

CARBON CAPTURE

Sustainable Energy Economy Workshop - Research & Development
of Nuclear Light Water Reactors and Hydrogen Hybrids

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Tuesday 14 January 2020

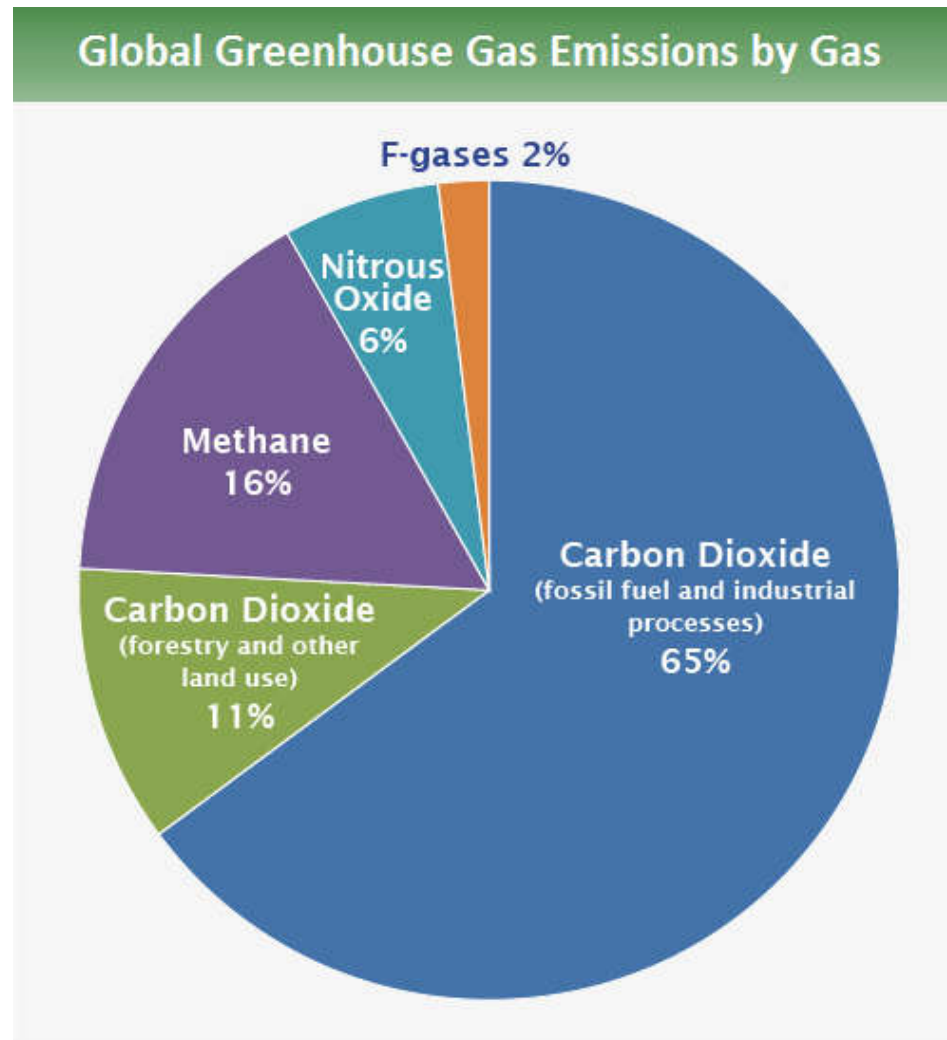


Outline

- CO2 Emissions
- CO2 Capture Targets
- CO2 Capture Technologies
- Direct Air Capture (DAC)



Greenhouse Gas Emissions



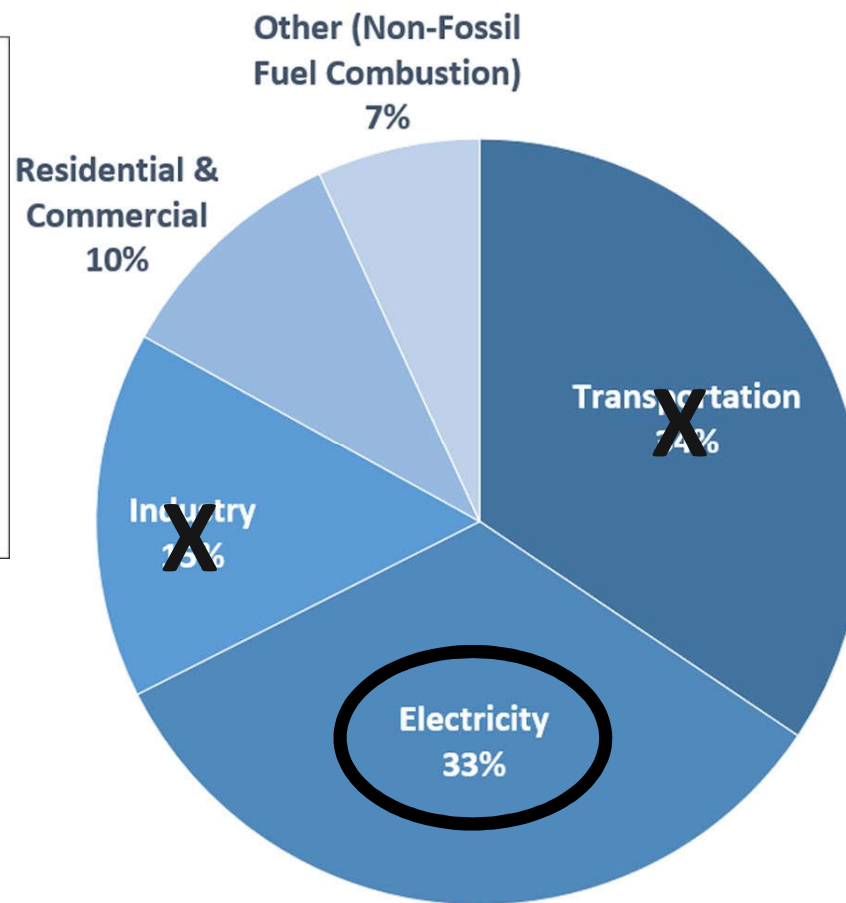
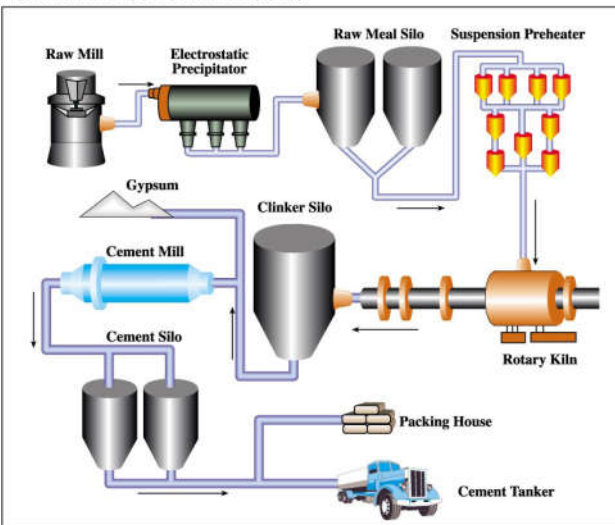
<https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>



CO2 Emissions

2017 U.S. Carbon Dioxide Emissions, By Source

Cement Production Process



U.S. Environmental Protection Agency (2019). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017

<https://www.epa.gov/ghgemissions/overview-greenhouse-gases#carbon-dioxide>



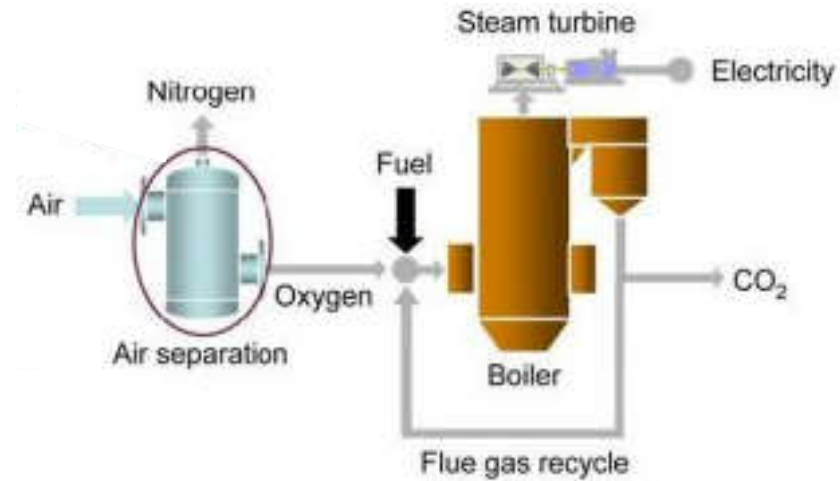
CO2 Capture Targets

- < \$40/tonne by 2025
- < \$30/tonne by 2035
- Flue gas targets:
 - 90% capture
 - > 95%
 - < 35% increase in levelized cost of electricity

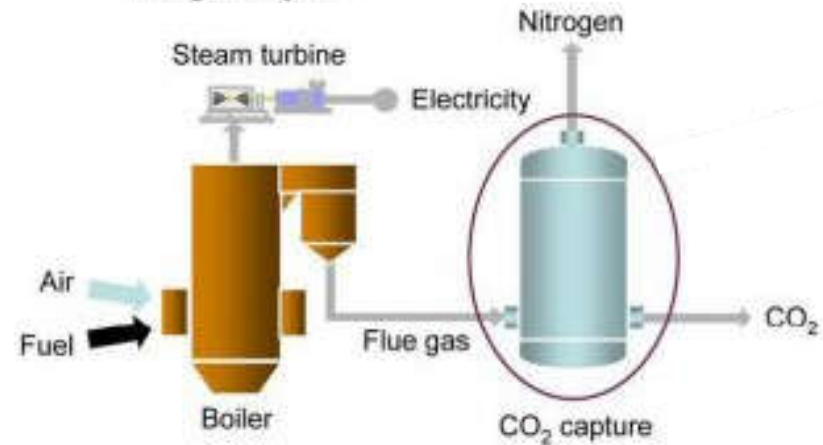


CO2 Capture Technologies

Oxy-combustion

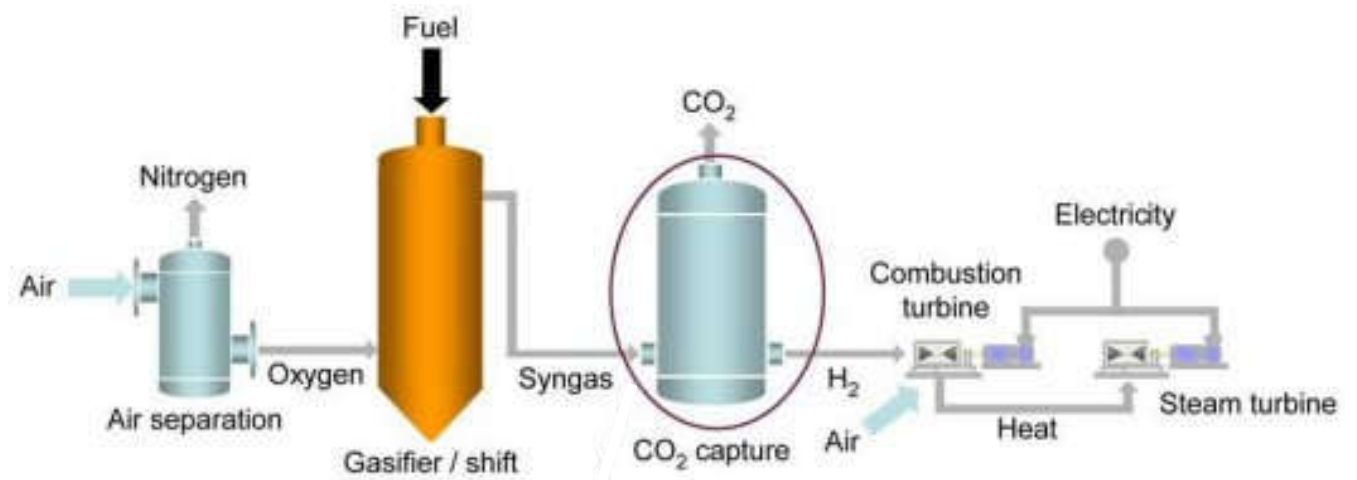


Post-combustion

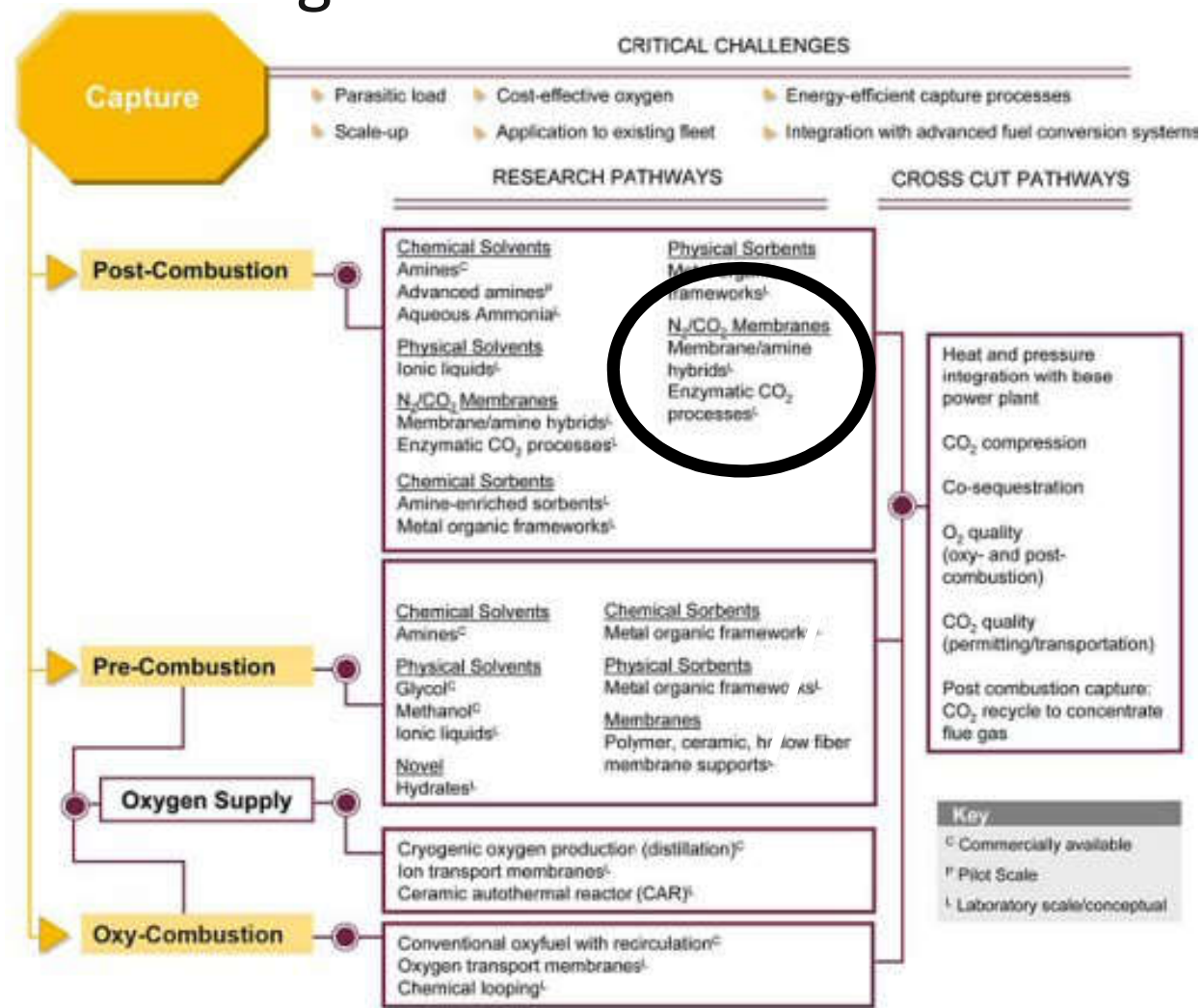


CO2 Capture Technologies

Pre-combustion



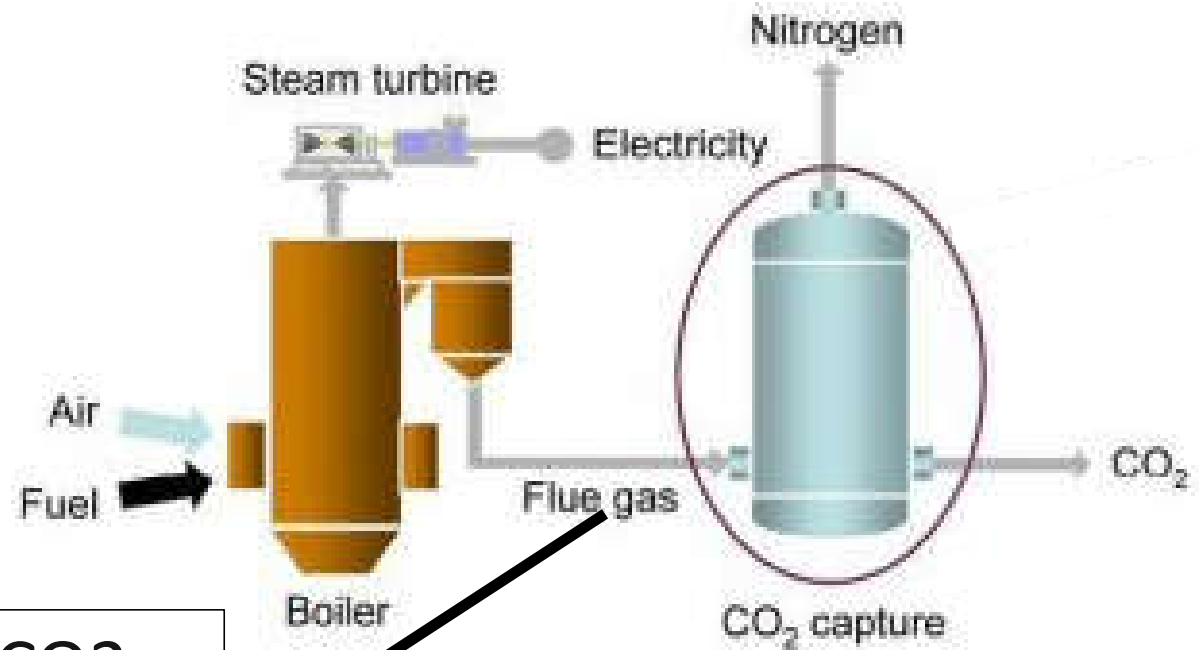
CO2 Capture Technologies



<https://netl.doe.gov/research/coal/energy-systems/gasification/gasifedia/capture-approaches>

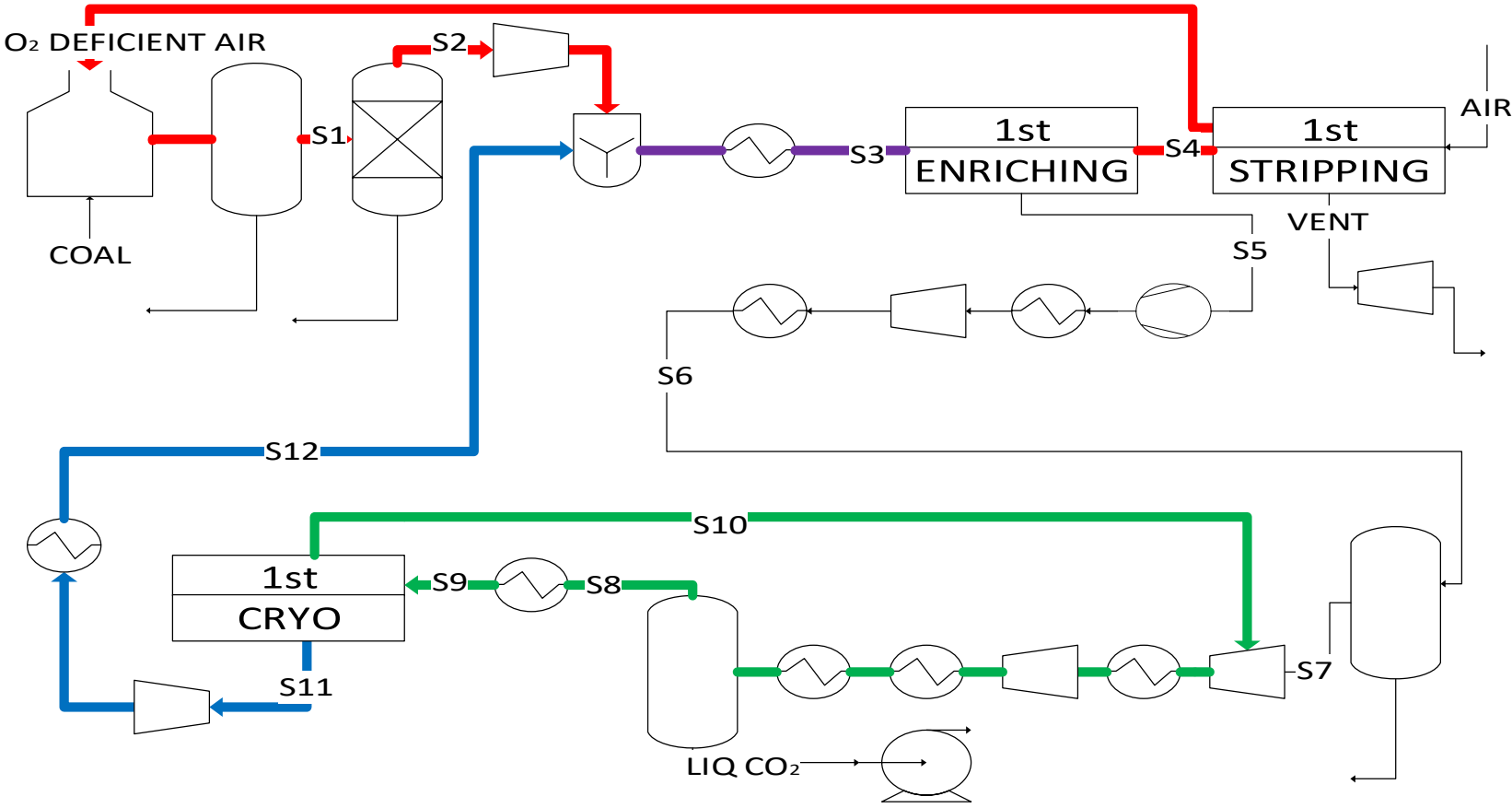


CO2 Capture Technologies

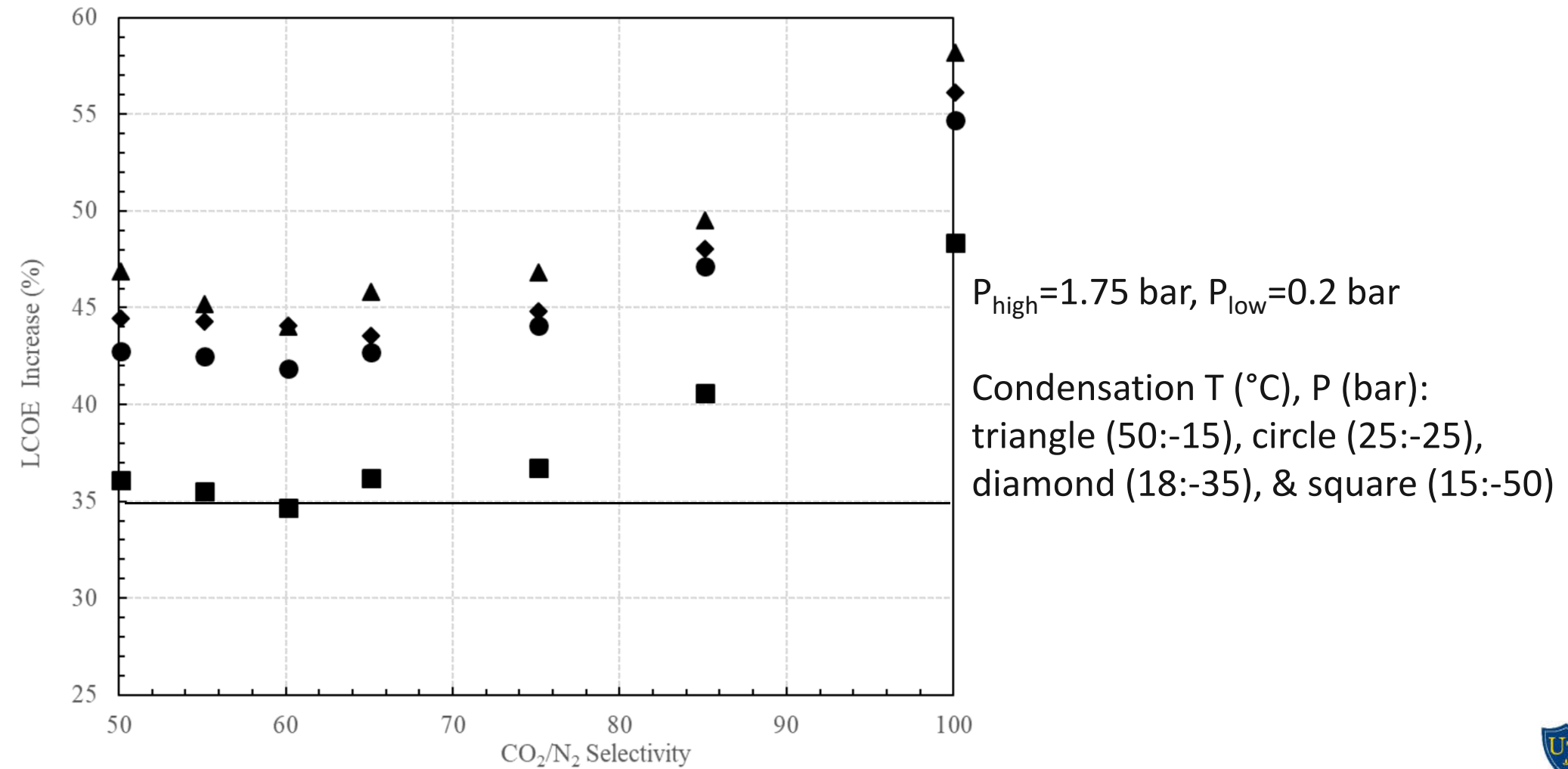


NG: 3-10 % CO2
Coal: 10-15% CO2

MTR Membrane Capture Process



Membrane and Process Optimization



MTR Membrane Capture Process

Advanced Amine Vendor

PSTU

MTR system

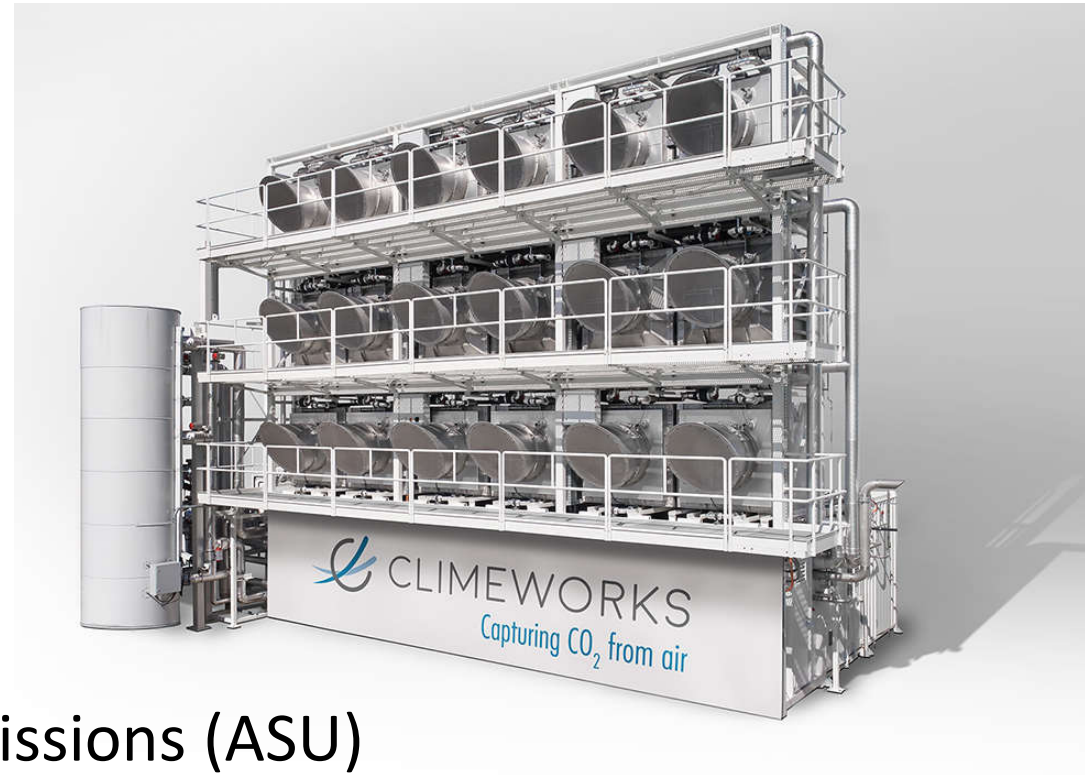


Three 20 TPD systems, Photo provided by MTR

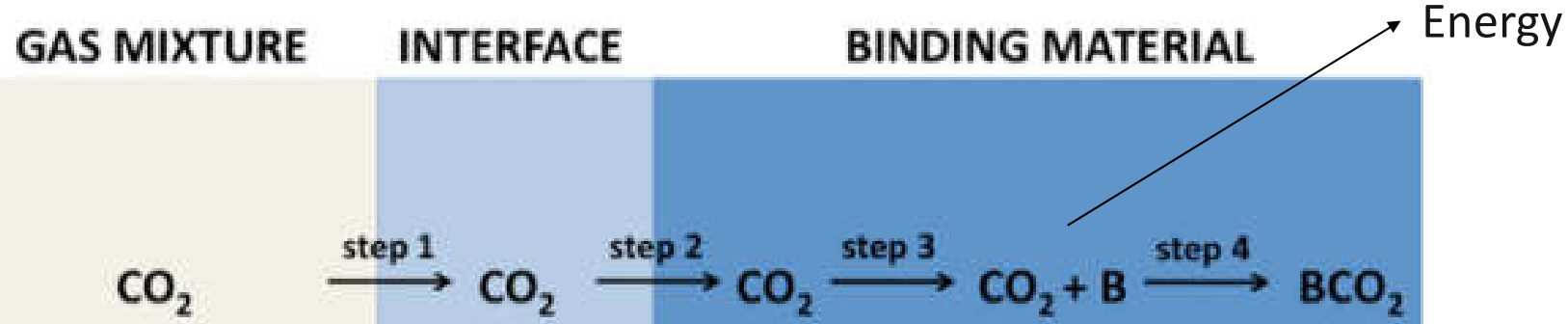


DAC

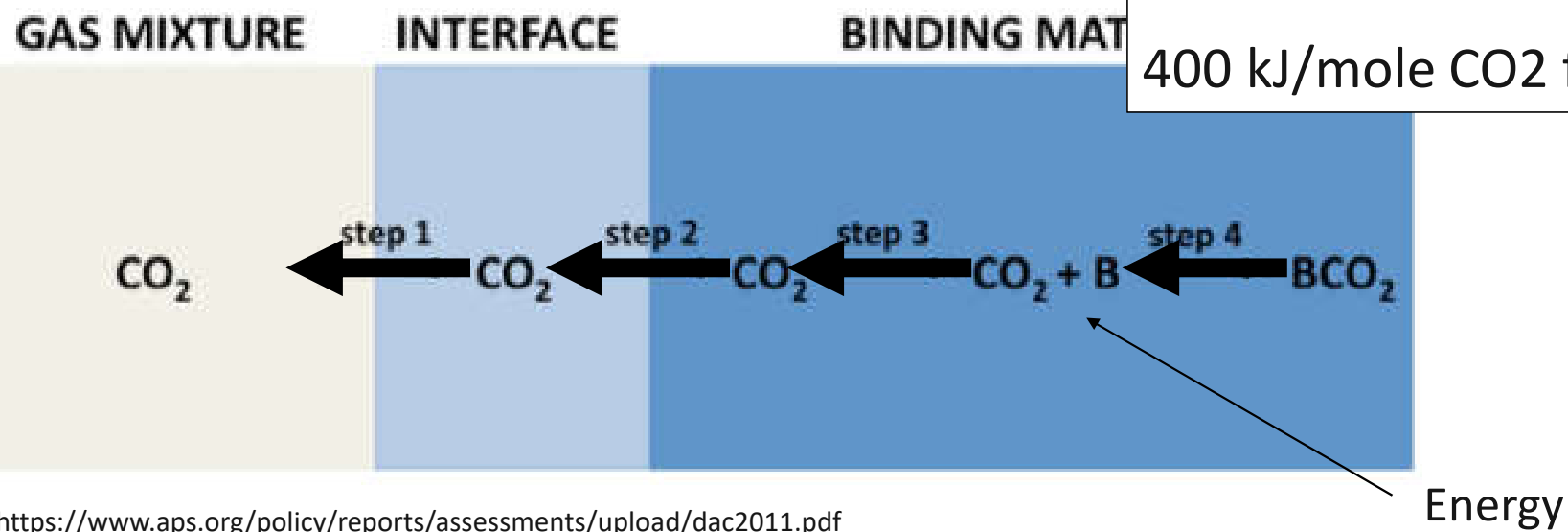
- Carbon Engineering Ltd
- Climeworks
- Global Thermostat
- Inphinitree
- Skytree
- Soletair Power
- Oak Ridge National Laboratory
- Center for Negative Carbon Emissions (ASU)



DAC



455 kJ/mole CO_2 min energy input
400 kJ/mole CO_2 from NG



<https://www.aps.org/policy/reports/assessments/upload/dac2011.pdf>



DAC

- Energy and capital intensive
 - Current costs \$600-700/tonne
- Potential paths to \$100/tonne?
 - Free energy
 - Process improvements



Opportunities

- O₂ from electrolysis
 - Pre-combustion
 - Oxy-combustion
- DAC

