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PREPARATION OF MANUFACTURERS OF ENGINES AND EMISSION ABATEMENT DEVICES FOR FORTHCOMING EMISSION REGULATIONS

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Summary of answers from manufacturers of engines and emission abatement devices

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The main objective of the survey targeted to the manufacturers of the engines and emission abatement devices was to gather information and review the current situation related to the emission abatement devices, especially the scrubber systems.

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Contents

INTRODUCTION **2**
Background information on study and manufacturers involved 2
Readiness to deliver scrubber systems 2
Factors affecting delivery of orders 3

FEASIBILITY OF ABATEMENT DEVICES **3**
Factors affecting cost-efficiency of different abatement devices 3
Importance of different issues when installing scrubbers on vessels 4
Operational costs of scrubber use 6
Amount of scrubbers onboard and requirements for engines 7

NOX REGULATIONS IN 2016 (TIERIII) **7**
Nitrogen emission control area (NECA) and NOx technology 7
Estimating the cost-efficiency of NOx abatement devices in newbuildings 8
Effects on the investments of new vessels 8

CONCLUSIONS **9**

INTRODUCTION

Background information on study and manufacturers involved

A survey targeted to the manufacturers of the engines and emission abatement devices was realized in 2012 during the BSR Innoship –project in order to gather information and review the current situation related to the emission abatement devices, specially the scrubber systems. In the first phase the companies providing abatement technology were mapped with a result of approximately ten potential respondents to a questionnaire. It was revealed in a closer examination that some of these respondents were geographically out of the scope of the survey, i.e. their action was concentrated elsewhere than in the Baltic Sea Region. Also a couple of companies the core business of which was not the abatement technology were left aside. The remaining six companies having activities in the Baltic Sea Region were contacted and they all responded which gives a 100% response rate.

The responded companies are specialized in the abatement technology providing exhaust abatement systems to a large variety of industry, although some are concentrated only on marine solutions. The scrubbers available at the moment can be divided to two groups: dry scrubbers and wet scrubbers which can be further divided to open loop, closed loop and hybrid scrubbers. Among the manufacturers there are differences between the types of the systems they are offering. Majority of the manufacturers are providing wet scrubbers available in a hybrid version which enables operating by either open or close loop mode. At the moment there is only one manufacturer producing dry scrubbers. In general, the systems available are suitable for both retrofits and newbuildings, which are considered to be simpler for installation due to for instance the space requirements aspects. Installations to retrofits are mostly realized during a scheduled dry dock, but there are some examples of installations during continuous service.

Readiness to deliver scrubber systems

Sulphur in ship fuels will be limited to 0.1% after 1.1.2015 in SECA (Sulphur Emission Control Area: the North Sea, the English Channel and the Baltic Sea). Current sulphur limit is 1% and global limit 3.5%. The readiness among the respondents to deliver the scrubber abatement technology to the vessels before the sulphur regulation comes into force in 2015 is high: 85% reported their readiness to deliver abatement technology being very good (five alternatives from very good to very bad). A common opinion among the respondents was that other technologies than scrubbers are almost non-existent at the moment. Besides, the current systems are fairly tailor-made products, but in the future there will probably be more standardized systems. Also, different kind of scrubbers will probably be developed in the coming years.

The amount of scrubbers that could be installed in a year varied quite significantly among the respondents. In general, the minimum amount of the scrubbers that is possible to install in a year varied from ten to fifteen and the maximum was over hundred systems. Readiness to deliver four hundred systems in a year or even as many as necessary were reported by some companies. That is possible because those companies have global network of large manufacturing plants which can be utilized to manufacture the scrubbers.

The situation is naturally changing within the coming years, because the manufacturers are developing their processes all the time, and the situation is dependent on the incoming scrubber orders. The whole system is a ramp-up procedure where increasing amount of scrubber systems can be delivered each year. The complexity of a system affects to the time of delivery also; large number of standard systems can be delivered than complex ones. In general, one abatement system can consist of more than one

scrubber unit. Some of the responded companies provide smaller scrubbers for each engine to be installed separately, whereas others use large multi-inlet scrubbers serving simultaneously several engines.

Factors affecting delivery of orders

Time when the orders should be placed at the latest in order that scrubbers would be in use in the beginning of the year 2015 ranged from the end of the 2013 to the end of 2014. Naturally, the delivery time is depending on the amount of the placed orders. It was believed that a demand peak for the systems will be reached during 2014-2015. If all orders will accumulate to a certain moment, the delivery capacity will be a bottleneck that affects significantly the delivery times.

The respondents expressed many different factors that are affecting the time of delivery and the readiness to supply scrubbers. The most important factor mentioned was the amount of orders which affects the capacity and the time of delivery. The respondents hoped that the shipping companies begin to order and install the scrubbers immediately, because it is necessary to scale their activities in order to be prepared for the enormous glut of orders to be expected at the latest in 2015. Other important issues affecting the deliveries were material lead time and fabrication as well as the availability of key components (such as pumps) and equipment, and the material availability in general. Well-functioning network of sub-suppliers and also the availability of the personnel, such as project engineers, were mentioned as essential factors in order to deliver the orders on schedule.

FEASIBILITY OF ABATEMENT DEVICES

Factors affecting cost-efficiency of different abatement devices

There was a wide range of answers concerning the issues that should be taken into consideration when the cost-efficiency of different abatement devices to reduce sulphur emissions is calculated. The issues varied from present and forthcoming fuel costs to an experience of suppliers of devices. Based on the answers from the respondents the considerations was divided to five categories (fuel, costs, system, environment, other) presented in Figure1.

The main issue that should be taken into consideration when a ship owner calculates the cost-efficiency of abatement devices for their vessels to reduce SOx was different costs. The cost of equipment itself plus cost of all peripheral equipment required, cost of installation as well as operational costs were mentioned as important considerations. The costs of electrical power were stressed because the use of the equipment needs energy. Ship owners should also use as realistic estimates as possible of the fuel prices; the future expected price of fuel containing 0.1% sulphur and the price of high sulphur fuel (in practice HFO). In general, the fuel price development and the price difference between MGO and HFO have the most dominant influence on the cost-efficiency of devices, and is undoubtedly the most difficult issue to predict.

In addition to the different kind of costs concerning the equipment and the fuel, the factors related to the system types and requirements for a vessel were highlighted. Firstly, the system type between a fresh, a sea water, a hybrid and a dry scrubber has to be decided. The second concern is the placement of a system which affects to a ship stability, and a space needed for a scrubber means generally cargo and/or passenger reduction. The rest of the considerations were categorized to group other; both the operation area of the vessel and the operation profile of the vessel were mentioned in many responses. Besides, the experience of a supplier is an important factor that can affect strongly to the decision making.

Although investment of a scrubber causes various costs and might be regarded as a compulsory means, there exist also possibilities that should be kept in mind. Environmental advantages resulting from the use of scrubbers are undeniable. According to tests conducted by the manufactures, it is possible not only to abate sulphur emissions but also to reduce particulate matter and carbon dioxide (CO_2) emissions by using the scrubbing systems. Results are dependent upon the tested scrubber types, and in the case of for example the particulates, their size have a significant effect to the abatement results.

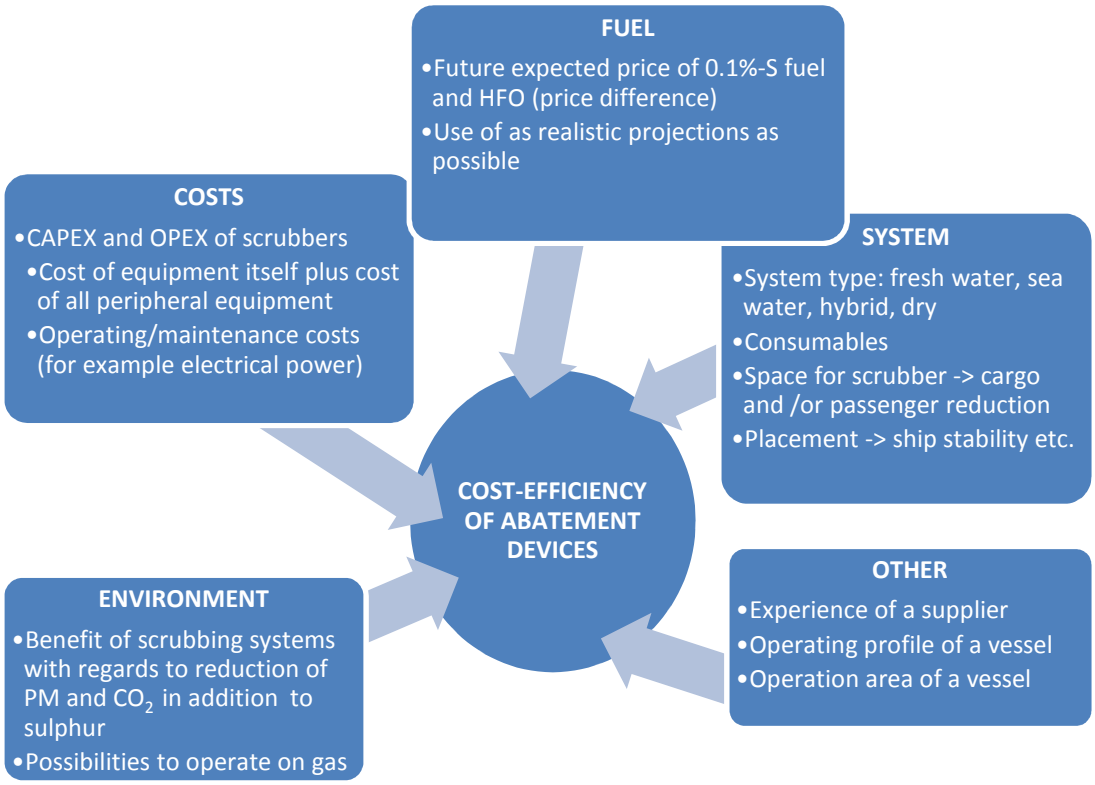

Figure 1. Issues affecting to a decision making when a cost-efficiency of abatement devices is calculated.

Importance of different issues when installing scrubbers on vessels

The respondents of the questionnaire were asked to weigh the importance of different issues when scrubbers are installed (Figure 2). Ten different alternatives were given and the respondent ranked those on scale from one to five. The tenth alternative was “other” where respondents could give issues not mentioned in the list. It was also possible to give comments to the alternatives given.

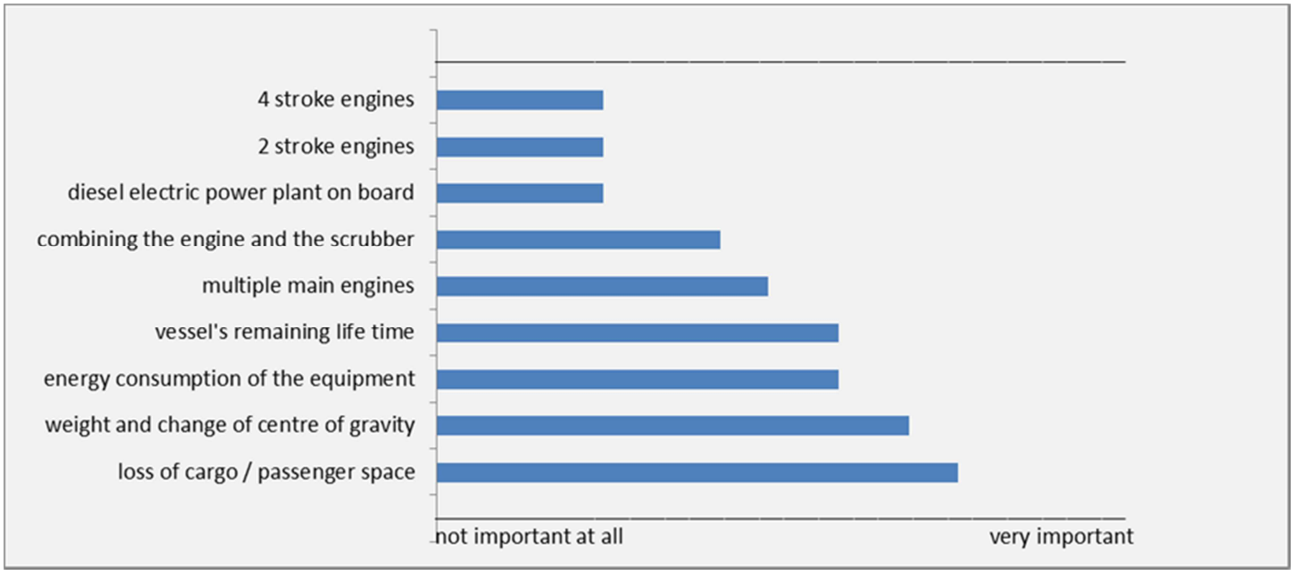

Figure 2. The importance of different issues when planning the installation of a scrubber.

The loss of cargo and/or passenger space was valued as the most important factor which is affecting to the installation of a scrubber. Due to its significance, it should be taken into consideration when the placement of the equipment is planned. The scrubber installation through the loss passenger/cargo capacity affects the payback time for a ship owner that should always be a part of the economical evaluation. The second most important issue to take into consideration was weight and change of centre for gravity. Although this was valued as an important factor, there were also opposite opinions according to which the effect is minor in general. Energy consumption of the equipment and vessel's remaining life time were regarded as third important factor. It was highlighted that the scrubbing systems will not be installed if the vessels' remaining lifetime is short. Energy consumption and remaining lifetime will affect significantly the payback time for a ship owner, so those should always be a part of the economical evaluation similar to the loss of cargo and/or passenger space.

Diesel electric power plant on board as well as 2-stroke and 4-stroke engines were regarded as factors which are least significant when the installation of a scrubber is planned. Combining the scrubber with one or multiple engines and boilers is not regarded as a very important factor according to responses of this survey. In general, there exist opposite opinions concerning the most effective way to handle the exhaust gases; some are of the opinion that the exhaust gases are reasonable to abate in one unit to save space, weight and costs, although there would be multiple engines, whereas others consider that having a scrubber to each individual engine/boiler is the most viable way.

Besides the given alternatives, there was a possibility to add own suggestions under "other" alternative where the operating profile of the vessel was mentioned as the most important factor. This applies particularly to the vessels which are operating mainly in the SECA where the stricter regulations for the sulphur content of the fuel are used. Issues affecting the scrubber investment decisions could be divided to four different categories which are presented in Figure 3.

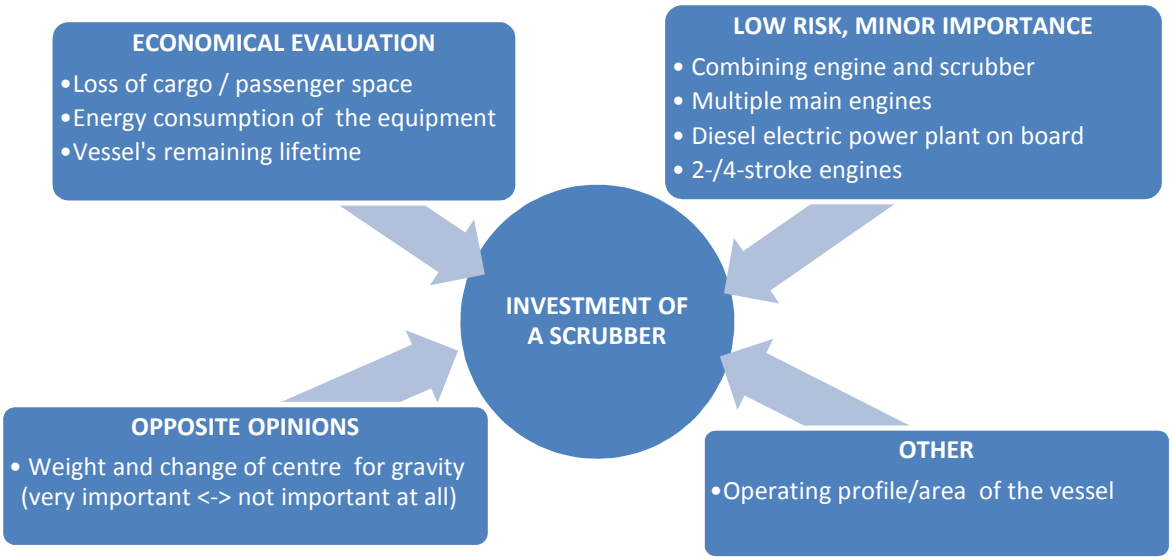

Figure 3. Issues affecting scrubber investment decisions.

Operational costs of scrubber use

A total cost of a scrubber is composed of several factors from a purchase price to the operational costs. It is important to know how the costs are divided between these different categories. The easiest to find out is the purchase price of the scrubber device itself, although the agreements between the shipping companies and the device suppliers are usually confidential. The given figures are mainly averages, and it is not evident what factors are included in the given sums. The operational costs and related issues are more difficult to solve. Bearing that in mind the respondents of the survey were asked to give their estimations on the operation costs caused by the scrubber use. The estimations were asked to be in per cent if possible.

Labour costs in per cent of engineers' work time ranged considerably, from 2% to 30%. It was emphasized that the share of the costs is dependent on a system and also on an experience of the engineers. One extreme value regarding to the system chosen was that the share of labour costs (% of engineers' work time) of wet scrubbers could be as high as 80%. In relation to this, the per cent of labour cost which are needed for the use of the dry scrubber was only 5%.

Besides the labour costs, there are maintenance costs that should be taken into consideration when the total costs are calculated. Sums were asked as per cent of equipment costs. Similarly with the figures of the labour costs, the maintenance cost per cent are dependent on a system, but the difference between the lowest and the highest per cents was smaller when compared to the labour costs. The range was from 1 % to 15%. Similarly with the labour costs, the highest maintenance costs were related to wet scrubbers.

The third issue concerned the other operational costs and other considerations of the installation onboard. The extra costs arise from the need of caustic soda (NaOH) and fresh water as well as the treatment of the sludge. The price difference between heavy fuel oil (HFO) and marine gas oil (MGO) will affect significantly to the cost-effectiveness of the scrubber investment. According to some calculations the savings that a ship owner can have with the use of HFO and abatement technology compared to the use of MGO can be 100% of the equipment cost each year from 2015. Calculations are based on a price difference of 350 $ (ca 270 euros) between HFO and MGO.

Amount of scrubbers onboard and requirements for engines

There were totally opposite opinions concerning the amount of scrubbers that is feasible to install in a vessel. According to the other extreme, the installation of one scrubber for each engine is the simplest and most cost-effective means. Combining many engines into a single scrubber becomes complex and the additional costs of ducting, isolation dampers and blower becomes very high. In spite of this, it was also highlighted that usually it is beneficial to have a separate scrubber for the main engine if the difference in power rate is significant, and also that it is reasonable to install own scrubbers for boilers. Other respondents expressed that in no circumstances there is a need for more than one scrubber. The opinion between these two extremes was that several scrubbers are needed only in cases with two separate engine rooms and separate funnels. Common understanding prevailed concerning the operation profile which affects partly to the amount of scrubbers needed. Nearly all respondents were of the opinion that auxiliary engines do not require their own scrubber in general, but they can be connected to a common scrubber that is intended for all engines and boilers onboard. In spite of this, for example extra water and power consumption should be taken into consideration when the total costs of equipment are calculated.

In addition to the amount of scrubber needed, the minimum engine size to which a scrubber is reasonable to install have to be decided. The reasonable size of the engine has to be evaluated separately in each case, because the operation profile, the operation area and also the complexity of the installation are affecting to the feasibility of the devices. In general, it was estimated that installing a scrubber becomes attractive upwards of 3MW when another opinion was that there will probably not be scrubber systems installed in ships with less than 3.5 MW. At the same time as low engine si zes as 2 MW and even 0.5 MW were regarded as reasonable sizes to install a scrubber.

NOX REGULATIONS IN 2016 (TIERIII)

Nitrogen emission control area (NECA) and NOx technology

Designating the Baltic Sea and the North Sea as NECAs would mean that the three-tier standards for new ship engines would come into effect in the area. The regulation would concern ship engines installed in 2016 or after. The aim of the Tier III programme is to reduce the emissions of new engines and also emissions of old engines through adaptation.

Designating the Baltic Sea and the North Sea as NECAs would not affect substantially to the strategies on developing NOx technology according to respondents, although some opposite opinions were expressed. In general, the designation of the Baltic Sea Area as NECAs would affect companies' strategies only moderately because they already have strategies on developing NOx technology. It was highlighted that the North American ECA regarding SOx, NOx and PM is in effect already, so the technology have to be developed anyway. The possibility of designating the North Sea as NECA is ongoing, and in future there will be a general need for low NOx solutions. The respondents also mentioned that new restrictions increase market potential for their products.

The technologies of reducing NOx emissions that are available at the moment and utilized commercially are selective catalytic reduction (SCR) and exhaust gas recirculation (EGR). Those are the same TIER III technologies that are believed to be available definitely in 2016. However, most of the respondents seem to rely more on SCR systems than on EGR systems. Also gas engines were mentioned to have a potential to become TIER III technology in the future and being a possible solutions to reduce NOx emissions as well as different kind of EGR technologies combined with other low NOx technologies.

Estimating the cost-efficiency of NOx abatement devices in newbuildings

Respondents were asked to offer their recommendations how a ship owner could estimate the cost-efficiency of SCR, EGR and other devices for their vessels to reduce NOx emissions in newbuildings. There are many factors such as fuel consumption, maintenance and consumable costs (urea, NaOH) as well as space requirement that have to be evaluated. Also possibilities to run the abatement system at different engine loads have to be considered. When comparing SCR system with EGR system, the former seems to be more cost-effective alternative according the respondents. For example EGR requires higher investment costs than SCR, which is regarded easier both to install and to operate than EGR. Furthermore, highlighted disadvantage of EGR is the need for NaOH, but at the same time there is a need for urea when using SCR.

Complying with the forthcoming NOx regulations, in general, applications of additional engine components and auxiliary systems are required. Extra costs will result when operating in Tier III mode despite of the systems chosen. Both systems have an impact on engine room, increase the fuel consumption and require power for auxiliary systems necessary for the operation.

Effects on the investments of new vessels

Manufactures were also asked about their opinion how the possible designation of the Baltic Sea and the North Sea as NECA areas would affect the investments of new vessels. The respondents were asked to rank four issues from one to five according to their importance (Figure 4). From the four given alternatives, the most significant was that the investment schedule will be affected in general. Postponing the orders or purchasing of ships built before 1.1.2016 could be the means how the ship owners adapt to the new situation. Building the ships before 1.1.2016 was ranked to the least significant means how NECA will affect the investments. The respondents were asked about their opinions concerning the maximum remaining lifetime of a vessel to still be feasible to invest in emission abatement technology. Because only few answers to this question were received, it is impossible to make reliable conclusions.

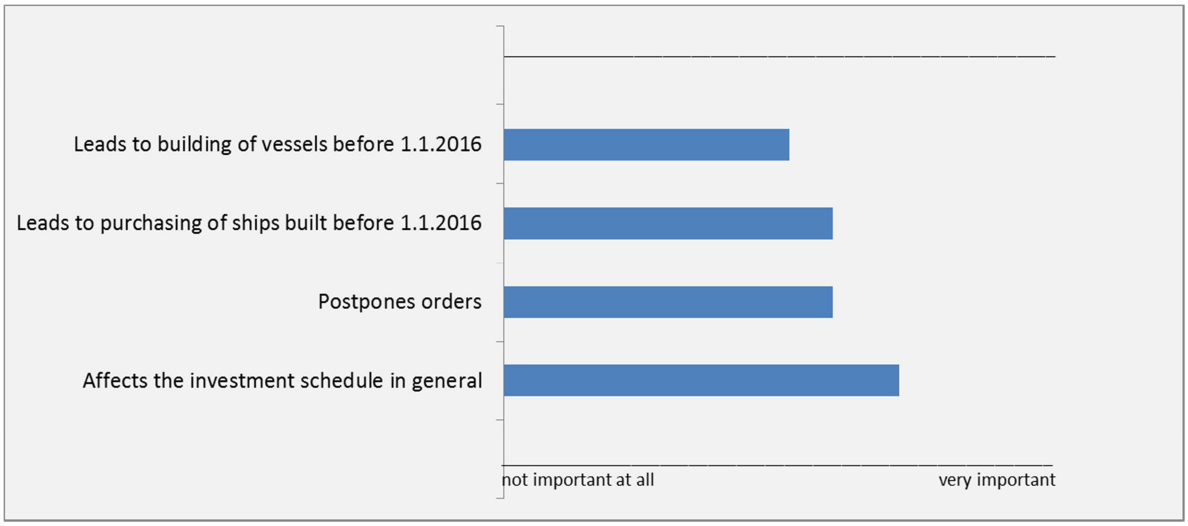

Figure 4. Ranking of effects that designation of NECAs might cause.

CONCLUSIONS

The year 2015 with the stricter limitations of the sulphur content of ship fuel is reality soon. The readiness among the respondents to deliver the scrubber abatement technology is high. The challenges related to the supply of the devices are the thin order books due to the hesitation among the shipping companies. There exists a general concern that all orders will accumulate to a certain moment, making the delivery capacity a bottleneck affecting significantly the delivery times. There was a common wish among the respondents who we hoping that the shipping companies begin to order and install the scrubbers immediately, because it is necessary to scale their activities in order to be prepared for the enormous glut of orders to be expected at the latest in 2015.

There are several causes which hinder the shipping companies' investments. The devices are expensive and careful cost-efficiency calculations have to be prepared, the type of different scrubbers compared, the requirements for a vessel considered, the payback time calculated etc. Although investment of a scrubber causes various costs and might be regarded as a compulsory means, there exist also possibilities that should be taken into consideration. Environmental advantages resulting from the use of scrubbers are undeniable. With scrubbers systems it is possible not only to abate sulphur emissions but also reduce particulate matter and carbon dioxide (CO_2) emissions. Nitrogen abatement technology is already developed due to the North American ECA, and the possible designation of the North Sea and the Baltic Sea as NECAs would increase the market potential to the products of the manufacturers.