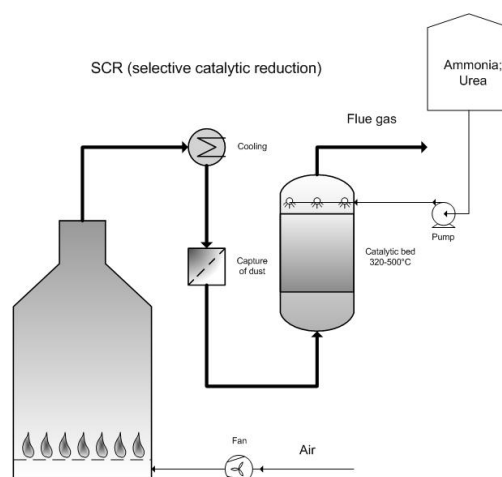


## SELECTIVE CATALYTIC REDUCTION

Selective catalytic reduction (SCR) is a process used to reduce nitrogen oxides (NO<sub>x</sub>) emissions from industrial exhaust gases by converting NO<sub>x</sub> into nitrogen and water through a reaction with a reductant, typically ammonia or urea, in the presence of a catalyst. This technology is widely employed in power plants, industrial boilers to comply with stringent emission regulations. SCR systems utilize various catalysts, including vanadium-titanium-based and manganese-based catalysts, which are selected based on their performance characteristics, such as operating temperature range and resistance to deactivation by impurities like sulfur and water.



Selective Catalytic Reduction

### REMOVED COMPONENTS

- Nitrogen oxides (NO<sub>x</sub>) as the primary target component with an efficiency of 90-94%<sup>1</sup>
- Sulfur dioxide (SO<sub>2</sub>) is indirectly targeted.

### FUNCTION IN CCU VALUE CHAIN

- Feed gas pretreatment.
- Reduction of NO<sub>x</sub> in the flue gas.
- Protects the integrity of CO<sub>2</sub> capture systems.

### LIMITATIONS

- Impurities in flue gas can cause solvent and catalyst degradation.
- Ammonia slip (NH<sub>3</sub>) could be around 2 ppm,<sup>2</sup> if the injected ammonia is not fully utilized in the reaction with NO<sub>x</sub>.
- Temperature sensitivity, the catalyst in SCR systems has typical operational temperatures (200–500 °C).<sup>1</sup>

### ENERGY

- Primary electricity is used for operating pumps, fans, and other equipment.
- Heating is generally not required for the SCR system since it relies on the heat present in the flue gas.

### CONSUMABLES

- Ammonia (NH<sub>3</sub>) at 29 wt.% concentration<sup>2</sup> or Urea (CH<sub>4</sub>N<sub>2</sub>O) used for NO<sub>x</sub> reduction.
- The catalyst needs to be replaced. Catalyst lifetime depends on the flue gas. It varies from 40,000 – 60,000 hours for oil and gas-fired units.<sup>2</sup>

#### Energy & consumables

Ammonia (kg/tNO <sub>x</sub> ) *	333 <sup>2</sup> - 370 <sup>1</sup>
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Electricity (kWh/tNO <sub>x</sub> )	~3530 <sup>2</sup>
Catalyst (m <sup>3</sup> /tNO <sub>x</sub> /hr) **	~788 <sup>2</sup>

\*Depends on the NO<sub>x</sub> concentration

\*\*Replaced every 3 years

### COSTS

The cost of installing an SCR system can vary significantly based on several factors, including the size of the unit, the type of ammonia system used, and the NO<sub>x</sub> removal efficiency design basis. Generally, the cost is around **€4000 per tonne of NO<sub>x</sub> removed**.<sup>3</sup> Another source ranges the NO<sub>x</sub> removal cost from **€2480 – €2665 per tonne of NO<sub>x</sub> removed**.<sup>2</sup> The larger units tend to have lower costs per ton of NO<sub>x</sub> removed compared to smaller units.

<sup>2</sup> Flue gas from coal boiler; inlet NO<sub>x</sub> rate – 0.19 t/hr; NO<sub>x</sub> removal efficiency – 85%; 2016 euros, catalyst lifetime – 24,000 hours; operational time – 8760 hours; electricity price – 32.5 €/MWh; 29 wt.% ammonia solution price – 90 €/t.

### TECHNOLOGY PROVIDERS

- SCR system by **Babcock & Wilcox**, USA
- SCR system and catalyst by **Shell**, UK
- SCR system by **Alstom**, France
- SCR system by **Mitsubishi Heavy Industries**, Japan
- SCR Technology by **GEA**, Germany

### ALTERNATIVE TECHNOLOGIES

- **Selective non-catalytic reduction (SNCR)** is a simpler, lower-cost technology that injects a reagent (ammonia or urea) directly into the flue gas stream at high temperatures (850–1050°C).<sup>4</sup>
- **Chemical absorption**, which involves chemical absorption of NO<sub>x</sub>, is often integrated into systems designed for multi-pollutant control.<sup>5</sup>

Belco® Wet Scrubbing by **Elessent Clean Technologies**, USA

- **Catalytic filters** (e.g., catalytic bag filters or candles) combine particulate removal with NOx reduction in a single unit.

CataFlex™ by **Topsoe**, Denmark

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## PARTNERS



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