

# Evaluation of fuel quality impact on a new coating technology for advanced exhaust gas after treatment systems

## Introduction

For emission regulation 97/68 EC stage IV, Liebherr developed a SCR-only solution with a SCR catalyst as the only necessary exhaust gas after treatment system. The particulate matter (PM) limit (0.02 g/kWh) for stage IV is entirely met with internal engine measures.

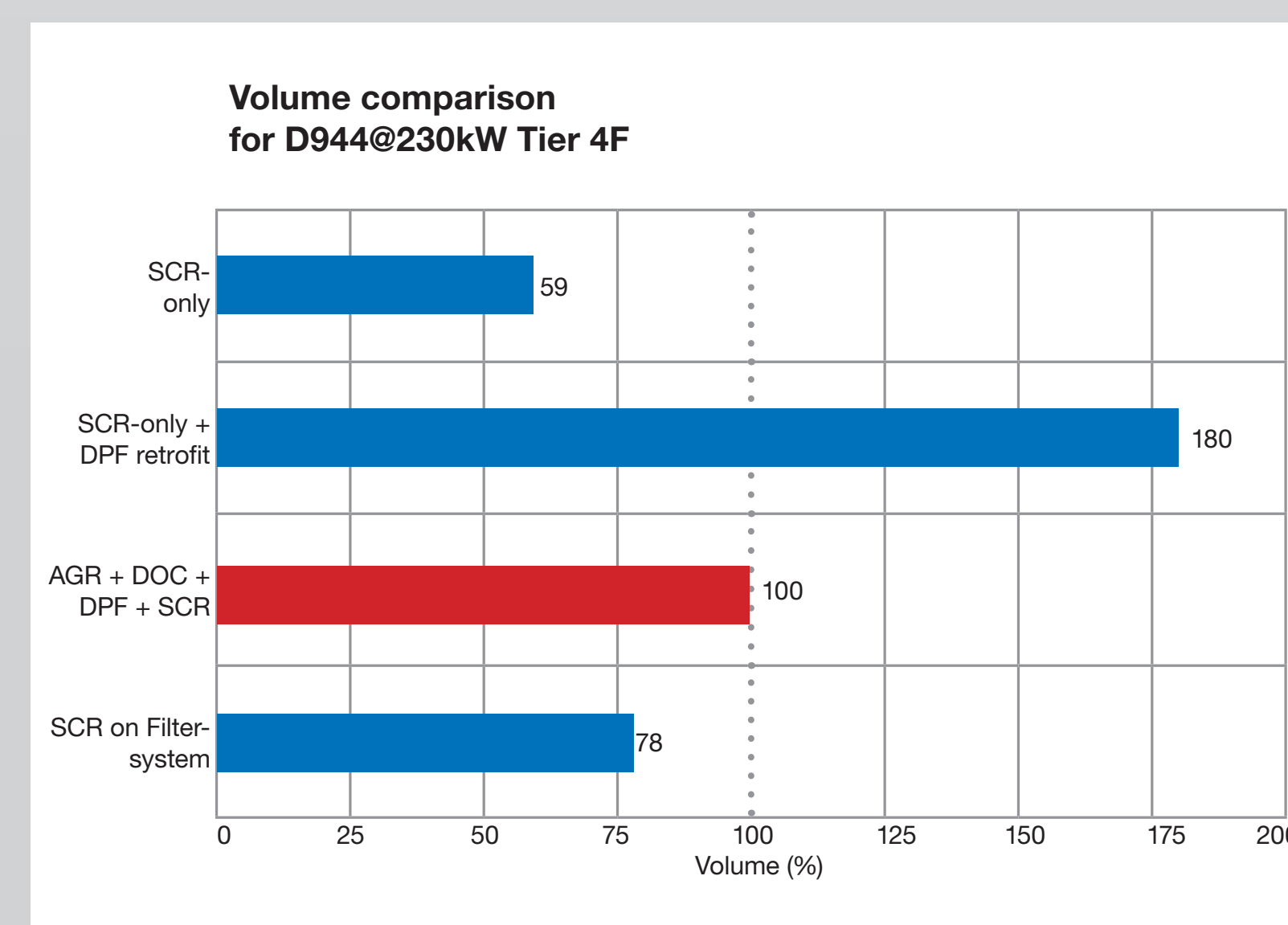
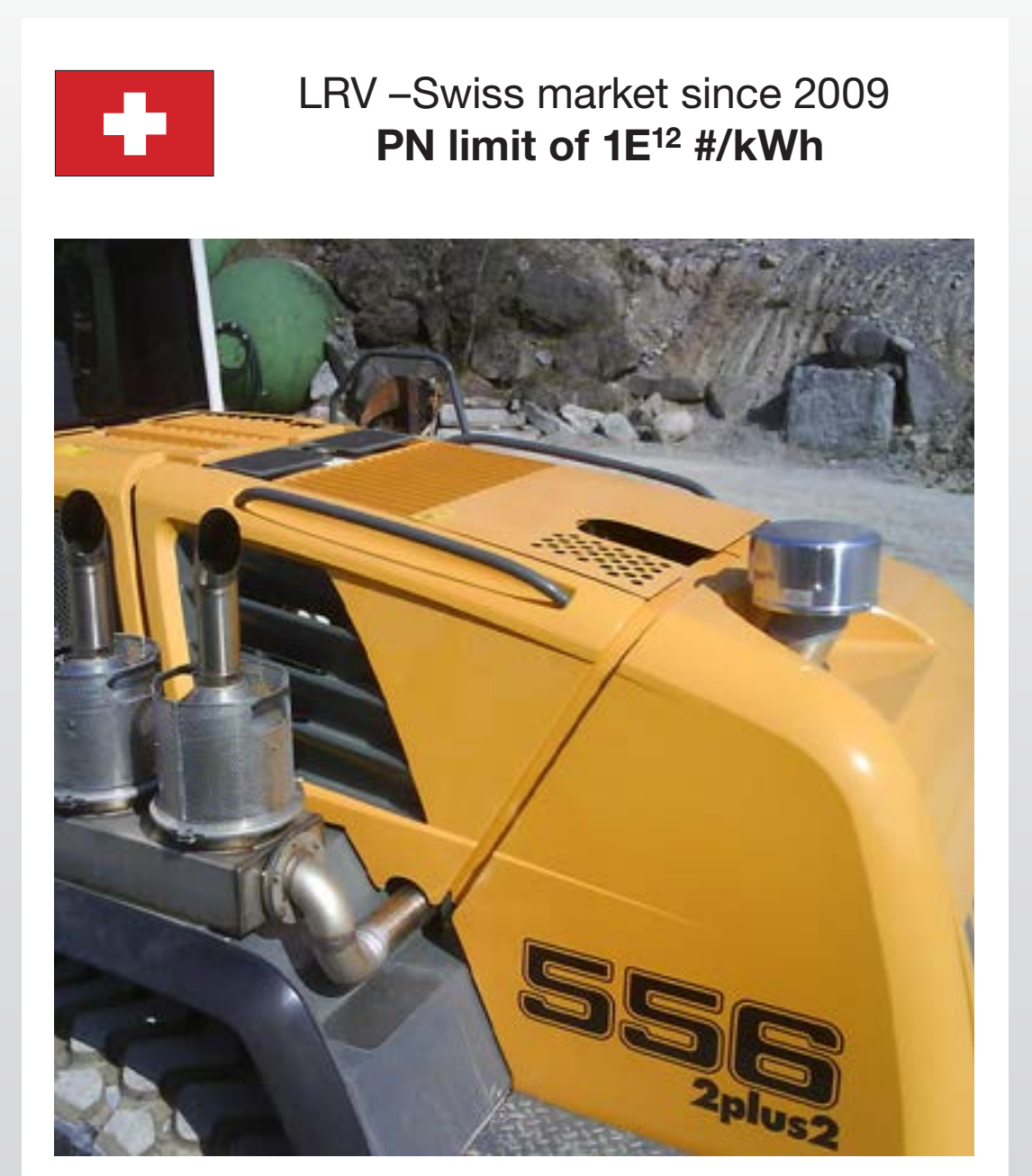
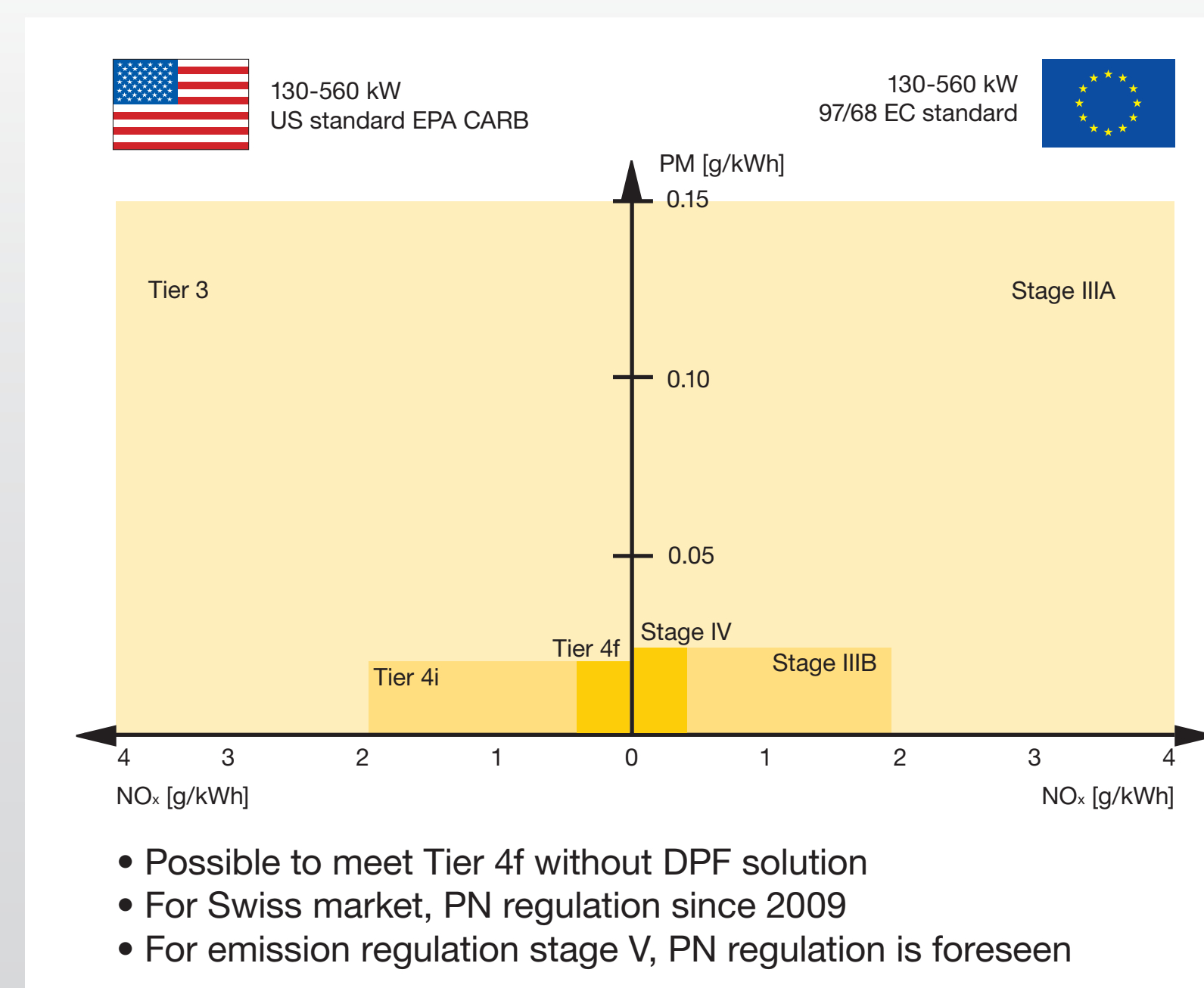
In Switzerland, a different legislation is in place that only allows for particle numbers (PN) lower than  $1E^{12}$  #/kWh. In order to also cover that market, Liebherr had to come up with another solution in addition to SCR-only.

The following options were considered:

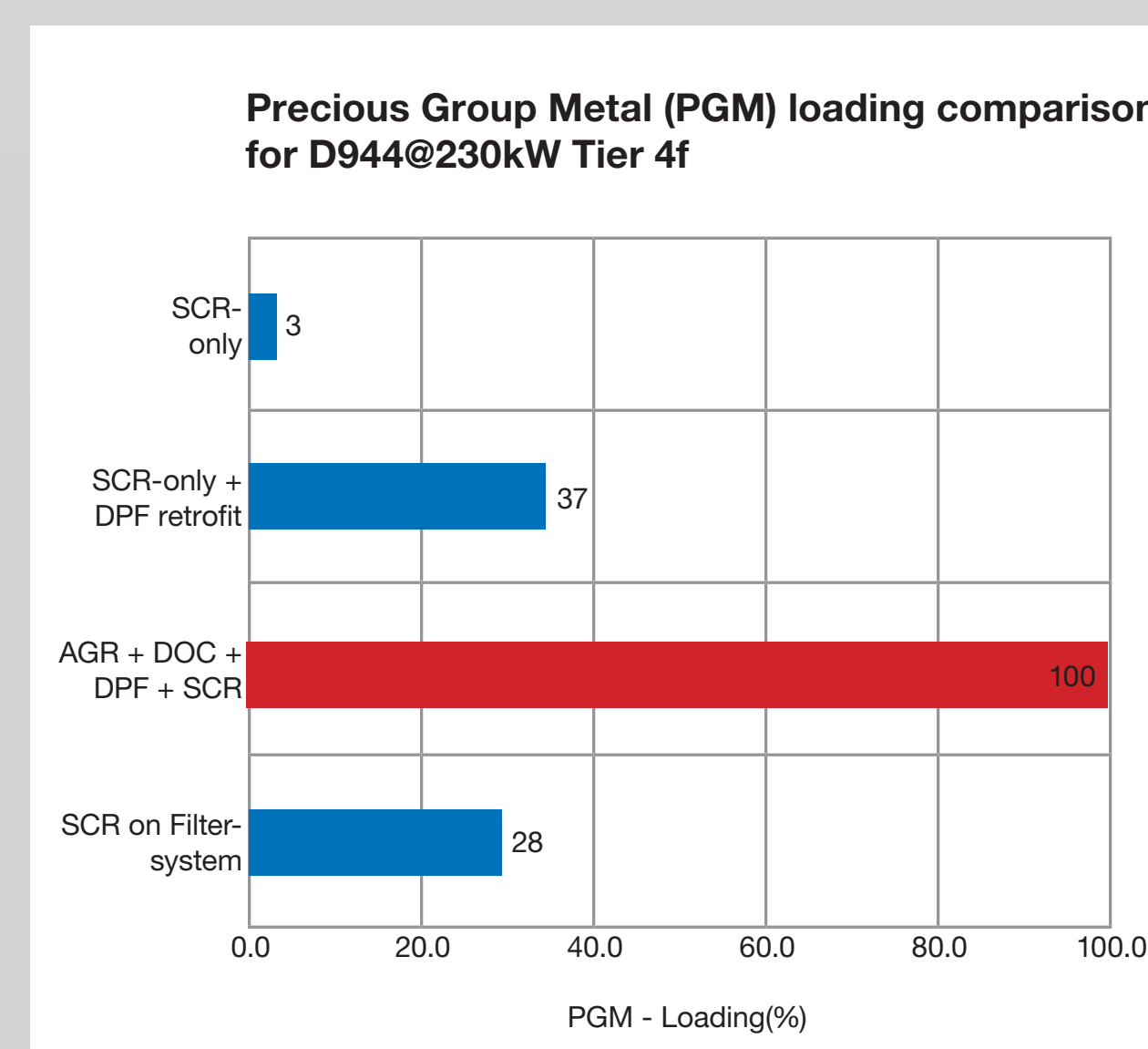
- Installation of a DPF retrofit solution after the SCR-only system
- Development of a new system solution consisting of DOC + DPF + SCR
- Development of a SCR on Filter system

Liebherr decided to develop the SCR on Filter system, mainly for packaging reasons and also because of the involved system costs.

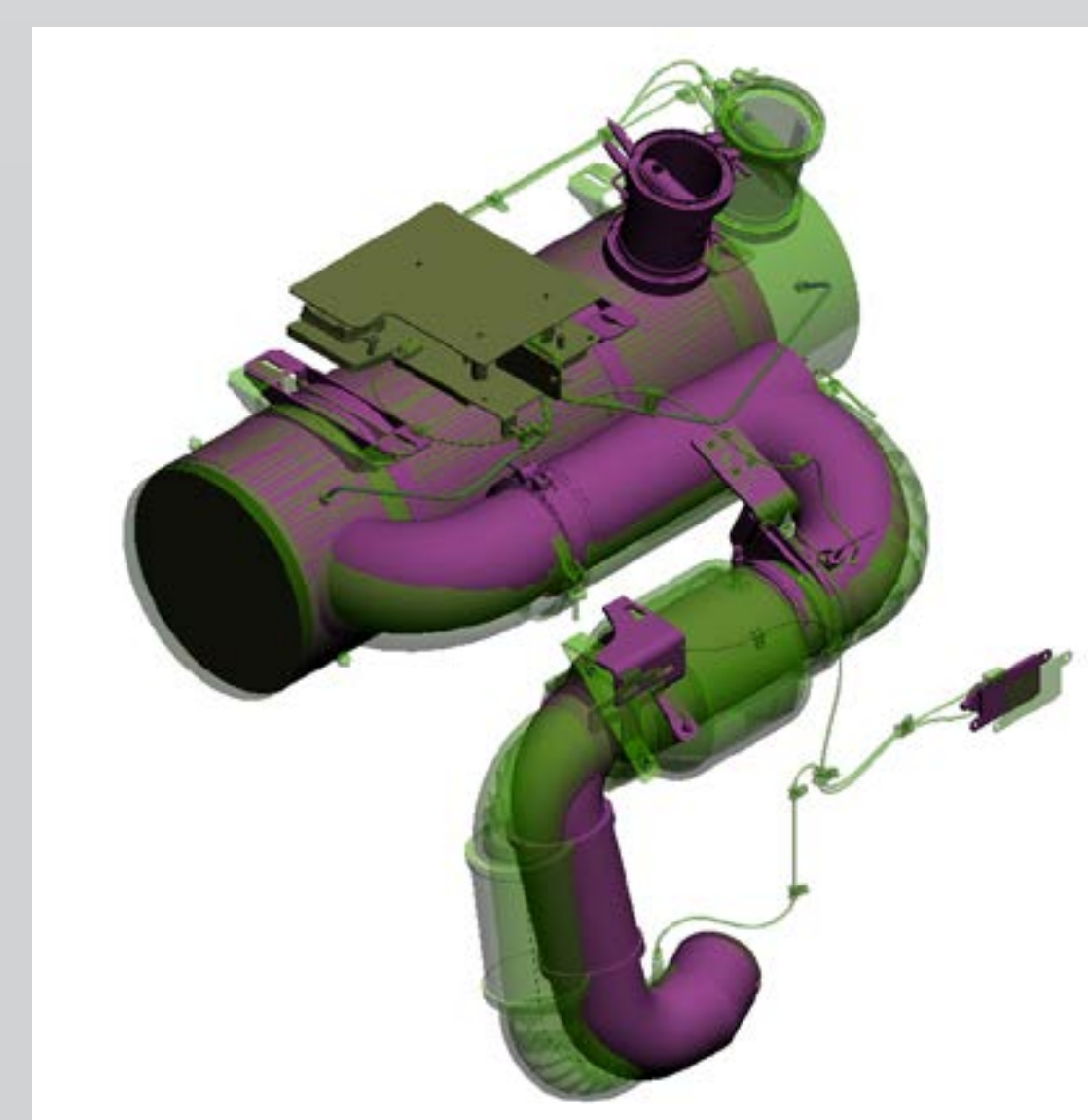
As the SCR on Filter technology has not been used in off-road applications before and might also be a possible solution for an upcoming stage V in the European Community, various validation processes are required.



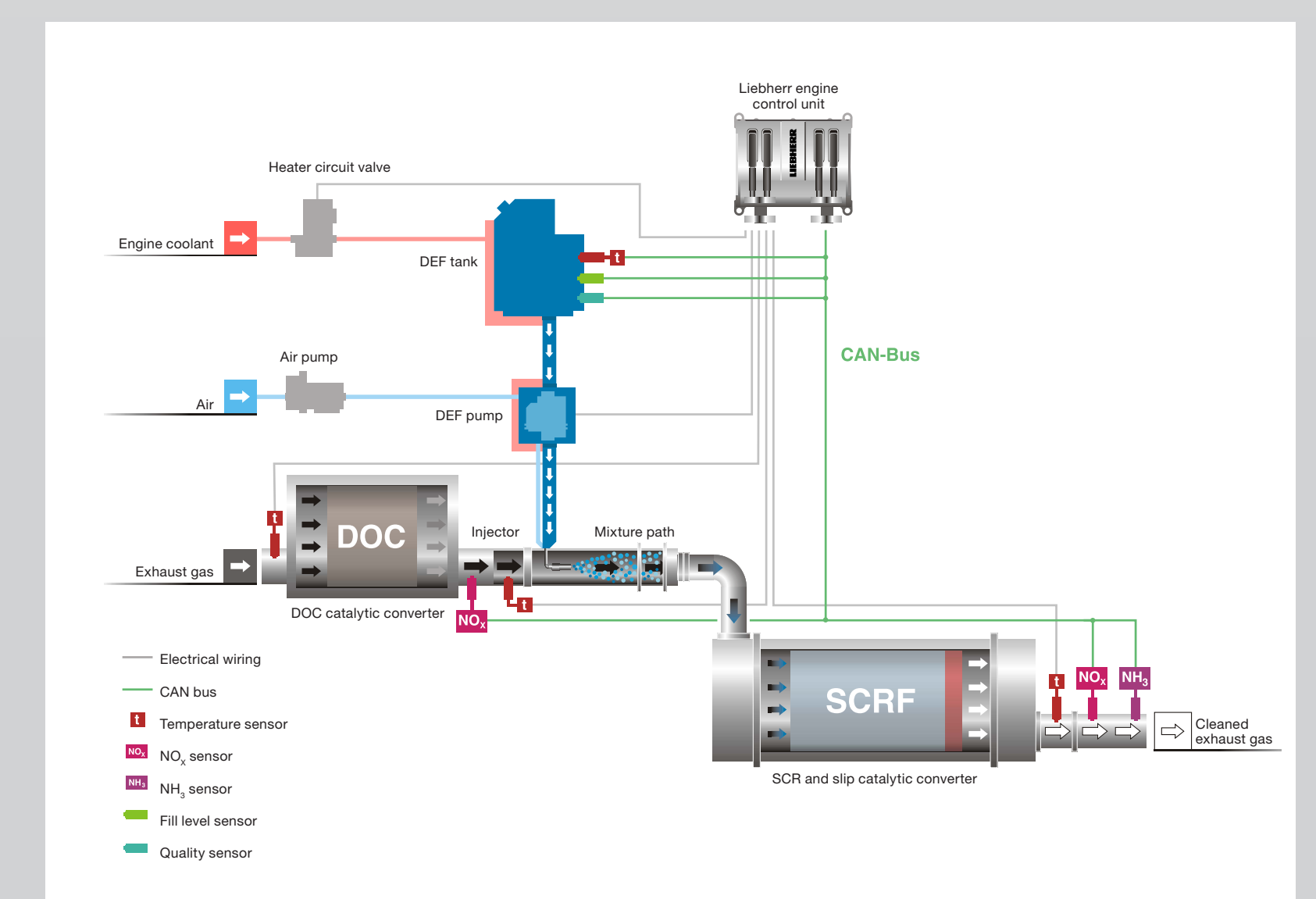
Graph 1: Volume of different EAS-systems for 4-cylinder diesel engine D944 with 230 kW



Graph 2: PGM loading comparison between different EAS solutions



Picture 1: SCR-only (violet) and SCR on Filter™-solution (green) for the same machine



Picture 2: SCR on Filter™-system description

## Opti-SCR™ project

One important question that needs to be answered in the validation process is the impact of biofuel on the functionality of the SCR on Filter system. In order to investigate this effect, an INTERREG France-Suisse funded project (so called Opti-SCR™ project) was started, together with universities and industrial partners in France and Switzerland.

A biofuel was selected and the engine with the SCR on Filter™ system will run for several hours. During this endurance test, measurement checks will be carried out in regular intervals in order to evaluate the performance of the SCR on Filter system.

- FR project carrier
- Test bed capacities
- Testing different fuels
- Test performing/analysing

- CH project carrier
- HW supplier
- Testprogramm definition

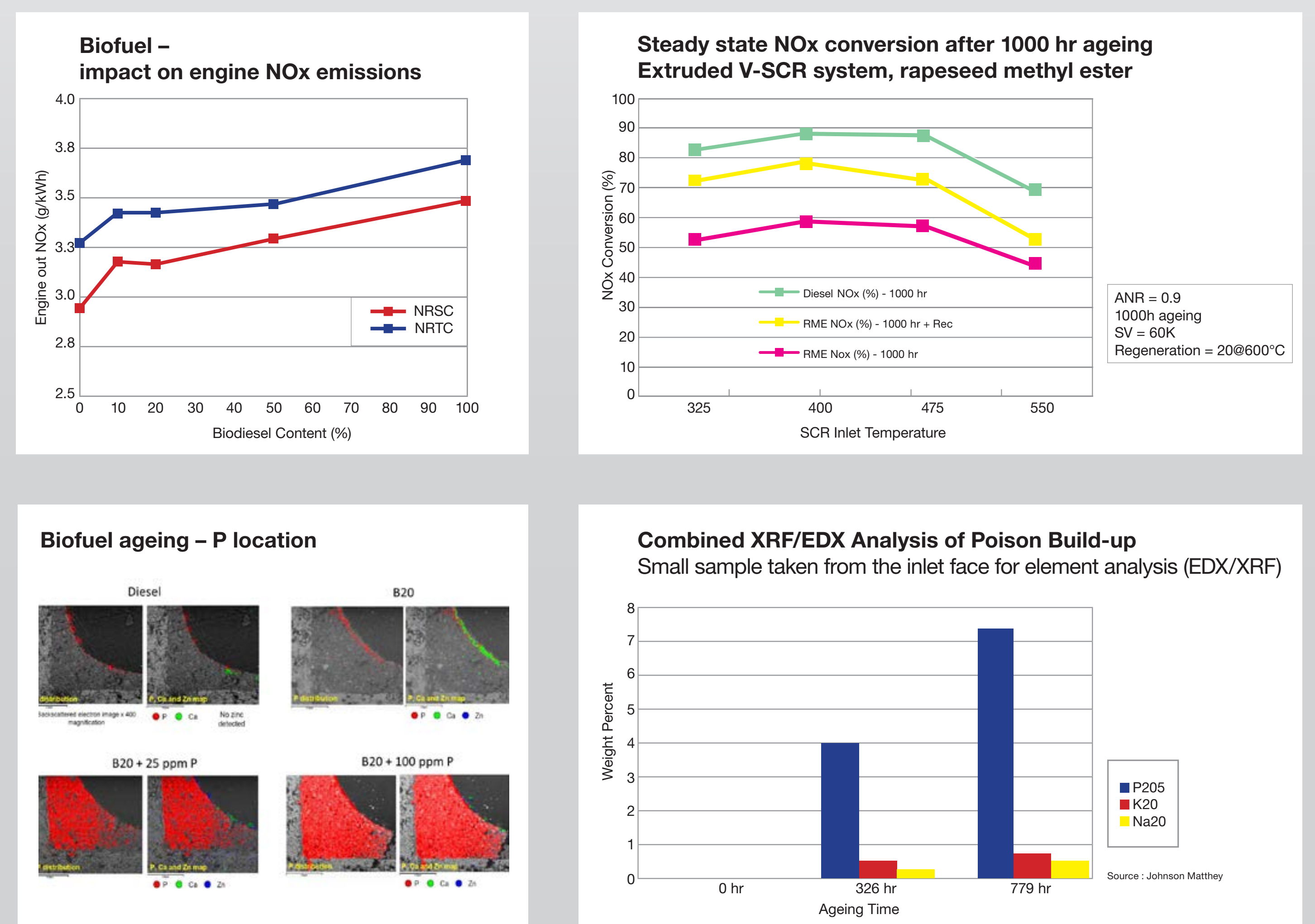
- V SCR catalyst sublimation study (EPA)
- Soot reactivity measurements

- PN Measurements (according to SN 277 206)

## Coating poisoning

It is well known, as shown in the graph below, that biofuel has an impact on the engine out emissions and on the NOx conversion efficiency of the SCR system.

This new system design should give the opportunity to keep the full functionality of the system even if a biofuel like B10 is used. The study included in the Opti-SCR™ project will confirm or disprove of this hypothesis.



## Expected outcome of the Opti-SCR™ project

The project started in November 2013. All necessary tests will be performed at the engine testbench from R&D Moteurs. Some specific measurements and analysis will be done by project partners.

All measurements will be done with a selected biofuel - EU: EN590 and US: ASTM-2D.

The endurance tests will be run only with the biofuel.

The following tests will be performed at 0 hours and after intervals of 500 hours:

- Engine OUT screening
- SCR on Filter system screening
- PN filtration efficiency of the SCR on Filter system. The PN measurement will be done by the Berner Fachhochschule Biel
- SCR on Filter system NOx conversion efficiency

In addition to that, an analysis of the soot reactivity on different customer cycles with the 3 different fuels will be done. The chemical analysis of the soot will be done by the University of Mulhouse.

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