

### Introduction

The Praxair® technology is based upon the selective, carefully controlled addition of oxygen to the low-NO<sub>x</sub> combustion system in order to inhibit NO<sub>x</sub> formation in the burner zone. A small fraction of the secondary combustion air is replaced by oxygen delivered through the proprietary mixing and injection system. Oxygen enhancement increases the flame temperature and promotes early pyrolysis (fuel devolatilization), as compared to operation without oxygen enhancement. As a result, the chemical kinetics favor the reduction of fuel-bound nitrogen to molecular nitrogen, rather than the formation of gaseous NO<sub>x</sub> compounds. Oxygen addition allows the stable operation of the low-NO<sub>x</sub> burner even at deeply staged conditions. Oxygen also minimizes the problems of unburned carbon/LOI (loss on ignition) that are encountered as low-NO<sub>x</sub> burners are operated under staged conditions with air alone.

### Oxygen-enhanced Low-NO<sub>x</sub> Technology

- Applicable to wall-fired boilers with net generating capacity from 15 MW to 500 MW
- Designed for use with existing low-NO<sub>x</sub> Burners and OFA (overfire air) Systems
- Demonstrated NO<sub>x</sub> emissions of 0.144 lb/MMBtu on a 125 MW commercial, wall fired boiler, firing bituminous coal at 80% nameplate capacity
- Achieved NO<sub>x</sub> emissions of 0.180 lb/MMBtu on a 125 MW commercial, wall fired boiler, firing bituminous coal at 100% nameplate

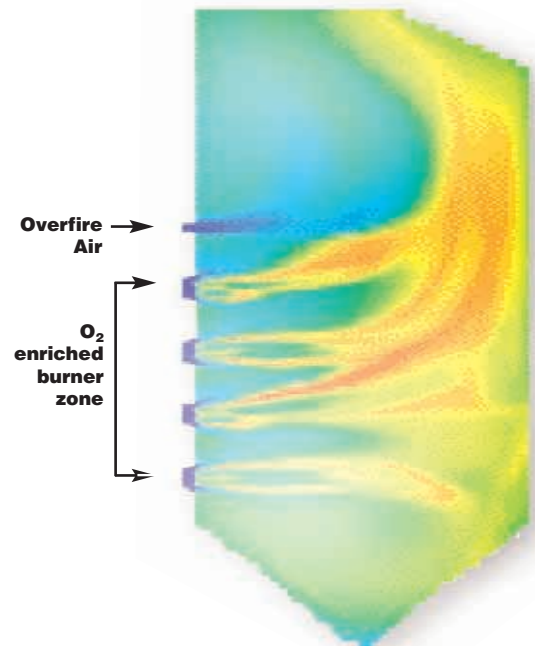
Praxair's patent-pending oxygen-enhanced low-NO<sub>x</sub> technology is a cost-effective and reliable means for decreasing NO<sub>x</sub> emissions from existing wall-fired boilers utilizing coal as the main fuel. This technology is a combustion-based approach to NO<sub>x</sub> emission control that has achieved results below the level currently mandated by the State Implementation (SIP) Call NO<sub>x</sub> legislation at pilot and commercial scales with various types of bituminous coals.

### Components

The key components of this new Praxair technology include the following:

- Oxygen supply system
- Oxygen piping and controls
- Proprietary mixing and injection technology

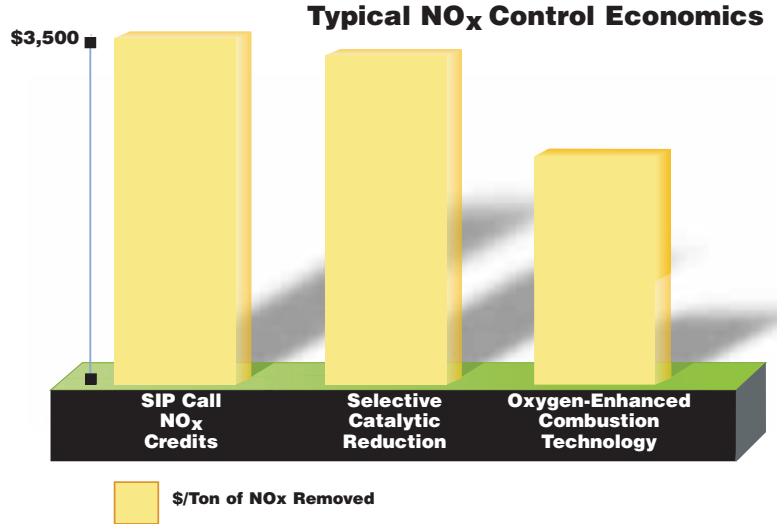
Praxair's oxygen-enhanced low-NO<sub>x</sub> combustion technology provides boiler owners with a large degree of system flexibility and a large operating range. Several boilers can be operated off a single oxygen supply source. More importantly, because the oxygen supply system can be located in an area that is remote to the boilers, it does not require a significant footprint adjacent to the boiler.



### Economics

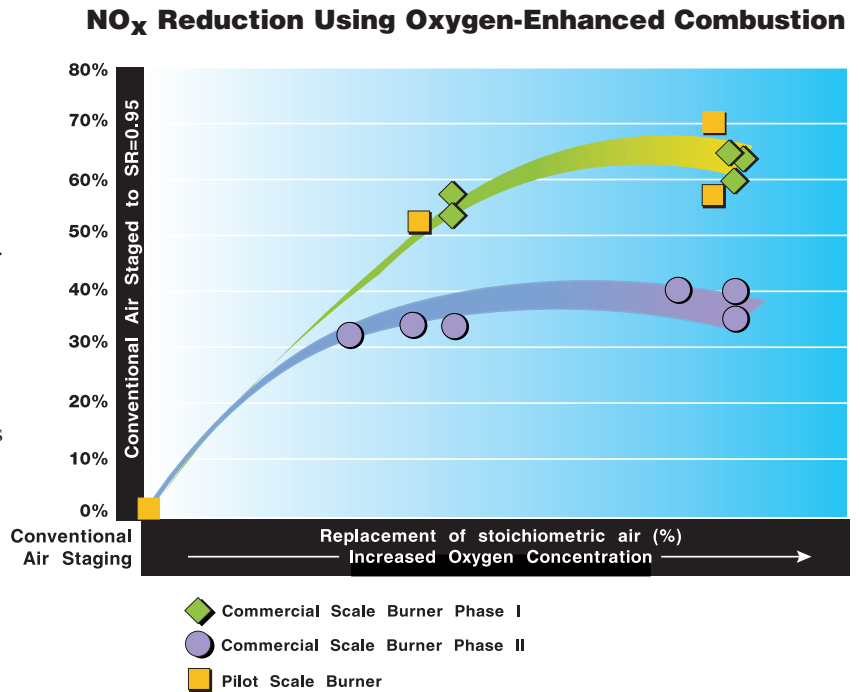
Praxair's oxygen-enhanced combustion is a cost-effective addition to your compliance portfolio. Not only is its cost per ton of NO<sub>x</sub> removed significantly less than credits or SCRs (see chart for typical costs at a 150 MW unit), it also offers:

- Minimal or no downtime for installation
- Minor or no modifications to furnace or ducting
- Potential savings related to LOI reductions



### Results

During single, commercial burner and full-scale boiler demonstrations, Praxair has achieved NO<sub>x</sub> emissions below 0.15 lb/MMbtu with various bituminous coals. The results from test work using a pilot scale burner and a single, off the shelf commercial burner are shown in the adjacent figure. Additionally, significant NO<sub>x</sub> reductions have been demonstrated on commercial wall fired boilers. Most recently, emissions rates of 0.14 to .20 lb/MMbtu have been demonstrated at varying firing rates on a 125 MW commercial boiler firing various bituminous coals using this technology. The lab scale through commercial scale results confirm that replacing a small portion of the combustion air with a stoichiometrically equivalent amount of oxygen significantly reduces NO<sub>x</sub>. Consistent NO<sub>x</sub> emissions reductions of up to 70% from unstaged air baseline operations have been demonstrated.



For Additional Information Please contact your local Praxair, Inc. representative or call 1-800-PRAXAIR (1-800-772-9247) for more information.

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