Reducing CO_2 Emissions from Fossil Fuel Power Plants

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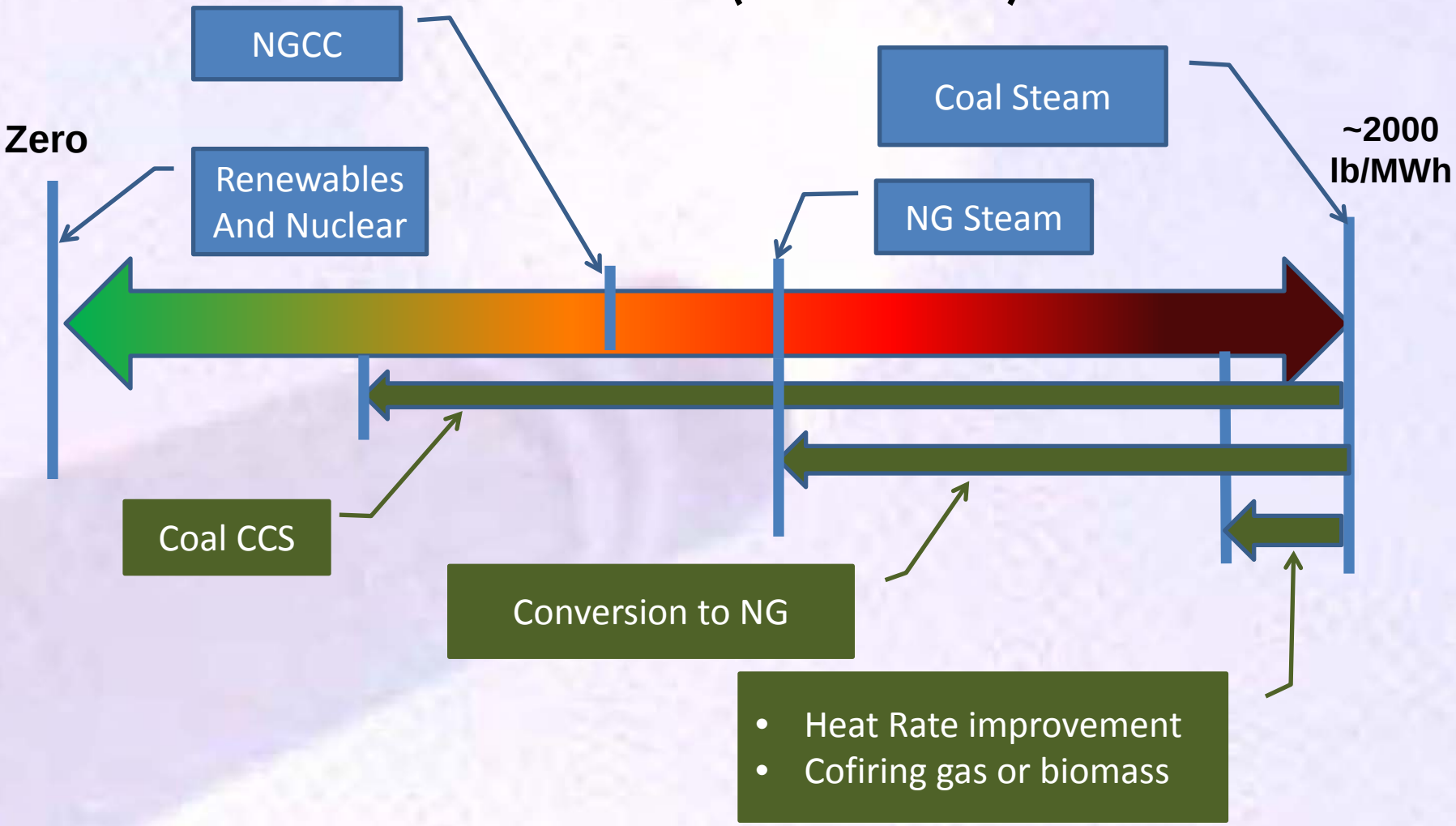
Typical CO_2 Emissions by Fuel and Cycle -Power Plants

Technology	CO_2, short tons/MWhr
Coal (Subcritical)	~1 .0 +
Coal (Supercritical)	~0.89
Coal (UltraSupercritical)	~0.78
Natural Gas Boiler (Subcritical)	~0.55-0.60
Natural Gas Combined Cycle	~0.40-0.50
Biomass	0 - ??
Wind/PV/Nuclear	0

Spectrum of Approximate Power Plant CO_2 Emissions (lbs/MWh)



Reducing CO_2 Emissions from Existing Coal

- **Heat Rate Improvement**
  - Improving boiler efficiency
  - Improving steam plant efficiency
  - Reducing auxiliary loads
- **Less Carbon-Intensive Fuels**
  - Gas co-firing or reburn
  - Gas conversion
  - Cofiring of biomass or biomass conversion/repower
- **CCS**
  - Unlikely to play a significant role

Potential Approaches for HR Improvement

- Coal Drying (esp., lignite coals)
- Variable Speed Drives
- Centrifugal to Axial fan conversion
- Steam turbine modifications
- Intelligent soot-blowing system
- New APH seals
- Repair boiler casing and duct in-leakage
- Condenser cleaning

Questions on Heat Rate Improvement

- Will a HR improvement provide a positive return?
- What is the current condition of the unit?
  - For some units may be little opportunity for further improvement
- What is the planning horizon?
- NSR trigger?
- What is the economic environment?
  - merchant versus utility
  - investor owned versus co-op versus government owned
  - local market dynamics for power
  - company budget constraints

Gas Conversion/Cofiring/Reburn

- **Conversion** (convert to 100% gas)
  - Being pursued by several utilities
  - Capital cost ~$80/kW (with gas on site)
- **Cofiring/Reburning** (10-15% gas)
  - Modest cost (somewhat higher for reburn), assuming gas is on site
  - Reburning may allow for additional NOx reduction

Biomass

- **Co-firing ***
  - Pulverized Coal ~$500-600/kW
  - Cyclone ~$300-400/kW
- **Repower**
  - PC to biomass fired CFB
    - (50 MW Schiller) $1600-1700/kW**

* Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722 and escalated to 2012 dollars
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Improving HR for Gas Turbines

- Compressor inlet modifications (guide vanes, etc.)
- Inlet Air Cooling
- Combustor upgrades
- Hot section coatings
- New seals

Recap

- Most likely options for existing coal to reduce CO_2 emissions are heat rate improvement or lower carbon fuel
  - No “one size fits all” solution
  - Best choice determined by several factors
  - CCS not expected to play a significant role
- Options for HR improvement exist for gas turbines as well
  - May also increase power output
- Methods that are low in capital and offer optionality will be preferred.