BUILDING A WORLD OF DIFFERENCE

IGCC COMPETITIVENESS AND DEVELOPMENT

Anthony F. Black

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TOPICS

Overview

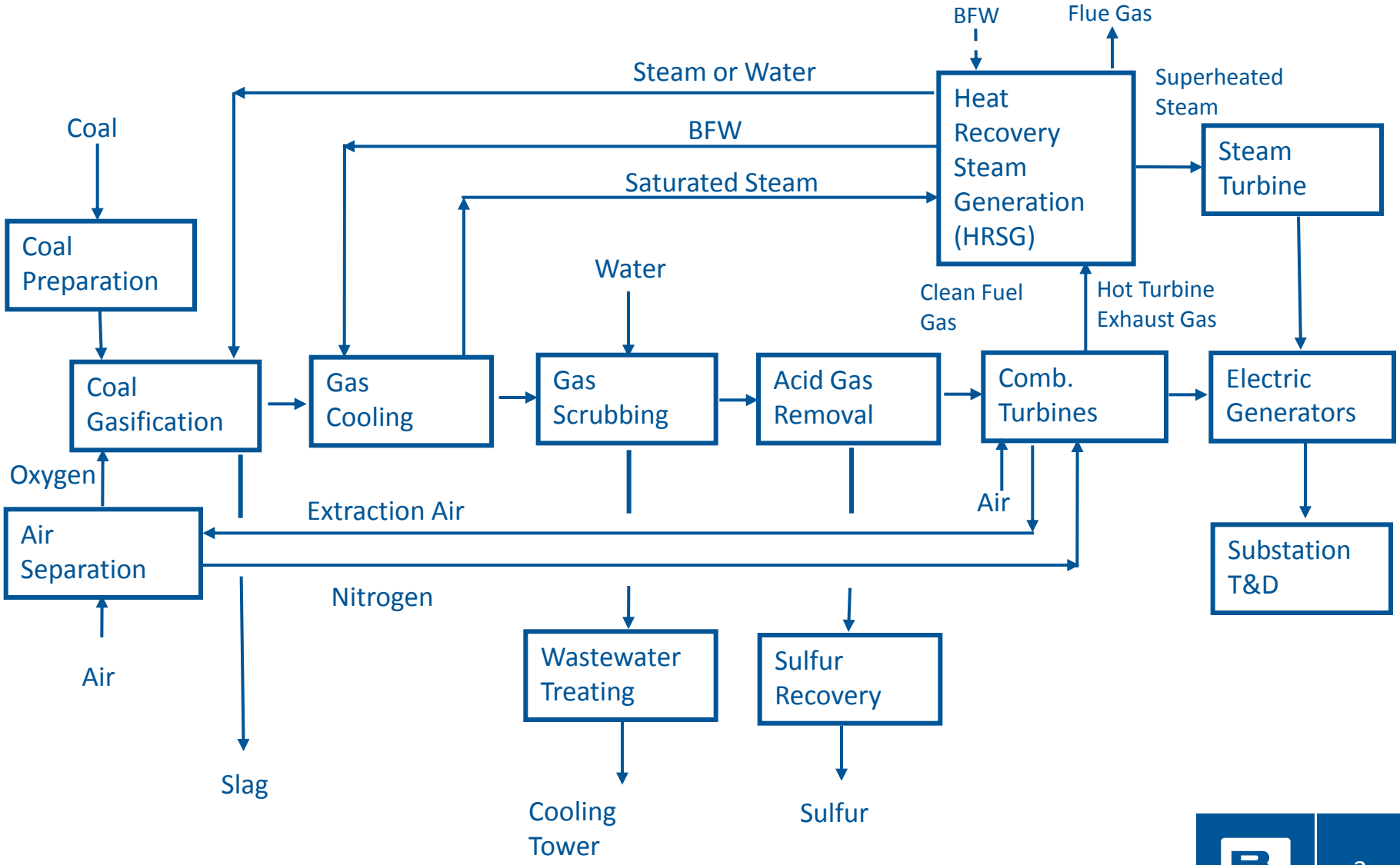
Current IGCC vs. PC

Expected Advances

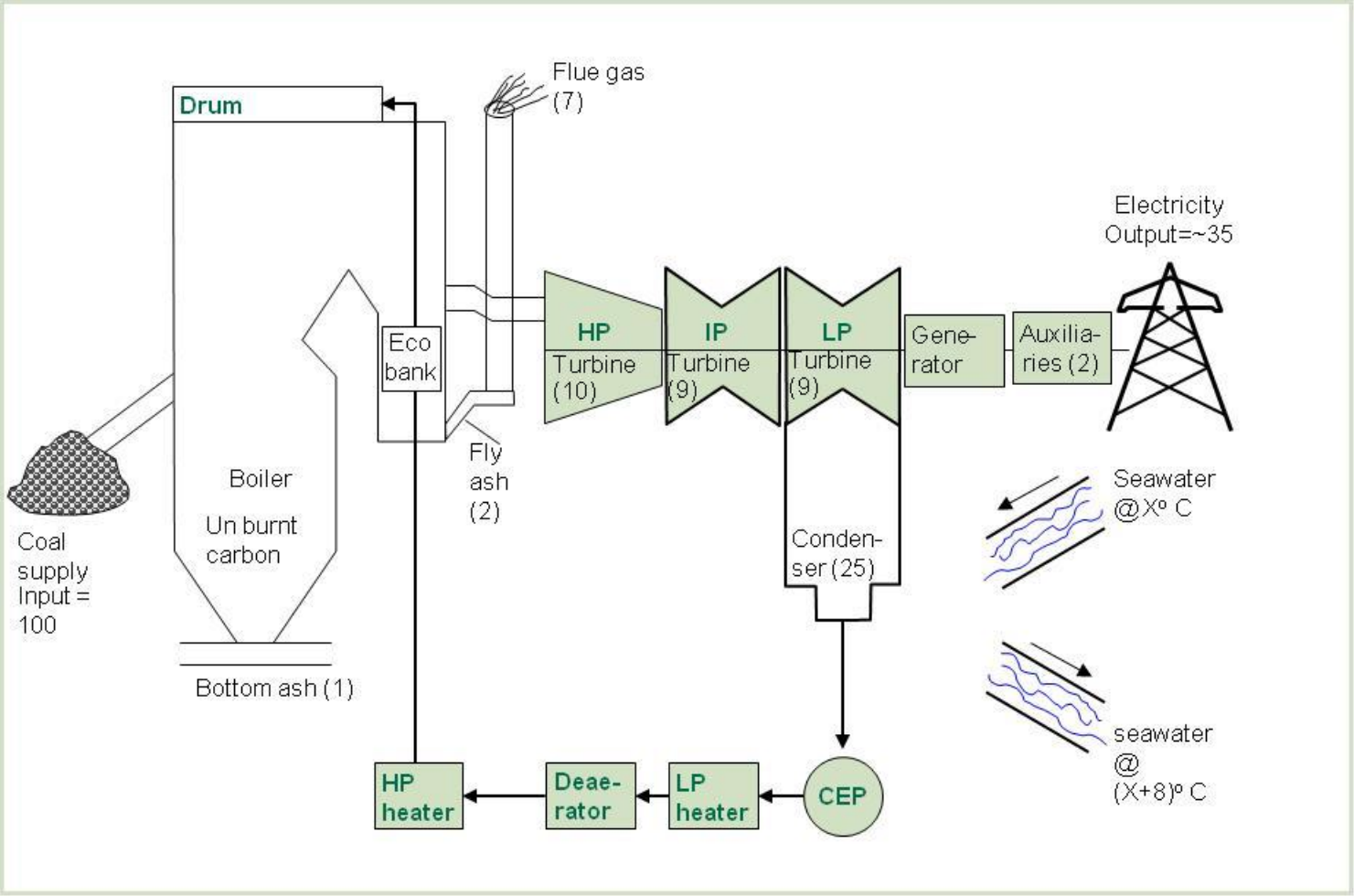
- SCPC
- IGCC

Questions?

COAL IGCC PROCESS DIAGRAM



SUPER CRITICAL PULVERIZED COAL (SCPC) DIAGRAM



CURRENT PROJECTS

- **Duke Edwarsport**
  - Expected 2012 completion
- **Kemper County**
  - Placed on indefinite hold

- **Longview**
  - Recently completed
- **Big Stone 2**
  - Abandoned
- **Holcomb 3**
  - Courts requiring additional environmental review

SUPERCRITICAL PC VS. IGCC

	Supercritical PC	Coal IGCC
First Year of Commercial Operation	1957	1993
Commercial Plants Worldwide	500+	5
Water Usage – Wet Cooling	10X	7.5X
Water Usage – Dry Cooling	X	2.5X

COAL IGCC ENVIRONMENTAL BENEFITS

- Emissions Approaching Natural Gas-Fired Combined Cycle
- 98 - 99+% Sulfur Removal
- Lowest Cost Mercury Removal
- Highest CO_2 Recovery Potential
- Lower Water Use

CURRENT STATUS OF EMISSIONS

Location	NOx (lb/MWh)	SOx (lb/MWh)	CO (lb/MWh)	PM10 (lb/MWh)	CO2 (lb/MWh)
Edwardsport, Indiana(1)	0.18	0.13	0.13	0.06	1,850(2)
Maidsville, West Virginia	0.56	0.83	0.96	0.16	1,850(2)

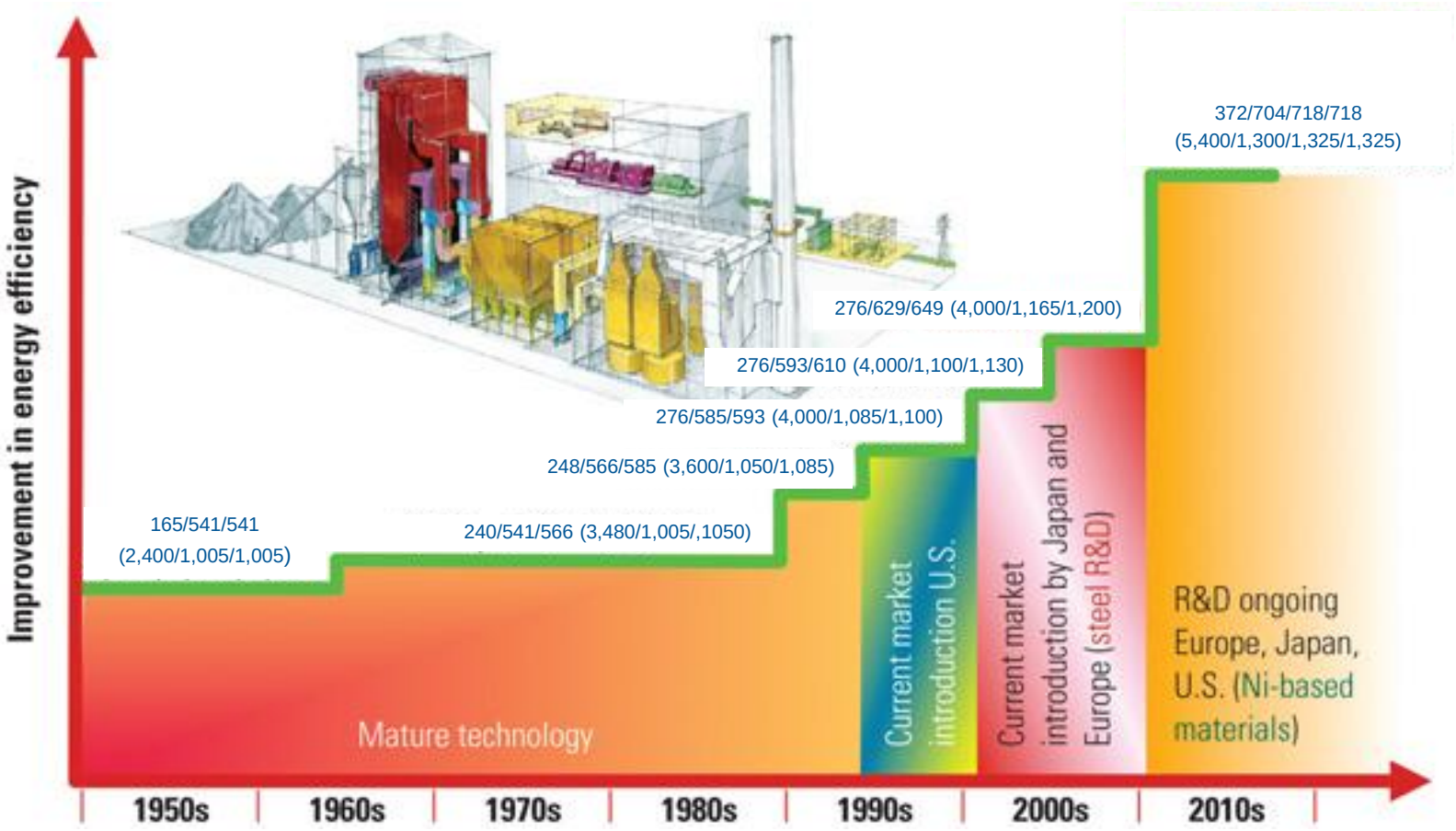
Notes
(1) Numbers based on the plant design efficiency of 37.5 percent
(2) Estimated

COMPARISON OF CURRENT IGCC AND SPC

- Efficiency approximately equal without carbon capture
- Capital cost significantly higher for IGCC
- Cost of energy about equal when carbon capture included

Drivers required for IGCC

ADVANCES IN STEAM CONDITIONS



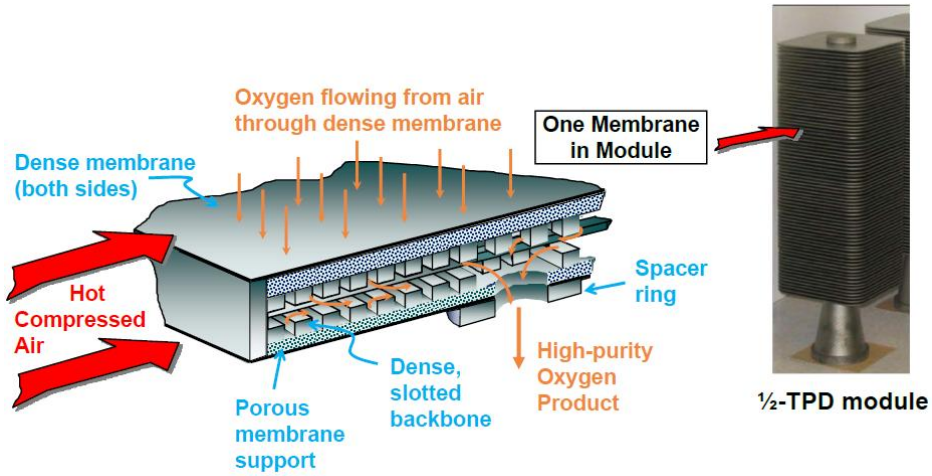
Above describes the Mainstream Pressure/ Main Steam Temperature/ Reheat Steam Temperature / Double Reheat Steam Temperature

Units: bar/°C/°C /°C (psi/°F/°F /°F)

Materials are key to increasing efficiency

ION TRANSPORT MEMBRANES IMPACT

- Nearly 50 percent decrease in ASU auxiliary load
- Almost 35 percent cost reduction in ASU island (5 percent overall)
- Cost reduction partially offset by additional heat recovery equipment



- Likely fully commercial around 2020

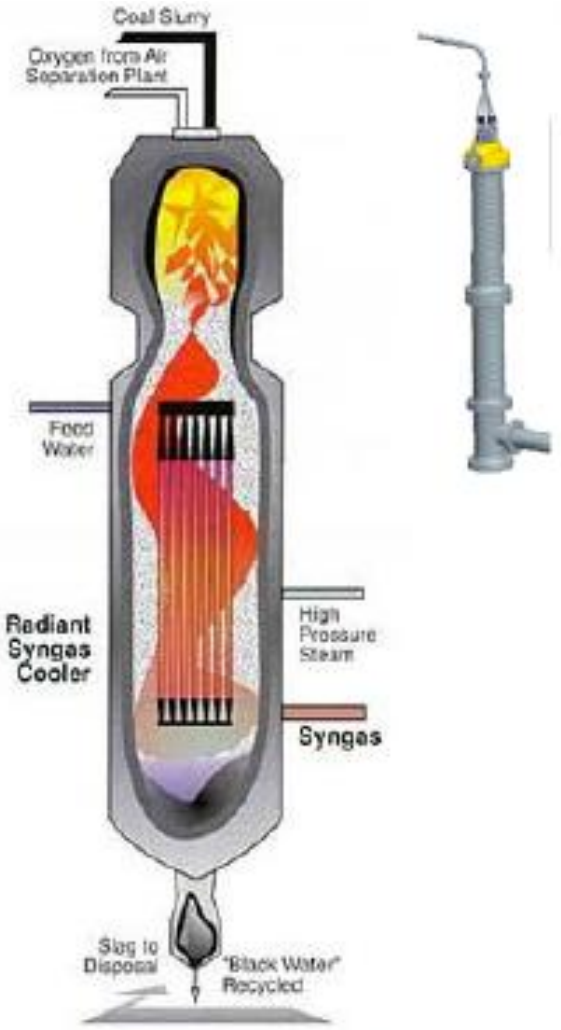
WARM GAS CLEAN-UP IMPACT

- One to two percentage points increase in overall IGCC efficiency
- 6 percent decrease in overnight EPC capital cost

- Likely fully commercial around 2020

ADVANCE GASIFICATION IMPACT

- Efficiency improvement between 1 and 3 percentage points
- 25 to 50 percent cost reduction in the gasifier island (6 to 12 percent overall)
- Likely fully commercial around 2020



Source: DOE paper (2006)

RECAP

- **Today IGCC is more costly than PC**
- **Drivers needed to make IGCC competitive**
  - Carbon capture
  - Improved efficiency
  - Lower cost
- **Key technology components likely commercially available around 2020.**

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