Non-CO_2 Greenhouse Gases: Nitrous Oxide

Source/Sectors: Energy/Stationary Combustion

Technology: Options for emission reduction related to stationary combustion (B.2.2)

Description of the Technology:
Stationary combustion includes all the combustion activities except waste incineration, transportation (mobile combustion), and biomass burning for non-energy purposes. For stationary sources, nitrous oxide may result from the incomplete combustion of fuels (USEPA, 2006a).

Emission concentrations of N_2O from burning of fossil fuels in stationary combustion processes are low, typically 1 to 2 ppmV for coal-fired plants and 1 ppmV or less for oil- and gas-fired plants. Sources with higher emission concentrations are flue gases from fluidized bed combustion (FBC), flue gases from the selective non-catalytic reduction (SNCR) process, and combustion of wood, waste, and other biomass (de Jager *et al.*, 2001). Technological options for emission reduction of N_2O may be categorized into three groups: (1) reduced emissions from fluidized bed combustion; (2) use of selective catalytic reduction; and (3) fuel shift and reduction in fossil fuel consumption (de Jager *et al.*, 2001; de Soate, 1993; EC, 2001).

- Fluidized bed combustion (FBC) – Fluidized bed combustion has a higher energy conversion than conventional pulverized fuel combustion, and it has lower NO_x emissions due to a lower combustion temperature. However, the lower combustion temperature, between 800 and 900 ^oC, leads to higher N_2O emission concentrations, in the range of 30-150 ppmV. Several technological measures to reduce N_2O emissions are potentially available: (1) optimizing operating conditions, (2) using reversed air staging, (3) use of afterburner, (4) use of catalytic reduction, and (5) use of pressurized fluidized bed (de Jager *et al.*, 2001; IEA, 2000). It was estimated in an EU report, for applications of these technologies at FBC facilities, the cost is approximately \$59/$MT_{CO2\text{-}Eq.}$ for installing the gas afterburner, \$51/$MT_{CO2\text{-}Eq.}$ for reverse air staging, and \$170/$MT_{CO2\text{-}Eq.}$ for "optimized" operating conditions coupled with the use of catalytic control (IEA, 2000). It should be noted that these cost estimates were based on a very limited set of studies.
- Use of selective catalytic reduction – Use of selective non-catalytic reduction (SNCR) for reducing NO_x emissions requires higher operating temperatures, but it also creates N_2O emissions. An alternative NO_x abatement system may be selective catalytic reduction (SCR), which is considered preferable with regards to N_2O emission reduction; however, the specific cost of NO_x abatement of SCR is twice as expensive than the cost of SNCR (de Jager *et al.*, 2001). It should be noted here that some consider SCR effective in reduction of N_2O emissions while the others hold an opposite view (USEPA 2006a; Smit *et al.*, 2001)
- Fuel shift and reduction of fuel consumption – A shift from coal to oil or gas would result in lower N_2O emissions from fuel combustion. Reduction in fossil fuel consumption can be achieved, for example, by applying energy-efficiency improvement measures, applying energy saving measures, and increasing use of renewable energy. A shift to non-fossil energy source will further reduce the emissions. However, it is very unlikely that these options will be implemented as part of a N_2O abatement option (de Jager *et al.*, 2001; IEA, 2000).

Effectiveness: Low

Implementability: Low

Reliability: Low

Maturity: Low

Environmental Benefits: It reduces nitrous oxide emission.

Cost Effectiveness: Low

Industry Acceptance Level: Low

Limitations: Most of these technological options are still in the development stage.

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