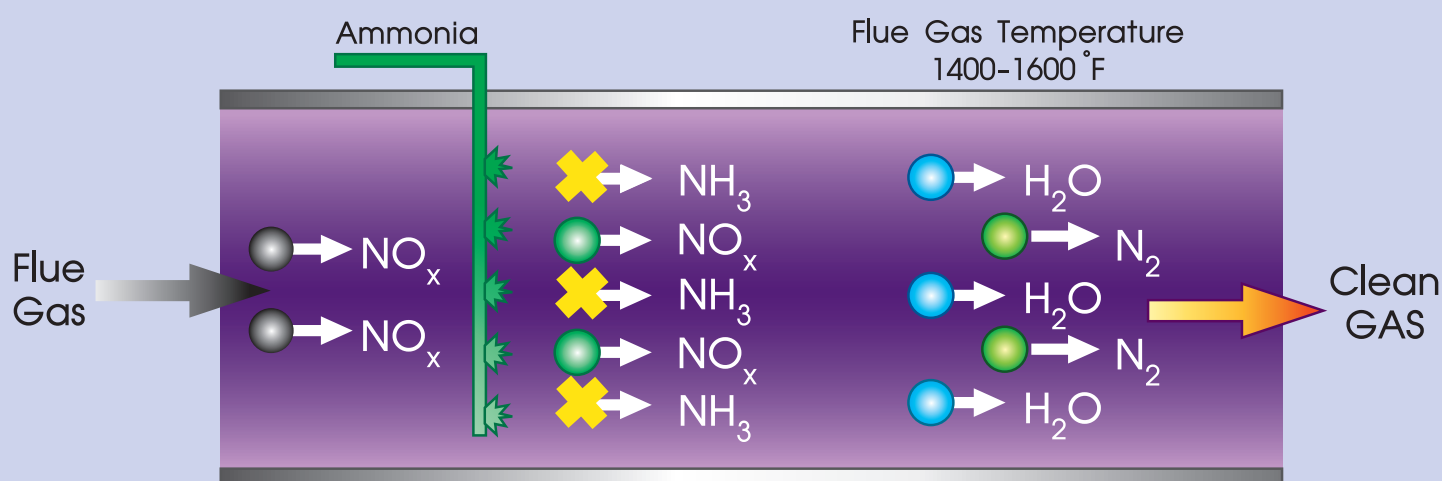


ADVANCED AIR POLLUTION CONTROL AT WASTE-TO-ENERGY FACILITIES

Selective Non-Catalytic Reduction (SNCR)



A new report published by the SWANA Applied Research Foundation provides a state-of-the-art review—supplemented by case studies—of nitrogen oxide (NO_x) and carbon dioxide (CO_2) control technologies that WTE facility managers can reference as they consider implementation of these technologies at their facilities.

Reducing these emissions would require significant capital investments and increased operating costs, and could force many WTE facilities to close, leaving communities with few if any options to locally meet their solid waste disposal needs. As discussed in the report:

- US air quality has improved dramatically over the last 50 years.
- WTE emissions have been significantly reduced over the last 30 years with the implementation of Maximum Achievable Control Technology (MACT), based standards. Seven of the nine regulated pollutants have been reduced by an average of 95 percent while NO_x emissions were reduced by about 24 percent. There have been additional reductions with application of "Reasonable Available Control Technology" (RACT) standards, specifically in the Northeast and Mid-Atlantic states.¹

Despite these accomplishments, WTE facilities are often targeted by environmental groups to further reduce their emissions since they are often among the largest point sources of NO_x emissions in a community, even though the largest source by far of these emissions is generally the transportation sector.

¹ USEPA will require additional reductions in the future when they complete mandated revisions to the MACT standards.

Advancements in NO_x Emission Reductions

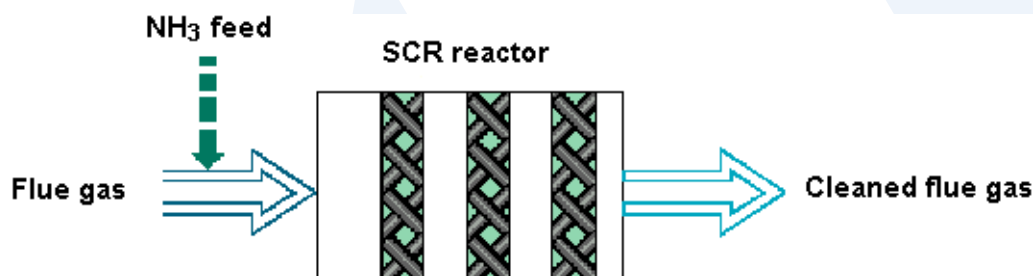
There are two major types of air pollution control (APC) equipment that can be utilized to reduce NO_x emissions from WTE facilities:

- Selective-Non-Catalytic-Reduction (SNCR) technology (including Advanced SNCR)
- Selective-Catalytic-Reduction (SCR) technology

The major difference between these technologies is that one utilizes a catalyst to accelerate the reaction of ammonia with NO_x to produce nitrogen and water vapor.

Most WTE facilities in the US have been equipped with the SNCR technology to comply with the regulatory requirements regarding NO_x emissions. In the SNCR process, nitrogen oxides ($\text{NO} + \text{NO}_2$) are removed by injecting a reducing agent (typically ammonia or urea) into the furnace. SNCR can achieve nitrogen oxides emissions reduction in the 60–80 percent range. ASNCR is an effective NO_x reduction technology capable of achieving a 70 percent reduction.

In the SCR process, an ammonia-air mixture (the reduction agent) is added to the flue-gas and is passed over a catalyst, usually a mesh (e.g., platinum, rhodium, titanium dioxide, zeolites). When passing through the catalyst, ammonia reacts with NO_x to produce nitrogen and water vapor. A schematic of an SCR flue gas treatment application is provided below.



For both the SNCR and SCR processes, the use of ammonia (NH_3) or derivatives of ammonia (e.g., urea ($\text{CO}(\text{NH}_2)_2$)) as the reduction agent is common and has been successful. The nitrogen oxides in the flue-gas basically consist of NO and NO_2 and are reduced to N_2 and water vapor by the reduction agent.

In July 2015, the Palm Beach Renewable Energy Facility No. 2 (PBREF No. 2) began commercial operation. The plant is owned by the Solid Waste Authority (SWA) of Palm Beach County and is the first greenfield waste-to-energy (WTE) facility to come online in North America in 20 years.

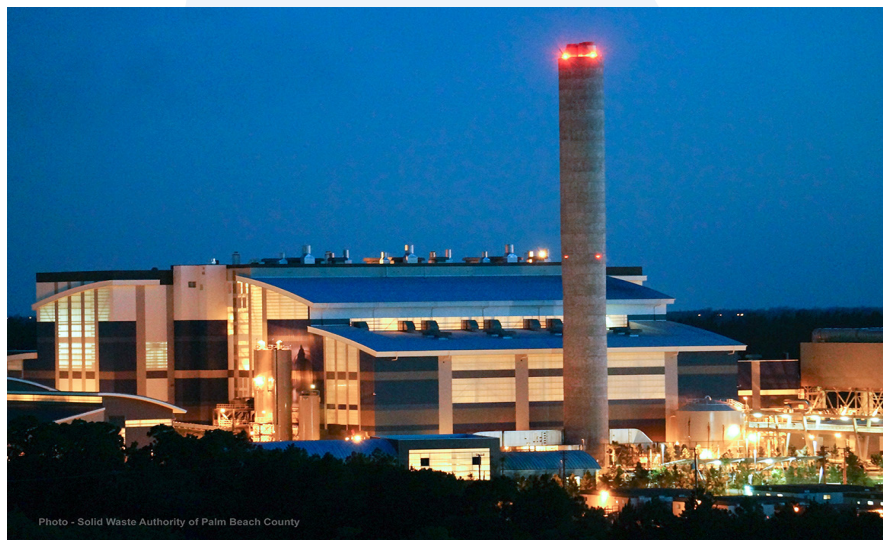


Photo - Solid Waste Authority of Palm Beach County

Palm Beach County Renewable Energy Facility No. 2.

The PBREF No. 2's SCR NO_x reduction system, which is the first of its type to be installed at a WTE facility in North America, is a low dust and low temperature system that is located after the pulse-jet fabric filters. Data on the NO_x and other emissions from the PBREF No. 2 are provided in the table below. The emissions from this facility are very low and comparable to those emitted from a natural gas turbine.

PBREF No. 2 Emissions — As Good as or Better Than a Gas Turbine			
Pollutant	Natural Gas Turbine Exhaust	PBREF No. 2 Emissions Permit	PBREF No. 2 Actual Emissions Test
Nitric Oxide	20–220 ppm	< 50 ppm	30–31 ppm
Nitrogen Dioxide	2–20 ppm	Included above	Included above
Carbon Monoxide	5–330 ppm	< 100 ppm	15–24 ppm
Sulfur Dioxide	Trace–100 ppm	< 24 ppm	10–21 ppm
Sulfur Trioxide	Trace–4 ppm	Not required	Not detectable/Trace
Unburned Hydrocarbons	5–300 ppm	< 7 ppm	0.2–2.7 ppm
Particulate Matter	Trace–25 ppm	12 mg/dscm	0.6–2.5 mg/dscm

The case studies in the report present three different approaches that can be considered by WTE plant managers interested in evaluating NO_x technology reduction options for their facilities. The SCR technology implemented at PBREF No. 2 can achieve the lowest NO_x emission levels for new WTE facilities constructed in the US and will be required for new WTE units subject to Best Available Control Technology implementation under USEPA NSR/PSD regulations. However, SCR has never been retrofitted on an existing US WTE facility, and would represent both a significant technical and economic challenge due to space constraints and other physical limitations, high capital costs and operating expenses, and the impact on net power generation.

Some facility managers with certain WTE furnace/boiler configurations also have the option of adding the LN™ technology option to their current facilities and continuing to use their SNCR systems. This approach would cost significantly less than the SCR Technology option and would reduce NO_x emission levels by 50 percent below the current MACT standards. However, the LN™ technology is not applicable to all MWCs, including some MWCs operated by Covanta. For those MWCs, the ASNCR technology evaluated by Babcock Environmental for the Wheelabrator Baltimore facility provides a good example of a retrofit technology that can be used to lower NO_x emissions. The ASNCR technology can potentially reduce NO_x emissions to the 90–110 ppmv/24-hour range depending on WTE boiler design and furnace configuration.

Implementation of additional NO_x control at a WTE facility should be compared to other NO_x reduction options, especially those targeted at much larger sources of NO_x in communities—such as the transportation sector—where reductions would more directly improve air quality.

Reducing Carbon Dioxide Emissions

Interest is growing in the utilization of carbon capture technologies at WTE plants due in part to the large point sources of CO₂ that these facilities typically represent in their host communities.

Of the three carbon capture approaches (pre-combustion, post-combustion, and oxy-fuel combustion), post-combustion carbon capture is the only one that has been commercialized. As described in the report, this technology has been implemented at commercial scale at three WTE facilities worldwide—two in the Netherlands and one in Japan.



CO₂ Capture System at the Duiven WTE Facility (Netherlands). SOURCE: The Global CCS Institute

All three facilities involve the capture of the CO₂ in the flue gas using a solvent through which the flue gas is passed. The CO₂ is absorbed in the solvent which is subsequently reheated to release the CO₂. The CO₂ is then dried and either used directly as a gas or cooled and compressed for transport in liquid form. The CO₂ is used as a fertilizer in agricultural applications and displaces the combustion of fossil fuels to generate the CO₂ for this purpose. It is also used to produce sodium bicarbonate (for use in WTE flue gas treatment) and for the production of dry ice.

While post-combustion carbon capture may have the most potential for application in WTE facilities it is still in the early stage of commercialization and large-scale applications need to be technically and economically demonstrated. Further, considering the significant capital and costs and uncertain economic benefits with implementation of CCS, these technologies may need subsidies to be viable and will be especially dependent on the development of costly large-scale public infrastructure for the transport and storage of CO₂ if captured CO₂ cannot be fully utilized onsite.

The full report, *Advanced Air Pollution Control at WTE Facilities* is currently only available to SWANA ARF subscribers. SWANA members receive free access to ARF industry reports one year after publication. For more information on the SWANA Applied Research Foundation, contact Jeremy K. O'Brien, P.E., Director of Applied Research at SWANA at jobrien@swana.org, or 704-906-7269.