

Regulatory concerns for NO_x control of major point sources

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Abstract

There has been considerable recent pressure in most Australian states for major point sources to minimise their emission levels and emission rates of nitrogen oxides NO_x. This arises from a desire to minimise local air quality (from a health impact and odour perspective) and avoid increasing smog levels on those few days per year when the photochemical nature of the Australian urban air-sheds is NO_x-limited. Strict emission controls or load-based licensing are currently in place or being advocated for new point sources, often with little demonstration that significant benefits will thus accrue.

This paper provides a concise summary of the key parameters and characteristics for the evaluation of NO_x impacts, the current regulatory requirements, the nature of smog generation within industrial plumes and the benefits of NO_x-control. Some discussion is given of future trends and drivers for improved NO_x-control, either via source emission technology or via temporary NO_x reductions. Recent work in Australia, United States and Europe suggests that local air quality may be as strong a driver as regional considerations. Recent Queensland studies also suggest that near-source odour impacts may be quite important for coal-fired power stations in various environments and gas-fired power stations in densely-populated urban areas.

1. Introduction

Historically, sulphur dioxide has been the prime gaseous pollutant of concern to most power generation facilities, even in Australia with its abundance of low sulphur fuels. Major combustion facilities emit often equal or more amounts of nitrogen oxides (NO_x). Of these emissions, only a small proportion occur as nitrogen dioxide (NO₂), which is the only NO_x species to have health guidelines. Around 5-10% of NO_x will occur as NO₂ for coal-fired facilities, and 5-20% for gas-fired facilities. Nitric oxide (NO) forms the bulk (usually over 80%) of NO_x emissions and has relatively high thresholds for any physiological impact. Other nitrogen oxides (e.g. nitrates (NO₃²⁻), nitrous oxide N₂O and dinitrogen tetroxide (N₂O₄)) are usually found in trace quantities and are of little importance except for regional deposition rates and greenhouse gas auditing.

Several studies in Holland, United States and Australia have shown the relatively slow oxidation of NO to NO₂ within industrial plumes. For example, a major 1650 MW power station emitter in a rural environment will have conversion proportions of 30% within 5-10 km, 50% by 50 km and 60-80% by 100 km under typical adverse meteorological and photochemical conditions. The net effect, accounting for plume dilution with downwind distance, is that maximum NO₂ concentrations are usually greatest within 10 km downwind where less than 30% of the NO has been transformed to NO₂. In the absence of high background concentrations due to other sources, the NO₂ ground-level concentrations are rarely close to ambient guidelines. In this situation NO_x control would only be advocated to avoid plume visibility which is also dependent on the particulate loadings.