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Sustainable Growth and EU 2020
Sustainable Mobility and Automotive Industry

Stakeholder Consultation on the revision of Directive 97/68/EC on emissions from non-road mobile machinery engines

This document does not represent an official position of the European Commission. It is a tool to explore the views of interested parties. The suggestions contained in this document do not prejudge the form and content of any future proposal by the European Commission.

1. Introduction

The main objective of this document prepared by DG Enterprise and Industry is to consult stakeholders on policy options that have been identified for revising Directive 97/68/EC on pollutant emissions from non-road mobile machinery. It also provides an overview of the different issues to be addressed in this next revision and describes the results of background studies and preparatory meetings.

Given that most of the preparatory work is based on information and data which was available before 2010, stakeholders should be given the opportunity to comment on or confirm these policy options, in particular with regard to changes that took place in the aftermath of the economic crisis. The replies to this consultation will provide DG Enterprise and Industry with a broader range of views on the identified policy needs, with the aim of confirming or improving the envisaged approach.

Written replies shall be sent by 8 April 2013 by e-mail to the following address:
entr-nrmm-exhaust-emissions@ec.europa.eu

Replies will be published on the website of DG Enterprise and Industry as received and unedited. More detailed information on how to submit your contribution is available at:
http://ec.europa.eu/enterprise/sectors/automotive/documents/consultations/index_en.htm

It is also intended to organise a **stakeholder hearing on 14 February 2013** in Brussels which will allow stakeholders to present their views on the different policy options described in this consultation document. More detailed information about the hearing event, the date and the venue will be published shortly on the abovementioned consultation page.

The policy options described hereafter only address major changes to the Directive and have been prepared solely for consultative purposes. They do not prejudge the form and content of any future proposal by the European Commission.

2. Background

The adoption of Directive 97/68/EC under the 5th Environmental Action Program provides an important element within the EU Air Quality Policy. It regulates emission of major air pollutants (NOx, HC, PM, CO) from diesel and petrol engines installed in non-road mobile

machinery (NRMM). At the same time it provides harmonised procedures for placing engines on the market, based on type-certification and requires engine marking and information on the engines produced.

Since its adoption in 1997 the Directive was amended several times by:

– Directive 2002/88/EC extending the scope to small petrol engines;

– Directive 2004/26/EC extending the scope to constant speed engines as well as to rail and inland marine engines. New stages IIIA, IIIB and IV have been introduced as well as a flexibility scheme;

– Directive 2011/88/EU revising the flexibility percentage for Stage IIIB engines.

Furthermore, technical adaptations were made in 2001 and in 2010 and a new technical adaptation on Stage IV engine testing was adopted by the Commission on 6 December 2012.

A consolidated version of the Directive 97/68/EC and the amendments to it can be found on our website[1].

3. State of play and further need for action

Despite the limits set by Directive 97/68/EC the total NOx and PM pollutants emitted from NRMM continued to grow. The latest inventory made by the Commission's Joint Research Center (JRC) in 2008 shows that the pollution generated by non-road applications increased considerably between 1990 and 2005 in relative terms. This is the consequence of two factors: on one side the steep increase in the number of non-road machines put into service and on the other side the late introduction of reduction efforts by comparison to the on-road sector.

In order to reverse this trend and to decrease the emissions, subsequent amendments to Directive 97/68/EC, most notably 2004/26/EC introduced multiple further steps of emission reduction stages for existing regulated engine categories and brought other engines into the scope. The JRC Study shows that these further steps can be expected to provide a significant reduction in kilotonnes of pollutant emissions from NRMM over the next decade. Despite these efforts, several problems need to be worked on. One of the problems is that not all categories of NRMM engines are currently covered by the scope of the Directive. Another problem is related to the absence of new emission stages since the Directive was last amended in 2004, which has led to emission requirements for certain engine categories becoming outdated when compared to the state of the art of technology and the developments in the on-road sector.

Directive 2008/50/EC on air quality provides concentration limits that may not be exceeded in urban areas. Most Members States failed to meet these limits in various cities, even considering the flexibilities included in that Directive. As stated in stakeholder meetings on the Revision of the EU Air Quality Policy[2] and the relevant supporting documents, further emission reduction is needed and measures aiming at the reduction at source must be implemented. This approach has also been agreed by the Commission during its debate on the

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1997L0068:20111213:en:PDF
[2] CIRCABC: https://circabc.europa.eu/w/browse/52ca8880-cc08-43fa-b6e0-3ae09e18177c

future of Air Quality Policy[3] [4]. At the same time considerable efforts have been made in other areas and the relative contribution from engines falling under the scope of Directive 97/68/EC becomes more important. The Technical Review Study prepared by the JRC[5] on the development of the emissions inventory from the NRMM sector shows that there is still significant potential for reducing emissions, mainly from engines in lower power bands (< 19 kW) and higher power bands (> 560 kW), constant speed engines and inland waterway vessel engines. Controlling real world emissions may also help improving the air quality. Furthermore, more evidence has been gathered about the health effects of particulate matter. Experts concluded that even the most ambitious levels defined with Stage IV do not guarantee adequate protection from such pollutants. In line with the developments in the on-road sector, the introduction of a new emission stage (Stage V) targeting particle number limits rather than particle mass limits needs to be considered, which should focus on the engines in the power range between 56 and 560 kW which provide by far the largest contribution to NRMM emission. Specific considerations are also needed for emissions of propulsion engines in the inland navigation sector which is falling behind other modes of transport with respect to emissions, and is therefore at risk of losing its traditionally green image if no substantive action is taken.

Furthermore, new emission limits for some specific categories of spark ignited engines such as those used in snowmobiles need to be considered. Alongside the environmental benefits, this would also guarantee a fair treatment of all equivalent power sources on the market and avoid that one technology gains undue advantages due to its exclusion from the Directive compared to regulated ones.

4. Preparatory work

To investigate the different options, check the feasibility and estimate the effects of the revision of Directive 97/68/EC several studies have been carried out. The Technical Review Study prepared by the JRC provides an inventory of NRMM emissions and defines different policy options for reducing emissions from specific engine types and their application.

Furthermore, a comprehensive impact study was carried out by Arcadis N.V. on the monetised impacts of the policy options developed by the JRC. In addition, two complementary studies have been undertaken to further assess, on one side, the impacts of a possible inclusion of the rail and the inland navigation sectors in the flexibility scheme, and on the other side the impact on SMEs, including the amendment of the flexibility scheme's percentage.

These studies highlighted a number of uncertainties on how the proposed options may translate into practice. For this reason, stakeholder meetings were held under the GEME expert group during 2010[6], during which some 60 text proposals on the different chapters covered by the JRC and Arcadis reports were developed. In 2011, a specific impact study has been commissioned with Risk & Policy Analyses Ltd. on new emission limits for constant speed engines.

[3] Summary debate: http://ec.europa.eu/transparency/regdoc/rep/10061/2011/EN/10061-2011-1944-EN-F-0.Pdf
[4] Press release: http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/31
[5] JRC, (2008), Technical Review of NRMM Directive
http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/final_report_nrmm_review_part_i_en.pdf
[6] CIRCABC: https://circabc.europa.eu/w/browse/57232555-1ae6-4eb4-bad2-35a236725afc

Finally, a complementary assessment of policy options targeted at the inland navigation sector is being finalised by PANTEIA which analyses various additional options for emission standards for the inland navigation sector along with an assessment of the various technologies which would allow achieving these standards.

5. Content of the revision

5.1 Extension of the scope

For land-based machines, the Directive covers only compression ignition (CI) engines between 18 kW and 560 kW. Smaller and larger engines, which are currently not covered, represent together 10% and 14% respectively of NOx and PM emissions from non-road mobile machinery[7] [8]. As the regulated engines will significantly decrease their emissions thanks to the already adopted Stages IIIB and IV, these unregulated engines will gain more relative importance.

Engines of more than 560 kW represent the overwhelming part of these emissions. Considering the difference in cost between regulated engines below 560 kW and the more powerful unregulated engines just above, many manufacturers will be tempted to migrate to the cheaper unregulated ones thus further increasing emissions and distorting the market. This is why these categories should contribute to the emission reduction effort.

While the more powerful machines such as harvesters, dozers or mining equipment are mostly used in rural areas, the smallest engines are frequently used in urban areas. Therefore, in order to meet the objective of the EU Air Quality policy for reducing pollutants emission, the scope of the Directive should be extended to smaller and larger engines.

5.1.1 Including CI engines below 19 kW

The category below 19 kW can be subdivided into two categories: 8-19 kW and below 8 kW.

For the power band between 8 and 19 kW market forces and third-country legislation (US, Japan) have already led to a shift towards lower emission engines. It can thus be assumed that new EU limits could be achieved at very low cost, as the necessary R&D activities have already been carried out. The introduction of EU limits would impose certain type approval costs, but these are likely to be offset by the benefits that internationally harmonised limits would create for EU manufacturers. Tighter limits than those already applied in other world regions would, however, imply additional R&D costs and the loss of harmonisation with important external markets, in particular the transatlantic market. This would negatively affect the return on investment.

For engines below 8 kW it appears appropriate to set EU limits that are aligned to major third markets, such as the U.S. and Japan. This would allow for realising the environmental benefits of already available and partly implemented technologies without hampering export opportunities. In order to accommodate the certification costs for very small diesel engines

[7] JRC, (2008), Technical Review of NRMM Directive http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/final_report_nrmm_review_part_ii_en.pdf, Arcadis, (2010), Impact Assessment: Reviewing Directive 97/68/EC, http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/ia_study_on_nrmm-_final_report_-_arcadis_en.pdf

[8] or 0,8% and 0,7% of the total NOx and PM emissions in the EU27

(i.e. below 8kW) and to keep the measure proportionate to the expected emission reduction, a simplified conformity assessment module could be considered. Instead of the usual type approval approach, the engines manufacturer could, for example, be allowed to opt for the Internal Production Control Module for placing the engine on the EU market.

According to the Arcadis Impact Study (2010) the total monetised environmental gain of this extension of the Directive that would result from the decrease in NOx and PM emissions is 703 million euro. Since the compliance costs are only estimated at 15 million euro, the environmental gains clearly outweigh the costs of including the whole category below 19 kW in the Directive[9]. This calculation is based on the general type approval requirements involving a technical service conducting the type approval tests and the overall gains should increase if the manufacturers choose the Internal Production Control Module. In order to avoid that some SMEs are negatively affected by this measure, the flexibility scheme could be extended to these new engine categories.

5.1.2 Including engines over 560 kW

Engines with power greater than 560 kW used in applications other than rail and inland navigation are also currently not covered by the Directive. Still they are accountable for 9% of the NOx and 12% of the PM emissions from NRMM engines[10] and a significant emission reduction could be achieved in this segment. However, the bulk of this reduction at source would occur outside of urban areas. Setting limits for this category would also avoid market distortions that are likely to arise when major differences in permissible emission levels exist between adjacent power bands. The GEME working group developed two different options, one where the same limits would apply as for the engines between 130 and 560 kW and one where the limits of engines above 560 kW will be aligned with the U.S.[11]. Both options would lead to very important monetised environmental gains (6365 million euro for the first and 4664 million euro for the second). The inclusion of engines over 560 kW would also help to safeguard the functioning of the Internal Market. Without a harmonised European approach to this engine category, Member States may feel the need to impose their own limits, which could result in a fragmentation of the regulatory requirements within the European Union. The alignment of EU limits with the ones in the U.S., as foreseen in option 2, can also be expected to stimulate exports.

Among the negative consequences of new limits are the expected compliance costs resulting from the need to install aftertreatment systems. Increased fuel or urea consumption is also a factor that is to be taken into account in this context. However, as most European producers who are active in this market segment have already developed engines for export to regulated third markets, or supply engines for installation on railcars, the bulk of the necessary investment in R&D has already been made. The maximum estimate of compliance costs for U.S. alignment are 419 million euro, which is much less than the estimated 4664 million euro

[9] Arcadis, (2010), Impact Assessment: Reviewing Directive 97/68/EC, http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/ia_study_on_nrmm-_final_report_-_arcadis_en.pdf

[10] JRC, (2008), Technical Review of NRMM Directive http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/final_report_nrmm_review_part_ii_en.pdf

[11] JRC, (2008), Technical Review of NRMM Directive http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/final_report_nrmm_review_part_ii_en.pdf

in environmental gains[12]. The compliance costs of the other option are estimated at 2091 million euro. The cost of aftertreatment systems has decreased since these estimates were made and the currently available technologies used in railcars and trucks are technically capable of meeting even more stringent limits.

The GEME Working Group also discussed the benefit of two distinct sets of limit values for power bands from 560 – 800 kW and above 800 kW, but from that discussion a consensus emerged favouring a simplified approach with only one set of limit values. The GEME Working Group also concluded that there are practically no applications above 2000 kW and therefore no need for an upper limit.

5.1.3 Including stationary engines

Stationary engines are currently not covered by the Directive. However, these engines are manufactured on the same production lines and mostly with the same design as engines[13] used in mobile machinery. The only difference being that stationary engines are used in immobile applications and that they are not subject to the stricter NRMM emission requirements as a result. Due to environmental concerns, some Member States already started to develop national regulations concerning stationary engines[14].

In order to pursue the Directive's objectives of reducing air pollution and to safeguard the integrity of the Internal Market, it appears necessary to extend the Directive's scope to stationary engines. The feedback received from industry indicates that the compliance costs would be negligible for all engines for which mobile applications are already regulated today[15]. In contrast, the monetised environmental benefit would be around 377 million euro for emergency engines alone. In this context, the possibility of different limits for emergency engines, i.e. engines that are run for a limited number of hours per year (85% of the generator market) and non emergency engines could be further explored. Non emergency use engines could be subject to the most advanced equivalent NRMM engine stage, while emergency stationary engines could be subject to a simpler technology that would enable them to comply with Stage IIIA, which is considered the best emission level which does not require sophisticated after-treatment systems. An upper limit of the power range covered should also respect the distinction already made in the Gothenburg Protocol on Long-range Trans-boundary Air Pollution Prevention.

5.1.4 Including large spark ignited engines

Spark ignited (SI) engines above 19 kW are presently excluded from the Directive as they have no significant presence in NRMM and they are mostly imported from third countries. The professional users of machinery in the EU prefer to have a single fuel for all machines, including relatively small ones, mostly diesel as handling petrol on a work site can have potentially severe health and safety implications. However, the planned setting of Stage IV like limits for diesel engines between 19 and 37 kW could potentially encourage the use the cheaper SI engines imported from third countries without any exhaust emission control.

[12] Arcadis, (2010), Impact Assessment: Reviewing Directive 97/68/EC, http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/ia_study_on_nrmm-_final_report_-_arcadis_en.pdf

[13] constant and variable speed

[14] Germany: http://www.bmu.de/files/pdfs/allgemein/application/pdf/taluft.pdf, p99 and GEME Working group 12-5-2011

[15] Calculation based on Stage IIIA.

The resulting difference in price and ease of installation could affect the present user preference for diesel engines with potentially negative environmental and economic effects. The new Regulations on T (agricultural or forestry tractors) and L (Mopeds, Motorcycles, Motor Tricycles and Quadricycles) category vehicles have been recently adopted and are expected to be published in the Official Journal in February 2013 (application date January 2016). They allow for full flexibility for manufacturers of All Terrain Vehicles (ATV) and Side-by-Side (SbS) vehicles and a certain share of these vehicles will continue to be outside the scope of the T and L Regulations (if vehicles are exclusively used off public roads). **It is thus deemed necessary to address the resulting gap in emission legislation with the revision of Directive 97/68/EC.**

5.1.5 Including snowmobile engines

As with spark ignited engines above 19 kW, engines for snowmobiles are currently excluded from the Directive. Snowmobiles are used for both recreational and professional use and are exclusively powered by spark-ignited engines. These engines can be significant emitters of pollutants locally, particularly of HC and CO. In Canada and the USA emissions from snowmobiles are regulated through out-phasing of conventional two-stroke engines, thus promoting the use of direct fuel injection two-stroke technology or conversion to four-stroke engines. As snowmobile engine emissions are currently not subject to EU emission legislation, certain Member States could see the need to impose their own limits. This could result in different requirements within the European Union and potentially also deviate from the existing requirements in Canada and the USA, which are, by far, the biggest snowmobile markets. Therefore, **the setting of EU emission limits appears necessary for snowmobile engines.** The compliance cost for a regulation, harmonised with the requirements in Canada and U.S., would be insignificant as compliant products are already available on the market. However, there might be a shift in the products offered to the market from low cost high polluting, conventional two-stroke engines to direct fuel injection two-stroke technology and conversion to four-stroke engine. The additional costs may be offset by the advantage of preventing cheap imports from third parties which are often illegal copies of Japanese, North American or European engines breaching intellectual property rights

5.2 Introduction of new stages

5.2.1 Constant speed engines

Constant speed engines in most power bands are currently regulated, with the exception of the engines below 19 kW and above 560 kW. 95% of the engines within this range are used in generator sets. Since these machines emit significant amounts of NOx and PM[16] the application of a more stringent emission stage could be expected to lead to important societal benefits.

The two main options investigated so far are to align the limits with US limits or have the same limits as EU Stage IV emissions for NRMM. With the exception of the categories 37-56 kW and above 560 kW these limits are the same. As a result, compliance costs for both

[16] JRC, (2008), Technical Review of NRMM Directive
http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/final_report_nrmm_review_part_ii_en.pdf

options are estimated to be around 1.4 million euro for engine manufacturers[17]. These costs consist mainly of R&D, capital and operating costs. For OEMs and end users the effects are harder to estimate, but can be expected to be significant. The OEM market is characterised by a few big firms and many SMEs[18]. However, the R&D intensity is relatively low, which means that SMEs would not necessarily be more affected than larger firms. With the option to allow the type approval of constant speed engines within variable speed engine families, there wouldn't be any additional type approval and development costs. From a competitiveness perspective, the main advantages would be that exports from unregulated low cost countries would likely decrease and exporting to the U.S. would become easier.

The background study estimated the environmental benefits of an alignment with the U.S. at 4343 million euro for the period until 2050 assuming that all the new limits would come into force in 2015 and 2016. The differences between US tier 4 final and EU Stage IV environmental impacts are negligible compared to the overall benefit. It should also be noted that the different supply characteristics of 50 Hz and 60 Hz on the EU and U.S. market are limiting the opportunity for a common product.

5.2.2 Stage IV/V for Inland Waterway Vessels (IWV)

Since 2007 engines used in IWV are subject to Stage IIIA emission requirements. Despite this measure the atmospheric pollution from inland shipping remains significant with 17% of the overall non-road emissions and with high concentration levels in certain harbours and cities. It should also be noted that around 9 out of 10 IWV in the EU are registered in Belgium, the Netherlands, Germany and France where the environmental impacts are more intense. The European Commission already emphasised in the past that improving the environmental performance of this transport mode is a priority for EU Transport Policy and that options will be examined to achieve by 2020 an overall performance regarding emissions levels for inland waterway transport that is better or at least comparable to the performance of road transport[19].

The introduction of a future emission Stage IV/V plays a central role in these considerations and would complement other policy actions planned by DG MOVE on inland shipping. **The purpose of these actions is to improve the environmental performance of IWT in comparison with road transport.** The Central Commission for Navigation on the Rhine (option 1) as well as EUROMOT (option 2), who represent a part of the industry, suggested possible stage IV limits which were investigated by Arcadis. Further emission limits corresponding to Stage IV and V have been examined by PANTEIA as the aforementioned standards would not allow to close the gap with road transport in terms of environmental performance by 2020.

The Arcadis Impact Study concluded that the environmental benefits (respectively 2804 and 1979 million euro) calculated on the basis of emission limits which were less ambitious than those finally agreed and promoted by industry, outweigh the related compliance costs (respectively 2138 and 1145 million euro) for industry[20]. The compliance costs consist of the R&D investment, higher maintenance, urea and fuel (with SCR there is a fuel consumption

[17] RPA & Arcadis, (2010), A study in the view of the revision Directive 68/97/EC on NRMM, http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/finrep-mod1_en.pdf
[18] EUROMOT
[19] NAIADES project: http://ec.europa.eu/transport/inland/promotion/doc/2012_0168_final_swd.pdf
[20] Arcadis, (2010), Impact Assessment: Reviewing Directive 97/68/EC, http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/ia_study_on_nrmm-_final_report_-_arcadis_en.pdf

reduction and the additional urea cost is lower than the fuel cost reduction) consumption and the costs of complex aftertreatment systems. The results of the cost benefit analysis indicate that option 2 suggested by EUROMOT would have a higher cost/benefit ratio. Another concern expressed was that if stricter limits as defined in option 1 were introduced, the prices of IWV might increase to the extend that manufacturing firms might decide to leave the market, as the European market could be too small to justify the investment.

The analysis made by PANTEIA in 2012/early2013 finds that in the baseline scenario, 81% of the external costs comes from larger vessels (110m) and pushboats, which also have the most powerful engines. Setting stage V emission limits in this category would yield environmental benefits of up to 22000 million euro. This valuation is based upon a more detailed and updated analysis of the external cost savings compared to the Arcadis impact study. Such level of emission limits can be complied with by applying various technologies. If market operators were to choose the LNG technology to achieve the emission limits, the study concludes that the total net cost of investment plus operation would be lower than for the business as usual scenario and for the scenarios based upon Stage IV emission limits, implying that both the air quality and the economic operators would stand to gain. LNG technology is furthermore attracting a high interest from both the maritime and IWT sectors and significant efforts are being made to adopt the required safety standards for LNG. The benefit/cost ratio of deploying LNG is, however, not the same for all vessel/engine categories. For the smallest vessel, cost at current prices may even outweigh the societal benefits.

It is important to note that the IWV manufacturers, dealers and end users markets are dominated by SMEs and often by micro companies. For example, one-vessel enterprises make up 70% of the market. Another research project showed that there are no competitive disadvantages for SMEs when implementing the new legislation[21]. However, problems can arise when new engines become too expensive and no capital can be raised. It may therefore be necessary to consider flanking measures to facilitate access to capital. Especially since the IWT sector has been heavily affected by the economic crisis during the last years. It should also be noted that, if higher compliance costs would be passed through to the end consumers this might further contribute to a modal shift towards road transport. Conversely, lower operation costs due to the introduction of LNG technology might render IWT more attractive compared to road transport.

The key question is whether Stage V emissions limits for larger engine categories would trigger innovation such as the accelerated deployment of LNG technology and whether for certain engine categories the introduction of stage IV levels may be skipped in favour of immediately introducing Stage V emission limits. Stakeholder views on the framework conditions for this innovation to happen and on lead time needed for introducing Stage V levels would be particularly appreciated.

5.2.3 Stage IV 19-37KW

Stage IIIA is in place for engines between 19-37 kW since 2007, while the U.S. and Japan have stricter limits for these types of engines. These differences can create trade barriers for firms that want to export to these markets. From 2013 onwards the U.S. will apply even more stringent limits that again will increase the difference in limits significantly. On top of that it

[21] Arcadis, (2010a), SME test study and IA on possible options for reviewing the Directive 97/68/EC relating to NRMM, http://ec.europa.eu/enterprise/sectors/mechanical/files/nrmm/final_report_sme_test_nrmm_2010_03_29_en.pdf

is expected that the injection equipment that has been used so far in Stage IIIA engines will not be manufactured any more due to the small numbers of engines produced, at least for the EU market. On the other hand, low cost electronically controlled injection systems will be available and will make the step towards low emissions engines more affordable also in this power band. At this point there is no benefit; neither for the environment nor for industry to have a double stage approach to "stage IV stringency" limits and alignment with US Tier 4 final levels in one step would result in a decrease of PM emissions by more than 90%. Industry clearly prefers the new emission limits to be the same as the new US standards as this would reduce the trade barriers and allow manufacturers to use economies of scale. It, therefore, appears appropriate to introduce Stage IV limits for 19-37 kW engines which are aligned to the 2013 U.S. standards. It can be reasonably expected that compliance costs[22] remain low and are outweighed by environmental benefits. Furthermore, no problems with the ability to comply are expected by engine producers and machinery manufacturers. Since the 19-37 kW band is considered a global market and dominated by larger companies, the only SMEs affected will be those in the machine manufacturing. However, given the limited impact on engine prices and installation challenges, no problems are expected for SMEs. **It is understood that sufficient lead time for industry would be required. Stakeholder views on the timing of this transition would, therefore, be particularly welcome.**

5.2.4 New emission limits - Stage V

The particulate matter emitted by combustion engines has come to the forefront of the discussion on health effects of diesel soot through epidemiological research. Within this context, ultrafine particles have come to the centre of attention. In June 2012, the WHO reviewed the scientific evidence on the cancer-causing potential of diesel exhaust emissions and issued an official statement highlighting the relationship between diesel particle emissions and the development of cancer in humans, insisting on very low emission limits. One of the consequences is that current measurement techniques solely based on particle mass, no longer appear to be appropriate. In the future, it will be necessary to replace these techniques by particle number (PN) measurement. New measurement protocols will be required to assess these ultrafine particles emissions by number counting, like those already in place for light-duty and heavy-duty vehicles. This solution would also allow for tackling the problem of ultrafine particles emitted in the non-road sector which has been raised by the European Parliament and the Council which mandated the Commission[23] to address this issue in the revision of Directive 97/68/EC.

The engine and after-treatment technology necessary to meet this challenge is already available today and, to a large extent, is already applied by many manufacturers producing 130 – 560 kW NRMM engines. Information gathered on current market trends for non-road Stage IV engines shows a decreasing trend of closed filters being used. It is thus possible to reach the required Stage IV particle limits by redesigning engines, but without a control on the number of particles emitted. Action on this aspect becomes thus even more urgent to guarantee the health benefit of the legislation and it is suggested to provide new PN limits. In exploratory meetings held in 2011, Member States and industry acknowledged the feasibility of such limits under the condition that a lead time of at least 5 years between Stage IV and this so-called Stage V is provided. Industry and Member States, however, did highlight the need to demonstrate the cost-effectiveness of such a measure. Participants also expressed the

[22] EUROMOT and CECE
[23] Directive 2011/88/EU, Recital 2

view that the focus should be on the power categories from 56 – 560 kW arguing that this would result in the most effective contribution to emission reduction.

Due to urgency of the health considerations, it will be necessary to establish the exact particle number limit directly through the planned revision of the Directive. As a result, the approach may need to be closely aligned to the one taken by the Commission for Euro VI heavy duty emission limits. Stakeholder views on this, or any viable alternatives, would be particularly welcome.

5.2.5 In-service conformity

Air pollution is influenced by real equipment operation rather than test bed performance. For some vehicle types it has been demonstrated that, despite more stringent emission limits, the anticipated environmental benefits are not confirmed in practice. Electronic engine management systems do not necessarily guarantee that a good performance in the test laboratory is reflected in real use. For this reason, legislation has been developed in the heavy duty sector which is aimed at monitoring, via limited sampling, the emission performance of engines installed on machines performing normal work and over their service life. It appears appropriate to develop similar procedures for the non-road sector based on on-board measurements and with compliance criteria derived from a scientific assessment. Preliminary work on this issue is ongoing, coordinated by DG JRC (PEMS Project – The European Project on Portable Emissions Measurement Systems) and with the support of industry. The goal is to develop detailed test protocols and conformity factors. **The planned revision of the NRMM Directive should, at least, include the basic parameters of a process leading to the introduction of in-service conformity requirements.**

5.3 Exemptions, derogations and transitional measures

The transition to new emission limits often requires industry to redesign engines and machines, change production lines, acquire additional after treatment equipment or liquidate existing stocks. Different provisions are currently included in the Directive to make the transition towards next stages smoother and to address some specific needs of the different economic operators in the non-road market. The provisions currently included in the Directive are: transitional period; sell-off of stock provision; end of series provision and the flexibility scheme.

5.3.1 Description of the provisions

- Flexibility scheme

The flexibility scheme is an optional measure which allows non-road mobile machinery manufacturers (OEM) to derogate from the requirements of the Directive so as to avoid peaks of investment and resources necessary to manage the product redesign and relative production investments corresponding to changes between successive stages. This scheme defines per power category the number of engines an OEM may purchase in order to continue producing and placing on the market machines still fitted with engines meeting the stage immediately preceding the one in force. The flexibility scheme is limited in time and the number of engines is either determined by a percentage of historic sales figures, or, for small manufacturers, a fixed quantity.

– Sell-off of stock provision (Article 9.4a)

The sell-off provision is a transitional measure which offers to the engine manufacturer the possibility to place on the market engines produced before the end of a given stage during the first two years of validity of the next successive stage. These engines may further be used by OEMs to be installed at any time into the machine and placed on the market or registered (if applicable) without any further restriction.

– End of series

This measure allows for depleting stocks of engines in the sales network after a new stage has come into force. This is a typical "vehicle" transition clause that is not suitable for the placing on the market approach of the Directive and in fact it has never been applied. The unanimous opinion is to delete it.

5.3.2 Discussion and proposal

The combined effects of these provisions have created serious concerns both at Member State level and within industry.

On one side, excessive stocks have been reported, normally at the OEMs, after a new stage becomes applicable, which cause an undefined delay of the actual application of a new stage. This is mainly due to the significant price differential, which for Stage IIIB engines compared to Stage IIIA engines is estimated at 50%, which clearly induces OEMs to stock enough engines to skip this stage and develop their products directly for e.g. Stage IV. This abnormal increase of stocks results in unmanageable production cycles for engine manufacturers with severe economic consequences. One of the effects on engine manufacturers is a longer payback period on the investment made for developing new stage engines. There is also a negative effect on the environment, because the effective entry into force of a new emission stage is factually delayed. Member States are particularly concerned about the fact that they do not have any control over the quantity of engines involved and the resulting delay of the actual implementation of a new stage. Discussions in the European Parliament and Council on increased flexibility provisions to support industry during the economic crisis (Directive 2011/88/EU) brought these issues to the forefront. As a result, some Member States started a discussion in GEME to find possible alternative solutions.

Considering that the new stages foreseen as part of the revision of the Directive are unlikely to impose the same challenges as Stages IIIB and IV, it appears appropriate to maintain the transition system largely unchanged, but to introduce some minor provisions which allow a better control of the engines placed on the market and help to avoid significant stockpiling.

Firstly, it appears useful, like for US EPA, to add the month and year of engine manufacture to the other markings required by Section 3 of Annex I. This will allow improving the traceability of engines. **Secondly, it needs to be considered to introduce a clear time limit for the installation of sell-off engines, placing on the market of NRMM fitted with such engines.** This period may need to be limited to two years after the new stage becomes applicable, so as to minimise stockpiling. As agreed by the European Parliament and the Council, the flexibility percentage should remain at 20%. The discussion with Member states highlighted the need to clarify which legal entity is allowed to apply for flexibility. In order to avoid that different entities belonging to the same group apply for separate flexibility

schemes based on the total amount of sales, and thus getting an unfair advantage over their competitors, it may be useful to introduce the requirement that each application specifies any parent or subsidiary entity belonging to the same group. Similar provisions have been adopted by US EPA in Rule 40 CFR 1039.625.

5.4 Other Issues

- Simplification and better legislation

Since the adoption of the Directive in 1997 significant progress has been made at UNECE level in developing a globally harmonised standard for testing non-road engines. The result is now published in form of Regulation 96 (R96) on approval procedures for tractors and non-road mobile machinery, together with test cycles and approval procedures. **In the future, it is recommended to use the UNECE process in the most efficient way to maintain the test specifications and adopt new specifications where necessary, e.g. for new Stages. At the same time a major simplification of the Directive could be made by simply referring to the relevant UNECE measures.**

Recently, several Member States expressed the view that the legal act should be changed into a Regulation which would facilitate transposition, ensure more uniform application across Member States and could potentially speed up technical adaptations in the future. This would also offer the opportunity to consolidate the amendments to the Directive adopted since 1997 into an integrated text. The adoption of the New Legislative Framework, to the extent allowed by the Directive which is based on an "old approach structure", may also be necessary to provide adequate requirements for the economic operators and market surveillance.

- Alternative fuels

Alternative fuel engines based on ethanol, dual fuel (gas-liquid mixture) or gas (natural or bio gas) are currently not covered by the Directive. The market for such engines is however expected to increase rapidly over the next decade and alternative fuel engines may represent a considerable source of pollution in the future, if these engines are not appropriately designed and operated. Member States may take action to address this situation in the absence of a harmonised EU wide approach. **The definition of appropriate type approval criteria for such engines could also facilitate the introduction of alternative fuels. For this reason, the inclusion of alternative fuel engines into the scope of the Directive needs to be considered.** Such a step has already been discussed and stakeholders generally approve of it.

Summary table*

Section	Title	Comment
		Emission levels expressed in g/kWh
	CI - variable speed engines	
5.1.1	CI engines 0 – 8 kW	EPA Tier 4: CO: 8; NOx+HC: 7.5; PM: 0.6; alternative internal production control
	CI engines 8 – 19 kW	EPA Tier 4: CO: 6.6; NOx+HC: 7.5; PM: 0.40
5.1.2	CI engines > 560 kW	EPA Tier 4: CO: 3.5; HC: 0.19 NOx: 3.5; PM: 0.045
5.2.3	CI engines 19 – 37 kW	CO: 5.5; NOx+HC: 4.7; PM: 0.025
5.2.2	CI engines for IWV	Combined alignment with EPA Tier 3; EPA Tier 4 and IMO Tier III. See Appendix 1 for details.
	CI - constant speed engines	
5.2.1	All CI engines from 0 kW; no upper power limit	Alignment with EPA Tier 4
	CI engines 0-8 kW	CO: 8; NOx+HC: 7.5; PM: 0.6
	CI engines 8-19 kW	CO: 6.6; NOx+HC: 7.5; PM: 0.40
	CI engines 19-37 kW	CO: 5.5; NOx+HC: 4.7; PM: 0.025
	CI engines 37-56 kW	CO: 5; NOx+HC: 4.7; PM: 0.025
	CI engines 56 – 130 kW	CO: 5; HC: 0.19 NOx: 0.4; PM: 0.025
	CI engines 130 – 560 kW	CO: 3.5; HC: 0.19 NOx: 0.4; PM: 0.025
	CI engines P > 560 kW	CO: 3.5; HC: 0.19 NOx: 0.67; PM: 0.035
	CI - stationary engines	
5.1.3	CI engines < 5 MW thermal	New Stage IV aligned with mobile machinery engines (constant speed > 560 kW)
	CI engines 0-8 kW	CO: 8; NOx+HC: 7.5; PM: 0.6
	CI engines 8-19 kW	CO: 6.6; NOx+HC: 7.5; PM: 0.40
	CI engines 19-37 kW	CO: 5.5; NOx+HC: 4.7; PM: 0.025
	CI engines 37-56 kW	CO: 5; NOx+HC: 4.7; PM: 0.025
	CI engines 56 – 130 kW	CO: 5; HC: 0.19 NOx: 0.4; PM: 0.025
	CI engines 130 – 560 kW	CO: 3.5; HC: 0.19 NOx: 0.4; PM: 0.025
	CI engines 560 kW – 5 MWth	CO: 3.5; HC: 0.19; NOx: 0.67; PM: 0.035
	SI – petrol engines	
5.1.4	SI engines 19 – 56 kW	CO: 0.85; NOx: 1.4; HC: 0.16
5.1.5	SI snowmobiles	EPA Stage II CO: 275; HC 75
5.3	***Derogations and transition clauses***	
	New Marking	An engine production date shall be added to the engine marking for all engines (Annex I; section 3) to improve traceability of engines.
	Flexibility - Art 10 (7)	No change to the principles; as a response to MS request a new definition of legal entity applying for flexibility will be added (Annex XIII) Duration of flexibility schemes limited to 3 years.
	Sell-off – Art 8 (4) (a)	No change
	End of series – Art 10 (2)	To be deleted
	End date for derogations and transition clauses (for engine use)	No placing on the market of machines allowed: after two years with sell-off engines and after three years with flex engines

*The values included in this summary table include approximations that resulted from the preparatory activities carried out so far and require confirmation and further fine-tuning.

Appendix 1
Limit values for Stage IV Inland Waterways Vessels Engines

Category: swept volume/net power (SV/P) (litres per cylinder/kW)	Carbon monoxide (CO) (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (HC+NOx) (g/kWh)	Hydrocarbons (HC) (g/kWh)	Oxides of nitrogen (NOx) (g/kWh)	Particulates (PT) (g/kWh)
W1: SV < 0;9 and 37 kW ≤ P ≤ 75 kW	5.0	4.7			0.30
W2: SV < 0;9 and 75 kW ≤ P ≤ 130kW	5.0	5.4			0.14
W3: 0;9 ≤ SV < 1;2 and 37 kW ≤ P ≤ 130kW	3.5	5.4			0.12
W4: SV < 1;2 and 37 kW ≤ P ≤ 130 kW	3.5	5.6			0.11
W5: 130 kW ≤ P ≤ 600 kW	3.5		1.0	2.1	0.11
W6: 600 kW ≤ P ≤ 1400 kW	3.5		0.19	1.8	0.045
W7: 1400 kW ≤ P ≤ 3700 kW	3.5		0.19	1.8	0.045
W8: 3700 kW < P				See note (1)	

(1) NOx limit given by formula below

3.4 g/kWh when n is less than 130 rpm;
9 · n(-0.2) g/kWh when n is 130 or more but less than 2000 rpm; and
2.0 g/kWh when n is 2000 rpm or more;