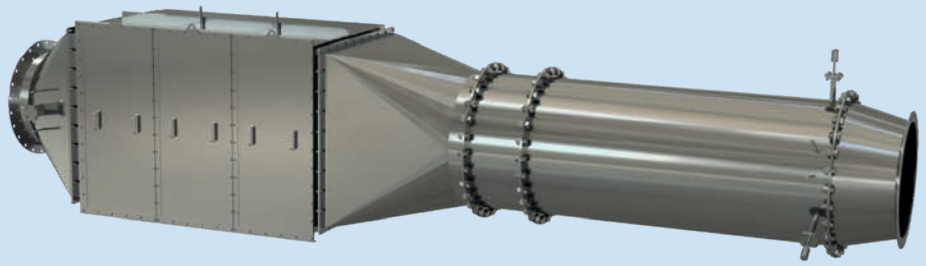
DeNOx SCR

Exhaust Gas Cleaning

ECOSPRAY
technologies for the planet

DeNOx SCR

SCR
Reactor



Exhaust Gas Cleaning

A wide range of **DeNOx systems** for marine applications, from small boats and motor Yachts to big ships, to remove Nitrogen Oxides from diesel engine exhaust gas, using **SCR** (Selective Catalytic Reduction) technology, up to 25 MW engine output. Our DeNOx SCR, and all the catalytic solutions, are designed and engineered by CatEMission.

Benefits

Designed to meet IMO Tier III and EU Stage V regulations.

Highly configurable to suit diverse installation and operational scenario with the most compact size.

Wide range of power covered covered, up to 25MW.

Extended lifecycle thanks to catalysts elements based on metallic substrates with high abrasion and mechanical resistance.

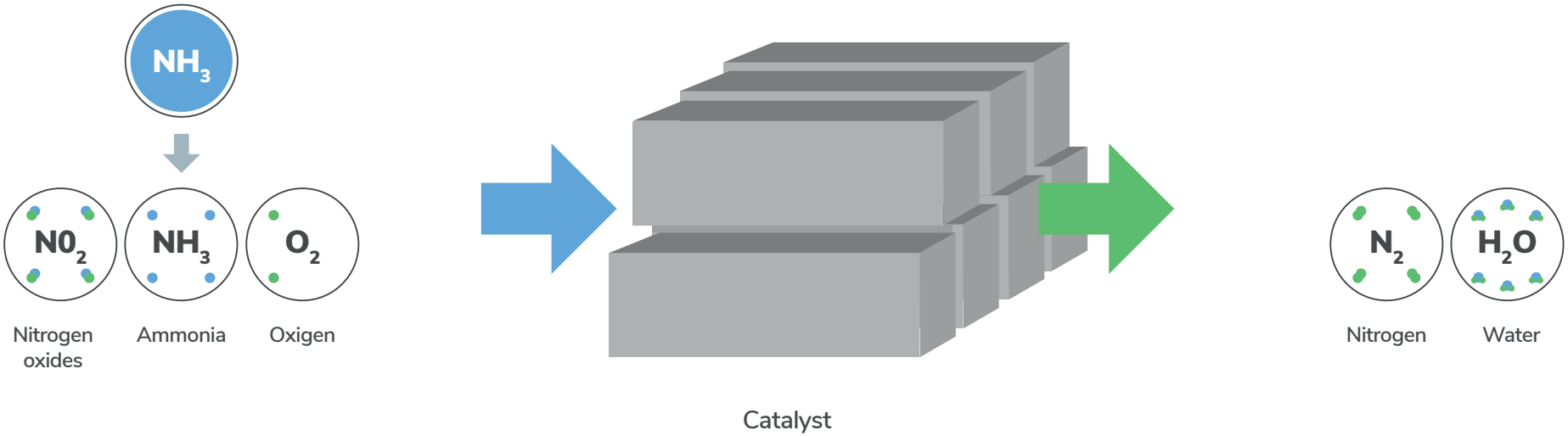
Overview

Ensure compliance

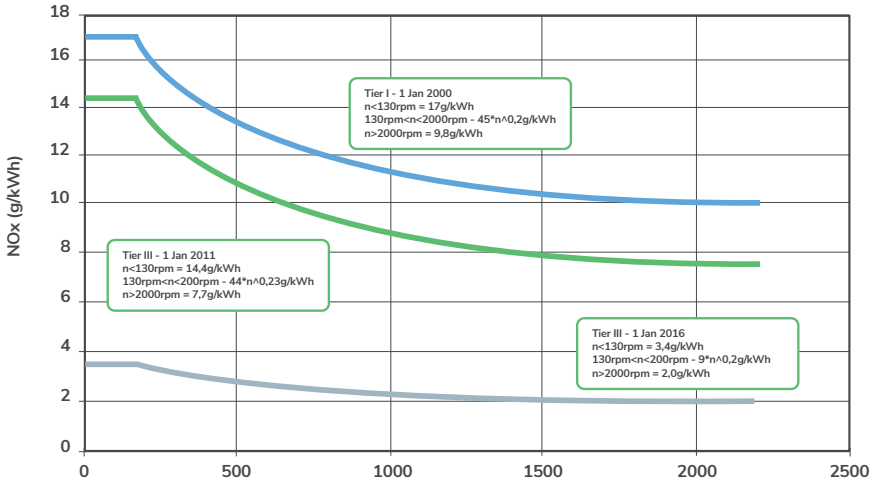
Ecospray solution to support Diesel Engines compliance with NOx emission control standards as defined in Regulation 13 of MARPOL Annex VI is based on **Selective Catalytic Reduction aftertreatment** (SCR). SCR uses reductant to treat the exhaust gases to reduce the amount of NOx emitted. The reductant, Ammonia in the form of Urea solution, is injected into the exhaust gas stream and mixed with the exhaust gases prior to entering the SCR reactor. The chemical reactions take place in the catalyst's elements, where Ammonia reacts with the NOx in the exhaust gases resulting in Nitrogen and water.

Reaction with ammonia $4\ NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$

Reaction with urea $2\ CO(NH_2)2 + 4\ NO + O_2 \rightarrow 4N_2 + 2CO_2 + 4H_2O$



IMO Tier III and EPA Tier IV compliance

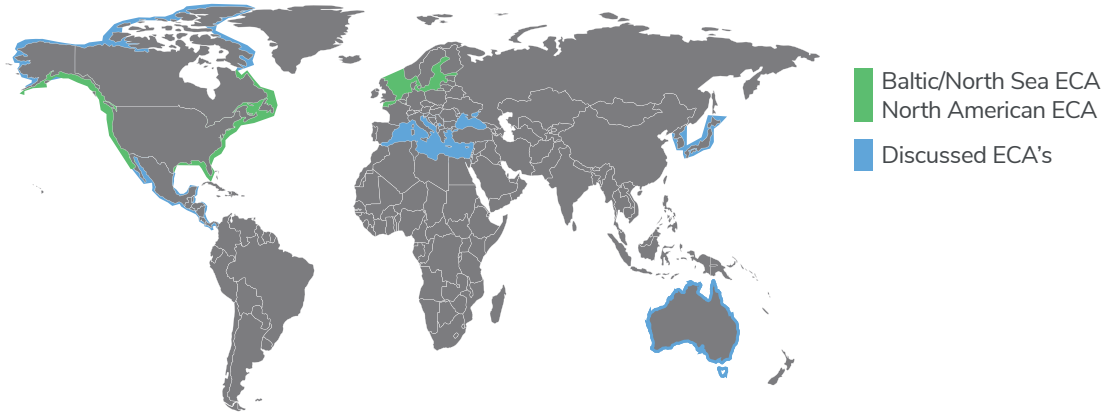


RPM	NOx calculated as total weighted emission of NO_2 (g/kWh)			Relative Reduction from Tier I
	<130	130 ≤ n < 2000	≥ 2000	
Tier I	17,0	$45*n^{(-0,2)}$	9,8	0%
Tier II	14,4	$44*n^{(-0,23)}$	7,7	15,5% - 21,8%
Tier III	3,4	$9*n^{(-0,2)}$	2,0	80%

Figure 1: IMO MARPOL ANNEX VI Regulation 13 NOx Limits

With the entry into force of the International Marine Organization's (IMO) NOx Tier III limits, the regulations governing **marine emissions** became significantly more stringent, lowering the permissible NOx emissions in NOx Emissions Control Areas (NECA) by about 75% in comparison to IMO Tier II.

Existing Emission Control Areas as of January 2021 include the Baltic Sea, the North Sea, the North American ECA, including most of US and Canadian coast, the US Caribbean ECA with Puerto Rico and the US Virgin Islands. Others are under evaluation (e.g. the Mediterranean Sea).



Ecospray SCR solution is designed to achieve IMO Tier III compliance and, when installed in conjunction with Ecospray DOC/DPF permits EU StageV **emission limits** to be respected as well.

Main features

1. Suitable for new build and retrofit installation.
2. HFO / MDO / MGO **compatible with SOx scrubber systems** and boiler/silencers (existing or tailor-made).
3. Ecospray patented **high-efficiency spraying** lances and nozzles.
4. High efficiency with limited Ammonia slip, low back pressure (<20mbar).
5. Highly configurable in shape (square, round), size and orientation (horizontal, vertical).
6. Choice of substrates (metallic, ceramic) and coatings (Vanadium, Cerium, Zeolite).
7. **Comprehensive scope of supply**, from engineering to commissioning and certification.
8. Long operational life thanks to durable catalyst elements and automatic cleaning (Pulse Jet® technology).
9. Control automation highly configurable with range of interfaces (ModBus, ProFiBus, RS432).
10. **Global after sales Service** (operations support; performance optimization, lifecycle management, spares and consumables).
11. The **DeNOx SCR** can be used in conjunction with Ecospray's integrated DOC (Diesel Oxidation Catalyst) + DPF (Diesel Particulate Filter) solution.

Performance

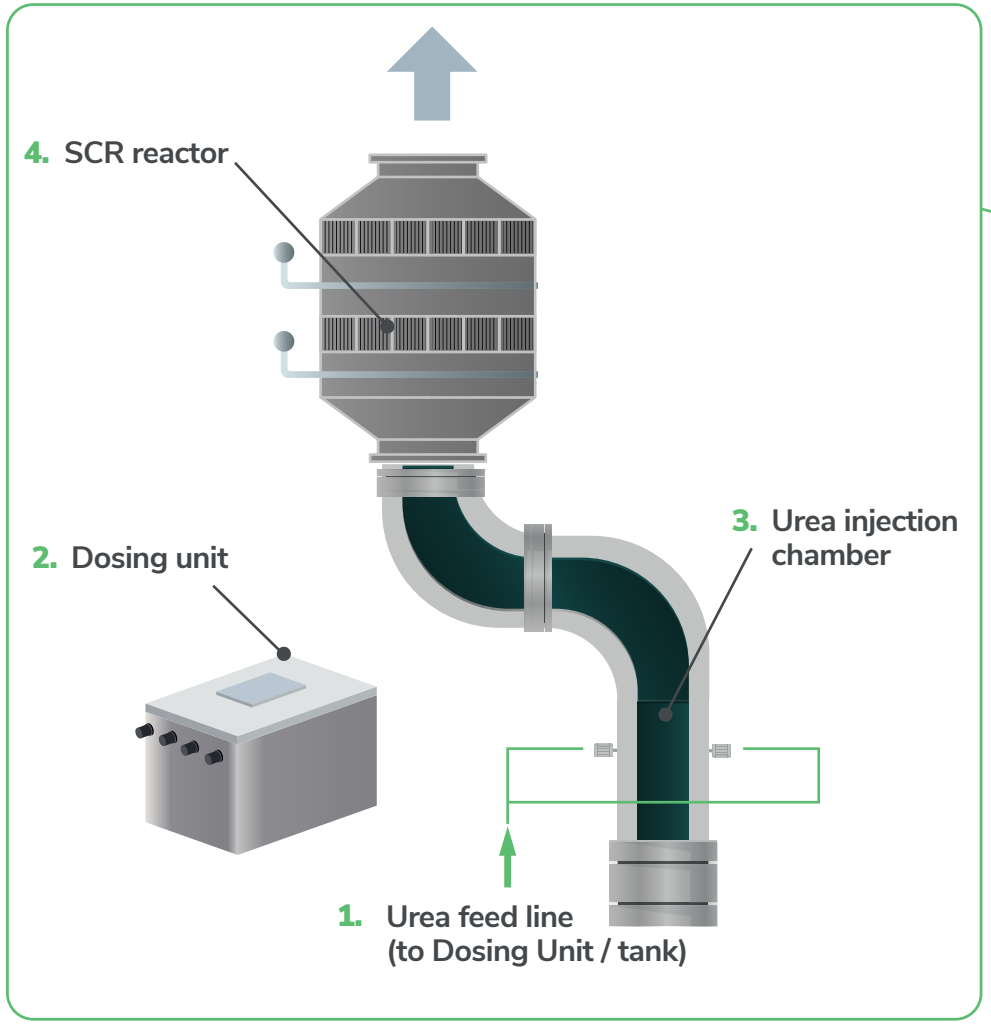
Overall efficiency in NOx reduction	> 85%
Ammonia slip	<5 mg/Nm^3 *
Average pressure drop (@100% load)	< 18 mbar *
Substrate type / CPSI	Ceramic, metallic / 200-400
Catalyst type	Vanadium based
Urea solution consumption at 100% load	27,67 l/hr (@32,5%) *
Catalyst operating life (average)	8.000/12.000 hrs
Construction material	SS316 (reactor, injection chamber), SS409 (mixer)

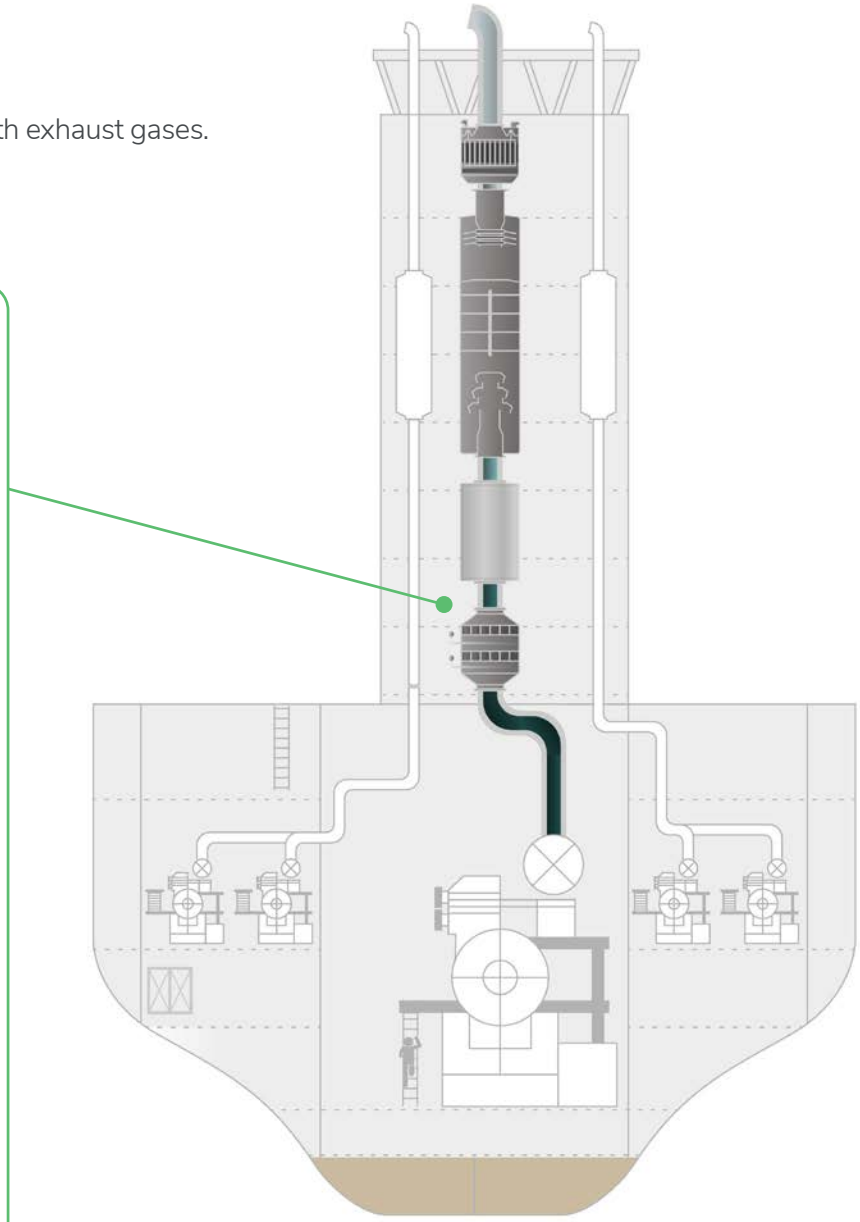
* The indicated data are related to a specific Engine Load and/or Exhaust Gas Flow. Different application can give different values.

How it works

The Ecospray SCR solution consists of the following components:

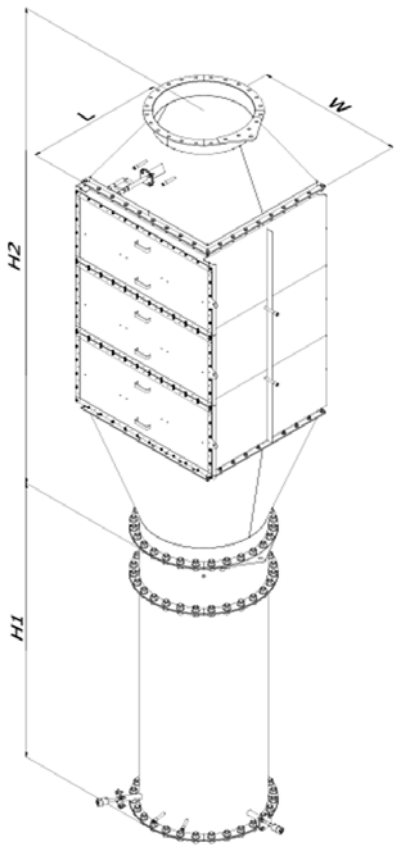
1. **Urea solution storage tank.**
2. **Dosing unit** that transfer urea from storage tank to mixing unit.
3. **Injection chamber** where urea solution is injected to the exhaust stream and mixes with exhaust gases.
4. **Reactor** containing the catalyst with cleaning system (optional) **control automation**.





Designed for your needs

A flexible concept to suit all installation requirements, Ecospray SCR is available in **square and round** design with catalytic elements of different substrate, coating and cell-density, configurable in size and layers to achieve the required efficiency vs. backpressure targets.



Engine size	MDO fuel (200 CPSI)					HFO fuel (100 CPSI)				
(kW)	**Layers** (mm)	**H2** (mm)(*)	**L** (mm)	**W** (mm)	**Weight** (kg)(**)	**Layers** (mm)	**H2** (mm) (*)	**L** (mm)	**W** (mm)	**Weight** (kg)(**)
0-200 (***)	4	1.200	405	405	110	4	1.200	405	405	110
200-450 (***)	4	1.450	595	595	225	4	1.450	595	595	225
450-1.000 (***)	4	1.725	805	805	410	4	1.725	805	805	410
1.000-1.600 (***)	4	1.925	960	960	575	4	1.925	960	960	575
1.600-3.000	3	2.200	1.300	1.300	1.210	4	2.800	1.700	1.700	2.870
3.000-4.000	3	2.500	1.700	1.700	2.160	4	3.000	1.700	1.700	3.590
4.000-5.000	3	2.700	2.100	1.700	2.690	4	3.000	2.100	2.100	4.480
5.000-6.000	3	2.700	2.100	2.100	3.360	4	3.200	2.500	2.100	5.380
6.000-7.000	3	2.900	2.500	2.100	4.040	4	3.200	2.500	2.500	6.460
7.000-8.000	4	3,200	2.500	2.100	5.380	4	3.700	2.900	2.500	7.530
8.000-9.000	3	2.900	2.500	2.500	4.840	4	3.700	2.900	2.900	8.790
9.000-10.000	4	3.200	2.500	2.500	6.460	5	4.000	2.900	2.900	10.980

(*) including cones, (**) including catalyst elements, (***)available in round or square shape.

Note:
- *Layers approximately 1.500 mm, depending on gas temperature and pipe size.*
- *The information provided are for reference purposes. Conditions: @85% MCR, t=350°C.*
- *Round reactor option and other CPSI variants available.*

Lifecycle management

Ecospray's exchange base plan for catalyst elements **replacements lower OPEX** by **tailoring SCR maintenance** and assisting in catalyst replacement and disposal. Using a metallic substrate with high mechanical resistance allows exhausted units be sent back to the factory to perform catalyst regeneration and be replaced with others which have been taken back to the original performance.
This service relieves customers from having to dispose of the exhausted catalyst which are classified as hazardous waste.

Technology Map

Exhaust Gas Cleaning

Advanced DeSOx

Exhaust Gas Cleaning Systems
Smart Scrubber
Wet Technology
Dry and Semi-Dry Technology

Catalytic Abatement

DeNOx SCR
Diesel Oxidation Catalyst
Methane Slip Reduction
Water Fuel Emulsion

Filtration

Wet Electrostatic Precipitator
Diesel Particle Filtration
Baghouse Filters
Filter Cassettes

Clean Fuel

Pre-Treatment and Upgrading

Pre-Treatment
Smart Blending
Biogas Upgrading
Nitrogen Rejection Unit

Liquefaction

Methane and Biomethane Liquefaction

Green Power Generation

Lean Gas To Power

Lean Gas To Power

Decarbonization

Carbon Capture Utilization & Sequestration

Fuel Cell

Carbon Friendly Fuel Cells

Air and Water Treatment

Advanced Water Filtration

Wash Water Filtration

Sanitization

Air and Surface Sanitization

Fogging

Fogging

Gas Cooling

Gas Cooling

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