

THERMAL INTEGRATION OF CO₂ COMPRESSION HEAT TO IMPROVE POWER PLANT HEAT RATE

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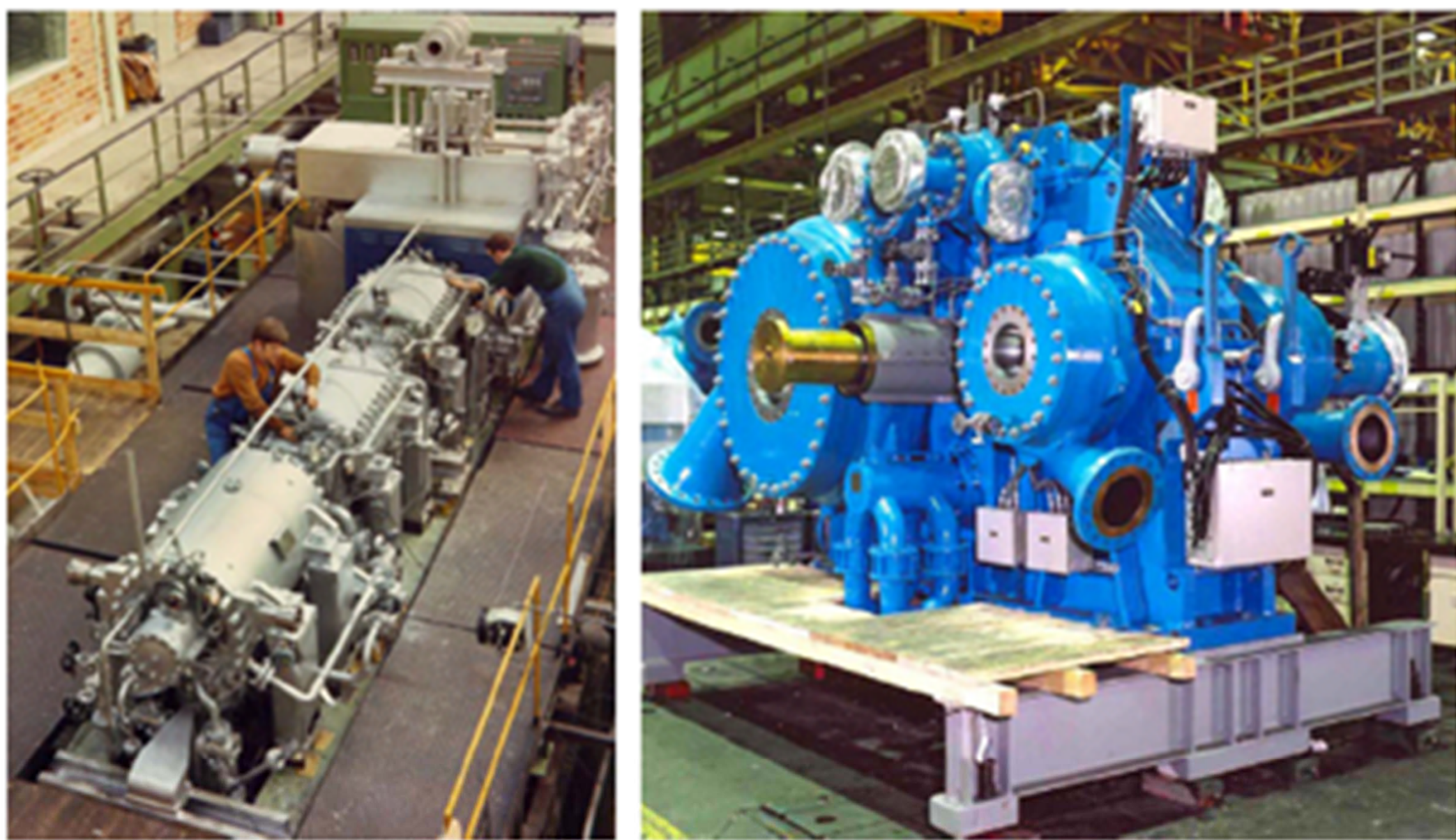
CO₂ COMPRESSION

- Compress from suction pressure of 14.7 to 300 psia to a discharge pressure greater than 2200 psia
- CO₂ flow rates ~ 1 million lbm/hr
- Will add parasitic load and reduce unit efficiency
- Opportunities for thermal integration innovations

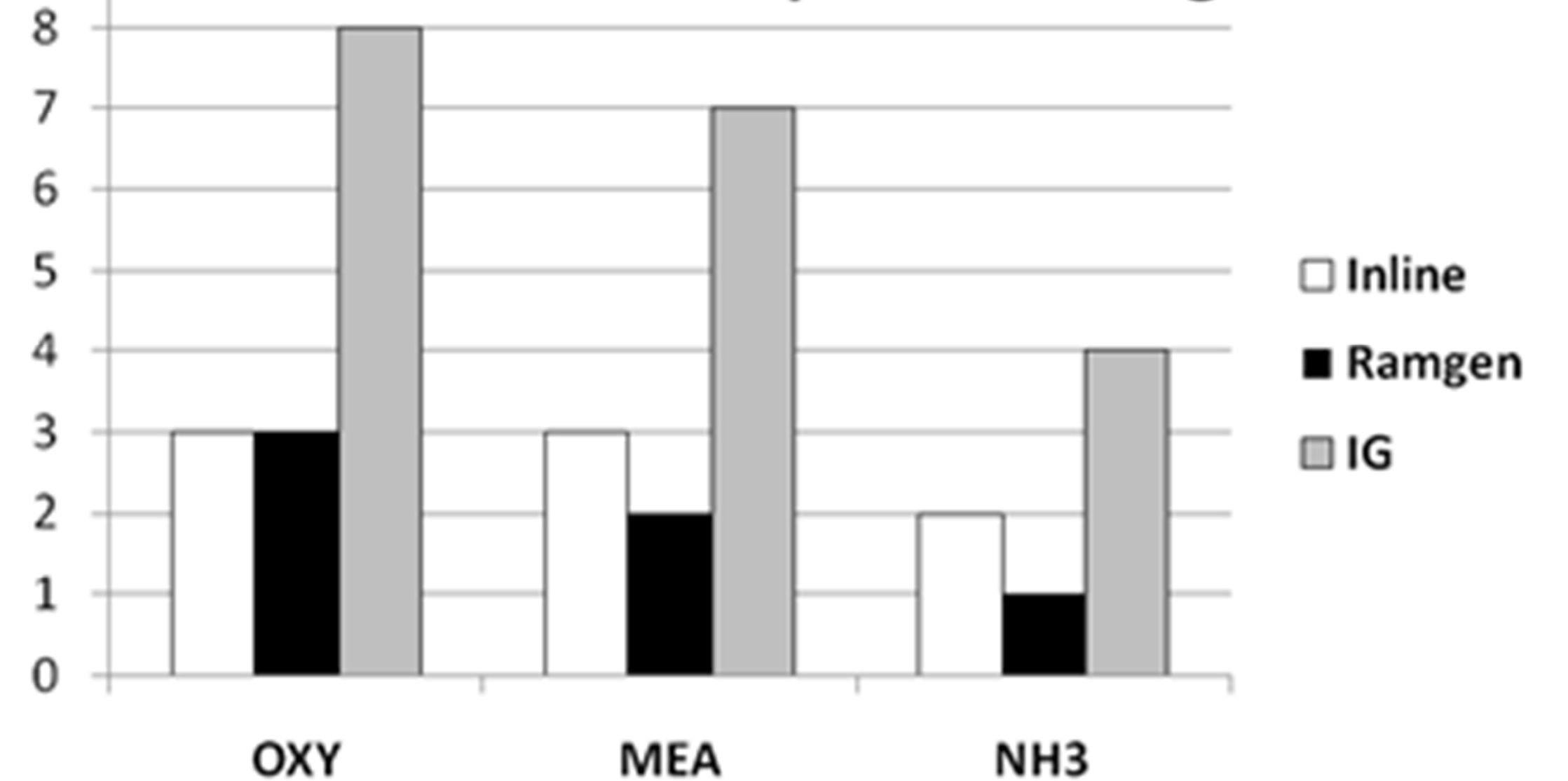
TYPICAL STAGE PRESSURE RATIOS

- Inline 2 to 6
- Integrally Geared 1.5 to 2.5
- RAMGEN 10

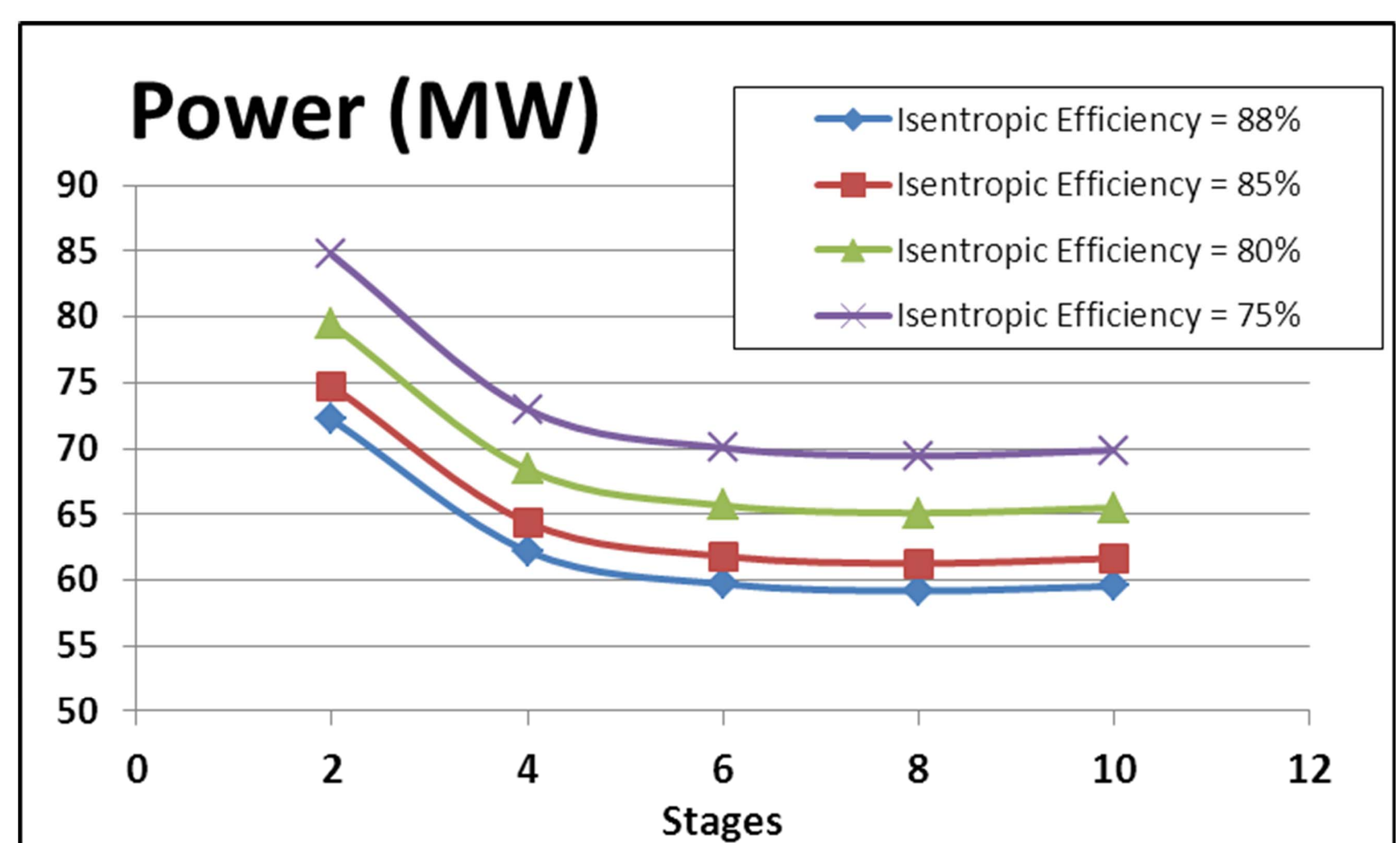
INLINE AND INTEGRALLY GEARED COMPRESSORS



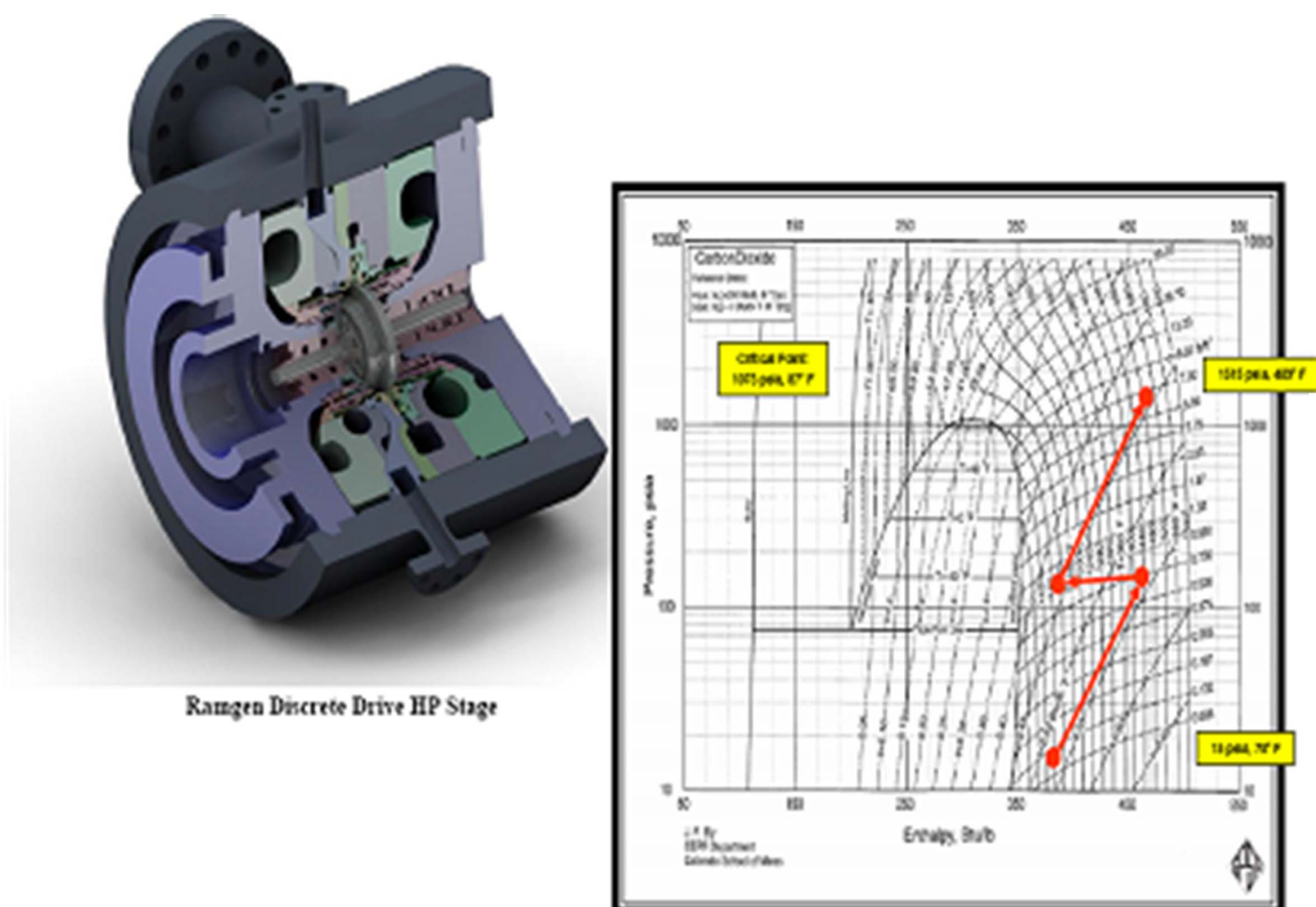
Number of Compression Stages



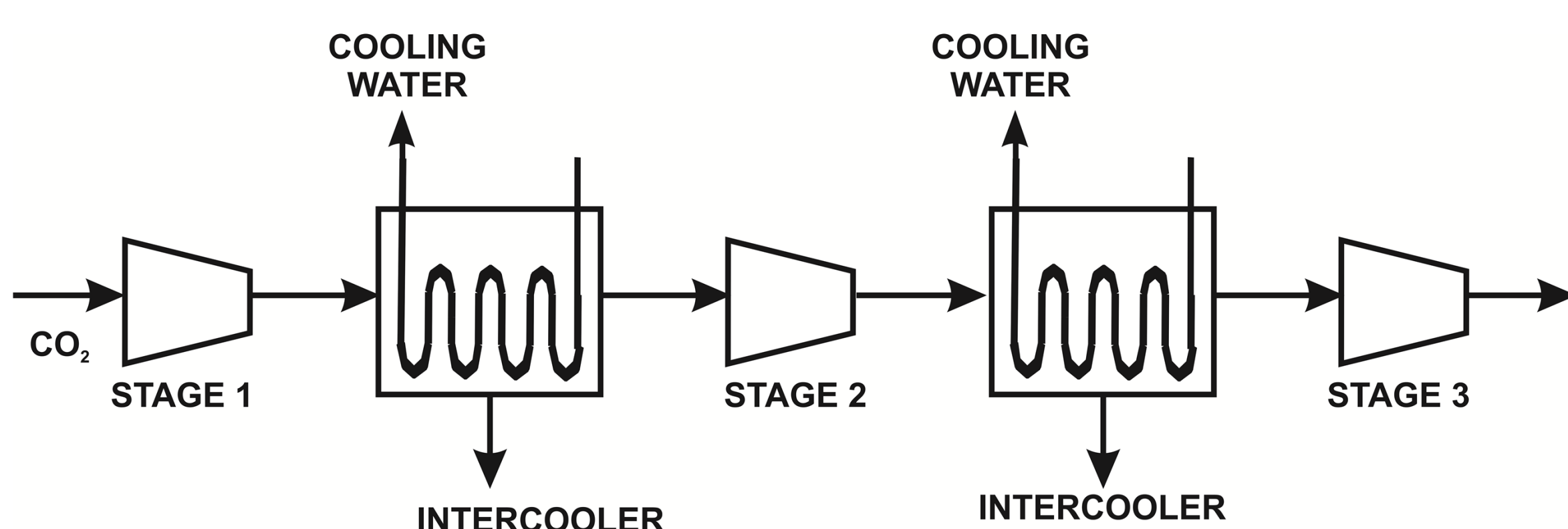
EFFECTS OF STAGE EFFICIENCY AND NUMBER OF STAGES: OXYCOMBUSTION



RAMGEN COMPRESSOR



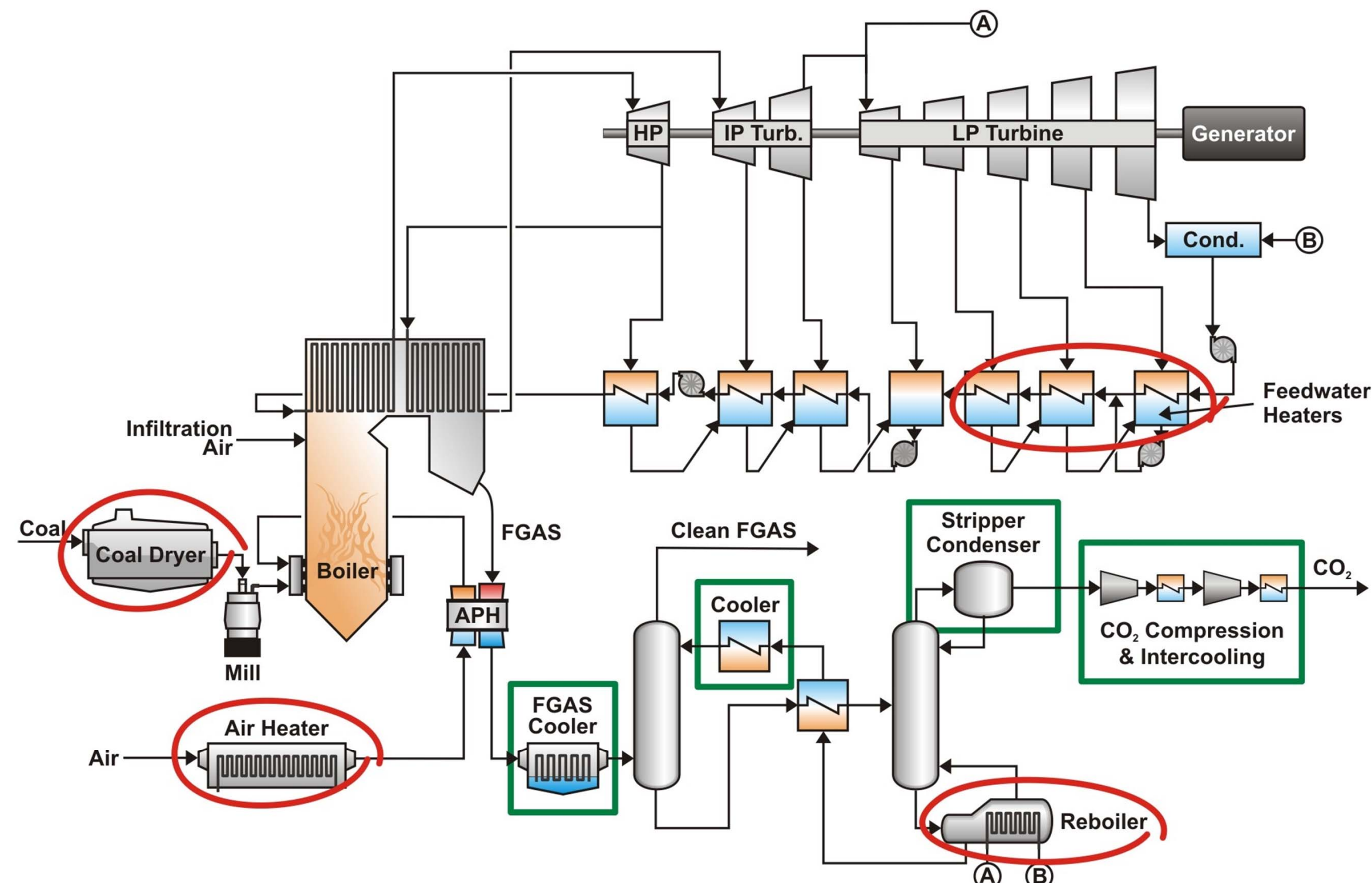
INTERCOOLING NEEDED BETWEEN STAGES



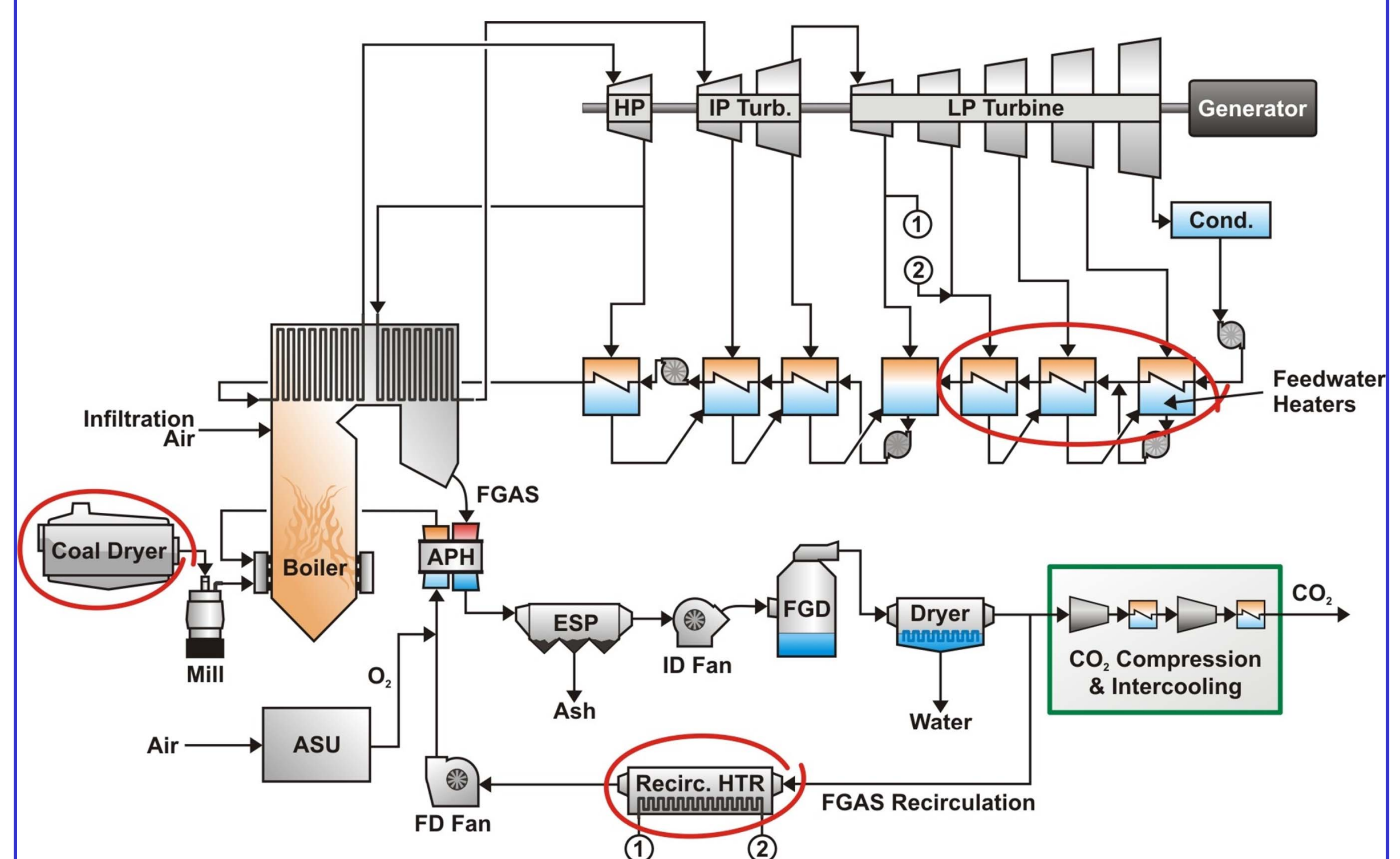
POWER PLANT SIMULATIONS

- Used ASPEN Plus to model a 600 MW supercritical pulverized coal steam power plant firing PRB coal
- Developed separate models for MEA and oxycombustion capture systems
- Included compressors and coolers into models

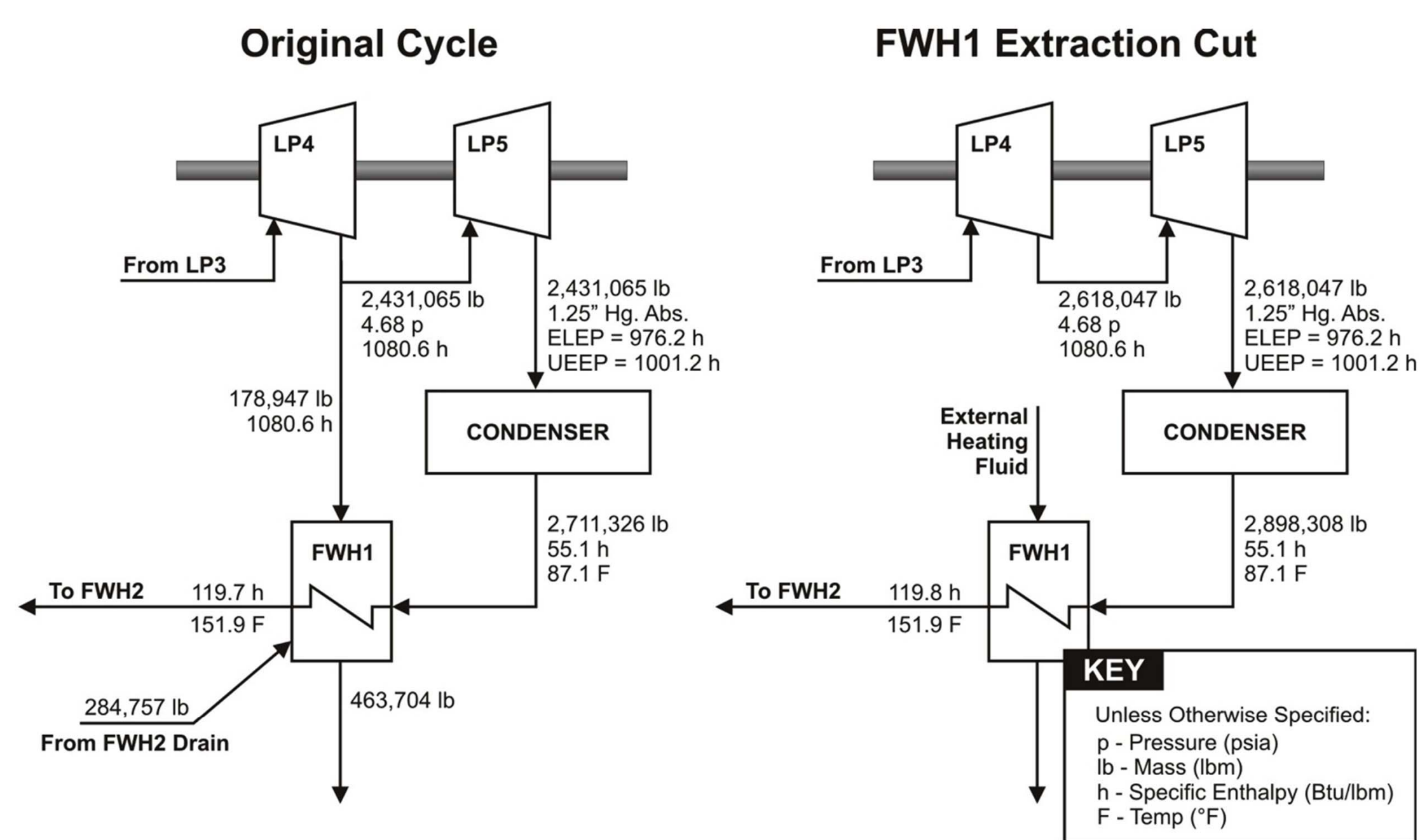
MEA POST-COMBUSTION CAPTURE



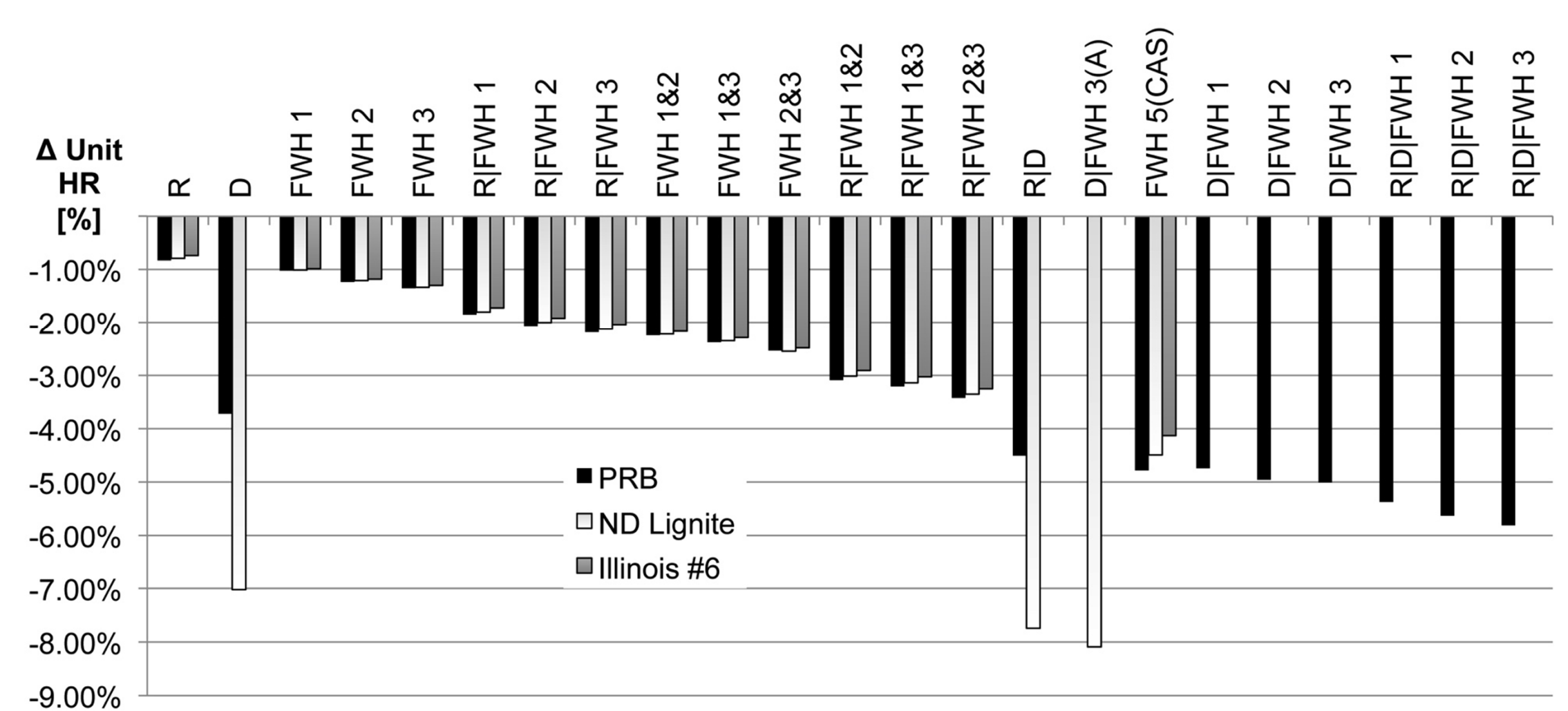
OXYCOMBUSTION



REPLACE FWH1



OXYCOMBUSTION – EFFECTS OF COAL TYPE AND HEAT SINK



COMPARISON OF OPTIONS: MEA POST COMBUSTION CAPTURE

PRB	7.43	FWH & Coal Drying
Lignite	10.45	FWH & Coal Drying
Illinois #6	3.59	FWH

COMPARISON OF OPTIONS: OXYCOMBUSTION CAPTURE

Coal	Recirculated Flue Gas	FWH	Coal Drying	Best Combined Case
PRB	0.83	1 to 4.78	3.72	5.81
ND Lignite	0.79	1 to 4.49	7.02	8.09
Illinois #6	0.74	1 to 4.13	-	4.13

HEAT RATE IMPROVEMENTS: MEA CAPTURE--PRB COAL

HEAT SOURCE	HEAT SINK	ΔHR (%)
Stripper Condenser	FWH 1-3	1.2
Compressor	FWH 1-3	2.08
Compressor	FWH 1-5	3.23
Compressor	FWH 4 or Reboiler	2.31
Compressor	FWH 4-5	2.51
Compressor & Stripper Condenser	FWH 1-5	3.90
Compressor & Stripper Condenser	Coal Dryer	3.74
Compressor & Stripper Condenser	FWH 1-5 + Coal Dryer	7.43

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