TRANSPORT & ENVIRONMENT

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Briefing

Non-Road Mobile Machinery: The good, the bad and the dirty

Summary

Non-Road Mobile Machinery (NRMM) includes all kinds of internal combustion engines, from the small spark ignition engines used for gardening equipment to very large diesel engines used in mining activities as well as rail and inland water engines. Regulating such a wide range of equipment in a single text required separation of engines into various categories, mainly by power bins, combustion type, and operation profile (constant or variable speed). The new regulation proposal is expected to replace a directive that is more than a decade old and makes modest progress in covering a wider range of engines types and in tackling the issue of particulates emissions. It nevertheless leaves some empty spaces that are likely to create market distortion and favour specific fuel/technologies that cannot be justified.

With engines usually staying in operation for several decades, the new proposal is finally looking at post-market introduction issues, with baby steps towards in-service testing – but with no requirement on existing engines to adopt retrofit equipment to have an earlier impact on air quality. The impact of such a slow implementation in the proposed regulation won't be measurable before 2030, and that is an unacceptably long wait in light of the persistent air quality problems around Europe.

The Non-Road Mobile Machines: Diversity of use and application

NRMM engines are used for many different machines, from the lawnmower to the power generator, going through the railcar and river barges propelled by liquid or gaseous fuels. Construction machines, gen sets, rail and inland water engines are the most significant categories of engines included in NRMM.

The World Health Organisation has said diesel exhaust is carcinogenic, while diesel machines are a major local source of urban air pollution near some railways stations and construction sites. In London, for example, construction machines account for 15% of all PM emissions and 12% of NOx. Air pollution causes 100 million sick days and more than 400,000 premature deaths in Europe every year.

The share of NOx emissions is expected to rise in the coming years as other sectors have reduced their emissions faster.

The low ambition of the NOx emissions limit for NRMM heretofore will make the share of NOx from NRMM rise from 15% to 20% of total NOx emissions between 2005 and 2020[1].

Agricultural tractors fall under a separate directive (EC/167/2013) and must meet the emissions limits from the previous NRMM directive (EC/97/68). Tractors should adopt the revised NRMM emission limits as soon as the proposal is adopted and not remain under the old directive limits.

Other countries are regulating non-road machines, and this proposal is aligning quite closely with the US Tier 4 limits for most pollutants (HC, NOx, CO, PM) that has been phased-in from 2008 to 2014. Most countries are basing their legislation on the US and EU standards,

[1] Arcadis, TML, Impact Assessment Study - Reviewing Directive 97/68/EC - Emissions from non-road mobile machinery, http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/ia_study_on_nrmm-_final_report_-_arcadis_en.pdf

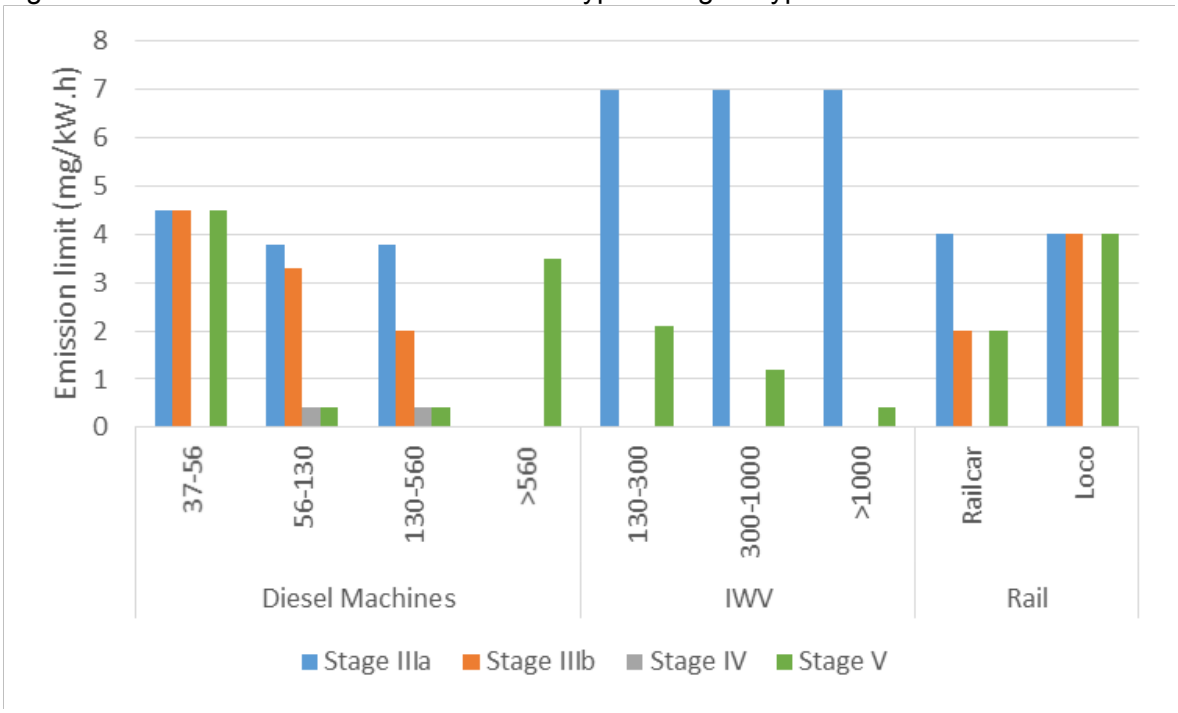
so it is important for Europe to set ambitious targets that would then be adopted all over the world. Switzerland has more stringent regulations on construction machines that require fitting a particulate filter for all engine sizes above 18kW.

The White Paper on transport[2] published by DG MOVE in 2011 calls for a shift from road to rail and water for energy efficiency reasons. It is therefore fundamental that rail and water modes be made as clean as trucks, which is not the case with this proposal. There should not be a trade-off between energy efficiency/climate change and air pollution, as similar emissions limits can be achieved in rail and water with the technologies developed for/by the truck industry.

The evolution of emission limits and the 'forgotten' engine types

The new proposal is expected to enter into force gradually from 2019 to 2021. It won't significantly change NOx emission levels, which are expected to remain broadly constant with existing levels (Figure 1), except for Inland Water Vessels (IWV). The focus in this new proposal is on particulate matter, with a tightening of the PM limits and the introduction of Particulate Number (PN) limits (Figure 2).

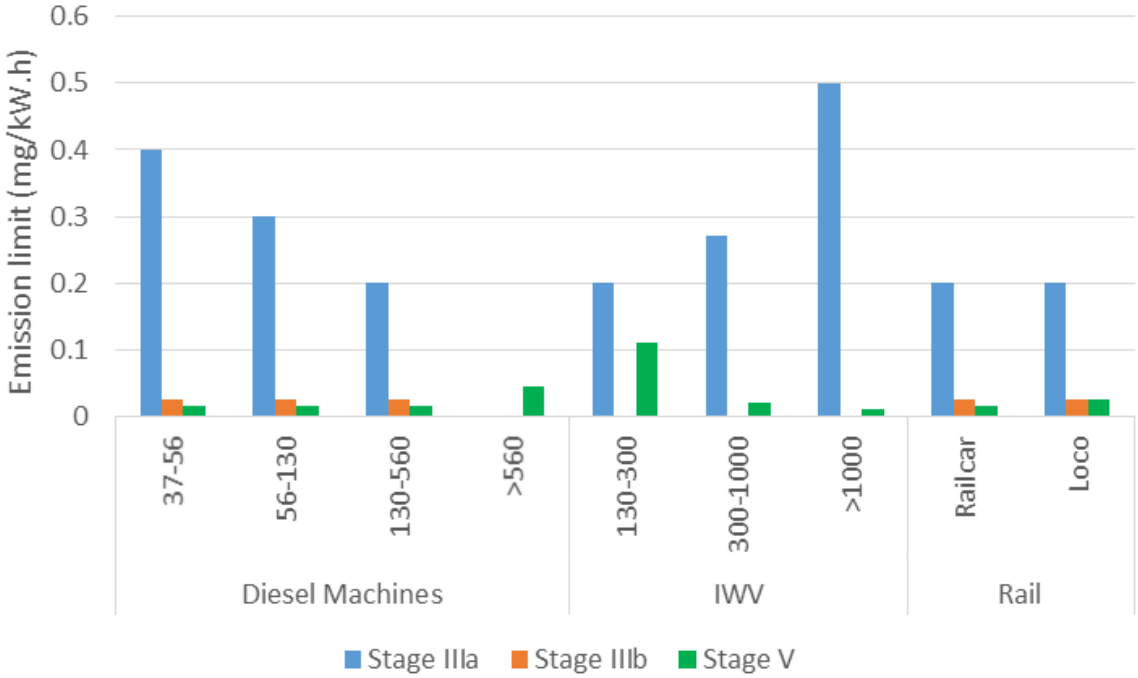
Figure 1: NOx emissions limits evolution for typical engine types



Note: Inland Water Vessels (IWV) categories have changed, so Stage IIIa values are an estimation based on previous categories

[2] http://ec.europa.eu/transport/themes/strategies/2011_white_paper_en.htm

Figure 2: PM emissions limits evolution for typical engine types



Note: Inland Water Vessels (IWV) categories have changed, so Stage IIIa values are an estimation based on previous categories.

For some engine types, there is actually no progress from the last stage of emission limits: diesel locomotives have the same limits in Stage IIIb and the proposed Stage V for all pollutants (and are excluded from the PN limit), and still get a late implementation date in 2021 of stage V that is hard to justify.

New IWV emissions limits are going in the right direction, but will enter into force very late – giving more time to manufacturers to sell polluting engines, as there are no intermediary steps between Stage IIIa and Stage V for this category. Even though IWV engines targets look ambitious for the Stage V proposal, they still fall short of meeting road heavy-duty trucks emissions limits. IWVs would at least need to match the trucks emission limits if they are to be labelled a clean mode of freight transport.

The need for PN limits for all engine types

The major innovation of the Commission proposal is the inclusion of a PN limit for most engine categories that would require the use of a particulate filter. Industry stakeholders stated informally that below 10^{12} particulates/kWh a wall-flow filter is needed to meet the standard. Such particulate filters are more than 99% efficient at reducing particle number emissions as long as the conditions are met on a regular basis to perform the regenerations (which require high exhaust temperature). In order to be consistent with road modes, a limit of $6*10^{11}$ would be more meaningful and is feasible today as most trucks are subjected to such a limit today.

The Commission proposal nevertheless excludes some engines types from fitting a particulate filter. The main categories that are not required to reach a PN limit in the proposal are the large engines >560kW, the small engines for IWV, and the rail locomotives. The justification used by the Commission to exempt such categories is questionable (Table DD) and could lead to significant market bias and distortion that should be avoided in order to have a more predictable and competitive market.

Table DD: Reasons for not exempting some engine categories from having a PN limit

	Engine > 560kW	Engine for IWV<300 kW	Engine for locomotives
Reasons for having a PN limit	- Switzerland already requiring diesel particulate filters for such engines - Similar power IWV engines have a PN limit	- Leisure ship owners less concerned by cost effectiveness - Ship manufacturer would be able to fit 2 engines <300kW into a 600kW boat, leading to potential market distortion	- Diesel locomotives are not likely to be phased out in the foreseeable future - room should not be an issue if a filter can be fitted in a railcar - relevance of a stage 5 emission limit questionable as it is strictly similar to IIIb

Omitting PN limits for certain engines will create a dangerous precedent and is likely to distort the market towards those engines that would be cheaper to buy and to run as they would require less maintenance. A consistent limit of $6*10^{11}$ particles would make all modes on an equal footing and allow for a better harmonisation of engine technologies.

As the technology is ready for all these engines to have a PN limit, the co-decision process should amend the proposal to include all types of engines so as to truly address the particulate problem and its dangerous health effects. Following the WHO statement on diesel fumes being carcinogenic to humans[3]; the World Medical Association recently called for DPF deployment on all combustion engines[4], including retrofitting the existing fleet.

Retrofit and engine replacement to reduce pollutant emissions

NRMM engines, and especially the larger ones that emit a lot of pollutant emissions, have long lifecycles, operating for more than 30 years in many cases. The engine fleet takes a long time to be replaced, and so taking action only on new engines further delays the urgent emission reductions that are required to improve air quality. Retrofitting of exhaust post treatment devices is a common operation for heavy-duty road engines, in the case of diesel particulate filters (DPF). Action on vehicles operating in densely populated areas where a lot of citizens are directly exposed has to be prioritised, and enforced as soon as possible so as to accelerate the introduction of DPFs in the existing fleet of machines.

Switzerland has been very proactive in regulating the particulate emission and requiring DPF in tunnel machines, extending the requirement to all construction sites in the late 2000s. Switzerland has successfully retrofitted many tens of thousands of diesel engines in operation, and is maintaining an online information database to identify filter manufacturers meeting every possible need[5].

Even though the mandate of the European Commission stops once the engine is placed on the market, a proper retrofit strategy should be considered and added in this proposal (for example, by requiring Class IV retrofits following the provisions of UNECE regulation 132 on the approval of Retrofit Emission Control devices (REC)). There is no time to wait for the next NRMM regulation.

[3] www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf
[4] http://www.wma.net/en/30publications/10policies/a21/index.html
[5] Swiss Federal Office for the Environment, 2012, *Less soot from diesel engines, Switzerland's success in reducing emissions*, http://www.bafu.admin.ch/publikationen/publikation/01671/index.html?lang=en&download=NHzLpZig7t,lnp6I0NTU042l2Z6ln1ad1IZn4Z2qZpnO2Yuq2Z6gpJCGfIF_g2ym162dpYbUzd,Gpd6emK2Oz9aGodetmqaN19XI2IdvoaCVZ,s-.pdf

HC for natural gas engines

Another questionable proposal in the draft legislation is the way dual fuel engines are treated; for such engines working on gaseous fuels (mainly natural gas), there is a wide allowance for additional HC (mainly CH4) to be emitted depending on the engines type. For some engines, the HC limit can go from 0.19 g/kWh for a diesel engine to 6.19g/kWh for its natural gas equivalent. That is more than 30 times the limit for diesel engines.

When translating the lax HC limit for natural gas engines into CO2 equivalent, natural gas engines are allowed to emit over 140gCO2eq/kWh more than diesel engines just because they operate on natural gas.

Technology neutrality should prevail and allowing for such a high emission limit on HCs for natural gas cannot be justified.

Implementation calendar and transition scheme

With the co-decision process due to start in 2015, entry into force is expected in early 2016, with mandatory dates of application starting in 2019 for most engines categories, 2020 for engines of 56-130 kW and IWV engines of 300-1000kW, and 2021 for IWV engines >1000kW and engines for rail. In addition to these dates there is a transition scheme to take into account the time difference between the date of manufacture, the date when placed on the market, and the time spent on the market by the machinery before being sold. This adds up to 18 extra months to sell an engine that had been manufactured just before the new legislation entered into force.

So, as it stands, all engines sold will comply with the proposed Stage V by mid-2022 at the latest

This leaves a lot of time and really misses the point of reducing pollutant emissions from fuel combustion. Lead times are very long, and other precedents in the road transport sector show that industry can deliver quickly when requested to meet policy deadlines. With many industrial actors present in both road (where more stringent limits are already in place) and non-road activities, shorter lead times should be sought and implemented.

'In-house' technical services

In anticipation of the Transatlantic Trade and Investment Partnership (TTIP), and to harmonise with the US legislation, Article 46 in the proposal offers the possibility for an engine manufacturer to certify their products in-house. This is a dangerous precedent and is not acceptable as it stands, with very little surveillance and in-service conformity tests currently. Technical services should be separate entities from engine manufacturers, and not only a different department within a company.

T&E has been calling for a European Type Approval authority that would collect and redistribute testing fees in order to ensure proper financial independence of technical services and type approval authorities.

Allowing for in in-house certification would prevent type approval being made independent and trust-worthy. Such provisions should be deleted.

Stepping up the ambition level: T&E's proposals

The Commission's proposal for a new NRMM regulation goes in the right direction but is lacking ambition to really tackle the pollutant emissions from such engines. The implementation process is very slow and only concerns new engines. Emissions reduction effects are not likely to be noticeable for 10 to 15 years. All engines should be covered and a comprehensive retrofitting strategy adopted as soon as possible so that air quality can be improved as soon as the new regulation enters into force.

This proposal also contains inexplicable exemptions for PN limits for certain engine types, and high hydrocarbons limits for gaseous fuels engines that are likely to significantly increase greenhouse gas effect emissions.

The co-decision process should ensure that the market distortion incentives set out in the proposal are addressed to make a more consistent and comprehensive proposal to quickly reduce pollutant emissions for non-road machines in the near future.

To improve the Commission proposal, T&E suggests it should:

1. **Harmonise emission limits of NRMM engines with the ones for heavy-duty trucks:**

T&E proposal

Stage V	Diesel Machines				IWV			Rail		Trucks
g/Kwh	37-56	56-130	130-560	>560	130-300	300-1000	>1000	Railcar	Loco-motive	
PM	0.015	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PN	1E+12	6E+11	6E+11	6E+11	6E+11	6E+11	6E+11	6E+11	6E+11	6E+11
NOx	4.7	0.4	0.4	0.46	0.4	0.4	0.4	0.46	0.46	0.46
HC		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
CO	5	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75

2. **Not favor specific fuel types by allowing higher emission limits:**
   Higher HC limits for natural gas engines should be removed. Natural gas engines can enter the market if they are as clean as other engines types.

3. **Have only one date for entry into force of all engine types:**
   Entering into force on 1 January 2019 leaves sufficient lead-in time given the fact that technology is already available from other markets, in other modes or in other countries.

4. **Make sure the existing fleet also cleans up:**
   Develop a retrofit strategy similar to what happened in Switzerland for tunneling and construction machines. When engines need replacement, make sure the new engine meet the latest emission limit in place.

5. **Reform the test procedure to better reflect real-life operating conditions:**
   More realistic test cycles would allow the delivery of better emission performance where it matters.

For more information

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