One of the easiest and most cost-effective ways to limit NOx emissions is to measure oxygen (O₂) and combustibles (COe).

NOx emissions from combustion sources contribute to the formation of ground-level ozone and fine particles. For this reason, most countries have regulations limiting the amount of NOx which can be emitted from combustion plants. In the USA, the Transport Rule establishes a strict program for NOx reductions in many areas. This makes NOx control an important consideration for plant operators.

**HOW TO LIMIT NOx EMISSIONS**

One of the easiest and most cost-effective ways to limit NOx emissions is to limit the amount of available O₂, which can combine with N₂ to form NO. Because the mixing of air and fuel can never be perfect, some excess air is required to ensure complete COe. If too little excess air is available, the COe in the flue gas rise dramatically. Knowing the O₂ and COe concentrations in the flue gas allows the amount of excess air to be controlled, while maintaining good combustion efficiency. The optimum control point to minimize NOx emissions and efficiency losses is shown in Figure 1.

The optimum operating point depends on load conditions, age of equipment, fuel type and process conditions. By continuously monitoring the amount of O₂ and COe in the flue gas, prompt adjustments can be made to maintain optimum burner conditions.

When relying on an O₂ and COe measurement to control combustion efficiency and minimize NOx, the analyzer needs to be placed as close to the combustion process as practical. Tramp air leakage downstream from the combustion process can cause the analyzer to read incorrectly. Also, the closer to the process the analyzer is placed, the faster the analyzer will respond to changing conditions.

**What is NOx?**

In a combustion process, fuel is burned in air to produce heat. Nitrogen (N₂) and O₂ molecules from the air dissociate to their atomic forms at the high temperatures typically found in flames. These produce NO as they react with the remaining air molecules. The dissociation takes place mainly at temperatures above 1600°C (2900°F).

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**Combustion efficiency**

![Figure 1. COe vs. excess O₂ showing efficiency losses (this figure for illustration purposes only)](image-url)
THERMOX FLUE GAS ANALYZERS

The WDG-V monitors both O₂ and COe in flue gases. O₂ is measured using zirconium oxide sensor technology. COe in the flue gas are detected using a catalytic sensor. This flue gas analyzer can be placed close to the flame source (1648°C (2998°F)), thus eliminating tramp air leakage effects on O₂ readings.

The WDG-V sets the standard for fast and accurate response in a flue gas analyzer and is ideal for light oils and gas applications. The analyzer can be used with either the AMEVision Display User Interface or the PC configuration software. The controllers provide analog outputs, alarm contacts and an RS485 interface, which can be integrated into your overall boiler and NOx control system.