# Worldwide Pollution Control Association

## Gulf Power Coal to Gas Seminar

## May 30-31, 2012




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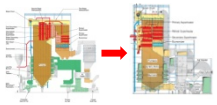
# *Coal to Gas Conversion*

## *B&W Boilers*

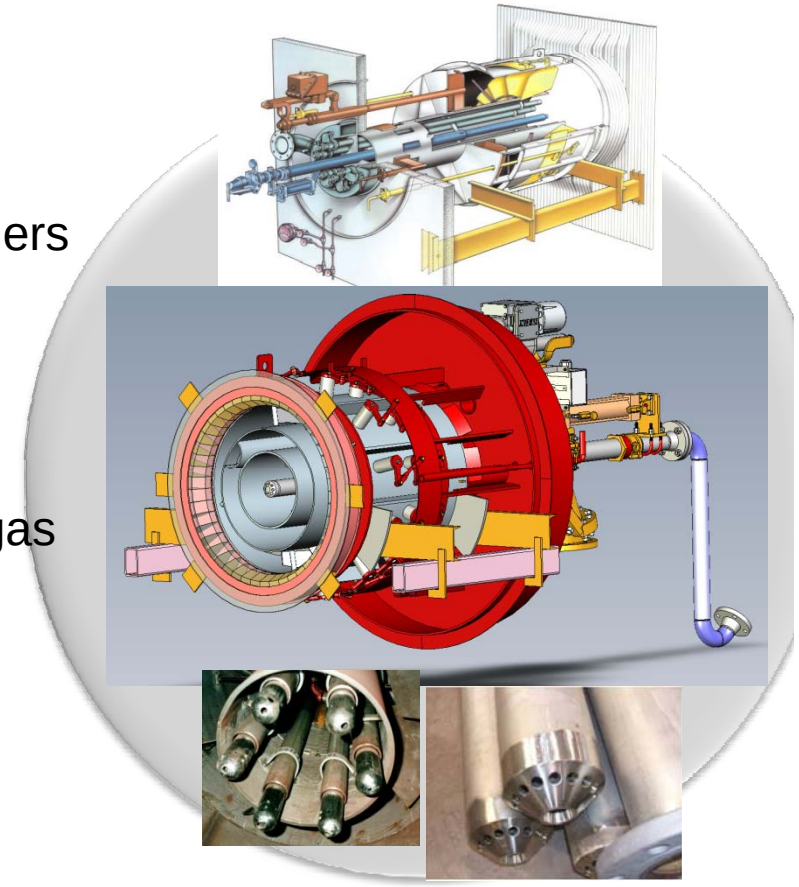


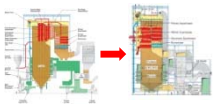
Don Ryan
Division Mgr, BWSC Engineering

# *Coal to NG Conversion Burner Options*

For coal fired boilers there are four approaches depending on the owner's objectives

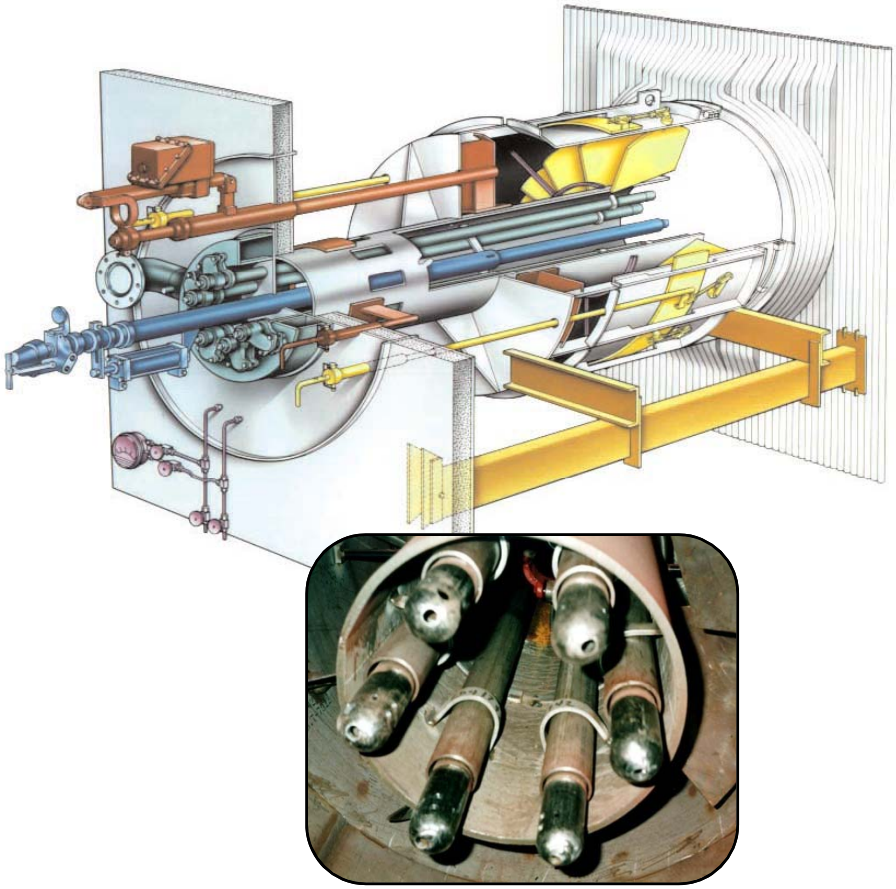
1. Completely abandon coal – Replace all burners with new gas burners
2. Retain ability to fire coal – Coal nozzle replacement only with gas elements
3. Retain ability to fire coal – PC burners with gas elements
4. Continue to fire coal – Partial burner replacement/modification





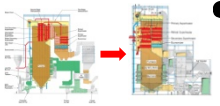
# *Coal to NG Conversion*
# *Approach 1 – Abandon Coal – Complete Retrofit*

- Complete Burner replacement with new gas only burners
- Adjust SH surface (if necessary) to reduce spray flows
- Adjust RH surface (if necessary) to maintain temperature
- Possibly adjust Economizer surface.



**Highest cost & longest outage time**

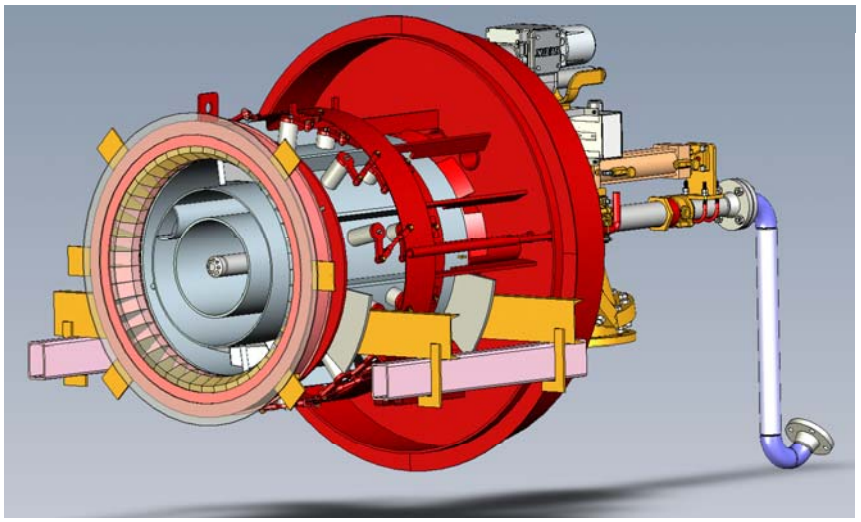
**Allows for best combustion and boiler performance**

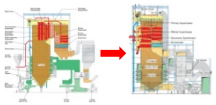


# *Coal to NG Conversion*
# *Approach 2 – Continue Coal – Coal Nozzle Replacement*

Where a unit is already equipped with PC burners, a replacement coal nozzle can be supplied incorporating a gas element

- Lower cost & shorter outage time
- Performance compromises
- Can modify all or some burners
- Pressure part metallurgy must be reviewed
- <u>Provides a hedge against gas curtailments & shortages</u>



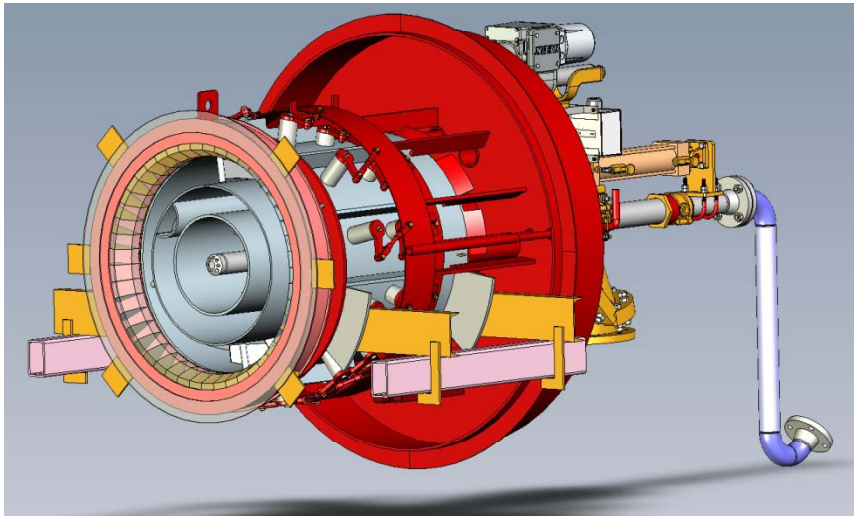


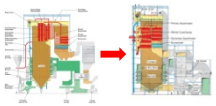
# *Coal to NG Conversion*
# *Approach 3 – Retain Coal – Burner Replacement*

Where existing burners are not suitable for a simple coal nozzle replacement, a complete PC burner with gas elements can replace existing burners

- Higher cost & longer outage time
- Allows for good compromise between fuel flexibility and combustion performance
- Burners can be sized for reasonable pressure drop and/or to accommodate FGR
- Pressure part metallurgy must be reviewed

- <u>Provides a hedge against gas curtailments & shortages</u>

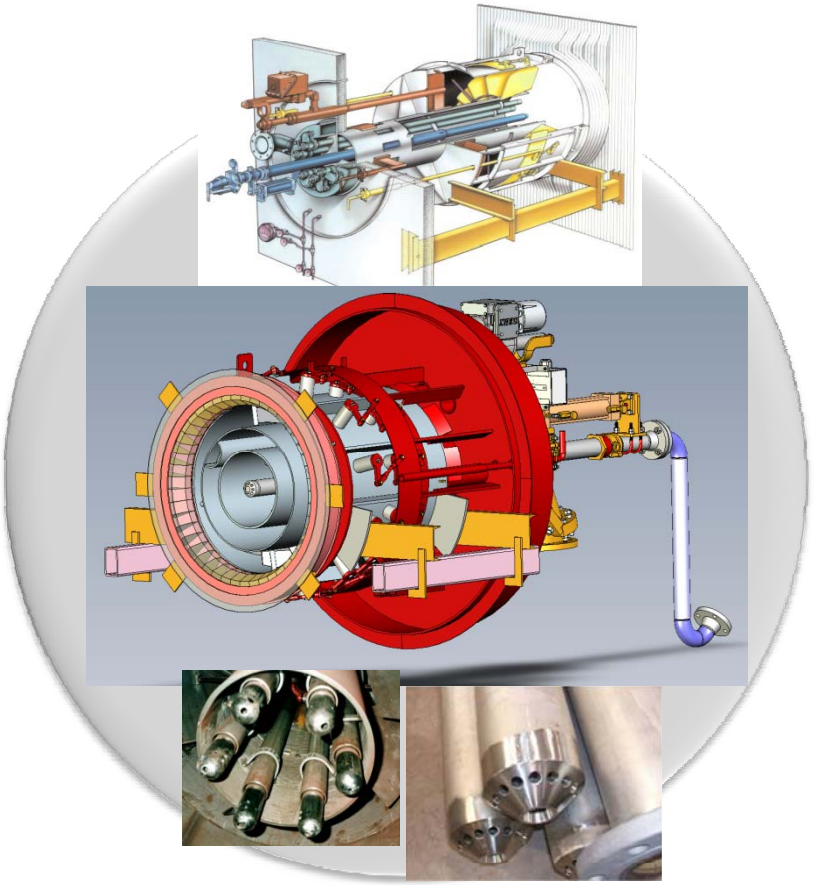


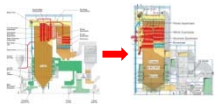


# *Coal to NG Conversion*
# *Approach 4 – Retain Coal – Augment / Partial Replacement*

In some cases where an owner plans to continue to fire coal but would like to augment with gas to lower emissions or improve turndown, some burners can be replaced or modified for gas firing

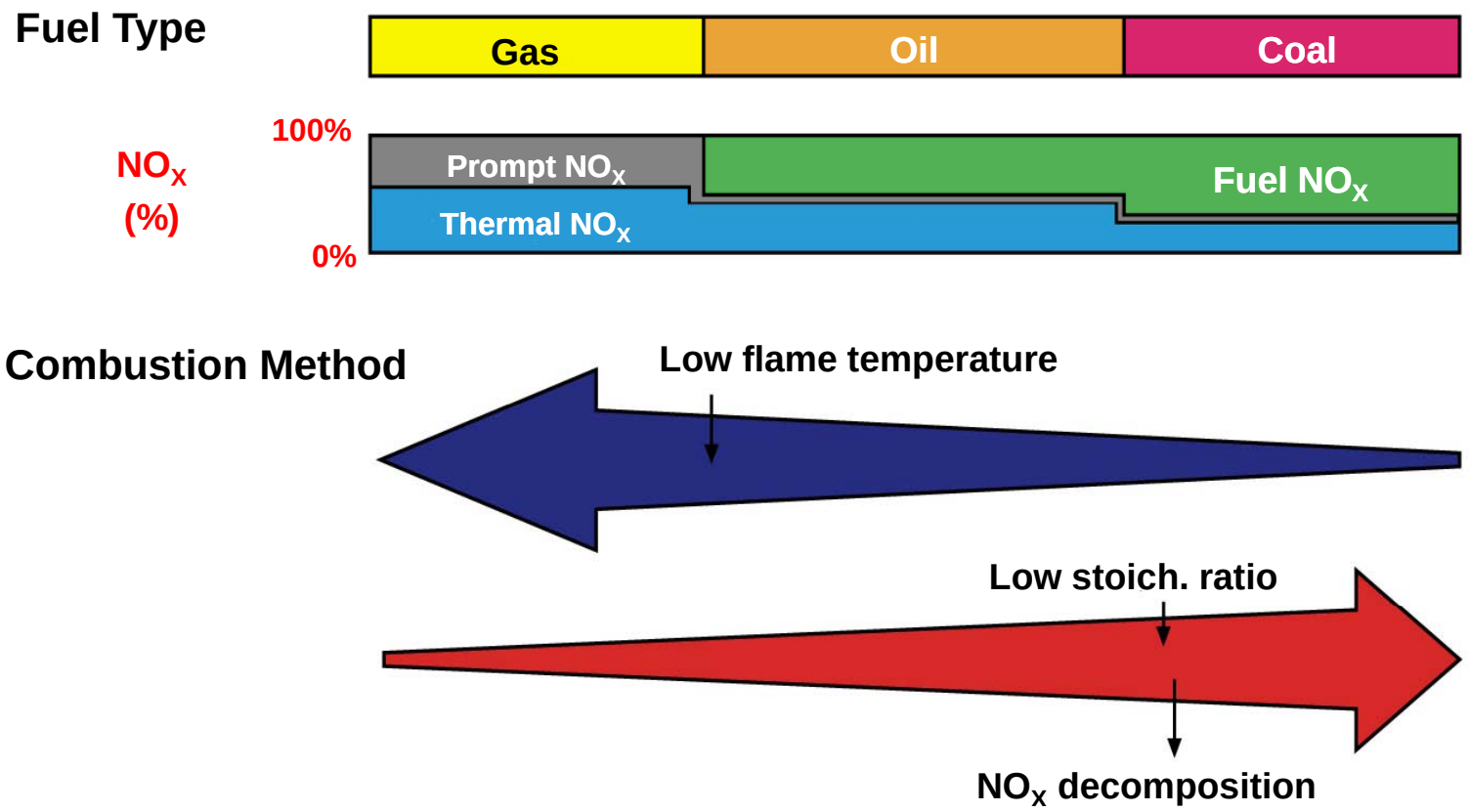
- More applicable to larger units (≥ 250MW)
- Good tool for turndown improvement
- Can be coupled with change to gas ignitors for incremental increase in heat input on gas

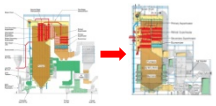




# Coal to NG Conversion

## *NOx Formation and Control*



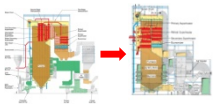



# Coal to NG Conversion

## *NOx Formation and Control*

### *Thermal $NO_X$*

- Dissociation & oxidation of <u>nitrogen from combustion air</u>

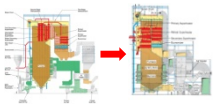


# Coal to NG Conversion

## *NOx Formation and Control*

### *Thermal $NO_X$*

- Dissociation & oxidation of nitrogen from combustion air
- Exponentially dependent on temperature, threshold ~2800F

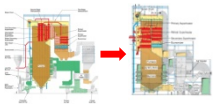


# Coal to NG Conversion

## *NOx Formation and Control*

### *Thermal $NO_X$*

- Dissociation & oxidation of nitrogen from combustion air
- Exponentially dependent on temperature, threshold ~2800F
- Primary mechanism for $NO_X$ formation from natural gas

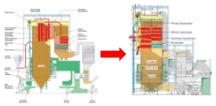


# Coal to NG Conversion

## *NOx Formation and Control*

### *Thermal $NO_X$ Control Strategies*

- Burner Zone release Rate



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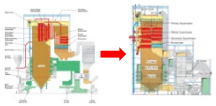

# Coal to NG Conversion

## *NOx Formation and Control*

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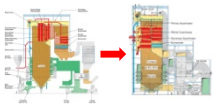
- ~~Burner Zone release Rate~~
- Gas Recirculation to Windbox

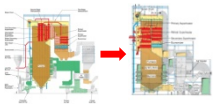


# Coal to NG Conversion

## *NOx Formation and Control*

### *Thermal $NO_X$ Control Strategies*

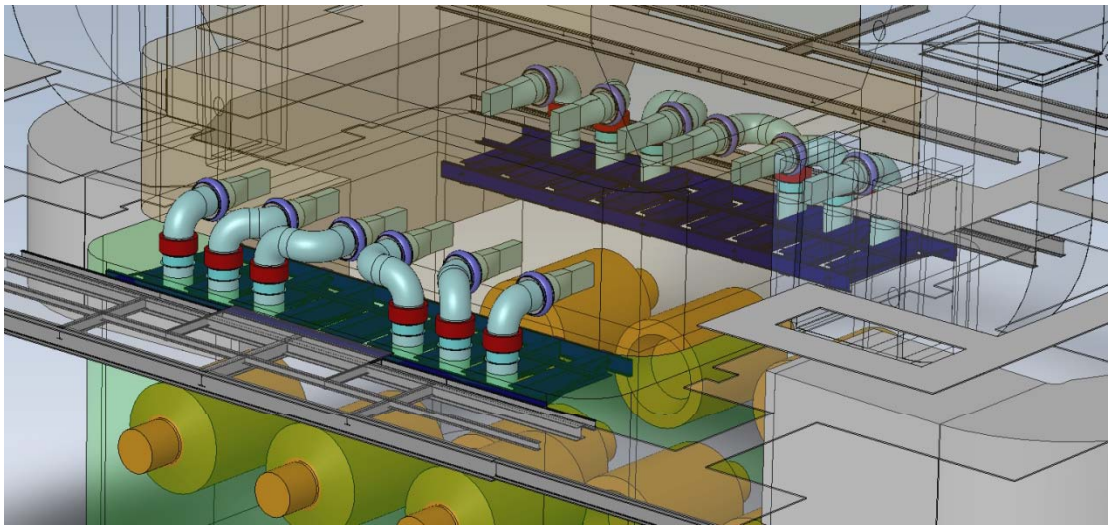
- ~~Burner Zone release Rate~~
- Gas Recirculation to Windbox
- Staging

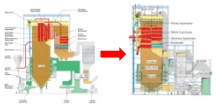


# Coal to NG Conversion

## Other Burner Scope Items:

- FGR or IFGR system – depending on NOx performance level desired
- OFA system – depending on NOx performance level desired
- Burner throat openings (not common)
- New ignitors

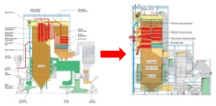




# *Coal to NG Conversion Equipment Boiler Considerations*

## Pressure Parts:

- Convective surface absorptions are higher due to gas weight, gas properties and surface effectiveness



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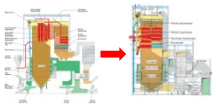

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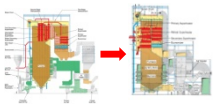
- PSH, SSH and RH outlet sections often require surface adjustments and/or materials upgrades



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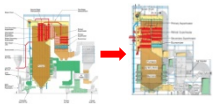

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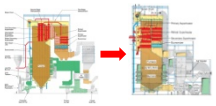
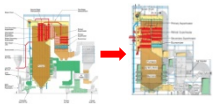
- Spray attemperator capacities need to be checked
- PSH, SSH and RH outlet sections often require surface adjustments and/or materials upgrades
- PSH outlet headers sometimes need to be upgraded
- Economizer surface may need to be modified to prevent steaming



# Coal to NG Conversion
# Air System Considerations

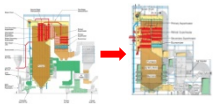
## The FD Fan Capacity will need to be checked

- **After a gas conversion, all combustion air must be delivered by the FD fan through the existing Secondary AH and Secondary Air ducts to the windbox and through the burners (and/or OFA system).**

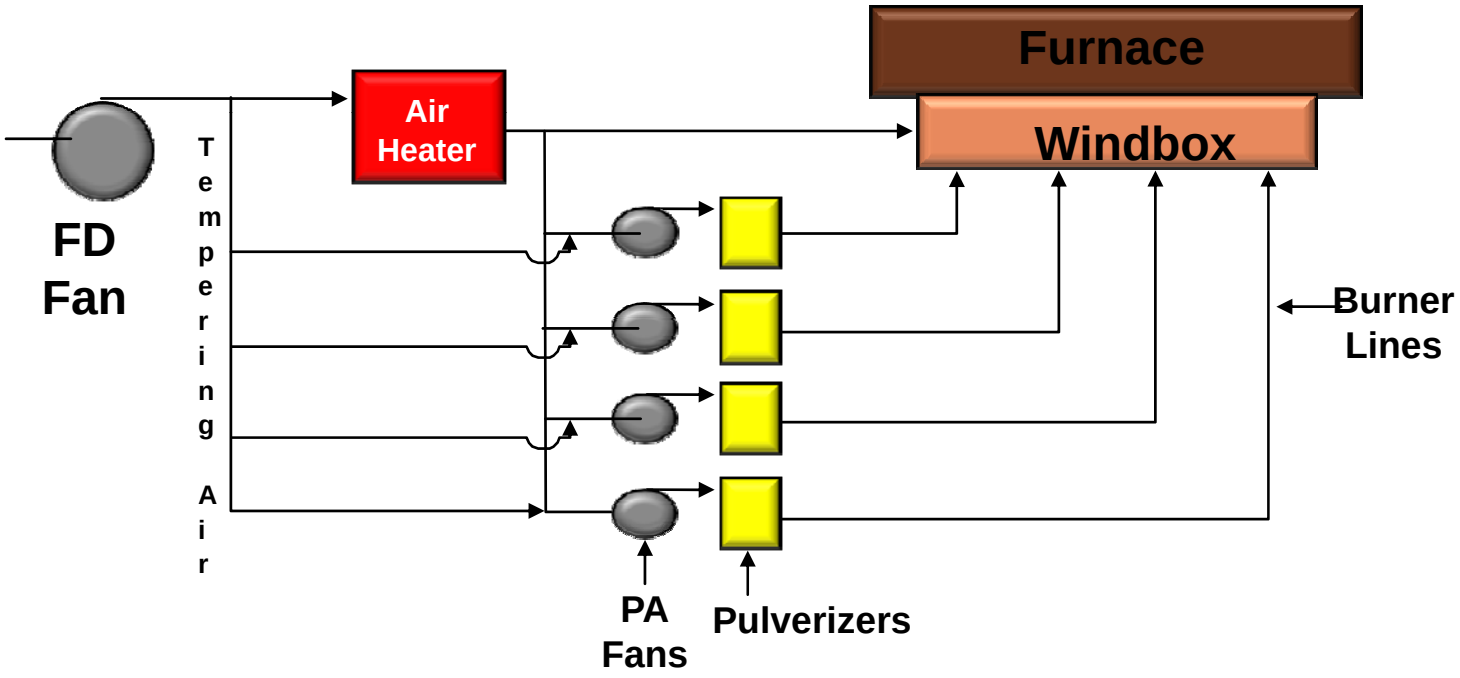


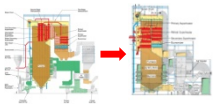
# Coal to NG Conversion
# Air System Considerations

- **Various Primary/Secondary Air System Configurations exist:**



# Coal to NG Conversion
# Air System Considerations
## Hot PA



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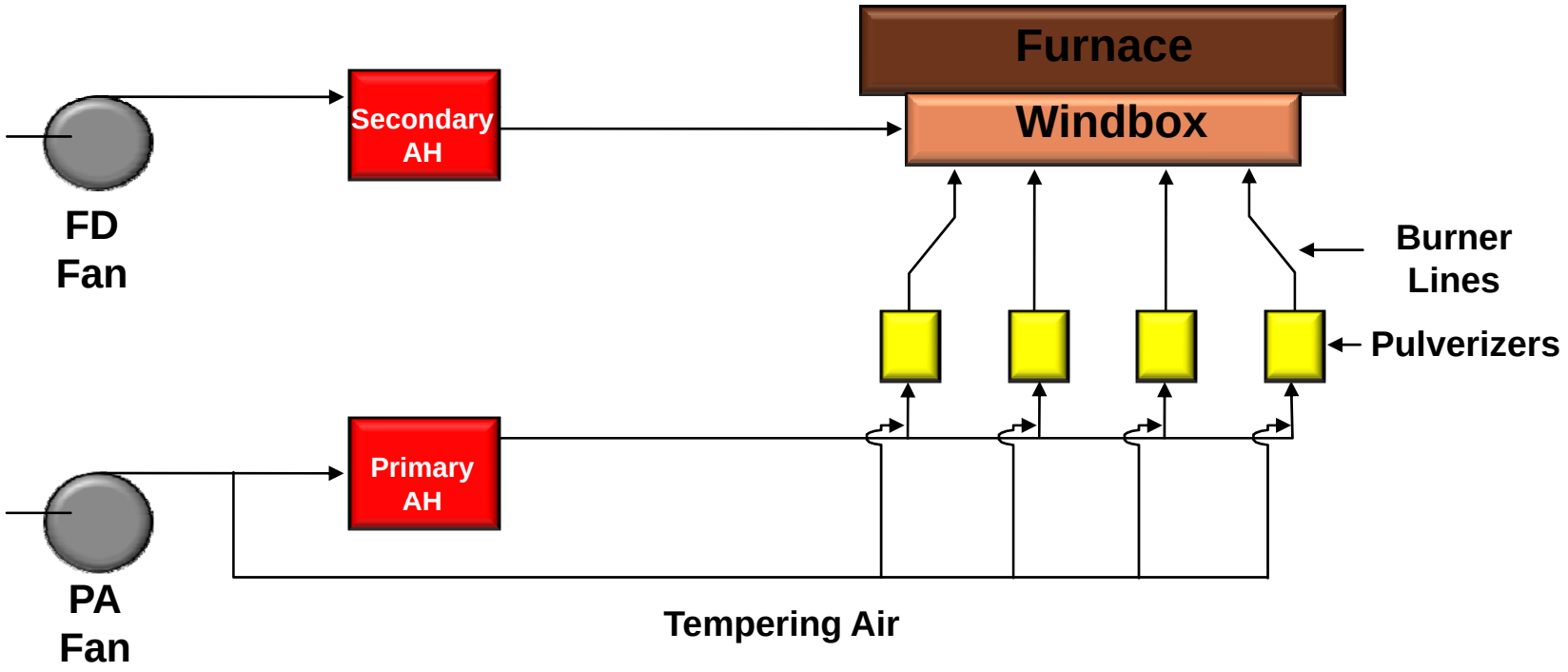
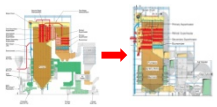
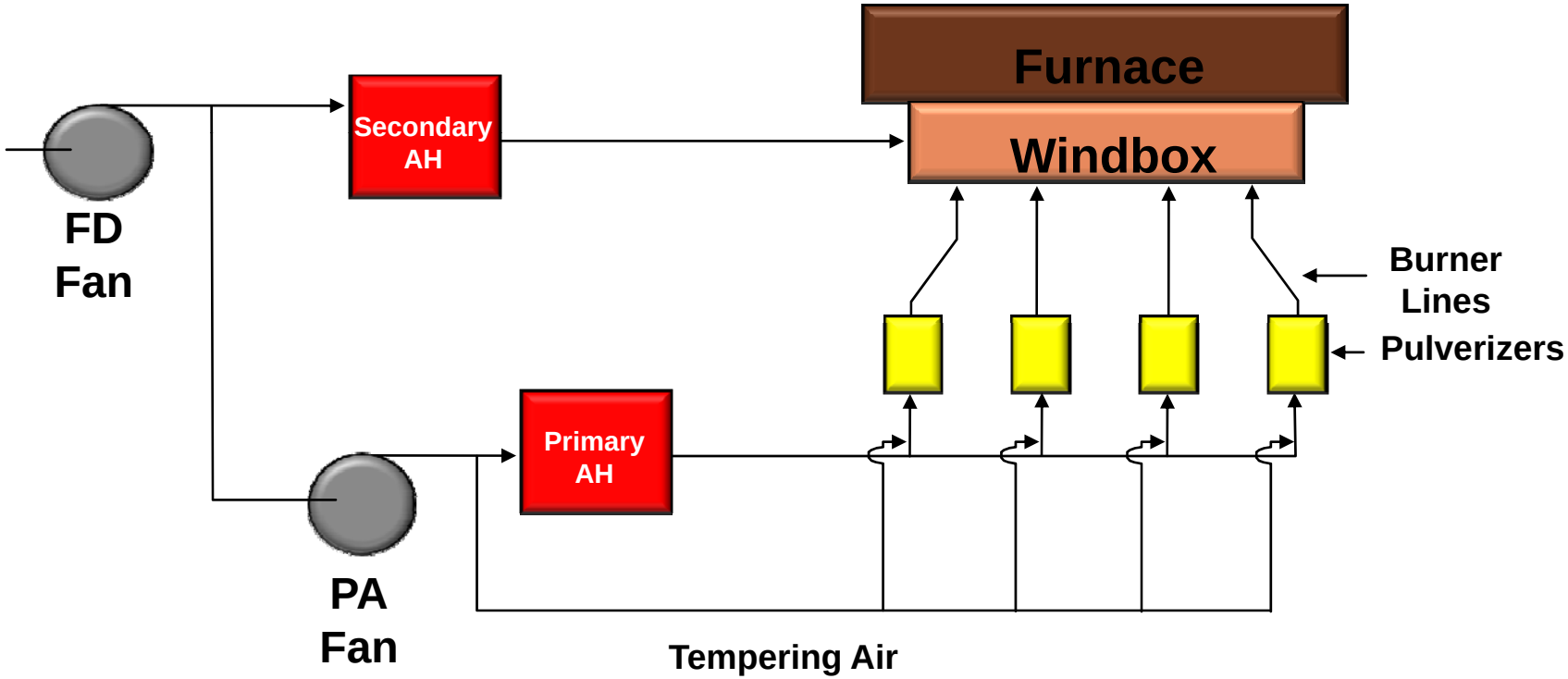
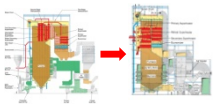
# Air System Considerations
## Cold PA



# Coal to NG Conversion
# Air System Considerations
## Boosted PA



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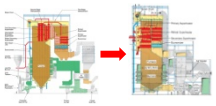
- FGR (if required) will exacerbate the FD fan issues



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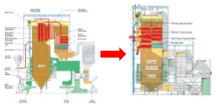
- The airheater performance should also be checked, especially if IFGR is used for NOx control



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# Questions?