CIBSE
CHP & District Heating Group

# What are $NO_x$ Emissions?

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$NO_x$ is the generic term given to nitrous oxides; various combinations of the gas nitrogen and oxygen, typically NO and $NO_2$, which form at high combustion temperatures. $NO_2$ in particular has adverse environmental and health impacts, therefore its emissions are regulated. A local authority has a statutory duty to monitor local air quality, including nitrogen dioxide ($NO_2$) levels and a responsibility to achieve agreed air quality targets. $NO_x$ should not be confused with nitrous oxide ($N_2O$) which is often used as an anaesthetic.

## How Are $NO_x$ Emissions Produced?

Some $NO_x$ emissions are generated wherever fuel is combusted (i.e. Power Stations, Cars, Buses, Lorries, Aircraft, Boilers, Stoves). Emissions of $NO_x$ are linked to combustion temperatures (higher combustion temperatures produce more $NO_x$ emissions), therefore, in modern boilers, $NO_x$ levels have been significantly 'designed' out by better burner design. Typically, within built up areas, road vehicles make the single largest contribution to increased $NO_x$ concentration in air.

## Measurement of $NO_x$ Emissions

When discussing $NO_x$ emissions from CHP and boilerplant, a common metric used is 'Thermal Input'. This is defined as:

| Fuel Consumption at max. continuous rating | X | Net CV of fuel | = | Thermal Input |
|---|---|---|---|---|

Thermal Input is expressed as $kW_{th}$ or $MW_{th}$ (kilowatts or megawatts thermal). This is confusing when considering CHP and boilers as it is the fuel consumption of plant expressed as a thermal unit. Since the plant produces a thermal output, it is easy to confuse input with output. There is often a requirement to measure $NO_x$ against thermal output, in which case it is very important to make it clear which metric is required.

A common metric to compare all $NO_x$ emitting plant is $mg/Nm^3$ (milligrams of dry $NO_x$ per Normalised Meter Cube of Exhaust). Note the 'N' is used to describe 'normalised' and should not be confused with the SI unit of torque, newton metres. The unit $mg/Nm^3$ is used to describe the amount of $NO_x$ in a volume of exhaust gas emissions, corrected to Normal Temperature and Pressure conditions (293.15 K, 101.325 kPa respectively). It is also typically corrected to a standard excess oxygen content (often 5% $O_2$).

## Dispersion Modelling

To estimate the impact that $NO_x$ emissions from an exhaust flue has on background air quality at ground level (0-3m), a dispersion analysis of the emission source and quantity is required, so that the amount of $NO_2$ and the impacts of dilution with surrounding air is better understood.

Good dispersal can be achieved by a combination of high stack, high exhaust gas velocity and high exhaust gas temperature. Unfortunately, maximising heat recovery can increase the ground level emission due to reduced buoyancy of the plume.

**This datasheet was produced by the CHP Group of the Chartered Institution of Building Services Engineers (CIBSE) to inform building professionals about all forms of CHP. To join or contact the CHP Group go to www.cibse.org/chp or contact CIBSE, 222 Balham High Road, London, SW12 9BS (020 8675 5211).**