Large Pilot Testing of the MTR Membrane Post-Combustion CO_2 Capture Process

(DE-FE0031587; FOA 1788)

Richard W. Baker, Tim Merkel, Brice C. Freeman

Membrane Technology and Research, Inc.

NETL Project Manager: Sai Gollakota

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Project Overview

- **Award name:** Large Pilot Testing of the MTR Membrane Post-Combustion CO_2 Capture Process (DE-FE0031587; FOA 1788)
- **Project period:** 4/1/18 to 7/31/19
- **Funding:** $957k DOE + $239k cost share = $1.196M total
- **DOE-NETL Project Manager:** Sai Gallokota
- **Participants:** MTR (prime), Trimeric, WorleyParsons, EPRI, NRG, WY-ITC (host)

- **Overall goal:** Design, build, and operate a 200 TPD large pilot using partial capture to achieve ~$40/tonne CO_2.
- **Project plan: (Phase I)**
  - selection of the host power plant
  - secure financial commitments
  - conduct environmental information volume
  - update design and budget, and finalizing team commitments and organization for Phase II / III

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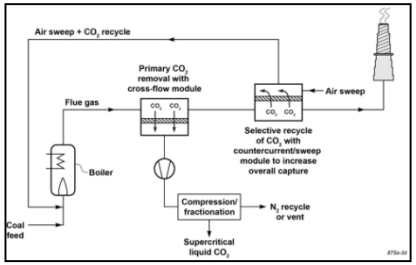
MTR CO_2 Capture Development Timeline

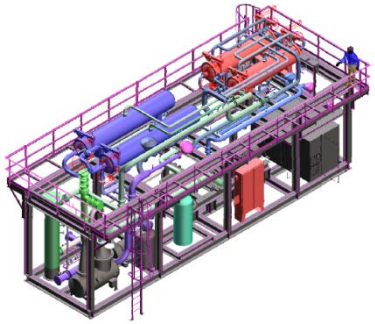
Feasibility study
- Sweep concept proposed
- Polaris membrane conceived



APS Red Hawk NGCC
- First Polaris flue gas test
- 250 lb/d CO_2 used for algae farm

APS Cholla Demo
- First Polaris coal flue gas test
- 1 TPD CO_2 captured (50 kW_e)

NCCC 1 MW_e Demo
- 11,000 hours of 1 TPD system operation
- 1 MW_e (20 TPD) system operation



Low Pressure Mega Module
- Design and build a 500 m^2 optimized module

Hybrid Capture
- Membrane-solvent hybrids with UT, Austin

B&W Integrated Test

10 MW_e Pilot

TRL3 TRL4 TRL5 TRL6 TRL7 TRL8

2006 2008 2010 2012 2014 2016 2018 2020

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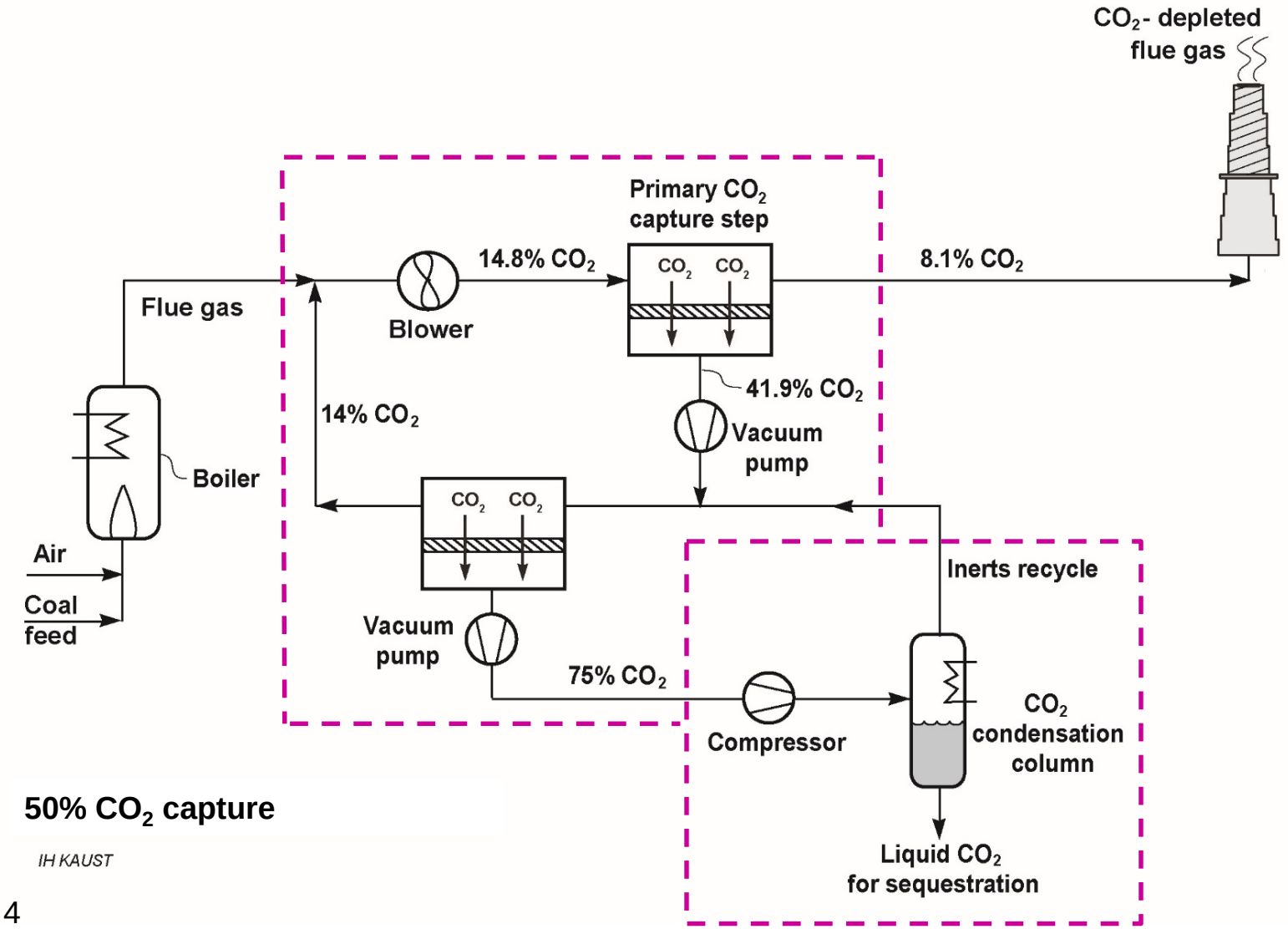
Partial CO_2 Capture with a Two-Stage Membrane Process



50% CO_2 capture

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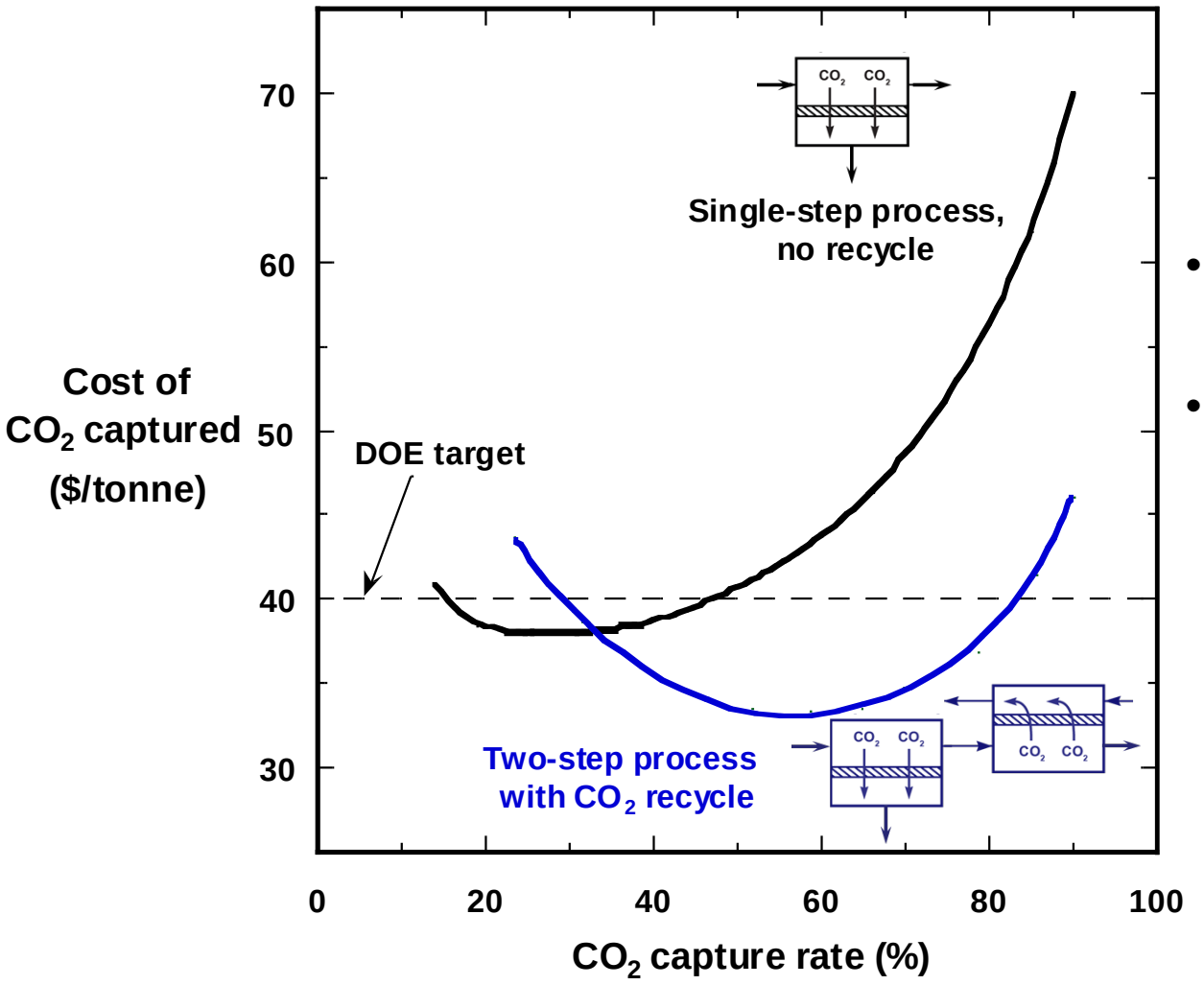
Membranes are Particularly Effective at Partial Capture



- Membranes show a minimum in capture cost
- To reduce coal plant emissions to that of a natural gas plant requires 40-50% capture

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20 TPD System at NCCC

- Membranes are simple and compact compared to competing technologies, such as amines (see columns in photo).

- MTR pilot system completed successful six months of operation.

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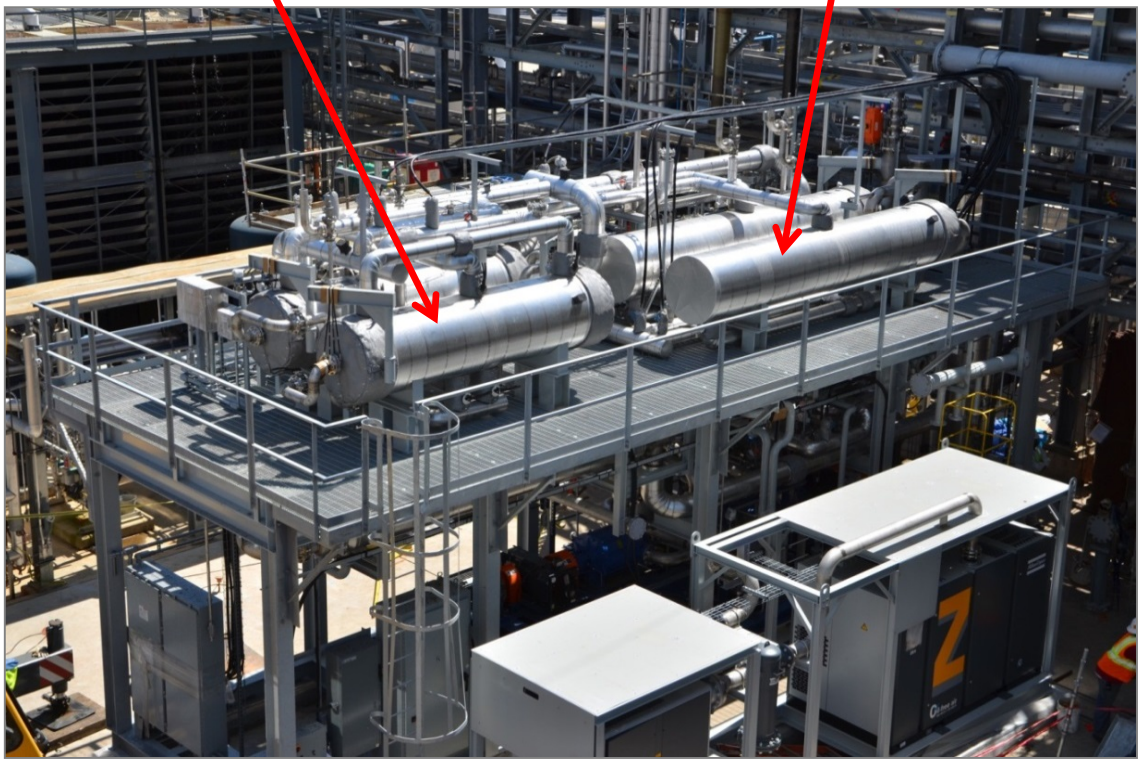
The NCCC 1 MW_e System Used Nested Module Tubes in a Single Large Vessel

Bundled spiral sweep modules

Bundled Polaris spirals



We Also Tested Large Area Plate-and-Frame Modules at NCCC

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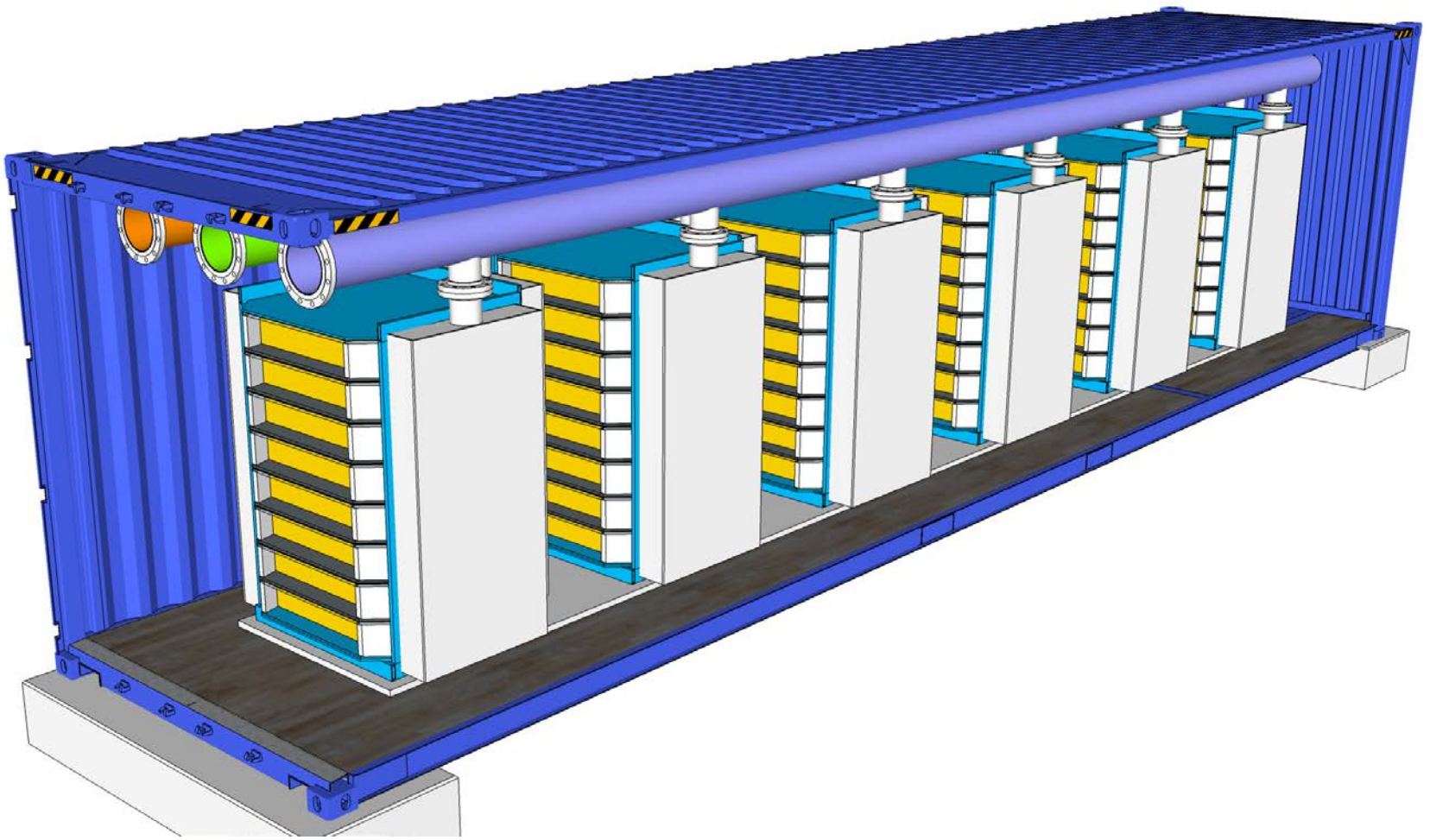
The Future: Low-Pressure Containerized Plate-and-Frame Modules



Impact of Base Case Changes 2017-2020

Description			Cost ($/tonne CO_2)
Todays Base Case 2017			84.7
How Hard	**Description**	**Impact of Changes to 2017 Base Case**	
			Change of Cost ($)
Engineering improvements to be used in the 200 tonne/day system			
Easy	Lower module pressure-drop		-15.2
Easy	Lower module cost		-21.5
Easy	Lower skid cost		-11.3
?	Better membrane P/ℓ 2,000 $\propto$ 30		-11.4
?	First-stage vacuum pressure reduced to 0.1 bar		-30.1

At Partial Capture Rate

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Impact of Base Case Changes 2017-2020

Description	Cost ($/tonne CO_2)
2017 Base Case	84.7
Easy changes only	50.1
Easy changes plus better membrane	44.0
Easy changes plus first-stage vacuum @ 0.1 bar	38.1

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Wyoming's Integrated Test Center

The ITC

- One of the world's largest post-combustion demonstration scale test facilities
- 20+ MW of coal derived flue gas from the Dry Fork Power Station
- Simple design minimizes costs, provides flexibility & quick turnaround times
- Designed for maximum flexibility and scalability for testing

Credit: Basin Electric Cooperative

ITC WYOMING INTEGRATED TEST CENTER

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NETL CO_2 Capture Technology Meeting

Pittsburgh, PA

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