# Utility Boiler Computer Modeling for Low-NOx Burner and Low LOI Fly Ash Design

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**Abstract**

Controlling unburned carbon in utility boiler flyash presents a significant challenge to the design, operation, or modification of any coal combustion system. By itself, reducing the unburned carbon in boiler ash results in an increase in efficiency, reducing fuel costs and $CO_2$ emissions. Conversely, an increase in the level of carbon in the flyash can incur additional costs to dispose of the ash or reduce its potential utilization by making it unsalable. Added to this, increased unburned carbon in boiler flyash is the most common by-product of many Nitric Oxide (NOx) reduction technologies.

NOx can be reduced at the cost of increased combustion inefficiencies and increased unburned carbon but this is an unacceptable operating alternative. The NOx must be reduced without increasing unburned carbon and reducing corrosion problems, and this can only be done through properly engineered combustion mixing profiles.

Computer modeling has become routine in the design of many boiler retrofits, particularly for NOx control. With improvements in accuracy and reduction in the cost of modeling, it is becoming more prevalent to include unburned carbon among the issues addressed with a CFD model. This allows unburned carbon to be addressed in the design phase of a boiler retrofit. Unburned carbon becomes one more factor in achieving an optimized design.

This paper presents examples of combined optimization of boiler retrofits for NOx and unburned carbon. Computer modeling of unburned carbon as part of NOx reduction retrofits is presented as an example of consideration of unburned carbon during the design phase. Field optimization of the balance between unburned carbon and NOx reduction is presented as an example of consideration of unburned carbon during the implementation phase. The contrast between dealing with unburned carbon during the design phase or the implementation phase is explored.