



Key Messages from AMF Research

Annex 50

5/2018

Fuel and Technology Alternatives in Non-Road Engines

**Operating Agent: Swedish Transport Administration,
Partners: Canada, Finland, Germany and Switzerland**

Major Conclusions

Compared with on-road vehicles, especially old non-road mobile machinery are high emitters of local pollutants. However, Annex 50 has shown that the latest emission class, Stage V, results in extremely low emissions during real world operation of non-road mobile machinery. The recommendation is, when possible, to leapfrog directly from less sophisticated technology to Stage V. Alternatively, if sulphur free diesel can't be guaranteed, leapfrogging to Tier 3/Stage IIIA would be the best option. Renewable and advanced drop-in fuels are a viable option to reduce GHG and regulated emissions from both new and existing machinery.

Background

Non-road mobile machinery includes agricultural machinery, forestry machinery, construction equipment and more. Despite its wide use, non-road mobile machinery is lagging behind the road sector in terms of emission performance and energy efficiency. Non-road mobile machinery is often a high emitter of both nitrogen oxides and exhaust particles. However, by applying state of the art emission regulations (calling for sophisticated emission control systems) and advanced motor fuels this could be changed.

Research Protocol

In Annex 50, five contracting parties and more than ten industrial partners cooperated in gathering information regarding emission and fuel consumption performance through measurement, simulation and national emission inventories. New first-line performance data was generated, and emission and fuel consumption measurements were conducted both in laboratory conditions and during real world use of the machines. Several different technology options were investigated in combination with advanced motor fuels. The Annex worked together with the International Council on Clean Transportation (ICCT) on emission regulation and technology options for non-road mobile machinery. Policies in the participating countries were collected and reported.

Key Findings

Key findings from the project can be summarized as follows:

- Non-road mobile machinery fulfilling emission class Stage V delivered extremely low regulated emissions in real world operation
- Countries that can guarantee sulphur free (less than 15 ppm) diesel should leapfrog directly to Stage V emission regulation to get real-life low emissions
 - If sulphur free diesel can't be guaranteed then Tier 3/Stage IIIA gives the best emission performance
- The regulated emissions of non-road mobile machinery are first and foremost determined by the emission control technology, not the fuel
 - Notwithstanding, clean burning fuels like paraffinic diesel can deliver significant reductions in regulated emissions and exhaust toxicity, especially in less sophisticated engines
- CO₂ assessment should be carried out on a well-to-wheel basis, in addition to tailpipe CO₂ emissions
- For selected applications, electrification with low-carbon electricity shows promising potential for reducing both air pollutants and GHG emissions
 - Electrification is unlikely to be able to replace the need for renewable fuels in the foreseeable future
- Stage V in combination with a renewable fuel is a good option for the local environment as well as the climate
- Procurement requirements and environmental zones can assist in reducing local pollutants

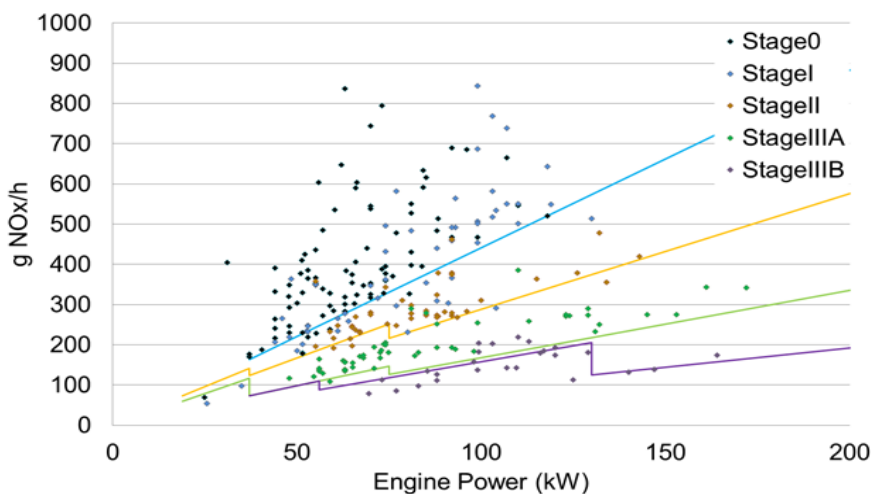


Figure 1. Nitrogen oxide emissions by emission class (identified by colour). The solid lines depict the expected performance of various emission classes. For each colour, dots below the lines represent compliance, dots above the lines non-compliance.