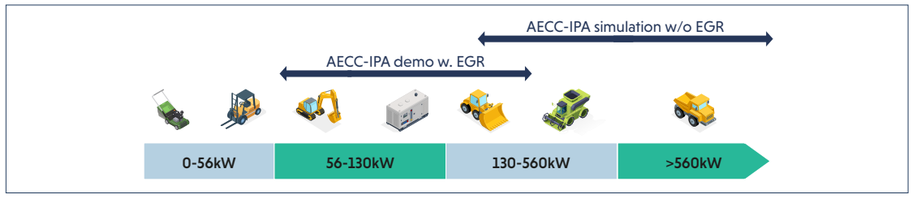
The importance of NRMM

As emissions from on-road vehicles continue to decline, the relative contribution of Non-Road Mobile Machinery (NRMM) to overall air pollutant emissions, is becoming increasingly significant. Further reducing emissions from the NRMM sector therefore offers an important opportunity to improve air quality. This is particularly relevant as many NRMM applications operate for extended periods at low load and idle conditions, where achieving effective emissions control remains challenging.

Complementary project data

This NRMM demonstrator with EGR (Exhaust Gas Recirculation) complements another simulation study w/o EGR. The combined dataset covers all applications above 56 kW. There are also emissions control opportunities below 56 kW, e.g. DPF and SCR on DPF, but these applications have not been tested. A third project that complements the dataset was conducted with TNO, analysing real-world NOx emissions of machines in actual operation. That project showed there is a significant variability and there are gaps between Stage V requirements and emissions in actual operation.



For further reference

Project 1
Real-world NOx emissions of Stage V NRMM

Project 2
Simulating Potential for Reduction in NRMM Real-World Emissions

Project 3
Demonstration of Potential for Reduction in NRMM Real-World Emissions

ASSOCIATION FOR EMISSIONS CONTROL AND CLIMATE (AECC)
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Paving the road towards reducing emissions

from Non-Road Mobile Machinery

The project

The project goal was to assess whether future NRMM emission reductions, can be achieved using commercially available diesel engine and emissions control technologies, particularly under challenging low-load and idling conditions.

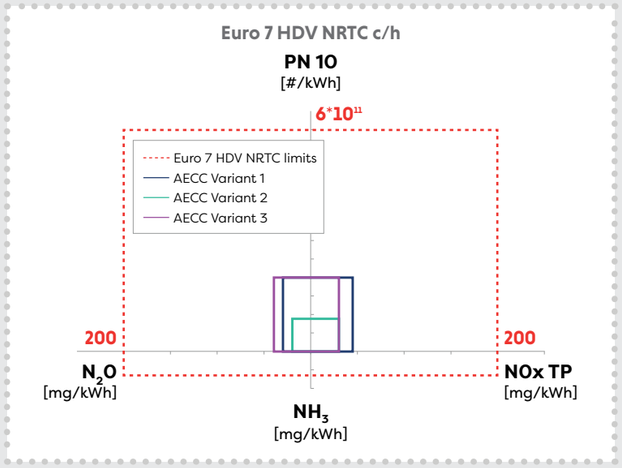
Technologies

The engine was equipped with 3 emission control variants. The systems combined a diesel oxidation catalyst and diesel particulate filter with SCR catalysts. Dual-SCR or exhaust gas heater were used as an option to yield lowest emissions under low load conditions.



Available technology can achieve very low pollutant emissions

As illustrated below, the project showed that commercially available emission control technologies can achieve very low pollutant emissions from NRMM. The tested systems delivered NOx emissions within Heavy-Duty Euro 7 limits, demonstrating that further reductions in NRMM emissions are technically feasible today. The project also demonstrated all 3 variants within the Tier 4 limits.



PN emissions are within Euro 7 limits

Particle number (PN) emissions remained within the proposed Euro 7 limit across all test cycles. The diesel particulate filter achieved above 99.6% filtration efficiency across conditions tested. Engine-out PN10 emissions were around 10^{14} particles/kWh, whereas tailpipe emissions remained in the range of 10^{10}–10^{11} particles/kWh.

>99.6%
filtration efficiency

Control of non-regulated emissions

The study shows that advanced emissions control systems can deliver very low regulated emissions while maintaining good control of non-regulated pollutants. Emissions of ammonia (NH_3), nitrous oxide (N_2O) and particle number remained at low levels across the different operating conditions, demonstrating that significant reductions in NOx can be achieved without creating trade-offs in other emissions.

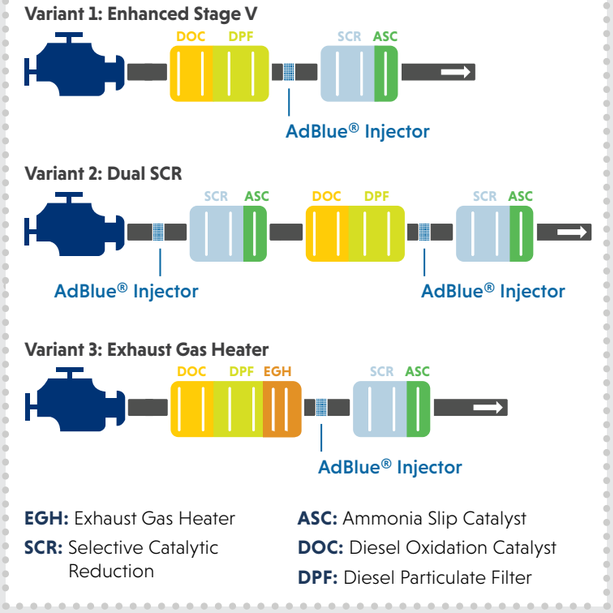


Tested Engine

The demonstrator used a 4-litre class, 100 kW diesel engine equipped with cooled high-pressure EGR (Exhaust Gas Recirculation) and an intake throttle, producing around 4 g/kWh engine-out NOx. Low-load emissions performance was improved with modified air path and EGR calibration.

Tested Emission Control Equipment

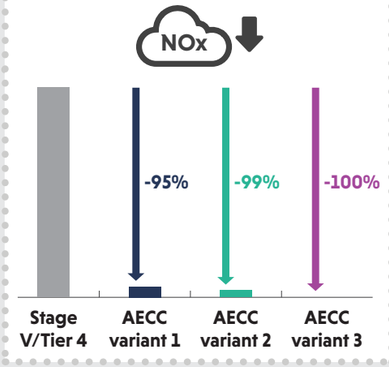
3 variants of the emission control system have been tested



EGH: Exhaust Gas Heater
SCR: Selective Catalytic Reduction
ASC: Ammonia Slip Catalyst
DOC: Diesel Oxidation Catalyst
DPF: Diesel Particulate Filter

Emissions reduction under low load operation

The project showed that all three emission control variants significantly reduce NOx emissions under low-load operation.



More information

Project and measurements conducted by AVL