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

(DE-FE0031587; FOA 1788)

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Pittsburgh, PA
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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 (Phase I):** 4/1/18 to 8/31/19
- **Funding:** $957k DOE + $239k cost share = $1.196M total
- **DOE-NETL Project Manager:** Sai Gallokota
- **Project Team:** MTR (prime), WITC, Basin Electric (Host), Sargent & Lundy, Trimeric, Worley Parsons
- **<u>Overall Goal:</u>** Design, build, and operate a 200 TPD large pilot membrane capture system.

Phase I	Phase II	Phase III
• Feasibility • Site selection • Create team (Done)	• FEED study • Permitting (Underway)	• Build, operate, and demonstrate process performance and costs

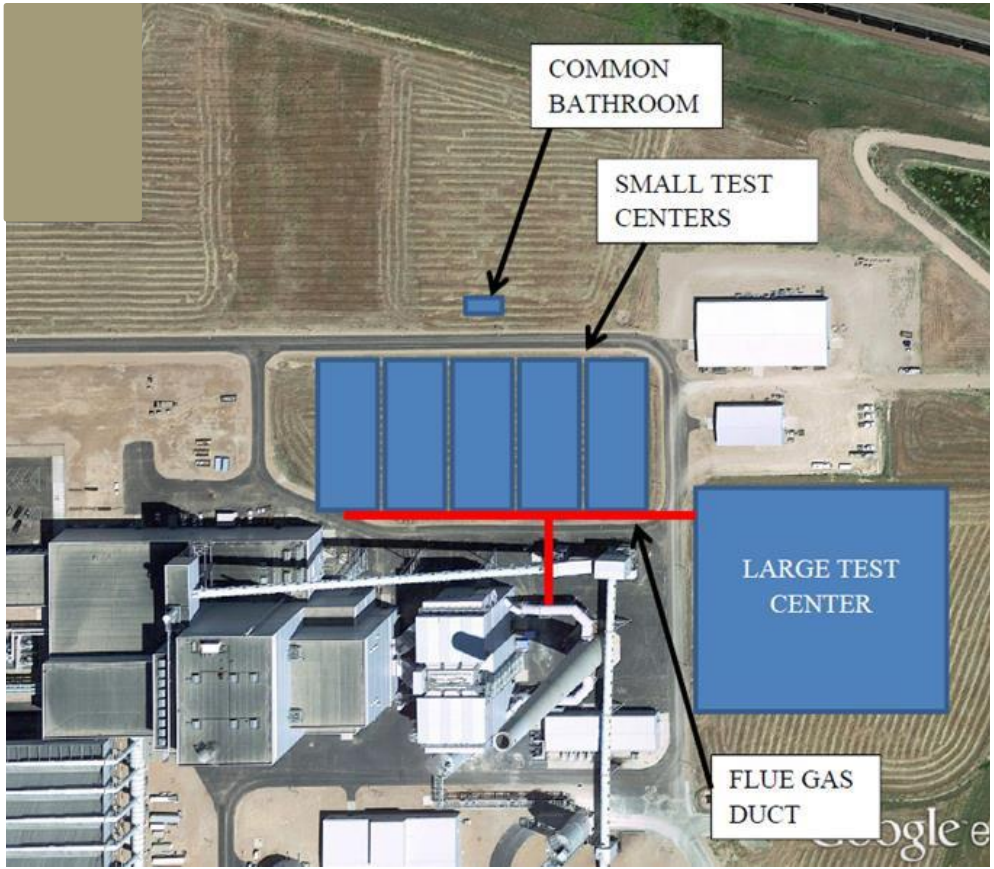
The Project Team

DOE Office of Fossil Energy
Program Management

Membrane Technology & Research, Inc.
Overall Project Management
Co-Principal Investigators:
Richard Baker, Project Coordination
Brice Freeman, DOE and Team Coordination

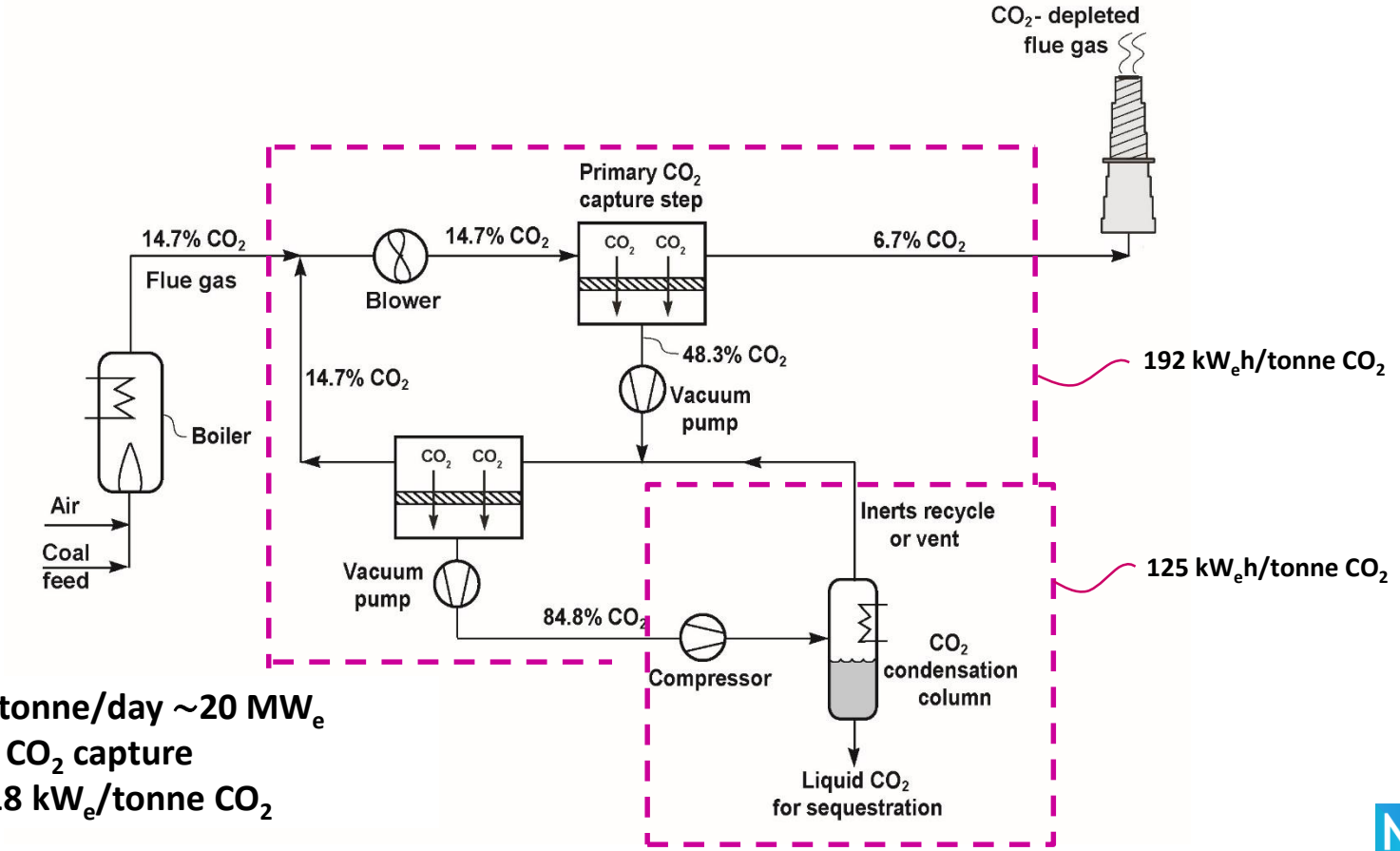
The Project Team - Phase II			
WITC / Bain Electric *Host Site* Will Morris, WITC - All test site issues John Jacobs, Basin - All power plant issues	**MTR** *Technology Supplier* Thomas Hofmann Erik Westling Engineering Design: - Membrane system - Permeate compression - Process simulation package - Revised TEA	**Trimeric** *Engineer* Ray McKaskle Engineering Design: - Direct Contact Cooler - Carbon Purification Unit	**Sargent & Lundy** *EPCM* Kevin Lauzze Danielle Koren FEED and Permitting Lead: - Construction planning - Scheduling - Utilities & power - Process control - Layout - Permitting

Basin Electric's Dry Fork Station



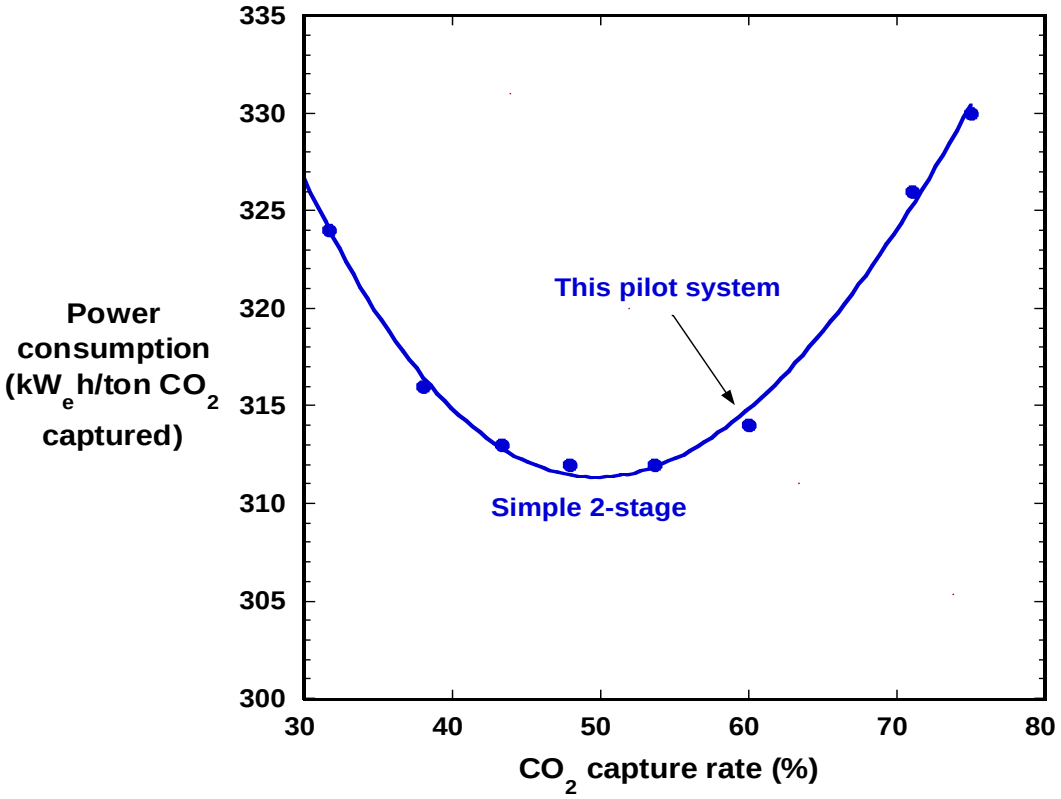
- Modern power plant
- High CO_2 concentration flue gas
- Test center built can support 20 MW_e projects
- Power, utilities and flue gas connections in place

The MTR CO_2 Capture Design



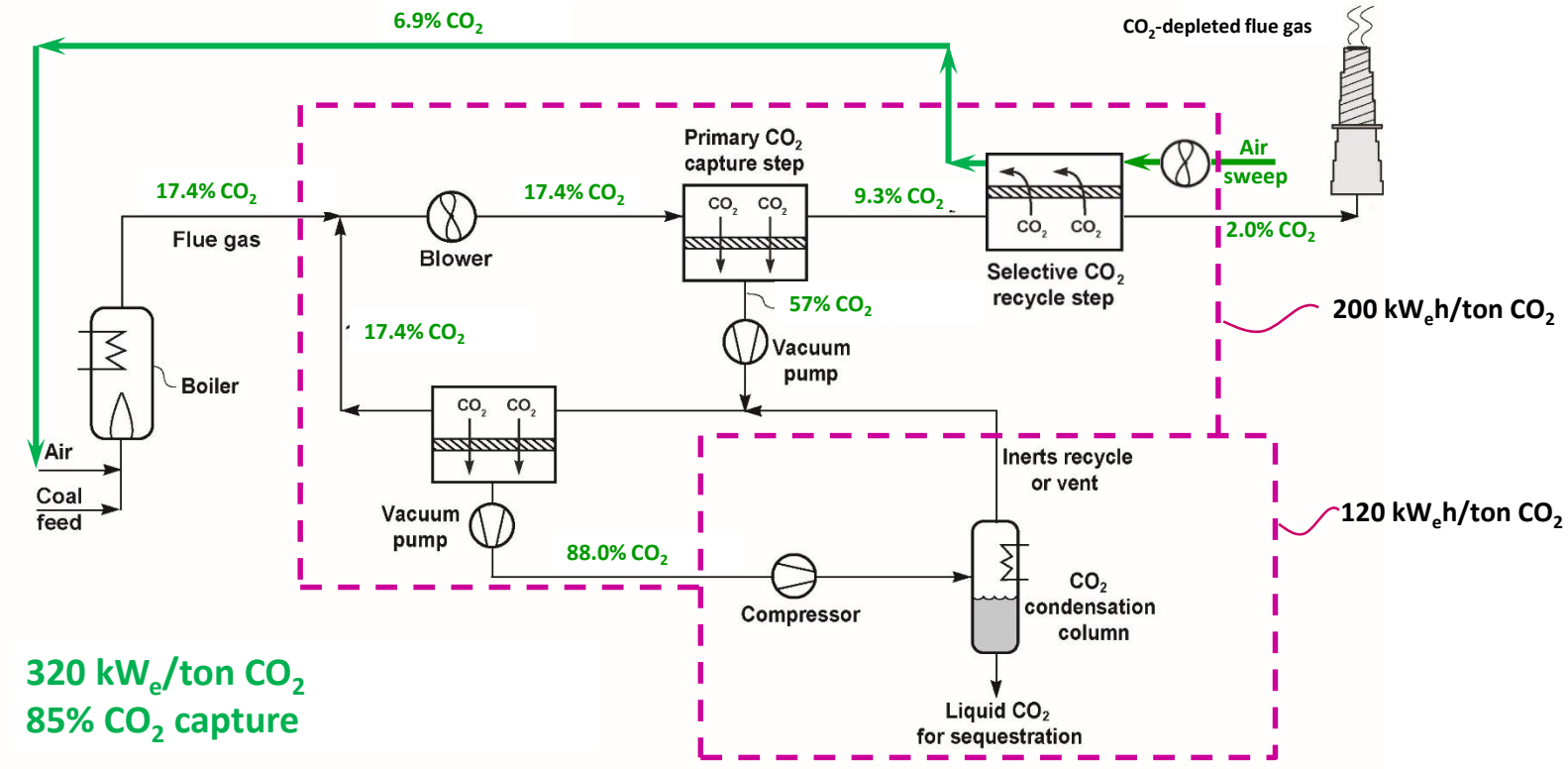
200 tonne/day ~20 MW_e
60% CO_2 capture
@318 kW_e/tonne CO_2

Power Consumption as a Function of CO_2 Capture Rate



Power consumption is expected to be between 310 and 320 kW_e/tonne CO_2 captured

Using a Contactor Helps



Using a contactor increases CO_2 capture from 60 to 85%

Why Consider Membranes?

- Simple, passive operation
- No hazardous chemical handling, emissions, or disposal issues
- Compact
- Water use lower than other technologies
- No steam use → no modifications to existing boiler/turbines
- Near instantaneous response; high turndown possible
- Efficient at partial capture (~60%)

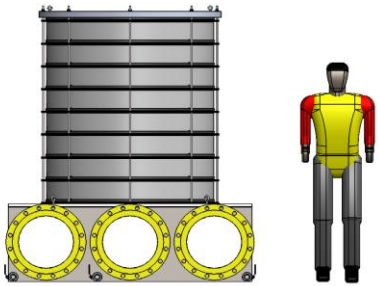
The MTR 20 TPD Small Pilot at NCCC Showing Membrane Vessels on Top Floor

We Developed Large Area Plate-and-Frame Modules and Tested them at NCCC 2014-2015

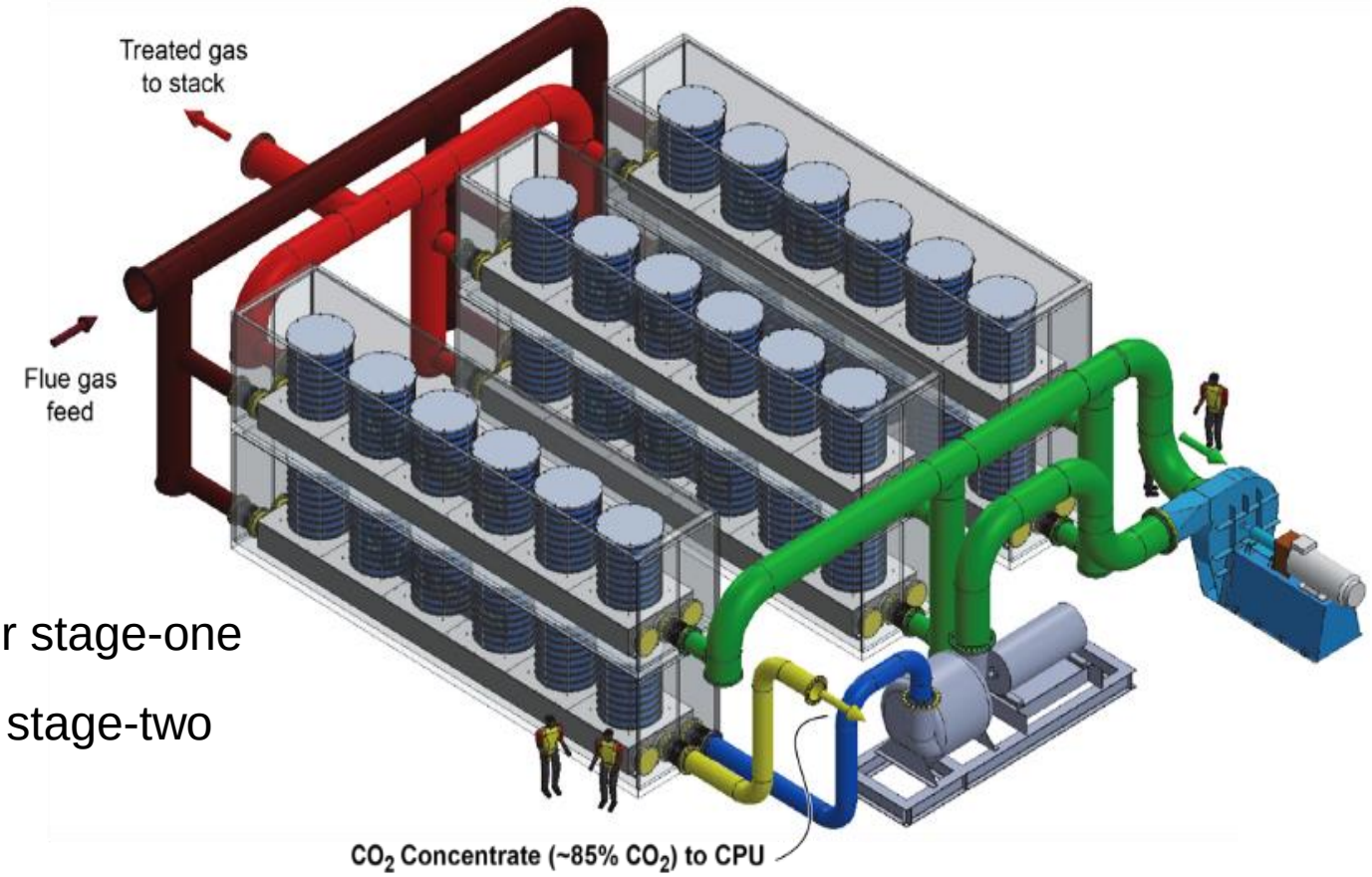
Work performed in DE-FE0005795 and DE-FE0007553

Our New Base Unit is a Container-Sized Skid Fitted with 48 Plate-and-Frame Modules

- Eight modules per stack
- Six stacks per container skid

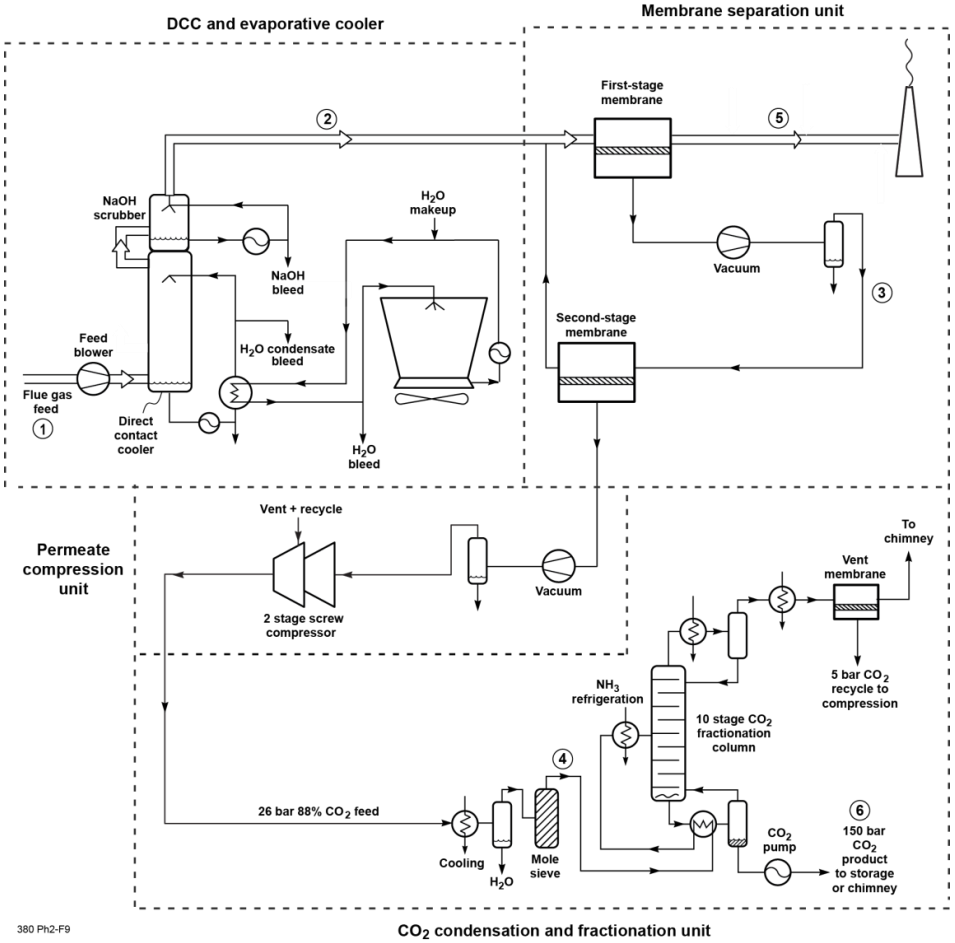


Layout Drawing of the 200 TPD Large Pilot Membrane Skid



- Five skids for stage-one
- One skid for stage-two

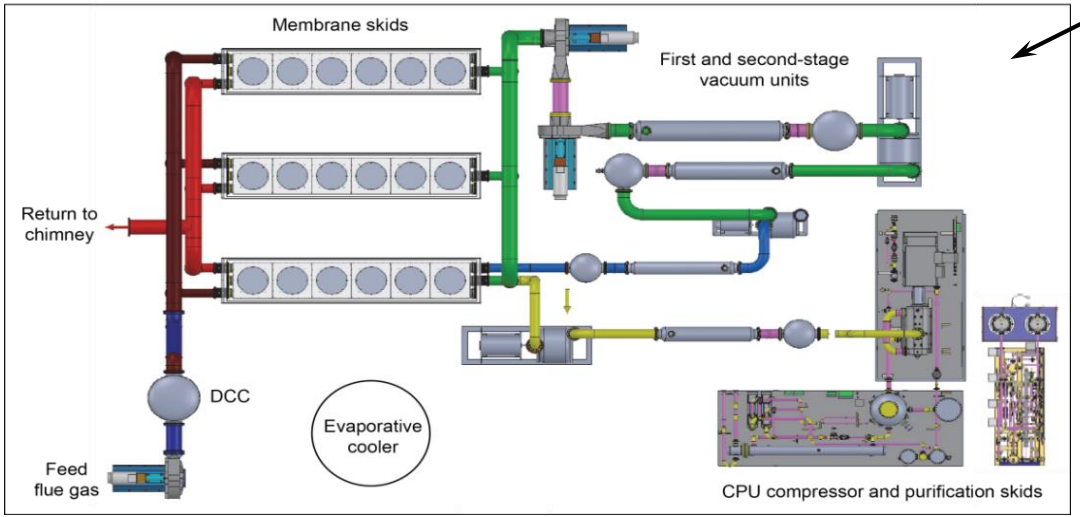
Process Flow Diagram of the 200 tonne/day Large Pilot Unit



At 60% CO_2 capture, a coal power plant emits less CO_2 than an equivalent-sized gas turbine without capture

A Birds-Eye View of the 200 TPD System

200 TPD Membrane System



The WITC Test Site,

Basin Electric Power Plant