Technology Considerations for Coal-to-Natural Gas Conversions

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Electric Power Research Institute

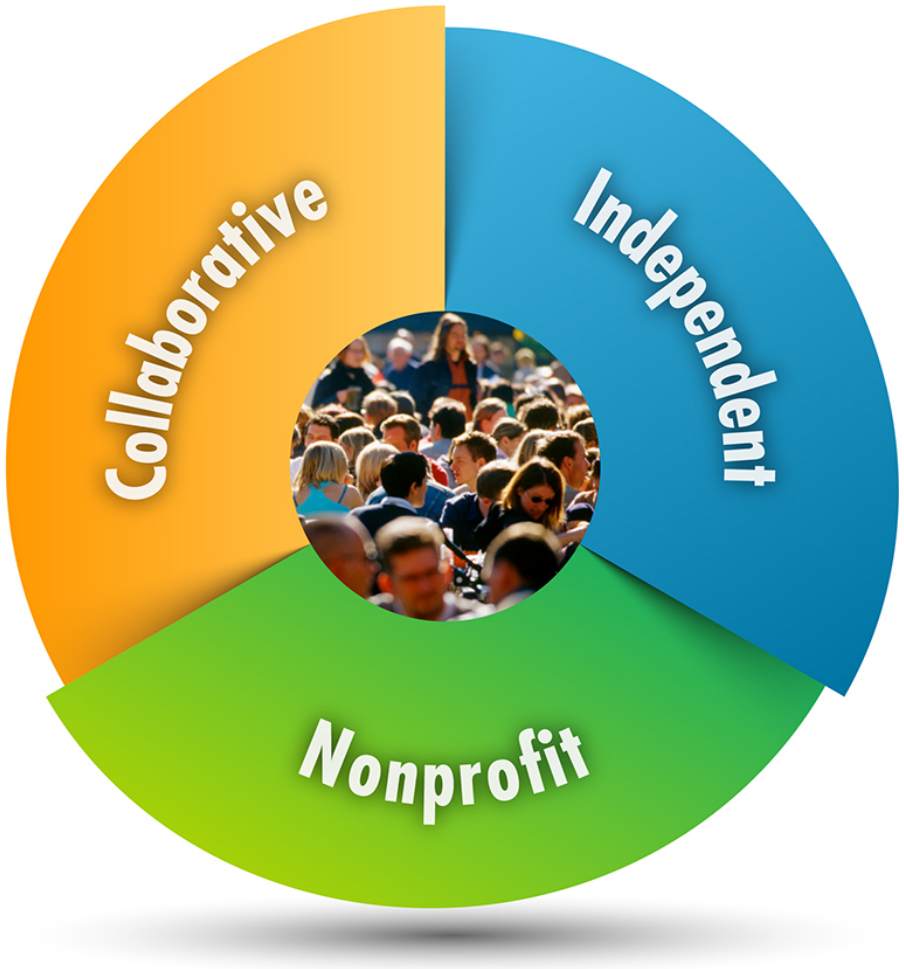
EPRI Mission

Advancing ***safe***, ***reliable***, ***affordable*** and ***environmentally responsible*** electricity for society through global collaboration, thought leadership and science & technology innovation

EPRI Strategic Direction

Innovative solutions that enable the transformation to more ***flexible***, ***resilient*** and ***connected*** power systems

Three Key Aspects of EPRI



Independent

Objective, scientifically based results address reliability, efficiency, affordability, health, safety, and the environment

Nonprofit

Chartered to serve the public benefit

Collaborative

Bring together scientists, engineers, academic researchers, and industry experts

What is coal-to-gas conversion?

- Modifications to an electric generating station to introduce natural gas-firing capability to a boiler previously designed to operate on coal
- This can include:
  - Switch to operating only on natural gas (conversion)
  - Ability to fire either coal or natural gas (dual fuel)
  - Ability to fire both coal and natural gas at the same time (co-firing)

Coal-to-gas conversions are considered for a number of reasons

- Environmental regulation compliance
  - Clean Air Act in 1990s
  - Mercury and Air Toxics Standards (MATS) in 2010s
- Low natural gas prices
- Plant cycling and minimum load capabilities

Several technical and economic factors need to be considered when evaluating coal-to-gas conversions

- Plant performance impacts
- Equipment modifications and upgrades
- Access to gas supplies
- Emission benefits and impacts
- Conversion, operational, and fuel costs

No two boilers are exactly the same. A detailed, site specific engineering analysis is required to determine technical performance impacts and viability of undertaking a fuel switch.

Firing natural gas in a coal boiler has a range of impacts on plant performance

- Decreased boiler efficiency
- Changes in boiler heat transfer temperature profile
  - Lower furnace heat absorption
  - Higher furnace exit gas temperature
  - Reduction/elimination of slagging and fouling conditions
- Reduced auxiliary power requirements

A boiler feasibility study should be conducted to verify proper heat absorption rates and tube and steam temperatures.

Changes in heat transfer characteristics typically require modifications in heat transfer surfaces or plant operation

- Upgrade heat transfer surface materials for higher combustion temperatures and change in heat absorption
- Derate plant output to reduce flue gas and tube metal temperatures in the furnace and convection pass
- Increase attemperator spray flow for steam temperature control

Converting a boiler to natural gas requires modifying existing and adding new equipment

- Installation of new natural gas igniters, scanners, cooling air, and associated equipment
- Addition of on-site natural gas piping, valves, and control stations
- Modifications to burner management and combustion control systems
- Pressure-part modification through the convection pass as needed
- Layup of coal/ash handling equipment, baghouse, etc. for plants without dual firing/co-firing

Most converted coal plants will require new access to natural gas supply

- Proximity to existing natural gas pipelines will significantly affect economics
- New pipeline lateral costs are affected by right-of-way costs depending on the area (rural versus residential) and obstructions (highway, bridges, rivers, railroads, etc.) of the proposed pipeline route
- Extensive permitting process must be completed with many different organizations and government agencies

Plant owners will also need to consider economics of fixed versus interruptible supply contracts

Emissions impacts are typically favorable for natural gas conversion plants and can be mitigated when they are not

- Reductions in SO_2, particulate matter, and CO_2 emissions are expected due to fuel properties
- Proper burner design and good combustion practices can minimize NOx, CO, and VOC emissions
- Use of low-NOx burners and/or flue gas recirculation can further lower NOx emissions
- If necessary, installation of CO catalyst can also be implemented

The effect of conversion on emissions will need to be evaluated to determine whether a gas conversion project will trigger new source review (NSR) or new source performance standards (NSPS) requirements.

Cost considerations for plant conversions include capital, operational, and fuel costs

- Scope of the conversion will determine the installation and additional maintenance costs
- Annual non-fuel O&M costs for an existing coal-fired plant will be lower with gas firing
- Projected fuel costs over the expected remaining life of the plant are usually the largest contributors
- Changes in the variable production cost can affect the merit order dispatch in the system and the plant capacity factor

While in some regions, gas can be justified based on fuel cost alone, typically a combination of costs, availability, and emissions requirements will determine the viability of a particular gas conversion project

Key Takeaways

- Even with today's low natural gas prices, the decision to convert from coal to gas depends on many factors:
  - Current and future regulatory environment
  - Impacts on plant performance
  - Access to gas supplies
  - Emission benefits and impacts
  - Conversion, operational, and fuel costs
- No two plants are exactly the same – detailed analysis is needed to determine the impacts and viability of conversion

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