

# The Future of Coal

Megan Parsons

Energy Development

Burns & McDonnell Engineering

February 16<sup>th</sup>, 2010

Design, Construction, and Permitting Schedules require several years....

**....we need to think ahead!**

## Drivers

- 10-15% Demand Growth by 2020
- Many old coal units being retired

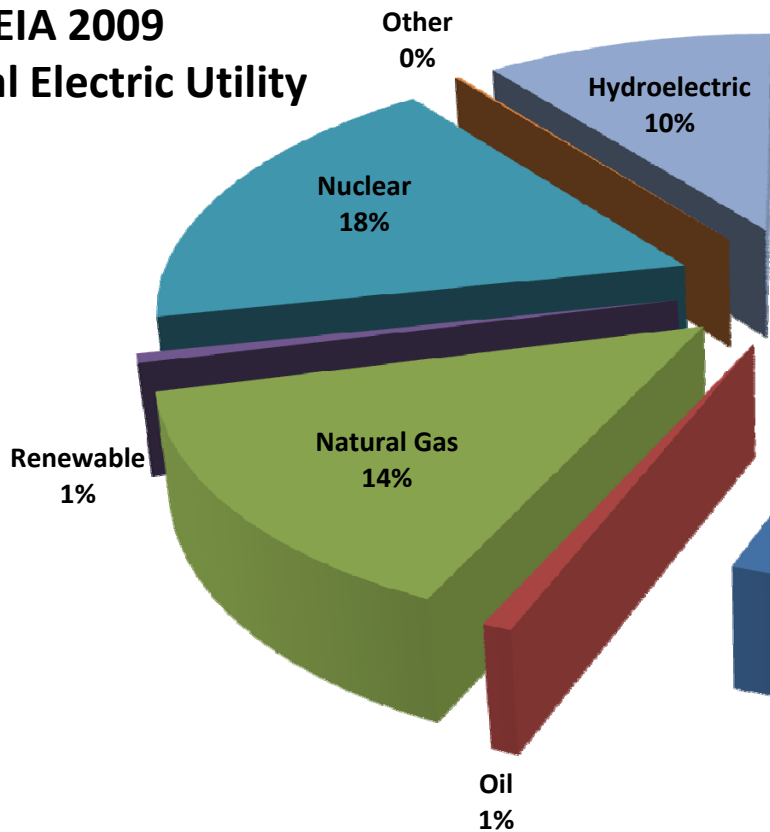
## Difficulties

- Environmental Policy?
- Fuel Costs?

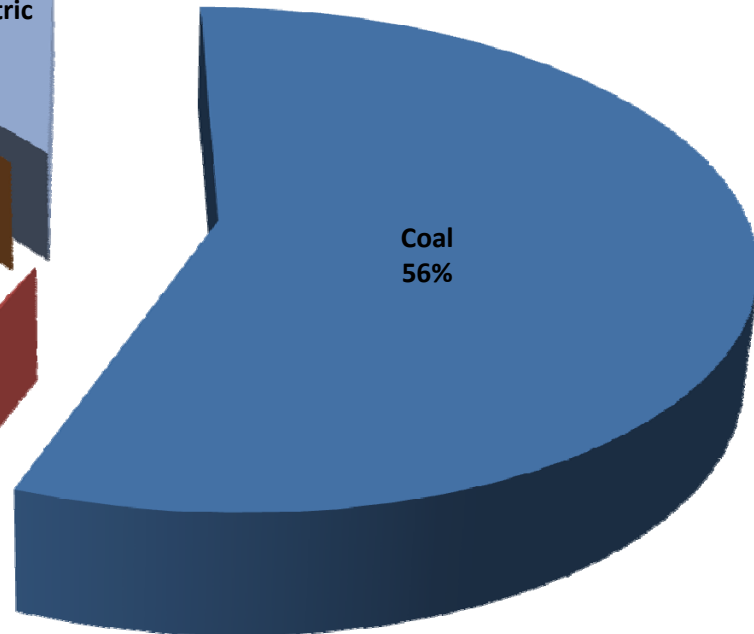


# Current Baseload Generation Resources

**EIA 2009  
National Electric Utility**



**Coal ≈ 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

# What Options are There?

## Typical Baseload options considered today:

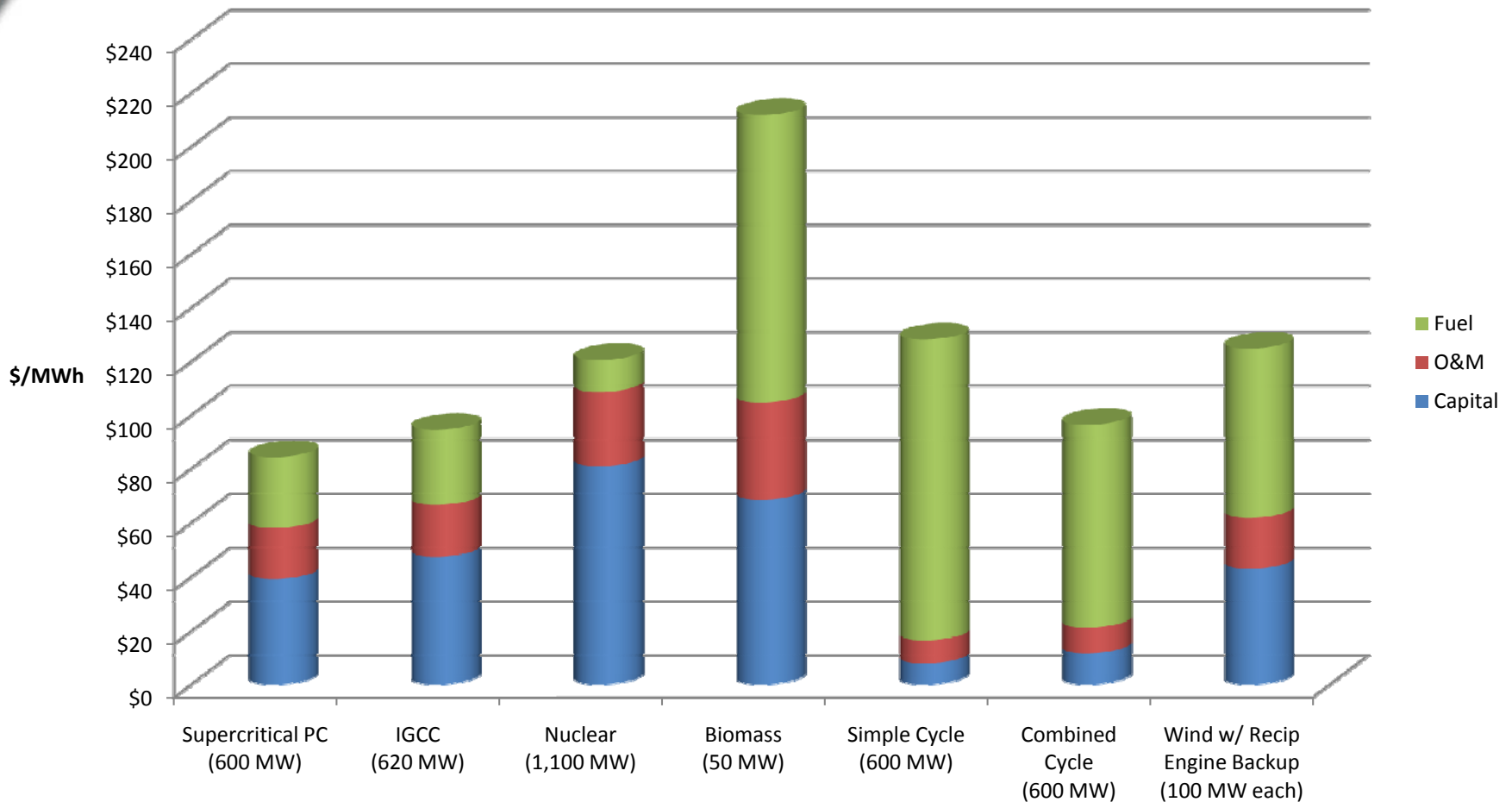
- Advanced Coal 600 MW
- Nuclear 1100 MW
- Natural Gas Combined Cycle 600 MW
- Woody Biomass 50 MW
- Wind w/ Natural Gas Backup 100 MW
  - 2.5 MW Wind Turbines w/ Reciprocating Engines



- Electric Demand
  - Load growth, energy efficiency
- Fuel
  - Supply/Demand, forecasts, transportation, markets
- Capital and Operating Costs
  - Inflation, technology development
- Emissions Costs
- Power Market
- Regulatory Impact
- Etc...

# Baseload Generation Costs

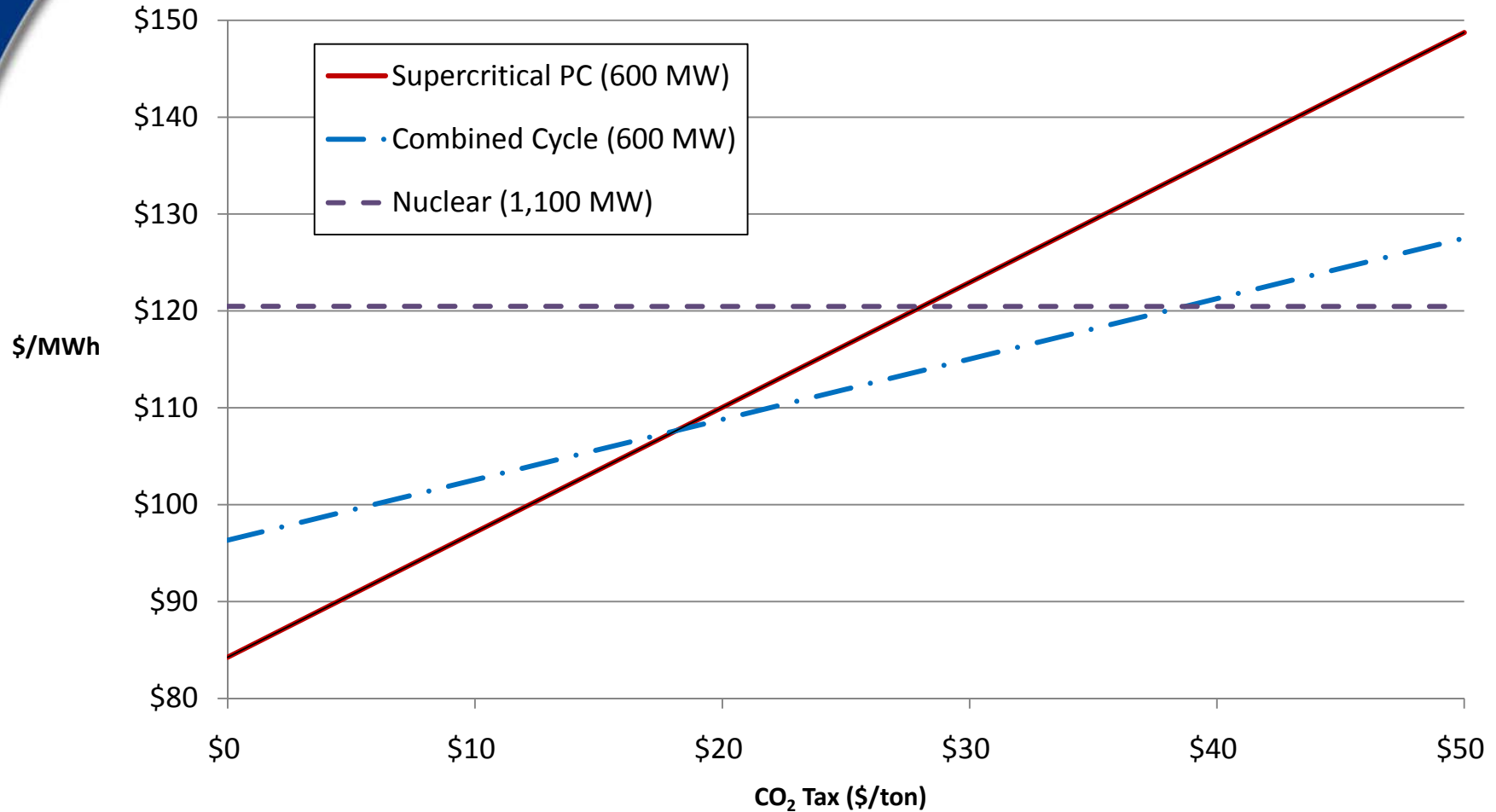
## 30-year Levelized Busbar Cost (2017\$)



- Delivered fuel costs based on coal at \$2.31 /MMBtu, biomass at \$5.80/MMBtu and gas at \$7.32 /MMBtu (2017).
- Costs based on Burns & McDonnell's experience as an EPC contractor and publicly available information.

# The Carbon Impact

## 30-year Levelized Busbar Cost vs Carbon Tax



- CO<sub>2</sub> tax applied to 90% of uncontrolled carbon emissions.

# What are our COAL Options?

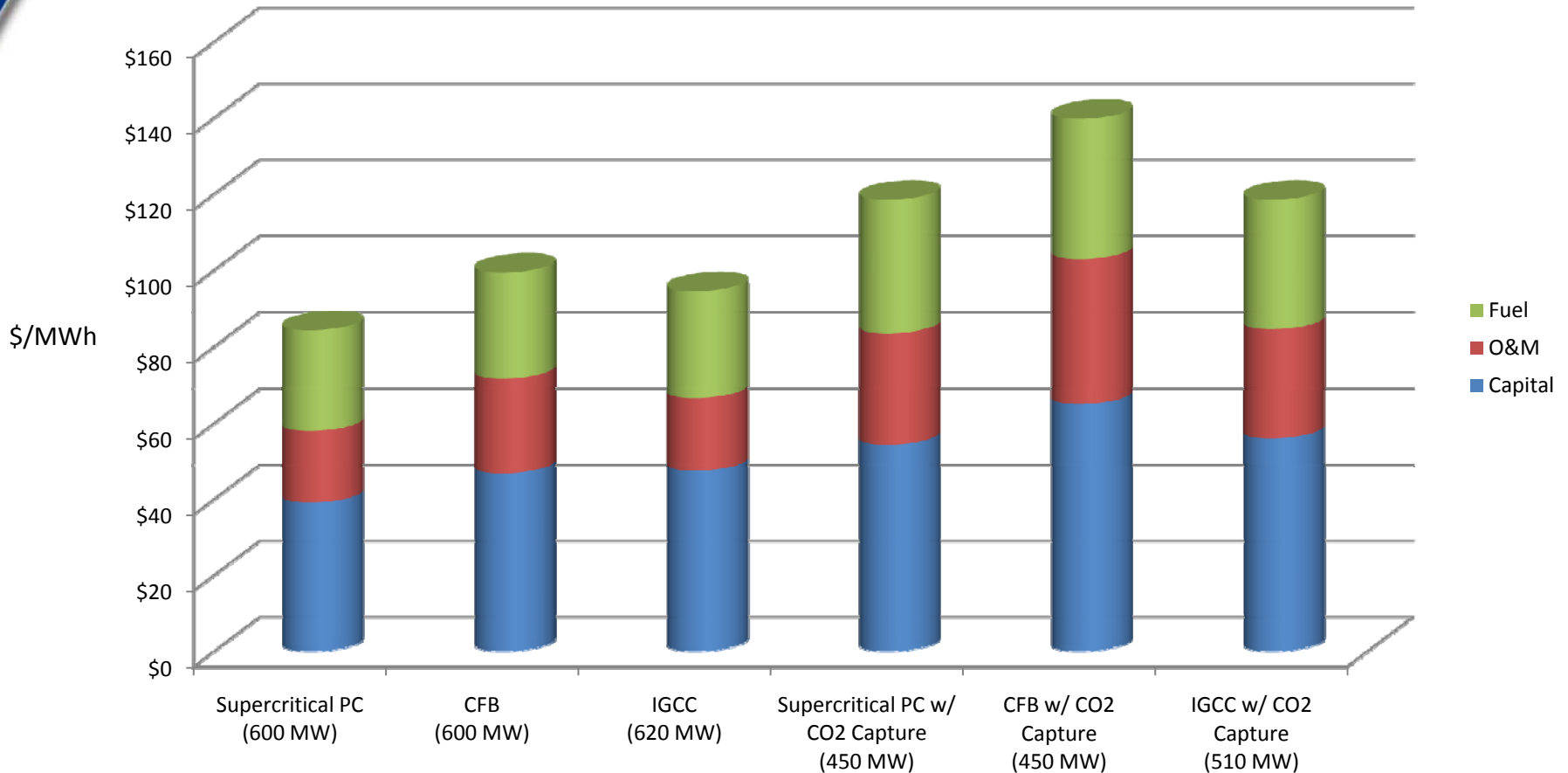
- Pulverized Coal (PC)
  - Low capital & operations
  - Proven, reliable
  - Advanced steam conditions
- Circulating Fluidized Bed (CFB)
  - Fuel flexibility, 100% pet coke and biomass blends
  - Units ~400 MW and smaller
- Integrated Gasification Combined Cycle (IGCC)
  - Flexibility – Coal to Gas or Power
  - Low emissions & least anticipated cost for CO2 Capture





# Coal Generation Costs

## 30-year Levelized Busbar Cost (2017\$)



- Coal costs based on coal price of \$2.31 / MMBtu (2017).
- CO<sub>2</sub> capture equipment assumes 90% capture capability.
- Costs based on Burns & McDonnell's experience as an EPC contractor and publicly available information.

## Historical

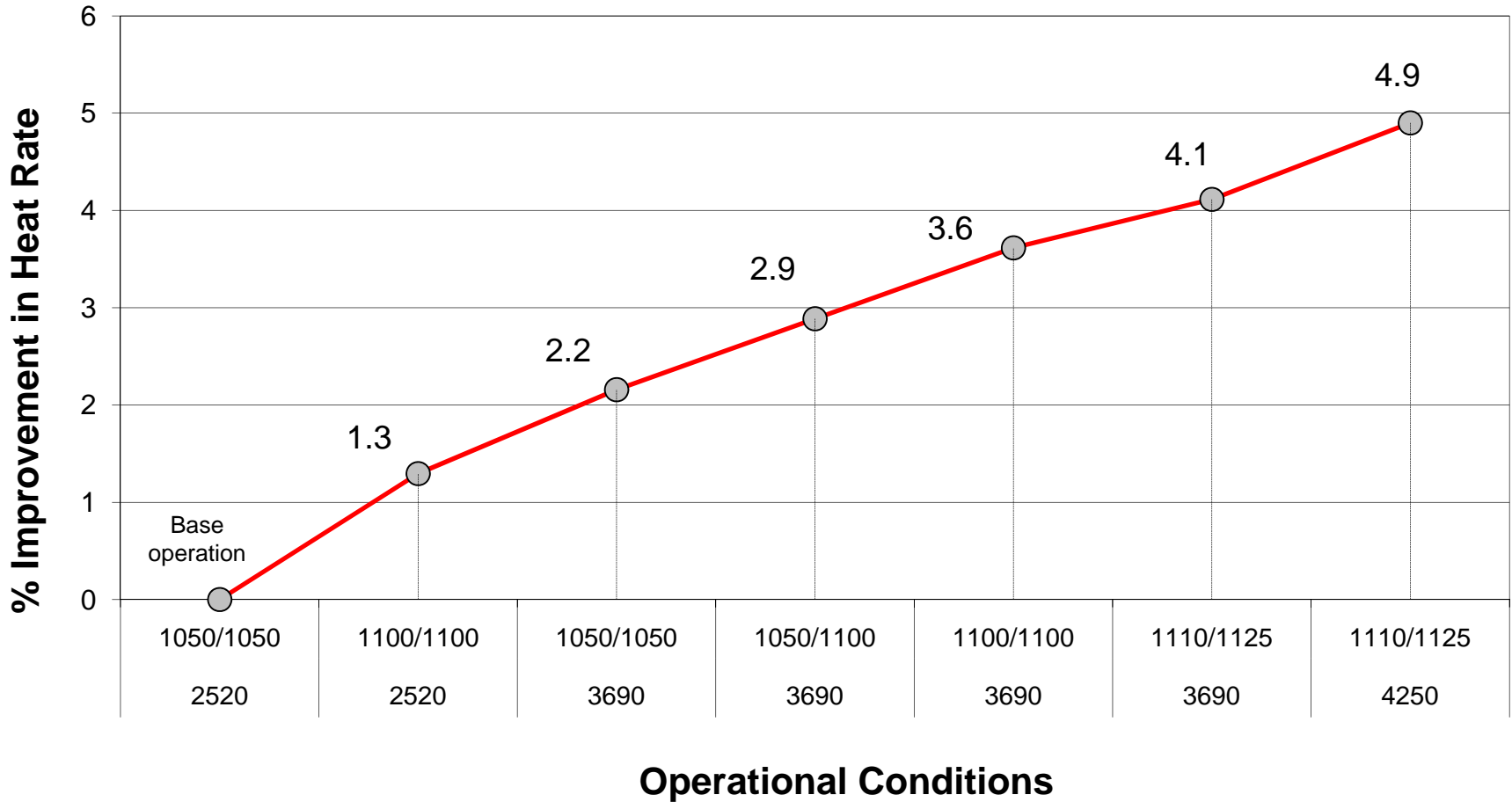
Subcritical
2500 psig 900°F - 1000°F
9,900 Btu/kWh
SNCR, ESP
Steam Drum Carbon Steel Tubes

## 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

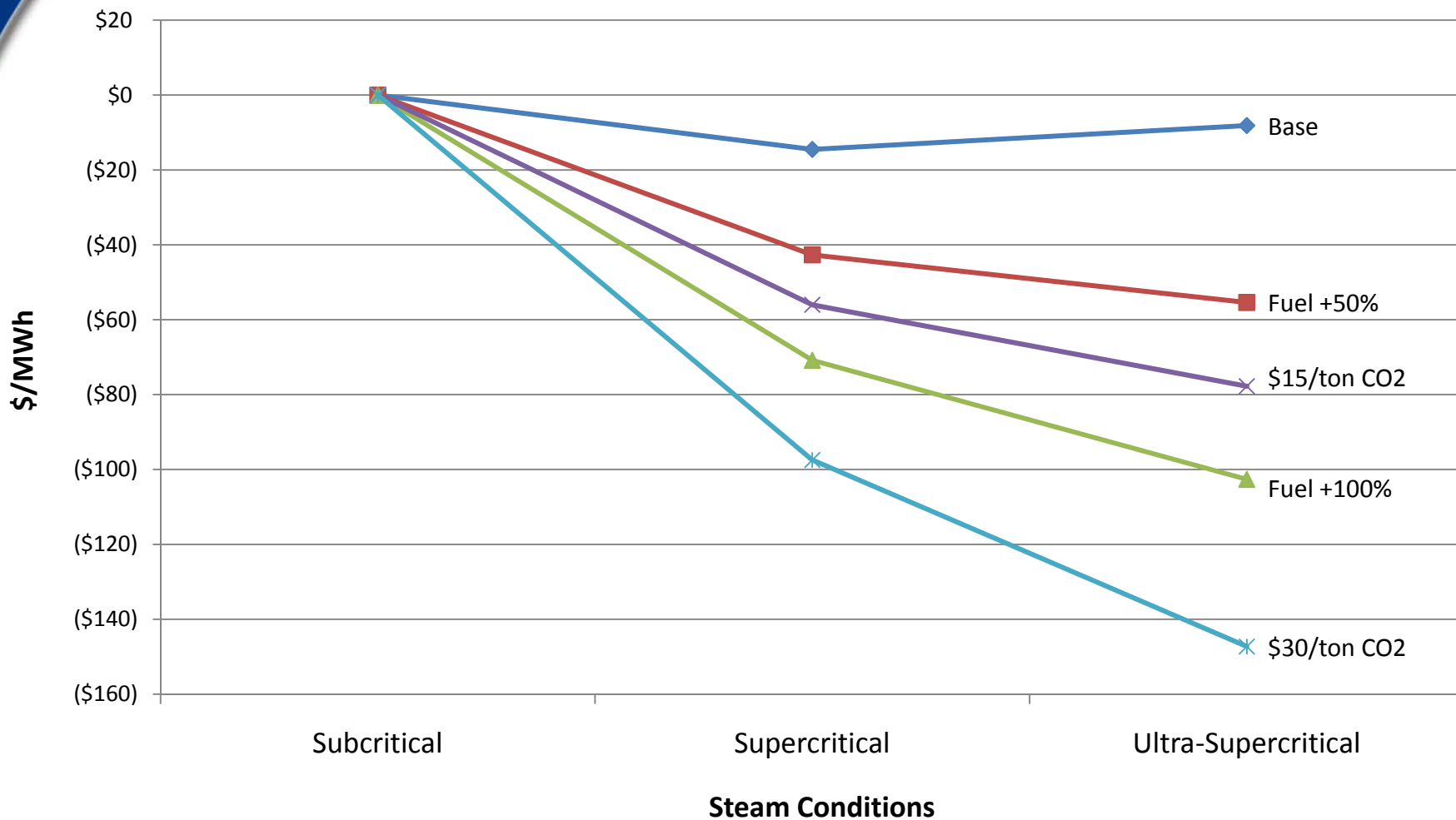
# Pulverized Coal Technology

**PC Steam Cycle - Performance Comparison**



# PC Coal Costs are Sensitive!

## PC Steam Conditions Sensitivity Analysis



- Coal is a major part of our generation mix
- Pulverized Coal is low cost, proven, stable technology
- Coal technology continues to advance in efficiency
- Coal development is stalled by undecided environmental policy

## **Megan Parsons, PE**

Development Engineer, Energy Division

Burns & McDonnell

Direct: 816-823-7101

Main: 816-333-9400

Fax: 816-333-3690

Email: [mparsons@burnmcd.com](mailto:mparsons@burnmcd.com)

Website: [www.burnsmcd.com](http://www.burnsmcd.com)