

What is the Future Role of New Coal?

Megan Parsons

Energy Development

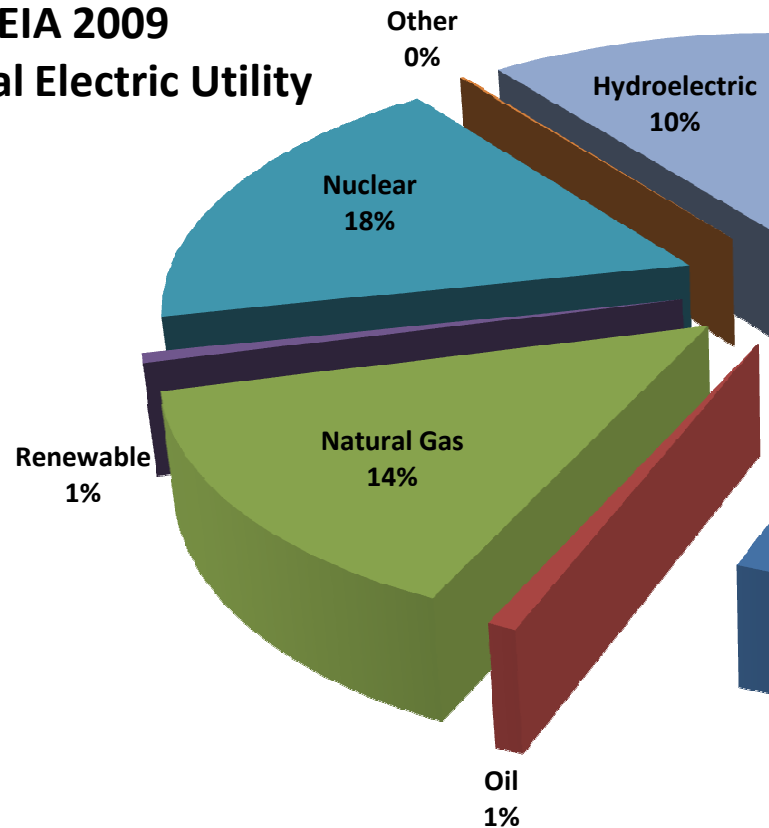
Burns & McDonnell Engineering

October 5th, 2010

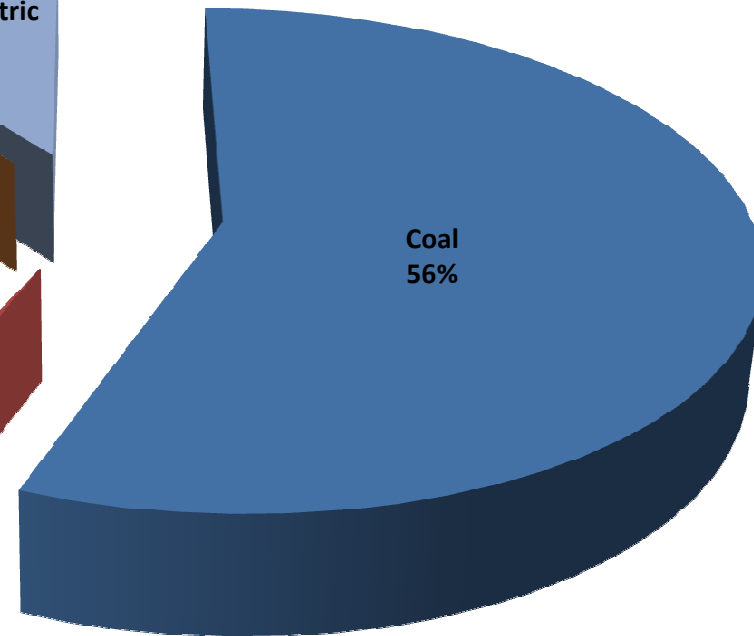
- Baseload Generation
 - Demand
 - Economics of New Generation
- Coal Conversion Technologies & Economics
- Future Concerns for Coal
 - Economics of CO₂ Tax
- Advanced Coal Technology
 - Supercritical & Ultra-supercritical

Utility Generation by Source

EIA 2009
National Electric Utility



Coal \approx 70 % Baseload Generation

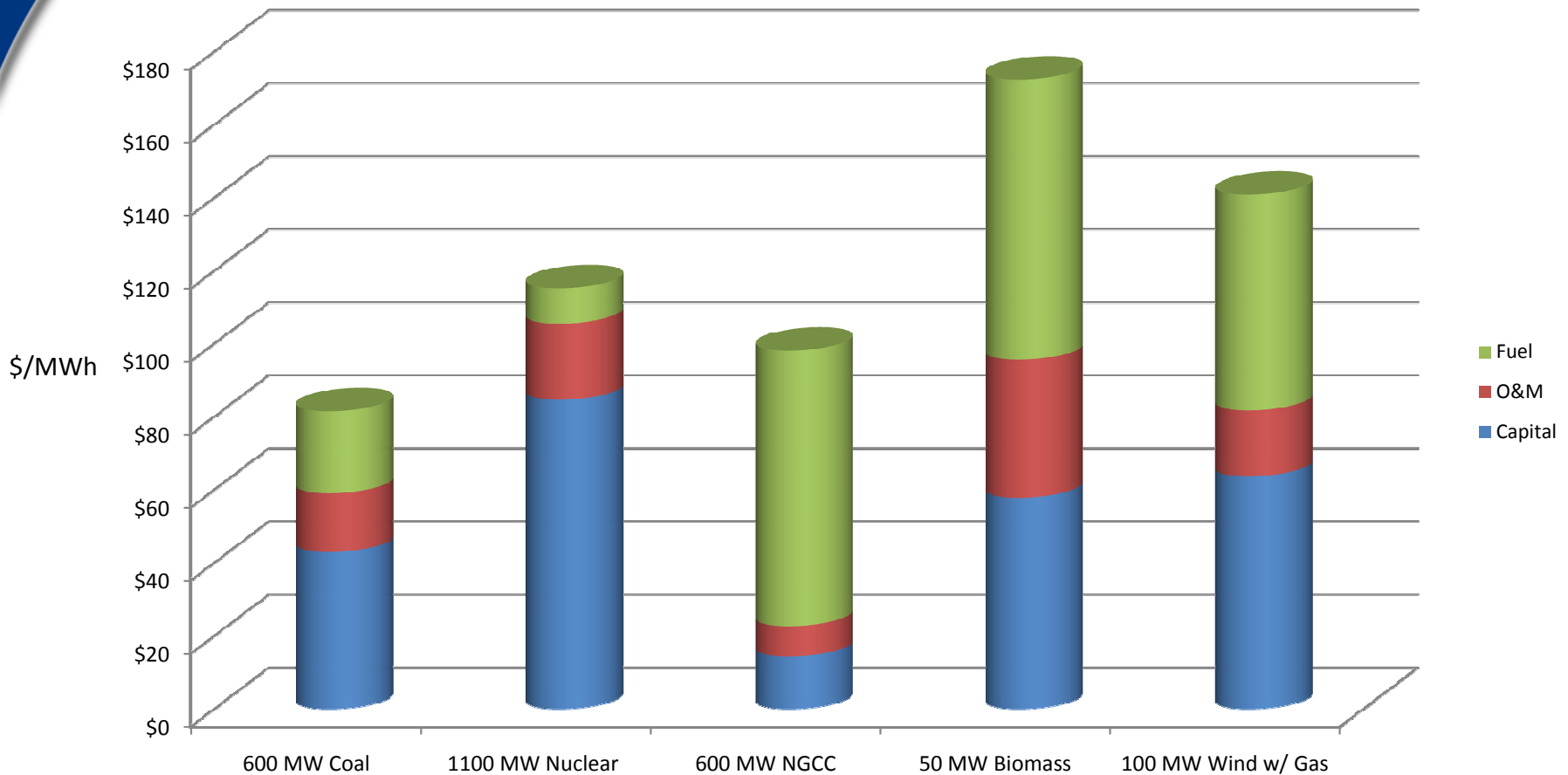


- Renewable generation represents wind, solar, biomass, MSW, and geothermal.
- Source: U.S. Energy Information Administration (EIA): Net Generation by Energy Source: Electric Utilities 2009

- Typical Baseload options considered:
 - Coal 600 MW - SCPC
 - Nuclear 1100 MW - ABWR
 - Natural Gas 600 MW - 2x1 7FA
 - Combined Cycle
 - Biomass 50 MW – BFB Wood
 - Wind w/ Natural Gas Backup 100 MW – Wind w/ Gas
 - Reciprocating Engines

Baseload Economics

30-year Levelized Busbar Cost (2017\$)

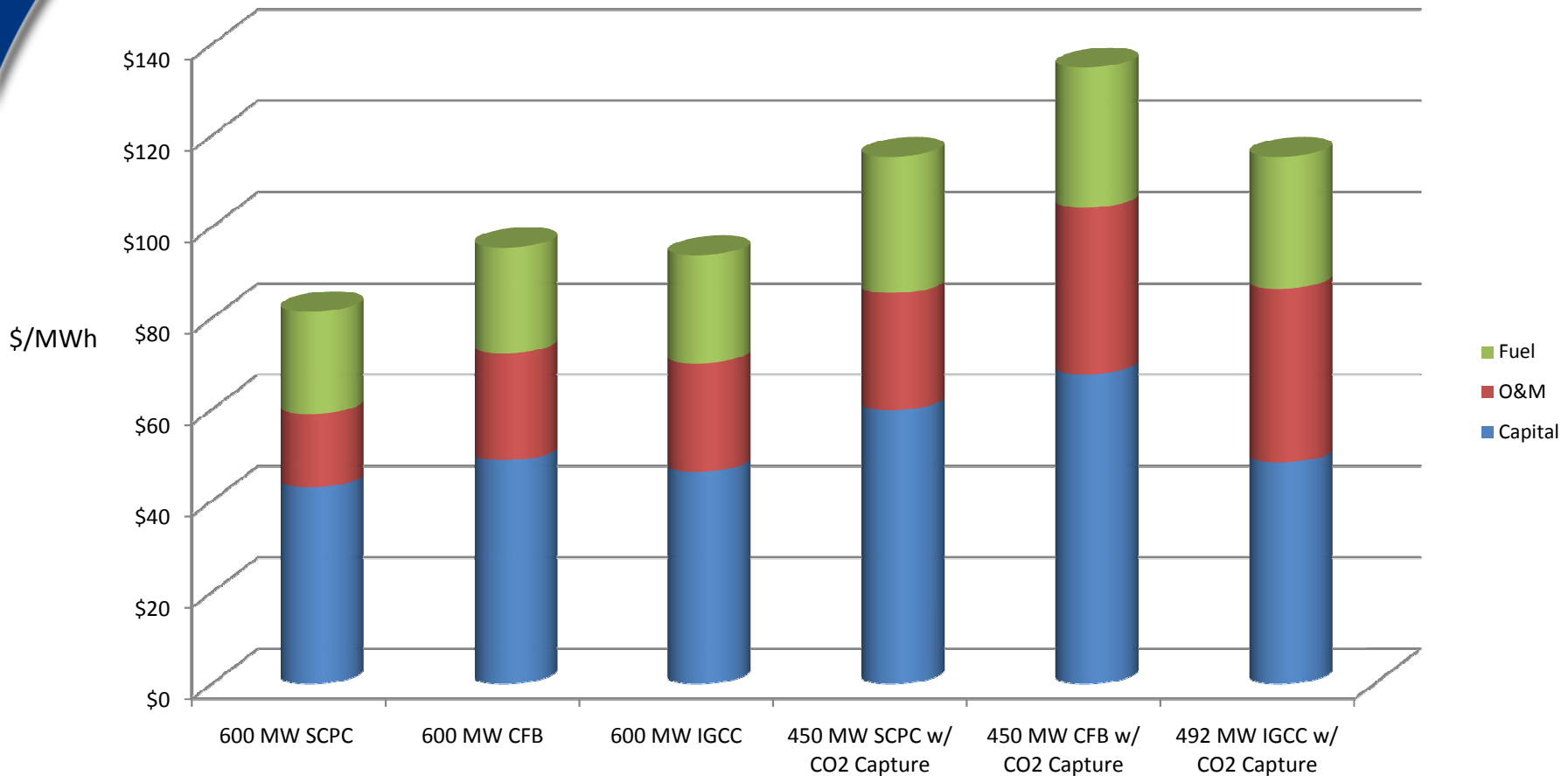


- Delivered fuel costs based on coal at \$2.00 / MMBtu, biomass at \$5/MMBtu and gas at \$5.25 / MMBtu (2010).
- Costs based on Burns & McDonnell's experience as an EPC contractor and publicly available information.

- Coal = Lowest \$/MWh
- Pulverized Coal (PC)
 - Low capital & operations
 - Proven, reliable
 - Advanced steam conditions
- Circulating Fluidized Bed (CFB)
 - Fuel flexibility
- Integrated Gasification Combined Cycle (IGCC)
 - Low emissions & least anticipated cost for CO₂ Capture



30-year Levelized Busbar Cost (2017\$)



- Fuel costs based on coal price of \$2.00 / MMBtu (2010).
- CO₂ capture equipment assumes 90% capture capability.
- Costs based on Burns & McDonnell's experience as an EPC contractor and publicly available information.

Moving Forward with PC

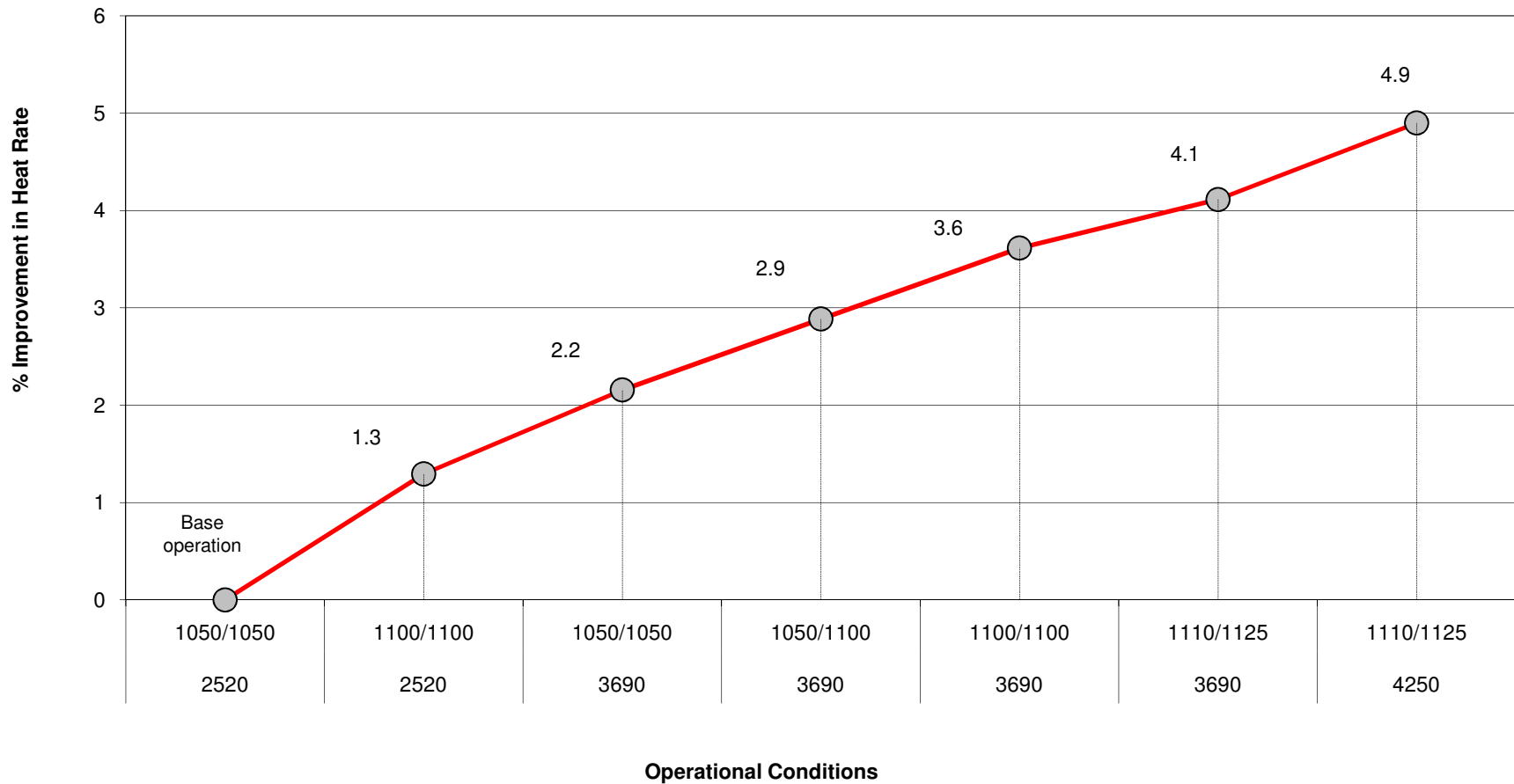
Historical

Subcritical
2500 psig 900°F - 1000°F
9,900 Btu/kWh
SNCR, ESP
Steam Drum Carbon Steel Tubes

Today and Tomorrow

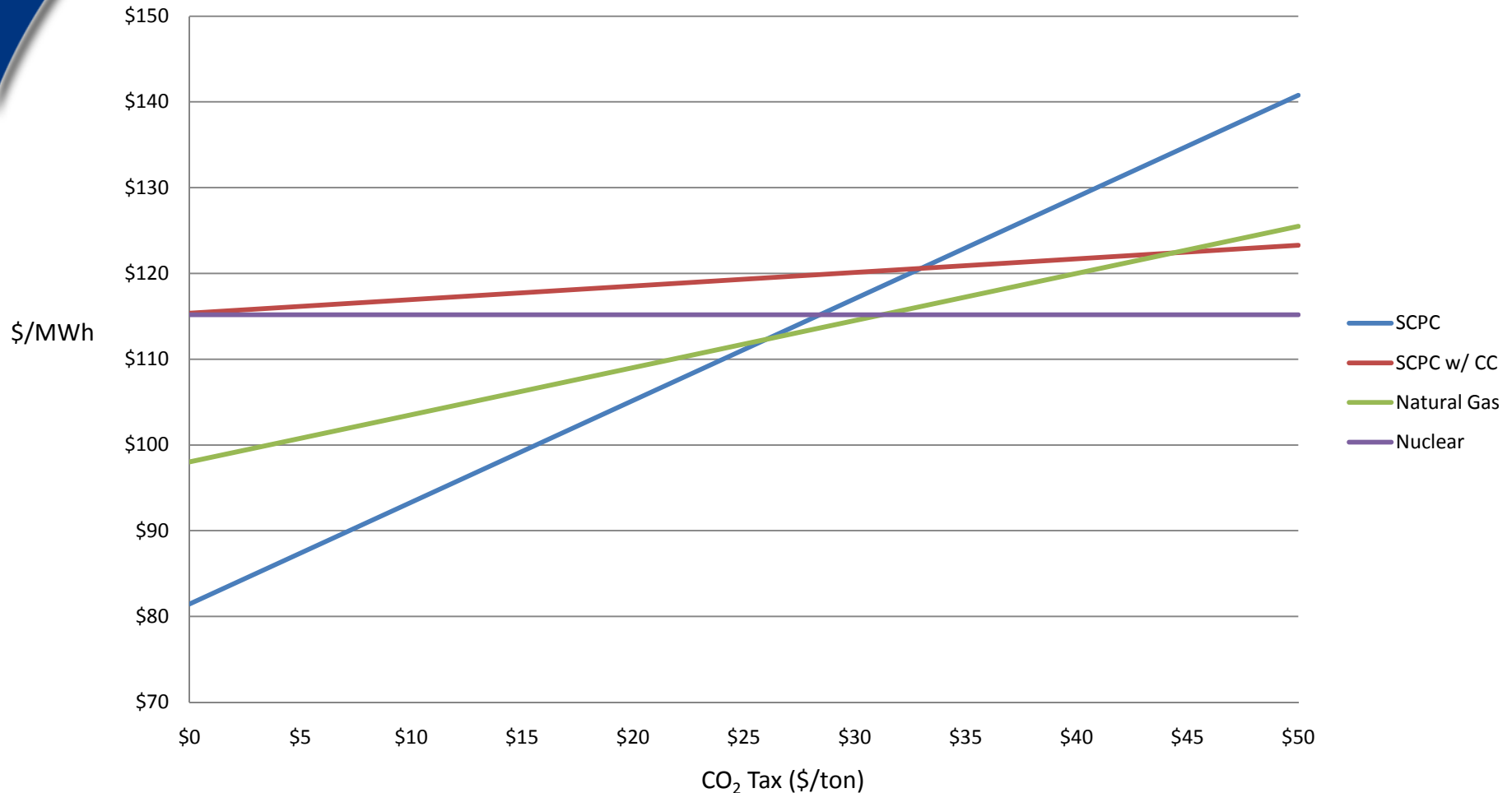
Supercritical	Ultra-Supercritical
3700 psig 1050 - 1100°F	4250 psig 1050 - 1125°F
8,800 Btu/kWh	8,700 Btu/kWh
SCR, WFGD, Baghouse, Acid Gas Sorbent	SCR, WFGD, Baghouse, Acid Gas Sorbent
SS Alloy Tubes	SS Alloy Tubes

PC Steam Cycle - Performance Comparison



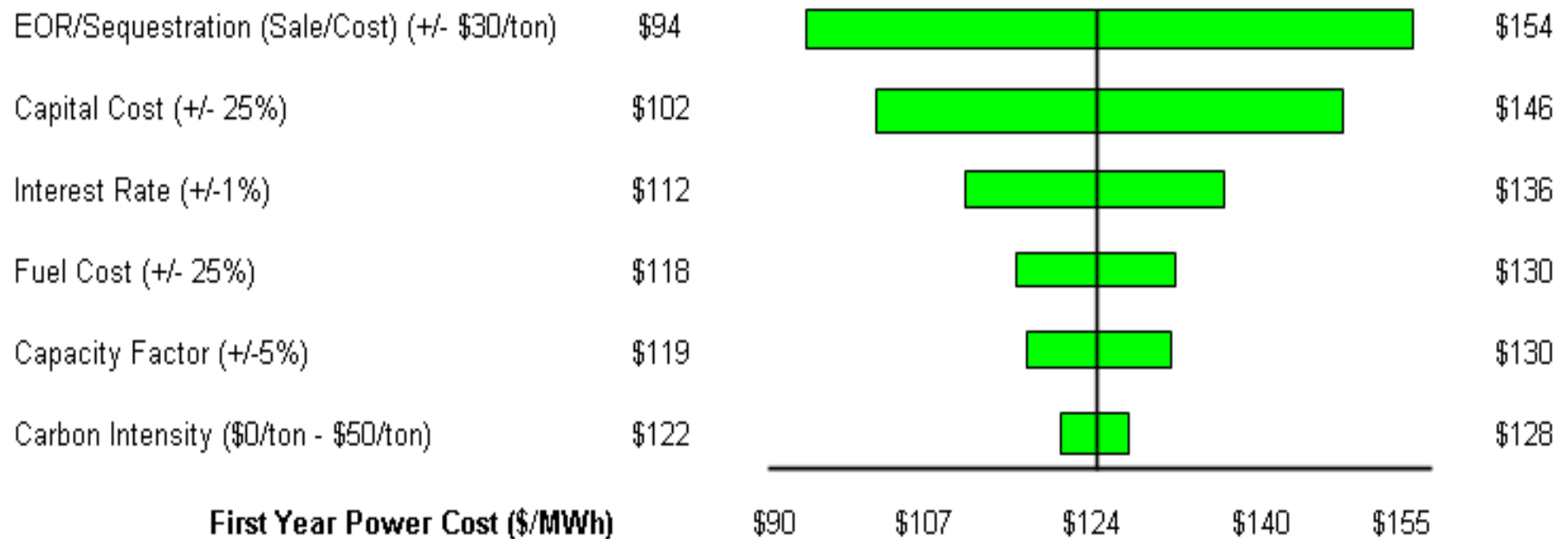
Where does Coal Play

30-year Levelized Busbar Cost vs Carbon Tax



- SCPC w/ CC assumes 90% carbon capture.
- CO₂ tax applied to 100% of uncontrolled carbon emissions.

PC Coal Costs are Sensitive!



- What is the future role of new coal?
 - Lowest \$/MWh baseload generation
 - PC is proven, efficient, “advanced” technology option
- Important to keep evolving good technology
- What about Carbon?
 - Currently coal is paralyzed.... tax? Cap and trade? BACT?

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