Study of the Feasibility of Shore-Side Power Supply for the Ports of the Hanseatic City of Bremen

Summary of Findings

On behalf of the Senator for Economics and Ports, the GAUSS mbH (Institute for Environmental Protection and Safety in Shipping) compiled a report entitled “Study of the Feasibility of Shore-Side Power Supply for the Ports of the Hanseatic City of Bremen with regard to Technical, Environmental and Financial Aspects”. In the study it had to be found out whether the sulphur reductions in ship fuels used during a stay in the harbour, which are specified by EU-Directive 2005/33/EG from 2010 onwards, would affect the ship waste accumulation and whether apart from sulphur reductions other measurements would be technically feasible and sensible, e.g. supplying ships with shore-side power. According to the so-called “sulphur directive” from 2010, only fuels with a maximum sulphur concentration of 0.1% are allowed to be used within port operations. Vessels can only be relieved of this directive if they “turn off all engines in the berth area and use electric power from an shore-side supply”. In any case, until 2015, a maximum permissible sulphur value of 0.1% in fuels (from presently 1.5%) will be gradually introduced for maritime traffic in the North and Baltic Sea areas that had been classified as Sulphur Oxide Emission Control Areas (SECAs) by the International Maritime Organization (IMO). Thus the SECA requirements were adjusted to the berth requirements in Europe according to the sulphur directive 2005/33/EG. Hence, for a transition period of five years ships could still use fuels with a higher percentage of sulphur at sea and then switch to shore-side electricity once being in the harbour.

There is a wide discussion about the consequences of harmful emissions through the use of diesel engines on seagoing vessels. A main focus in these discussions is the time that the vessel moors in the harbour because in some seaports the emission source is very close to urban areas, and an urgent need for action is required. Once a connection has been established and both systems have been synchronised, connecting the ship to shore-side power supply makes it possible to switch off the auxiliary diesel engines that are usually needed to generate electricity during port operations. However, the supplementary boiler that generates thermal energy is still used throughout the time of berthing.

Numerous important questions about the use of land based power supply for seagoing vessels have not been answered yet. Amongst these are the agreement of uniform standards for the power supply, different power qualities and inconsistent technical requirements, questions about the provision of extensive power capacities, legal frameworks, as well as questions of liability and warranty.

In addition, the viability of shore-side electricity for ships in the harbour depends on a number of criteria. First, the surroundings of the berth area need to be taken into consideration as it is in the immediate surroundings where the potential danger of emissions is the largest for people. The air quality of Bremerhaven and Bremen show unremarkable data; even the use of currently allowed fuels does not cause any health threats. Nevertheless, in this study it was calculated in what areas the quantitatively largest emissions are produced. This is the case at the “Stromkaje” (container terminal in Bremerhaven), followed by the car terminal in Bremerhaven and the “Neustädter Hafen” in Bremen. In comparison, proportionally fewer emissions are produced at the Columbus Cruise Center; however in relation to a single vessel there are a comparatively larger number of people exposed to the harmful substances.

In order to compare shore-side electricity with the pollutant accumulation caused by the auxiliary diesel engines, both energy changing units were given specific operating figures. With the help of these and on

the basis of the required net energy and the interconnected fuel consumption of the auxiliary diesel the emissions were calculated. For the auxiliary diesel the specific fuel consumption is the parameter for emission output and for cost calculation. On the other hand, shore-side electricity is determined vastly by the existing electricity mix on land. For example, the electricity mix in the city of Bremen contains a very large amount of energy gained through fossil fuel generation (82%). This is accordingly accompanied by high carbon dioxide emissions. Therefore, vessels berthing in the harbours of Bremen using shore-side electricity would cause higher carbon dioxide emissions compared to using an auxiliary diesel. In Bremerhaven the electricity mix contains a high amount of renewable energy (18%) but also a large amount of nuclear energy (36%). Hence, regarding carbon dioxide emissions in Bremerhaven, this causes only minor differences between shore-side power and the use of auxiliary diesel engines. However, the amount of nuclear waste, which was also calculated, turned out to be considerably higher than in Bremen (e.g. Stromkaje 01/04 – 31/12/2008: 125 kg). In 2008, the harmful gases sulphur dioxide and nitrogen dioxide would have been able to be reduced by 80-90% for the duration of mooring. The emission of particulate matter could only be calculated for the use of auxiliary diesel engines so that these could be seen as absolute values in relation to emissions like dust and pulverised fuel ash from land electricity. At the Stromkaje during a time period from 01/04 – 31/12/2008 123 t particulate matter (PM10) could have been prevented by using shore-side electricity for all vessels; at the same time this would have caused an excess of 1510 t dust and 1858 t fuel ash. Thus, it is the electricity mix with the largest possible amount of renewable energy that is of greatest importance for the supply of vessels with shore-side electricity because this determines the effect on emissions. If due to a surplus-capacity renewable energy cannot be fed into the mixed network, ships could use this energy instead of an auxiliary diesel. In a simplified comparison of direct costs of a kilowatt hour, running an auxiliary diesel, especially with heavy oil, was a lot cheaper (3-10 ct) than using shore-side power (12-14 ct), even if there was an all-time high of fuel prices (July 2008) in the specified time period.

In favourable conditions the supply of mooring vessels with shore-side electricity could reduce a large amount of harmful emissions. Nevertheless, the generation of significant amounts of emissions remains, e.g. during manoeuvres or entering and leaving the harbour, however, these were not part of this study. In these situations not only the auxiliary diesel engines that were a main focus in this study but the main engines produce emissions. Notably during the numerous load alternations during a manoeuvre, higher amounts of emission are produced, whereas the primary engine often produces more than five to ten times the engine power of auxiliary diesel engines. In order to reduce the collective emission of vessels in the harbour, it therefore seems to be feasible to extend the use of filter technology and explore other means of reduction. The analysis shows that regarding the emissions of auxiliary diesel engines and auxiliary boilers there is a high potential of reduction. This could be extended significantly by expanding to the primary engines as their emissions cannot be avoided by shore-side power supply. For locations in which an immediate exposure through ship emissions has to be avoided in near future, as for instance at the ferry terminal in Lübeck, there are no fully developed alternatives to shore-side electricity. For those cases other preconditions have to be provided, as for example the fitting of all vessels that use the concerning harbour. Currently, this seems to be feasible for liner traffic only.

Hence, in order to reduce ship emissions in the harbour there are a number of possibilities; the supply of mooring vessels with shore-side electricity is one of them. As this way of reducing emissions only affects the auxiliary diesel engine during the berthing period, the application of technology to reduce emissions in the exhaust gas in all power units on board possesses a higher potential of reduction overall.

Against the background of the upcoming legal readjustment on IMO and European level (revision of Annex VI of the MARPOL convention as well as EU directive 2005/33/EG) the course is set for an improvement of ship fuels and the connected reduction of air pollution through ships. In this respect, a significant reduction of pollution is anticipated anyway.