

October 8, 2008

Eltron Research & Development

CO₂ Capture and Hydrogen Production in IGCC Power Plants

Gasification Technologies Conference
October 5-8, 2008

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VP Technology



Outline

- Introduction to Eltron Research & Development
- Eltron's Membrane System
- IGCC – Carbon Capture & Storage (CCS)
- Techno-Economic Comparative Modeling
- Summary

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Introduction to Eltron

- Eltron Research & Development Inc.
 - 60 patents (25 licensed)
 - Eltron Water Systems LLC
 - Commercialization of water purification technologies
 - Continental Technologies LLC
 - Design and fabrication of engineered systems and pilot plants
- Eltron Areas of Expertise
 - Energy: Fuels, Fuel Reforming, Membranes
 - Materials & Catalysts
 - Air and Water Purification
 - Chemicals & Chemical Processing

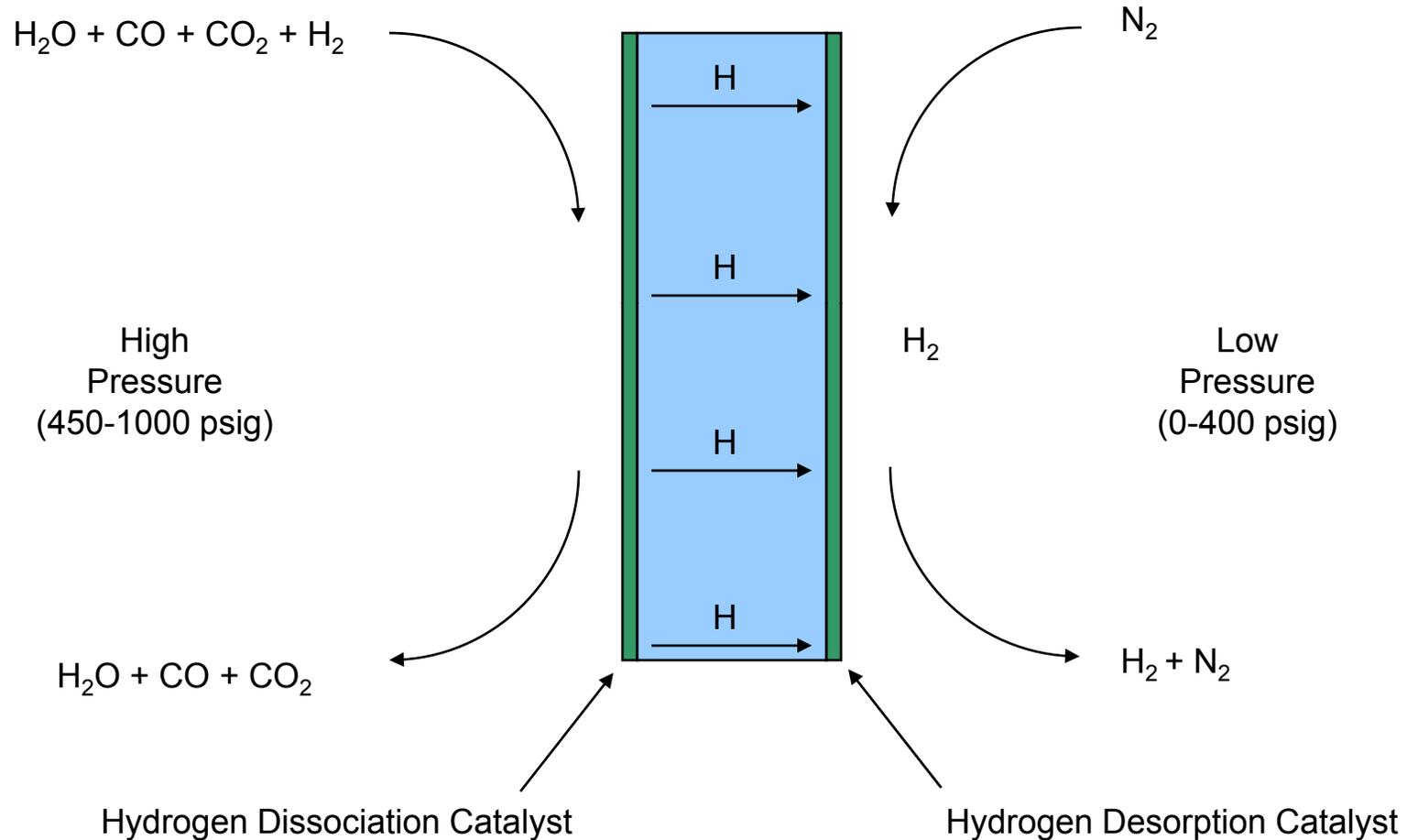
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Program Objectives

- Develop H₂/CO₂ Separation System, which
 - Retains CO₂ at coal gasifier pressures
 - Operates near water-gas shift conditions
 - Tolerates reasonably achievable levels of coal-derived impurities
 - Delivers pure H₂ for use in fuel cells, gas turbines, and hydrocarbon processing
 - Is cost effective compared to alternative technologies for carbon capture

CO₂ / H₂ Membrane System



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IGCC Test Conditions

- 41% H₂,
17% CO₂,
3% CO,
37% H₂O
- > 450 psig
- 280-440°C

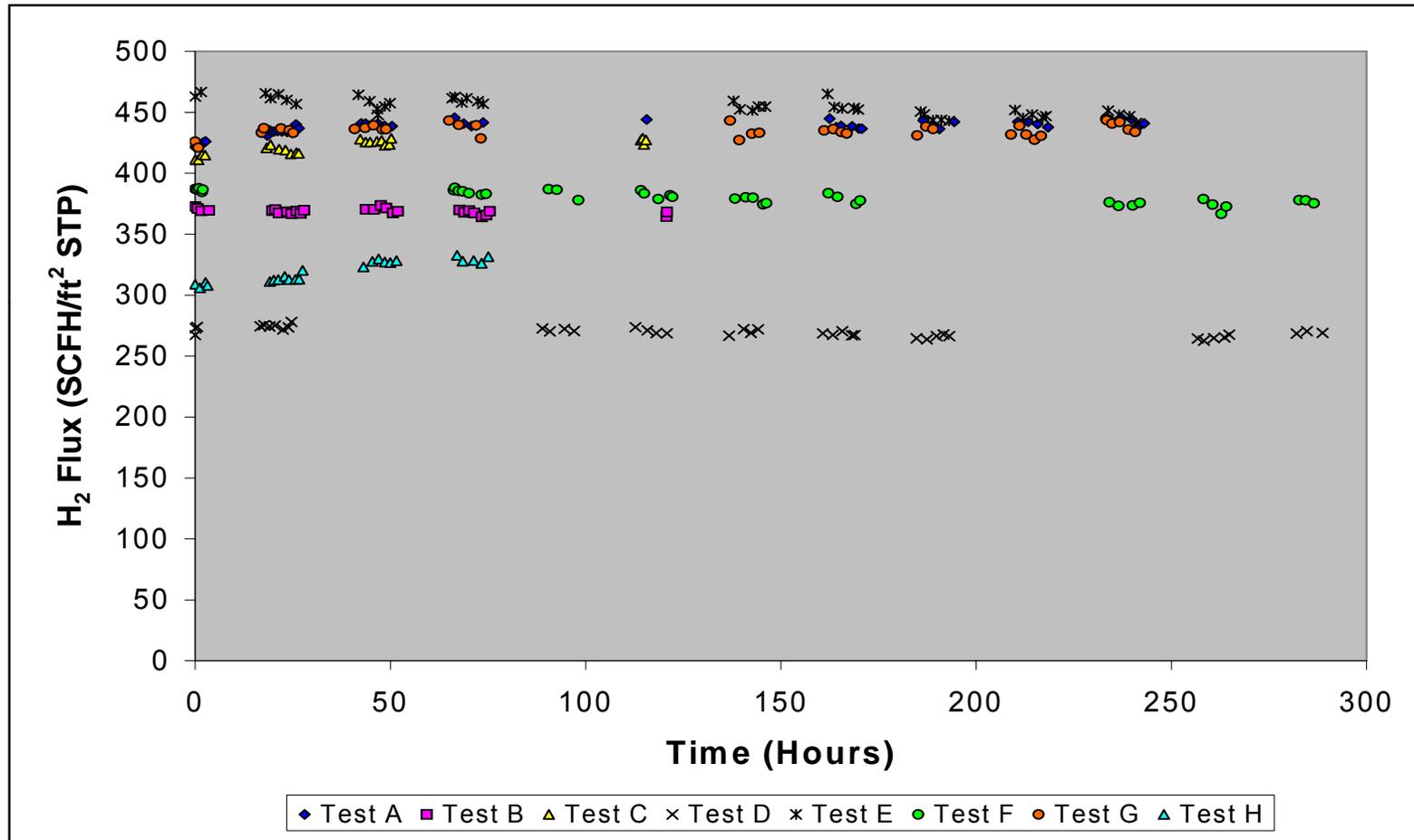


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Membrane Performance

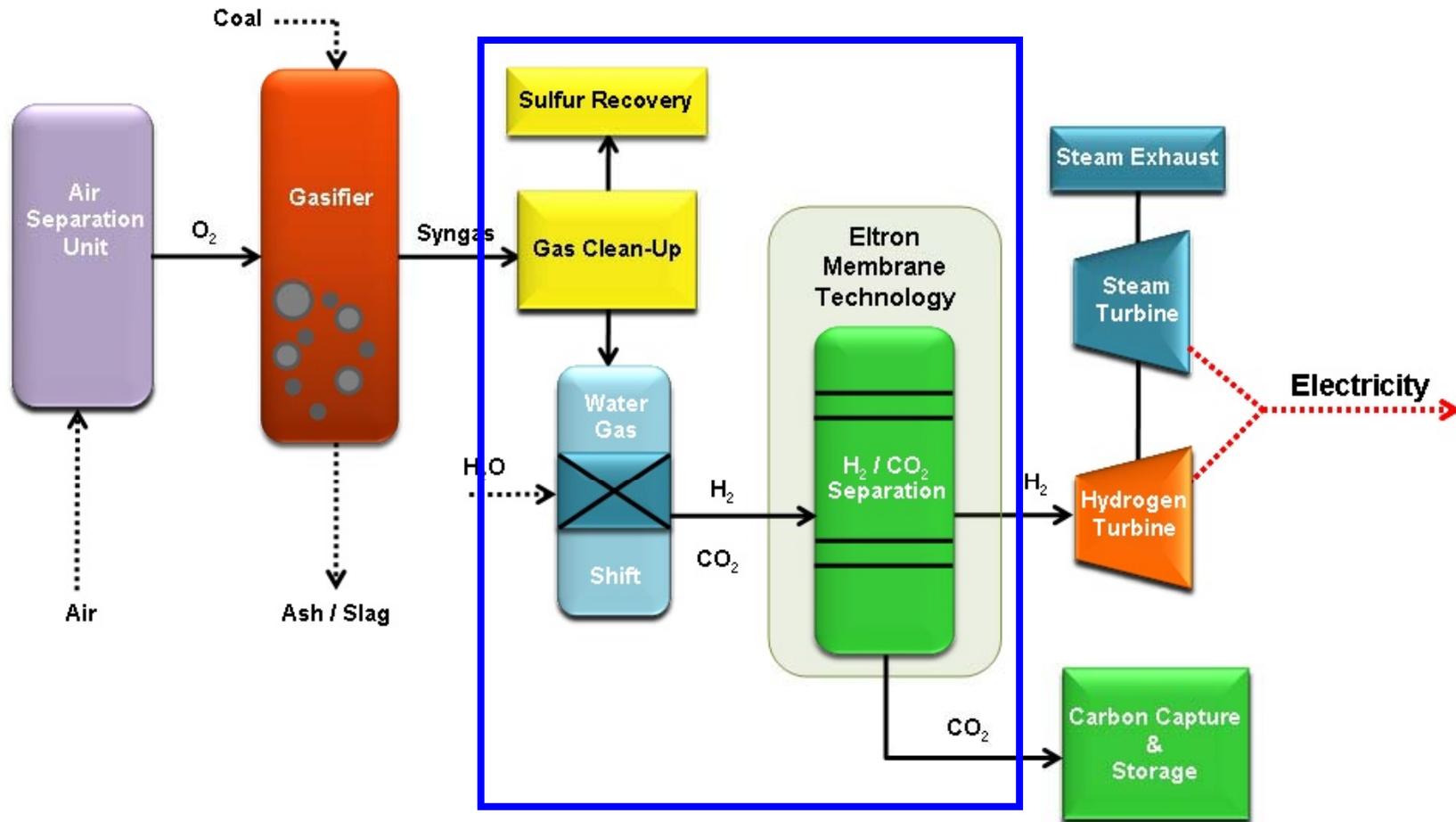
- Eltron's hydrogen membrane performs better than any other membrane under development for H₂ separation from coal.
- High H₂ flux rates > 200 mL/min/cm² (400 SCFH/ft²) demonstrated.
- 1.5 lbs H₂/day separation demonstrated under expected operating conditions.

Membrane Permeation Data



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IGCC-CCS



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Comparative Modeling

	Gas Cleaning (Sulfur Removal)	CO ₂ Capture / H ₂ Separation
Case 1	Conventional	Conventional
Case 2	Conventional	Eltron System
Case 3	Warm Gas Cleaning	Eltron System

Eltron's Membrane System:

- Higher Carbon Capture
- Higher Thermal Efficiency
- Lower Cost of Electricity

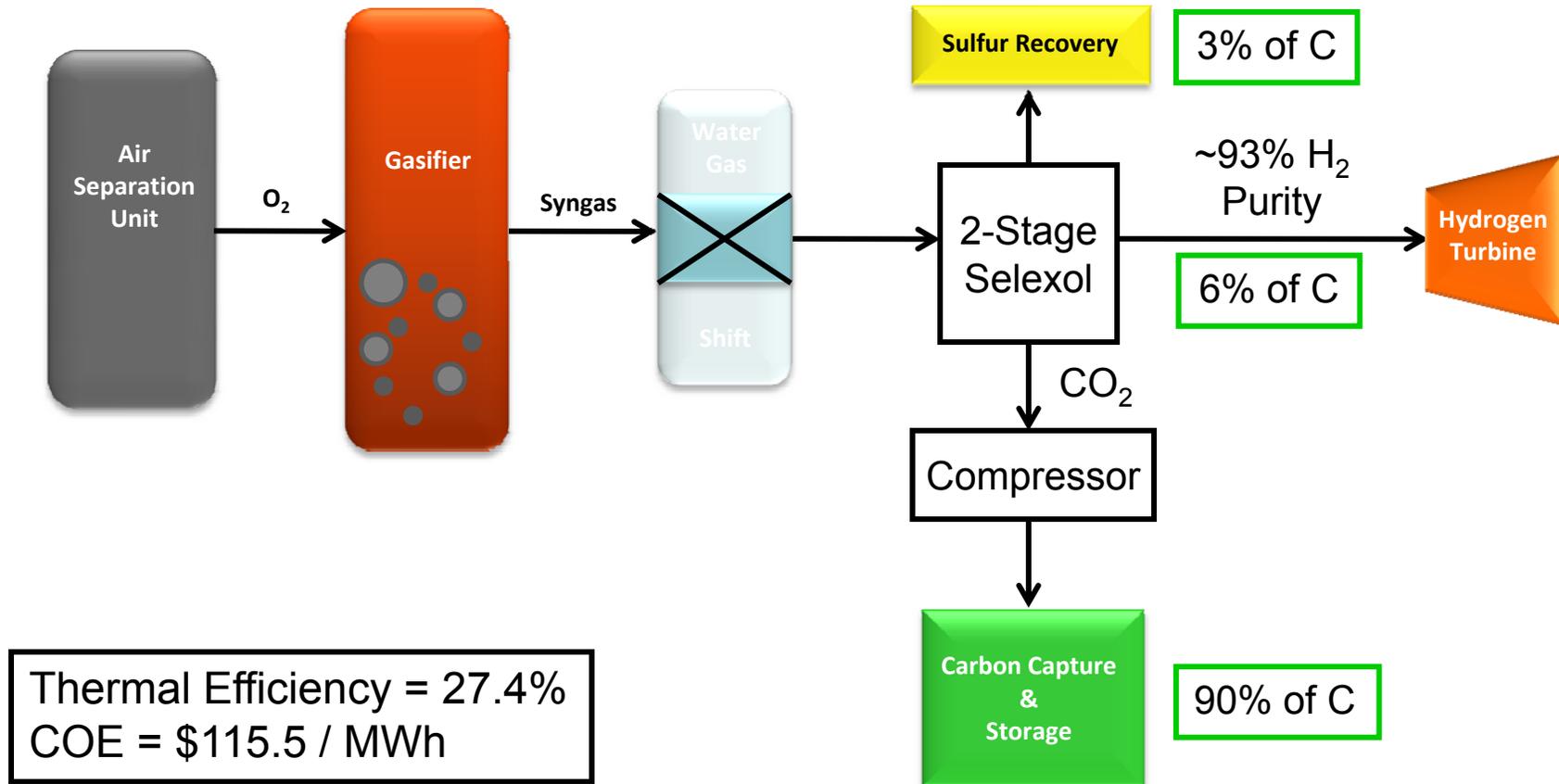
Techno-Economic Model Assumptions*

Plant Capacity	275 MW
Required Carbon Capture	90%
Required Sulfur Removal	99%
Required NOx Removal	≤ 0.05 lb/MMBTU NOx
Cost of Electricity	DOE Financial Model v3.0

* *FutureGen: Integrated Hydrogen, Electric Power Production and Carbon Sequestration Research Initiative*, US DOE Office of Fossil Energy, March 2004.

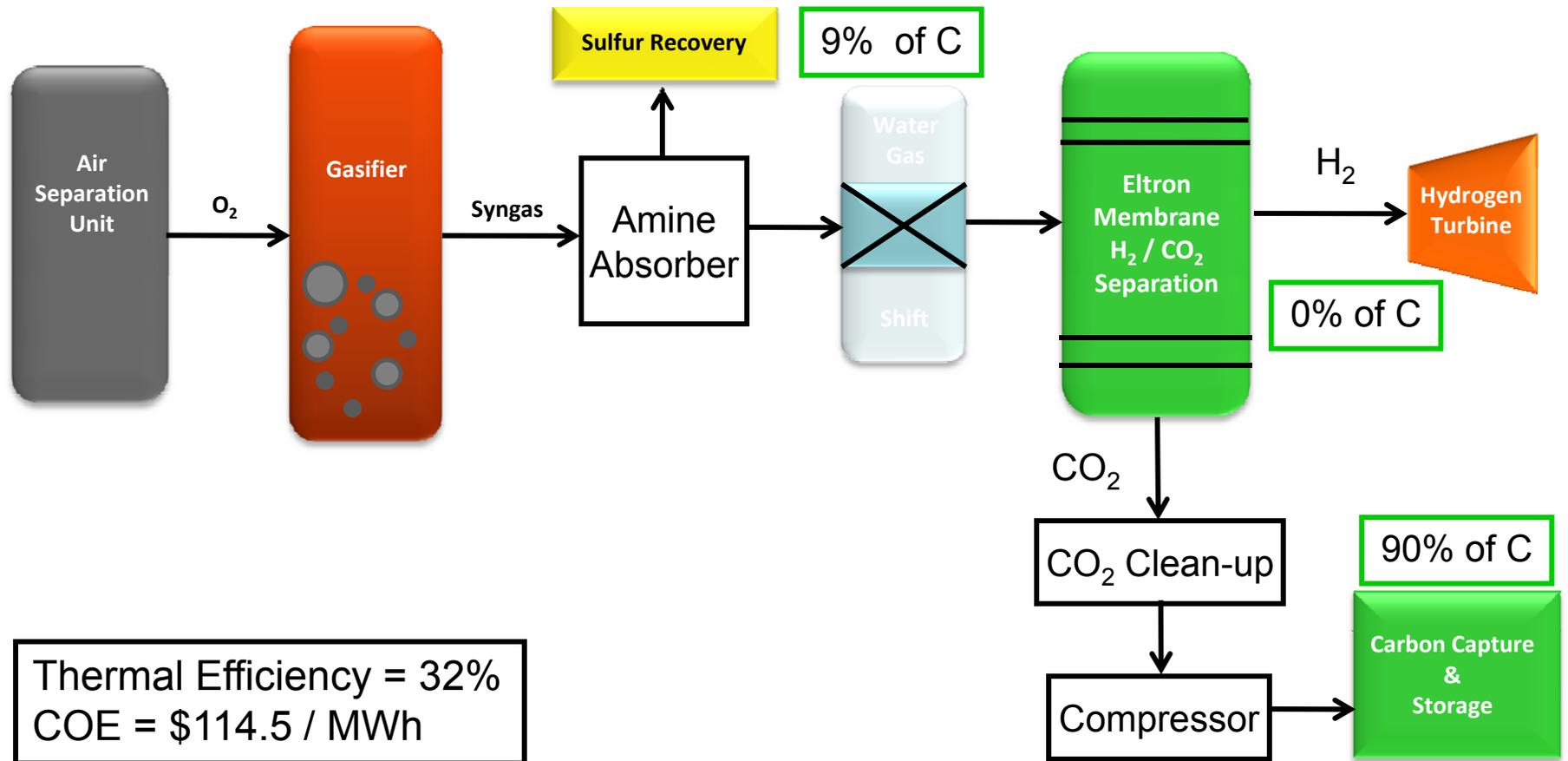
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Case 1: CO₂ Capture with Current Technology



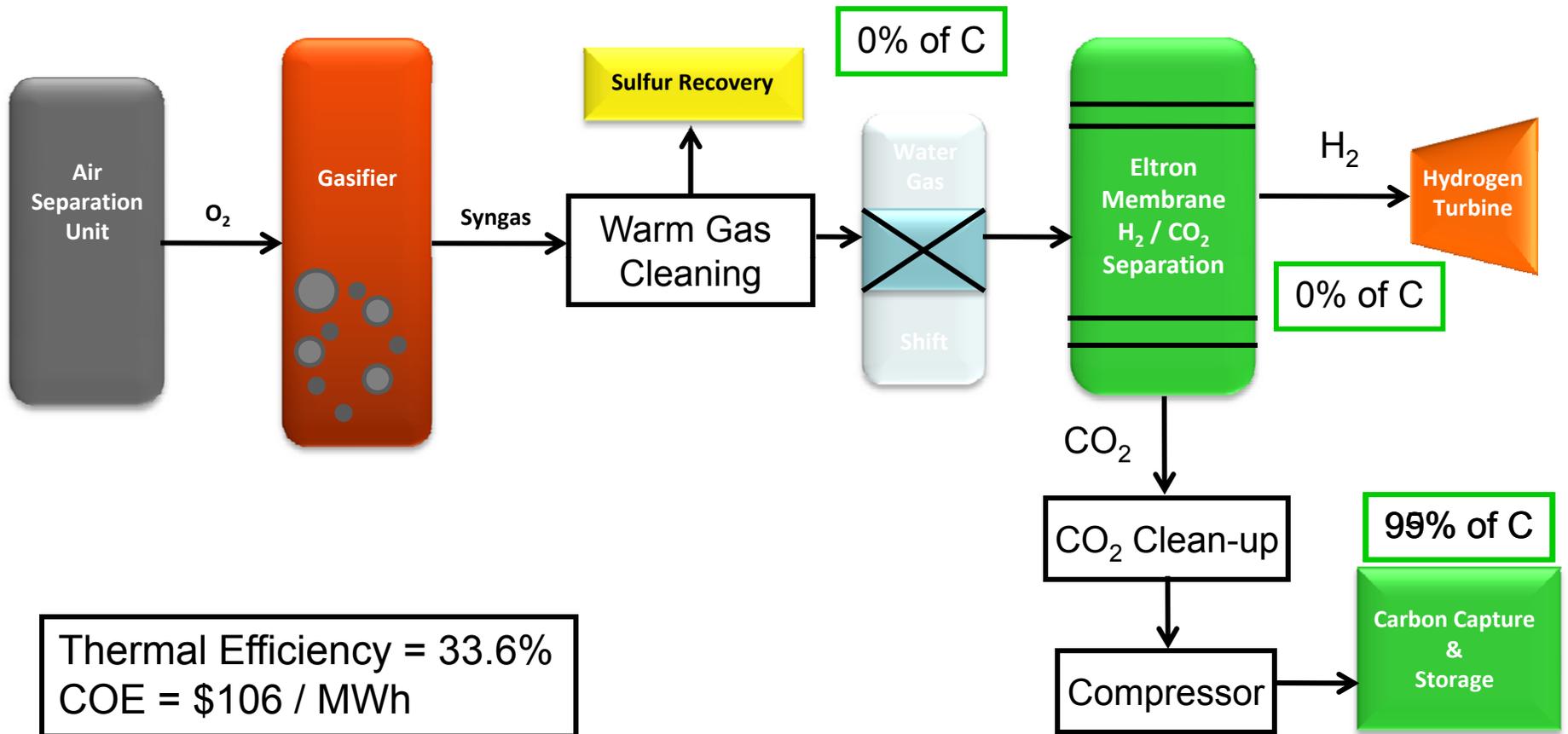
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Case 2: CO₂ Capture with Eltron H₂ Separation Membrane Technology



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Case 3: CO₂ Capture with Eltron H₂ Separation Membrane & Warm Gas Cleaning



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Economic Results Summary

Pre-combustion Gas Cleaning & CO ₂ Capture Method	2-Stage Selexol	Cold Gas Cleaning & Eltron Membrane	Warm Gas Cleaning & Eltron Membrane	Improvement
Thermal Efficiency	27.4%	32.0%	33.6%	6.2%
% CO ₂ Captured	90%	90%	99%	5.0%
Cost of Electricity (\$/MWh)	115.5	114.5	106	9.5

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Progress Towards DOE FutureGen Targets

<i>Performance Criteria</i>	<i>2010 Target</i>	<i>2015 Target</i>	<i>Current Eltron Membrane</i>
Flux, SCFH/ ft ²	200	300	450
Operating Temperature, °C	300-600	250-500	250-440
Sulfur Tolerance (ppmv)	2	20	20 (prelim.)
System Cost (\$/ft ²)	500	<250	<200
ΔP Operating Capability (psi)	400	800-1000	1,000
Carbon monoxide tolerance	Yes	Yes	Yes
Hydrogen Purity (%)	99.5	99.99	>99.99
Stability/Durability (years)	3	>5	0.9
Permeate Pressure (psi)	N/A	N/A	400

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Future Work

- Design, build & operate 220 lb/day PDU
- Continue work with commercial suppliers on manufacturing of full-size alloy membranes
- Life testing
- Understand impacts of contaminants
- Improve techno-economic models

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Summary

- Results demonstrate that technology is on track to meet DOE targets
 - Technical
 - Economics
 - Tools are in place
 - Experimental
 - Modeling at all scales
 - Flexibility in process design, including
 - Staged hydrogen recovery for polygen cases
 - Integrated water gas shift membrane reactors
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Praxair

Noram

THANK YOU

CONTACT

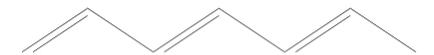
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