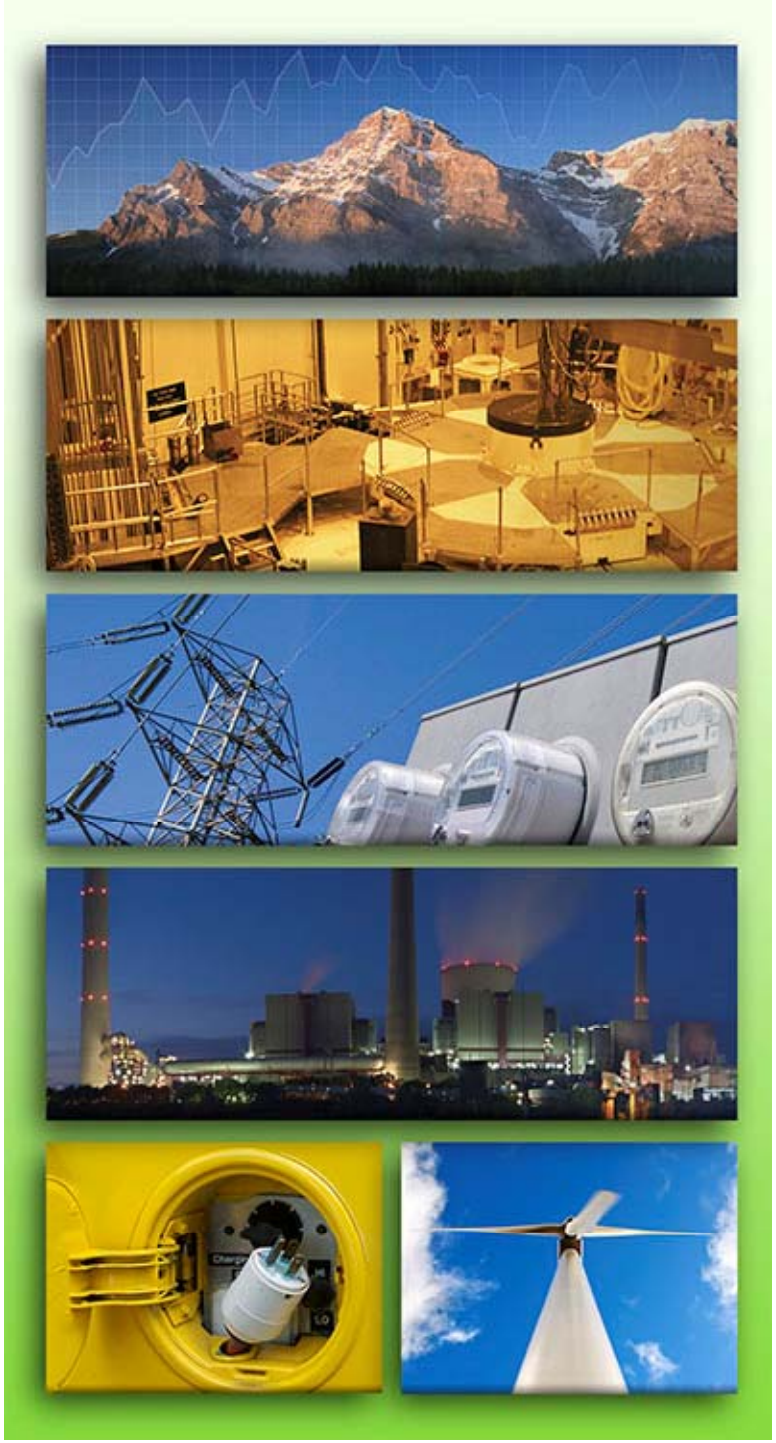

ELECTRIC POWER RESEARCH INSTITUTE

Perspective on R&D Needs in a Carbon Constrained World

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Electric Power Research Institute (EPRI)

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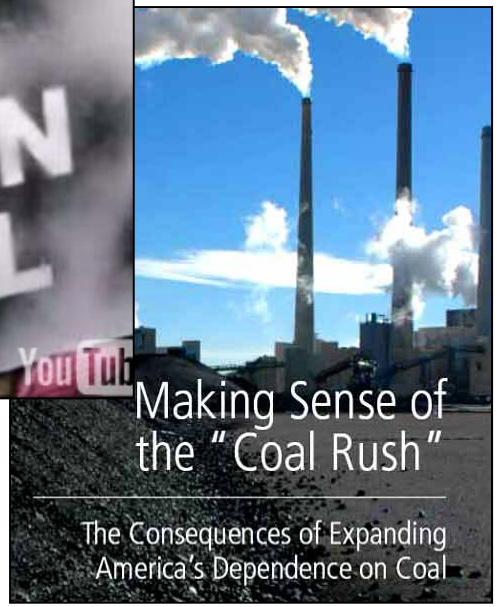
The State of Future Coal Power Generation



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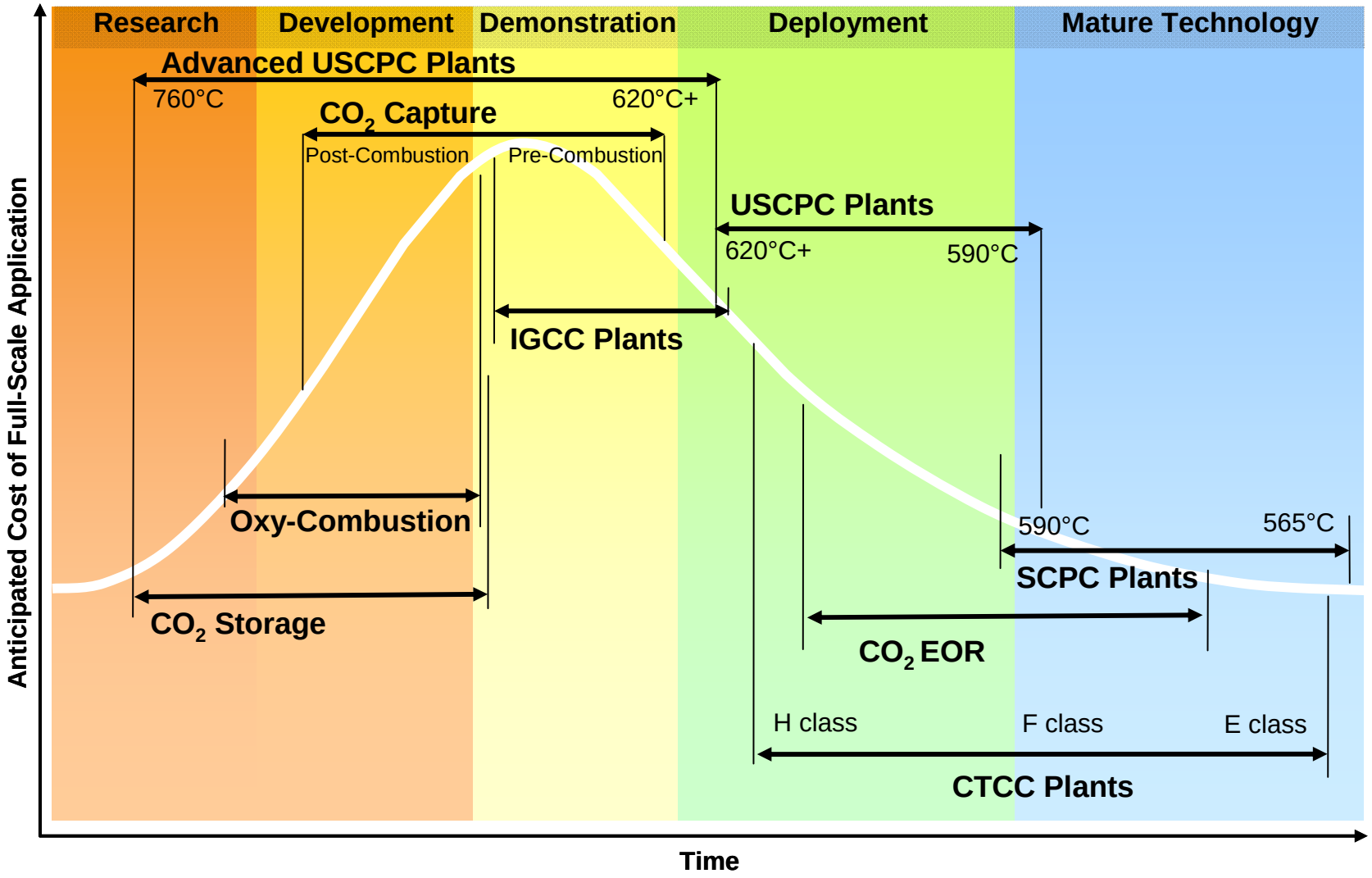
Grubb Curve for Fossil Fuel Based Technologies



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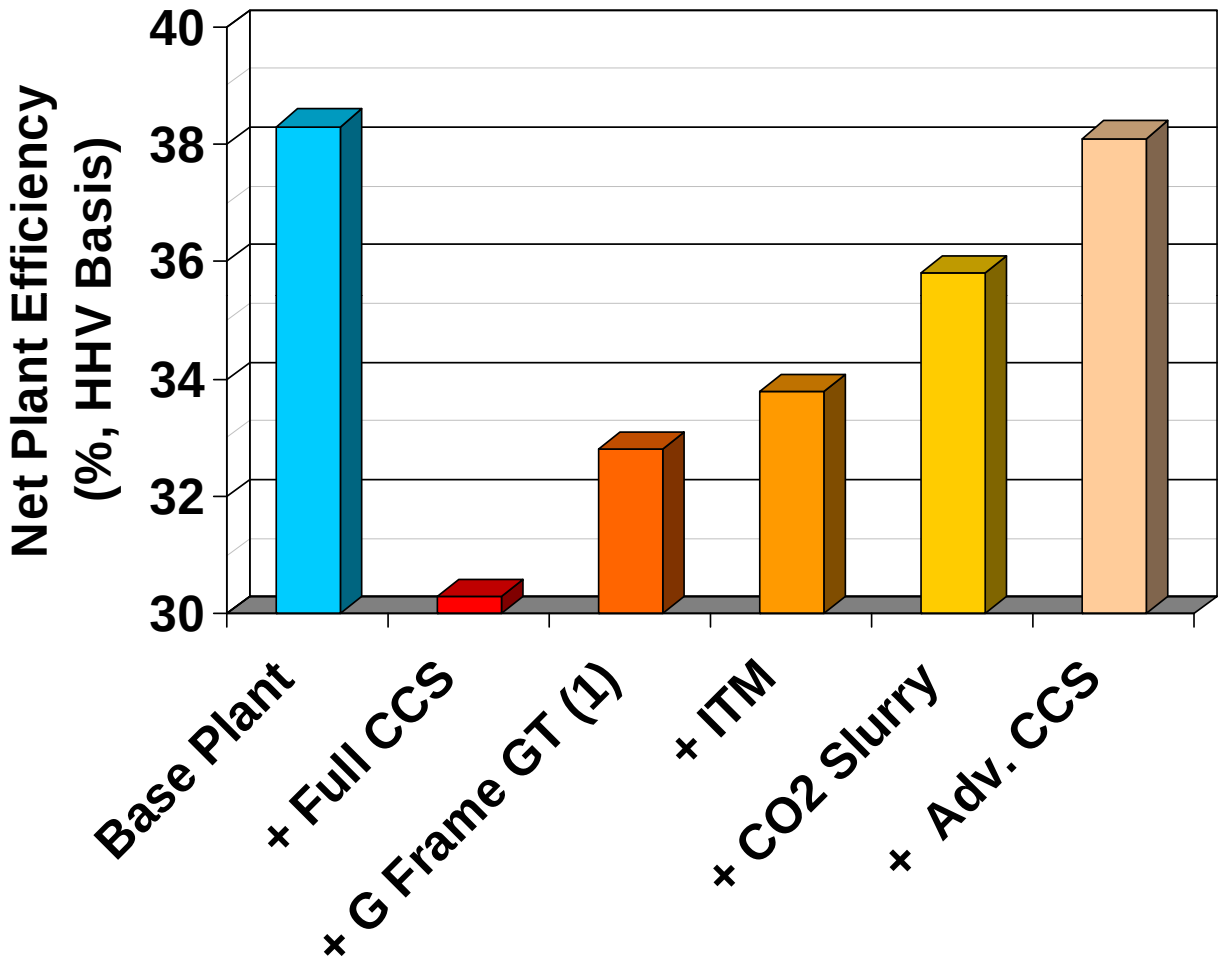
IGCC Technology Improvement Potential



Note: Efficiency improvements are cumulative

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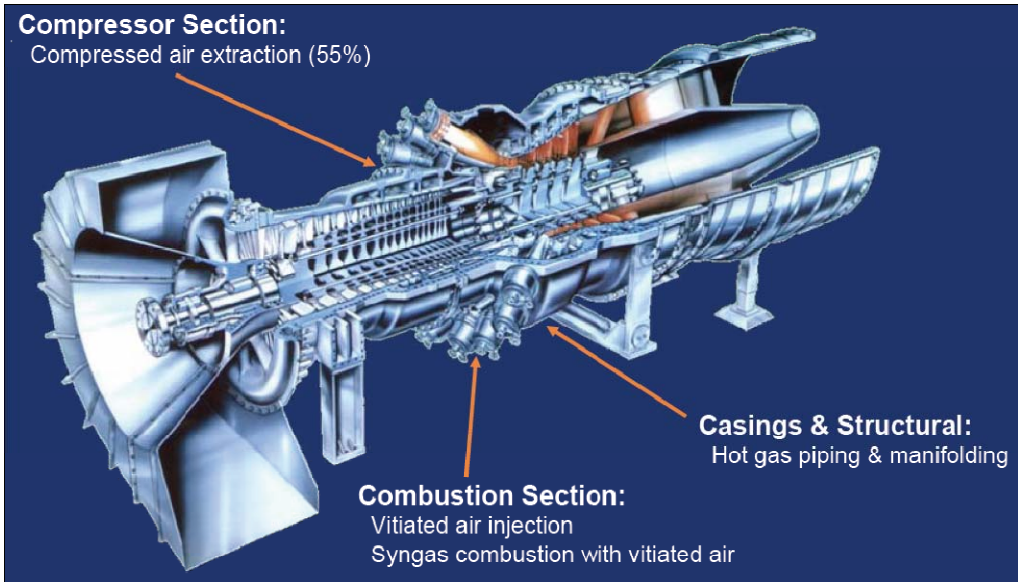
Advanced Gas Turbines for IGCC ?

- Firing Temperature Evolution of Gas Turbines
  - F-Class GT: ~2500°F [1370°C] (GE 7F and Siemens 5000F)
  - H-Class GT: ~2600°F [1430°C] (Manufacturers?)
  - J-Class GT: ~2700°F [1480°C] (MHI)
  - X-Class GT: ~3100°F [1700°C]
- Increased air extraction
- Higher output
- Higher net plant efficiency



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Gas Turbine Roadmap

Baseline IGCC vs. IGCC w/Advanced Gas Turbines

	Base Case	H-Class GT	J Class GT
Gas Turbine Power	1.00	1.49	1.61
Steam Turbine Power	1.00	1.56	1.55
Gross Power	**1.00**	1.52	1.59
ASU Auxiliary Power	**1.00**	**1.16**	**1.20**
Total Auxiliary Power	**1.00**	**1.25**	**1.28**
Net Power Output	**1.00**	**1.25**	**1.28**
Thermal Input	1.00	1.46	1.50
Net Plant Heat Rate, Btu/kWhr	**11,802**	**-1,303**	**-1,592**
Net Plant Efficiency, HHV	**Base**	**+3.6% Point**	**+4.5% Point**

Note: Results are preliminary and subject to change

IGCC Study for Canadian Clean Power Coalition

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IGCC R&D Improvement Potential

Current Status

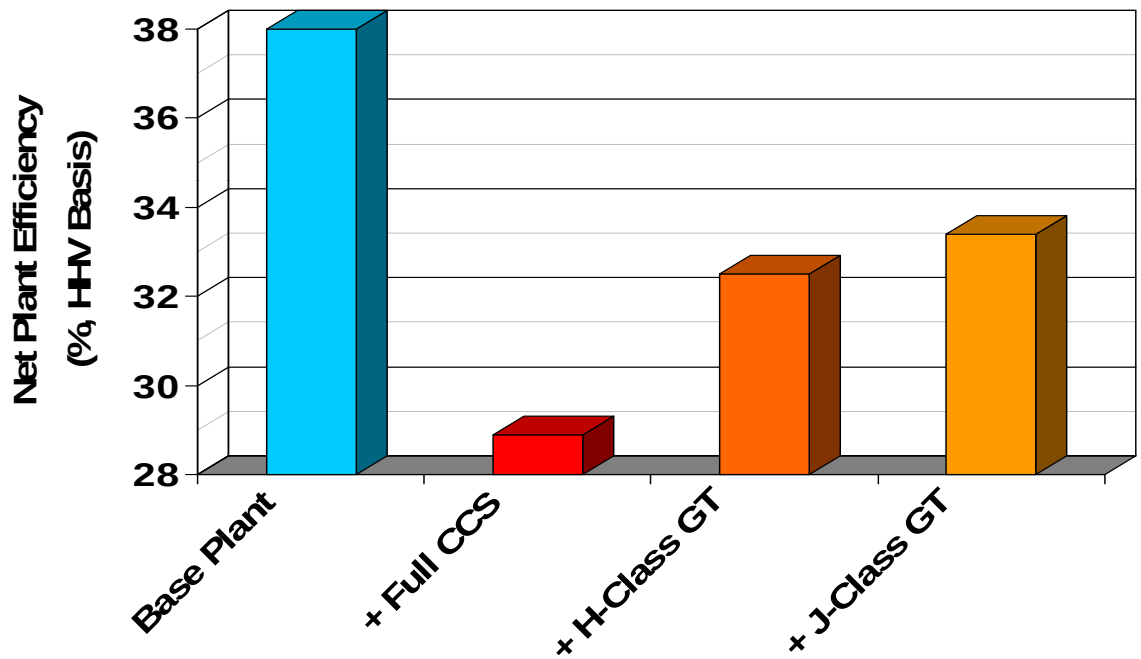
Gas Turbine

- Commercially available F-Class (~2500°F)
- No air integration

Carbon Management

- Commercially available and operating Selexol CO_2 capture technology
- CO_2: 200 lb/MWh emissions with full capture

Future Potential



Notes:

1. H+J Frame case with full air-side GT-ASU integration
2. Cumulative efficiency improvements denoted with '+'
3. Base case without CCS estimated ~38%

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Recommended R&D Topics

Increase efficiency of IGCC + CCS systems:

- Improve GT integration with Air Separation Unit
- Modify GT for lower pressure requirement for N_2 diluent
- Design for high H_2 syngas without derating firing temperature
- Improve combustor design for low NOx control for high H_2 syngas
- Offer larger MW GT for economy-of-scale advantage (G, H, J, ?)
  - MHI 320 MWe J-series (1700°C, 3100°F)

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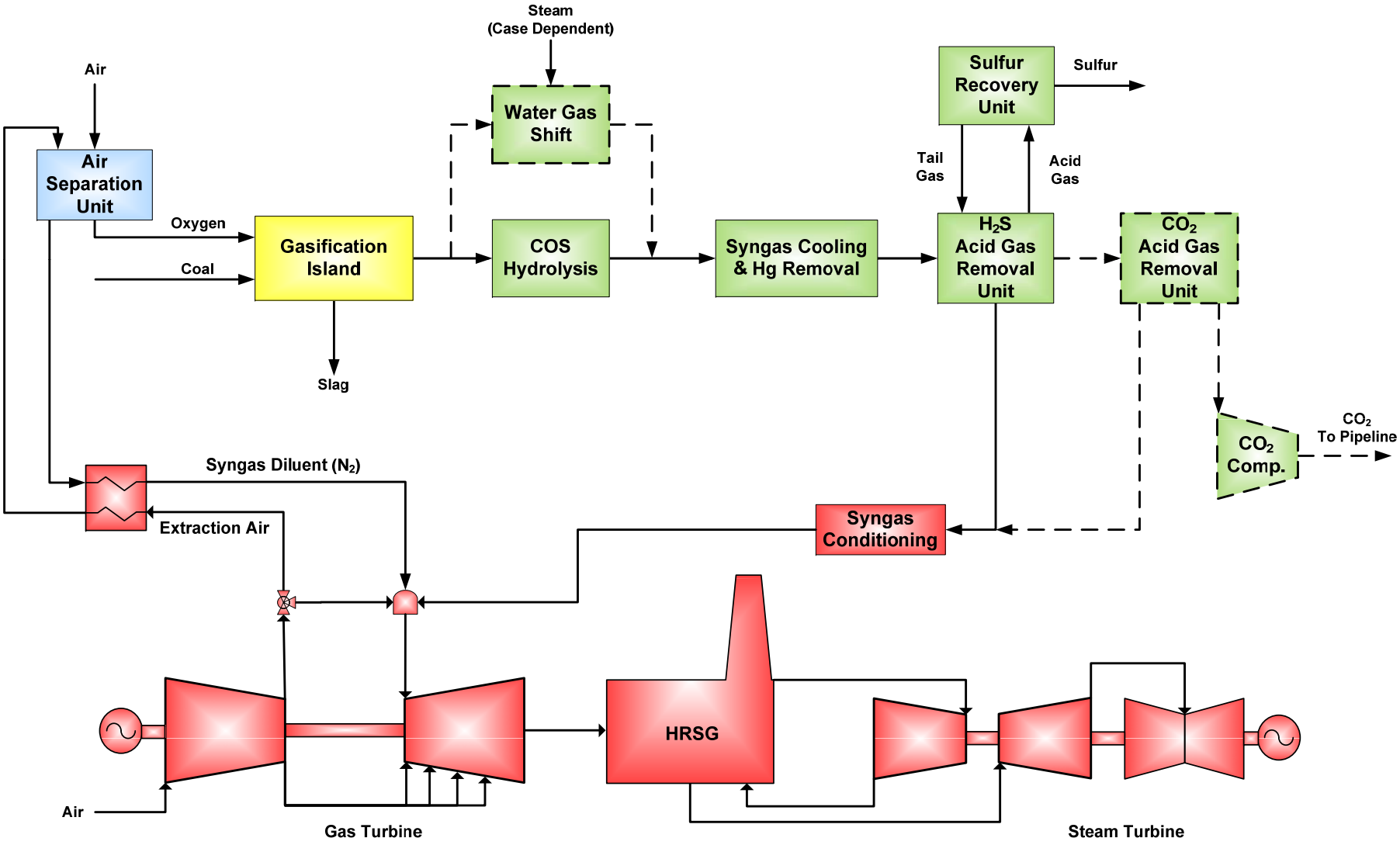
IGCC with CO_2 Capture

Process Flow Diagram



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