



EPA's CO₂ Separation & Capture Research Program

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*Annual NETL CO₂ Capture Technology for Existing Plants R&D Meeting
March 24-26, 2009
Sheraton Station Square Hotel - Pittsburgh, PA*

Research Triangle Park (RTP) Campus in North Carolina



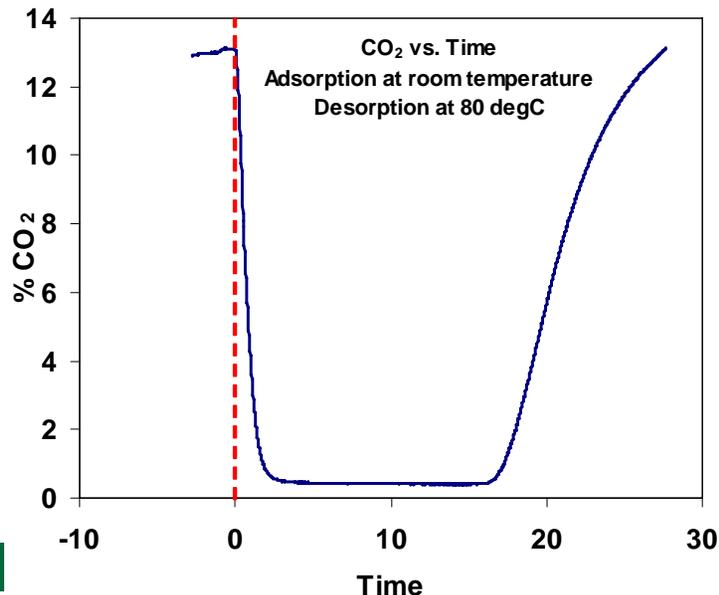
- National Institute of Environmental Health Sciences (NIEHS/NIH)
- Other research organizations (e.g., RTI International)
- Major research universities (Duke, UNC, NC State).
- One of the largest concentrations of multi-disciplinary environmental scientists in the world.

- GHG-related efforts
 - Technology development
 - MARKAL energy system modeling
 - Development of a GHG technologies database

- Equipment & collaborative research
 - Innovative Furnace Reactor
 - Multipollutant Combustion Research Facility

Technology Development – Alternative Absorptive Solutions

- New, cost-effective CO₂ capture technologies are needed to reduce CO₂ emissions.
- EPA-developed absorbents have shown some promise for CO₂ scrubbing from simulated flue gas.
- Scrubbing solutions – transition metal complexes
- Release CO₂ at mild temperatures (e.g., 80 C)

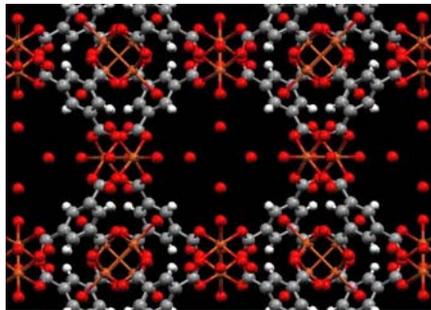


Dr. Marty Lail

- Also looking at other amine solutions
- Long term stability with cycling

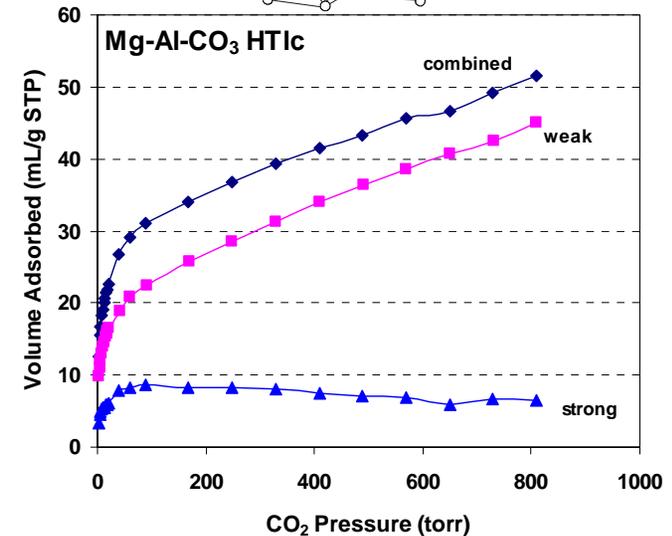
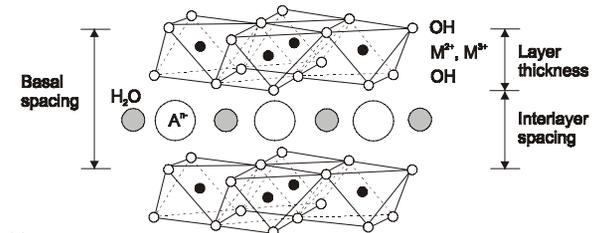
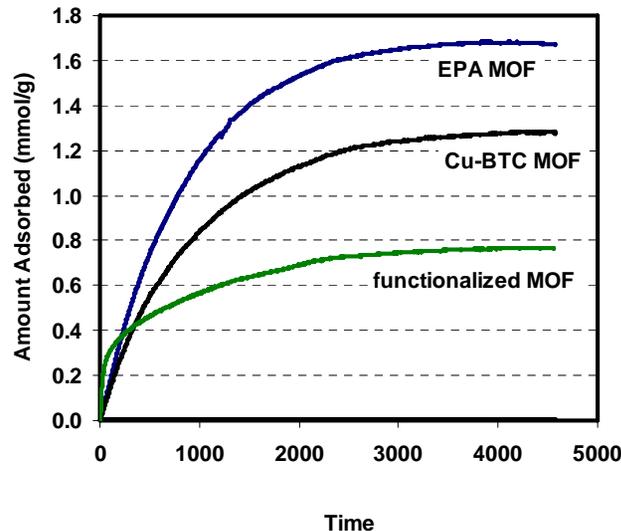
Technology Development – Novel Materials for Capture of CO₂

- Working on the development of new solid sorbents for CO₂ capture
- Concentrating on
 - Hydrotalcite-like compounds (HTC) – high temperature
 - Metal Organic Framework (MOF) sorbents – very high surface area
 - Amine-functionalized solid sorbents



Cu-BTC MOF

CO₂ Adsorption of Metal Organic Framework (MOF) sorbents

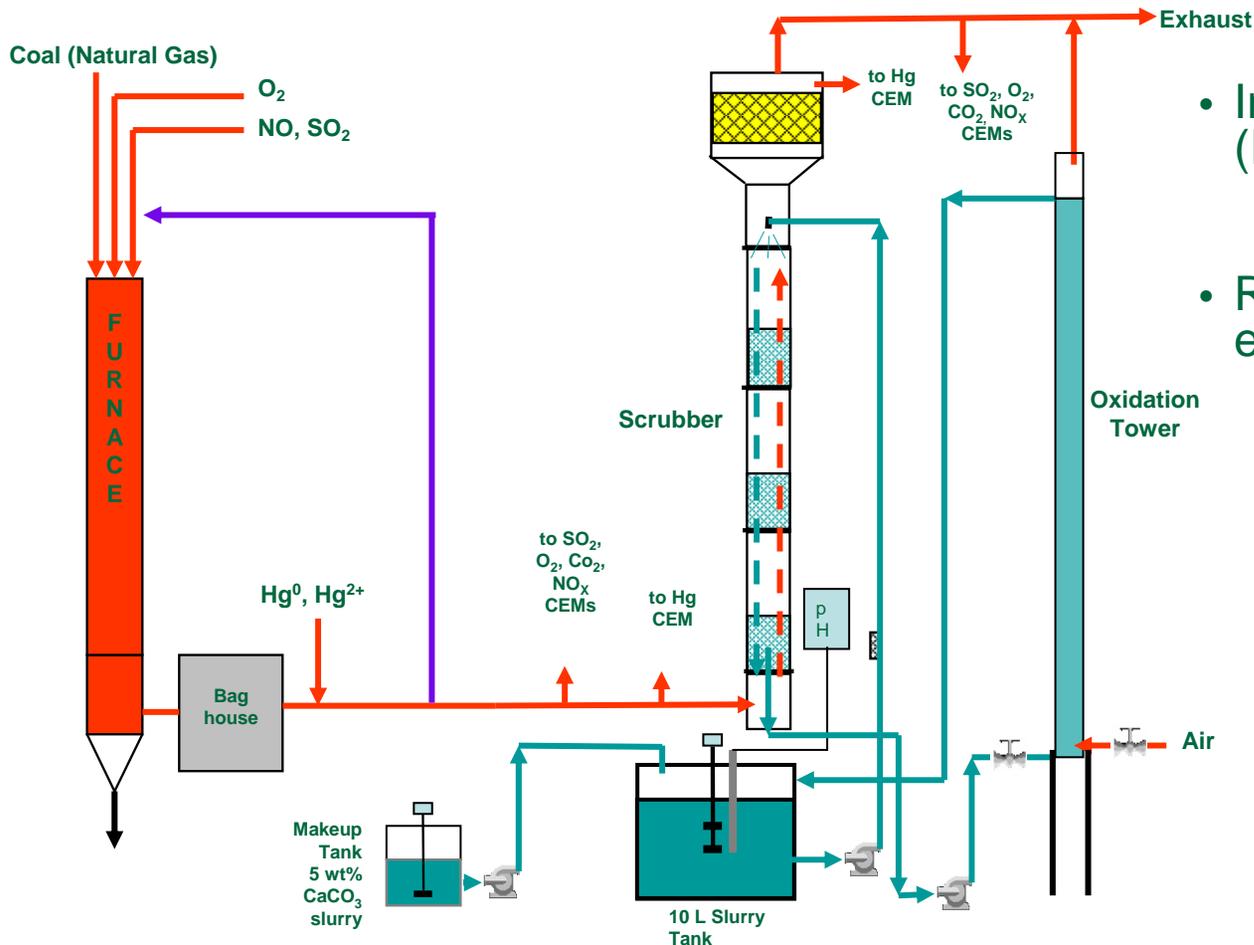


- ORD Energy & Climate Assessment (ECA) team
 - using the MARKAL energy system model
 - evaluate scenarios of the evolution of the U.S. energy system
- MARKAL represents the competition of fuels and technologies for market share
- EPA has developed a 9-region U.S. database for use with MARKAL
 - Resolution: 9 U.S. census regions
 - Time Horizon: 2000 through 2050
 - Coverage: Electricity production, industrial, residential, commercial, and transportation sectors
- Contact: Dr. Dan Loughlin, loughlin.dan@epa.gov

- EPA ORD is developing a comprehensive database of GHG mitigation technologies for sectors including power generation, transportation, industrial*, and waste management (and others).
- The database will include information on the state of development, cost and performance of the technologies as well as available data on their potential environmental implications.

*refineries, iron/steel, pulp/paper, cement

EPA Pilot-scale Equipment Oxy-fuel Research in the IFR



- Innovative Furnace Reactor (IFR)
 - 150,000 Btu/hr (30 cfm total flow)
- Research emphasis on environmental impacts
 - How does oxy-fuel operation affect emission/control of criteria and hazardous pollutants?
 - What is the effect on GHG emissions?
 - Other

Pilot-scale Multipollutant Combustion Research Facility



Coal Feeder

Furnace

SCR



**Lime-based
FGD scrubber**

Multipollutant Control Research Facility (MPCRF)

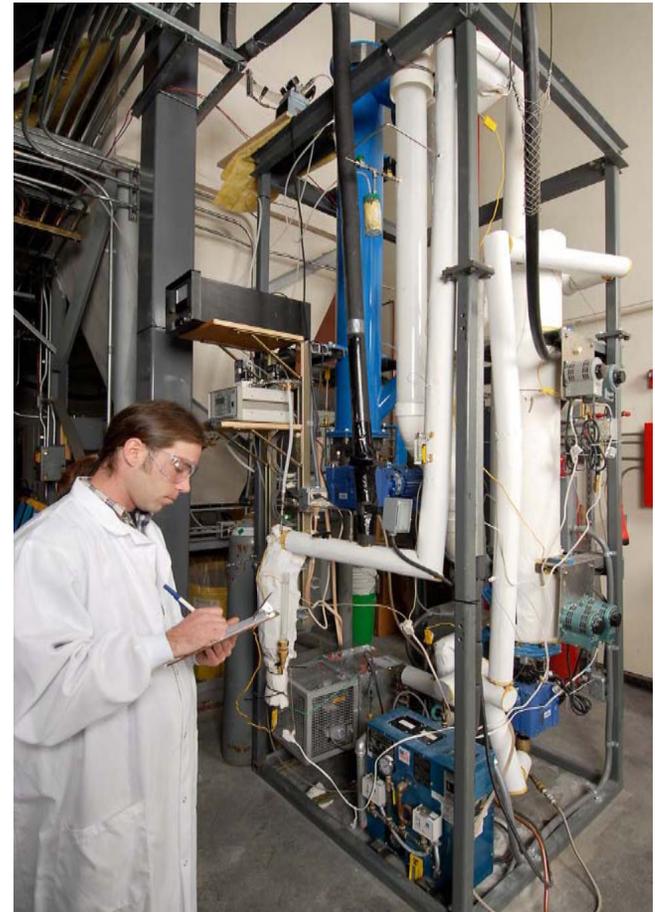
- 4 MMBtu/hr (1.2 MW_t) Pulverized Coal Furnace
 - Also Capable of Firing Natural Gas or No. 2 Fuel Oil
- Low NO_x Burners and SCR Unit for NO_x Control
- ESP or Fabric Filter (ESFF) for fine PM Control
- Wet Lime-based FGD Scrubber for SO₂ Control
- Continuous Emissions Monitors for O₂, CO₂, NO_x, SO₂, CO and Hg
- Multiple Sampling Ports Throughout Flow Path
- Design Facilitates Ease of Modification for Evaluation of Various Control Technologies

MPCRF: Past, Present and Future Activities

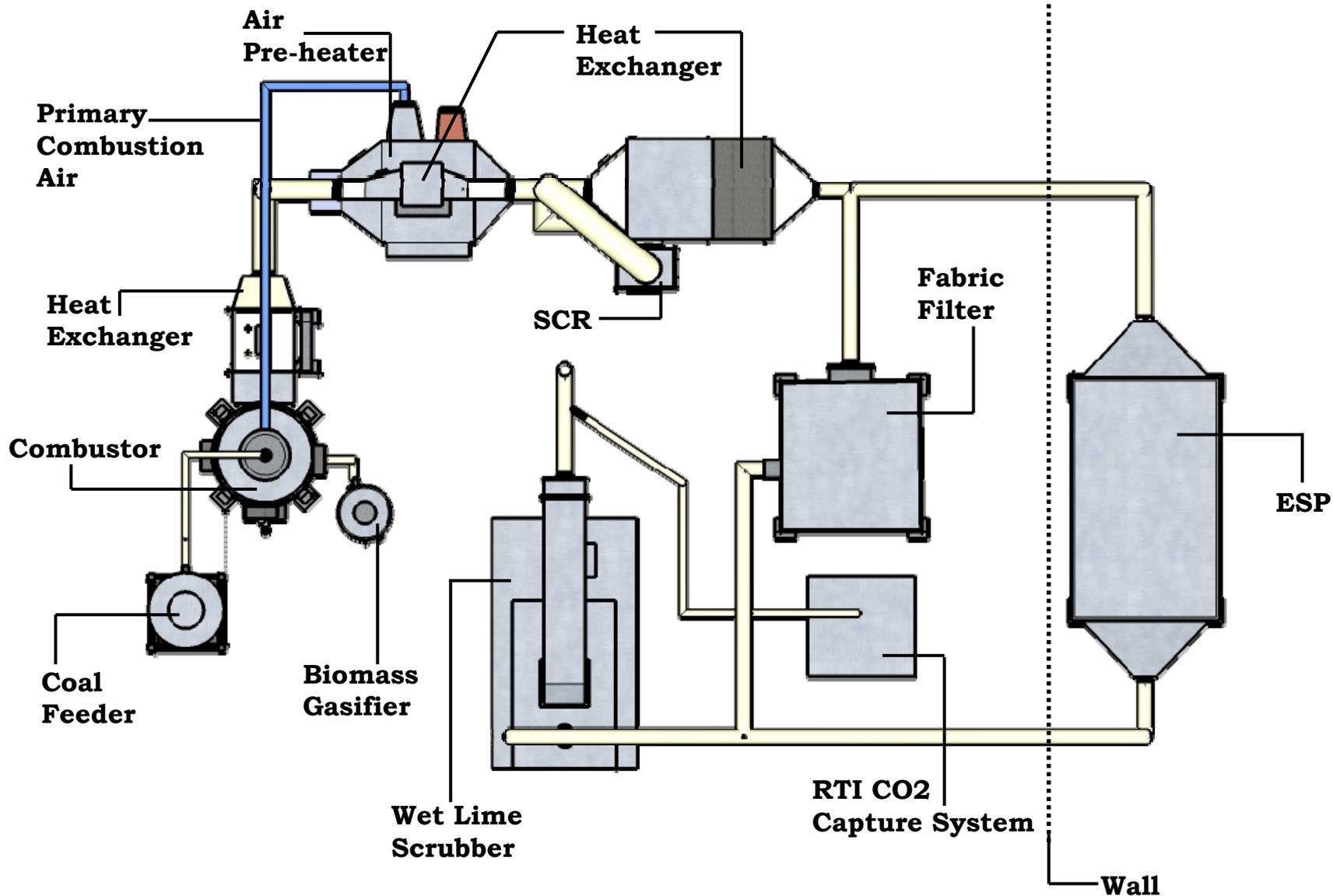
- Testing of conventional and advanced sorbents for Hg control
- Coal blending tests to examine effects on Hg oxidation (collaborative w/ EPRI)
- Testing and demonstration of Hg CEMs
- Testing and Demonstration of Innovative Technologies (e.g., SBIR)
- CO₂ capture technologies (collaborative w/ RTI)
- Biomass gasification

RTI CO₂ Capture Process

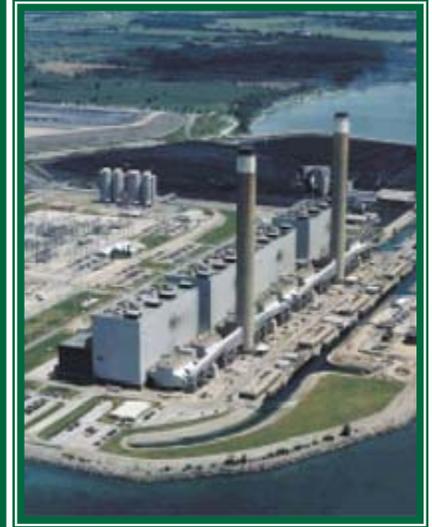
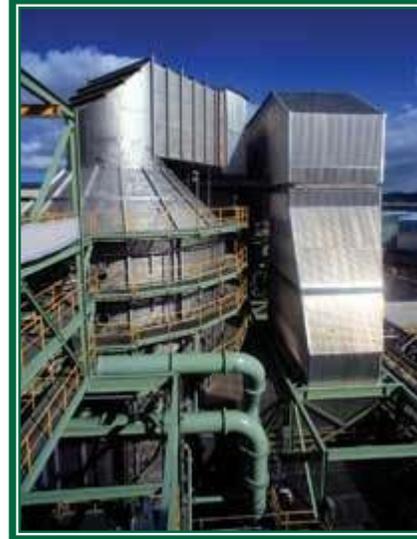
- Small-scale testing at EPA in summer 2007
 - 130 hrs on natural gas
 - 105 hrs on coal
 - 3.0-5.0% slip stream
- Additional larger-scale testing planned (next presentation)



- Biomass gasification for reburn fuel
 - Collaborative project with Italian Gov't (Ministry of Environment & Territory)
 - Gasify biomass feedstock to produce synthesis gas
 - Reduction of NO_x and CO₂ emissions
- Installation of pilot-scale gasifier early 2009
 - Begin testing in spring 2009
 - First feedstock will be wood chips (CO₂ neutral)
 - 50-60% NO_x reduction anticipated
- Additional tests and programs are being discussed with IMET



Other collaborative research?



Bench-scale



Small pilot



Large pilot
(slip stream)



Full-scale
demonstration

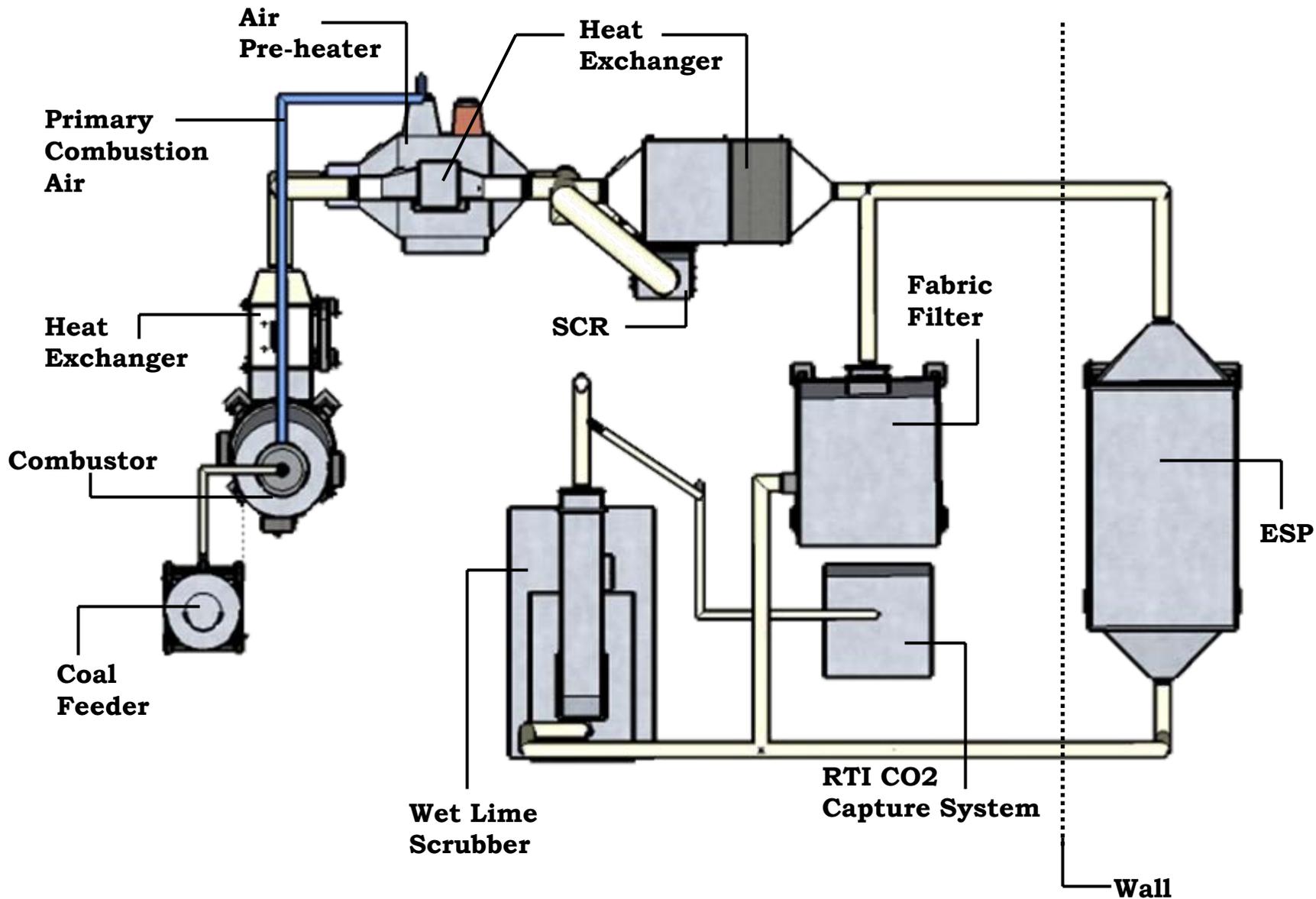
Cost
Time
Risk
Complexity

Increasing

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Illustrative MARKAL Outputs

Energy Flows

