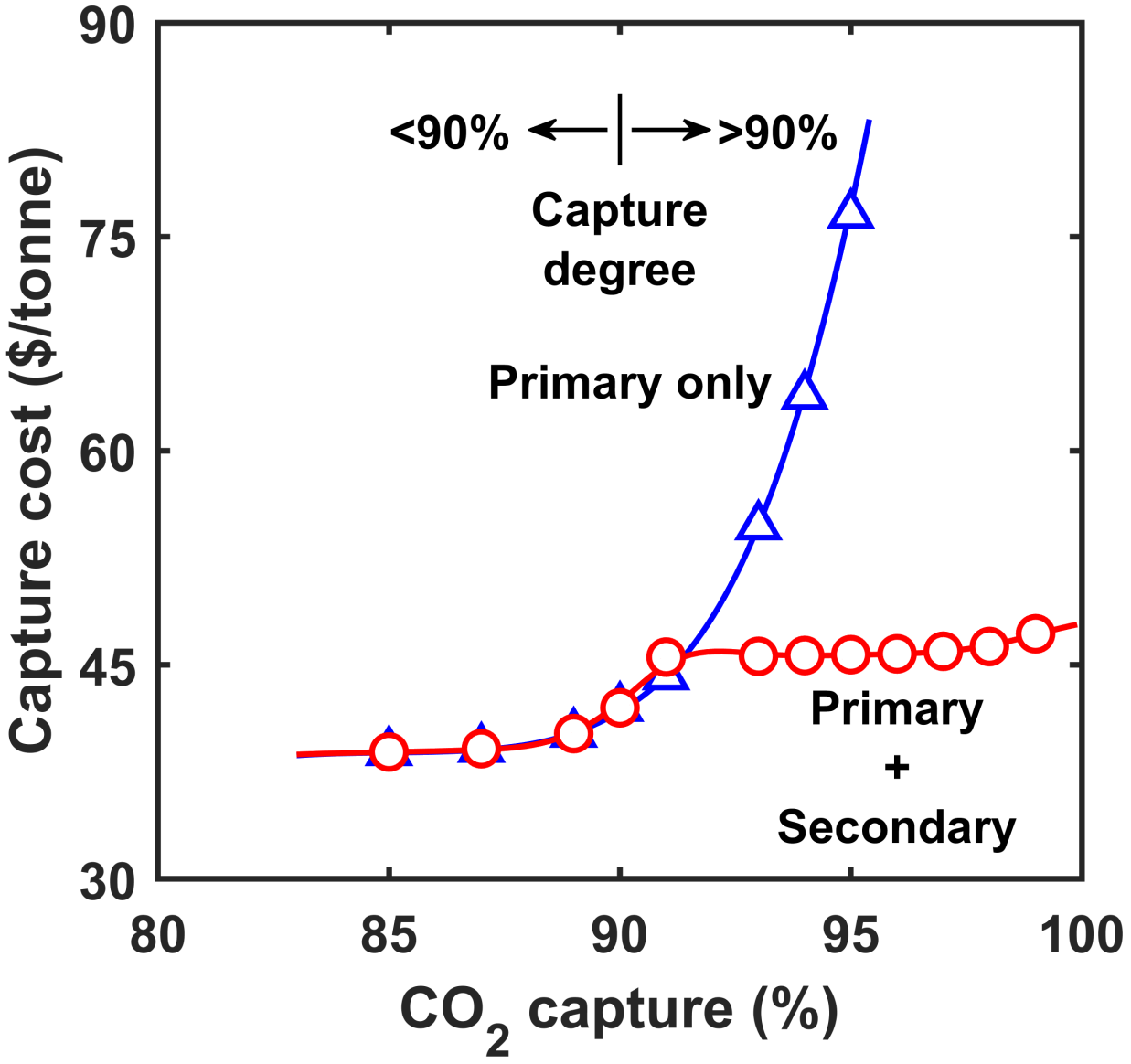


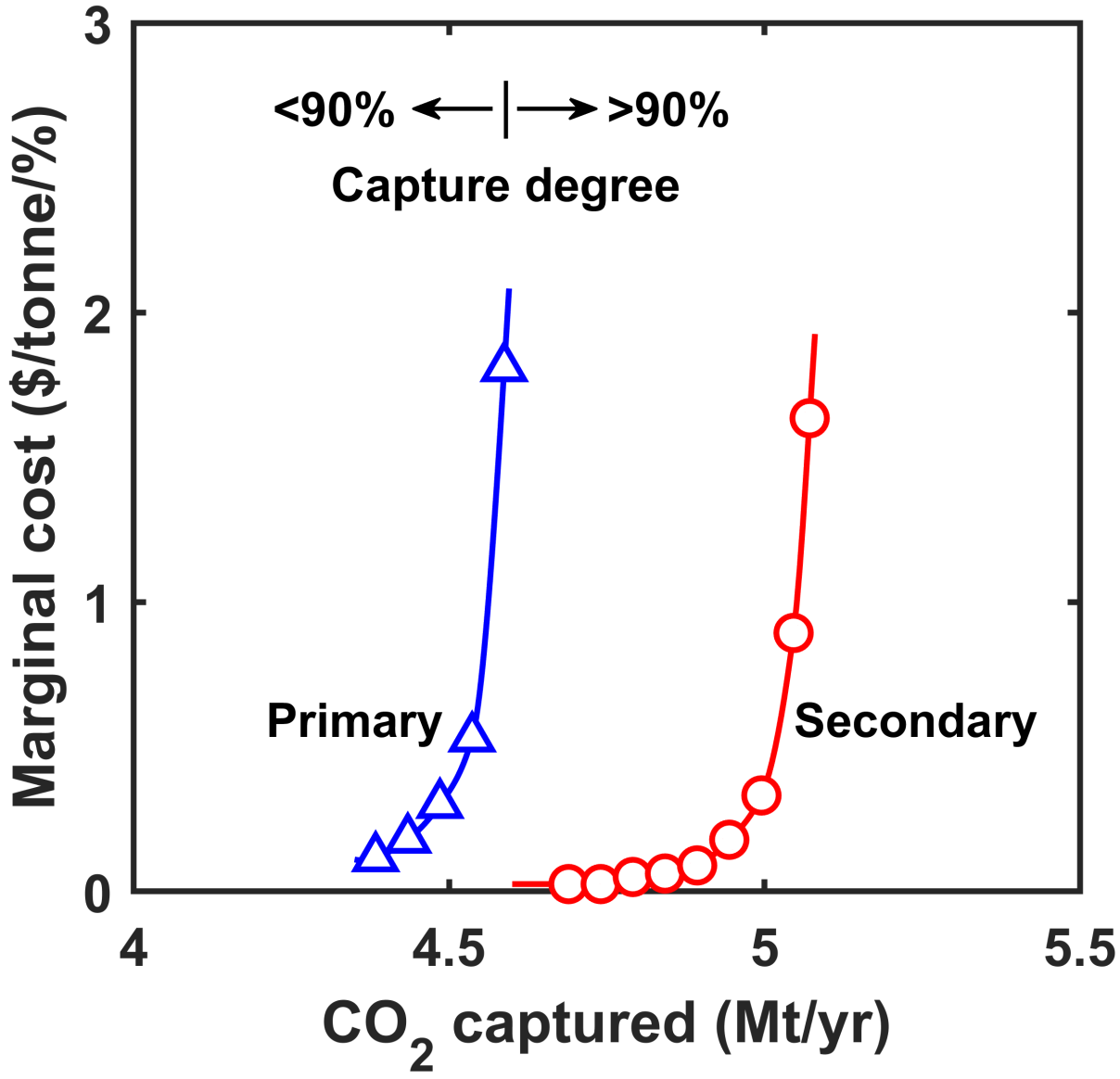


Membrane-Only Process for 90+% Capture



Marginal Costs for Beyond 90% Capture





Timeline of Key Field Demos

1 TPD integrated membrane skid
Coal FG at OSU; NG FG at NCCC

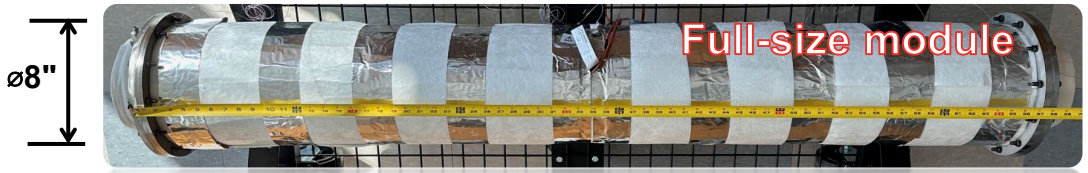
2018
DE-FE0026919

1.4 m² SW module
Coal FG at NCCC

2022
DE-FE0031731

2025
DE-FE0031946

20 TPD membrane skid
Coal FG at ITC
8 full-size SW modules



5 TPD membrane skid
NGCC FG at ITC

- **6 full-size SW modules**
- **Repurposed skid at ITC**
- **95% CO_2 capture**

2027
DE-FE0032467

2028
DE-FE0032463

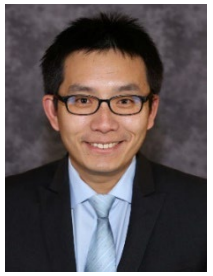
3 TPD membrane skid
Cement FG at Holcim

- **2 full-size SW modules**
- **Holcim plant in Holly Hill, SC**
- **99% CO_2 capture**

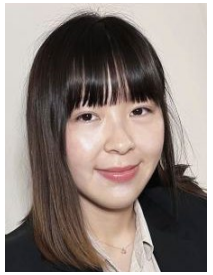
Acknowledgments

Active layer

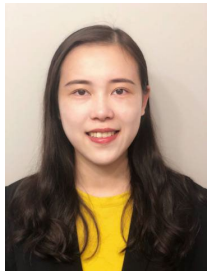
Prof. W.S. Winston Ho
(OSU)



Prof. Li-Chiang Lin
(NTU)



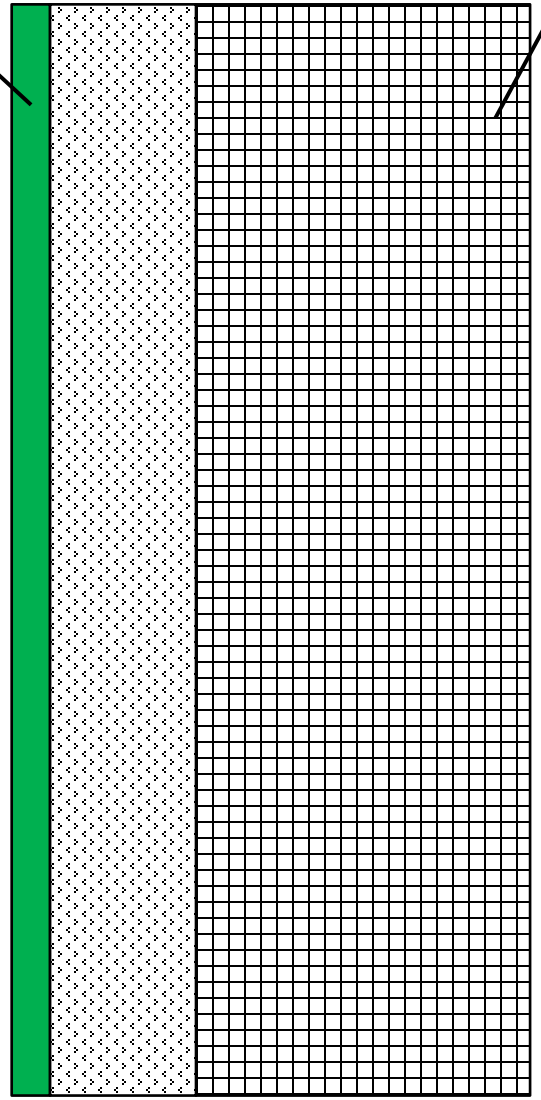
Dr. Jingying Hu
(NREL)



Dr. Yutong Yang
(OSU)

Dr. Andrew Deng
(OSU)

Shraavya Rao
(OSU)



Support

- **DOE/NETL**
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  - DE-FE0032463
  - DE-FE0032467

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