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IMPACT ASSESSMENT

Accompanying the document

Proposal for a
DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 94/25/EC on the approximation of the laws, regulations and administrative provisions of the Member States relating to recreational craft, as amended by Directive 2003/44/EC.

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Contents:

1. INTRODUCTION

1.1 Overview of the EU legislation for Recreational Craft

This Impact Assessment concerns the revision of EU legislation relevant for the recreational craft sector - the Recreational Craft Directive[1] (RCD) was adopted in 1994 to regulate the placing of pleasure boats on the European market. It first laid down essential safety requirements that manufacturers shall respect when designing crafts in order to place it on the EU market. The manufacturers must fulfil several obligations in order to show that their product complies with the Directive, including a Declaration of Conformity of the craft with the essential requirements of the Directive, affixing the CE marking on the product and providing the users with information on the use and maintenance of the product.

The amended Directive 2003/44/EC introduces specific requirements for propulsion engines, for both the compression ignition (CI) engines and the spark ignition (SI) engines. The Recreational Craft Directive covers pollutants from engines exhaust emissions such as particulate matters (PM), nitrogen oxides (NOx) and hydrocarbons (HC). It does not address CO_2 or other green house gas (GHG) emissions. Currently no inventory or data is available on GHG emissions from recreational craft engines. Nevertheless, GHG emissions from engines in the recreational craft sector might be addressed in the future in line with developments in the road sector.

Directive 2003/44/EC also provides for a review clause (Article 2) asking the legislator to take account in a future revision of the need to further reduce emissions of air pollutants and noise in order to meet environment protection requirements. At the same time the vulnerable position of the SMEs should be taken into account as the recreational craft sector consists mainly of small and medium enterprises (more than 95% of businesses are SMEs).

The Commission issued a report in 2007 (COM (2007/313) in which it describes several options to further reduce the exhaust emission limits of recreational marine engines and announces to assess the impacts thereof.

1.2. Overview of the Recreational Craft market in the EU

The recreational marine activities across Europe involve some 37 000 companies which represent a wide range of aactivities such as marinas, boatyards, marine equipment manufacturers, hire charter and sailing schools, marine solicitors, insurance brokers etc. The sector directly employs some 272 000 workers and its annual turnover is estimated at 23.4 billion €. The approximately 2 600 EU boat builders are established in 12 Member States with Italy being by far the most important boat builder in value terms, while France is the leading builder in terms of number of boats (see details in Annex I).

Manufacturers of marine engines can be separated in two main categories: the original engine manufacturers and the so-called marinisers. While original engine manufacturers are mainly large international companies, marinisers are exclusively very small companies (ca. 25 employees), producing on average 500 units per year. The latter adapt engines which are

[1] Directive 94/25/EC of the European Parliament and of the Council of 16 June 1994 on the approximation of the laws, regulations and administrative provisions of the Member States relating to recreational craft (OJ L 164, 30.6.1994; p.15)

originally produced for other purposes such as automotive engines and convert these for marine use. The EU counts some 40 engine manufacturers and marinisers.

The recreational craft manufacturing sector is strongly export oriented with the U.S. being the main market followed by the EU market.

2. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

Lead Directorate General: DG Enterprise & Industry

Other involved services: SG, DG ENV, DG ECFIN, DG TREN, DG JRC, DG SANCO, DG MARE

Agenda planning / WP reference: 2009/ENTR/010

2.1 External expertise:

Several external studies have been commissioned to examine further improvements of environmental characteristics of recreational marine engines and the impact thereof. The studies are publically available on the European Commission's website, DG Enterprise and Industry, Maritime Industries.

- **TNO**[2] *"Stocktaking study on the current status and developments of technology and regulations related to the environmental performance of recreational marine engines – Final Report", January 2005.* ("Stocktaking study"). The Commission requested this study after having introduced environmental requirements in the Recreational Craft Directive. Its objective was to evaluate the environmental impact from propulsion engines used in recreational craft. The study identified four possible options for further emission reduction measures, taking into account the overall air emissions of each option (for details see: p.21).
- **European Confederation of Nautical Industries**[3] **"***Study on The Feasibility and Impact of Possible Scenarios for Further Emission Reduction Measures for Recreational Craft Engines in the Context of Directive 94/25/EC, as amended by Directive 2003/44/EC: Impact Assessment Report – Final Report", 26 October 2006".* This study identified and measured in detail the impacts and distributive effects of the four possible scenarios for emission reduction measures as identified in the TNO study. It was concluded that each of the scenario options investigated would result in a relatively low emission reduction, and would entail disproportionate cost for certain European SMEs.
- **ARCADIS**[4] *"Complementary Impact Assessment Study on possible emission reduction measures for recreational marine engines" – June 2008.* Following the results of the previous study, the Commission launched another study in order to

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2 Stocktaking study on the current status and developments of technology and regulations related to the environmental performance of recreational marine engines – Final Report, January 2005, TNO for DG Enterprise; http://ec.europa.eu/enterprise/sectors/maritime/documents/index_en.htm

3 Study on the Feasibility and Impact of Possible Scenarios for Further Emission Reduction Measures for Recreational Craft Engines Impact Assessment Report", 26 October 2006, ECNI". http://ec.europa.eu/enterprise/sectors/maritime/documents/index_en.htm

4 Complementary Impact Assessment Study on possible emission reduction measures for recreational marine engines, June 2008, ARCADIS for DG Enterprise http://ec.europa.eu/enterprise/sectors/maritime/documents/index_en.htm

identify and assess new scenarios which would take into account the peculiar position of SMEs in the recreational craft sector. This study assessed the impact of four scenarios (including a baseline scenario) taking into account SMEs. It identified the most ambitious, yet feasible, scenario to maximise the emission reduction potential of recreational craft engines and to mitigate social and economic impacts on SMEs.

2.2 Consultation of external stakeholders:

Five Standing Committee meetings were organized in the period between October 2008 and December 2009 with the participation of the national public authority experts, the representatives of industry, customer associations, standardisation bodies, representatives of conformity assessment bodies and Ministries of Environment. The objective of the meetings was to present the methodology and possible ways on how to improve the environmental characteristics of the recreational marine engines and to collect the opinions and comments of the main stakeholders. Stakeholders contributed by identifying the most suitable scenario which further restricts the exhaust emissions of marine engines and accounts for necessary measures to mitigate the impact on SMEs. This scenario is analysed in the report among other options.

Five Working Group meetings took place in the period between October 2008 and April 2009 to identify the list of technical issues which need to be revised in the Recreational Craft Directive. The participating experts – representatives of market surveillance authorities, notified bodies and industry associations - addressed recommendations to the Commission services which mainly dealt with obligations of private importers and self-builders, conformity assessment for the second-hand boats.

2.3 Consultation of the Commission services:

In line with the guidelines of the Impact Assessment (IA) an Inter Service Steering Group (ISSG) was set up and the following services actively participated in the preparation of the IA: SG, DG ENV, DG JRC, DG SANCO, DG MARE .Other services were informed about all steps taken, but did not attend ISSG meetings: LS, DG ECFIN, DG TREN. Meetings were held on the following dates: the 19th November 2009, 28th January 2010, and 10th March 2010. The report of the last ISSG meeting reflects the main concerns and conclusions expressed by the services.

2.4 Internet public consultation:

A public internet consultation was organized between 11th May and 19th July 2009. The Commission services received 32 responses to the questionnaire published in English only. 16 replies were sent on behalf of various institutions, 9 from enterprises and 7 on behalf of individual citizens. The contributions came from 12 different countries (11 EU states and 1 EEA state).

The main objective of the internet public consultation was to seek views and opinions of citizens, the representatives of enterprises and the public authority's representatives on various issues that may need to be addressed in a draft proposal to further amend the Directive. The consultation revealed overall support to introduce more restrictive limits for exhaust emissions while taking into account the specific position of the SMEs. The respondents indicated that limits should be common not only for the EU/EEA states but also for other parts of the world, the United States in particular. The survey confirmed that a

further reduction of noise limits of marine engines would not effectively solve the problem of excessive noise in the exposed areas. Respondents suggested that local restrictions on the use of boats will better address this problem.

The consultation highlighted that the specificities of the recreational marine sector should be better reflected in the EU legislation. Concerns were raised with regard to the very active second hand market as well as self-built boats. It also highlighted the need to clarify the obligations of economic operators including private importers as well as competences of the national enforcement authorities. A summary of the consultation is provided in the Annex II.

2.5 Consultation with SMEs representatives

- Meetings with SMEs
- Consultation with SMEs via Internet Public Consultation
- Round table discussions with the representatives of SME engine manufacturers
- A special SME assessment in the complementary Impact Assessment Study, ARCADIS 2008

2.6 Opinion of Impact Assessment Board (IAB):

The IA was submitted to the IAB on 22nd March 2010. The IAB concluded that the IA report presents an analysis of economic, environmental and social impacts while the assessment is not yet sufficiently clear and needs to address a number of analytical issues. The IAB recommended that report should be amended to clarify the problem, to better justify the options and to better explain the expected impacts and the basis of estimates and key assumptions. Additional information is needed on the EU market and trade in recreational craft, and on health and environmental impacts of emissions. The justification of the emissions option needs particular work, informed by a clear EU-US comparison. The impact analysis should cover all objectives. The views of stakeholders should be described more consistently, and views of health and environment stakeholders included.

On the base of the 1st IAB opinion the problem definition has been redrafted in order to clearly explain both the environmental and economic concerns with regard to the exhaust emission limits. The description of the impact of each option was completed by the monetization of environmental impacts which allowed the direct comparison with the compliance costs. The qualitative evaluation of the options has been strengthened. The definition of the problem and the impact analysis is completed by the description of environmental and health impacts of the reflected air pollutants and by the indication of its levels of hazard. A comparison of the current EU emission limits with the US limits has been provided as well as the comparison with other relevant EU legislations. The assumptions and methodology used for the calculations are addressed in the main text. An evaluation of how the policy options meet the objectives has been added. The stakeholders' opinions are reflected throughout the IA and in its analytical part. A summary of the internet public consultation is provided.

The revised IA was resubmitted to the IAB on 5th July 2010. The IAB concluded that the report has been significantly improved along the lines of the Board's first opinion, and provides evidence to justify action in this area. Following the 2nd IAB opinion, the mitigating

measures have been further clarified and the proportionality of options with mitigating measures has been indicated. The text has been improved with regard to the reduction of administrative burden, the SME test and the monitoring procedures.

3. PROBLEM DEFINITION

Since 1994 the EU has regulated the placing on the market of recreational craft and related products. Harmonised requirements on the safety of products have been adopted, which since 2003 have been completed by requirements on the environmental impact of recreational craft which cover the main environmental concerns of boat usage, namely the engine exhaust and noise emissions.

3.1 Exhaust emissions caused by recreational craft

3.1.1 Effects on environment and health

Approximately 6 million of recreational crafts are in use in Europe (including Turkey, Croatia, Norway and Switzerland). Of this total figure the majority (4.8 million) are motorboats, 1.1 million are sailboats and 0.1 million are personal watercrafts (PWC). Motorboats and PWCs use propulsion engines that are either spark-ignition engines (called SI or petrol engines) or compression ignition (CI or diesel engines) both for inboard and outboard use (see information on the specific engine terminology in Annex III).

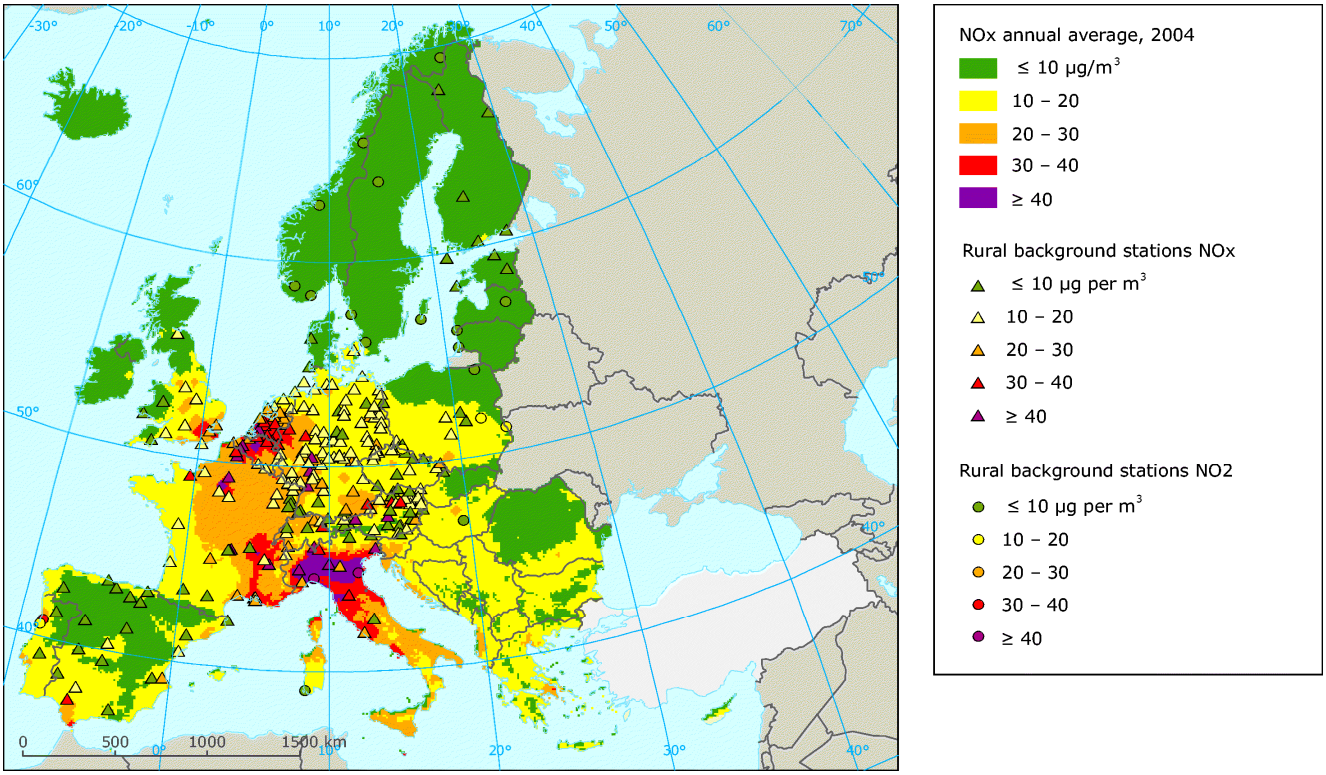
3.1.1.1 Impact of emissions to the air

According to the air emission inventory for Europe CORINAIR,[5] the overall emissions from recreational craft are in general minimal compared with other pollution sources such as energy producing industries, manufacturing industries, road transport, etc. Recreational crafts are estimated to contribute to approximately 0.5% of total hydrocarbon (HC) emissions and 0.1% of total NO_X emissions. Despite to this small contribution of recreational craft to the overall air emissions, its use however can lead to localised problems in areas that have a high concentration of recreational craft at certain times of peak activity. Such affected locations are the areas of big lakes and the attractive sea shores. Geographically, among the most affected locations belong the lakes and sea shores in the north of Italy, the shores of the Channel and the lake Constance. This is why in the late eighties local authorities in Germany, Switzerland and Austria bordering on Lake Constance started to regulate the use of boats and the exhaust emissions from boats to preserve a high quality of the air and the drinking water. As a consequence, in order to ensure a high protection of the environment while ensuring the correct functioning of the internal market, the so-called Stage I of the exhaust emission limits were adopted at EU level.

[5] CORINAIR European Topic Centre in Air Emissions: The results of an in-depth study published in 1998, CORINAIR 1994 Inventory were reconfirmed in 2007.

Figure 1 indicates annual average NOx emissions made by various sources of pollution. While it does not address the short term (or peak) periods, it can be deducted that for areas suffering from NOx concentrations above the Environmental Quality Standard (EQS)[6], the short term concentrations will be more significant. Information about the EU annual air concentrations of particulate matters (PM) is available in Annex IV.

Figure 1: Annual average NO_X air concentrations



Source: The Complementary Impact Assessment Study: ARCADIS (2008), p.58

As indicated, the most important air pollutants emitted from propulsion engines used in recreational crafts are nitrogen oxides (NOx), hydrocarbons (HC) and particulate matters (PM) as well as carbon monoxide (CO). All of them may affect human health either directly or indirectly. Nitrogen compounds derived from NOx emissions are considered as a particular harmful impact from exhaust emissions. Nitrogen dioxide (NO_2) causes direct acute and chronic effects to the respiratory system. Furthermore, NOx contribute to the nitrogen load in the environment which can result in significant impacts caused by eutrophication[7] of terrestrial and aquatic environments. Moreover, NOx and HC emitted by engines can react together in the presence of sunlight to form photochemical oxidants such as ozone. These can cause direct damage to vegetation, and can also form aerosols in the presence of PM. Together, these pollutants result in the formation of photochemical smog. In 2008, the health-related ozone target was exceeded at 35 % of all rural background measurement stations

6 EQS is a concentration established to ensure protection against exposure.

7 Eutrophication is an increase in the concentration of chemical nutrients in an ecosystem to an extent that increases the primary productivity of the ecosystem.

reporting to the EEA[8]. NOx emissions can also occur naturally, e.g. in salt marshes, estuaries and shallow water areas.

The contribution of recreational craft to the emissions of PM is rather small (see Table 1 - 3). The following tables show estimated concentrations of pollutants (NOx, PM, CO) measured in marine environment and compared to the environmental quality standards (EQS)[9]. EQS are available for NOx, PM and CO, but not for HCs. It indicates that **EQS' for NOx emissions exceed significantly in coast marinas in short term**. The concentrations of other pollutant are below the limits in all considered areas.

Table 1: Estimated concentrations of selected pollutants for Coast Marina

Pollutant	EQS (µg/m^3)	Current situation (baseline) (µg/m^3)
NOx long term[10]	40	17,54
NOx short term	**200**	**599,47**
PM long term	40	0,26
PM short term	50	0,59
CO long term	350	231,26
CO short term	10 000	3093,82

[8] EEA SOER 2010–Thematic Report Air Pollution at http://www.eea.europa.eu/soer/europe/air-pollution

[9] Directive 2008/50/EC refers to a limit value for NO_2 for the protection of human health and for NOx for the protection of the environment. As in other impact assessments, exhaust emissions are usually measured as NOx. For simplicity reasons, Tables 1-3 refer to NOx (sum of NO_2 and NO) only since NO emissions can be transformed into NO_2 in the atmosphere.

[10] Long-term concentration represents an annual mean

- Short-term ambient NO_2 concentrations represent a 99.79 percentile 1-hour mean

- Short-term ambient PM concentrations represent a 90.41 percentile 24-hour mean

- Short-term ambient CO concentrations represent a 100 percentile 8-hour mean

- Short-term ambient HC concentrations represent a 100 percentile 1-hour mean

- Long term EQS shall mean a concentration established to ensure protection against long-term exposure

- Short term EQS shall mean a concentration established to ensure protection against short-term exposure

Table 2: Estimated concentrations of selected pollutants for Lake Marina

Pollutant	EQS (µg/m^3)	Current situation (baseline) (µg/m^3)
NOx long term	40	13,17
NOx short term	200	213,97
PM long term	40	0,27
PM short term	50	0,56
CO long term	350	137,98
CO short term	10 000	1121,75

Table 3: Estimated concentrations of selected pollutants for Inland Waterways

Pollutant	EQS (µg/m^3)	Current situation (baseline) (µg/m^3)
NOx long term	40	0,16
NOx short term	200	2,5
PM long term	40	0
PM short term	50	0,02
CO long term	350	3,73
CO short term	10 000	29,64

Source of the tables: Environmental Impact Assessment Study, ECNI (2006), p.152

The fate of exhaust emissions entering the atmosphere is complex, and heavily influenced by the prevailing meteorological conditions as well as the topography of the land and the vegetation present. Whilst some emissions will travel long distances in the atmosphere, others may be deposited on land or intercepted by vegetation close to the emission source.

Carbon monoxide (CO) is hardly soluble in water therefore more than 80 % is emitted to the atmosphere. CO concentrated in enclosed and not ventilated spaces may have a direct negative impact on human health because it is highly toxic. However, the concentration of CO in the open air is short-living and rather small as CO quickly oxidizes and forms CO_2. It means that marine ambient is not normally affected by carbon monoxide.

Carbon monoxide may reach a boat user if the boat does not meet essential safety requirements requesting the inboard engine to be separated from living quarters within an

enclosure and the engine compartment to be ventilated. If the boat meets the essential safety requirements for design, the CO emitted by the boat should not endanger the boat user.

3.1.1.2 Impact of emissions to water

The exhaust gases of modern engines are emitted below the water surface with the major part being directly released to the atmosphere; a minor part will condense and suspend temporarily in the water. The fate of HCs in the water is complex: a large quantity evaporates quickly, particularly under the influence of propeller action, but other HCs form microfilms at the surface or adsorb to sediments. No evidence was found that HC from recreational craft build up to dangerous levels in sediments, or that HC levels exceed levels permitted by environmental quality standards in drinking water.

Despite the fact that water contamination is positively correlated to the size and intensity of the fleet, it is generally accepted that there is no need for general measures at EU level to restrict engine power levels or types of engines or even to prohibit the use of boats on lakes to preserve the quality of drinking water legislation.

3.1.2 The international context - emission regulations in the US

3.1.2.1 EU-US trade relations for RCD

The number of motorboats and personal watercrafts outreach the other boat categories. The sales figures of engines provided in tables 4 and 5 underline the importance of the EU and US markets. For SI (petrol) engines, the latter represents more then half of the sales in value terms and more than one third of units sold at the world market. Furthermore there is a dominance of SI engines at world level and clear preference of US customers for high power categories.

The EU and the US are also the largest mutual trading partners of the recreational marine engines. If EU manufacturers are dominating the CI (diesel) engines production with more then half of the world production, it only has a marginal share of the SI engine production. Exports from the EU are mainly concerning CI engines.

This close relationship between the EU and US market explains the continued effort to align exhaust emission regulations on both sides of the Atlantic, similarly to the discussion in other engine user sectors such as on-road or non-road.

Table 4: Sales of outboard SI engines per power category in units and value in Europe, U.S. and the Rest of World (2007)

Engine category (in kW)	Unit sales			Sales value (in million €)		
	EU	*US*	*Other*	*EU*	*US*	*Other*
< 3	49 608	7 596	71 017	39,2	6	57,8
3 - 20	84 652	74 168	121 186	173,5	152	255,5
20 - 75	54 242	98 550	77 652	357,5	649,4	526,4

75 - 110	10 524	36 235	15 066	113,1	389,3	166,5
110 - 150	7 684	37 082	11	107	516,1	157,5
> 150	4 119	48 070	5 896	80	933,6	117,8
Total	**210 829**	**301 701**	**301 818**	**870,2**	**2 646,4**	**1 281,5**

Source: The Complementary Impact Assessment Study: ARCADIS (2008)

Table 5: Sales of CI engines per power category in units and value in Europe, U.S. and the rest of the world (2007)

Engine category (in kW)	Unit sales			Sales value (in million €)		
	EU	*US*	*Other*	*EU*	*US*	*Other*
< 18	12 800	865		60,8	4,1	
18 – 37	9 200	622		82,5	5,6	
37 – 75	7 600	514		91,4	6,2	
75 - 130	3 600	1 147		60,8	19,4	
130 - 560	6 800	5 980		166,8	146,6	
Total	**40 000**	**9 128**	**15 872**	**462,2**	**181,9**	**107**

Source: The Complementary Impact Assessment Study: ARCADIS (2008)

3.1.2.2 Different EU/US emission regulations

The United States legislation for recreational craft contains more stringent emission limits for recreational marine engines than those provided in the EU legislation. The US Environmental Protection Agency (EPA) regulates emissions from SI and CI engines. Standards for CI engines were introduced in 1998 and been progressively reinforced until 2008 (CFR 40 Part 1042). Since 2001 the Californian Air Resources Board (CARB) sets independently requirements for SI marine engines which are now aligned to EPA rules (CFR 40 Part 1045).

As the use of SI engines far outnumber the use of CI engines (in the U.S. the relation is 30:1, in EU it is 5:1) a closer look is dedicated to the comparison of the main exhaust emission limits for SI outboard engines in the EU and the US.

Table 6: Comparison of the applicable limits for SI OB marine engines

Power ($P_{N)}$	Carbon Monoxide (CO)		Hydrocarbons + Nitrogen Oxides ($HC + NO_{X)}$	
	EU	US	EU	US
(kW)	*(g/kWh)*			
2,5	390	488	36	30
3	350	485	34	30
4,3	290	479	30	30
10	210	450	25	21
30	170	350	22	18
40	165	300	22	17
50	162	300	22	17
100	156	300	21	16

Table 6 compares the currently applicable emission limits in the EU with the most recently adopted US regulation which shows lower limit values for HC+NOx for SI OB marine engines in the US. While the RCD provides limit values for NOx, the US rules provides aggregated limit values for HCs and NOx which allows the engine manufacturer a certain degree of freedom when calibrating engines to meet the exhaust emission limits including CO and PM. HC emissions are unburned residues of fuel, where NOx is the reaction product after combustion. When optimising the engine performance, HCs and NOx perform in opposite direction, if one goes up, the other goes down. Other differences of EU and US emission limits for various types of engines are highlighted in the detailed overview provided in the Annex V.

As a consequence of the different regulatory standards the emission levels per recreational craft will be higher in the EU compared to the US. It will also affect engine manufacturers that have to meet the additional development costs and higher production costs for complying to the stricter US emission standards. The different requirements can result in keeping two separate production lines in place, which do not allow engine manufacturers to benefit from economies of scale. However we do not know the cost of having two separate production lines. Moreover most engines are regularly redesigned even in the absence of new emission limits. This requires recertification costs, which for most manufacturers who supply engines to the EU and to the US markets need to be paid twice. An enquiry among the representative companies in this market highlighted that the average costs per engine is approximately 20 000 € which in case of a small engine manufacturer producing low power engines may be up to 5% of the engine costs.

Stakeholders have asked the Commission to align the EU emission requirements with the more stringent US limits which they expect would limit production costs due to the advantages of scale and lower costs of testing procedures.

If the EU and the US are not able to agree on a common set of marine engine exhaust emission standards, it is unlikely that the rest of the world will be able to do so. The consultations between the European Commission and the EPA will be continued in order to coordinate the development of the exhaust emission limits in the future.

3.1.3 The EU Internal Market context - risk of diverging national standards

Some of the EU regions and local areas are particularly affected (see chapter 3.1.1) by exhaust and noise emissions caused by recreational craft and the relevant authorities are eager to take action to remedy to this situation. As the RCD is a full harmonisation directive, Member States can however not introduce individual national/local legislation to further restrict the exhaust emissions. Nevertheless, they have the legal means to introduce a limitation of a use and speed of boats. Some Member States apply this measure until the extreme such as a complete ban of use of some boats (usually PWCs) in their waters. Several court cases have been reported and stakeholders consider this extreme application as a breech of European Charter of Human Rights, Protocol 1 requiring the right of a citizen to use freely its possession. If the EU exhaust emission limits would become obsolete in case they are not revised according to the actual needs, more EU regions might use an extreme version of the use and speed limitations to decrease the exhaust emissions. This may escalate the conflict and become a serious internal market trade obstacle.

3.2 Noise emissions from recreational marine engines

Noise emitted from recreational craft has an impact on the surrounding nature and population as well as on the boat users. Crafts tend to operate close to the shore often in company with other users, generating a droning sound, made worse by weather conditions which may be very annoying to persons living close to the shore. The noise impact on the boat user varies largely depending on the boat itself but equally also on its use and speed as well as on the weather conditions. One can assume that in extreme cases the permanent exposure to noise will cause hearing impairment, hypertension, annoyance, sleep disturbance.

3.3 Safety and design concerns

Directive 94/25/EC harmonises all relevant safety characteristics for recreational craft in order to allow the correct functioning of the Internal Market. The essential requirements for safety remain unchanged till the present.

Some stakeholders have raised the need to modify certain essential safety requirements, namely the boat design categories. They propose to extend and re-define boat design categories in order to better reflect the specific risks of each boat category in relation to its use.

The essential requirements for safety have also been discussed in view to the possible need to introduce more detailed regulatory provisions on technical solutions to mitigate risks. This would be in contrary to the philosophy of the New Approach which is limited to fix the essential requirements in the legislation and leaves the definition of technical solutions to be fixed in Harmonised Standards.

A small modification has been discussed for the definition of the discharge prevention in sense of strengthening the requirement to install the holding tanks mandatorily and not only voluntarily.

3.4 Who is affected?

The analysis of the sector as well as stakeholders' consultations revealed that about 95% of the businesses active in the recreational craft sector are SMEs. The vast majority of these SMEs are boat builders. In 2007, around 2600 boat builders have been identified which are located in 12 EU Member States. The consultation has shown that boat builders are not likely to be affected by the restricted exhaust emissions since most boats are designed to host differently designed engines. The choice of the engine is often left to the customer.

The other group of SMEs consists of engine manufacturers and marinisers. Whereas the first manufacture genuine marine engines, the latter buy engines that are originally designed for applications such as automotive, and adapt them for the marine use. About 40 engine manufacturers (rather medium sized companies) and marinisers (micro or small companies) were identified in 12 EU Member States. As marinisers buy already compliant engines used for different applications (on-road, non-road), they will not be likely affected by the changes, too.

Therefore, the preliminary assessment leads to the conclusion that the small and medium sized engine manufacturers are the main affected party. Only a few engine manufacturers falling into this category were identified. Despite the fact that they act independently, they often belong to a group of large engine manufacturer and in fact do not meet *stricto senso* the criteria of an SME. The consultation has shown that there is at least one independent SME engine manufacturer.

3.5 Legal certainty and simplification - alignment with the NLF

With regard to the question whether the type of act chosen, namely a directive , which needs to be transposed by the Member States into national legislation, is appropriate, or whether a regulation should be envisaged instead, the current positive experience with the application of this directive did not show any reason for a change.

On 9 July 2008, the Council and the European Parliament adopted two horizontal instruments relating to the marketing of products in the Union. **Regulation (EC) No. 765/2008**[11] which is setting out the requirements for accreditation and market surveillance relating to the marketing of products and **Decision No 768/2008/EC**[12] on a common framework for the marketing of products. Both instruments apply to the recreational craft sector. Therefore, for clarity reasons a reference to the applicability of the Regulation in the recreational craft sector needs to be inserted into the proposal. In order to ensure further consistency with other product legislation, it is also appropriate to align certain provisions of the RCD Directive with the Decision, in so far as sector specificities do not require a different solution. The model articles of the Decision that have been taken over to the RCD proposal concern in particular

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[11] Regulation (EC) No 765/2008 lays down horizontal provisions on the accreditation of conformity assessment bodies, on the CE marking and on the Community market surveillance framework for, and controls of, products entering the European Union market, which also apply to the recreational craft sector. The Regulation is directly applicable and is applied from 1st January 2010.

[12] The Decision is a *sui generis* instrument, which provides common principles and reference provisions for the purposes of legislation based on the New Approach principles. The Decision is not applicable as such but it is addressed to the Union legislator. In the Decision, the Council and the European Parliament commit themselves to take the provisions of the Decision into account whenever legislation is drawn up which concerns a product already subject to other Union acts.

(1) horizontal definitions (e.g. placing on the market, manufacturer, importer, distributor, etc.), (2) obligations of economic operators (including obligations to ensure traceability[13]), (3) harmonised standards and presumption of conformity, (4) formal objection to harmonised standards, (5) requirements for conformity assessment bodies and for authorities notifying them as well as for notification procedures, (6) conformity assessment modules[14], (7) EC declaration of conformity and (8) provisions concerning procedures dealing with products presenting a risk (Safeguard clause procedures).

3.6 Consistency with EU Policies

The Recreational Craft Directive is embedded in a framework of European Legislation combining maritime and environmental aspects. A high level of environmental protection is a foremost objective of the Union set in the Treaty.

One of the flagship policies defined in the Europe 2020 strategy[15] aims at establishing a resource efficient Europe to meet the climate/energy targets. The integrated maritime policy[16] streamlines the protection of the environment in every Union policy, especially those affecting the maritime environment. The Recreational Craft Directive revision takes place in this general context. It also contributes to the objective of the 2010 International Year of Biodiversity.

The Recreational Craft Directive contributes to a progressive reduction of emissions, in particular with regard to localised areas such as marinas and harbours, which suffer from pollution peaks during certain periods of the year. It is therefore in line with the objectives of the Clean Air for Europe (CAFE) initiative[17], which provides an integrated and long term strategy for reducing the adverse impact of air pollution on human health and environment as specified in the Directive 2008/50/EC on ambient air quality and cleaner air for Europe.[18] The approach followed to regulate recreational craft emissions is derived from Directive 97/68/EC on non-road mobile machinery (NRMM)[19] with the introduction of emission stages and implementation dates as well as the test procedures.

Also the national ceilings Directive 2001/81/EC[20]establishes legally binding limits to be obtained by 2010 for the total permissible emissions at Member State level for several

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13 Import of recreational craft by private individuals from the third countries is specific for this sector. The obligations of the private importers should be to some extent harmonised with the obligations of manufacturers.

14 The conformity assessment modules to be used are set by reference to the modules set in the Decision, whereas the choice of the conformity assessment modules available to the economic operator is a sector specific issue.

15 COM (2019) 2020 final

16 See for instance Green Paper COM (2006) 275 final "Towards a future Maritime Policy for the Union: A European vision for the oceans and the seas", the Communication from the Commission COM (2007) 575 final "An integrated Maritime Policy for the European Union", and more recently, the Clean Ship Initiative proposed by DG Mare in 2009. All these initiatives acknowledge the need for high protection of the environment in the context of any maritime policy.

17 See the link: http://europa.eu/legislation_summaries/environment/air_pollution/l28031a_en.htm#KEY

18 See the link: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0050:EN:NOT

19 OJ L59, 27.2.98

20 Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants, OJ L 309, 27.11.2001, p.22

pollutants including nitrogen oxides. Current forecast suggest 11 Member States will not comply with their ceilings for NOx. Therefore, more stringent emission limits for combustion engines in recreational craft will however positively contribute to the overall objective of the mentioned Directive.

3.7 Does the EU have right to act?

With a large number of pleasure boats running across national waters, the significant part of recreational craft cruises is international. In the absence of common emission limits the EU national administrations used to create their national abatement strategies, which solved the problem locally but created another problems affecting proper functioning of the internal market, which is in contradiction with Article 120 of the Treaty on the Functioning of the EU (TFEU).

Further, Article 191 of the TFEU providing that European Union's policy on the environment shall contribute to protecting and improving the quality of the environment is yet another basis for Union's right to act. Environmental protection is a fundamental component of the harmonious and sustainable development of economic activities and non-inflationary growth (Article 3 of the Treaty on the European Union).

Finally, given that the exhaust emission limits have already been totally harmonised at EU level through the existing Directive, the revision of these limits is within the exclusive competence of the Union, and therefore, the application of the principle of subsidiarity within the meaning of Article 5 (3) of the TEU does not arise.

3.8 How is the current situation likely to evolve?

The exhaust emission levels set by Directive 2003/44/EC would become outdated over time and no longer meet societal needs for a better ambient air quality nor reflect the technical and scientific development in exhaust emission abatement technologies for recreational marine engines.

Lower emission requirements for recreational craft engines will be a disincentive for European manufacturers to innovate and thus lead to a situation where in a longer term perspective they would loose their competitive position. This will be particularly true for enterprises – mostly SMEs - supplying solely the EU market.

Finally the EU market could also attract new third country manufacturers which may strengthen their position in the EU market by selling lower environmentally performing and therefore cheaper engines in the EU market.

Not acting on the EU level could lead some Member States to introduce local stricter measures or it may lead even to the ban of use of the recreational craft in particular areas.

4. OBJECTIVES

The overall objective of this initiative is to further improve the environmental performance of recreational craft and thus to better protect the environment and human health, while at the same time ensure equal regulatory conditions with the EU main trading partners and a smooth functioning of the internal market for RCD.

GENERAL	SPECIFIC	OPERATIONAL
1) Protect environment and human health	1) Improve the environmental performance of RC	1) Revise exhaust emission limits. 2) Revise limits for noise emissions 3) Revise safety characteristics of the RC
2) Improve the functioning of the internal market	3) Prevent fragmentation of the internal market caused by different national requirements on the characteristics of RC	1) Revise exhaust emission limits.
	4) Protect vulnerable enterprises (SMEs in particular) from the worsening their position on the market and potential job losses because of complying with the new legislation.	4) Introduce mitigating measures for the most vulnerable RC market operators in Europe (SMEs).

	5) Provide the EU RC industry as well as citizens with legal certainty.	5) Align the RCD with the NLF
3) Promote the approximation of the emission limits worldwide	6) Reduce additional compliance costs from different regulatory regimes	1) Revise exhaust emission limits.

5. POLICY OPTIONS

A wide range of options that could achieve the above mentioned objectives has been taken into consideration.

5.1 Policy options discarded early in the impact assessment process

5.1.1 Option 1: Self regulation for exhaust emissions (Voluntary code of the industry)

This option consists in the introduction of further emission limits by a non-regulatory measure (e.g. by means of a voluntary industry code). The possibility of introducing more stringent emission limits through a non-legislative instrument has been assessed in particular with regard to the following aspects:

- The compatibility between more stringent limits of the non-legislative instrument and the legally binding ones of the Directive (and other legislation in force outside the EU). The need to ensure legal certainty for industry stakeholders has been raised in this context as being of major concern.

- The need to balance the interests of globally operating industry stakeholders on the one hand and those that are operating exclusively on the Union market and may suffer from a system geared to serve the interests of those engaged in international trade. If self regulation is left to the will of the manufacturers, the ones which are active worldwide are likely to soon benefit from a comparative advantage compared to the ones which are active locally. Indeed, it will be easier for them to achieve economies of scale while following the national rule they want.

- Uncertainty whether appropriate monitoring and enforcement tools could be developed and implemented to ensure a proper functioning of the non-legislative instrument.

Whereas the Member States and environmental stakeholders doubted about the fulfilment of environmental targets, the industry feared that the manufacturers from third countries would not respect the limits. Both, the Member States authorities as well as industry rejected this option mainly because of legal uncertainty of voluntary limits.

5.1.2 Option 2: Discontinuing existing EU action (Repeal of the exhaust and noise emission limits from the Directive)

Sub-option 2.1 Full repeal of the exhaust and noise emission limits from the Directive

The Annexes I.B and I.C. introduced by the Amendment 2003/44/EC would be repealed and Member States would impose their own tailor made emission limits.

Repealing the current provisions on exhaust and noise emission limits would enable the national administrations to introduce their own limits, precisely for the areas, where it is needed. The national authorities could set more lenient limits or no limits for the areas where the use of pleasure boats is not so intensive. However, this option entails the risk that polluting engines, which are often imported from third countries will be more frequently placed on the market and that the engine manufacturers would have fewer incentives to invest into the development of cleaner models. Furthermore, the internal market would become significantly distorted due to various limits in place.

During the discussions on the revision of the RCD, stakeholders refused this option as it will result in stepping back in the development of the sector. This option could be considered only if there were no internal trade between the Member States. As the option would not lead to the requested improvement of environmental characteristics of marine engines and could lead to the fragmentation of the internal market, the option is discarded from the beginning.

Sub-Option 2.2 Repeal of the exhaust and noise emission limits and the use of informative labels on the engines instead

With this sub-option, it is proposed that, while the exhaust and noise emission limits are repealed, a system of informative labels on the engines is put in place in order to inform the consumers about the exhaust and noise emission characteristics of the engine. Each engine installed in the recreational craft or intended to be installed, would have to bear such a label to be affixed by the person placing the engine or the boat on the EU market.

Although it might lead to consumer awareness, this option is likely not to have any positive impact on the environment given that the only potential protection of the environment would lie in the consumer choice to buy a more environment-friendly craft. This entails however the risk that the consumers would not make the choice of these environment-friendly products and that the measure would have no effect on the environment. Moreover, as demonstrated and reported by studies made in the car sector, it is likely that a substantial number of consumers in the RC sector might also prefer cheaper and more polluting engines rather than clean, but more expensive ones.[21] Therefore, the impact on the environment would be very limited with this option. In addition, it is unlikely that the consumers will examine the engines' labels before deciding to buy a boat. The usefulness of such label would therefore be questionable and disproportionate to the burden and costs generated for affixing it.

[21] Some studies have shown that the first determinant in the choice to buy a car for a company is the relationship it has with the retailer. The second factor entering in the purchasing choice is the brand name of the car. The environment criterion therefore is not an important factor in the buying decision. This would even more true in case of individual consumers rather than of companies.

As a significant part of the recreational craft placed on the EU market are second-hand[22] boats imported from third countries, the responsibility of testing the boat, estimating the emission limits and affixing the label would lay in this case on the private person importing boats for his/her own use. The emission values testing would considerably increase the costs of such private importers.

The option of introducing the informative emission labels is not in favour of stakeholders as it would not lead to the intended goal to improve environmental characteristics of recreational marine engines as well as it would mean the additional administrative burden for the industry.

5.1.3 Option 3 - Modification of essential requirements on safety

A revision of safety requirements, in particular with regard to new boat design categories should be achieved. However, the TNO Study 2004 concluded that there is no scientific evidence for the need to change the design categories.

In spite of some minor clarifications made in the essential safety and design requirements, the concerns described above have not been further assessed because there was no sufficient evidence to justify possible changes.

5.2 Policy options retained for further analysis

5.2.1 Exhaust emission limits for engines

Option 1 - No change

The existing **exhaust emission limits** in the Directive remain as defined by the amendment 2003/44/EC.

Option 2 - Stricter exhaust emission limits (Stage II)

This option foresees the possibility of introducing a new Stage of the exhaust emission limits. Five possible scenarios to restrict the limits depending on the engine's power (P_N) have been discussed. Four scenarios were developed by TNO in the Stocktaking Study 2004 and assessed by ECNI in the IA Study 2006. The introduction of these four scenarios was the answer to a request of the Council and the European Parliament to develop more stringent exhaust emission limits based on the technological development in the sector. These scenarios considered the alignment with the NRMM Directive as regards CI engines and introducing new stricter limits for SI engines. The alignment with the NRMM Directive was considered because of the similarities of the engine techniques and markets. After the assessment of the impacts of these four scenarios (see details below) the Commission deemed it necessary to develop a more ambitious but still economically sustainable scenario. Scenario 5 has thus been developed and assessed by ARCADIS in the Complementary Impact Assessment Study 2008.

[22] It is almost impossible to have a precise number of how many second hand boats there are in the European Union: indeed they are not registered in all countries and some second-hand boats are bought in the US on the Internet, it is therefore impossible to monitor all the second hand boats that are bought and brought into the EU.

Table 7: Overview of five scenarios

Scenario 1	Engine category	Legislation to comply with	Comment
SI engines	All SI engines	RCD Stage I	Limits of 4-stroke SI engines applicable for all engines
CI engines	P_N > 37kW	NRMM Stage IIIA[23]	Limits for propulsion engines of inland waterway vessels
	P_N < 37kW	RCD Stage I	
Scenario 2			
SI engines	All SI engines	RCD Stage I	75% of HC+NOx limits of 4-stroke SI engines
CI engines	P_N < 18kW	RCD Stage I	
	P_N 18 kW - 37kW	NRMM Stage II	Limits for propulsion engines of inland waterway vessels
	P_N > 37kW	NRMM Stage IIIA	Limits for propulsion engines of inland waterway vessels
Scenario 3			
SI engines	P_N > 30kW	RCD Stage I	75% of HC+NOx limits of 4-stroke SI engines
	P_N < 30kW and PWC engines	RCD Stage I	
CI engines	P_N < 18kW	RCD Stage I	
	P_N 18 kW - 37kW	NRMM Stage II	Limits for propulsion engines of inland waterway vessels
	P_N > 37kW	NRMM Stage IIIA	Limits for propulsion engines of inland waterway vessels

[23] Table with the NRMM Stage IIIA limits available in Annex VI

Scenario 4			
SI engines	P_N > 30kW	RCD Stage I	75% of HC+NOx limits of 4-stroke SI engines
	P_N < 30kW and PWC engines	RCD Stage I	
CI engines	All CI engines	NRMM Stage II	Limits for propulsion engines of inland waterway vessels
Scenario 5			
SI engines	All SI engines	US EPA emission standards for new non-road SI engines, equipment and vessels	
CI engines	All CI engines	US EPA emission standards for marine diesel recreational engines	

Scenario 1 harmonises Stage I limits for all SI engines and aligns the limits for CI engines with the NRMM standards.

Scenarios 2-4 significantly restrict SI engine limits and align CI engine limits with the EU NRMM legislation with different levels of stringency.

Scenario 5 proposes to harmonise the limits for SI and CI engines with the US EPA 2008 rules.

The assessment of scenarios 1-4 demonstrated that even though the environmental effect would be satisfactory, the high compliance costs and possible job losses would outweigh the reduction of the exhaust emissions. Annex VI provides a detailed comparison of the scenarios.

Following this analysis, the scenario 5 seems to be the most suitable scenario for further evaluation. Consequently, this scenario is considered in the Impact Assessment as option 2.

Option 3 - Stricter exhaust emission limits (Stage II) combined with mitigating measures to limit negative economic/social effects

The stakeholders' consultation revealed that the introduction of higher emission limits may have negative economic and social effects. Therefore, option 3 was developed to look into different possibilities to tighten the rules for exhaust emissions while at the same time including a mitigating measure to limit negative economic and social impacts. The option 3 is divided into sub-options according to the type of mitigating measures used.

Sub-option 3.1 – Use of a flexibility scheme

An option to mitigate the effects of stricter exhaust emission rules might be the introduction of a flexibility scheme as enshrined in Article 4 of Directive 97/68/EC[24] on the emission of gaseous and particulate pollutants from engines to be installed in non-road mobile machinery (NRMM). Under this directive a CI engine manufacturer may place on the market, on request by an equipment manufacturer and when permission being granted by an approval authority, during the period between two successive stages of emission limit values, a limited number of engines that only comply with the previous stage of emission limits." The idea for the RCD is to allow the engine manufacturers to place on the market a limited number of recreational marine engines compliant with the previous stage of emissions, still after the entry into force of new emission limit values.

This meets also the measures provided in the US legislation with the most widely used provision being the *Average, Baking and Trading* system (ABT) which is part of most emission control programs. It allows manufacturers to certify engines with emissions above the applicable emission standard, provided that the emissions differential is offset by engines certified below the standard. Credits can be traded with other companies or saved for later use. Another mitigating measure in the US is the hardship relief that addresses unusual circumstances which may affect companies outside their control. Similar as for the ABT this measure is however not appropriate to the EU due to the absence of a central monitoring unit, the creation of which would be disproportionate. The idea had already been discussed in the context of the last amendment of the NRMM Directive where it was rejected because of its incompatibility with the EU legislative and administrative system. Finally the US also provide a flexibility mechanism that allows SMEs to postpone the redesign of low volume engines or difficult engine categories and as such to decrease the cost of compliance with new emission limit values.

Sub-option 3.2 – Use of a transitional period for all engine manufacturers (3 years)

New and revised regulations mostly provide additional lead time before new standards take effect for business. In a similar way it is proposed as an alternative mitigating measure to grant additional lead time to all engine manufacturers before their engines shall comply with the new emission standards. It gives the companies more time to redesign the engines and to adapt the production lines to the new technologies. Additional lead time had also been provided under Directive 97/68/EC to manufacturers of engines used in certain small hand-held equipment for which technological solutions were not available yet. The proposal is to provide a **three years transitional period after the entry into force** of the revised RCD. This transitional period would be composed of the normal transposition period of EU Directives by the EU Member States (2 years) plus one additional year for technical adaptation.

5.2.2 Noise emission limits for engines.

Option 1 - No change

The existing **noise emission limits** from the recreational craft in the Directive remain as defined by the amendment 2003/44/EC.

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[24] OJ L 59, 27.2.1998, p. 1 , Consolidated version of Directive 97/68/EC

Option 2 – Stricter noise emission limits

This option looks into the introduction of stricter noise limits for engines on the EU level and how these would contribute to the abatement of noise produced by recreational craft.

5.2.3 Alignment of the RCD with the New Legislative Framework

Consequently to the adoption of Regulation (EC) No 765/2008 and of Decision 768/2008/EC, the Recreational Craft Directive has to be brought in line with the principles of New Legislative Framework. It means basically the inclusion of the chapters describing the obligations of economic operators, the competences of conformity assessment bodies and market surveillance authorities, new conformity assessment modules and the status of CE marking.

6. ANALYSIS OF IMPACTS

6.1 Impact of stricter exhaust emissions limits

6.1.1 Option 1 - No change of limits

There are two main concerns related to this option: environmental and trade concerns. Firstly, it has been demonstrated in Section 3.1.1.1 (see Table 1) that NOx concentrations do exceed the environmental quality standards in coast marinas. Secondly, if the current limits would continue to apply, the engine manufacturers and especially marinisers may be tempted to install more polluting engines complying with Stage I instead of the cleaner but more expensive engines complying with the more stringent US standards.[25]

Another concern related to this option is the fragmentation of the Internal Market due to the likely adoption of diverse regional regulations as mentioned in Section 3.7. Industry would continue to offer two different products and will not be able to benefit from economies of scale.

6.1.2 Option 2 – Stage II of the exhaust emissions limits

Implementing Stage II of exhaust emission limits would follow the technological progress of the recreational marine engines as well as the EU commitment to support less polluting technologies and the alignment of the limit levels internationally. The option would also prevent a fragmentation of the Internal Market because the restricting of the limits would satisfy those Member States who would intend to introduce various restrictive measures aiming at reducing emissions from recreational crafts.

Environmental impact

In order to assess the environmental impacts a formulaic approach has been adopted allowing the emissions to the air to be modelled under each regulatory option. The details of the methodology applied are explained in Annex VII.

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[25] The engine manufacturers declare to include their R&D and certification costs to the increased price of the cleaner engine.

For the purpose of modelling air quality, it has been assumed that all emissions from recreational craft exhausts enter the air. The assessment does not consider the impact of so-called wet exhaust emissions to the water because only a marginal proportion of the exhaust pollutants remain in the water.

Table 8: Total emissions change measured in tons per year

	HC+NOx (tons/year)	PM (tons/year)	CO (tons/year)
Option 1 - No change of the limits	40 907	539	153 142
Option 2 - Stage II	30 061	296	184 634

Source: ARCADIS Complementary Impact Assessment Study July 2008, p.57

According to the findings of the adopted approach the yearly emissions of HC+NOx, PM for Stage II are lower than for the baseline scenario. CO emissions increase.

Table 9: Average emission change / year compared to the Option 1[26]

	HC + NOx	PM	CO
Option 2 - Stage II	-26,51%	-45,08%	+20,56%

For the monetization of environmental benefits, the Cost-Benefit Analysis of Policy option scenarios that have been developed for the CAFE Programme (2005)[27] have been used. Environmental benefits are expressed as monetized damage savings per tonne of the air pollutant. The methodology of monetization is described in Annex IX.

For calculation purposes we assume the NOx emissions to represent 40% of aggregated HC+NOx emissions[28] .

Table 10: Value of damage avoided / year compared to the Option 1

	Value of damage avoided (M€) / year (NOx)	Value of damage avoided (M€) / year (PM)
Option 2 - Stage II	9,5 M€ - 45,5 M€	3,2 M€ - 18,2 M€

[26] Detailed calculation of the emission reductions available in Annex VIII

[27] http://www.cafe-cba.org/assets/marginal_damage_03-05.pdf.

[28] Source: ARCADIS Complementary Impact Assessment Study July 2008, page 57

Economic impact

Compliance costs are purely related to costs incurred by engine manufacturers and marinisers and do not include downstream economic impacts related to competitiveness, changes in the market structure, changes in fuel economy, etc.

Compliance costs are evaluated in the scope of the time horizon within which these costs are made: Fixed costs occur in the course of first years, later they are fully amortized. They are linked to the development, production, validation and certification of Stage II engines. This includes recertification, redesign of components, adaptations to assembly line, environmental validation tests, etc. After a particular period of time, some fixed costs will appear again (e.g. renewable of certificate). Variable costs remain a cost item in the long run but will probably decrease as manufacturers learn over time to produce the engines with the new technologies or after treatment at a lower cost. **These figures are for guidance only and should be regarded as orders of magnitude rather than absolute figures.** For the unit costs, see Annex X.

Table 11: Estimation of total compliance costs linked to the Option 2 - Stage II limits

	CI Engines	**SI Engines**
Option 2 (Stage II)	5,7 M€ to 19 M€ / year	5,1 M€ to 10,6 M€ / year

Source: ARCADIS Complementary Impact Assessment Study July 2008, Table 6.13, page 85

The wide range of cost estimates is due to the large variety of the variable costs for lower power engine families (P_N < 75kW). The higher costs indicated in Table 11 relate to engine manufacturers which serve only the EU market and have no exports to the US including indirect ones via boats in which their marinised engines are mounted. Small and medium sized engine manufacturers may face the temporary discontinuation costs including loss of profit and loss of market share by not being able to provide a certain engine model to the market. The details of the calculation of compliance costs are provided in Annex X.

It has to be noticed that the compliance costs are calculated assuming that the new standards are equally phased-in in the EU and in the US. Harmonisation of RCD emission standards with the recently adopted US EPA emission standards will have a different impact depending on whether companies are active on both markets or only on the EU market. For those which are active on both markets the costs to meet the emission standards can be regarded as sunk costs as they have to be made for the US market already. Their fixed costs will be limited to re-certification and related testing and calibration.[29] The situation is however different for those companies which supply only the EU market which have to bear the full compliance costs. These are mainly SMEs.

Option 2 (Stage II) would be effective to the extent that it would meet both general and specific objectives pertinent to the environment as described in section 4 for most European companies. However, it creates difficulties for SMEs as they would be unable to comply timely with the new exhaust emission limits.

[29] These are common for CI and SI engine manufacturers. They can reach up to 19 900€. The table in Annex X provides the details.

Indeed SMEs do not have the same liquidity and access to finance as bigger companies to finance these investments. Hence they supply a limited market they will not be able to spread fixed costs over a larger production and use economies of scale, as bigger manufacturers can. The SME engine manufactures also do not benefit from the experience gained from redesigning of engines for other user markets, as this is the case of their large volume competitors who do not only supply marine engines.

As a result, SME engine manufacturers may be obliged to limit their production of engine ranges as they will not be able to comply with the new limits for all ranges at the same time. In cases where compliance costs are too high, companies are likely to discontinue the production of certain models. Discontinuing product ranges is often very costly, especially if products have not reached the end of their lifetime or in case of newly developed engines. The costs linked to discontinuation include loss of profit generated by the models and additionally the loss of market share by not supplying these models. Recreational craft engine manufacturers generally keep a wider range of power categories of engines.

The stakeholders' consultations revealed that SME SI engine manufacturers producing low power engines will have the highest difficulties to comply with the new Stage II limits due to their limited R&D capacity to redesign the engines. Low power SI outboard engines (i.e. $P_N <$ 15 kW) are particularly affected as it requires the same high investment to develop the new engines while at the same time due to the lower revenue of such engine categories, the payback time is longer than for the high power engine categories.

Total compliance costs (mainly dedicated to the R&D) of these manufacturers[30] may reach up to 1,8M – 5M € or 67,35% of their annual turnover while a maximum ratio for large engine manufacturers is 2,76%.[31]

Particular case of CO limits

Option 2 leads to a relaxation of CO limits. As explained in the chapter 3.1.1.1 CO has an impact on human health and the limits provided in the current RCD aim at avoiding any serious risk of expose for the boat user and other persons. Even with the proposed relaxation of the limits the CO emitted by the recreational marine engines stays well below the environmental quality standards therefore should not pose significantly greater risk to user's health. However, the appropriate CO emission limits for recreational craft may be reflected upon in a future revision.

Keeping CO emission limit values at the current level while at the same time NOx, HC and PM limit values are significantly restricted in, the SI outboard engines and PWC would require the use of a catalyst technology which is not yet technically feasible in the marine environment. The development of catalyst outboard program would likely require 2-3 year completing and converting all outboard engine categories to catalyst technology is likely take 8-9 years[32]. The costs of redesigning an engine family can run up to 30 million € which

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30 That is small and medium sized engine manufacturers producing low power engines

31 Based on consultation results. ARCADIS Impact Assessment Study (2008), p. 90-93. Details of impact on competitiveness of large and small companies described in Annex XII

32 Source: Development and Demonstration of a Low Emission Four-Stroke Outboard Marine Engine Utilizing Catalyst Technology , Mercury Marine, CARB Technical Seminar, 2010

represents 10–25 % of EU annual sales of a large outboard engine manufacturer in this particular engine category. The costs may be especially critical for some solely EU based small and medium sized SI engine manufacturers with the annual turnover not exceeding 20 million €[33].

6.1.3 Option 3 – Stage II of the exhaust emissions limits *with mitigating measures*

Complying with the new EU emission standards will entail additional costs. The recreational craft sector has been seriously hit by the economic and financial crisis of 2008/2009. The sales of new boats decreased up to 50 % in years 2008 and 2009 comparing to 2007.[34] Option 3 would allow maintaining the introduction of higher emission standards while at the same time mitigating possible negative economic/social impacts.

Sub-option 3.1 – Use of a flexibility scheme

In this sub-option, the mitigating measure considered would be a flexibility scheme, in line with the one in place in the framework of the NRMM Directive 97/68/EC. Similar to the ABT provided in the U.S legislation (see under 5.2.1.), the objective is to allow companies to optimise their strategy for complying with the required new emission standards and the reach the same absolute level of emission reduction at lower costs.[35]

Environmental impact

Due to lower emission reductions, introducing a flexibility scheme will result in a less positive impact on the environment compared to Option 2 (Stage II), which is demonstrated in the tables below.

Table 12: Total emissions change measured in tons per year

	HC+NOx (tons/year)	PM (tons/year)	CO (tons/year)
Option 1 - No change	40 907	539	153 142
Sub-option 3.1 - Stage II + Flexibility scheme	31 105	387	180 698

Source: ARCADIS Complementary Impact Assessment Study July 2008, Table 5.5, page 57

Table 13: Average percentage change / year compared to Option 1 [36]

	HC + NOx	PM	CO
Sub-option 3.1 - Stage II + Flexibility scheme	-23,96%	-28,20%	+17,99%

33 Source: The Complementary Impact Assessment Study, ARCADIS (2008)

34 Source: Information provided by ICOMIA

35 According to the available information there is just one company actually relying on the ABT system; other engine manufacturers consider the administrative costs involved too high.

36 Detailed calculation of the exhaust emission reductions is provided in Annex VIII.

Table 14: Value of damage avoided / year compared to the Option 1

	Value of damage avoided (M€) / year (NOx)	Value of damage avoided (M€) / year (PM)
Sub-option 3.1 - Stage II + Flexibility scheme	8,6 M€ - 41,2 M€	2,0 M€ - 11,4 M€

Economic impact

Flexibility will result in saved compliance costs for the industry.

Table 15: Total compliance costs linked to the Sub-option 3.1[37]

	CI Engines	SI Engines
Sub-option 3.1 - Stage II + Flexibility scheme	1,2 M€ to 8 M€ / year	4,6 M€ to 10 M€ / year

Source: ARCADIS Complementary Impact Assessment Study July 2008, Table 6.15, page 86

In the case of the flexibility scheme provided in the NRMM Directive, the limited number of engines to be placed on the market under this scheme is limited by the entry into force of the next stage of emission limits. Since there is no such stage in the RCD Directive, the implementation of the flexibility scheme would require an end date to remain proportional and to limit the period for placing on the market of more polluting engines.

Furthermore the objective of the flexibility scheme established under the NRMM Directive is to provide the Original Equipment Manufacturer (OEM) with additional lead-time for adjusting the machine design. The OEM is the last actor in the production chain, who will always depend on the engine manufacturer and the availability of the newly designed engines. The time necessary to redesign the machines by the OEM may be very short and substantial R&D investments need to be achieved in a limited period, which may result in a substantial increase of costs. The possibility to use a limited number of previous stage engines allows balancing this peak in investment costs.

This scheme can however not be directly transposed to the recreational craft In the case of recreational craft the major development costs occur at the engine design and production while the costs for the boat manufacturer remain marginal. Therefore the mitigating measure, in this case the flexibility, must be provided to the engine manufacturer and not to the boat producer.

While in case of NRMM the OEM will only use the flexibility scheme when it is needed to overcome a momentary period of peak R&D investments, the engine manufacturers in the case of recreational craft would be tempted to fully use the Flexibility Scheme and to place on the market maximum of engines compliant with the previous stage even if this is not

[37] Methodology and assumptions used for calculation of compliance costs available in Annex X

economically needed. This measure would disqualify its mitigating effect for the companies in serious economic troubles and would result in an indirect postponement of the implementation date of the new Stage of exhaust emission limits.

Other problems could also rise from the implementation of the flexibility scheme. In the framework of the NRMM Directive, the flexibility scheme is managed by the established national approval authorities. It would be necessary to create a similar authority in the framework of the RCD Directive, thus creating costs for the public administration as well as costs for the enterprises that occur in the administrative procedure. The administrative burden could be substantial for SMEs, as the latter may incur opportunity costs, as part of their staff would need to be given up for administration burden related activities rather than core tasks. It could potentially disrupt company's normal operations.

From the industry's point of view, the flexibility scheme would be a convenient mitigating measure as the companies could place on the market a number of non-compliant engines and delay the investments. On the other side, doubts have been expressed by enforcement authorities about monitoring possibilities and effectiveness of this scheme and additional administrative burden.

Sub-option 3.2 — Use of a transitional period for all engine manufacturers

The aim of this option is to grant a transitional period of 3 years to all engine manufacturers so that they have enough time to adapt to the new rules. The transitional period reflects the time when the exhaust emission limits will become fully applicable in the US so the production of majority of engine manufacturers should comply with these limits already. The period would start from the entry into force of the Directive, meaning that approximately two years would overlap with the transposition period of the Directive, leaving one extra year for adaptations.

Environmental impact

Table 16: Average percentage change / year compared to Option 1[38]

	HC + NOx	PM	CO
Sub-option 3.2 - Stage II + Additional transition period	-19,88%	-33,81%	+15,42%

Table 17: Value of damage avoided / year compared to the Option 1

	Value of damage avoided (M€) / year (NOx)	Value of damage avoided (M€) / year (PM)
Sub-option 3.2 - Stage II + Additional transition period	7,1 M€ - 34,2 M€	2,4 M€ - 13,7 M€

[38] Detailed calculation provided in the Annex VIII.

HC+NOx emissions for this option will decrease less than in the case of previous options. However, the transitional period seems to be better choice in terms of decrease of PM than the flexibility scheme (presented in Sub-option 3.1). These results are given assuming that during the 3-year transitional time, the possibility to continue placing on the market the engines compliant with the previous stage of emissions will be used to the fullest and that no engines compliant with the new limits will be placed on the market, which is a rather extreme assumption unlikely to happen in reality.

Economic impact

Certain engine manufacturers or marinisers will encounter problems to have all their engines certified on time unless they are allowed specific additional lead time. Such a specific measure would therefore help to limit and spread out the compliance costs, i.e. guarantee a better scheduling of investments rather than having high compliance costs concentrated over a very short period of time. If an additional lead time could be granted to the companies, this would allow the engine manufacturers or marinisers to avoid investments on products coming close to their end of life and would allow keeping them alive until the new products are ready.

Table 18: Total compliance costs linked to the Sub-option 3.2

	CI Engines	SI Engines
Sub-option 3.2 - Stage II + Transitional period	2 M€ to 8 M€ /year	1,8 M€ to 5 M€ / year

Source: ARCADIS Complementary Impact Assessment Study July 2008, Tables 6.13 and 6.15, pages 85, 88

As can be seen in the Table 18, the compliance costs will be probably lower as the majority of engine manufacturers will have spent the R&D costs already earlier in order to be able to comply with the US rules. These costs can therefore be considered as sunk costs.

Use of a transitional period is generally accepted by stakeholders as a compromise mitigating measure which is not burdensome in terms of administration. However, industry considers it not fully adapted for the needs of SMEs.

Sub-option 3.2 would thus be effective to the extend that it meets the general objectives for protecting the environment and human health as well as improving the Internal market, but it would fail to fully meet the specific objective for protecting vulnerable enterprises.

Sub-option 3.3 – Use of a transitional period for all engine manufacturers + a specific transitional period for small and medium sized engine manufacturers placing on the EU market the SI outboard engines ≤ 15 kW (3+3 years).

For a very limited number of small and medium sized engine manufacturers which clearly meet the SME definition [39] the new emission standards will remain a serious challenge. This is why, after applying the SME test as described in Annex XIV, it is recommended to add an additional SME specific mitigating measure. One SME that would be eligible for this measure has been identified during the stakeholder's consultation although a few others may also exist.

[39] Commission Recommendation on the definition of SMEs , OJ, L124, 20.5.2003 , p.36

Environmental impact

The mitigating measure as proposed in this option would relate to at least one small and medium sized SI engine manufacturers. The environmental impact of this mitigating measure is estimated at about 6,16 tons/year of HC+NOx emissions more comparing to Sub-option 3.2. It would represent 0,015 % of the total annual HC+NOx emissions from recreational craft. This figure does not make a real difference in the overall annual exhaust emissions from the recreational marine engines. The PM emissions are not considered here as the SI engines do not emit PM.

Economic impact

A special transitional period of 3 years (in addition to the 3 years granted already to all engine manufacturers) would be granted to those small and medium sized engine manufacturers who place on the EU market the low power SI outboard engines. Contrary to a complete exemption from the Stage II for SME SI engine manufacturers placing low power engines on the EU market, which would mean a distortion of competitive environment as some of the companies would not need to invest to the new technology at all, this option simply provides a longer period for adaptation and mitigates the negative economic and social impact. At the same time it does not provide a disproportionate competitive advantage. The proposed additional transitional period gives a limited number of companies enough time to adapt their production. The time to develop the appropriate new technology for low power SI outboard engines is assumed to be about 6 years.

If the additional transitional period of 3 years is granted, the small and medium sized SI engine manufacturers will be able to upgrade their engine families to the new emission standards. These manufacturers will not be forced to limit their product offer.

The worldwide market share of small and medium sized SI engine manufacturers is negligible (0.5% as reported by ARCADIS). Therefore the impact of this additional mitigating measure on the relevant market, which is the global market, remains marginal. The affected companies usually serve only European market and do not have a chance to increase their production capacity and consequently their market share due to the limited capacity to invest. The proposed mitigating measure will not have a negative impact on competitiveness of large manufacturers. This was discussed with representatives of large manufacturing companies and no objections were raised.

A transitional period for all industry and specific time granted to SMEs did not receive any objection from stakeholders.

Final comparison of the options

Table 19: Comparison of the environmental impact measured as emission reduction/ year

	Average annual emission reduction of HC+NOx (%)	Average annual emission reduction of PM (%)	Average annual emission change of CO (%)
Option 1 - Stage I. – Baseline scenario	0%	0%	0%

Option 2 – Stage II of the limits	-26,51%	-45,08%	20,56%
Sub-option 3.1 – Stage II + Flexibility scheme	-23,96%	-28,20%	17,99%
Sub-option 3.2 – Stage II + Transitional period	-19,88%	-33,81%	15,42%
Sub-option 3.3 – Stage II + Transitional period + Specific time for SI engine SMEs	-19,78%	-33,81%	15,36%

Table 19 ranks the **Option 2** as the preferred one in terms of reduction of exhaust emissions. However, the achieved emission reduction has to be seen in the context of related economic and social costs. Therefore, Table 20 compares the monetized environmental effect with the compliance costs resulting from the restriction of the limits. Although the availability of data enables to monetize the environmental benefits only for NOx and PM, the positive financial effect may be concluded for all the options. Expected damage savings vastly outweigh the expected compliance costs. It is probable that the overall damage savings would be even higher if the savings of HC emissions are included.

Table 20: Comparison of environmental benefit / year with the compliance costs / year for all options

	Value of damage avoided (M€) / year (NOx)	**Value of damage avoided (M€) / year (PM)**	**Average compliance costs (M€) for CI engines / year**	**Average compliance costs (M€) for SI engines / year**
Option 1 - Stage I. – Baseline scenario	0	0	0	0
Option 2 – Stage II of the limits	9,5 M€ - 45,5 M€	3,2 M€ - 18,2 M€	5,7 M€ - 19 M€	5,1 M€ - 10,6 M€
Sub-option 3.1 – Stage II + Flexibility sceme	8,6 M€ - 41,2 M€	2,0 M€ - 11,4 M€	1,2 M€ - 8 M€	4,6 M€ - 10 M€
Sub-option 3.2 – Stage II + Transitional period	7,1 M€ - 34,2 M€	2,4 M€ - 13,7 M€	2 M€ - 8 M€	1,8 M€ - 5 M€
Sub-option 3.3 – Stage II + Transitional period + Specific derogation for SI engine SMEs	7,1 M€ - 34,1 M€	2,4 M€ - 13,7 M€	2 M€ - 8 M€	1,8 M€ - 5 M€

Despite the positive environmental effect, **Option 2** entails the highest economic and social costs. Sub-option 3.1 shows up the solid exhaust emission decrease as well as reasonable level of compliance costs and job losses. However, one has to consider that the flexibility scheme is not suited for the recreational craft sector. The administrative costs for national market surveillance authorities which would have to grant and monitor the flexibility scheme may be a considerable burden too. Sub-options 3.2 - 3.3 limit the danger of high discontinuation costs and enable spreading out other compliance costs in time, which makes the difference between these Sub-options and Option 2. For better transparency a table of net economic benefit has been added. It aggregates the damage savings of referred pollutants as well as compliance costs for all engines. It keeps the range of lower and higher bound of costs/savings.

Table 21: Net economic benefit (savings/costs analysis)

	Net benefit (M€)
Option 2 – Stage II of the limits	1,9 M€ - 34,1 M€
Sub-option 3.1 – Stage II + Flexibility scheme	4,8 M€ - 34,6 M€
Sub-option 3.2 – Stage II + Transitional period	5,7 M€ - 34,9 M€
Sub-option 3.3 – Stage II + Transitional period + Specific derogation for SI engine SMEs	5,7 M€ - 34,8 M€

Following the information provided in the Table 22 all options would entail a price effect (price increase) and could also generate a disruption of the lines of products, leading to a decrease in consumer choice, which would have a negative impact on consumer welfare. The Complementary Impact Assessment Study (2008) quantified the number of jobs directly linked to the recreational craft industry to amount to approximately 2300. The job losses[40] derive directly from the price increase and the price effect: increase in price will result in important decrease in demand because of the elasticity of recreational craft, the decrease in demand will lead to job losses. The job losses in engineering positions may be linked to discontinuation of those engine families that generate too low profit to invest money to make them compliant with the new limits. Such a discontinuation is probable for Option 2 and Sub-option 3.1. Job losses in marketing and sales positions may be caused by the loss of market share.

Table 22: Comparison of the social impact

	Total job losses for CI engines	**Total job losses for SI engines**
Option 1 - Stage I. – Baseline scenario	-	-
Option 2 – Stage II of the limits	less than 100	less than 100

[40] Quantification of job losses for Option 2 and Sub-option 3.1 described in Annex XIII

Sub-option 3.1 – Stage II + Flexibility scheme	less than 10	less than 100
Sub-option 3.2 – Stage II + Transitional period	job losses unlikely	less than 100
Sub-option 3.3 – Stage II + Transitional period + Specific derogation for SI engine SMEs	job losses unlikely	job losses unlikely

Such job losses are unlikely to occur in the **Sub-option 3.3** since no price increase or loss of market share should occur. Although the same costs will arise in this sub-option, they will be spread over a longer period of time. Therefore, unlike the other options, the enterprises (especially SMEs) will not have to support these high costs on a very short time span and will support these cost over a longer period of time. This will allow the manufacturers to reduce the price increase to a minimum, and to keep their market shares. As the price effect will be limited for **Sub-option 3.3**, the demand remains steady and job losses will be unlikely or minimised. Spreading the costs over a longer period of time should allow the industry to keep the current jobs and not to resort to job cuts. Similarly, spreading the costs will also allow the industry to continue producing all the lines of products. No decrease in consumer choice should therefore occur. As a consequence, in this last sub-option, the negative impact on consumer welfare and the overall social impacts are the lowest.

Basically all the presented options meet the general objectives as they firstly lead to the decrease of air pollutants in the environment and secondly they provide the common legislative framework for the engine manufacturers operating within the EU market and thirdly ensure the alignment of engine emission requirements with the US. However, Option 2 does not sufficiently meet the specific objective to protect vulnerable enterprises from worsening their position on the market. Considering the SMEs as the most vulnerable companies in the sector, the Sub-option 3.3 meets the best designed objectives.

Sub-option 3.3 is the most efficient compromise for SMEs in terms of environmental effects combined with economical and social losses. Therefore it becomes the preferred option. Tables 23-25 compare the environmental impact of the preferred option with the baseline scenario and with the EQS. The preferred option will enable to decrease the most exposed pollutant – NOx in Lake Marinas under the EQS level and will contribute to the decrease of NOx in Coast Marinas.

Table 23: Estimated concentrations of selected pollutants for Coast Marina

Pollutant	EQS (µg/m^3)	Current situation baseline (µg/m^3)	Preferred option (µg/m^3)
NOx long term	40	17,54	14,07
NOx short term	**200**	**599,47**	**480,89**
PM long term	40	0,26	0,17

PM short term	50	0,59	0,39
CO long term	350	231,26	266,78
CO short term	10 000	3 093,82	3 569,03

Table 24: Estimated concentrations of selected pollutants for Lake Marina

Pollutant	EQS (µg/m^3)	Current situation baseline (µg/m^3)	Preferred option (µg/m^3)
NOx long term	40	13,17	10,56
NOx short term	**200**	**213,97**	**171,65**
PM long term	40	0,27	0,18
PM short term	50	0,56	0,37
CO long term	350	137,98	159,17
CO short term	10 000	1 121,75	1 294,05

Table 25: Estimated concentrations of selected pollutants for Inland Waterways

Pollutant	EQS (µg/m^3)	Current situation baseline (µg/m^3)	Preferred option (µg/m^3)
NOx long term	40	0,16	0,13
NOx short term	200	2,5	2,01
PM long term	40	0	0
PM short term	50	0,02	0,01
CO long term	350	3,73	4,30
CO short term	10 000	29,64	34,19

6.2 Impact of the noise emissions limits for engines

Option 1: Impact of no policy change

The current noise limits for recreational craft would remain as provided by the amendment Directive 2003/44/EC. They were harmonised to ease the functioning of the internal market.

Table 26: Current noise emission limits in the RCD

Rated engine power (kW)	Maximum sound pressure Level = L_{pASmax} (dB)
$P_N \leq 10$	67
$10 < P_N \leq 40$	72
$P_N > 40$	75

Furthermore, in line with the provisions of the Treaty, Member States may take tailor-made national measures to further protect some sensitive areas from noise emitted by recreational craft, such as limiting the speed and use of boats. It enables to effectively restrict noise and to achieve environmental benefits through specifically designed measures for the areas in which craft operates.

Sound impact greatly depends on the number of recreational craft used and the duration of activities. Therefore, measures such as speed restriction restricted use of the craft at certain hours seem to be more effective measure for further reducing noise. Table 27 shows that speed limits or restricted use at certain hours could be a more effective solution than a requirement for all boats or engines to meet severe standards.

Table 27: Estimated environmental sound impact for some typical cases, expressed in dB[41]

Situation	Low Intensity		High intensity	
	Intensity (number of hours)	Sound Impact (dB)	Intensity (number of hours)	Sound Impact (dB)
Canal (50 m)	15	43	45	47
Lake (200m)				
Boats	10	50	40	56
PWC	0.2	42	0.8	48
Marina (200m)				
Boats	1	40	7	49
Passing (25 m)				
Boats	2	38	20	48
PWC	2	45	20	55

Source: Stocktaking Study, TNO (2004)

These levels should be compared against following target values:

[41] Assumptions for measurement of environmental noise impact settled in Annex XII

Table 28: The permissible levels differentiated for different types of areas and their use

Area concerned	Target value (in dB)
Residential Area	55
Recreational Area	40-60
Park / Nature Conservation Area	30-40

Source: Stocktaking Study, TNO (2004)

Both tables show that the environmental sound impact on humans varies for normal use depending on the area in which the craft is used. The environmental sound impact on humans varies for normal use between 38 dB (A) and 56 dB (A), which is not critical for residential areas, some types of recreational areas and for boat user's health. For other types of recreational areas this could be too high for parklands and conservation areas it is clearly too high. In those cases additional measures such as speed limits and restrictions of use will be necessary. Speed limits alone might not be enough, especially for low power engines where the sound from the engine dominates over the sound from the moving hull.

Another consequence of retaining the current limits and relying on reduction of the use is that the companies would not have to invest in new technologies to further reduce noise.

Despite its benefits, this option presents also a risk: as Member States are free to implement different national, tailor-made, measures, this could lead to trade distortion or barriers to trade within the EU, or measures having an equivalent effect to a quantitative restriction (contrary to Article 34 of the TFEU. Such measures can only be implemented by Member States since they have to be specifically designed for specific areas. Considering the principle of subsidiarity and the repartition of competences between the Union and the Member States, such specific measures shall be taken at the national level and not at the Union level.

Option 2: Impact of stricter noise emissions limits

The option to introduce more restrictive noise emission limits for engines only has a limited real impact on the environment and on overall sound levels. The TNO study provides several arguments showing that the reduction of engines' noise is not the key to reducing the overall craft noise.

First of all, noise from the boat does not entirely result from the engine's noise emissions but rather, they are a result of a combination of factors (use/speed of the boat, boat structure, subjective criteria linked to the area, the person listening etc.). Therefore, since the directive can only act on the noise emission from the engines, its impact on the total noise felt by the user/bystanders will remain marginal.

Moreover, although the sound level itself is mainly responsible for some negative effects, the *annoyance* experienced by human beings depends on other aspects, including the type of sound (level, frequency, content, temporal variation, etc.), the type of surrounding (harbour, recreational area, parkland or conservation areas, etc.), time of occurrence (type of day, day or night, etc.) and several subjective and personal aspects such as the feeling about the type of source and the usefulness of the source and its use. The use of a recreational craft can therefore be just as important as the sound emission of that craft; and even the sound emission

of the craft is determined largely by its user. In addition, several studies have shown that the perceived annoyance is not based on the sound levels alone and perceived annoyance is much higher in case of personal watercrafts (PWC).[42]

Furthermore, engines' noise emissions are only a small part of the overall noise emitted by the craft. Table 29 shows the expected sound reduction for the overall craft when decreasing the noise emissions from the engines.

Table 29: Overall sound reductions that can be obtained from reducing noise from engines

Type of engine	Sound reduction of the engine (in dB)	Total craft's sound reduction obtained (in dB)
Outboard P_N > 40 kW	-6 / -8	-3
Outboard 10 < P_N < 40 kW	-4 / -5	-3
Outboard P_N < 10 kW	-4 / -5	-3
PWC P_N > 40kW	-4 -3	-3 -2 / -1

Source: Stocktaking Study, TNO (2004)

If only measures are taken in order to modify the engines, the maximum achievable total sound reduction for craft with outboard engines in the higher power range is about 3 dB. However, to achieve such a reduction, outboard engine's emissions would have to be reduced by at least 6 dB, which is quite significant. For the lower power range the potential is somewhat higher: a total sound reduction by 3 dB requires 'only' 4 dB reduction for the outboard engine, still a significant reduction. Also for PWCs the required sound reduction of the engine is about 4 dB in order to obtain a total sound reduction of 3 dB. Moreover, if the sound contribution of the engines is only reduced by 3 dB, that would result in an overall reduction of the sound impact of 1 to 2 dB which is not significant.

The cost involved in the modification of engines entailed by the introduction of stricter standards should also be taken into account. Manufacturers will have to bear R&D and investment costs to introduce new technology to achieve higher noise emission standards.

Contrary to the exhaust emission limits, there is no common policy at federal level related to noise of recreational crafts in the US. California as the state with the highest concentration of recreational crafts specifies a single limit of 75 dB for all engine power categories whereas the EU requires tougher limits for smaller power ranges. Thus, a more severe limit value of EU noise limits would disalign the rules with the US.

Despite positive reactions from some Member States on legislative restriction of noise limits, the option is strongly opposed by the industry. The letter points out the findings of TNO Study 2004 and underlines in particular the limited environmental benefit entailed by the

[42] Stocktaking Study, TNO (2004), p. 67

introduction of stricter noise emission limits, the importance of the changes necessary to achieve a small emission reduction and the costs entailed by such changes.

This leads to the conclusion that current noise limits are necessary to guarantee the functioning of the internal market. Further decreasing noise of recreational craft can be most effectively achieved by national measures on the boat use.

6.3 Impact of the measures aligning the Recreational Craft Directive with the New Legislative Framework (NLF)

Most of the provisions from the NLF codify the current practice and do not introduce important new changes in the sector. The impacts of the integration of the model Articles into the RCD sector are therefore minor.

The significant impacts should be mostly positive, since the horizontal provisions clarify certain issues[43] which are uncertain for the moment. Legal certainty will be beneficial for all parties: economic operators, national and European Union administration as well as consumers. Certain new obligations set for economic operators, can have an economic impact in terms of new costs for the economic operators.[44] In particular, importers have new obligations to ensure the compliance of the product. However, these impacts should be largely overweighed by the benefits stemming from these provisions for consumers in terms of increased safety of recreational craft and for national administrations in terms of reduced costs following clearer new rules on responsibilities of economic operators.

Administrative Burden

According to the current Directive, the Member States are obliged to inform Commission when the Safeguard Clause is applied and when the Notified Body is appointed or withdrawn from the list of the bodies notified to make a conformity assessment for recreational craft. These administrative measures are considered to be necessary and effective and are proposed to be kept in the Directive.

As explained in Problem Definition on the page 13, the administrative burdens arise to the engine manufacturers from different certification requirements in the EU and the US. The preferred option is based on aligning the rules on both sides of Atlantic, therefore the requirement to certify twice for two different markets might be reduced.

7. MONITORING AND EVALUATION

The Commission has several tools at its disposal to make sure that the objectives set in this new piece of legislation will effectively be achieved.

The main tool is market surveillance by the competent authorities of Member States. Non-compliance will also be spotted as a result of complaints addressed to the Commission.

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[43] For instance horizontal definitions, requirements for Notified bodies and notified authorities and for notification, content of conformity assessment modules, content of the EC declaration of conformity.

[44] The impact of the alignment with the NLF is closely evaluated in the Omnibus Impact Assessment (COM
proposal aligning several directives to the NLF at the same time).

The Commission will be able to detect any problems regarding to the correct application of the RCD through the following initiatives:

- Regular reports that Member States have to send every five years to the Commission. These reports will contain at least the following elements

- an evaluation of the situation concerning the safety of products
- an evaluation of the effectiveness of the RCD
- effectiveness of tracking non-compliant products
- effectiveness of stricter exhaust emission limits through air pollution measurement in marine/lake/inland waterway areas.

The Commission will provide a guidance document to the Member States on key monitoring indicators. The Commission services will evaluate national reports and publish a summary report

There is also a reporting obligation on market surveillance activities, which includes the area of recreational craft, provided by the NLF Regulation 765/2008

– ADCO group meetings are organized twice a year. Questions and remarks raised at these meetings should give a good insight on the actual functioning of the RCD.

– The new information exchange systems provided by Art. 23 of Regulation 765/08/EC framework will allow the Commission to monitor the effectiveness of the RCD.

– The group of notified bodies (RSG), organizes one plenary session and two sub-groups per year. It coordinates the common application of the conformity assessment rules and issues Recommendations for use (RFU), the number of which provides a good indicator on the possible need for clarification and application of the RCD.

– Requests & remarks received by the Commission from the public will help to monitor the eventual infringements of the internal market.

– All important information about the functioning of the RCD is published on a dedicated CIRCA website which can be consulted by Member States, professional associations and NGOs.

Glossary

2s	2-stroke
4s	4-stroke
ABT	Averaging, Banking and Trading System (flexibility system in the US)
CARB	California Air Resources Board
CI	Compression ignition (diesel) engine
CO	Carbon Monoxide (emission component)
DI	Direct Injection
DIY	Do it yourself
EEA	European Environment Agency
EFI	Electronic fuel injection
EPA	United States Environmental Protection Agency
EUROMOT	European Association of Internal Combustion Engine Manufacturers
EQS	Environmental Quality Standard
GHG	Green House Gas Emissions
HC	Hydrocarbons (emission component)
IB	Inboard Engine
IMEC	International Council of Marine Industry Associations' Marine Engine Committee
Mariniser	a company which purchases engines from the engine manufacturer producing engines for different applications (automotive, non-road use) and convert or adapt them for marine use
NLF	New Legislative Framework
NOx	Oxides of Nitrogen (emission component)
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NRMM	Non-Road Mobile Machinery
OB	Outboard Engine
OEM	Original equipment manufacturer
PM	Particulate Matter (solid emission pollutant)
PWC	Personal Watercraft
RCD	Recreational Craft Directive, 94/25/EC
R&D	Research and Development
SI	Spark ignition (petrol) engine
SME	Small and medium enterprise
SOER 2010	The European environment – state and outlook 2010
SOx	Oxides of Sulphur (emission component)
TA	Type Approval
TFEU	Treaty of Functioning of the European Union
UN-ECE	Economic Commission for Europe of the United Nations

ANNEX I: Overview of recreational craft and engines for recreational craft sector

Economic importance of the recreational craft sector per country (2004)

Country	GDP €			Employment		
	TOTAL	Recreational craft sector contribution		Total labour force	Recreational craft sector employees	
Austria	214.000.000	55.000	0,03%	4.300.000	960	0,02%
Belgium	279.000.000	55.000	0,02%	4.440.000	940	0,02%
Bulgaria	12.100.000	14.000	0,12%	3.830.000	440	0,01%
Croatia	16.900.000	153.000	0,91%	1.700.000	3.470	0,20%
Cyprus	6.740.000	19.000	0,28%	377.000	515	0,14%
Czech Republic	75.200.000	5.000	0,01%	5.200.000	150	0,00%
Denmark	182.000.000	324.000	0,18%	2.860.000	5.290	0,18%
Estonia	5.220.000	13.000	0,25%	609.000	470	0,08%
Finland	139.000.000	386.000	0,28%	2.600.000	6.750	0,26%
France	1.410.000.000	2.220.000	0,16%	26.600.000	41.200	0,15%
Germany	2.150.000.000	1.980.000	0,09%	41.900.000	26.900	0,06%
Greece	150.000.000	225.000	0,15%	4.370.000	4.270	0,10%
Hungary	68.300.000	8.000	0,01%	4.200.000	280	0,01%
Ireland	121.000.000	123.000	0,10%	1.800.000	2.850	0,16%
Italy	1.230.000.000	2.920.000	0,24%	23.600.000	92.000	0,39%
Latvia	7.400.000	2.000	0,03%	1.100.000	95	0,01%
Lithuania	10.300.000	4.000	0,04%	1.500.000	130	0,01%
Malta	4.150.000	7.000	0,17%	160.000	210	0,13%
Netherlands	414.000.000	1.070.000	0,26%	7.200.000	20.700	0,29%
Norway	169.000.000	525.000	0,31%	2.400.000	6.600	0,28%
Poland	162.000.000	106.000	0,07%	17.600.000	2.910	0,02%
Portugal	124.000.000	128.000	0,10%	5.100.000	2.480	0,05%
Romania	44.900.000	10.000	0,02%	9.900.000	330	0,00%

Slovakia	28.500.000	1.000	0,00%	3.000.000	65	0,00%
Slovenia	18.300.000	32.000	0,17%	857.000	716	0,08%
Spain	665.000.000	487.000	0,07%	17.100.000	9.020	0,05%
Sweden	246.000.000	742.000	0,30%	4.400.000	6.930	0,16%
Switzerland	284.000.000	233.000	0,08%	4.000.000	2.780	0,07%
Turkey	219.000.000	152.000	0,07%	23.800.000	5.370	0,02%
UK	1.440.000.000	1.490.000	0,10%	29.700.000	26.400	0,09%

	9.896.010.000	13.489.000	0,14%	256.203.000	271.221	0,11%

SOURCE: Economic and Social Impact Analysis, Appendix A, ECNI (2006)

Number of companies in the European recreational craft industry chain (2007)

Country	Boat builders	Engine manufacturers / marinisers
Denmark	30	1
Finland	58	0
France	156	7
Germany	412	11
Greece	87	0
Ireland	4	0
Italy	800	10
Netherlands	450	1
Portugal	55	0
Spain	25	3
Sweden	50	3
UK	500	5
	2 627	**41**

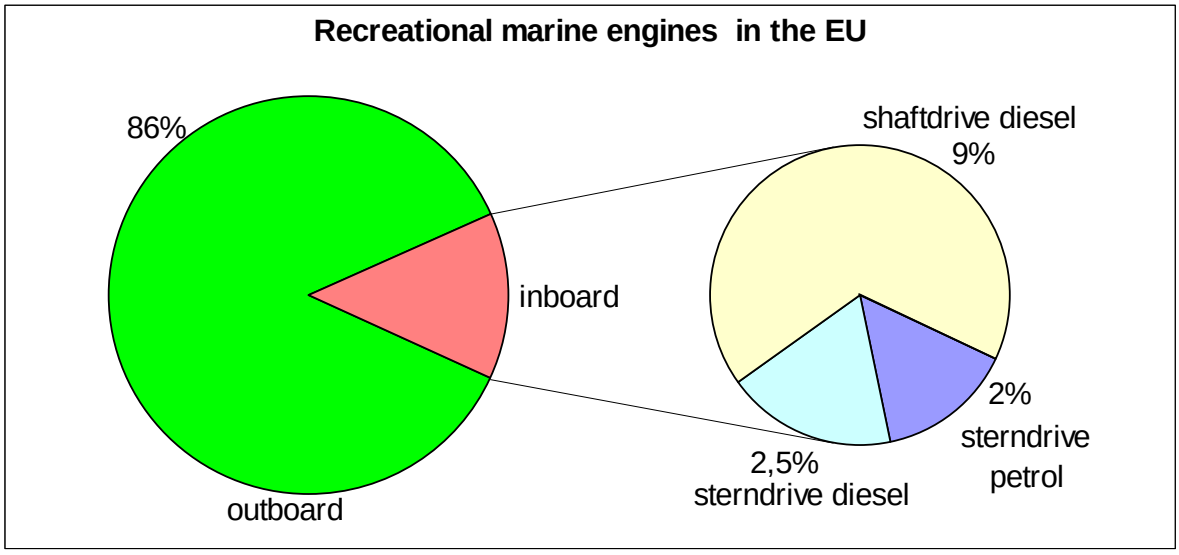
Croatia	65	1
Norway	95	2
Switzerland	18	7
Turkey	300	0
	478	**10**

SOURCE: The Complementary Impact Assessment Study: ARCADIS (2008)

Due to the financial and economic crisis which hit the sector from 2008 onwards this number has been reduced mainly as a result of merger & acquisition. The manufacture of recreational craft engines is a small industry compared e.g. to car or truck sector, although it plays a significant role in specific regions. The largest marine engine manufacturers are located in Sweden, followed by Germany, Italy and the UK. The European engine manufacturers provide some 2300 jobs.

The total number the outboard engines sold in the EU by far outnumbers the sales of inboard engines. The vast majority of outboard engines are SI (petrol) engines.

The use of recreational marine engines in the EU



Source: Stocktaking Study: TNO (2004)

There are nine manufacturers of **outboard engines** world-wide in 2008, with annual production volumes of 800 000 pc. (cca 210 000 in the EU / cca 302 000 in the US).[45] The **inboard engines** are essentially marinised diesel engines obtained from the industry. For these engines, the European sales very much depend on whether they are inboard petrol engines or inboard diesel engines. The inboard diesel engines' market is primarily a European one (40 000 units sold per year in the EU out of 65 000 units / year worldwide); whereas inboard petrol engines sales in Europe only represent only 7, 5% of worldwide sales (approximately 10 000 units per year in Europe and 130 000 units / year worldwide).

Personal watercrafts (including its **inbuilt PWC engines**) sold on the European market are produced by 4 manufacturers, two Japanese and two North-American companies. The total estimated annual sales of personal watercraft in Europe is about 10 000 units, which represents less then 10% of the global market.

[45] Source: The Complementary Impact Assessment Study: ARCADIS (2008)

ANNEX II: Public consultation on a possible approach to revision of the RCD, summary of responses

1. Introduction

The European Commission launched an open public consultation to gather views on its outline proposals for revising the legislation on recreational craft. Various policy options for drafting a proposal amending the Recreational Craft Directive have been identified in close consultation with stakeholders. They address the needs for:

1. further improving the environmental performance of recreational marine engines by proposing the next stage of exhaust emission limits;
2. aligning the provisions of the Directive with the principles of the new legal framework;
3. improving the existing provisions of the Directive which are not covered by previous two points.

The main objective of this public consultation was to ask citizens and stakeholders for their views and opinions on the various issues that might need to be addressed in any proposal for further amending the Directive. The replies to this consultation have provided the Commission with a broader range of views on the policy needs identified and should enable it to improve or confirm the approaches envisaged.

2. Overview of respondents

The consultation was launched on 11 May 2009, with 19 July as the deadline for replies. The Commission received 32 responses: 16 of them were sent on behalf of an organisation or institution, 9 by enterprises and 7 by individual citizens.

Most of the contributions sent by organisations were from public authorities. However, industrial organisations, notified bodies and non-governmental organisations also made their voices heard. Boat manufacturers and SMEs in particular were the main contributors on the side of enterprises. Invaluable contributions were also received from individual citizens.

Contributions were received from 12 different States (11 EU States and 1 EEA State). The bulk of the responses were from Poland and Germany.

3. Further improving the environmental performance of recreational marine engines: need for further reducing emissions of air pollutants

About 65 % of respondents agreed with the approach of further reducing the exhaust emission limits for recreational marine engines, provided sufficient attention is paid to mitigating measures for small and medium-sized enterprises, on which any further restrictions would have the greatest impact. A slight majority of respondents were in favour of a derogation as the most acceptable option to cushion the impact on SMEs. However, there is also strong support for exempting SMEs from complying with any new limits, especially amongst enterprises and citizens. By contrast, 19 % of the respondents, in particular institutions, disagreed with mitigating measures for SMEs.

The idea of mitigating measures for SMEs has overwhelming support. The softer solution – a derogation – seems to be a compromise between the concerns of the industry (which is in favour of exemptions) and the public authorities (which doubt the need for any alleviation).

4. Further improving the environmental performance of recreational marine engines: need for further reducing noise

The idea of regulating noise from recreational craft by means of operational measures regulating use of noise-emitting craft rather than further lowering the noise emission limits in the Directive has strong support among all parties: institutions, enterprises and boat users. The respondents expressed the opinion that the local authorities might be more effective at reducing noise by means of specially tailored limits.

5. Subject-matter and scope

Public authorities in particular indicated that the classification of the products covered by the Directive should be clearer. The status of partly completed boats appears especially unclear. The reason probably lies in the vague wording of the declaration by the builder that the boat will be completed by others. For citizens and enterprises, clarification of the classification is not such an issue.

More than half of the respondents have no problem understanding the scope of exemptions from the Directive. However, some institutions stated that craft built for own use and racing (rowing) craft in particular should not be exempted from the Directive as this would create confusion and leave room for possibly side-stepping the system. Objections were raised against exempting craft intended to carry passengers for commercial purposes, but such craft are regulated by other EC legislation.

The discussion about the status of amphibious vehicles and pontoons indicated that they should also be exempted from the Directive.

6. Alignment with the new legal framework

The questionnaire proved that stakeholders especially strongly support clearly defining the obligations of economic operators. There were also calls for defining and imposing obligations for persons importing craft from countries outside Europe for non-commercial purposes. Institutions are more in favour of defining the obligations of each link in the economic chain, whereas manufacturers and citizens would prefer to clarify the rules for the conformity assessment procedures and for affixing the CE marking.

7. CE marking of propulsion engines

The stakeholders indicated that all engines covered by the Directive (including inboard engines and stern-drive engines without integral exhaust) should be explicitly required to have the CE marking affixed to confirm that they comply with the noise and exhaust emission limits.

8. Choice of conformity assessment modules

The recreational craft sector has already been using the various conformity assessment modules before they are introduced in the new legal framework. The choice of those modules seems to be adequate and sufficient in the view of the vast majority of the respondents.

9. Post-construction assessment procedure

Post-construction assessment (PCA) is a special conformity assessment procedure used preferably by importers when neither the manufacturer nor the manufacturer's authorised representative takes responsibility for the conformity of the product with the Directive. The current Directive explicitly allows use of this procedure for recreational craft only, but not for personal watercraft or engines. Opinions on widening the scope of the PCA to other products differ between stakeholders. There are equal numbers of supporters and opponents. Institutions support the idea that post-construction assessment should apply to all products covered by the Directive. By contrast, some manufacturers are convinced that the PCA is not desirable for other products and, in particular, would not even be technically feasible for personal watercraft. However, there is broad agreement that the PCA procedure should be defined in a separate annex.

10. Enforcement and market surveillance

Both governments and businesses consider that market surveillance activities in the field of recreational craft are not sufficient and that the new legal framework should help in this area. However, there are also manufacturers who think that the market surveillance authorities have strong powers. Nevertheless, those who wish to reinforce the powers and activities of enforcement authorities consider that preventive measures and enhanced cooperation between market surveillance authorities and customs authorities are the most powerful tools. Institutions are in favour of tighter controls at borders and even obligatory registration of boats, whereas manufacturers and citizens prefer improvement by means of cooperation and exchanges of information between enforcement authorities.

11. Feedback from stakeholders

Other interesting opinions expressed as feedback from stakeholders included:

- Revision of the wave height of design categories is needed, as it appears inadequate for some categories.
- Partly completed boats should be accompanied by the technical documentation when placed on the market.
- Alignment of the exhaust emission limits with the US limits is more desirable for SI engines. For CI engines, alignment with the limits for non-road mobile machinery is preferable.

ANNEX III: Schematic representation of different drive principles for boat engines

Types of engines involved in the motorboats and personal watercraft are:

- ❖ Spark-ignition [SI] engines (called also petrol engines)

Outboard engines

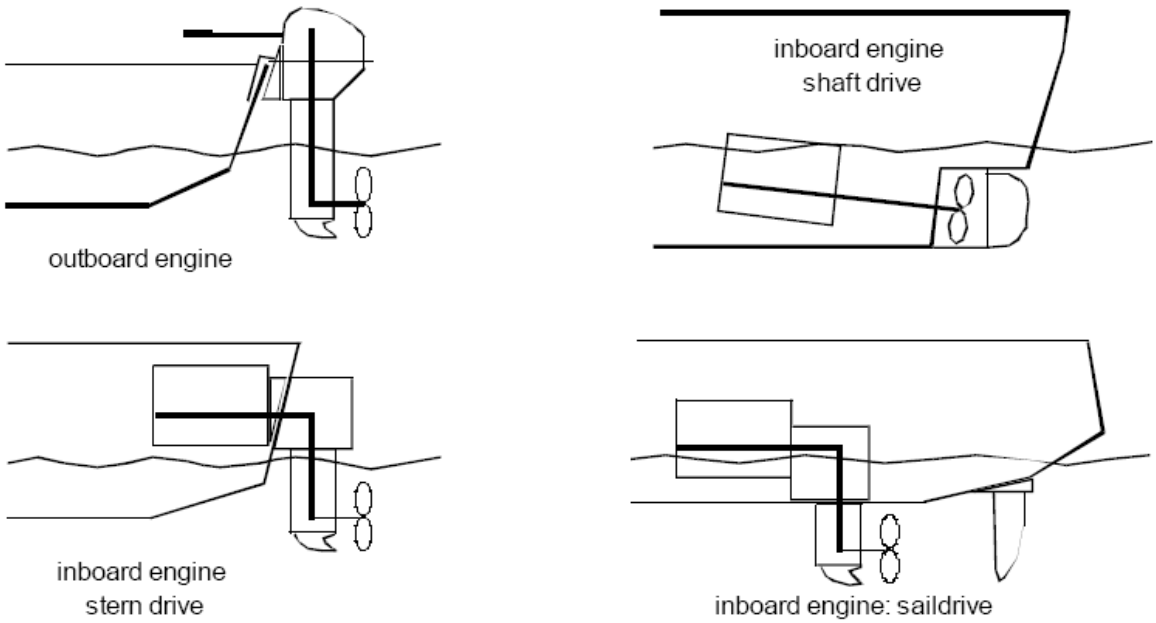
- ➢ Inboard (stern-drive) engines
- ➢ Inboard (shaft-drive) engines
- ➢ PWC engines - used in the personal watercrafts

- ❖ Compression-ignition [CI] engines (called also diesel engines)

Inboard (stern-drive) engines

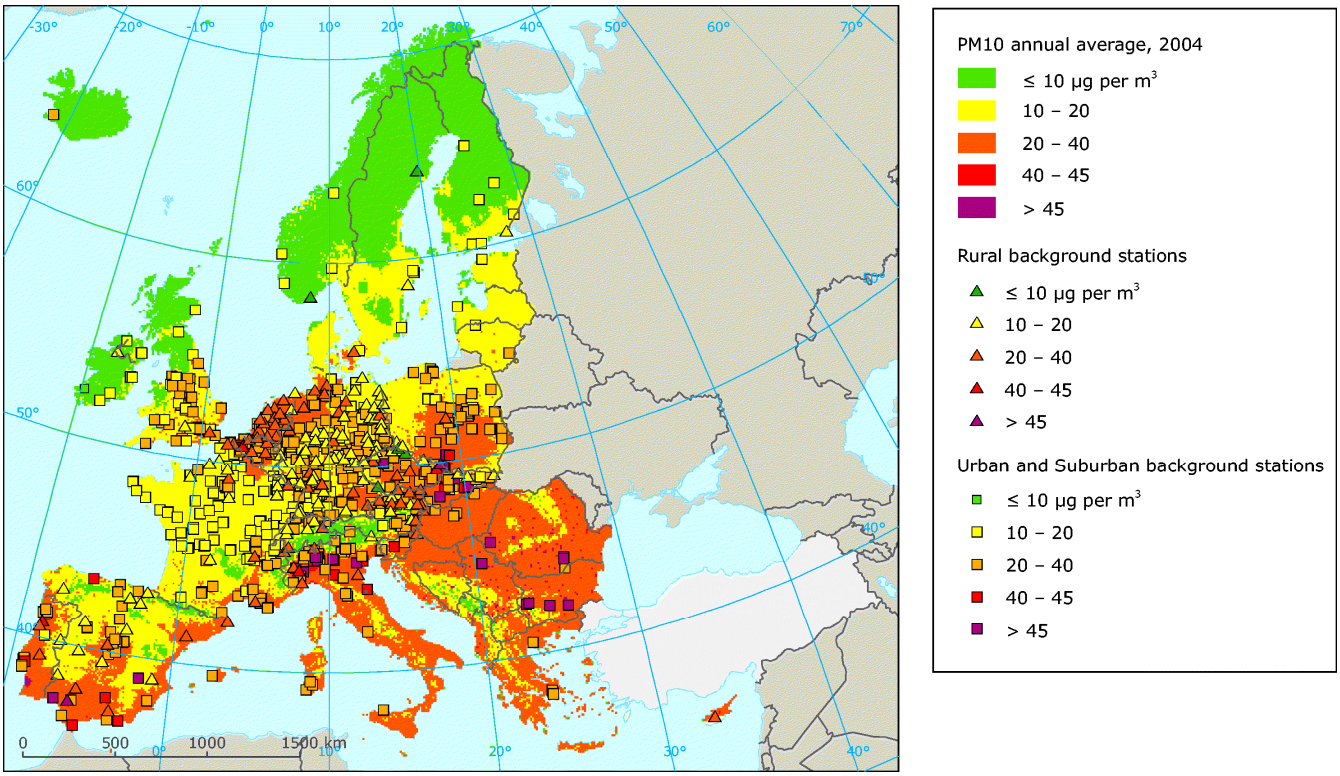
- ➢ Inboard (shaft-drive) engines

Figure 2.1: Different engine installation configurations.



ANNEX IV: Annual average air concentrations in Europe - affected locations

Annual average PM air concentrations



ANNEX V: Overview of the exhaust emissions limits in the EU and the US

Recreational Craft Directive 94/25/EC:

Exhaust emission limits							*(g/kWh)*	
Type	Carbon monoxide $CO = A + B/P_N^n$			Hydrocarbons $HC = A + B/ P_N^n$			Nitrogen oxides NO_x	Particulates PT
	A	B	n	A	B	n		
Two-stroke spark ignition	150,0	600,0	1,0	30,0	100,0	0,75	10,0	Not applicable
Four-stroke spark ignition	150,0	600,0	1,0	6,0	50,0	0,75	15,0	Not applicable
Compression ignition	5,0	0	0	1,5	2,0	0,5	9,8	1,0

Where A, B and n are constants in accordance with the table, P_N is the rated engine power in kW.

US EPA standards for marine CI engines (CFR 40 Part 1042)

Maximum Engine Power	**L/cylinder**	**PM g/bhp-hr (g/kW-hr)**	**NOx + HC g/bhp-hr (g/kW-hr)**	**Applicable for model year**
<19 kW	<0,9	0,30 (0,40)	5,6 (7,5)	2009
19 to <75 kW	<0,9[a]	0,22 (0,30)	5,6 (7,5)	2009
		0,22 (0,30)[b]	3,5 (4,7)[b]	2014
75 to <3700 kW	<0,9	0,11 (0,15)	4,3 (5,8)	2012
	0,9-<1,2	0,10 (0,14)	4,3 (5,8)	2013
	1,2-<2,5	0,09 (0,12)	4,3 (5,8)	2014
	2,5-<3,5	0,09 (0,12)	4,3 (5,8)	2013
	3,5-<7,0	0,08 (0,11)	4,3 (5,8)	2012

(a) <75kW engines at or above 0,9 L/cylinder are subject to the corresponding 75-3700 kW standards.
(b) Option: 0,15 g/bhp-hr (0,20 g/kW-hr) PM / 4,3g/bhp-hr (5,8g/kW-hr) NO_X-HC in 2014

US EPA standards for marine SI engines (CFR 40 Part 1045)

Type of engine	Rated Engine Power P_N (kW)	Carbon monoxide CO (g/kWh)	Hydrocarbons + Nitrogen Oxides HC + NOX (g/kWh)	Applicable for model year
Stern-drive and inboard engines	$P_N \leq 373$	75	5	2010
	$373 < P_N \leq 485$	350	16	
	$P_N > 485$	350	22	
Outboard engines and PWC engines	$P_N \leq 4,3$	$500 - 5,0 \times P_N$	30	
	$40 > P_N > 4,3$	$500 - 5,0 \times P_N$	$15,7 + \left(\frac{50}{P_N^{0.9}}\right)$	
	$P_N > .40$	300	$15,7 + \left(\frac{50}{P_N^{0.9}}\right)$	

The US EPA rules include a couple of mitigating measures which may be used by the engine manufacturers marketing their products in the US (such as additional lead time, flexibility scheme, averaging, banking and trading provisions and hardship relief provisions).

Comparison of the exhaust emissions limits in the EU and the US for CI engines

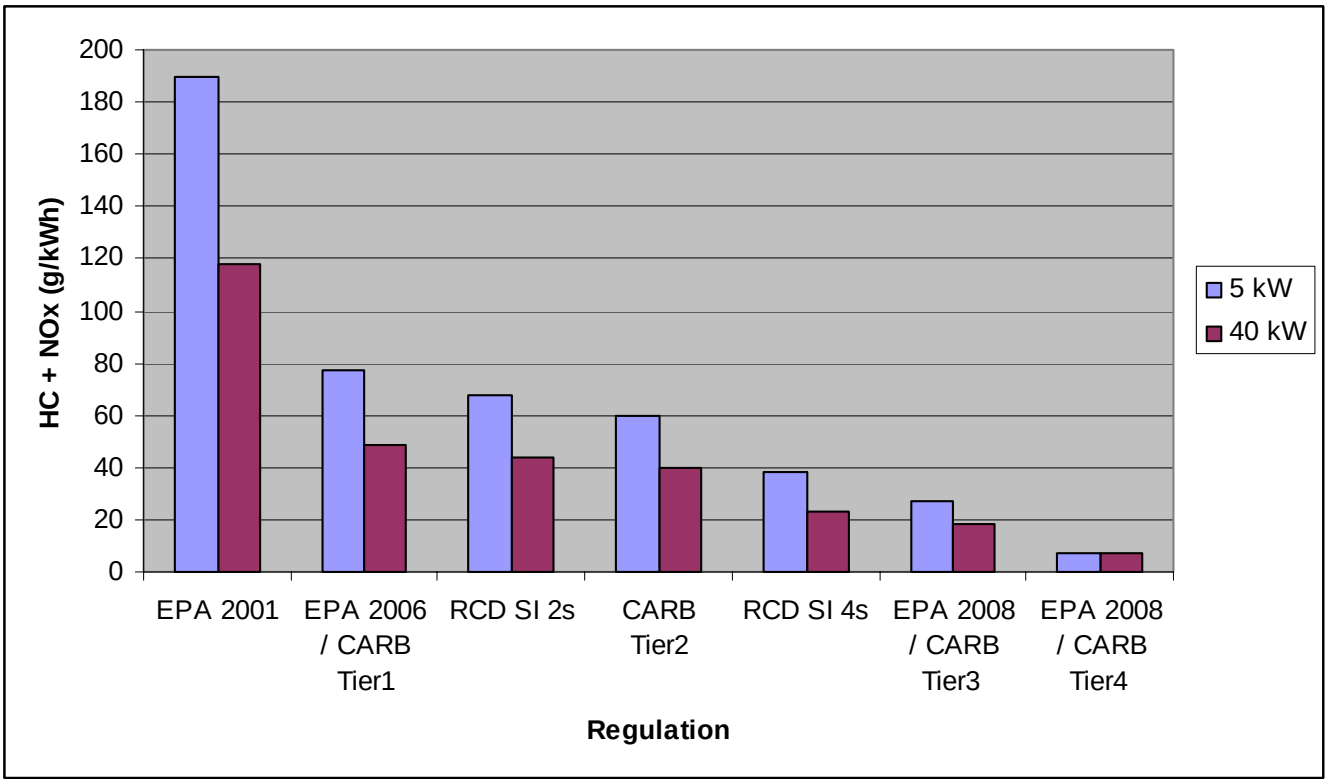
Power (PN)	Particulates (PM)		Hydrocarbons + Nitrogen Oxides (HC + NOX)	
	EU	US	EU	US
(kW)	(g/kWh)			
PN < 37	1	1	11,4	11,4
37 ≤ PN <75	1	0,3	11,3	4,7
75 ≤ PN < 3700	1	0,15	11,3	5,8

PN < 3700	1	0,14	11,3	5,8
		0,12		5,8
		0,12		5,8
		0,11		5,8

Limits for non road mobile machinery CI engines - Stage IIIA

Swept Volume SV	PN	PM	HC+NOx
(L/cyl)	(kW)	(g/kWh)	(g/kWh)
SV < 0,9	P ≥ 37	0,4	7,5
0,9 ≤ SV < 1,2		0,3	7,2
1,2 ≤ SV < 2,5	37 ≤ P < 75	0,2	7,2
2,5 ≤ SV < 5		0,2	7,2
5 ≤ SV < 15		0,27	7,8
15 ≤ SV < 20		0,5	9,8
20 ≤ SV < 25		0,5	9,8
25 ≤ SV < 30		0,5	11

Development of the exhaust emission limits applying to engines of power ratings (5kW and 40kW) in the EU and the US



The following conclusions were drawn from this figure in the report:

(1) Current EU Stage I. (amendment of the RCD 2003/44/EC) requirements for 2-stroke engines are similar to the obsolete US EPA 2006 requirements

(2) Current EU Stage I 4-stroke requirements are between the CARB Tier 2 and Tier 3 requirements

(3) The US EPA 2008 requirements (40 CFR, part 1045) for SI outboard and PWC engines are consistent with the requirements adopted by CARB Tier 3

(4) The US EPA 2008 requirements (40 CFR, part 1045) for SI inboard engines are consistent with the requirements adopted by CARB Tier 4

(5) Proposed EU Stage II would align with the harmonised US EPA 2008 limits and Californian CARB limits.

ANNEX VI: Analysis of 5 different scenarios

Scenarios assessed in ARCADIS Complementary IA Study (2008) as well as the TNO (2004) scenarios assessed in the ECNI IA Study (2006) are presented in terms of their effectiveness, efficiency and consistency. All scenarios are compared by means of a multi-criteria analysis. By altering the weights attributed to the different scenarios, insight is provided in the sensitivity of the ranking of the scenarios. Finally, the environmental benefits are compared to the corresponding compliance costs. In this way, the scenarios can be ranked on the basis of their likely contribution to overall welfare.

Assumptions made in the ECNI IA Study (2006) are sought to those of the ARCADIS Complementary IA Study (2008) and vice versa, depending on which ones are the most realistic. As in the ECNI IA Study (2006), the risk associated with this impact assessment relates to the assumptions made when calculating the impacts. The crucial factors are the expected compliance costs, emission reductions and socio-economic impacts associated with each regulatory scenario. These risks have been addressed by a thorough and transparent stakeholder consultation.

The impacts have been grouped in terms of their:

(6) Effectiveness – how well does each of the scenarios achieve the objectives (reducing exhaust emissions)?

(7) Efficiency – the level of resources needed to achieve the stated objectives (impacting technical, economic and social

(8) Consistency – the balance, trade-offs and synergies of positive and negative (un)intended (in)direct effects on economic, social and environmental systems

In the following table the environmental and socio-economic impact of the various scenarios are presented through a number of synthetic indicators. The second and third columns present the absolute annual reduction of HC+NOx and PM emissions. Scenarios 3 and 1 are the most and the least effective from an environmental point of view. However, (social) cost-efficiency should also be considered, as the means by which the environmental objectives are realised should be proportionate to the benefits. Therefore, the reduction in HC+NOx and PM emissions is compared to the expected compliance costs and job losses faced by industry. The reduction in HC+NOx and PM emissions was added up, accounting for the higher social costs of PM emissions compared to HC+NOx emissions. Factor 9 was used to convert PM emissions into NOx equivalents. This factor has been derived from the study "Estimates of the marginal external costs of air pollution in Europe" by Netcen which has been referred to in the NRMM Directive. Moreover, the following factors are used as proxies of the marginal external costs of NOx and PM:

- NOx – 4 200 €/tonne
- PM – 36 420 €/tonne

As it is not known how the reduction in HC+NOx emissions is split up between NOx and HC, we only rely on the NOx marginal external costs as a proxy for the social benefits of the reduction in HC + NOx emissions.

The following Table demonstrates that scenarios 3, 2 and 5 are the most effective. Scenario 5 outperforms the other scenarios in terms of PM reduction whereas 2 and 3 are performing better for HC + NOx. Scenario 5 realise emission reductions in a more cost-efficient way. The potential compliance costs and job losses per kiloton reduction in emissions are much lower than for other four scenarios developed by TNO Study (2004). Scenario 5 performs best on both effectiveness and cost-effectiveness criteria. Industry pointed out that the higher socio-economic impacts per kiloton reduction for the TNO Study (2004) scenarios relates to the technical difficulties of adopting the required technology in the short term.

Scenario	**Absolute annual reduction (in kilotons)**			**Compliance costs per kiloton reduction (in € million)**		**Job losses per kiloton reduction (in number of jobs)**	
	NOx+HC	*PM*	*NOx+HC & PM (expressed in NOx equivalents)*	*min*	*max*	*min*	*max*
1	8,14	0,09	8,99	6,75	6,75	23,75	23,75
2	12,65	0,11	13,63	14,68	14,68	32,38	32,38
3	13,39	0,11	14,37	12,44	12,44	29,59	29,59
4	9,39	0,11	10,37	12,97	12,97	24,46	24,46
5	10,85	0,24	13,03	0,83	2,27	1,93	5,87

Source: ARCADIS Complementary Impact Assessment Study (2008)

ANNEX VII: Methodology used for environmental impact analysis

Initially, fleet composition across Europe was investigated, including types of vessels, numbers and the engine mix within of groups of vessels in various environments. This included linear waterways, coastal areas and lakes. Data on the numbers of vessels were limited and therefore estimates have been made based on limited registration data, aerial photography and European stocktaking data from industry sources. Based on this data, a hypothetical fleet was defined for each of the three environments. This included a predicted number of vessels, operated in a hypothetical environment aligned as closely to real situations as possible. Sensitivity swings were calculated to understand the variation in the data and to account for the variability in real life situations. To quantify impacts, sensitive receptors such as areas of conservation and residential areas were modelled in the scenario building. The engine sizes, types, usage and distribution within the fleet were used to calculate the total emissions per annum arising from the use of the craft. These emissions were adjusted by a load factor to account for the fact that the engines are not operated at full power throughout their life. The overall emissions were then modelled using Atmospheric Dispersion Model AERMOD to give long term and short term results for a range of air quality parameters. This allowed for the changes in the Directive to be directly related to environmental impacts and compared to each other and the environmental quality standards (EQS).

Calculation and modelling of Fleets, Engine populations and Emissions are provided in Appendix B and C of Environmental Part ECNI Study 2006

The impacts relating to water quality were also considered in relation to quality standards and emissions. Although changes to the Recreational Craft Directive primarily limit emissions to air, there may be some benefit in reductions through pathways such as deposition and aqueous sources.

ANNEX VIII: The calculation of the exhaust emission reductions

The environmental impact is demonstrated by the aggregated exhaust emissions in four-year period. The overall exhaust emissions measured per one year are delivered by ARCADIS Impact Assessment Study (2008) for Options 1 and 2 and Sub-option 3.1. The exhaust emissions for Sub-options 3.2 and 3.3 had to be extrapolated from the available numbers. Calculation in four-year period demonstrates the best how the exhaust emissions for Sub-options 3.2 and 3.3 were calculated.

When the summarized emissions are divided by 4, we get the average annual emissions also for Sub-options 3.2 and 3.3. Then the percentage reduction calculated for 4 years is conforming to the percentage reduction calculated per one year.

HC+NOx (Hydrocarbons+Nitrogen Oxides)	Year 1	Year 2	Year 3	Year 4	Tons / 4 years
Option 1 - Stage I	40 907	40 907	40 907	40 907	163 628
Option 2 - Stage II	30 061	30 061	30 061	30 061	120 244
Sub-option 3.1 - Stage II + Flexibility scheme	31 105	31 105	31 105	31 105	124 420
Sub-option 3.2 - Stage II + Transitional period	40 907	30 061	30 061	30 061	131 090
Sub-option 3.3 - Stage II+Tran period+Spec time SI SMEs	40 907	30 067	30 067	30 067	131 108

	Reduction compare to Opt. 1
Option 2 - Stage II	**-26,51%**
Sub-option 3.1 - Stage II + Flexibility scheme	**-23,96%**
Sub-option 3.2 - Stage II + Transitional period	**-19,88%**
Sub-option 3.3 - Stage II+Tran period+Spec time SI SMEs	**-19,87%**

PT (Particulates)	Year 1	Year 2	Year 3	Year 4	Tons / 4 years
Option 1 - Stage I	539	539	539	539	2 156

Option 2 - Stage II	296	296	296	296	1 184
Sub-option 3.1 - Stage II + Flexibility scheme	387	387	387	387	1 548
Sub-option 3.2 - Stage II + Transitional period	539	296	296	296	1 427
Sub-option 3.3 - Stage II+Tran period+Spec time SI SMEs	539	296	296	296	1 427

	Reduction compare to Opt. 1
Option 2 - Stage II	**-45,08%**
Sub-option 3.1 - Stage II + Flexibility scheme	**-28,20%**
Sub-option 3.2 - Stage II + Transitional period	**-33,81%**
Sub-option 3.3 - Stage II+Tran period+Spec time SI SMEs	**-33,81%**

CO (Carbon monoxide)	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Tons / 4 years**
Option 1 - Stage I	153142	153142	153142	153142	612 568
Option 2 - Stage II	184634	184634	184634	184634	738 536
Sub-option 3.1 - Stage II + Flexibility scheme	180698	180698	180698	180698	722 792
Sub-option 3.2 - Stage II + Transitional period	153142	184634	184634	184634	707 044
Sub-option 3.3 - Stage II+Tran period+Spec time SI SMEs	153142	184502	184502	184502	706 648

	Relaxation compare to Opt. 1
Option 2 - Stage II	**20,56%**
Sub-option 3.1 - Stage II + Flexibility scheme	**17,99%**
Sub-option 3.2 - Stage II + Transitional period	**15,42%**
Sub-option 3.3 - Stage II+Tran period+Spec time SI SMEs	**15,36%**

ANNEX IX: Monetization of environmental benefits

Environmental benefits are measured as the average damages per tonne of emission of NOx and PM2.5 for the EU25 (excluding Cyprus) and surrounding sea areas under different sets of assumptions.

Analysis follows the impact pathway methodology developed in the ExternE Project funded by EC DG Research. The pathway described by the analysis is as follows:

Emission of pollutants → Dispersion of pollutants → Exposure of people, ecosystems, materials, etc. → Quantification of impacts → Valuation of impacts

Methodology is closer described in Cost-Benefit Analysis of Air Quality Related Issues, in particular in the CAFE Programme at http://www.cafe-cba.org/assets/marginal_damage_03-05.pdf.

The Study refers to four methods differing in measurement of value of mortality. These methods are VOLY median, VSL median, VOLY mean and VSL mean. The environmental benefits are calculated for all these methods in two various environments: inland and seas. The tables 10, 14, 17 and 20 of the Impact Assessment indicate the range of environmental benefits taking together results for all four methods. Environmental benefits are calculated for NOx and PM.

Environmental benefit of each option = Amount of tonnes/year of particular pollutant * Damage/tonne of particular pollutant

Total emissions measured in tonnes per year produced by recreational crafts

	NOx (tons/year)	PM (tons/year)
Option 1 - No change	14 317	539
Option 2	10 521	296
Sub-option 3.1	10 887	387
Sub-option 3.2	11 470	357
Sub-option 3.3	11 472	357

Source: ARCADIS Study, p. 54, the emissions of NOx measured as 35% of HC+NOx emissions

Average damage savings / tonne of emissions per various air pollutants

Measures	Method	Damage / tonne (€) NOx	Damage / tonne (€) PM
		Inland	
PM mortality, O_3 mortality, Health core, Health sensitivity, Crops, O_3/health metric	VOLY median, VOLY median, Included, Not included, Included, SOMO 35	4 400	26 000
PM mortality, O_3 mortality, Health core, Health sensitivity, Crops, O_3/health metric	VSL median, VOLY median, Included, Not included, Included, SOMO 35	6 600	40 000
PM mortality, O_3 mortality, Health core, Health sensitivity, Crops, O_3/health metric	VOLY mean, VOLY mean, Included, Included, Included, SOMO 0	8 200	51 000
PM mortality, O_3 mortality, Health core, Health sensitivity, Crops, O_3/health metric	VSL mean, VOLY mean, Included, Included, Included, SOMO 0	12 000	75 000
		Seas	
PM mortality, O_3 mortality, Health core, Health sensitivity, Crops, O_3/health metric	VOLY median, VOLY median, Included, Not included, Included, SOMO 35	2 500	13 000
PM mortality, O_3 mortality, Health core, Health sensitivity, Crops, O_3/health metric	VSL median, VOLY median, Included, Not included, Included, SOMO 35	3 800	19 000
PM mortality, O_3 mortality, Health core, Health sensitivity, Crops, O_3/health metric	VOLY mean, VOLY mean, Included, Included, Included, SOMO 0	4 700	25 000
PM mortality, O_3 mortality, Health core, Health sensitivity, Crops, O_3/health metric	VSL mean, VOLY mean, Included, Included, Included, SOMO 0	6 900	36 000

Source: Cost-Benefit Analysis of Air Quality Related Issues, in particular in the CAFE Programme

VOLY - Valuation of mortality using value of a life approach
VSL - Valuation of mortality using the value of statistical life
SOMO 35 - Sum of Means Over 0 ppb.days
SOMO 0 - Sum of Means Over 35 ppb.days

ANNEX X: Methodology and assumptions used for economic impact analysis, calculation of compliance costs

Based on the technologies that would be required to achieve the emission limit values, the costs of bringing engines in compliance with the proposed environmental standards have been calculated for the selected basic scenario without flexibilities. Technical impacts linked to the application of the scenario are reflected in associated compliance costs. The level of costs to become compliant with the emission limit values set in the scenario depends on a set of factors:

- The level of technology currently used by the manufacturer and level of technology used by the manufacturer to be compliant with other regulations in markets outside the EU
- The sources of the engine and if applicable its original application;
- Engine families and needs for simultaneous up-grading for the full engine range to continue component sharing;
- The emission reduction technologies already available for the engine in other applications;
- The production volumes between manufacturers and their suppliers;
- The development and certification costs;
- Tooling costs;
- Component cost per engine

Compliance costs are purely related to costs to be made by engine manufacturers and marinisers and do not include downstream economic impacts related to competitiveness, changes in the market structure, changes in fuel economy, etc. Compliance costs are evaluated in the scope of the time horizon within which these costs are made. **Fixed costs** occur the first years after which they are fully amortized. After a particular period of time, some fixed costs will appear again (e.g. renewable of certificate). **Variable costs** remain a cost item in the long run but will probably decrease as manufacturers learn over time to produce the engines with the new technologies or after treatment at a lower cost.

CI engines:

Fixed costs

These are the costs linked to the development, production, validation and certification of Stage II engines. This includes re-certification; re-design of components, adaptations to assembly line, environmental validation tests, etc.

The unit fixed costs per engine are ranged between 30€ - 50€ for large manufacturers whereas those costs vary from 31€ - 664€ for small manufacturers. The lower bound reflects a situation in which these companies only have to cope with (re)certification costs and related

testing, the upper bound a situation in which other fixed costs related to R&D, additional testing and retooling of assembly lines should be taken into account.

The higher costs are for the companies which only serve the EU market and have no indirect exports to the US via boats in which their marinised engines are mounted. For large manufacturers, the fixed costs can be assumed as rather limited, basically reflecting costs for recertification. R&D costs are negligible for the majority of engine manufacturers, as these costs have already been borne by road engine manufacturers.

Variable costs

Variable costs cover improved or added technology on every engine (after treatment systems, etc.). It usually includes costs on the material, the labour and the energy requirements.

The unit variable costs per engine are ranged between 14€ - 384€ for small power engines and between 34€ - 108€ for large power engines. In general, variable costs for the CI engine manufacturers are offset by the added value deriving from the newly developed engines which allows the manufacturers to increase prices.

Unit costs per engine for CI engines

Maximum Engine Power	L/cylinder	Units put on the market (1)			Fixed costs large manufacturers /engine (2)		Fixed costs small manufacturers & marinisers/engine (3)		Variable costs/engine (4)		Costs linked to temporal discontinuation of engine models (5)
		total	large manufacturers	small manufacturers & marinisers	min	max	min	max	min	max	
<19 kW	<0.9	12.800	9.600	3.200	30 €	54 €	31 €	664 €	- €	- €	
19 to <75 kW	<0.9a	16.800	12.600	4.200	30 €	54 €	31 €	664 €	14 €	384 €	
19-37		*9.200*	*6.900*	*2.300*	*30 €*	*54 €*	*31 €*	*664 €*	*14 €*	*384 €*	
37-75		*7.600*	*5.700*	*1.900*	*30 €*	*54 €*	*31 €*	*664 €*	*14 €*	*384 €*	
75 to <3700 kW	<0.9	2.080	1.560	520	30 €	54 €	31 €	664 €	34 €	34 €	
	0.9-<1.2	2.080	1.560	520	30 €	54 €	31 €	664 €	34 €	34 €	
	1.2-<2.5	2.080	1.560	520	30 €	54 €	31 €	664 €	49 €	49 €	
	2.5-<3.5	2.080	1.560	520	30 €	54 €	31 €	664 €	51 €	51 €	
	3.5-<7.0	2.080	1.560	520	30 €	54 €	31 €	664 €	108 €	108 €	
		40.000	30.000	10.000							3.689.250 €

SI outboard engines

Fixed costs

The unit fixed costs per engine are between 6€ - 7€. However, some SI engine manufacturers face the significant additional fixed costs. The solely EU SI outboard engine manufacturer faces a significant R&D and testing costs. R&D costs can amount up to approximately 3 100€ per engine and up to 2 M € per engine family.

Variable costs

The unit variable costs per engine may reach 1€ - 17€. The variable costs for these engines can be regarded as limited.

Costs of recertification

These are common for CI and SI engine manufacturers. They can reach up to 19 900€. The table below provides with the details.

	Typical costs [EUR, 2007] for engine >18kW, per engine family
Transport engine to test location	500 €
Certification by notified body	1.500 €
Administration by manufacturer [40hours x 200€]	8.000 €
Engine testing [40 hours x 235€/h]	9.400 €
Periodical update of certificate	500 €
	19.900 €

Discontinuation costs

These costs include loss of profit and additionally the loss of market share by not providing a certain model to the market. For EU based, SI outboard engine manufacturer, not active on the US market, high fixed costs could be generated by R&D and redesigning engines from scratch; this could result in the decision to discontinue the particular models and could have indirect social and economic impacts on suppliers and customers. If one manufacturer was to discontinue one of its models, it would obviously affect the supplier who would not be receiving any new orders for this model. Moreover, the discontinuation of one model will entail a loss of profit and a loss of market share for the manufacturer who might have to increase the prices of the other models to compensate for these losses. If the price of the other models of the manufacturer increases, that will indirectly affect the consumer and its buying power. Similarly, for the small engine manufacturers and marinisers mainly focusing on small engine power ranges that are only sold in the EU, the high compliance costs could lead to a decision to discontinue engine models. The discontinuation costs of CI manufacturer engine models may reach up to 3,6M €. If the non-European SI manufacturers, relying on the US ABT do not have the possibility to rely on a mitigating measure in the EU, they might have to discontinue particular models or to stop putting these engines on the EU market.

Unit costs per engine for SI engines

Maximum Engine Power	L/cylinder	Units put on the market (1)	Fixed costs/engine linked to recertiication (2) min	Fixed costs/engine linked to recertiication (2) max	Other fixed costs/ engine (3)	Variable costs/engine (4) min	Variable costs/engine (4) max
SI Outboard							
< 3	< 4	49.608	6 €	7 €		1 €	1 €
< 20	< 27	84.652	6 €	7 €		3 €	3 €
< 75	< 110	54.242	6 €	7 €		8 €	8 €
< 110	< 150	10.524	6 €	7 €		14 €	14 €
< 150	< 230	7.684	6 €	7 €		17 €	17 €
> 150	> 230	4.119	6 €	7 €		17 €	17 €
		210.829					
	Large companies using US ABT system				1.688 €		
	Small companies without export to US market				3.092 €		
SI Inboard							
< 110	< 150	1.918	22 €	61 €		4 €	302 €
< 147	< 200	2.214	22 €	61 €		6 €	426 €
< 184	< 250	3.015	22 €	61 €		6 €	479 €
< 220	< 300	1.018	22 €	61 €		8 €	586 €
< 274	< 373	1.722	22 €	61 €		9 €	687 €
> 274	> 373	296	22 €	61 €		13 €	1.022 €
		10.182					
PWC		**9.034**	7 €	9 €		11 €	11 €
		230.045					

These figures are for guidance only and should be regarded as orders of magnitude rather than absolute figures.

Option 2 – Stricter limits - compliance costs

Compliance costs have been estimated for the **CI engine** sector to comply with the proposed Stage II exhaust emission limits without flexibilities. Costs for CI engines vary widely, i.e. between **5,7 M € and 19 M € per year**.

Total compliance costs (€ per year) – Option 2: CI engines

Maximum Engine Power	L/cylinder	Units put on the market (1)			Total costs per year			
		total	large manufacturers	small manufacturers & marinisers	min		max	
<19 kW	<0.9	12.800	9.600	3.200	389.997 €	7%	2.640.328 €	14%
19 to <75 kW	<0.9a	16.800	12.600	4.200	752.212 €	13%	9.909.910 €	52%
19-37		*9.200*	*6.900*	*2.300*	*411.926 €*	*7%*	*5.426.856 €*	*29%*
37-75		*7.600*	*5.700*	*1.900*	*340.286 €*	*6%*	*4.483.055 €*	*24%*
75 to <3700 kW	<0.9	2.080	1.560	520	133.383 €	2%	499.062 €	3%
	0.9-<1.2	2.080	1.560	520	133.383 €	2%	499.062 €	3%
	1.2-<2.5	2.080	1.560	520	165.806 €	3%	531.485 €	3%
	2.5-<3.5	2.080	1.560	520	169.594 €	3%	535.273 €	3%
	3.5-<7.0	2.080	1.560	520	288.609 €	5%	654.288 €	3%
		40.000	30.000	10.000	2.032.984 €		15.269.408 €	
	Costs linked to temporal discontinuation of engine models				3.689.250 €	64%	3.689.250 €	19%
					5.722.234 €	100%	**18.958.658 €**	100%

Total compliance costs of Option 2: **SI engine** vary between **5,1 M € and 10,6 M € per year**:

- Compliance costs of SI OB are around 4,7 M € per year. The highest burden is covered by small engines (<75kW) as these represent the highest share of the market.
- Compliance costs of SI IB vary between 0,3 and 5,7 M € per year
- Compliance costs of PWC amount to around 0,2 M € per year.

The compliance costs for outboard engines include costs to be made by a limited number of companies facing very high compliance costs:

- EU based companies not serving the US market, with costs up to 1,8 M €/year reflecting the situation of one EU based SME and based on rough estimates provided by the industry. These high costs would result in the decision to discontinue particular models and would have significant social and economic impact on suppliers and costumers

Total compliance costs (€ per year) - Option 2: SI engines

Maximum Engine Power	L/cylinder	Units put on the market	Total costs per year min		max	
SI Outboard						
< 3	< 4	49.608	352.902 €	15%	367.189 €	15%
< 20	< 27	84.652	765.919 €	32%	790.299 €	32%
< 75	< 110	54.242	778.853 €	33%	794.475 €	33%
< 110	< 150	10.524	212.807 €	9%	215.838 €	9%
< 150	< 230	7.684	176.455 €	7%	178.668 €	7%
> 150	> 230	4.119	94.581 €	4%	95.768 €	4%
		210.829	**2.381.517 €**	100%	**2.442.237 €**	100%
	Large companies using US ABT system		520.011 €		520.011 €	
	Small companies without export to US market		1.766.667 €		1.766.667 €	
			4.668.194 €		**4.728.914 €**	
SI Inboard						
< 110	< 150	1.918	49.608 €	17%	696.673 €	12%
< 147	< 200	2.214	60.879 €	21%	1.078.359 €	19%
< 184	< 250	3.015	85.002 €	29%	1.627.794 €	29%
< 220	< 300	1.018	30.136 €	10%	658.649 €	12%
< 274	< 373	1.722	53.266 €	18%	1.288.563 €	23%
> 274	> 373	296	10.467 €	4%	320.677 €	6%
		10.182	**289.358 €**	100%	**5.670.716 €**	100%
PWC		**9.034**	**163.817 €**		**183.792 €**	
		230.045	**5.121.368 €**		**10.583.422 €**	

Sub-option 3.1 – Stricter limits with granting flexibility scheme as a mitigating measure - compliance costs

Costs for **CI engines** vary between **1,2 M € and 8 M € per year**. Compared to the basic Option 2, this means a cost decrease of 4,5 to 11 M €/year. It is due to the fact that some companies will not have to discontinue certain engine models and instead can rely on a flexibility scheme. However, this needs to be regarded as an underestimation of the total impact of the flexibility scheme for the CI sector as the figure does not reflect the impact of lost market share, nor additional benefits linked to the ability for companies to spread investment costs over time to meet the revised emission standards.

Taking into account the lower bound of the variable costs, the highest contribution of this decrease comes from the implementation of the flexibility scheme rather than from the installation of an exemption of power ranges below 37 kW. When focusing on the upper bound of the variable costs, a dominant effect of the high variable costs for the smaller power ranges prevails. This means that these costs would disappear in case of an exemption of power ranges below 37 kW.

Total compliance costs (€ per year) - Sub-option 3.1: CI engines

Maximum Engine Power	L/cylinder	Units put on the market (1)			Total costs per year			
		total	large manufacturers	small manufacturers & marinisers	min		max	
<19 kW	<0.9	12.800	9.600	3.200				
19 to <75 kW	<0.9a	16.800	12.600	4.200				
19-37		9.200	6.900	2.300				
37-75		7.600	5.700	1.900	339.653 €	28%	5.249.449 €	66%
75 to <3700 kW	<0.9	2.080	1.560	520	133.383 €	11%	499.062 €	6%
	0.9-<1.2	2.080	1.560	520	133.383 €	11%	499.062 €	6%
	1.2-<2.5	2.080	1.560	520	165.806 €	13%	531.485 €	7%
	2.5-<3.5	2.080	1.560	520	169.594 €	14%	535.273 €	7%
	3.5-<7.0	2.080	1.560	520	288.609 €	23%	654.288 €	8%
		40.000	30.000	10.000	**1.230.428 €**	100%	**7.968.619 €**	100%

Total compliance costs of **SI engines** vary between **4,6 M € and 10 M € per year**, which is only slightly lower compared to Option 2. This can entirely be attributed to the fact that the company relying on ABT in the US market would be able to rely on a similar flexibility scheme in the EU, in which case the additional costs of 1,8 M € per year to meet the RCD emission standards can be regarded as sunk. Other conclusions made for Option 2 remain valid.

The decrease in compliance costs indicates a small impact from the flexibility scheme. However, this figure does not take into account additional benefits which are linked to the ability of companies to spread investment costs over time to meet the revised emission standards.

Total compliance costs (€ per year) - Sub-option 3.1: SI engines

Maximum Engine Power	L/cylinder	Units put on the market	Total costs per year			
			min		max	
SI Outboard						
< 3	< 4	49.608	352.902 €	15%	367.189 €	15%
< 20	< 27	84.652	765.919 €	32%	790.299 €	32%
< 75	< 110	54.242	778.853 €	33%	794.475 €	33%
< 110	< 150	10.524	212.807 €	9%	215.838 €	9%
< 150	< 230	7.684	176.455 €	7%	178.668 €	7%
> 150	> 230	4.119	94.581 €	4%	95.768 €	4%
		210.829	**2.381.517 €**	100%	**2.442.237 €**	0%
	Small companies without export to US market		1.766.667 €		1.766.667 €	
			4.148.184 €		**4.208.904 €**	
SI Inboard						
< 110	< 150	1.918	49.608 €	17%	696.673 €	12%
< 147	< 200	2.214	60.879 €	21%	1.078.359 €	19%
< 184	< 250	3.015	85.002 €	29%	1.627.794 €	29%
< 220	< 300	1.018	30.136 €	10%	658.649 €	12%
< 274	< 373	1.722	53.266 €	18%	1.288.563 €	23%
> 274	> 373	296	10.467 €	4%	320.677 €	6%
		10.182	**289.358 €**	1 €	**5.670.716 €**	100%
PWC		**9.034**	**163.817 €**		**183.792 €**	
		230.045	**4.601.358 €**		**10.063.411 €**	

Sub-option 3.2 - Stricter limits with granting transitional period as a mitigating measure - compliance costs[46]

Costs for CI engines may vary between **2 M € and 8 M € per year**. Cost decrease compared to the Option 2 is due to the fact that some companies will not have to discontinue certain engine models as they can rely on a mitigating measure. The transitional time of 3 years from entry into force means in fact a delay of 1 year of Directive's application when 2 years are presumably dedicated to transposition of rules into national legislations. Such additional 1-year lead time would have a similar effect on compliance costs as a flexibility scheme for majority of CI engine manufacturers (they will avoid discontinuation of production). However the lower bound of costs is expected a bit higher comparing to Sub-option 3.1 due to the shorter lead time for particularly small engine categories. (1-year granted for Sub-option 3.2 and 4-years for Sub-option 3.1 – duration of flexibility scheme).

According to the information of industry, the additional lead time granted to SI engine manufacturers will be sufficient to consider the compliance costs as sunk costs because they will fulfil already the US limits applied earlier. Except one EU-based SME SI engine manufacturer which assumes their compliance costs between **1,8 M € and 5 M € per year.**

Sub-option 3.3 - Stricter limits with granting transitional period + specific transitional period for small and medium sized SI engine manufacturers placing on the market the engines $P_N \leq 15$ kW as a mitigating measure - compliance costs

Compliance costs for CI engines will be the same as for Sub-option 3.2 because the specific derogation would apply only to SI engines.

Even though the costs (mainly development and recertification costs) of the SME SI engine manufacturers would remain in the same amount as for Sub-option 3.2 they may be spread over longer time. This is crucial for the decision to continue with the production of some engine categories as the company doesn't generate sufficient profit to finance R&D of all engine categories in one and they are dependant on the external financial sources. With the granted additional lead time they will have the access to necessary financial resources to continue the production.

[46] Compliance costs of the sub-options 3.2 and 3.3 are not precisely quantified by the ARCADIS Impact Assessment Study, but they are derived from the assumptions and qualitative description in the mentioned study

ANNEX XI: Assumptions made to estimate the environmental noise impact – typical cases

The sound impact depends on the number and duration of activities (passing craft, circling craft), the sound emission per craft during that activity and the propagation to the observer. To give some estimate, based on the data presented so far, we will consider the situation along a typical canal or river, around a marina, around open water (lake) and on such open water. For the number and use of the boats we will use estimates for an average day in the summer season and a peak day in that season. Other situations could be estimated from these results. Possible speed restrictions have not been taken into account, as these would represent additional measures to limit the impact of sound emissions.

Canal, river

Assume the canal or river has a width of 50 to 100 m and the observers are living along the shores; the average distance between the passing craft and the observers is assumed to be 50 m. Since the use of PWCs is more restricted to a certain area and not so much passing, these craft will be neglected here. Furthermore it is assumed that the craft are used for 80% during the daytime (7:00h to 19:00 h) and for 20 % during the evening (19:00 to 23:00h) and are not used during the night period; this division does not prove to be critical though.

Open water

In case of open water the craft will not so much pass the observer but will be distributed over (a large part of) the water, so partly at larger distance from the observer at the shore. As a representative average a distance of 200 m is chosen. The same distribution over day and evening is used as for the canal; in this case also PWCs are considered with a use of 1 h per day, equally divided over day and evening time. Outboard engines in this case are considered to be used only part of the time, leading to an engine use varying from 1/2 h (sailing boat) to 3 h (motor boat). Another aspect in this case could be the disturbance of people in one craft by another craft. For this situation a typical minimum passing distance of 25 m is chosen; all others assumptions are taken as identical.

Marina

For a marina also a distance of 200 m is arbitrarily chosen, but the global effect of other distances is indicated. It is assumed that engines are used for 1/3 h for each boat to leave and enter a marina. Other activities in the marina are neglected as well as sound reduction through screening by buildings and other obstacles.

Additional remarks

It should be clarified that the sound production is lower when less power is used (lower speeds) and higher when more throttle and thus higher speeds are used. For outboard and inboard engines the data show about 8 dB(A) higher levels by using full throttle than the conditions assumed here as normal; for PWCs higher levels by up to 15 dB(A) have been reported depending on the use of the craft. Though these circumstances have a direct effect on the higher or lower *maximum* sound levels, the effect on the *equivalent* levels is much less, due to the effect of an also changed passing speed. It is questionable whether the disturbance

in case of increased use of power is mainly due to the higher sound level or due to the disapproval of the type of behaviour and other disturbing effects like higher waves.

ANNEX XII: Share of compliance costs in turnover, impact on competitiveness

All SMEs for which the share of compliance costs in yearly turnover of engine sales on the EU market could be calculated will – at least in relative terms – face much higher compliance costs than their larger competitors. Although larger engine manufacturers and marinisers are likely to have higher absolute compliance costs, the burden on SMEs is likely to be substantially higher. The compliance costs / sales ratio offers an indication of the impact higher emission standards may have on companies' operations and, when considering the ratio for a series of companies, the impact higher emission standards may have on the company's competitiveness.

The ratio reveals that SMEs face a major burden and may see their competitiveness deteriorate as a result of higher exhaust emissions standards. Compliance costs of SMEs for the proposed emissions standards range between 5,75% and 67,35% of annual turnover when the stricter limits will be applied. Large engine manufacturers have a much more moderate ratio, varying between 0,06% and 2,76%.

Relationship between the level of compliance costs and competitiveness effects

Significance of compliance costs	Possible actions	Possible consequences for competitiveness
Insignificant	No action	Business as usual
Significant	Increase the selling price	Decrease in sales, shrinking market*
	Absorb the compliance costs	Decrease in profits, less investments
	Modify production function	Depending on how the new combination of inputs affects the selling price
Very significant	Increase the selling price**	Decrease in sales, shrinking market*
	Shift the focus of the business	Survival as a niche player
	Cease operation	Out of market

* The actual effect depends on the price elasticity of demand for recreational craft engines.

** A further increase of the selling price will only be possible if the price elasticity of demand for recreational craft engines is very inelastic.

Source: ARCADIS Impact Assessment Study (2008), p. 90-93

ANNEX XIII: Impact of price effects on the number of jobs

The number of jobs in the recreational marine engine manufacturing and marinising industry in Europe on which the study is based for deriving the likely number of job losses is listed in the following Table. The number of employees directly involved in the manufacture and marinisation of CI and SI OB engines in the EU is probably higher than the number of jobs indicated in the following Table. Only taking into account those companies having replied to the questionnaire and/or being interviewed the number of employees involved in the production of CI engines in the EU amounts to 1 600 people. The total number of employees directly involved in the manufacture and customisation of SI OB engines in the EU is slightly over 400. The numbers of 1 600 and 400 employees will be used for quantifying job losses in the EU based CI and SI OB engine manufacturing / marinising chain.

The assumptions concerning the price elasticity of demand, employment elasticity and the multiplier for assessing the indirect employment effects in the supply chain are developed in ECNI Impact Assessment (2006). The elasticity of demand for marine engines, which is a derived demand of the elasticity of demand for boats, is set at -2. This means that for every 1% price increase the quantity demanded would fall by 2%. Similarly, the employment elasticity provides an indication of the percentage change in direct employment that is associated with a change in output. The employment elasticity is set at 0,35. Finally, the multiplier for assessing the overall (direct and indirect) employment effect is 1,6 meaning the indirect employment effect amounts to 60% of indirect employment effect.

Based on the above assumptions, following Table provides the potential job losses in the EU CI engine, SI OB engine and PWC manufacturing chain. No job losses in the EU SI IB engine manufacturing chain as we assumed production of SI IB engines in the EU to be negligible.

Potential job losses in the CI engine manufacturing chain

Option		Number of direct jobs	% increase in average retail price	% decrease in demand	% decrease in direct jobs	Direct job losses	Indirect job losses	Total job losses
Option 2	min	1 600	1,24%	2,48%	0,87%	13,9	8,3	22,2
	max		4,10%	8,20%	2,87%	45,9	27,6	73,5
	max		3,30%	6,61%	2,31%	37,0	22,2	59,2
Suboption 3.1	min		0,27%	0,53%	0,19%	3,0	1,8	4,8
	max		1,72%	3,45%	1,21%	19,3	11,6	30,9
	max		3,29%	6,57%	2,31%	36,8	22,1	58,9

Potential job losses in the SI OB engine manufacturing chain

Scenario		Number of direct jobs	% increase in average retail price	% decrease in demand	% decrease in direct jobs	Direct job losses	Indirect job losses	Total job losses
Option 2	min	400	0,54%	1,07%	0,38%	1,5	0,9	2,4
	max		0,54%	1,09%	0,38%	1,5	0,9	2,4
Suboption 3.1	min		0,48%	0,95%	0,33%	1,3	0,8	2,1
	max		0,48%	0,97%	0,34%	1,4	0,8	2,2

Potential job losses in the PWC manufacturing chain

Scenario		Number of direct jobs	% increase in average retail price	% decrease in demand	% decrease in direct jobs	Direct job losses	Indirect job losses	Total job losses
Option 2	min	300	0,16%	0,32%	0,11%	0,3	0,2	0,5
	max		0,16%	0,32%	0,12%	0,4	0,2	0,6
Suboption 3.1	min		0,18%	0,35%	0,11%	0,3	0,2	0,5
	max		0,18%	0,35%	0,12%	0,4	0,2	0,6

Source of all Tables: ARCADIS Impact Assessment Study (2008), p. 98-100

ANNEX XIV: SME Test

The SME Test

(1) Consultation with SMEs representatives	See section 2.2.
(2) Preliminary assessment of businesses likely to be affected	See section 3.4
(3) Measurement of the impact on SMEs	See sections: - 6.1.2; Option 2, Economic impact - 6.1.3 Option 3, Sub-option 3.1, Economic impact - 6.1.3 Option 3, Sub-option 3.2, Economic impact - 6.1.3 Option 3, Sub-option 3.3, Economic impact
(4) Assess alternative options and mitigating measures	See sections: - 6.1.3 Option 3, Sub-option 3.1, Economic impact - 6.1.3 Option 3, Sub-option 3.2, Economic impact - 6.1.3 Option 3, Sub-option 3.3, Economic impact *The preferred sub-option 3.3 envisages some general mitigating measures common to all enterprises, as well as a specific transitional*

	period for SMEs placing on the EU market the SI outboard engines.