

Advanced Hydrogen and CO₂ Capture Technology for Sour Syngas

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Air Products provides technology to capture CO₂ from fossil-fuel-based processes



Hydrogen production from natural gas with CO₂ capture

- For power generation, vehicle fuels, refinery applications



Oxyfuel technology for pulverized coal boilers

- Amenable to both new-build supercritical power plants and retrofitting the large installed base of existing coal-fired assets



CO₂ capture from gasification

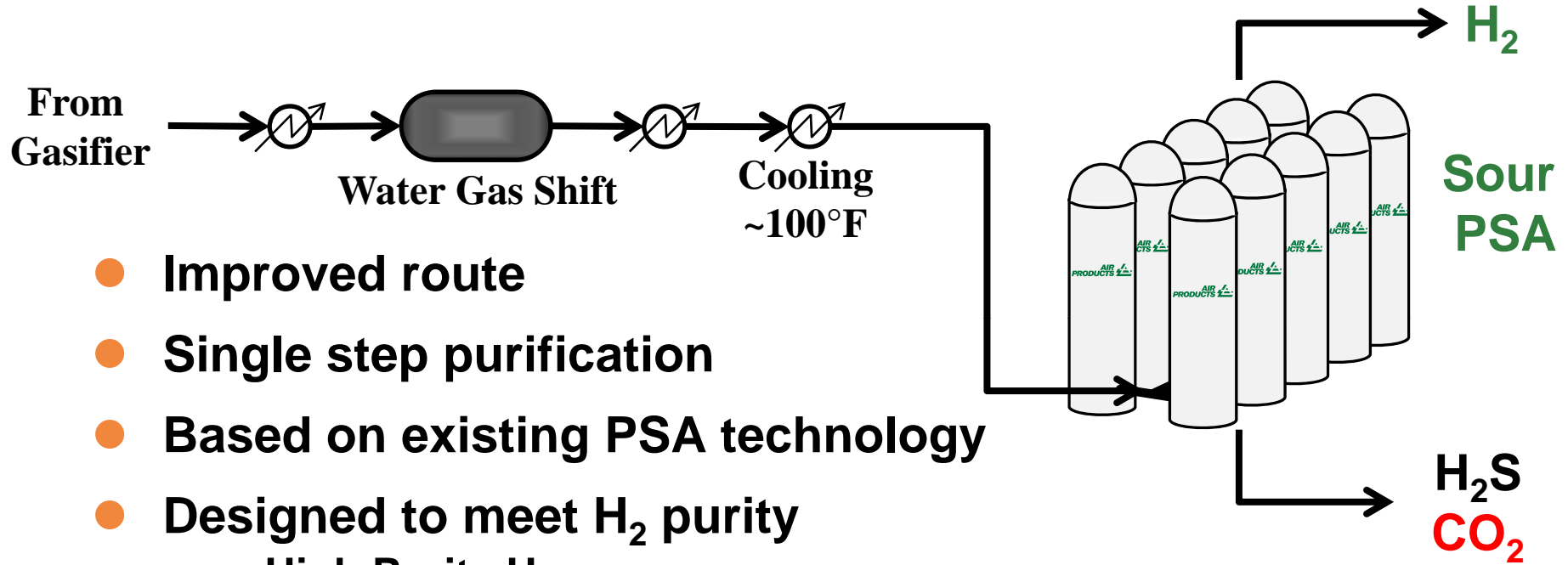
- Integrated CO₂ capture and acid gas removal



Advanced separation technology

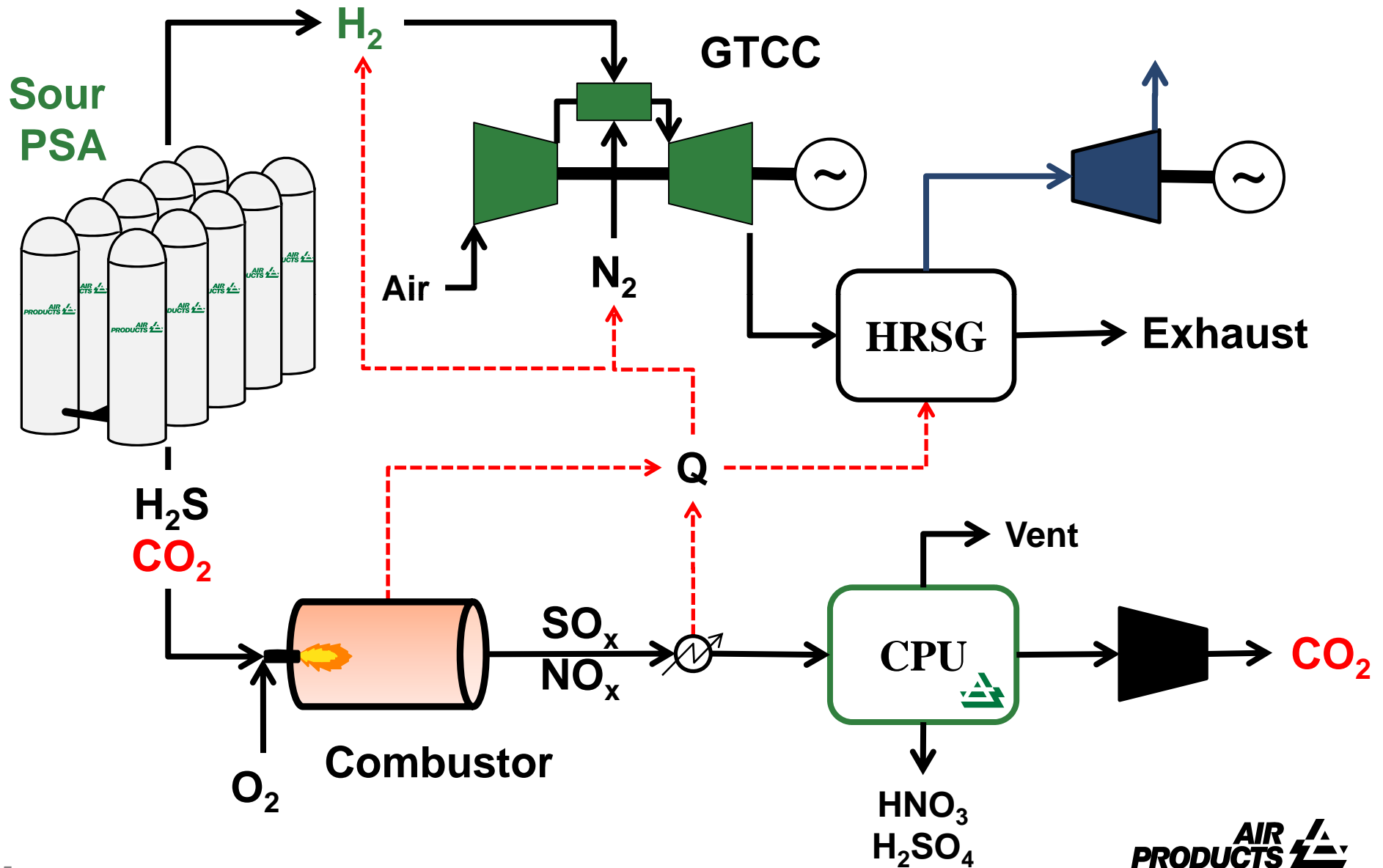
- CO₂ technology using membranes, adsorption, absorption and cryogenic systems

Air Products' "Sour PSA" Technology for H_2 Production and CO_2 Capture

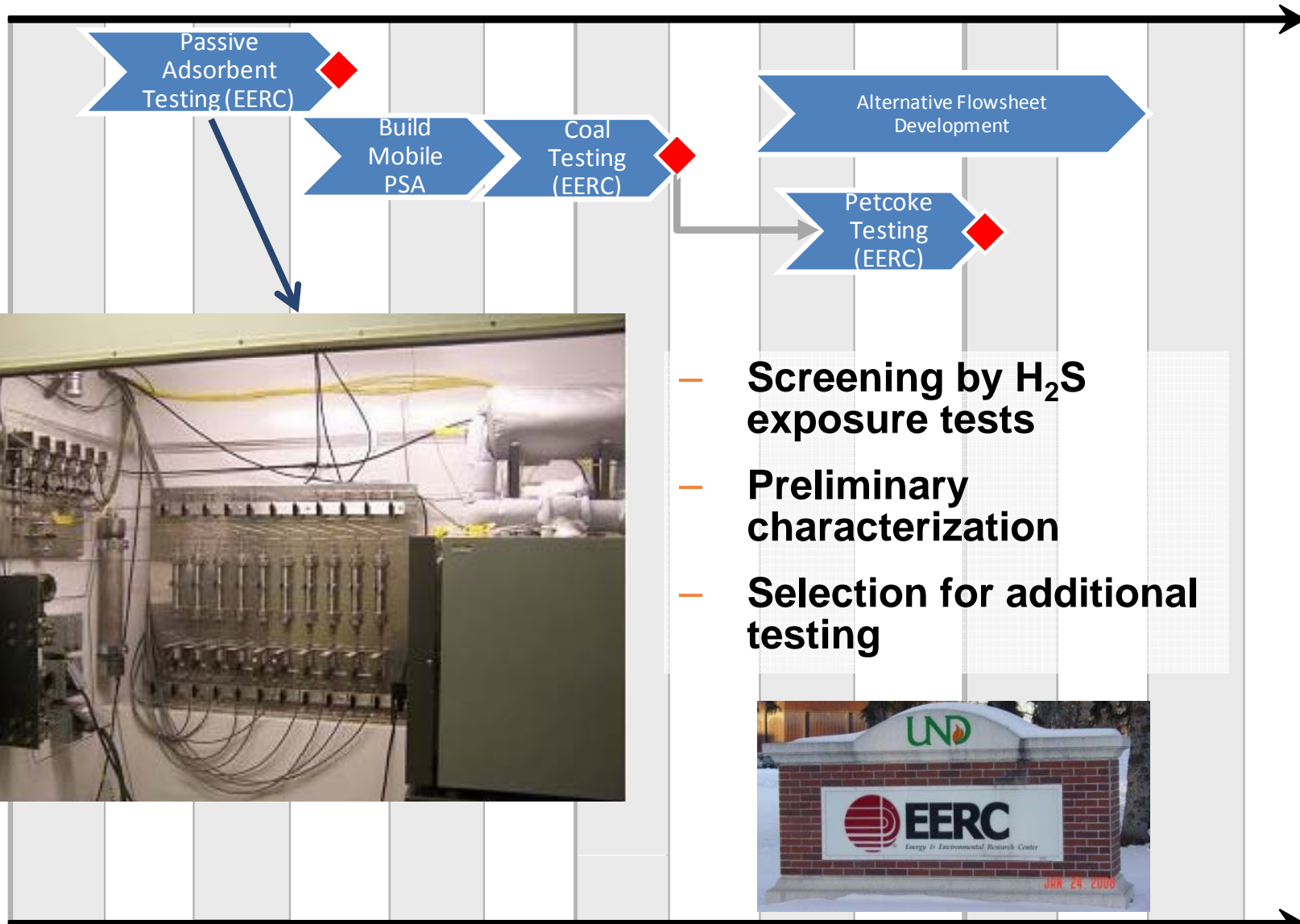


- Improved route
- Single step purification
- Based on existing PSA technology
- Designed to meet H_2 purity
 - High Purity H_2
 - Lower purity for power
 - Sulfur slip of < 3 ppmv, can design for ppb applications
- Reduced capital and operating cost
- Reduced cooling duty, no chilling or refrigeration
- CO_2 and H_2S rejected in tailgas

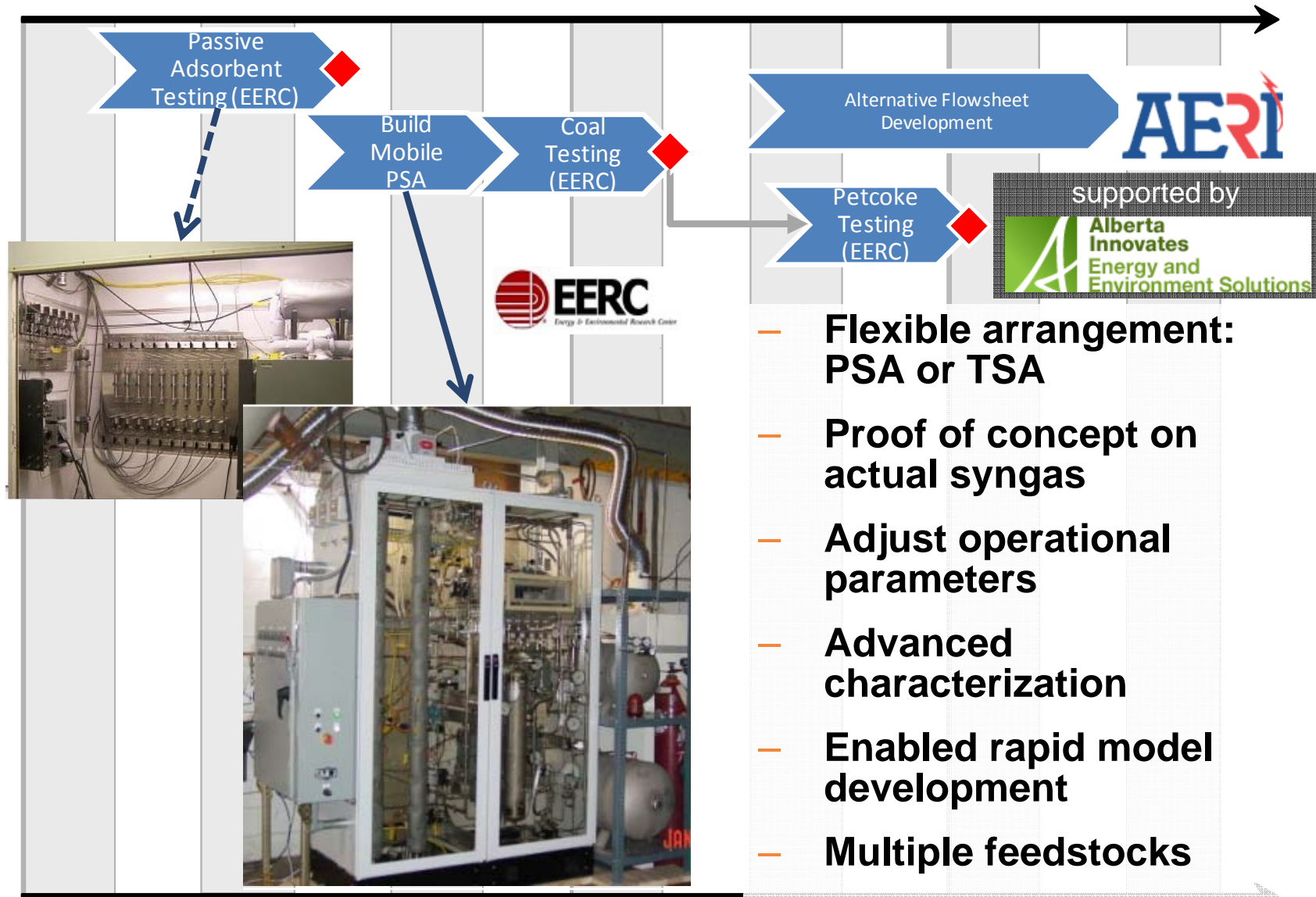
Tailgas Disposition and Integration



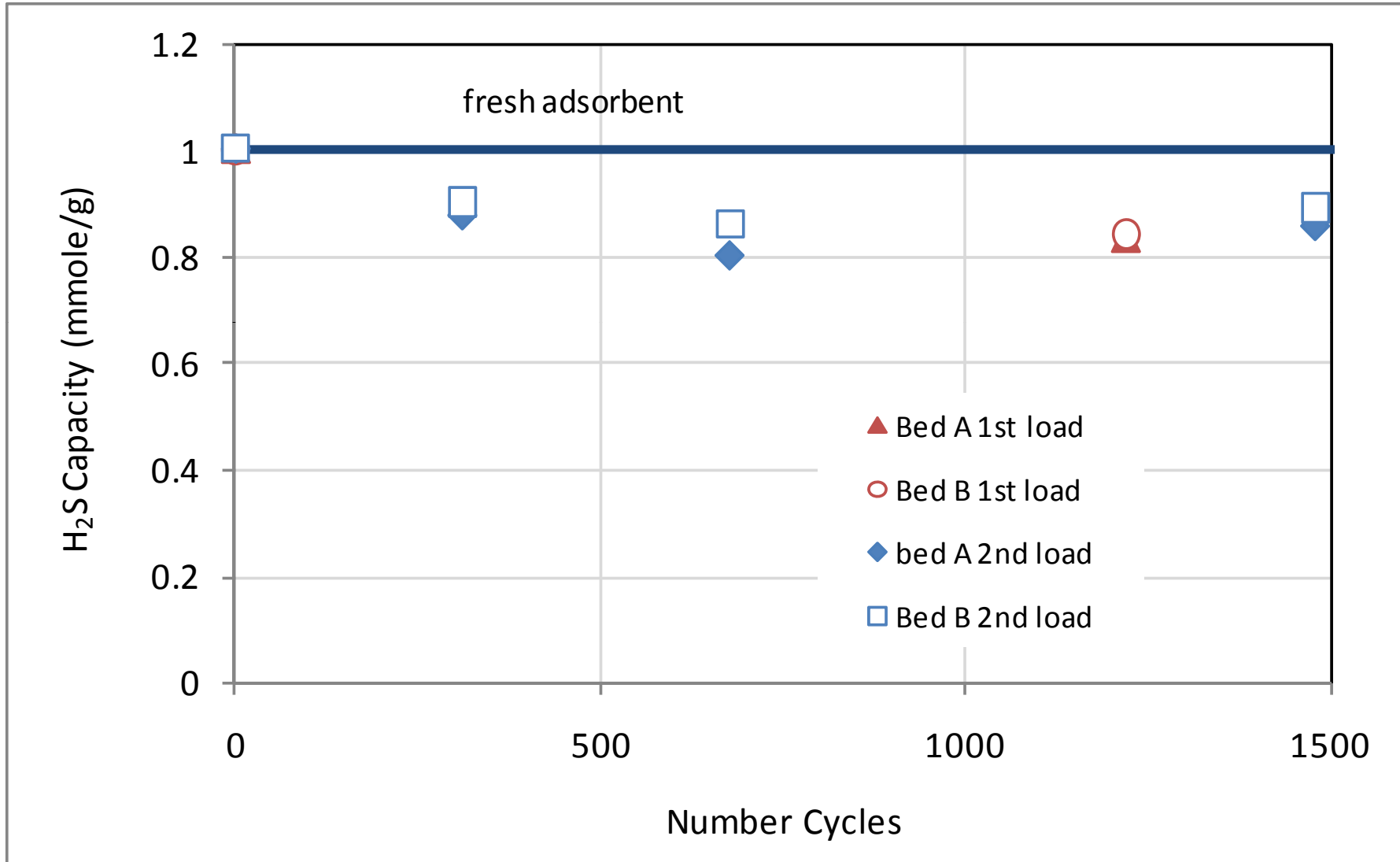
Sour PSA Technology Development



Sour PSA Technology Development



H₂S Capacity Stabilizes



Sour Combustor Development

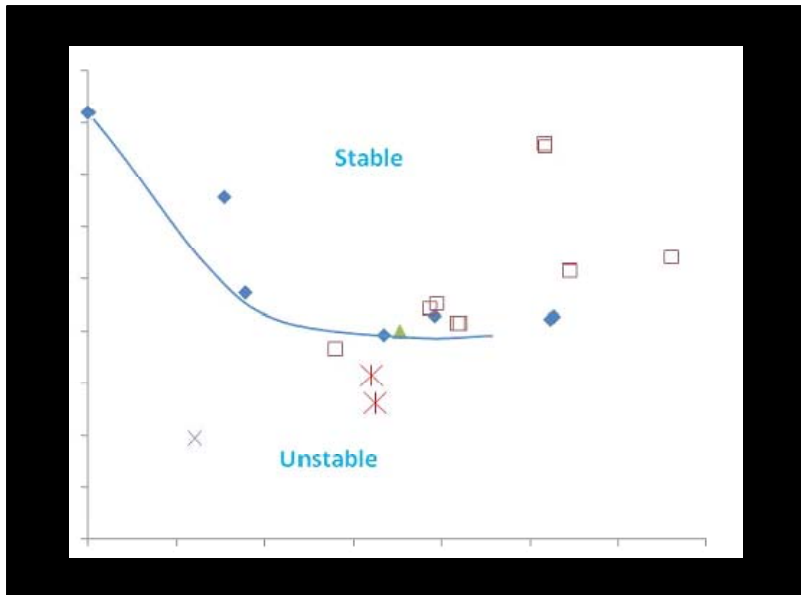


- **Design Basis**

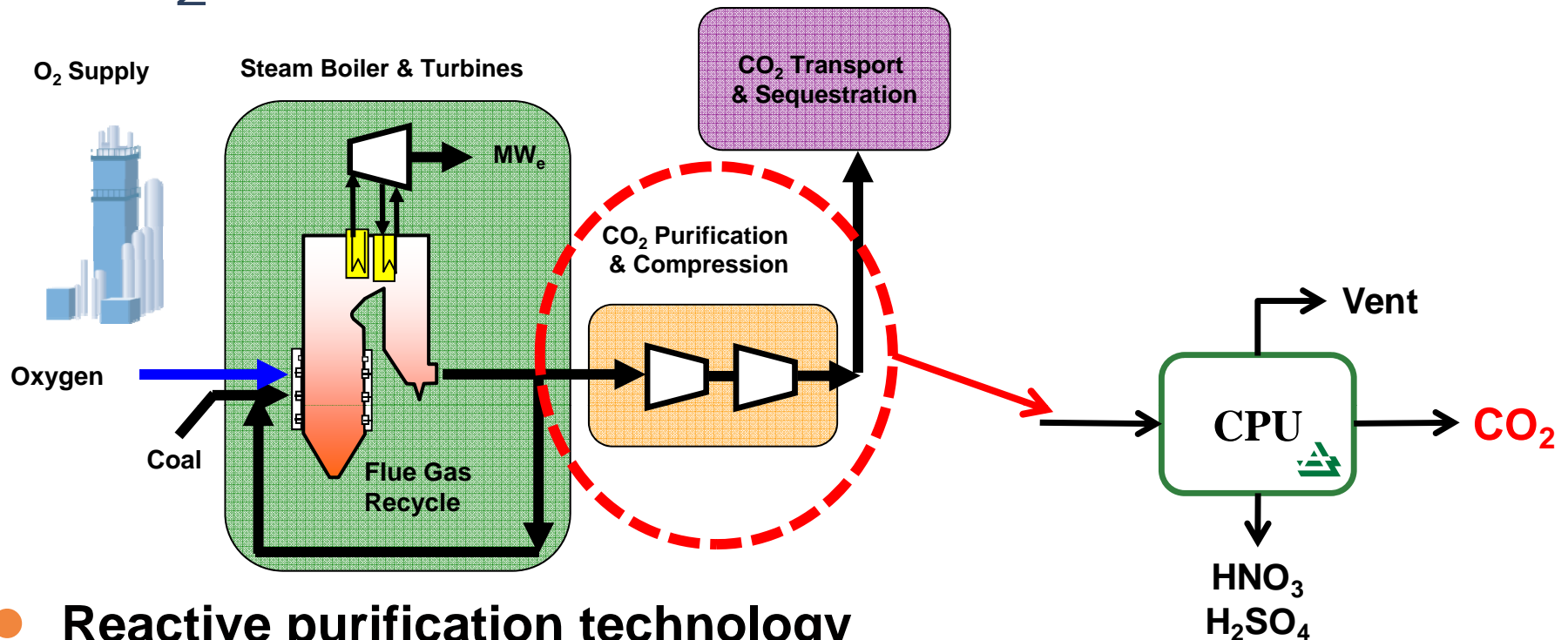
- Oxy-Tailgas burner
- Leverage off oxy-fuel combustion expertise
- Single or multiple burners
- Housed in a fired heater or package boiler

- **Status**

- Designed and tested prototype burners
- Conducted tests with H_2S laden stream
- Stability map established
- Performance mapping underway



CO₂ Purification Unit



- **Reactive purification technology**
 - High pressure NO_x catalyzed oxidation of SO₂ to H₂SO₄ acid
 - Further purification to remove water and inerts
 - Flowsheets for storage or EOR grade CO₂ applications
- **Originally developed for oxycoal power boiler applications**
 - Currently in the pilot phase of development
- **Extended for sour combustion flue gas**

Techno-Economic Benefits

Case	Units	High Purity H ₂		Power	
		Base	Sour PSA	Base	Sour PSA
Petcoke Input	MT/d	4,000	4,000	4,000	4,000
H ₂ Produced	kNm ³ /hr	305	299		
	MMSCFD	279	273		
Power Produced	MW _{net}			453	473
% CO ₂ Captured		~95%	>99%	~90%	~91%
Capital Savings	Millions USD\$	106		147	
Operating Savings	Millions USD\$/yr	24		2	
Reduction in CO ₂ Capture Cost		25.2%		19.7%	

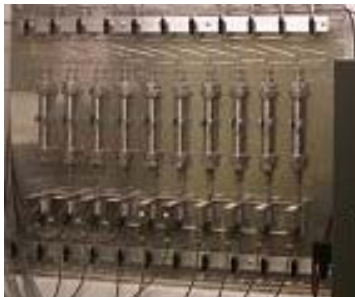
Summary and Conclusions

- **Air Products is developing a proprietary low-cost CO_2 capture option for pre-combustion systems**
 - **Applicable to H_2 and power production**
- **The technology consists of:**
 - **H_2 PSA adapted to handle sour syngas**
 - **Low-BTU oxyfuel burner**
 - **SO_x , NO_x , and inert removal system developed by Air Products for oxyfuel coal combustion**
- **Potential advantages over the state of the art:**
 - **Lower capital and operating costs**
 - **25 % reduction in the cost of CO_2 capture**
 - **Feasible to achieve ~100 % CO_2 capture rate**

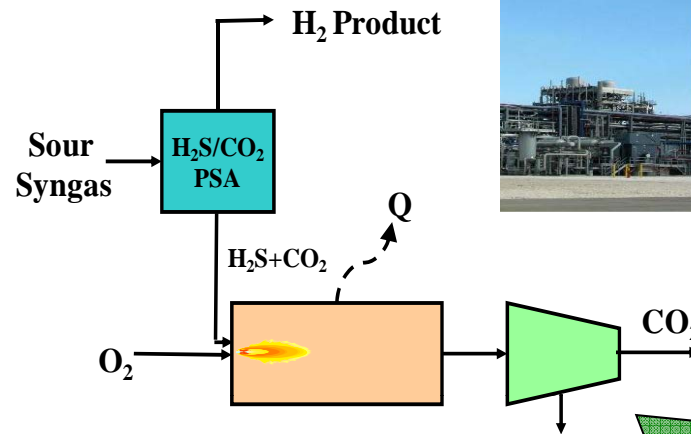
Scale-Up Pathway



**Lab scale
Gasifier / PSA**



**Adsorbent
life tests**



**Design of
pilot plant**

Pilot



Thank you

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