The European Association of Internal
Combustion Engine Manufacturers

EUROMOT

EUROMOT POSITION

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20 YEARS Promoting Engine in Society

Comments regarding the review of smaller combustion plants carried out under the Industrial Emissions Directive

1. Introduction

In the context of the review of small combustion plants below 50 MWth as foreseen by Article 73, 2 (a) of the Industrial Emissions Directive, AMEC Environment & Infrastructure UK Ltd prepared the "*Final Report: Collection and analysis of data to support the Commission in reporting in line with Article 73(2) of Directive 2010/75/EU on industrial emissions on the need to control emissions from the combustion of fuels in installations with a total rated thermal input below 50 MW*" dated July 2012 for the European Commission (AMEC Report).

EUROMOT has tried to analyse this report. In general, we found the report to be difficult to read and understand especially when one of the most important reference papers for stationary internal combustion engine plants – VITO (2011): "*Beste Beshikbare Technieken (BBT) voor niuwe, kleine en middelgrote stookinstallaties, stationaire motoren en gasturbines gestookt met fossiele brandstoffen*" dated September 2011 – is **available only in Dutch language**. Taking into account the language issue and the extremely short deadline over the holiday season, we are at this stage only able to give limited feedback on some major issues we have detected in the AMEC (2012) and VITO (2011) reports. For a more comprehensive feedback a translation into English of all relevant documents including the above mentioned Flamish report are needed in order to enable all stakeholders to make a proper review the material.

In the sections below we comment the available secondary emission technology for internal combustion engines, cost aspects and on the used CAFE factors.

2. Damage cost factors

In the report made by AMEC (2012) CAFE damage cost functions have been used to derive indicative benefits of the achieved emission reductions. In figure 5.5 (on page 66) the costs and benefits of option 2a ("most stringent Member State national legislation" with comparisons of different sensitivity analyses) are shown.

The results of the AMEC report (2012) contain big uncertainties and limitations due to following issues:

- Often only partial data was provided by member states and extrapolations to cover missing data were needed to be done
- The quality of data: Some member state data was rough or approximate and it is highly questionable whether the data provided is realistic.
- For the main analyses it was assumed that < 50 MWth plants all are based on boilers. A sensitivity analyses that assumes all liquid and gas fired plants to be stationary engines have also been assessed.

The report makes following statement (AMEC 2012, p. 58):

"*The results suggest that monetized benefits outweigh the cost across all quantified options and across all capacity classes. When comparing low costs with low benefits and high costs with high benefits.* ***When comparing high costs against low benefits, the cost exceed the benefits: in option 2a for the 1 – 5 MWth and 20-50 MWth capacity classes*** *..* and in option 3 for the 20 - 50 MWth capacity class*..*".

In the AMEC study, the used **CAFE** damage cost factor numbers **are not shown**. According to source /1/ the CAFE factors may vary substantially, see table at page ii: e.g. NOx cost range varies by 270 %, PM2.5 almost by 290 %, etc.
Therefore it is important to state what CAFE factors were used in the AMEC study!

The British Interdepartmental Group on Costs and Benefits (IGCB) **Air quality damage costs per tonne are given in table at** http://www.defra.gov.uk/environment/quality/air/air-quality/economic/damage/ **and these differ substantially from CAFÉ –** for example for NOx:

- IGCB: "Central estimate" 955 British pounds = about 1170 Euro/tonnes
- CAFE: "VOLY Mean" 8200 Euro/tonnes

The difference **between the two damage factors** is more than **700 percent!**
The impact of the chosen damage factor can also be seen from the British document /3/: **when comparing the CAFE and IGCB damage cost factor impacts, a big difference can be seen in on page 23 , depending on the chosen emission pollutant the CAFE factor gives an about 6 to 7 times higher cost benefit figure than the IGCB damage factor !**

Conclusion:

As the European Union covers a large diverse area consisting of city and rural areas with different existing air qualities/needs and emission impacts, it is necessary to prepare a cost benefit analysis also taking into account other damage factors and not just focusing on the conservative CAFE damage factor. Due to the large uncertainties of the study, it is necessary to prepare a comparison between low benefit and high costs as the AMEC report also states as one option in the report. This report shows (despite the conservative CAFE damage factor) an overall – sometimes questionable benefit – of ruling combustion installations below 50 MWth. In our opinion a comparison needs to be prepared using also other damage factors than CAFE such as IGCB to ensure a more realistic analysis and to avoid drawing costly wrong conclusions and implementing policy measures which cannot fulfil the hoped for environmental benefits.

3. Available abatement technologies and cost impact

As mentioned above, the Vito (2011) study is only available in the Dutch language and thus we have not been able to study it in detail. Nevertheless, we try to comment based on our understanding of the text.

In table 5.10 on page 64 of the AMEC study, an abatement matrix is given for engine plants:

- For PM removal bag filter is in the list with a 90 % abatement efficiency
- For NOx removal SCR is listed for liquid fuels with a 90 - 95 % abatement efficiency dependent on size of plant. For natural gas fired engines advanced lean burn with a 50 % NOx abatement and SCR with a 90 % abatement are listed.
- For SO_2 removal dry FGD is in the list with a 70 – 80 % abatement efficiency dependent on plant size.

Vito (2011) document:

PM:

It is important to note that the emission concentration reference point of 5 vol-% O_2 is not suitable for stationary engines /6/ and actually in IED 2010/75/EU Directive I a reference point of 15 % O_2 is used for lean burn gas engine units! For the sake of clarity and comparability to the industrial emissions directive and international stationary engine legislation, we have converted the proposed VITO (2011) limit values to 15% O_2 in the following text.

In table 40 of chapter 6.1.3: A **BAT limit for PM is 20 mg/Nm^3 (5 % O_2) = 7.5 mg/Nm^3 (15 % O_2)** is proposed.

EUROMOT comment: This is definitively NOT BAT (see also Euromot reference /7/ pages 4 – 7), there is no suitable secondary technique available for bigger stationary liquid fired engines especially when operating on Heavy Fuel Oil (HFO)!). The EU LCP BREF /8/ table 6.48 on page 405 prescribes as BAT for a big (> 50 MWth) liquid fired diesel engine plant consisting of several **$\geq$ 15 MWth** engine units following PM BAT limits:

- o 30 mg/Nm^3 (15 % O_2) for light fuel oil (LFO)
- o 50 mg/Nm$_3$ (15 % O_2) for heavy fuel oil (HFO)

In chapter 6.1.5 "b. Stationary engines" of the VITO study is stated (translated into English): "*In reducing dust emissions from diesel engines powered by fuel oil,* ***only a soot filter*** *is a "recognized" technique. It could be considered BAT, but only with sufficient operating hours ... Experience from abroad (the* ***Netherlands*** *for example) indicates that soot filters are increasingly used and are therefore in principle also achievable in Flanders ..*" .

EUROMOT comment: From source /7/ can be seen that operation of a bag filter in context with an oil fired diesel engine is rather complicated (cooling of flue gas temperature needed, etc.) and reduction rate is heavily dependent of the formed "filter cake" thickness on the filter surface. Thus **the 7.5 mg/Nm^3 (15 % O_2) VITO BAT limit is not achievable in most bag filter cases.** We are not aware of any bag filter installations in the Netherlands in context with a liquid fired diesel engine and we really hope that in the VITO (2011) report does not confuse it with diesel particle trap/filter (DPF). A prerequisite for a DPF is ultra low sulphur diesel (ULSD) with a maximum Sulphur content of 10 - 15 ppm S = 0.001 .. 0.0015 wt-% S oil which normal LFO (max. 0.1 wt-% S) and HFO (max. 1.00 wt-%) used in power production in diesel engines exceed substantially!

Conclusion of PM:

EU LCP BREF BAT limits are about 4 to 7 times higher (dependent on fuel type) than the VITO (2011) proposed BAT limit for small plants ! I.e. VITO (2011) proposed limit is BEYOND BAT ! Describe secondary BAT technology performance is not correct.

NOx:

The stationary gas engine category > 5 MWth (table 39 in VITO (2011) document) has a very stricty NOx limit of 50 mg/Nm^3 (5 % O_2) = **about 19 mg/Nm^3 (15 % O_2)** which is achievable only with usage of SCR. To note is that the IED 2010/75/EU Directive stipulates for **big** (> 50 MWth) gas engine plants the BAT NOx-limit 75 mg/Nm^3 (15 % O_2), i.e. a limit **about 4 times higher** ! To also note is that the NOx limit (table 43 in VITO (2011)) set for a gas turbine (< 50 MWth) operating > 360 h/year is s 50 mg/Nm^3 (15 % O_2) i.e. an about 2.7 times higher **limit** than set to the small stationary gas engine !

For the liquid fired stationary engine > 5 MWth the NOx limit in table 40 (HFO) of the VITO (2011) report is set to 250 mg/Nm^3 (5 % O_2) = **about 94 mg/Nm^3 (15 % O_2)** achievable only with a SCR with a very high reduction efficiency ! In table 41 (LFO) NOx limit is for a > 5 MWth engine set to 200 mg/Nm^3 (5 % O_2) = **about 75 mg/Nm^3 (15 % O_2) only achievable with an efficient catalyst.**

Note that for the gas turbine unit (< 50 MWth) (in VITO (2011)) NOx limits in liquid/gas modes are such that these can be fulfilled by primary measures. For peak operated (< 360 h/year) gas turbines a separate much higher NOx limit is granted (this option is not existing for stationary engines. Grid peaking is a big potential business segment for stationary engines due to their excellent part load efficiency and fast start up capability, etc.)!

EUROMOT Conclusion of NOx:

The NOx limits for the stationary gas engine plant < 50 MWth proposed in the VITO (2011) report go beyond BAT and are not balanced when comparing with other limits! These NOx emission limit values for the gas fired stationary engine are only achievable when using a big, expensive, efficient SCR and the limit values are more than 2.7 times stricter than for the gas turbine in gas mode. The liquid fired gas turbine NOx limits are in general achievable by primary measures but liquid fired stationary engines have to use very big, expensive and highly efficient SCR:s for compliance. For the stationary engine the grid peaking option (limited running hours/year) is left out but existing for gas turbines. This does not offer a balanced approach.

SO_2:

In table 41, for the 20 - 50 MWth plant a SO_2 limit of 10 mg/Nm^3 (5 % O_2) = about 3.4 ppm-v (5 % O_2) = 1 - 2 ppm-v (actual O_2) is stipulated with a 1 % S HFO fuel. This means that an about 99.4 % SO2 reduction rate is needed in the FGD (**F**lue **G**as **D**esulfurization plant), this is far above the 70.. 80 % reduction efficiency mentioned above ! **A dry FGD (same as semidry FGD ?) cannot reach this kind (> 99 %) of desulphurization rate !**

EUROMOT Conclusion of SO_2:

The proposed limits are far BEYOND BAT !

Cost Impact:

On page 66 of the AMEC study comparisons of the sensitivity analyses on option 2a are done. In figure 5.5 the stationary engine only option is marked as “vi”. When comparing option “vi” to “2a” one can observe that the high cost alternative for alternative “vi” is always lower than boiler option “2a”. In UNECE Document /4/ pages 10 – 12 SCR operating costs for liquid fired stationary engines at different NOx reduction efficiencies are given, it can be seen that in context with liquid fuels the operation and maintenance cost impact of the SCR is very high. In Euromot document /5/ on pages 8 – 9 it is shown that the cost impact Euro/MWhe is **3 to 9 times higher for a stationary diesel engine compared to the boiler case.**

A bigger (> 5 MWth) stationary engine exhaust gas contains a much higher oxygen content than a boiler flue gas /6/ this means that the size of the secondary abatement equipment such as a Flue Gas desulpfurization (FGD) unit will be bigger and **thus also the investment cost compared to a similar sized liquid fired boiler plant case.**

EUROMOT Conclusion:

The cost impact figures for stationary engine have to be checked! It seems questionable whether the maximum costs which are shown to be lower than for the “boiler only” case are correct.

4. Overall Conclusion

In EUROMOT’s opinion there is a need to update the AMEC study and base the stationary engine plant conclusions on the available technologies for different engine types and not only focus on high speed non road engines

Similarly an overall cost benefit analyses has to be prepared which also applies other damage factors than the over conservative CAFE factors (above the British IGCB is given as an alternative) otherwise there is a high risk that wrong conclusions are drawn which do not consider the needs of the different regions in the EU.

In the AMEC document pages 33 – 34 the Gothenburgh strict NOx emission limits are mentioned for the stationary engines **but the important flexibility mechanisms in the Protocol in order to make the limits more cost-efficient and at the same time considering the environment need are forgotten**. This important information should be added to the text otherwise the Protocol limits will be wrongly applied !

In this position paper, it has been shown that it the VITO (2011) study does not describe larger stationary engine units above 5 MWe correctly. It appears that the focus was rather on smaller non-road reciprocating engines which are smaller in unit size and normally operate on ultraclean liquid fuels and can thus adopt different abatement techniques e.g. PM traps. These do not work in medium speed engines, For more information about different stationary engine technologies see UNECE paper /9/.

In order to enable proper reviews of the study a translation of all relevant documents is needed into English, now one of the key documents namely the VITO (2011) report is available only in the Dutch language. It was not possible to prepare a thorough analysis considering the language issue and the timespan provided.

EUROMOT – 2013-01-04

Sources:

/1/ " Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas ", March 2005 at http://ec.europa.eu/environment/archives/cafe/activities/pdf/cafe_cba_externalities.pdf

/2/ Bristish **IGCB Air quality damage costs per tonne at** http://www.defra.gov.uk/environment/quality/air/air-quality/economic/damage/

/3/ The Industrial Emissions Directive , *Summary: Analysis & Evidence* at http://www.legislation.gov.uk/ukia/2011/266/pdfs/ukia_20110266.pdf

/4/ UNECE " Document for the determination of costs for activities of annexe V Sector: New stationary engines **" available at:** http://www.unece.org/fileadmin/DAM/env/documents/2011/eb/wg5/WGSR49/Informal%20docs/17_EGTEI-Cost-stationary-engines-UNECE-06-04-2011.pdf

/5/ Euromot "Position for WGSR 49" available at : http://www.unece.org/fileadmin/DAM/env/documents/2011/eb/wg5/WGSR49/Informal%20docs/9_UNECE_Gothenburg_EUROMOT_Position_final_2011-08-16.pdf

/6/ Euromot Position on "O_2 reference point in Exhaust emission Legislation" available at: http://www.euromot.org/download/9ec5ee32-4de3-4afe-9a1a-e0139e42eefc/GENERAL%20O2%20reference%20point%202002%2010.pdf

/7/ http://www.euromot.org/download/a625184f-9f85-4a64-9551-0f9437b393d8/GENERAL%20engine%20emission%20legislation%20TA%20Luft%202002%2010.pdf

/8/ EU Large Combustion Plant (LCP) Best Available Rerference Technique (BREF) document available at http://eippcb.jrc.es/reference/BREF/lcp_bref_0706.pdf

/9/ Draft Guidance Document GD 7-42 "Stationary Engines" available at http://www.unece.org/fileadmin/DAM/env/documents/2009/EB/wg5/wgsr45/Informal%20docs/guidance%20document%20-%20pdf.zip

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