Norwegian School of Economics
Bergen, Spring 2018

Environmental Sustainability Practices in European Ports

An analysis of environmental management system tools, sustainability instruments and green practices, improving environmental performance of European cruise ports

Valeriia Denisova

Supervisor: Gunnar Eskeland

Master Thesis in Economics and Business Administration
Energy, Natural Resources and the Environment

NORWEGIAN SCHOOL OF ECONOMICS

Abstract

The main subject of this Thesis is the environmental sustainability management tools used to improve environmental performance of European ports. In the first part the problem of environmental impacts from port operations is introduced with a focus on air pollution caused by emissions from the cruise vessels visiting ports. Here the main pollutants are described, and their impact on human health is addressed. Then, the comparison of main environmental management system tools is drawn. Finally, an overview over environmental policy aspects and sustainability reporting principles are provided.

In the second part of the Thesis thirteen biggest European cruise harbours, including the Port of Bergen, have been analysed within a developed system of environmental management performance indicators. The analysis includes determining the most popular environmental management tool and other environmental sustainability instruments and green practices in ports. Importance of communicating environmental ambitions both to port employees and to external stakeholders as well as the advantages of sharing knowledge through the network with other ports and collaboration with local businesses have been emphasized. Additionally, the researched ports' environmental priorities have been addressed with the main focus on air quality and onshore power supply technology as a possible mitigation of emissions from cruise vessels docked at ports.

The findings of the research might urge the Bergen Port Authorities to adopt some sustainability practices used in other cruise ports and consider environmental management system certification alternative to ISO 14001 international standard that the port is aiming to implement.

Keywords: Environmental Management System, Environmental Performance Indicators, Air Quality, Cruise Ports, Shipping Pollution, Cruise Vessels, Port Cities.

Table of Contents

1. Introduction

1.1 Research problem

Cruise tourism continues to show a major international growth (Johnson, 2002). Busy cruise port terminals and harbours play a vital role in the economic development of their surrounding areas. At the same time, port operating activities can lead to an irretrievable harm to marine and coastal ecosystems as the berths, docks and storage warehouses are often placed in ecologically significant areas, such as bays and mangroves (Buruaem et al., 2012). Moreover, pollution can occur not only in normal conditions, but also accidentally. The continuous movement of ships in port occasionally leads to the collisions between ships and the coast, and a consequent risk of releasing hazardous materials (Darbra et al., 2004). Potential environmental impacts vary from water contamination to the biodiversity loss (Grech et al., 2013).

Cruise vessels docked at ports do not only generate substantial damages to natural habitats but also can worsen the quality of life in the port cities and neighbouring settlements. For instance, onboard activities are often accompanied with the use of loud speakers because of safety measures. This irritates inhabitants of the surroundings (Badino et al., 2012). Noise pollution has become a prioritised environmental problem for port authorities almost on a par with air pollution caused by hotelling and manoeuvring cruise vessels (EcoPorts, 2017). Moreover, research reveals that 70 per cent of ships' emissions are released 400 kilometres from land (Chatzinikolaou and Ventikos, 2014; Endresen et al., 2003). With the wind carrying emissions towards the coastline, the air quality in local communities can be significantly worsened. Such a scenario will lead to the adverse impacts on human health, particularly, on cardiovascular and respiratory systems (Dominici et al., 2006). Additionally, what is also contributing to air pollution is the emissions from port activities themselves, high concentration of traffic and industrial activities in port areas.

It has been estimated that cruise ships are responsible for 25 per cent of all waste generated by merchant vessels, although they represent less than one per cent of a global merchant fleet (Butt, 2007). Taken that cruise ships generate 70 times more waste than a typical cargo ship,

cruise ports and ports of call are obliged to have an efficient waste management system and ship-generated waste reception facilities, providing vessels with a discharge option (Sustainable Cruise Project, 2011).

The Port of Bergen faces the above-mentioned consequences as a Norway's second largest port and one of the most popular cruise destinations in Europe. In 2017 it welcomed 307 cruise calls and 329 cruise calls are planned for 2018. The port is operated by an intermunicipal enterprise Bergen Port Authority (Bergen havn, 2018). As the research revealed, to minimize environmental impact the Port Authorities have planned to implement an environmental management system - the framework that helps an organization to reach its environmental goals through consistent review, evaluation, and improvement of its environmental performance, and certify it to ISO 14001 international standard. At the same time, there is a number of competitive schemes and standards that might be more applicable and efficient to implement at the port. Therefore, alternative options should be further considered.

Additionally, as Bergen is Norway's leading cruise port, one of the major concerns of the Port Authority is the air pollution and emissions from cruise vessels calling at port. As it was clear from the number of face-to-face sessions with the port's Environmental Manager, air quality in Bergen city is feared to be threatened by emissions coming from port area, therefore, port authorities consider investing into an onshore power supply for cruise vessels as a potential mitigation technology.

1.2 Research objective

Research problem has led to the number of main questions that this Thesis attempts to answer:

- *What are the alternatives to implementing EMS to ISO 14001 international standard and what are their key differences as compared to ISO 14001?*

- *What are the other sustainability instruments and green practices that are used in European ports?*

- *To what extent does the Port of Bergen meet the requirements of discussed EMS standards, schemes and certifications along with the other European cruise ports?*

Additionally, the research addresses the extent, to which the Port of Bergen impacts air quality in Bergen city area and discusses onshore power supply to cruise vessels as a solution to mitigate air pollution.

1.3 Outline

Chapter 2 of the Thesis describes the methods used to approach the research questions. In Chapter 3 the general problem of environmental impacts from port operations is presented. Special attention was put to air pollution from vessels maneuvering and hotelling at ports. The main types of emissions from port operations were described with a special focus on their impact on human health. Additionally, Chapter 3 executes the relationship between air pollution and climate change, addressing the human health risks associated with it.

Chapter 4 includes an overview over existing literature focusing on sustainability in ports, environmental performance indicators, and discussing various certifications of environmental management systems implemented in harbors. Then, Chapter 5 reveals the analysis of environmental sustainability instruments: environmental management system, environmental policy and sustainability reporting. Implementation of EMS to ISO 14001 international standard as well as the comparison of the standard to the alternative EMS schemes, certifications and tools is provided. This Chapter serves the ground for developing a system of performance indicators based on the research of the requirements posed by ISO 14001 and other EMS tools and sustainability reporting guidelines. Chapter 6 reveals the findings regarding the performance of the Port of Bergen and other 12 European ports across that multidimensional framework. Additionally, it discusses the onshore power supply solution based on the opinions of interviewed representatives from the researched ports. Finally, Chapter 7 provides a discussion, where the key learning takeaways are outlined and recommendations to the Port of Bergen Authorities are provided.

2. Methodology

2.1 Data collection

Survey research method was used to collect fundamental data about ports' environmental performance. Twenty-two cruise ports across eleven European countries have been selected for getting in contact with. The ports were selected by size and the importance of the cruise destination. The database with the contact details of ports' representatives, responsible for environmental sustainability management, was built. The representatives were approached with a request for collaboration and filling out an online questionnaire ''Environmental Sustainability at Ports'' (Appendix 3). Based on the degree of informativeness of the survey responses, ports' environmental reports and policies; the follow-up interviews were set up to gather in-depth information about the thirteen ports, which responded to the survey. Therefore, the survey helped to collect basic information on ports' environmental performance and prepared a solid ground for the interviews with the ports' environmental managers.

The qualitative research method was used to gather an in-depth information regarding the sustainability issues and best practices of mitigating those issues at ports through interviewing ports' environmental representatives. The following documents were requested from the port authorities, in case they were not publicly available: internal environmental policy, internal environmental agenda and annual sustainability/environmental report or review. To fully identify the current state of the Bergen port's environmental performance, ambitions and future development strategy, several face-to-face sessions were held with the port's Environmental Manager Even Husby. To better understand the specificity of Bergen Port location, climate and weather conditions, as well as their influence on air pollution, a face-to-face session with a subject-matter expert from Nansen Environmental and Remote Sensing Center was run. Additionally, to collect missing data regarding the activities and services of the EcoPorts initiative within ESPO organization, the EcoPorts Coordinator was interviewed. To get the insights into the Eco-lighthouse certification procedure, the interview with Senior Advisor at Eco-lighthouse Foundation was conducted.

The total number of interviews is nine, including the ones with ports' representatives and subject-matter experts. The notes from some interviews can be found in Appendix 4-10. Every interview was limited to a maximum of an hour, most of the conversations were run via audio conferences, some of them were conducted through emails (due to an interviewee's request) and during face-to-face meetings, as it was mentioned earlier. Up to ten interview topics were selected in a semi-structured format to ensure a natural flow of conversation. Open-ended questions were structured in a neutral way not to influence interviewee's replies.

2.2 Data analysis

Collected data was classified according to the developed framework, mapping the subject ports performance across the indicators of four main dimensions, namely: Instruments for communicating environmental ambitions, Environmental Management System, Environmental Policy and Environmental Sustainability Reporting. The total of fifteen criteria were selected based on the comprehensive analysis of the requirements, posed by four environmental management system certification options, namely: ISO 14001 international standard, Eco-Management and Audit Scheme (EMAS), Eco-Lighthouse certification scheme and Port Environmental Review System (PERS).

Additionally, sustainability practices, environmental projects and green strategies were discussed as a part of Environmental Agenda section to identify researched ports' environmental priorities and provide the ports with an opportunity to learn from each other. Special attention was paid to the question of cost-efficiency of onshore power supply technology for cruise vessels.

3. Environmental Impacts from Port Operations

Major environmental impacts can be caused by port operations, such as vessels docked at port, port's industrial activities, connecting transport networks that serve the port hinterland, and port activities themselves (Organisation for Economic Co-operation and Development, 2018). The impacts depend on various aspects, such as port size and design, type of activity, traffic volume and the local geography and hydrology. The heterogeneity of these factors makes it problematic to develop a unified framework for port sustainability and environmental protection (Schottli, 2018).

3.1 Air pollution from the port area

Vessels emit a significant amount of air pollutants, contributing to the global climate problems and worsening air quality in the large port areas (DNV GL, 2017). Ship emissions are strongly dependent not only on the type of engine and the quality of fuel, but also on the ship speed. Vessel speed varies in different operational modes: cruising at sea, slow cruising in reduced speed zones, maneuvering and hotelling at berth (Yau et al., 2012). Last two are the ones of this research interest as the Thesis is primary focusing on mitigating environmental impacts such as pollution at berth associated both with vessels and port activities.

The engine room of a motor vessel contains of several engines for the specific purposes. The main engines ensure the vessel's propulsion through turning the propeller and pushing the ship through the water. The auxiliary engines ensure an onboard operation not related to the propulsion, such as providing electricity for lighting and heating. Marine diesel engines typically burn sulphurous heavy fuel oil, using marine diesel oil for the start-up and maneuvering (Rambøll, 2017). Figure 1 schematically illustrates the operation of a four-stroke marine diesel engine and gives an overview over added fuel, exhaust gases and atmospheric chemistry.

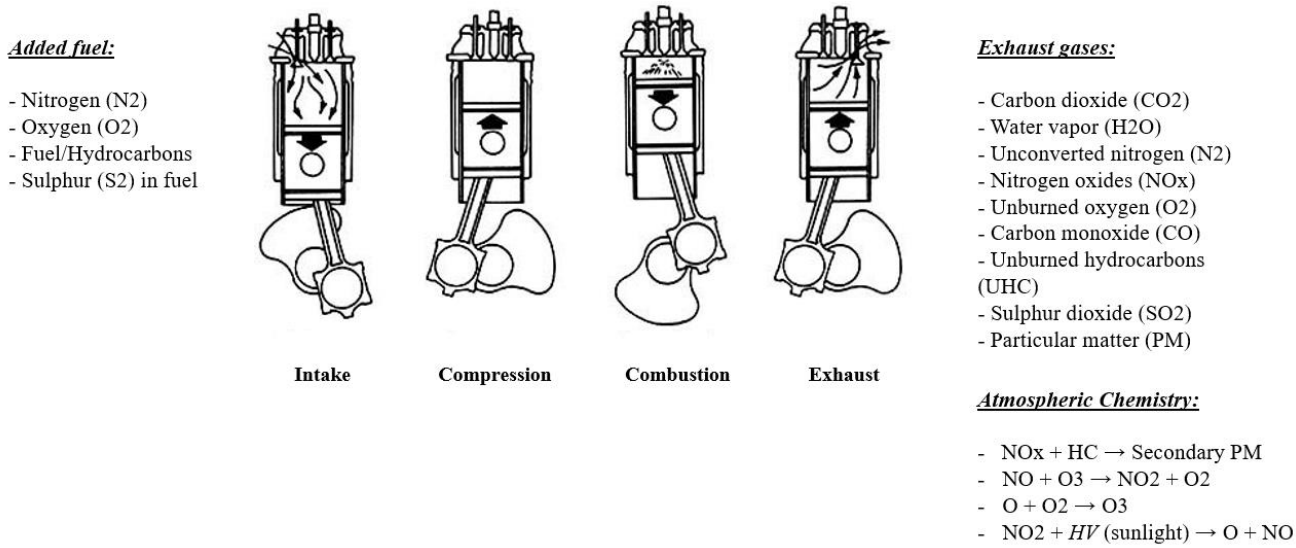

Figure 1. Operation of marine diesel four-stroke engine (Rambøll, 2017; Leduc, 2001).

Onboard combustion and energy transformation processes for propulsion and energy production purposes release different substances to the atmosphere. The exhaust gases emitted to the air consist of products of combustion, mainly carbon dioxide (CO2) – main greenhouse gas and water vapour (H2O). The most dangerous for health pollutants affecting local air quality are nitrogen oxides (NOx), sulphur dioxide (SO2), particulate matter (PM), carbon monoxide (CO) and unburned hydro-carbons (UHC). As seen in Figure 1, some of the compounds in the exhaust gases cause a number of chemical reactions. NOx and hydrocarbons form secondary particulate matter. Nitrogen monoxide (NO) and nitrogen dioxide (NO2) form part of a cyclic process, where ozone (O3) is central, and this equilibrium varies depending on atmospheric conditions such as irradiance and ozone concentration (Rambøll, 2017). Some of the substances listed above may be detrimental to health in concentrations above a certain level.

3.2 Human health risks from air pollution

Air pollution is recognized as the world's largest environmental health risk: it is a cause of one in eight of total global deaths. According to the World Health Organization, air pollution exposure results in approximately seven million premature deaths every year as well as a larger number of hospitalizations and days of sick leave (2018).

In this research NOx, PM, SO2 are considered as crucial pollutants, which exposure consequences are discussed in detail.

Nitrogen Oxides (NOx)

In the ambient air nitrogen oxides (NOx) mainly consist of nitric oxide (NO) and nitrogen dioxide (NO2) - the significant pollutants of the lower atmosphere. The last one is of the most importance, when it comes to the potential threat for human health. High concentration of NO2 in the air can lead to the irritation of the airways in the respiratory system. Periodical exposures to NO2 may worsen respiratory diseases, such as asthma, and result in the respiratory symptoms, namely, coughing, wheezing and labored breathing. Continuous exposure to the increased concentrations of NO2 in breathing air may promote the development of asthma and increase the susceptibility to respiratory infections. However, there is a limited experimental evidence on the effects of inhaled NO2. A lot of experiments with human volunteers were conducted in 80s-90s and have been reviewed by Advisory Group on the Medical Aspects of Air Pollution Episodes and later by World Health Organization (MAAPE, 1993; WHO, 1997; National Research Council, 1998; WHO, 2005). Both underlined the inconsistency of the various experimental results. While one experiments proved the low levels of NO2 to result in the effects on the pulmonary, respiratory functions, airways responsiveness and symptoms, others found no effects at the relatively high levels of exposure. Experiments subjects were relatively healthy, and the study panels were small. Therefore, there was no realistic representation of the general population, which would include the percentile of individuals more susceptible to the effects, e.g. suffering from asthma, chronic respiratory problems and lung diseases. Further clinical experiments described by World Health Organization found the effects on lung function, airways responsiveness and symptoms. Additionally, the studies have shown asthmatics to be more susceptible to effects than the healthy subjects. The NO2 exposure can also contribute to the development of asthma for the subjects predisposed to asthma and respiratory diseases (WHO, 1997; WHO, 2005).

Along with other NOx, NO2 enters into the chemical reaction with other chemicals in the air to form both particulate matter (PM) and ozone (O3), which can also be dangerous for the respiratory system, when inhaled (EPA, 2016).

Particulate Matter (PM)

Airborne particulate matter is a product of chemical reactions and physical processes in the atmosphere. It greatly varies in size, origin and composition - the sum of solid and liquid particles suspended in the air. PM can consist of both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets (World Bank Group, 1998). Based on their diameters, particular matters are commonly divided into the following size fractions: coarse PM10, fine PM2.5 and PM1 with diameters smaller than 10 μm, 2.5 μm and 1 μm respectively. Ultrafine particles (PM0.1) have a diameter less than 0.1μm (Amaral et al., 2015).

The aerodynamic properties of particles determine how far they get into the air passages of the respiratory system. The size of the particle indicates the potential adverse effects of particulate matter on health (WHO, 2000). Panel studies have a strong evidence of the fine particles (PM2.5) to be more biologically active and, therefore, more harmful than the coarse ones in terms of mortality and the adverse effects on cardiovascular and respiratory systems (Mcdonnell et al., 2000; Schwartz et al., 1996; Klemm et al., 2000; Kan, 2007; Schwartz and Neas, 2000). PM10 is mainly associated with the effects on the pulmonary system (Pentinen, 2004; Kim et al., 2005; Rambøll, 2017). High PM concentrations lead to the adverse effects on human health with certainty in Europe. Cohort studies have shown that the long-term exposure to PM decreases life expectancy by up to a few years, which is directly related to the increased cardiopulmonary and lung cancer mortality (Greenstone et al., 2015; Brunekreef, 1997; Krewski, 2009; Xing et al., 2016). Similar findings from the analysis of time-series studies have shown death to be advanced by periods of at least a few months, for causes of death such as cardiovascular and chronic obstructive pulmonary disease. Other effects include possible contribution to the increased infant mortality in the highly exposed areas, increased chronic bronchitis and reduced lung function for children and adults (Burnett et al., 2003). The evidence of almost all types of health effects has been found not only in Europe, but also in North America and Asia, which strengthens the worries towards the PM concentrations worldwide (WHO, 2003; Fann et al., 2016; Health Effects Institute, 2003; Bell et al., 2004; Health Canada, 2013).

Sulphur Dioxide (SO2)

Extensive pollution by sulphur dioxide can lead to the aggravation of chronic diseases, reduced lung function and increased mortality in a particularly sensitive group - asthmatics (Rambøll, 2017; WHO, 2000; WBK & Associates Inc., 2003). At the same time, to result in such adverse effects on human health, the SO2 concentration in the air should be relatively high. In fact, the SO2 emissions and concentrations in outdoor air have been considerably declined in the Western European countries over the last decades (WHO, 2000). At the moment SO2 does not pose a health risk in most places in Norway (Rambøll, 2017).

3.3 Relationship between climate change and air quality

As it was mentioned earlier, the cruise vessels emit CO2 and water vapor - the greenhouse gases, contributing to climate change. Climate change and air quality are highly interconnected (Fiore et al., 2015). Meteorological variables, such as temperature, humidity, wind speed and direction, and mixing height extensively contribute to determining pollution emissions, transport, dilution, chemical transformation and eventual deposition of air pollutants (Kinney, 2008). Climate change is expected to negatively affect air quality in many polluted regions through changing air pollution meteorology, precipitation and other removal processes, atmospheric chemistry as well as anthropogenic and natural sources (Fiore et al., 2015). This will affect primary (e.g. CO, NOx, NO, SOx, PM) and secondary (e.g. O3 and NO2) pollutants. Climate change will provoke a chain reaction, where worsened air quality will directly affect human health and ecosystems, so that they could also damage human health and alter climate in a causal loop (Haase et al., 2014).

Several studies indicate that air quality has already been affected by climate change. The simulation run by Fang et al. showed that in the period between 1860 (pre-industrial) and 2000 (present) climate change has caused a five per cent increase in global population-weighted PM2.5 concentrations and two per cent increase in near-surface ozone concentrations (2013). Other models on premature mortality due to past climate change have indicated that European premature annual deaths in the period between 1850 (pre-industrial) and 2000 (present) resulted in up to 10 700 and 774 deaths due to ozone and PM2.5 respectively (Silva et al., 2013). The study by Bloomer at al. is based on three million valid simultaneous measurements of temperature and ozone. The findings disclose that

approximately every degree of warming (°F) is accompanied with a corresponding increase of 1.2 parts per billion (ppb) in ozone pollution (2009). With the continuing change of climate, these impacts are expected to aggravate (Orru, 2017).

3.4 Human health risks from climate change

Climate change results in a direct and indirect impact on human health not only through affecting air pollution, but also through influencing weather and ecosystems. The impact of greenhouse gases rise on human health includes, but is not limited to the factors illustrated in Figure 2.

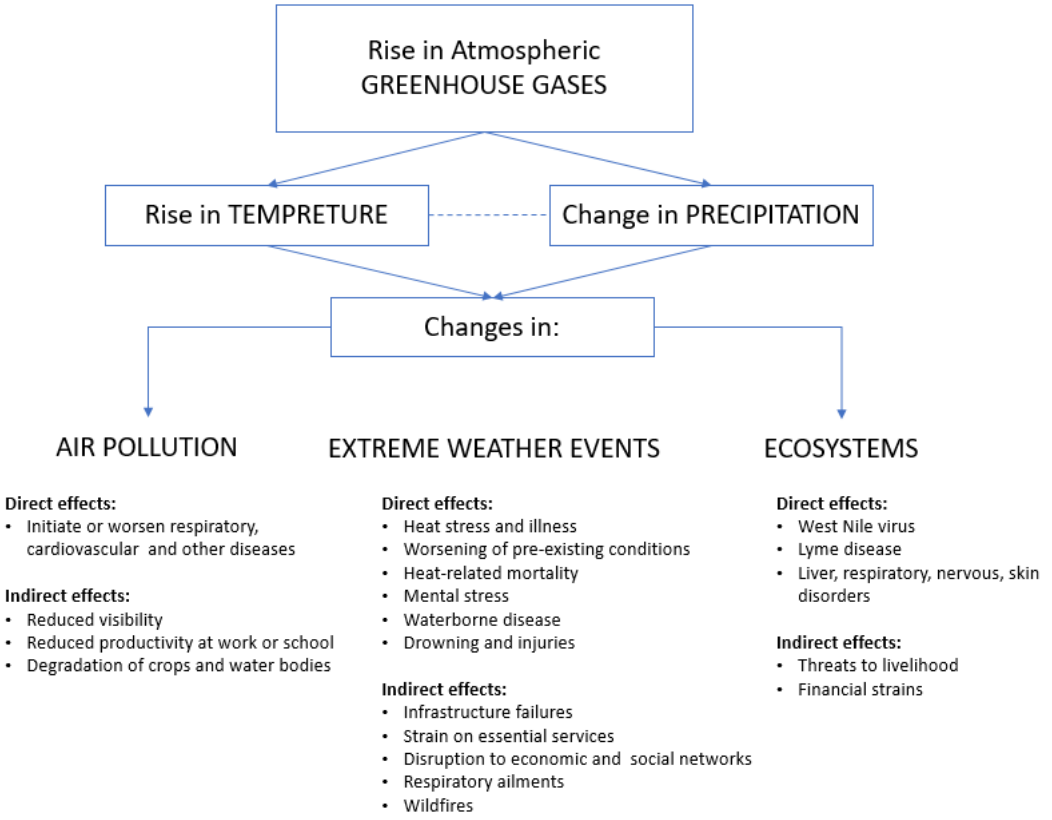

Figure 2. Impact of GHG rise on human health and wellbeing (Minnesota Department of Health, 2015).

Increased greenhouse gas emissions result in the raise of ambient temperatures that provoke severe changes in precipitation and a wide range of consequences (Minnesota Department of Health, 2015). In Figure 2 severe weather events include thermal extremes, such as heat

waves, altered frequency and/or intensity of floods, rain and snow storms, drought periods and heavy downpours. The severe conditions in a long run will change ecological systems, negatively impacting energy, agriculture, forestry, water resources and biodiversity of species (Scott et al., 1990). Hunger, shortage of drinkable water, uninhabitable weather will lead to the massive migrations of people, trying to avoid climate-related hazards. Large number of climate refugees will undermine financial and economic stability of developed countries.

Climate change is a global problem that shipping industry should contribute to as least as possible. Therefore, it is essential that port authorities and shipping companies work together not only on the improvement of local air quality, but also on climate change mitigation.

4. Literature Review

4.1 Sustainability in ports

There is a wide range of environmental issues that can be caused by port operations. Researchers in this field explore such environmentally sensitive subjects as air and water pollution (Trozzi et al., 1995; Lucialli, 2007; Liao et al., 2010; Saxe and Larsen, 2004; Grifoll et al., 2011; Bailey et al., 2004; Bailey and Solomon, 2004), contamination of port zone sediments (Buruaem et al., 2012; Buruaem et al., 2013), harm to marine ecosystem and habitats (Iannelli et al., 2012; He and Morrison, 2001), handling ballast water, garbage/port waste production, impact of dredging (Bateman, 1996; Moran, 1991) and noise pollution (Schenone et al., 2014; Khoo and Nguyen, 2011).

Research on sustainable ports has targeted the ports' activities, design and construction (Wooldridge et al., 1999; Rijsenbrij and Wieschemann, 2011). When it comes to the environmental sustainability in harbours, studies have focused on Environmental Management Systems (Kuznetsov, 2014; Mohee et al., 2012; Darbra et al., 2004; Saengsupavanich et al., 2009), Environmental Management Plans (Gupta et al., 2005) for ports and developing new Health, Safety and Environment (HSE) indicators for managing port impacts (Peris-Mora et al., 2005; Puig et al., 2014; Antão et al., 2016; Saengsupavanich et al., 2009). However, the research looking into the adoption of EMS at the ports is very limited and lacks the best practices from ports' experiences. The latest study in this field was conducted in 2007 (Schottli, 2018).

Additionally, some studies focus on strategic management of the ports, observing such subjects as port security (Harrald et al., 2004), sustainable supply chains and maritime operations (Denktas-Sakar and Karatas-Cetin, 2012; Asgari et al., 2015; Martino, 2013; Dinwoodie et al., 2012), green port strategies (Lam and Van de Voorde, 2012) and sustainable development of port and port-cities (Daamen, 2007). Other works draw on ports' policies and practices based on stakeholder participation (Hiranandani, 2014) and observe the influence of innovation on the environmental sustainability of the ports (Acciaro et al., 2014; Martino, 2013).

4.2 Environmental priorities of the ports

The European Sea Ports Organization (ESPO) provides an annual EcoPorts Port Environmental Review, which reveals the top ten environmental priorities of European ports. The table below shows the priorities from the latest review, in which 91 ports participated, compared to the ones of 2013 and 2016 (EcoPorts, 2017).

Priority	2013	2016	2017
1	Air Quality	Air Quality	Air Quality
2	Garbage/Port Waste	Energy Consumption	Energy Consumption
3	Energy Consumption	Noise	Noise
4	Noise	Relationship with local community	Water Quality
5	Ship Waste	Garbage/Port Waste	Dredging: operations
6	Relationship with local community	Ship Waste	Garbage/Port Waste
7	Dredging: operations	Port development (land related)	Port development (land related)
8	Dust	Water Quality	Relationship with local community
9	Port development (land related)	Dust	Ship Waste
10	Water Quality	Dredging: operations	Climate Change

Table 1. Top ten environmental priorities of European Ports (EcoPorts, 2017).

It clearly shows the persistence in giving the first priority to an emission related issue Air Quality. The top three priorities are the same during the last two years and top two priorities are both emission related. There are also some changes in the order of the priorities: in 2017 the Garbage/Port Waste issue does not seem so critical anymore, while Noise pollution has gained its importance. For the first time the ranking included Climate Change as a new

entrant to the top ten priorities. Under EcoPorts review the subject of Climate Change covers energy efficiency, greenhouse gas emissions reduction and adaptation (EcoPorts, 2017).

EcoPorts Environmental Review provides an overview over the tendencies in the port sector. There are vital differences in the physical nature of ports, their operations and, as a result, their environmental priorities. In order to estimate the priorities of a single port, environmental monitoring should be adopted as a fundamental component of environmental management (Wooldridge et al., 1999).

4.3 Environmental performance indicators

The study by Wooldridge et al. identifies various physical and chemical environmental quality indicators vital for determining the nature and level of impacts on the environment and ecosystem. It argues that in order to efficiently manage environmental challenges, first of all, the port should be aware of its environmental performance (Wooldridge et al., 1999). Researchers extensively focus on executing environmental performance indicators for monitoring port's performance. The overview over the most relevant and recent studies can be found in the table below:

(Peris-Mora et al., 2005)	**Study Focus:** Development of a system of sustainable environmental management indicators for sustainable management of port activities **Environmental Impacts:** Air, noise, odour, water, soil pollution, waste creation, resource consumption, alteration of sea floor, coastal habitats and littoral dynamic, impact on landscape, soil occupation **Environmental Performance Indicators:** Air quality (CO, NOx, SO, O, PM10); Atmospheric contaminant emissions: VOCs and particles; Gas emissions with greenhouse effect (CO2, CH4, N2O); Noise pollution; Inner port water quality; Amount and description of accidental spills in inner port waters; Quality of

	spilled waste water; High risk areas for soil pollution; Urban and dangerous waste creation; Creation of sludge from dredging; Efficient water consumption; Efficient fuel consumption; Efficient electric energy consumption; Alteration of sea floor; Soil occupation efficiency; Social image of the port; Number of incidents with environmental repercussions
(Darbra et al., 2004)	**Study Focus:** Providing an overview over the structure and main features of the Self-Diagnosis Method **Environmental Impacts:** Air quality, dredging, dust, energy use, habitat loss, health and safety management, noise, soil contamination, waste management, water quality **Environmental Performance Indicators:** SDM consists of two sections. *Port Profile* Legal status and port operators, port location and port area, port business, main commercial activities and cargo handling, main cargo *Environmental management and procedures* Indicators on environmental policy, management organization and personnel, environmental training, communication, operational management, emergency planning, monitoring and records, review and audit
(Saengsupavanich et al., 2009)	**Study Focus:** Integration of the ISO14001 procedures and port state control to establish environmental performance indicators, specific to industrial ports and estates **Environmental Impacts:** No specified environmental impacts

	Instead indicators cover management aspects: success, awareness, determination, preparedness, policy coverage **Environmental Performance Indicators:** Number of ISO14001-certified factories and ship terminals; Number of complaints; Number of oil/chemical spill incidents; Water quality around the port; Types of parameters monitored in the environmental monitoring program; Environmental impacts managed; Punishments against operators who breach the regulations; Number of staff in environmental division; Number of ships inspected annually; Taxes and subsidies; Environmental expenditure and investment; Emergency plan availability; Frequency and topics of trainings; Knowledge of staff about port state control; Coverage of environmental policy
(Puig et al., 2014)	**Study Focus:** Identification and selection of Environmental Performance Indicators (EPIs) in port areas **Environmental Impacts:** No specified environmental impacts **Environmental Performance Indicators:** *Management Performance* Environmental Management System; Environmental policy, communication, training and awareness, audit, legislation, complaints and budget; Objectives and targets; Environmental monitoring programme; Significant Environmental Aspects; Management organisation and personnel; Emergency planning and response; Other management indicators *Occupational Performance* Resources consumption, Carbon Footprint, Noise, Waste Management, Port development

	Environmental Condition Air quality, Water quality, Soil quality, Sediments quality, Ecosystems and habitats, Odour

Table 2. Overview over environmental performance indicators literature.

As it is seen from the table above, some of the researchers develop environmental performance indicators, e.g. air quality, while others are also focusing on managerial and procedure perspective, e.g. coverage of environmental policy and EMS.

In addition, the research on small recreational ports and the assessment of their environmental performance exists (Kuznetsov et al., 2015; Tselentis, 2008). The study by Kuznetsov et al. includes the development of sustainability management system based on eleven indicators of knowledge criteria and a self-scoring mechanism. Here, most of the indicators bear strategic character, while environmental performance indicators are only two, namely: Environmental Management and Environmental Knowledge and Awareness (Kuznetsov et al., 2015).

There is a lot of research regarding environmental impacts and environmental performance within ports and harbours. As Wooldridge et al. mentioned, the most frequent environment related question asked by port managers is ‘’We know why it should be done, but HOW is this to be achieved?’’ The key to an efficient environmental management of the ports is a realistic and systematic environmental management system, with clear targets, environmental performance indicators and practicable implementation procedures (Wooldridge, 1999).

4.4 EMS tools in ports

Studies widely discuss various EMS tools used by ports (Saengsupavanich et al., 2009; Darbra et al., 2004; Dinwoodie et al., 2012; Wooldridge et al., 1999; Peris-Mora et al., 2005). However, only the study by Darbra et al. has given a comprehensive comparison of EMS tools in the context of their applicability for ports. The most researched EMS tools are Eco-management and audit scheme (EMAS), the ISO 14001 international standard, the Self-Diagnosis Method (SDM) and the Port Environmental Review System (PERS). Dinwoodie

et al. provides an assessment of these EMS tools in a Figure below. This assessment is mainly based on the study by Darbra et al. that explores new methodology to assess environmental management in sea ports (2004).

Initiative	Aims to:	Implementation
Self-diagnosis method (SDM)	Identify environmental risks and establish priorities for action and compliance	Port manager completes a checklist. EcoPorts guidance on benchmarking performance; analysis of strengths, weaknesses, opportunities and threats; strategic advice
Port environmental review system (PERS)	Assist ports to implement an environmental management system (EMS) through developing components within it to raise its effectiveness	Ecoports offer an independent review consisting of guidelines and example documents
ISO 14001	Promote continual improvements by encouraging ports to adopt and implement EMS; assist systematic development of a formalised management process, and evaluate effectiveness of activities, operations, products and services	Continuous monitoring improves understanding and assists risk management, supported by appropriate data collection techniques and record keeping
Eco-management scheme and audit scheme (EMAS)	Promote ongoing improvements	Preparation of an environmental review and statement. See regulation EC1221/2009
Associated British Ports	Identify environmental issues and associated risks; achieve scale economies	Multi-site applications of standardised procedures

Figure 3. Assessment of EMS tools by Dinwoodie et al. (2012).

The study by Darbra et al. argues that both ISO 14001 and EMAS involve relatively complex methodologies and their implementation requires considerable effort and know-how (2004). Here, ISO 14001 and EMAS are approached as the ‘’second level’’ standards, i.e. more applicable for the ports with a certain degree of experience in environmental management.

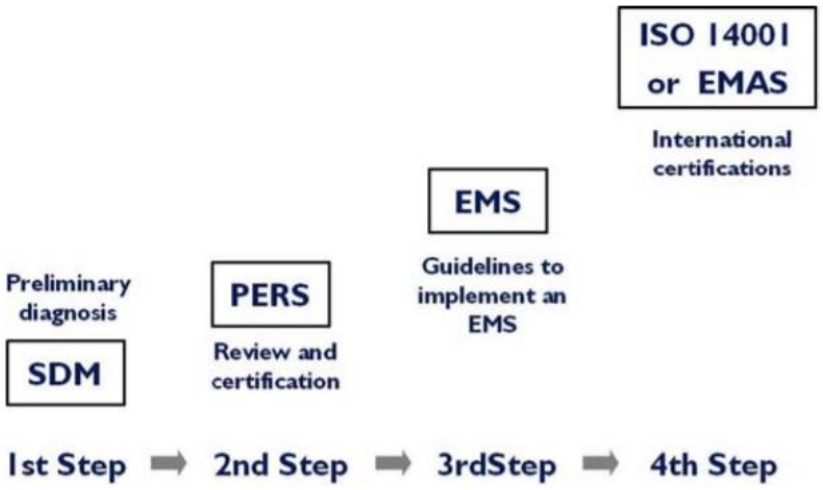

Figure 4. The relationships between EMS tools (Darbra et al., 2004).

As it is seen from the scheme above, SDM and PERS are considered as the ‘‘first level’’ tools, giving inexperienced ports an opportunity to preliminary evaluate their environmental management strategies and detect ways of improving them (Darbra et al., 2004). SDM and PERS are aimed to prepare the ports for the implementation of a higher level and more powerful methodology.

The research exploring the differences between EMS tools at ports is very limited, that is why, the Thesis addresses this gap in the next Chapter.

5. Environmental Sustainability Instruments

5.1 Environmental Management System (EMS)

The Port of Bergen is currently aiming at establishing EMS and certifying it to ISO 14001 standard. To address the current needs of the port, it is essential to not only describe the procedure of implementing a certified EMS in port, but also analyse and compare alternative EMS certifications.

5.1.1 Definition of EMS

Ensuring environmental sustainability is a management issue rather than just a matter of compliance (Waste & Resources Action Programme, 2015). EMS is a framework that helps an organization to achieve its environmental goals through consistent review, evaluation, and improvement of its environmental performance (EPA, 2017). Although implementing and certifying EMS is voluntary, ports that choose to do so, get an opportunity to demonstrate a proactive commitment to managing their environmental impacts and working towards continual environmental improvement (Waste & Resources Action Programme, 2015).

5.1.2 Benefits of EMS implementation for ports

The key benefit of having EMS onboard is an improved environmental performance because of a robust system of environmental performance indicators, allowing the port to consistently quantify, monitor and control its impacts. Additionally, EMS boosts sustainability initiatives, such as waste recycling or reduction of noise from port activities. Additionally, it provides a structured management of environmental risks, ensuring safer operations and working conditions for port employees (Waste & Resources Action Programme, 2015).

Although EMS implementation and certification can be demanding, there is a great chance that long-term benefits will outweigh the costs (Pataki and Crotty, n.d.). Since EMS helps ports to comply with applicable legal requirements and policies as well as ensures staying up-to-date with the upcoming changes in environmental regulations, the cost savings result from the decreased instances of noncompliance and avoidance of fines and prosecutions, which implies less visits from the environmental authorities and lower insurance premiums.

Keeping track of legislation changes allows to have adequate time to address issues, implement changes and ensure compliance. Additional savings arise from a lower record keeping costs due to the improved environmental performance, decreased cost of materials due to the improved efficiency, and decreased waste disposal and treatment costs (Pataki and Crotty, n.d.).

Some benefits have no tangible value but are significant to underline. Improved cooperation and environmental awareness in conjunction with employees' involvement and enhanced morale result in an increased motivation and a strengthened ability to adapt to changing circumstances. On contrary, poor environmental records can quickly worsen public image and damage reputation in the eyes of numerous stakeholders. EMS claims environmental impacts to be a priority, shows stakeholders that the best practices and innovative systems are in place, makes local community, regulators, customers and partners perceive the organization as ethical and credible. Lower operational costs allow to pass cost savings on to the customers, which makes the port more attractive for both potential and current clients. EMS ensures organizational continuous improvement of its sustainable development, helps to control risks, enhances corporate governance and contributes to sound operational and financial performance, and can be considered as a source of competitive advantage (Musser, 2013; Sroufe et al., 1998).

5.1.3 Costs of EMS implementation for ports

The costs can be divided into external and internal ones to better illustrate the nature of an expense and provide the Port of Bergen with an opportunity to evaluate their available resources for a potential implementation of an EMS.

External Costs

If the port decides to get an official certification or conduct a baseline assessment, there are additional fees associated with the work of the third parties. Some certifications require conducting not only certification and recertification audits, but also annual surveillance audits. Training of the personnel can be outsourced to some other company or performed by an external consultant. Ports might also hire an external environmental consultant to do a large portion of the work, then consulting fees are applied.

Internal Costs

One of the major internal costs includes employees' time and effort. Some part of the working hours of the dedicated managers will be spent on information collection, preparation of transition procedures, facilitation of EMS sessions, participation in EMS development, change management processes, awareness and communication sessions, and a personnel training. Employees will also have to dedicate some time for an environmental and EMS training. In case of the absence of dedicated environmental personnel, the ports, having a direct social and/or environmental impact, will most likely have to hire an environmental manager/consultant for an accurate EMS set up and maintenance. Employees' time and effort will be a certain cost for an organization, no matter, if it chooses to implement an in-house EMS or register and get an official certification from the third parties. Additional internal expenses may arise from using technical resources for assessing environmental impacts and improvement options as well as resources for implementing the necessary changes. There might be an opportunity cost due to prioritizing environmental friendly strategic decisions.

Both internal and internal costs highly depend on the type of EMS, which the port is going to implement.

5.1.4 Types of EMS

There are several ways of developing and implementing an EMS strategy within the organization:

1. The port can build its own EMS;
2. It can comply with the requirements of ISO 14001 international standard or EMAS without pursuing formal ISO 4001 certification or EMAS registration;
3. The port gets an ISO 14001 certification or completes EMAS registration;
4. The port uses the only port sector specific environmental management standard PERS after registering for the SDM.

5. The port can certify their EMS under nationally recognized EMS standard, if it exists. For example, for Norwegian ports, it is going to be national environmental certification scheme Eco-lighthouse.

The following chapters will discuss ISO 14001 standard in detail and address the similarities and differences of ISO 14001 as compared to the alternatives.

5.1.5 The ISO 14000 Series

ISO 14000 is a series of internationally recognized standards for structuring an organisation's EMS and managing the environmental performance of the system to stimulate environmental improvements and increase cost savings (Weiß and Bentlage, 2006). The series of standards are managed by the International Organisation for Standardization (ISO) and are presented in Figure 5. The ISO 14000 family of standards provides unified practical instruments suitable for any organizations, willing to fulfil their environmental responsibilities (ISO, 2018).

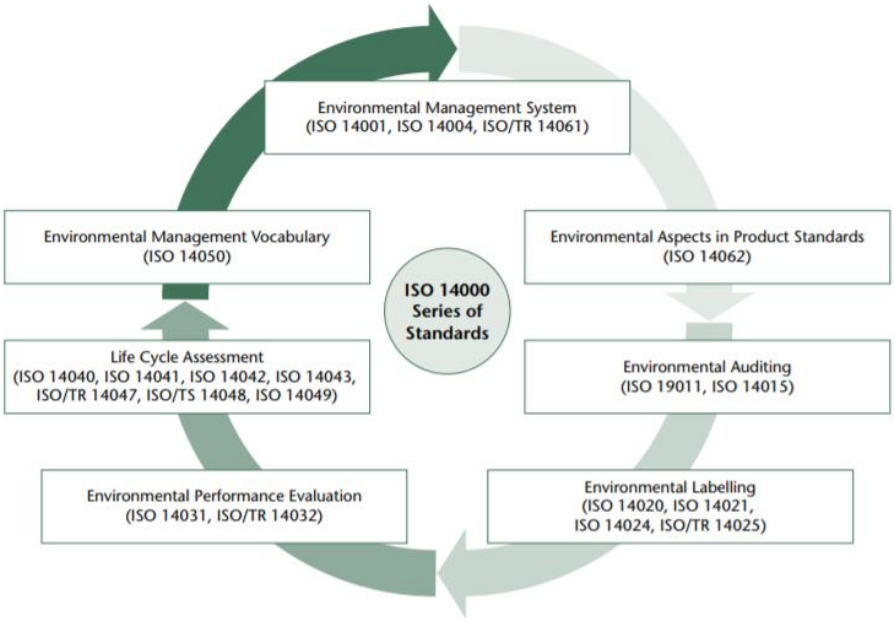

Figure 5. The ISO 14000 Series of Standards (Weiß and Bentlage, 2006).

The latest revision of the ISO 14001 standard was published on September 15th, 2015. New ISO 14001:2015 is designed to reflect the latest trends and ensure its compatibility with

other management system standards (ISO, 2018). It is going to be referred to as an ISO 14001 standard in this Thesis.

5.1.6 ISO 14001

For the last two decades regulators and researchers within strategy, business management, economics, and public policy have been interested in why an increasing number of companies certify their EMS to ISO 14001 standard, although the certification is not obliged by law (King, 2005; Darnall, 2001; Potoski and Prakash, 2005).

One of the reasons of such a proactive behaviour is that the standard has become a market requirement for some industries. For example, in automotive industry such major car manufacturers like Ford Motor Company, who set a requirement for all its suppliers to be ISO 14001-certified already in 2003, became catalysers that pushed market players towards implementing environmental standard (González and Sarkis, 2008; Jeffery, 2003). Additionally, if manufacturers did not require a formal certification and registration, at least they strongly encouraged it: in 2002 General Motors wanted all its suppliers to implement an EMS that conformed to ISO 14001 (Jeffery, 2003).

The number of ISO 14001 certifications continues to grow. As for December 31st, 2016, the total of 346 189 valid certificates was available worldwide - this is eight per cent more compared to the data of 2015 (ISO, 2017). There is a limited information available regarding certified ports and maritime services companies encouraging each other to obtain certification, therefore, it is unlikely that such an implicit requirement exists in the industry. However, according to the EcoPorts Network database, 43 out of 84 ports across 18 European countries are ISO certified, which is more than 50 per cent of the sample (EcoPorts, 2018). Thus, there is an existing tendency for establishing ISO 14001 certified EMS at European harbours and the Port of Bergen serves as an example of a port, planning to follow this tendency.

5.1.7 EMS implementation to ISO 14001 standard

ISO 14001 provides no specific requirements and environmental targets. Therefore, the standard cannot guarantee an improved environmental performance. Only the commitment

of the management and employees can make a positive change and achieve the objectives by using the standard.

Figure 6 illustrates the sequence of establishing EMS under ISO 14001:

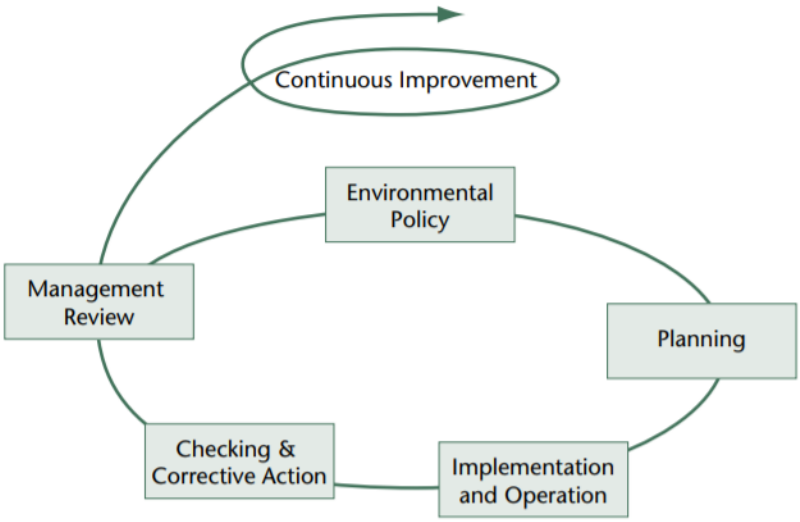

Figure 6. Model of the ISO 14001 environmental management system (Weiß and Bentlage, 2006).

Environmental Policy

First, to obtain the certification, the organization should develop and commit to an environmental policy, which becomes a foundation of EMS.

Planning

To develop, the plan the organisation defines the environmental aspects of its operations, e.g. air or water pollution, biodiversity loss or hazardous waste that can be adverse for the society or/and environment. After the aspects are selected and prioritized, the company sets the objectives and targets for the improvement of environmental performance. To achieve those targets, the organization develops an action plan, which includes designation of responsibilities, scheduling, and definition of concrete steps to meet the targets (Whitelaw, 2004).

Implementation and Operation

The next step is an actual implementation of the plan that also involves structuring and documenting EMS according to the standard, establishing operational and document control systems to keep track of all past operations, impacting environmental aspects and to make sure no relevant information is lost. The standard also requires the organization to implement the precautionary measures for identifying potential accidents and develop the response to them. A key component is the requirement for all the employees, who significantly impact the environment, to undergo the awareness and competence training programme to make sure the targets are communicated fully and appropriately to the staff (Whitelaw, 2004; EPA, 2017).

Checking and Corrective Action

After EMS is already in place the organization steps into a checking phase of monitoring and evaluating its performance against the set targets, maintaining and improving EMS. Organization assesses its environmental performance and in case the targets are not met, the corrective action is taken. The Checking and Corrective Action phase involves monitoring and evaluation, non-conformance recording, corrective and preventive action (Weiß and Bentlage, 2006).

Management Review

Management gets familiar with the results of evaluation to make sure the EMS is optimized and effective; occasionally revises and updates the environmental policy and sets the new targets in a revised plan that is newly implemented. Therefore, the organization follows a repeating cycle of a continuous environmental improvement (EPA, 2017; European Commission, 2017).

5.1.8 Comparison of EMAS and ISO 14001

The EU Eco-Management and Audit Scheme (EMAS) is a management instrument developed by the European Commission available for all types of organisations seeking to evaluate, report, and improve their environmental performance (European Commission, 2017). As for April 2018, there are 3 866 organizations and 9 004 sites, which are EMAS certified. Both ISO 14001 and EMAS are voluntary environmental management instruments. Similar to ISO 14001 model, in order to obtain EMAS certification the organization is

required to implement the set of actions, which is described in Appendix 1. The EMS implementation procedure under EMAS is more complex but includes most of the steps that are required for implementing EMS to ISO 14001 standard. In fact, it is possible to ‘’upgrade’’ the ISO 14001 certified organisation to EMAS, according to the European Commission EMAS Factsheet (Appendix 2) (European Commission, 2011; European Commission, 2014). European Commission (EC) admits ISO 14001 to be an integral part of EMAS since 2001, which allowed a large number of ISO-certified organisations to easily obtain an EMAS registration (European Commission, 2011). Although EC emphasizes EMAS to go beyond the requirements of ISO 14001, the main difference between them is the stronger focus of EMAS on external communication strategy, making environmental information more transparent and publicly available through compulsory publications of annual environmental reports and statements (Weiß and Bentlage, 2006; European Commission, 2016; European Commission, 2017).

A significant difference from ISO 14001 is that EMAS is a governmental regulation, not an international standard. It is regulated by the European Parliament and the Council under public law, while ISO 14001 has no legal basis (Weiß and Bentlage, 2006). Although both schemes are voluntary, ISO 14001 is an international standard with the worldwide availability, while only organisations operating in the EU and EEA can take part in EMAS (European Commission, 2011). This can explain why the number of ISO 14001 certified organizations is much higher than the one of the EMAS registered ones.

Although ISO 14001 is more flexible, popular and wider recognized, EMAS has a major advantage over it – it encourages raising awareness, using the logo (Figure 7) as a green marketing tool that promotes registration and shows an environmental commitment, while ISO 14001 does not provide such an opportunity for the certified organizations (European Commission, 2013; Esakki, 2017). Publicly available environmental statement required by EMAS becomes beneficial, while communicating with stakeholders.

Figure 7. Example of EMAS Logo with a registration number (German EMAS Advisory Board, 2013).

The table below sums up the differences between EMAS and ISO 14001 EMS implementation (Weiß and Bentlage, 2006; European Commission, 2011):

EMAS	**ISO 14001**
Initial environmental review of the organizational performance is required to be preliminary conducted.	No requirement regarding initial environmental review.
Detailed external reporting and a transparent dialog with external stakeholders are required. Environmental policy and statement, EMS aspects and detailed environmental performance are required to be published and regularly updated.	The only obligation is a publicly available environmental policy and developed and annually update environmental reviews.
EMAS specifically states the frequency and methodology of internal audits of the EMS and organizational environmental performance.	Internal EMS audits are compulsory, but their frequency and methodology are not specified (ISO 14001 Certification, 2018).
EMAS registration is valid for three years. No external audits are scheduled in the	Certification is valid for three years. Recertification is needed every third year.

period between recertifications (European Commission, 2017).	Surveillance audits are normally run once per year in the two years between recertification audits. Large organizations might be assigned with more frequent surveillance audits (ISO 14001 Certification, 2018).
Strict and complex checking procedures, including required validation of full legal compliance.	Only commitment to comply with applicable legal requirements is necessary. No compliance audit is needed.
High level of involvement and commitment of personnel is compulsory. Training for employees is foreseen, but not required.	To ensure employees' involvement, environmental training programs are required.
Tighter influence and control over contractors' and suppliers' environmental performance is required under EMAS.	ISO 14001 only requires that relevant procedures are communicated to the suppliers and contractors.
The use of EMAS logo after registration is highly encouraged to promote its environmental commitment.	ISO logo for the standards does not exist. ISO logo is not allowed to be used or modified (ISO, 2010).
When registered, an organization gets publicly reachable record in EU EMAS register.	No register is provided.

Table 3. Comparison between EMAS and ISO 14001 EMS implementation.

The fact that EMAS is aiming beyond the ISO 14001 requirements can be perceived both positively and negatively by the companies: the flexibility and generic approach of ISO 14001 signifies the user-friendliness and easier EMS launch, while EMAS is seen to be more strict and costly to implement. Relative flexibility of ISO 14001 EMS implementation can be explained with a non-governmental nature of ISO organization as well as a wider coverage of ISO 14001 standard, which has to be applicable worldwide. On contrary, EMAS as a government regulation needs to ensure that certified organizations comply with all relevant

environmental legislation, targets and trends of the EU and EEA member states, which puts an additional pressure on companies willing to achieve certification (European Commission, 2017).

5.1.9 Eco-lighthouse (Miljøfyrtårn)

Eco-lighthouse Foundation develops and administers Norwegian environmental certification scheme Eco-lighthouse - an environmental management system for public and private companies willing to document their environmental efforts and social responsibility. The scheme intends to raise environmental performance in SMEs and public enterprises. Organizations that meet pre-defined industry criteria are certified as Eco-lighthouses.

Eco-lighthouse is a national scheme, which is not that widely recognized and well known as EMAS and ISO 14001. Further section reveals more information on the scheme approach and foundation history. To gain these insights, the interview with Anna Despard Asgard, a Senior Advisor at Eco-lighthouse was conducted.

About Eco-lighthouse

First Eco-lighthouse activities started as ‘’some kind of a local initiative, bright idea of two or three employees from the municipality of Kristiansand ‘’ - says Anna Despard Asgard, a Senior Advisor at Miljøfyrtårn. The municipality was contacted by a local businessman, who had become concerned about the environment, improved environmental issues like waste disposal and established a Health Safety Environment system in his company and requested the municipality of Kristiansand: ‘’ I […] improved my environmental profile, worked hard to make my business eco-friendly, now I would like to get some proof for what I have done. ‘’ As a result, the first Eco-Lighthouse diploma was assigned in 1997. Since then, when business becomes an Eco-lighthouse, it gets a permanent diploma as a decorative element and an Eco-lighthouse certificate that is valid for three years. By 2003 the initiative has grown into the formal non-for-profit Eco-lighthouse Foundation independent from the municipality.

Figure 8. Eco-lighthouse logo.

In 2011 the number of certificates started to increase steeply due to the introduction of Eco-lighthouse web portal, accessible by all certified enterprises, certifiers, contact people, municipalities, Eco-lighthouse consultants, etc. The web portal is a communication tool, allowing foundation to track the certificates, certified enterprises' activities and expiry dates of the certifications. This is also the place for climate environmental reporting, information and documentation on certification and recertification storage. At the same time, the portal provides no opportunity for the certified enterprises to create a network, communicate, share their knowledge and experience, and this is, as Anna Despard Asgard admitted herself, something Eco-lighthouse might need to look into.

The other reason for the increase in the number of certificates was an introduction of the head office model. Anna Despard Asgard: '' The key principle is that each location should have only one certificate: if you have ten shops, then each shop should have one certificate. […] Then we introduced new rules in 2011-2012: if the organization is very centralized, then a lot of the criteria are being fulfilled at the head office, not in other locations, so we verify the criteria fulfilled in the head office and we do not have to spend time checking them in other locations.'' New approach made the scheme more organized and applicable for large organizations and municipalities.

Way Forward

Anna Despard Asgard mentioned that the foundation is actively looking to achieve an international recognition of the scheme to enable it to compete with the global certifications and standards. Eco-lighthouse scheme has already gained some recognition. In 2000 Eco-lighthouse won Best Social Innovation award from the British Institute for Social Invention in London. In 2001 it was awarded with a Hederspris at the Synergi 21 conference in Stavanger. Lately, the scheme has become recognized by EU as an environmental

management system: ‘’ We are the first recognized organization apart from EMAS. This allows Eco-Lighthouse certified enterprises to bid on a par with ISO 14001 and EMAS certified companies in Europe.’’ – says Anna Despard Asgard.

5.1.10 Comparison of Eco-lighthouse and ISO 14001

Eco-lighthouse is a national scheme with a less recognition as compared to ISO 14001 international standard. However, there are several environmental certifications used in Norway: ISO 14001, EMAS, Eco-lighthouse and Nordic Swan (ecolabel) and out of them Eco-lighthouse certification scheme is Norway’s most widely used (Eco-lighthouse, 2018). Today 5 583 businesses in Norway are certified as Eco-lighthouses. One of the reasons for it is the scheme’s applicability to both large organizations and SMEs, while ISO 14001 is not always convenient and affordable for organizations of all the sizes.

If an enterprise wants to become an Eco-Lighthouse, it is required to hire an external Eco-Lighthouse consultant, who helps to identify the main environmental impacts of the organization and set an EMS. The enterprise will need Eco-lighthouse consultant only for the first certification and not for the following recertifications. However, some enterprises hire a consultant again for a short period of time to check, whether all criteria are fulfilled, before certifier comes. Alternatively, large organizations might choose to train their employee at Stiftelsen Miljøfyrtårn to always have an internal competent source in-house. There is no such a requirement to implement an EMS to ISO 14001 standard.

As it was mentioned earlier, ISO 14001 has no legal basis, while to get certified with Eco-lighthouse the enterprise must demonstrate and meet both the regulatory requirements and criteria imposed by the Eco-Lighthouse certification. However, as Anna Despard Asgard is pointing out: ‘’Our criteria are supposed to be well formulated and understandable for everyone. A lot of the criteria are based on legal requirements, but then we take the legal one and translate it into ‘’understandable Norwegian’’. Therefore, there is no additional need to meet governmental legislation, if the Eco-lighthouse requirements and fulfilled.

Eco-lighthouse requires the fulfilment of basic block of general criteria, which are common for all industries (Eco-lighthouse, 2017). This includes developing EMS, integrated into the HSE or internal control system (that the enterprise must have anyway). On contrary, EMS to

ISO 14001 standard is an independent initiative, separately documented with the references to all relevant subdocuments.

After providing organizations with common criteria Eco-lighthouse follows an industry-oriented approach. Industry specific criteria have been developed in close cooperation with the companies (Eco-Lighthouse, 2009). Therefore, Port Authority Criteria covering environmental, health and safety legislation, energy use, emissions and set more realistic goals specifically for ports in Norway. Also, it might be needed to combine the requirements from different industries: ‘’… if you are a hotel, for example, you fill in the criteria for a hotel, if you have a restaurant on the ground floor of your hotel, you also add the restaurant criteria to your hotel criteria.’’ – says Anna Despard Asgard. Meanwhile, ISO 14001 has industry independent criteria and relies on companies’ self-assessment, giving them flexibility to build their own action plan based on the desirable level of environmental performance. Industry specific criteria are the core difference of Eco-lighthouse from ISO 14001 and EMAS, reveals the interview.

By now Eco-lighthouse has developed customized requirements for over 70 different industries (Eco-Lighthouse, 2018). The certificate is awarded by an independent appraisal done by a certifier, who is assigned by the municipality of business location. All the certifiers must be approved by Stiftelsen Miljøfyrtårn. At the same time, ISO 14001 certifying body comes from an accredited certification company, which is not directly linked to the governmental authorities.

Both instruments oblige companies to demonstrate their environmental improvements. While Eco-lighthouse requires certified companies to submit annual climate and environmental report to the Eco-lighthouse web portal. The report should include the performance regarding environmental indicators of industry specific requirements, the progress and already implemented measures as well as an action plan for the next year. ISO 14001 does not require publishing annual environmental reports from the certified companies. Instead, they should develop and annually update environmental reviews.

Both ISO 14001 and Eco-lighthouse certifications are valid for three years, after that the organization needs to be recertified. Additionally, ISO 14001 surveillance audits are assigned by the accredited certification body, which is not the case with Eco-lighthouse.

Eco-lighthouse certifiers are licenced, not accredited, as it is the case with ISO 14001. Accreditation is a time consuming and costly process, which leads to the increase of prices for the accredited agencies services. Eco-lighthouse excludes external audits in-between re-certifications and, therefore, decrease the overall cost of being Eco-lighthouse.

5.1.11 EcoPorts tools

EcoPorts is a leading environmental initiative directly associated with the port sector in Europe. It was set by a number of proactive ports in 1997 and since 2011 it has been incorporated into the European Sea Ports Organisation (ESPO), the representative body of the port authorities, port associations and port administrations of the seaports (member states) of the EU and Norway (ESPO, 2018).

The aim of EcoPorts is ‘’to increase awareness about environmental challenges, deliver compliance with legislation and demonstrate a high standard of environmental management’’ (EcoPorts, n.d.).

EcoPorts Network

The EcoPort’s network is the organizational driving force that improves and protects the environment through cooperation and knowledge sharing between the ports. Sotiris Raptis - EcoPorts Coordinator and Senior Policy Advisor for Environment & Safety at ESPO admits that the network is a good mechanism of searching information and best practices among the ports of different size and geographical location. According to the annual environmental review, most of the large European ports are the members of the EcoPorts, which is essential, as large ports have resources and the capacity to deal with environmental issues and implement innovative practices (EcoPorts, 2017). The network facilitates the flow of information also to the smaller ports, enabling them to see what larger ports do and implement it in their businesses.

Figure 9. EcoPorts Statistics (EcoPorts, 2018).

EcoPorts network provides its members with two tools: Self-Diagnosis Method (SDM) and Port Environmental Review System (PERS). Those tools are voluntary and, as Sotiris Raptis emphasised in the interview, active participation of the members in EcoPorts network, sharing knowledge and experience with each other is the first priority for EcoPorts. This way EcoPorts can efficiently communicate the concerns and priorities of European ports to the authorities and public: the basis of the annual environmental report is the top ten environmental priorities of the port based on the answers of the member ports (EcoPorts, 2016).

Self-Diagnosis Method (SDM)

To join the network, port has to get registered on the EcoPorts website and complete an SDM Checklist of 206 questions. **SDM Checklist** is an environmental checklist that allows the port authority to identify the main environmental challenges and risks in port. Once the questionnaire is completed, the member port gets an access to the SDM Comparison, SDM Review and Port Environmental Review System (PERS). **SDM Comparison** is an option to apply for a comparison of the port's SDM score with the sector's benchmark of performance, which is based on aggregate average data provided by EcoPorts members. **SDM Review** allows port to apply for an expert's advice and customized recommendations on how to improve port's environmental performance. The expert will run a gap analysis regarding the established environmental management standards and a SWOT analysis. Sotiris Raptis calls SDM a wake-up call, which shows the strengths and weaknesses of the ports on their way to obtain PERS.

A completed SDM is valid for a period of two years.

Port Environmental Review System (PERS)

The **Port Environmental Review System** (PERS) is the only available port sector specific environmental management standard (EcoPorts, 2018). EcoPorts claims PERS to incorporate the main requirements of recognised environmental management standards and also take into account specificities of the ports. Sotiris Raptis stated that one of the main objectives of PERS is to prepare the ground for obtaining ISO 14001 and EMAS certification, although these certificates do not consider special characteristics of a port sector. For example, PERS

looks at the activities that are directly linked to the port operations, but also covers the activities of businesses located in the port territory, illustrating that the port authority is indirectly responsible for their decisions as a land owner. Therefore, as a part of PERS assessment, the port authority has to report what could be done regarding an environmental performance of other industries located in the port area.

PERS builds upon the policy recommendations of ESPO and gives ports clear objectives to aim for (EcoPorts, 2018). The certification is valid for a period of two years. PERS assessment and certification are independently reviewed by the third certified party Lloyd's Register Quality Assurance (LRQA, 2018).

5.2 Environmental Policy

Environmental policy is a statement by the organization of its intentions and principles in relation to its overall environmental performance, which provides a framework for action and for setting its environmental objectives and targets (ISO, 2015).

Existence of an Environmental Policy established within an organization demonstrates that the environmental values are considered in organizational decision making. Unfortunately, this is not always the case due to the several reasons. First, environmental effects are economic externalities and polluters do not bear the consequences of their actions as the adverse effects occur globally or/and in the future. Second, natural resources are common goods that are easily accessible and, therefore, under-priced. When individuals use common goods in the pursuit of personal gain, neglecting the well-being of society, the tragedy of the commons occurs. In order to avoid this economic issue, organizations should act sustainably and make responsible decisions. Environmental policy demonstrates organizational intention to exclude opportunistic behaviour through acting ethically, considering the limitations of common resources and aiming to decrease the negative effects of their activities.

5.3 Sustainability Reporting

The times, when sustainability disclosure was the prerogative of a few remarkably sustainable and CSR-oriented organizations, have irretrievably passed. Despite the

shareholder primacy view discussed by Milton Friedman in his study on social responsibility of business, nowadays business of business is no longer cultivated around increasing profits (2007). According to the conflicting stakeholder theory of R. Edward Freeman, modern organization has the obligations not only to its shareholders, but to all its stakeholders (Stieb, 2009). Today sustainable disclosure in light of an open dialog with the public is a crucial element in succeeding in the long term and the best practice adopted by the companies worldwide. No doubt that sustainable reporting has gained a foothold in a modern business environment (EY, 2016).

5.3.1 Seven core subjects of sustainability reporting

Notwithstanding the primary focus of environmental sustainability in this paper, when it comes to sustainability reporting, it is essential to focus on all aspects of the CSR reports. ISO 26000 standard providing the guidance on social responsibility for organizations, defines seven core subjects of CSR that the organizations should focus on. Those subjects are often discussed in sustainability reports of the companies (Port of Gothenburg, 2018).

1. **Organizational Governance**

Organizational governance is a core function of all kinds of organizations as it serves as the framework for decision making within the organization. It is the system by which an organization makes and implements decisions to achieve its objectives. In the context of social responsibility, organizational governance is the most important factor in enabling an organization to take responsibility for the impacts of its decisions and actions and to integrate social responsibility into the organizational culture (ISO, 2007; ISO, 2014).

Organizational governance can include both formal mechanisms based on defined governance procedures and informal mechanisms that are strongly associated with the organizational culture and values, often influenced by the leaders of the organization.

According to ISO 26000, organizational governance is both a core subject on which organizations should act and a means of increasing the organization's ability to behave in a socially responsible manner with regard to the other core subjects (Fethallah et al., 2016).

2. **Human Rights**

The second core subject is based on the Universal Declaration of Human Rights, which provides the basis for internationally recognized human rights law (United Nations, 1948). ISO 26000 requires an organization to have the responsibility to respect and support human rights, including within its sphere of influence and through the collaboration with stakeholders. The collaboration with a partner that is known to violate human rights is a complicity and breaks human rights law. ISO 26000 suggests the organizations to consider possible human rights violations by any business partners along their value chains and terminate any collaboration in case such a violation occurs (ISO, 2007).

Among the fundamental human rights, there is a right to work, which must be respected by any organization. The international human rights law is dealing with the areas, according to which organizations must align their activities (ISO, 2007):

- equal opportunities and non-discrimination,
- measures to prevent and eliminate torture and other cruel, inhuman or degrading treatment or punishment,
- the freedom of association and collective bargaining,
- elimination of forced labour,
- elimination of child labour,
- protection of migrant workers and their families,
- rights of persons with disabilities.

3. **Labour Practices**

Secure employment is a cornerstone of living standards improvement, while meaningful and productive work is a vital aspect in human development. The absence of these factors leads to the wide range of social problems. The creation of jobs and wages are the organization's crucial economic and social contributions. To provide a high-quality working experience and improved living standards of the workers and their families, the organization should act upon

socially responsible labour practices that are essential to social justice, stability and peace. Those labour practices include (ISO, 2007; ISO, 2014):

- the recruitment and promotion of workers;
- disciplinary and grievance procedures;
- the transfer and relocation of workers;
- termination of employment;
- training and skills development;
- health, safety and industrial hygiene;
- any policy or practice affecting conditions of work, in particular working time and remuneration.

Discussing the impact of labour practices, the ISO 26000 refers to the International Labour Organization (ILO) established for setting global labour standards. Additional ILO labour practices include the recognition of worker organizations, participation of both workers and employer organizations in collective bargaining, social dialogue and tripartite consultation to address social issues related to employment (ISO 2007).

4. **The Environment**

Environmental and social responsibility is the central focus of this paper. Organizations are constantly making irretrievable environmental changes that lead to the wide range of environmental challenges. In order to contribute to mitigation of these challenges, ISO 26000 requires organizations to respect and promote the following environmental principles (ISO 2007):

- **Environmental responsibility.** The organization should take responsibility for its environmental impacts and aims to improve both its environmental performance as well as the performance of others within its sphere of influence.

- **Precautionary approach.** The organization should follow the precautionary principle: the absence of full scientific certainty about the risk of damage to the

environment and human health cannot be used as an excuse for postponing cost-effective measures to prevent this damage. Cost-effectiveness should be considered in the long-term perspective.

- **Environmental risk management.** The organization should launch programs based on the environmental risk and sustainability approach, evaluating, avoiding, decreasing and mitigating environmental risks and impacts from its actions. Additionally, the emergency response procedures should be developed to reduce and mitigate environmental, health and safety impact caused by accidents. The awareness-raising activities should be implemented to inform the authorities and local community about environmental incidents.

- **Polluter pays principle.** The organization is to bear the cost of pollution caused by its activities to prevent damage to human health and environment. The cooperation of organizations, joining forces in coping with costs of major environmental incidents, is possible.

5. **Fair Operating Practices**

Fair operating practices focus on the ethical conduct of an organization's relationships with its stakeholders.

The organization should demonstrate **an anti-corruption behaviour**, implementing anti-corruption practices; identifying and avoiding any risk of corruption and supporting and training employees to counter corruption and bribery.

The organization can be politically involved to encourage the development of public policies that benefit society at large. However, it should demonstrate **a responsible political involvement**, being transparent about lobbying, political contributions, political involvement and potential conflicts of interest.

Organization should promote **fair competition**, complying with competition laws and regulations, cooperating with appropriate authorities, increasing employee awareness, preventing anti-competitive behaviour such as taking advantage of social conditions (e.g., poverty) to gain competitive advantage.

The organization should **promote social responsibility in its value chain**, incorporating ethical, social, environmental and gender equality requirements into purchasing, distribution and contracting practices as well as monitoring partner's practices to avoid compromising organization's own commitment.

Organization should demonstrate **the respect for intellectual and physical property rights** and traditional knowledge (ISO 2007).

6. **Consumer issues**

This core subject deals with the obligations the organization has towards its customers and aims at minimizing risks in the use of the services and products provided to the consumers. These obligations include educating consumers about the product/service, eliminating misleading, unfair or unclear marketing information and contractual processes, promoting sustainable consumption, protecting health and safety as well as data and privacy of the consumers. ISO 26000 encourages the companies to develop products and services accessible for all consumers, including vulnerable and disadvantaged ones (ISO 2007).

7. **Community Involvement and Development**

Businesses do not operate in a vacuum. Organization should consider itself as a part of the community it is operating in. Community involvement and community development are indispensable elements of sustainable development (ISO, 2014).

The following specific principles are applicable to community involvement and development. According to ISO 26000, an organization should demonstrate sustainable community involvement through the following principles (ISO, 2014):

- recognition and taking into the account the rights of community members to make decisions in relation to their community
- recognition and considering unique characteristics (e.g., culture, religion, traditions and history) of the community of company’s operation
- recognition of the value of working in collaboration with community, getting involved into experience, resources and efforts sharing

The seven core subjects within the sustainability reports and environmental reviews of researched harbours are discussed in Chapter 6.2.3.

5.3.2 Relationship between CSR, sustainability disclosure and financial performance

The moral evaluation of CSR actions, as well as the motivations, consequences and characteristics of those actions, can have various root causes and studied within the confines of normative ethical theories. Disregarding, whether the profit increase is a main motive behind the implementation of a CSR practice, it can become an outcome of such a strategic decision. According to the Caroline Flammer's study on correlation between CSR shareholder proposals and financial performance at approximately 6 000 companies, the adoption of close call CSR proposals leads to a significant increase in shareholder value by 1,77 per cent (Flammer, 2015). In light of the resource-based view, this finding makes CSR a valuable resource.

Sustainability reporting, in its turn, is an illustration and communication of those CSR proposals and initiatives that had a go decision within an organization to the public. There are a few evidential studies proving beneficial effect of the transparency created by sustainability reporting on the performance of the company. A 2009 meta-analysis of 251 studies of the relationship between corporate social and financial performance indicated the positive effect of CSR on CFP and declared that there is a high chance that organizations might prosper through intensively communicating their CSR achievements. The research also focused on transparent CSR reporting of the companies and revealed the positive market reactions to it (Margolis, 2011). Positive market reactions to environmental, social, and governance engagements were also documented in American public companies within an "Active Ownership" finance study. Moreover, the study indicated a positive abnormal return of an average of 4,4 per cent a year as well as the improvements in activists' operating performance, profitability, efficiency, shareholding, and governance as a result of successful CSR engagements (Dimson et al., 2012). Not only the transparency as it is, but also the quality of environmental disclosure should be considered as a new factor influencing the value of sustainable firms. According to the research by Plumlee et al., the companies with a higher quality of voluntary environmental disclosure face the increased cash flows (2015).

Recent research, investigating the relationship between sustainability reporting and firm value based on listed companies in Singapore, has indicated that sustainability reporting is positively related to firm's market values notwithstanding the sector or firm status such as government-linked companies and family businesses (Loh, 2017).

5.3.3 Relationship between CSR, sustainability disclosure and access to capital

Socially responsible investment (SRI) is an approach to investment that aims to account for environmental, social, governance (ESG) and ethical factors, driven by a need for a superior risk management and sustainability of long-term returns (Scholtens, 2014). Although there is no methodology to assess responsible investing, Eurosif has provided investors with seven SRI strategies, which include investing in themes or assets linked to the sustainability development, weighting best-performing investments based on ESG criteria, investing into engaged in and voting on sustainability matters companies, investing into organizations and funds generating social environmental impact apart from the financial return, integration of ESG criteria to the financial analysis and assessment (Eurosif, 2016). These strategies were created in 2012 to assist investors in making an SRI and transparent companies in need for funding. The popularity of the SRI strategies continues to grow worldwide and the ESG integration is the second fastest growing strategy as for 2016 (Bloomberg, 2016). Increasing interest in SRI and ESG criteria from investor's side implies that more transparent and CSR engaged companies face lower capital constraints and, therefore, have a wider open door to new sources of capital. This hypothesis was supported within a research by Cheng et al., which documented that the firms with a superior CSR performance are better positioned to obtain financing in the capital markets. High transparency levels decrease informational asymmetries between the CSR reporting company and investors, which helps the company to convince investors that it is a competitive and low-risk investment option (Cheng et al., 2011). superior stakeholder engagement enhances the revenue or profit generating potential of the firm through the higher quality of relationships with customers, business partners and among employees.

5.3.4 Other influence of CSR and sustainability

Strategic view of CSR considers CSR programme as a differentiation strategy, which primarily purpose is standing out from the competition and raising company's profitability (Rangan et al., 2012). Communicating good deeds create a positive reputation of a general firm quality and increase the consumer's willingness to pay in competitive markets. The research has distinguished that in a highly competitive market environment, market players are more socially responsible and tend to initiate more types of CSR programmes as they exploit strategic CSR to positively differentiate themselves (Fernandez-Kranz and Santaló, 2010). Positive reputation is closely connected with the level of customer trust and loyalty, which can have a direct and profound effect on a company's bottom line (Raman et al., 2012). Therefore, reputation is vital for the survival of a business.

Issued reports are the means of interaction with stakeholders, local and global communities. In highly competitive markets, communicating organization's sustainability commitments increases company's performance, reduces negative social influence such as consumer boycotts, and benefits society at large (Fernandez-Kranz and Santaló, 2010).

Developing CSR strategy, establishing EMS, participating in joint sustainability initiatives as well as collecting information about sustainability measures and constructing CSR report can motivate the company to take a fresh look at the long-held practices, create a new approach towards waste management and share this in-house know-how with the partners. Sustainability reporting can lead to discovering the insights into potential changes in business (EY, 2016). CSR and Sustainability disclosure can initiate innovation, modernize the processes and, as a result, reduce environmental impact.

Reporting can be very influential not only towards external stakeholders, but it can also have a direct effect on employee's satisfaction and productivity. Sustainability achievements of the organization communicated through the CSR reports to the employees might provide an additional meaning and value to their job. Several experiments run by psychologists and behavioural economists have proven that the employees, whose occupations are traditionally regarded as having some meaningful purpose, large and ''noble'' goal, derive more satisfaction from a feeling that their job brings value to the society and environment, which leads to the lower reservation wages (Ariely et al., 2008). Apart from inspiring current

employees, sustainability disclosure can become a decisive factor in a competitive job market. Organization's reputation for responsible transparent disclosure can attract new talents and assist recruiting efforts.

Apart from inspiring current employees, sustainability disclosure can become a decisive factor in a competitive job market. Organization's reputation for responsible transparent disclosure can attract new talents and assist recruiting efforts (Crifo and Forget, 2012). In fact, more responsible, "green" organizations can recruit motivated employees with teamwork values, which will secure organizational survival and long-term performance (Brekke and Nyborg, 2005).

6. Findings

6.1 Instruments for Communicating Environmental Ambitions

To identify the best practices and provide essential recommendations for the Port of Bergen authority, an in-depth assessment of the various instruments adopted by a significant number of selected ports is necessary. The following table contains the research results across seven sub-dimensional performance indicators for communicating environmental ambitions based on the interviews with the representatives of the selected ports, information contained in the ports' annual and sustainability reports and the results of a survey, the port representatives filled in.

	Instruments for Communicating Environmental Ambitions						
Port	*Port's vision and/or mission is linked to environmental sustainability*	*Environmental Policy is available to the public*	*Environmental Report/Review is available to the public*	*Existence of designated environmental personnel*	*Existence of Environmental Manager(s)-Specialist(s)*	*Existence of environmental responsibilities of key management personnel*	*Existence of an environmental training program for port employees*
Port of Oslo	Yes	Yes	Yes	Yes	Yes	Yes	No
Port of Bergen	Yes	No	No	Yes	Yes	Yes	No
Port of Trondheim	No	No	Yes	Yes	Yes	Yes	No
Port of Flåm	No vision/mission statement	No	No	Yes	No	Yes	No
Port of Stockholm	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Port of Gothenburg	No	Yes	Yes	Yes	Yes	Yes	No
Copenhagen Malmö Port	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Port of Aalborg	No	Yes	Yes	Yes	Yes	Yes	No
Port of Helsinki	No	No	Yes	Yes	Yes	Yes	No
Port of Hamburg	No	Yes	Yes	Yes	Yes	No	No
Port of Rostock	No	Yes	No	Yes	No	Yes	No
Port of Amsterdam	Yes	No	Yes	Yes	Yes	Yes	Yes
Freeport of Riga	Yes	Yes	Yes	Yes	Yes	Yes	No

Table 4. Instruments for Communicating Environmental Ambitions Performance Indicators.

6.1.1 Port's vision and mission statement

Like businesses, some port authorities formulate and periodically update their vision and mission statements that communicate the port's ambitions regarding the development of port and an intention for scrupulous serving stakeholders needs.

Port's vision can also be used as a tool for stating an environmental ambition of the port to the stakeholders. Apart from including business vision and mission into the annual report, some ports, such as the ports of Stockholm and Gothenburg, choose to come up with the separate statements in their sustainability reports to highlight their long-term goal regarding social and environmental responsibility, e.g. '' Our vision is an efficient operation of the port, contributing to an environmental protection, sustainable society and economy. Our mission is to achieve a 20 per cent reduction of carbon dioxide emissions from shipping within the port's geographical area by 2030.'' *Existence of a vision and/or mission statement linked to an environmental sustainability* is taken as an important performance indicator in this research, influencing successful communication of port's values to the stakeholders.

Twelve ports have developed their vision and/or mission statements, and six of them indicate the environment/sustainability/environmental sustainability as one of the priorities within those statements (Table 4). The vision of the Port of Bergen is: ''Bergen – fremtidsrettet internasjonal miljøhavn'' (Bergen – future-oriented international environmental port) (Bergen og Omland havnevesen, 2009). Although the Port of Trondheim authority admits that its vision was developed for the benefits of society, business and environment, the statement itself has no explicit focus on the social or environmental values, as it is the case with the vision of the Port of Stockholm: ''Ports of Stockholm is the number one Baltic Sea port – a business-promoting and welcoming partner with a focus on sustainability'' (Ports of Stockholm, 2016; Trondheim Port, 2014). The ports, separating their business vision from environmental values, underline the ambition of pursuing economic growth, getting sustainable competitive advantage, increasing value creation, developing state´s largest port, in their statements (Port of Helsinki, 2018; ROSTOCK PORT GmbH, 2018; Hamburg Port Authority, 2018; Port of Gothenburg, 2012). Although, neither ISO 14001, nor EMAS requires the ports to link their vision and mission statements to environmental sustainability, 46 per cent of researched ports use this as an instrument of communicating their core values to the public, demonstrating that sustainability is a high priority for the port's authority.

6.1.2 Environmental policy and report/review are available to the public

As it was discussed in Chapter 5.1.8, to get an official recognition of EMS under EMAS, the port should publish annual environmental reports, statements and intensively communicate environmental performance to the stakeholders. In its turn, ISO 14001 standard requires the port to develop and annually update an environmental review and make an environmental policy publicly available, implying that if anyone from the public requests the environmental policy set by organization, organization must present the policy to them (ISO, 2010). Criteria *Environmental Policy is available to the public* and *Environmental Report/Review is available to the public* check, whether these requirements are fulfilled for an existing or potential EMS certification, and to what degree the port is maintaining the dialog with the public.

Eleven ports have released and published either an environmental policy or a report or both (Table 4). The Port of Bergen, aiming at getting certified to ISO 14001 standard, is one of two ports that have not communicated any of two documents to the public yet. Most of the ISO 14001 certified ports keep their environmental policies available to the public through the port's websites. The representatives of Hamburg, Aalborg and Rostock ports provided environmental policies upon request. Although the Port of Helsinki is ISO 14001 certified, the policy was not provided after repeating requests, which signifies a noncompliance and clearly requires a further investigation by ISO.

6.1.3 Environmental personnel at port

Most of the largest European ports have at least one environmental/sustainability manager, who is ensuring that the port departments comply with both external legislative environmental standards and internal environmental requirements set by the port. He/she creates, implements and monitors environmental strategies and action plans to promote sustainable development in port. Environmental manager communicates the port's strategy, targets and requirements to the departments, monitors and evaluates, whether the superiors, peers and subordinates follow them accordingly. One of the key responsibilities is assessing, where improvements can be made within organization, proposing and implementing these positive changes. Therefore, existence of such an employee, whose primary focus is

corporate social and environmental responsibility, is essential not only for the port's sustainable operation, but also for initiating change management projects, leading implementation of environmental policies and practices, setting and achieving environmental targets beyond those required by legislation.

Existence of a designated environmental personnel is a criterion, identifying whether port's human resources are assigned with any environmental responsibilities. The *Existence of environmental manager(s)-specialist(s)* signifies that the Port has at least one environmental specialist, whose focus is solely environmental sustainability and who could potentially develop and maintain an EMS at port, cooperate with the EMS certifiers, incorporate green practices, initiate cooperation with other ports, issue sustainability review/reports, communicate with the public, etc. The job tittle of an environmental specialist could be one of the following: Environmental Manager, HSE Manager, Environmental Controller, Environmental Strategy Manager, Sustainability and Environmental Manager, CSR Manager, Environmental Coordinator or equivalent. *Existence of environmental responsibilities of key management personnel* criterion defines, whether the environmental responsibilities are assigned to the top management level.

According to the results of a survey and interviews, all ports have got designated staff assigned with environmental responsibilities (Table 4). The Figure below shows the number of employees with environmental responsibilities at the ports, except for the Port of Rostock, where the environmental responsibility is reported as ''decentralized'', i.e. there is no environmental manager at the port and environmental duties are spread among the number of employees, which is unknown by the reporting port representative Andrej Vatterrott (Rostock Port Development and Strategy).

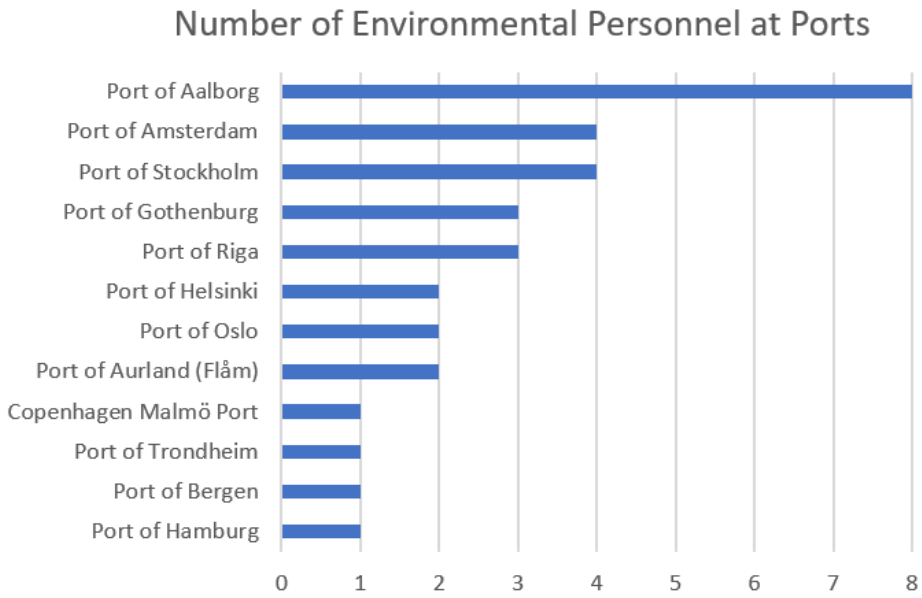

Figure 10. Number of Environmental Personnel at Ports.

The Port of Aalborg has got the highest number of environmental employees followed up by the ports of Amsterdam and Stockholm. The reason for that is following an approach of spreading environmental responsibilities among many employees, while also having one environmental coordinator, who ensures that those responsibilities are fulfilled, as the interview with Environmental Coordinator and Harbor Engineer of the Port of Aalborg, Brian Dalby Rasmussen, revealed.

Although the Port of Flåm is the smallest port of the list with the total number of two employees, they both fulfil environmental duties on daily basis, as it was clarified in the explanatory email of Jon Olav Stedje, Manager Port Operations. The Port of Bergen has got only one environmental employee, who specializes on environmental management and sustainability at port. All ports, except for the ports of Flåm and Rostock, have got at least one environmental manager, whose primary specialization is environmental sustainability (including health and safety) at the port.

In the interview Environmental Manager of Copenhagen Malmö Port Petra König stated that her responsibilities include the maintenance of EMS to ISO 14001 standard, keeping up with permits and legislative policies to ensure port's legal operation, developing future strategy for the port based on the upcoming trends. Petra König admits that she is also an environmental consultant for all the employees: '' I am sort of a hot-line for the colleagues

with all the questions: what we are doing right now - is this okay? We have a customer and he wants this product – is it in line with our permits or do we need to somehow contact environmental authorities? How much fuel consumption do we have per year?'' The variety of responsibilities of the environmental manager clearly shows that to operate sustainably the port of a large size needs to have qualified human resources with the constant focus on decreasing environmental impacts and improving performance.

6.1.4 Internal strategic communication

Unfortunately, the full dedication of port's top management towards the implementation of an action plan or EMS cannot guarantee successful launching. New environmental initiative within an old organization involves the change in working process, behavior of employees and resource management. According to Harvard Business Review, more than 70 per cent of strategic change initiatives fail, because the reason for change is often not transparent enough and poorly communicated to all stakeholders influencing the change process (Beer and Nohria, 2000). It is often the case that only the top management fully understands, why the change is essential and communicates the idea to the middle management, which fails to explain the rationale behind necessary actions to the rest of the workers, who, as a result, often show high degree of resistance to change (Kotter and Schlesinger, 2013).

ISO 14001 requires organizations to communicate environmental policy to all employees, working within or on behalf of the organization (Hammar, 2018). Ideally environmental values stated in the policy should be a part of the port's organizational culture, which could illuminate the resistance to environmental change. Therefore, it is essential to educate employees on the essence of climate change, air and water pollution, waste management, noise pollution, etc.; and teach them the ways of contribution towards solving the world's environmental challenges through their work. Thus, the *Existence of an environmental training program for port employees* is a performance indicator that identifies, whether the port ensures employees' environmental awareness and competence.

Additionally, under ISO 14001 requirements, organization needs to ensure high competence of employees, whose work affects organisational environmental performance; determine training needs associated with the environmental aspects and EMS; where applicable, take actions to acquire the necessary competence; and evaluate the effectiveness of the actions

taken. Applicable actions can include, for example, the provision of training to, the mentoring of, or the re-assignment of currently employed persons; or the hiring or contracting of competent persons (Performance Review Institute, n.d.). Therefore, environmental training would not only boost the competence of existing employees, but also eliminate the need of acquiring new resources to fulfil this requirement.

Only three ports have implemented an environmental training for port's employees (Table 4). Such a low rate correlates with the results of Port Environmental Review, where in 2016 EcoPorts estimated an 11 per cent decrease in the number of ports that have an environmental training program for their employees compared to the estimations of 2013 (EcoPorts, 2016).

The Environmental Manager of Copenhagen Malmö Port Petra König explained the way the port authority organizes an environmental training for all employees in port: '' Twice a year we have a three-day training program. The goal is that everybody within the company should attend at least one of the days. The curriculum of a program is repetitive for all three days (as we cannot take everyone out of production at the same time) and then everybody gets to choose which date they can attend. This is where the management can explain the economic and financial situation in the port, discuss the news, etc. There are different stations with different themes, and the Environment is always one of the themes within a program. I always try to find new topics: it can be our environmental goals or an EMS that we have just updated, changed quite drastically and improved a lot.'' Petra König also underlined that environmental training is performed through not only communication of environmental themes to staff, but also an active participation of employees in decreasing environmental impact of the port: ''… so, employees are quite aware, they come to me and tell me they are not feeling comfortable with something functioning this way or that way, because it is having an environmental impact, they would like to make a change to decrease it. So, there is quite a big awareness, they are very proactive, they have a lot of comments, ideas…''. To facilitate employees' proactive behavior, Petra König reports the efficiency of a workshop training method: ''… at the same time I am out meeting different groups [of employees] at different terminals, looking together at what kind of environmental impacts we have and making workshops together. They can contribute with their own thoughts, and we try to work on it together […], – it makes us think outside the box sometimes.''

Although the port of Aalborg does not provide any environmental training to its employees, its environmental controller Brian Dalby Rasmussen acknowledges the importance of internal communication: ‘’ … we try to promote the culture of doing things smarter, because your workday is a subject for improvement, if you are using one kind of machine, think, how you can use it more efficiently…’’ and interaction with port staff regarding environmental issues: ‘’ There is a short way to my desk, where the ideas are collected and processed. It is my job to take these ideas, either implement them or let them die loudly. […] We are trying to push people to come forward with ideas.’’ The interview reveals an example of an employee’s idea that was successfully implemented at the Port of Aalborg: ‘’… on the way out of the office we put the recycling rubbish bins, which can be used by the drivers without getting off the car. It was a move to fight the problem of truck drivers, throwing the garbage out of the window. One of our employees came up with this idea, when he was on vacation and saw a similar system abroad, he took a picture of it and came straight to the environmental manager. We tested it, and it was a big success, we had to empty the recycling tube twice a week, i.e. it collects a lot of garbage that is no longer out in the environment.’’

6.2 Environmental Sustainability Instruments at Ports

This Chapter executes an analysis of studied ports according to the instruments previously discussed in Chapter 5. The Figure below shows the assessment of the ports’ performance across eight performance indicators.

	Environmental Management System		Environmental Policy			Environmental Sustainability Reporting		
Port	*Existence of certified EMS*	*EcoPorts network membership (SDM Checklist)*	*Existence of an environmental policy*	*Policy aims to improve environmental standards beyond those required under legislation*	*Policy includes the set of environmental goals*	*Existence of a regularly issued environmental sustainability review or report*	*Report defines the focus, objectives and targets for environmental improvement*	*Port reports the results for the last year performance and the fulfillment of environmental agenda*
Port of Oslo	ISO14001	No	Yes	Yes	Yes	Yes	Yes	Yes
Port of Bergen	No	Yes	Yes	Yes	N/A	No	N/A	N/A
Port of Trondheim	Eco-lighthouse	No	Yes	No	N/A	Yes	No	No
Port of Flåm	No	No	Yes	Yes	N/A	No	N/A	N/A
Port of Stockholm	ISO14001	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Port of Gothenburg	ISO14001	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Copenhagen Malmö Port	ISO14001	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Port of Aalborg	ISO14001	No	Yes	Yes	Yes	Yes	No	Yes
Port of Helsinki	ISO14001	Yes	Yes	Yes	N/A	Yes	No	No
Port of Hamburg	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Port of Rostock	ISO14001	No	Yes	No	Yes	No	N/A	N/A
Port of Amsterdam	No	Yes	Yes	Yes	N/A	Yes	Yes	Yes
Freeport of Riga	ISO14001	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5. Environmental Sustainability Instruments Performance Indicators.

6.2.1 Environmental Management System (EMS)

The importance of having an efficient EMS in port has been revealed in detail in Chapter 5.1 of this Thesis.

Existence of certified EMS performance indicator checks, whether the researched ports have established an EMS, which type of EMS was chosen by the port authority for implementation, and what EMS tool the port pursued. As it has been discussed in the literature review, SDM and PERS are perceived as the tools used by the ports as the first steps on their way to obtain an ISO 14001 or EMAS certification, therefore, they were also included into the multiple-choice survey to identify, at what stage the port is on its way towards the potential establishment of an EMS.

EcoPorts network membership

EcoPorts network is intended to provide its members with the best practices and mitigation cases regarding the most sorts of pollution associated with European ports. The network encourages small and large ports to cooperate, share knowledge, learn from each other's

experiences and internal environmental agendas, become a part of mutual projects and initiatives.

Eight researched ports have developed and certified EMS to the internationally recognized standards and the Port of Trondheim got certified its EMS with Eco-lighthouse national scheme (Table 5). As it is seen from the results, certified Nordic ports prefer ISO 14001 standard over EMAS. This trend is adopted not only in the Nordics: according to the EcoPorts Network data, only six ports out of 94 have certified their EMS with EMAS standard, while 49 ports hold an ISO certification (EcoPorts, 2018). The majority of EMAS certified ports from this list have also achieved ISO 14001 and PERS certifications. As for the EcoPorts port members, EMAS is the most popular among Spanish ports (EcoPorts, 2018).

Although the Port of Bergen has not got a certified EMS system, it has completed an SDM Checklist to confirm its current EcoPorts membership along with another seven researched ports. No researched ports have chosen to certify their EMS with a PERS standard. As for now, there are 28 ports certified with PERS across nine countries and there are no Nordic ports among them (EcoPorts, 2018).

Independent networks and cooperation of the ports

Although the Port of Aalborg is no longer a part of EcoPorts Network, its Environmental Controller Brian Dalby Rasmussen states that the port maintains a close cooperation with other ports: ‘’ … we had to establish the black and grey water facilities. We talked to Copenhagen Malmö Port to figure out, how they do it in Copenhagen. We also went to Skagen Havn, because we know, they have just established this kind of facility in port. They had the first two-three cruise vessels discharged at that time. So, we wanted to visit them, because they have got a recent experience in handling this issue. So, we saw […] their equipment, found out the names of the suppliers, etc. We tried to pull out every source of information to settle our own system as good as possible.’’ These examples signify the demand for knowledge sharing and practical value of a ports network. Brian Dalby Rasmussen mentioned the port’s intention to rejoin EcoPorts network in the future.

He also emphasizes the role of collaboration not only with the ports, but also with industrial companies: ‘’Six years ago, we created an industrial network, group of 25 companies, and now we are 170 companies – members of this network. We work a lot to share our practices within this network and inspire other companies to decrease their environmental impact. We are working with partners and local community to spread the word.’’

Copenhagen Malmö Port is a part of Neptunes Project, which involves the cooperation between ports from around the world and sharing the experience of reducing noise pollution. This initiative is discussed in detail in Chapter 6.3.3.

6.2.2 Environmental policy

Both ISO 14001 and EMAS state *the existence of an environmental policy* as a vital requirement to achieve certification. As for PERS: *policy should include the set of environmental goals, objectives or targets* to state the focus of intended environmental improvement and *aim to improve environmental standards beyond those required under legislation,* which has become a motivation behind setting Environmental Policy performance indicator in this research.

All ports reported the existence of either internal or external environmental policy. Apart from the ports of Trondheim and Rostock, the ports’ policies aim to improve environmental performance beyond the legislative requirements (Table 5). ‘’The port aims constantly to enhance the environmental performance. The basis to our operation is set by the national and international legislation, but we constantly keep working to serve our clients better and that often means that we perform better than the legislation [requires].’’ – Aino Rantanen, Quality and Environment Management of the Port of Helsinki. ‘’Yes, legislation is the basis, and we aim to be in the forefront.’’ – Petra König, Copenhagen Malmö Port.

The analysis of all eight publicly available environmental policies allowed to derive the following similarities, serving the basis for the common focus of the ports:

- Reduction of environmental impacts from the port activities;
- Prevention and mitigation of air pollution;
- Energy consumption efficiency;

- Compliance with environmental legislation;
- Efficient use of resources;
- Water pollution mitigation;
- Noise pollution mitigation;
- Waste management.

Additionally, Freeport of Riga, the ports of Gothenburg and Aalborg emphasize in their policies the importance of internal and external communication and demonstrated their willingness to actively collaborate with the customers, suppliers, relevant authorities and other stakeholders to achieve port's environmental ambitions. The Port of Aalborg is intended to cooperate with the customers to find environmental measures that benefit both parties, while the port of Gothenburg aims at consulting and cooperating with the customers, suppliers and other stakeholders to contribute to the reduction of greenhouse gases, noise and local discharges to water and the atmosphere from shipping, port operations, port development and land transportation (Port of Gothenburg, 2012; Aalborg Port, 2017). The Freeport of Riga has admitted focusing on the creation of awareness in the society and among port's business partners of the port's environmental aims and tasks, as well as accomplished tasks in the environment protection area (Freeport of Riga, 2017). Apart from external communication, the Port of Aalborg is to motivate all port employees to take environmental responsibility in their daily work and make proactive environmental efforts (Aalborg Port, 2017).

6.2.3 Environmental sustainability reporting

While environmental policy states an overall official position and attitude towards the community and environment, regularly issued environmental sustainability report or review requires tangibility and accuracy in setting specific targets and deadlines as well as reporting on the status of the previous and ongoing sustainability projects.

Chapter 5.3 reveals the motivation and benefits behind sustainability and environmental reporting. Ten out of thirteen researched *ports regularly issue sustainability or environmental reports/reviews* and seven of them *define the goals, objectives and targets* for

the next year environmental improvement. Additionally, eight ports *report the progress on achieving previous goals and fulfilling environmental agenda* (Table 5).

The diagram below illustrates the focus of the researched reports in regard to the seven core subjects of ISO 26000 standard.

Figure 11. Ports Environmental and Sustainability Reports' Focus.

There is a significant limitation to the reports comparison, since the reports of Oslo and Riga ports are purely focusing on the Environment, disregarding other sustainability subjects. Additionally, the Port of Helsinki and the Copenhagen Malmö Port do not issue separate sustainability reports but incorporate sustainability topics into their annual reports. The port of Aalborg only provides a limited environmental review revealing the key figures regarding energy, diesel, electricity consumption, climate impact, waste management, etc. Sustainability reports of the ports of Stockholm, Gothenburg, Hamburg and Amsterdam discuss all ten subjects as their sustainability reports are developed in accordance with GRI G4 global sustainability reporting guidelines, the most widely used sustainability reporting framework in the world that has a significant overlap and convergence with ISO 26000 standard topics (ISO and GRI, 2014). However, despite the homogeneity of the reports, the Environment is a core subject that all of them pursue.

Community Involvement and Development serves as the second most discussed subject in the reports. Reports reveal the joint projects they have with local community and residents. For example, the Freeport of Riga has an educational cooperation with the schools of the city. The port of Stockholm is looking into bringing social benefits to both citizens and

visitors, regularly carrying out the surveys to find out what people think about the port. The port of Oslo is working towards noise prevention and mitigation in Oslo Kommune, the architecture and the port aesthetics as being perceived as a better neighbor is the port's goal. Although the Copenhagen Malmö Port does not explicitly discuss the community involvement within its report, Petra König states that community dialogue is a vital point of port's sustainability agenda: '' In Copenhagen, before the cruise season starts, we always have a meeting with all the residents in the area to tell them the number of ships coming this year. […] We also listen to the residents. For example, they told us they were very annoyed with a public-address system – with the loud speakers at the vessels. Then we spoke with the captains of cruise ships, and told them not to use loud speakers, when they are outdoors on the ship. However, then there were more complaints saying that they are still using loud speakers and we found out that every time they have a new passenger on the ship, they have to conduct the safety training – and a part of it is being out on a deck and using the loud speaker. Then we come back to the residents, saying that this is a part of the safety routine and they have to do it according to laws, otherwise, they cannot operate. Then residents say: '' Oh, okay, then we know, why.'' This is a very good way of creating acceptance about a certain amount of noise from the ships.''

6.3 Environmental Agenda

In this Thesis organizational environmental agenda is considered as the list of specific environmental sustainability goals set per each quarter or half-year. Ten researched ports report an existence of environmental agenda. Port of Hamburg and Rostock report an absence of quarterly available environmental agenda. No data was gathered about Copenhagen Malmö Port.

6.3.1 Ports' priorities

The port representatives were asked to choose subjects that fall under the environmental agenda and rank those subjects according to the agenda priorities at port. The subjects are correlating with the annual research by EcoPorts, revealing the top ten environmental priorities of European ports that were discussed in Chapter 4.2 in detail (EcoPorts, 2017).

Results of a survey allow to extract the first three priorities of ten researched ports:

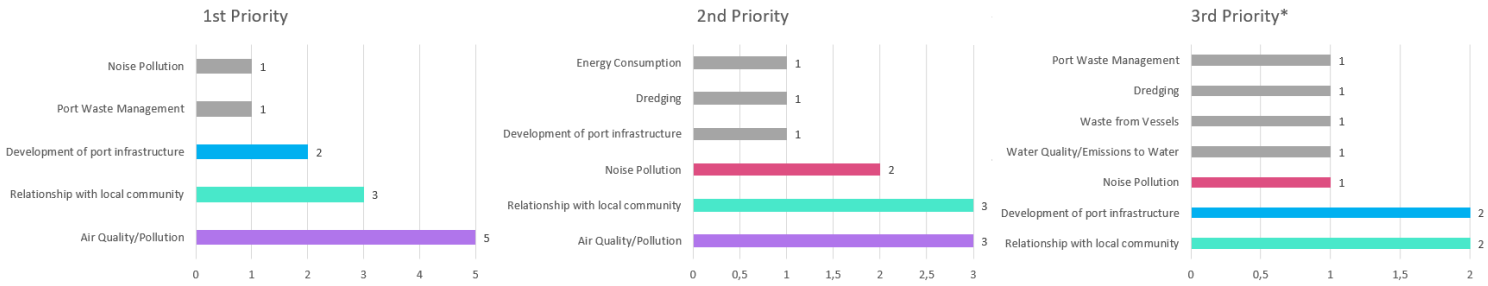

Figure 12. Top three environmental priorities of ten researched ports.

(*) 3rd priority is determined among nine ports

6.3.2 Air quality/pollution

On average, air quality is the first or second priority for eight out of ten researched ports, which is positively correlating with the results of EcoPorts annual review (EcoPorts, 2017). The survey allows a free choice of priorities, meaning that the port representatives could choose several subjects per each priority. Port of Helsinki, Freeport of Riga, Copenhagen Malmö Port refused to reply to this question: as Petra König said, it is impossible to prioritise the subjects that the port is constantly working on and takes all as a first priority.

Monitoring pollutants affecting both climate change and air quality is essential for acknowledging port's impact. According to the survey results, eleven ports out of thirteen carry out air quality environmental monitoring at port. As Chapter 3.1 reveals, air pollution in port areas includes not only the pollution from port activities, but also from vessels at port. Ports are the actors, who can promote and incentivise the eco-friendly practices of maritime transport: "Our goal is to use economic incentives for ships with the lowest environmental footprint in our ports," stated the representative of the Port of Bergen (Port of Oslo, 2017). In June 2017 Bergen Port along with nine Norwegian ports, including the port of Flåm and the Port of Oslo, have initiated the Environmental Port Index (EPI), which will focus on emissions from ships at berth. One of the goals of the EPI is to promote the good work the ships are already doing to reduce their emissions and environmental footprint (Port of Oslo, 2017).

Air Quality in Bergen area

The Figures 13 and 14 illustrate the sources for PM and NOx emissions in Bergen area in 2015.

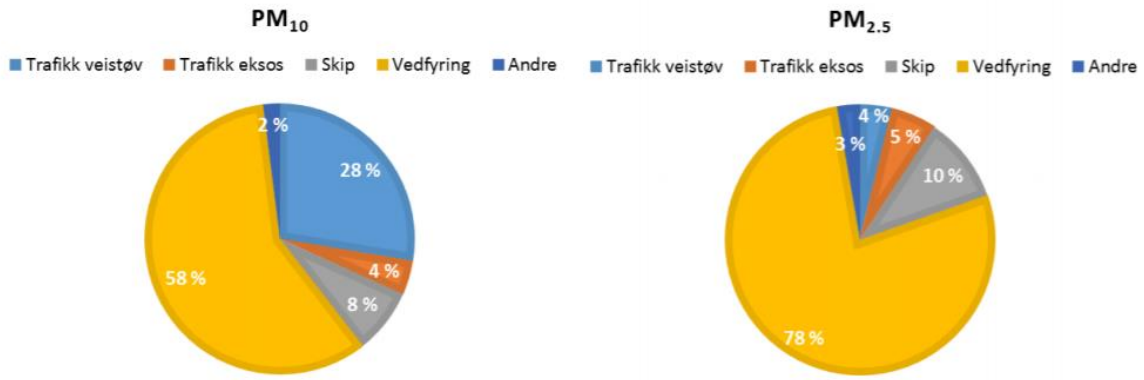

Figure 13. PM10 and PM2.5 emissions sources in Bergen area in 2015 (Høiskar et al., 2017).

As it is seen from Figure 13, the dominant source for PM10 and PM2.5 is fuelwood. Shipping accounts only for eight per cent and ten per cent respectively. This is not the case with NOx:

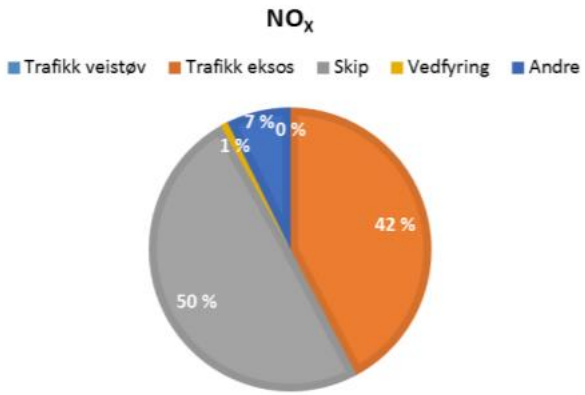

Figure 14. NOx emissions sources in Bergen area in 2015 (Høiskar et al., 2017).

Dominant sources of NOx emissions are shipping as well as exhaust and dust from traffic.

Pollution from Cruise Vessels

As it was discussed in Chapter 3.1, cruise ships emit, while docked in port. In 2017 Bergen Port reached 307 calls, accommodating 534 221 passengers. Additionally, 329 calls are

planned for 2018. The table below illustrates that in 2017 Bergen Port is the busiest cruise ports in this study:

Port of Oslo	101	**Port of Aalborg**	37
Port of Trondheim	116	**Port of Helsinki**	300
Port of Flåm	142	**Port of Hamburg**	150
Port of Stockholm	257	**Port of Rostock**	190
Port of Gothenburg	28	**Port of Amsterdam**	132
Copenhagen Malmö Port	300	**Port of Riga**	39

Table 6. The number of cruise calls per researched port in 2017.

Both the number of calls and the duration at berth matter when estimating environmental impact of the cruise vessels. In Oslo cruise vessels stay at berth for approximately eight hours, while in Helsinki the duration time varies: some cruise vessels stay for approximately four hours, but the average time is from eight to ten hours as for international cruises. In Bergen the cruise vessel stayed in port for up to 15 hours in 2017.

In Oslo Port cruise vessels account for 22 per cent of NOx emissions, while international ferries and cargo ships contribute by 35 per cent and 20 per cent of air NOx pollutants respectively. In Bergen most of calls are scheduled in a tourist season between May and September (Bergen havn, 2018). According to Bellona Environmental Agency, in 2017 the estimation of total carbon dioxide (CO2) emissions generated with cruise ships in Bergen is 21 819 tonnes by burning 7 000 tonnes of fuel, while standby (Edvardsen and Lambrechts, 2017). CO2 is a greenhouse gas emission, contributing to the problem of global warming and climate change. When it comes to the local air quality worsened with the pollutants emitted by cruise vessels, the following estimations have been made: PM10 - 4,82 tonnes; NOx – 334,16 tonnes; SO2 – 68,83 tonnes. Estimated level of emissions from cruise ships in Bergen is equivalent to 13 000 diesel cars, not to mention that the pollution from cruise ships comes on top of the offshore vessels, using the port throughout the year (Edvardsen and Lambrechts, 2017). Although the emissions from cruise ships are significant, they might unevenly affect air quality in various inhabited areas of the city.

Wind Direction

The movements of emissions from harbour area are very dependent on weather conditions and wind direction. The interview with Tobias Wolf-Grosse, researcher at Nansensenteret, reveals that during the summer cruise season with the north or west wind emissions from ships in Bergen harbour will be transported to the inhabited areas near the sea line, which will affect the air quality in these areas. Tobias has been specifically studying the spread and concentration of NOx and PM2.5 emissions in the Bergen centre, focusing on the contributions from ships in Bergen Port. His finding also shows that in most cases, with high air pollution in Bergen city centre, the contributions from ships from Bergen harbour are small as emissions usually get transported out over Byfjorden and become diluted.

However, the research also illustrates that due to a greater variation in large-scale wind direction, alternative weather conditions can occur in summer time. This will lead to the dominant contribution from ships in Bergen harbour to the air pollution in Bergen city centre. The reason for this is significantly higher emissions from each cruise ship compared to the supply ships. At the same time, under such conditions, the total concentrations of NO2 and PM2.5 are significantly lower in contaminated areas than during high-air winter conditions. In winter relative and total proportion of emissions from docked ships in Bergen harbour increases for both NO2 and PM2.5 due to significantly higher energy consumption and emissions of each cruise ship.

Therefore, the research reveals that emissions from ships are not a significant contribution to air pollution in the city compared to the main source – traffic. The only areas subject to the reduced air quality under certain wind direction are Sandviken, Bergenhus, Nordnes, Gyldenpris, Møhlenpris og Laksevåg.

In Oslo wind direction affects the port emissions similarly: ‘’We have the main wind direction from the city towards the port and harbour area into the fjord. The highest NOx emission in Oslo is from the road traffic, which is 82 per cent, while everything from the port, including cruise, ferries, cargo - everything is nine per cent of NOx.’’ – says Heidi Nielson, Environmental Manager at port.

Finnish regulations oblige the port of Helsinki to monitor air quality, therefore, measuring station is established in one of the harbors every second year. It stands there for a whole year, constantly measuring emissions online. Environmental manager Aino Rantanen says: ‘’

We have had quite good results, the air quality in the harbor is normally a lot better than the other parts of the city.‘’ Alike in the port of Bergen, the reason for it is that Helsinki harbor is an open area, where air circulation is quite high. Environmental manager admits that port operations do not constitute the largest portion of city emissions as in Helsinki area there are energy plants, still running on coal.

Onshore Power Supply (OPS)

Even Husby claims that the current situation with OPS is that no party wants to take a first move: ports are waiting for the cruise companies to incorporate connecting points onboard, while vessels are waiting to see how many ports invest into new technology. Heidi Neilson supports this opinion: ‘’ Cruise ships don’t need to have it onboard, until they can use it, while ports don’t have any customers that could use it, so they are not going to build a facility that will cost more than a 100 million NOK without any guarantee that it will be of hand.’’ In Norway it is a discussion of who should start first. The port of Bergen is looking into becoming a pioneer in Norway, installing OPS facility first.

The debate around OPS has been going on for a decade. Petra König agrees that OPS has a huge value, when it comes to the reduction of air pollution from ships at berth. However, the great value comes at a large cost: ‘’ OPS is extremely expensive to install both in ports, but also for the cruise ships.‘’ Vessels need to have an installed equipment enabling to charge in different ports worldwide. Such an equipment is a complex and expensive connection point onboard, which will require removing four or five passenger cabins for machinery. This is a huge investment for the cruise companies topped up with the loss of income from the removed cabins. As for ports, both Even Husby and Petra König admit that vessels have a different design and in order to reach the connection point of each ship the port will need to have a flexible technology on a quay, which can be moved for 200 - 300 meters along the ship. This is a problem for CMP: ‘’ We cannot have the wires lying on the quay, because we are driving around, handling waste and packages.’’

Therefore, there is a lot of issues that need to be solved for an OPS to become widespread. For example, the electricity companies have a problem of supplying so much electricity at one time for just a few hours – this creates a demand peak that is hard to meet. Additionally,

Copenhagen Malmö Port is a private port, which owners will not allow to invest in OPS as it will not have any return for many years ahead. Instead, the electricity companies are the ones that gain profit from this costly investment of ports, cruise companies and municipalities. Therefore, electricity companies can become potential contributors to installing OPS in port through bearing a part of a cost.
One more disadvantage of OPS is that it does not mitigate noise pollution, which is one of the primary focuses of many ports, for example. When the ships are connected to OPS, it does not decrease the noise pollution: ‘’ the ventilation system, the pump station and things onboard are actually the ones that make the noise in port, this is not the engine as it might seem.’’ – says Petra König.

There is only one port in Europe that has an OPS for cruise ships, and this is the port of Hamburg, the home port for AIDA cruises. As Heidi Neilson reports, OPS was a huge investment and the port of Hamburg has not paid for this solution – it was a cooperation between the city and EU funding: ‘’ We have estimated the cost of building OPS to supply two big cruise ships simultaneously – it costs at least around 110 million NOK for a facility that can supply cruise ships. Plus, you need to have a big building in port, which is an additional cost.’’ All in all, Heidi Neilson agrees with Petra König saying that OPS is a poor investment, also because this facility will be seasonally used for four or five months per year only. Additionally, she emphasises that not only for the port of Oslo, but ‘’ … for all the ports that looked into an OPS business case, this is a really poor investment ‘’, unless funded by the state.

Heidi Neilson shares that it takes much time to adjust the smooth work of OPS facility, judging upon the experience of Hamburg Port: ‘’ … they have spent two years trying to get the facility work properly.’’ As managing OPS is more complicated for large ships are of different sizes, lengths, heights. Although the plug is of an international standard, the port still needs the facilities on the quay to enable the connection to all types of the ships.

Interviewed experts agreed on the fact that OPS is not a cost-efficient technology, otherwise, it would have been implemented on a large scale. As the Port of Hamburg communicated to Heidi Neilson: ‘’There is no way we could have done it at home. It is really-really a bad business case.’’ Aino Rantanen claimed that in most cases OPS is a very cost-inefficient

measure. As for the port of Helsinki, the cargo traffic between Helsinki and Tallinn includes a short turnaround time. ‘’ The vessels stay only for an hour or two hours in ports - there is no time to hook up with any OPS, plus I don’t think it is efficient for the engines either, to cool them down for an hour only and then hit them up again.’’ – says Aino Rantanen.

Additionally, Heidi Neilson stresses that it is important what type of emissions the actor is aiming to mitigate: ‘’… when you are talking about air quality and NOx emissions, OPS only reduces when the ship is docked at berth, while the NOx emissions are also high, while the ships are manoeuvring in and out of the quay.‘’ OPS is a relatively new technology, which is effective for mitigating greenhouse gas emissions, such as CO2, while air quality can be improved more effectively with a mature technology – catalyst.

Catalyst

Catalyst can reduce nitrogen oxide emissions (NOx) at sailing, manoeuvring and at berth up to 80 per cent – reveals the research by Tobias Wolf-Grosse. ‘’ If you want to reduce as much NOx emissions as possible in an area, where the ships actually emit NOx, then a catalyst, which is an old technology really, that has been used for years and years, actually has better results.’’ – says Heidi Neilson. According to her experience, catalyst is an efficient solution, which is massively undervalued, as it is considered as an old technology, while OPS is a much more sophisticated and interesting innovation. OPS is preferred by politicians, who mistakenly consider it as a zero-emission mitigation, which is not the case - OPS provides lower NOx emissions, but not zero.

One more problem revealed at the interview is the absence of any records regarding whether vessels coming to Oslo or Bergen have a catalyst installed or an OPS facility. This makes it hard for the ports to find out what technological trends are pursued by shipping companies and what steps ports need to undertake to accommodate those trends. However, Heidi Neilson specifies that according to her experience: ‘’ … quite a few of new ships install catalysts and what they also do is that they keep space for OPS, so it is possible to install at a later stage.’’

6.3.3 Relationship with local community and noise pollution

All in all, the results regarding Air Quality/Pollution correlate with the results of EcoPorts Study on top ten environmental priorities for European ports in 2017, which is not the case with the Relationship with Local Community (Figure 12), which is the second priority of the researched ports.

Interviews reveal that for many researched ports noise pollution is directly related to their relationships with local community. It has already been described that CMP is aiming at establishing close connection with neighbouring inhabitants through collecting complaints, communicating the action plan, informing and reporting the status of the problem, educating on the reasons why the problem cannot be resolved. Additionally, Copenhagen Malmö Port, Port of Hamburg, Stockholm, Gothenburg, Helsinki along with the Port of Amsterdam, Rotterdam, Turku, Vancouver, New South Wales and others are involved into an international project Neptunes, aimed to tackle noise pollution from moored vessels in co-operation with ports from all over the world (Neptunes, n.d.). In the interview Petra König (Copenhagen Malmö Port) reveals more information about the project: ‘’We have a number of complaints - and for larger ports like Rotterdam, Amsterdam this is a real problem – the complaints are about the noise pollution from the people that live close by and what we are doing together is that we are looking at how many complaints we have, the monitoring that we have done, what kind of values we have, do we have any good examples of how these problems have been solved?’’ Joint forces of the port serve a ground for knowledge sharing and result in a strong network between the participating ports.

The Port of Aalborg also admits that they used to face a noise pollution problem: ‘’ Most ships […] have diesel generator running all the time and residents living near port area anticipate the noise levels from the port activities and vessels.’’ Therefore, the port of Aalborg ‘’hides’’ all loud vessels at the industrial quays and not the city quays. This allows the port to have no complaints regarding noise pollution.

The Port of Oslo also invests into keeping its operations as quiet as possible – it has the world’s most silent cranes in the container terminal at Sjursøya. New equipment and routines for handling cargo is an ongoing issue in the Port of Oslo.

6.3.4 Development of port infrastructure

While CMP, the port of Aalborg, Oslo, Rostock and others have already installed sewage reception facilities, the port of Bergen is building them at the moment as required under Annex IV Regulations for the Prevention of Pollution by Sewage from Ships of MARPOL 73/78, which prohibits the discharge of sewage into water (International Maritime Organization, 2004).

The port of Torndheim is installing high voltage power supply for "Hurtigruten" vessels and aiming at investing into the electrical port cranes and am additional high voltage power supply in Orkanger for the special ships, spooling pipes to lay down gas-pipelines at the seabed offshore. As Kurt Kristiansen (HSE and Security Manager at the port of Trondheim) admits, one spooling operation can take three weeks in port and the environmental footprint (CO2/NOx) will be improved, using electricity instead of marine fuel as well as the noise pollution will be reduced.

6.3.5 Projects on environmental agenda

Green Practices in Ports

The diagram bellow shows the distribution of green initiatives practiced at the researched ports.

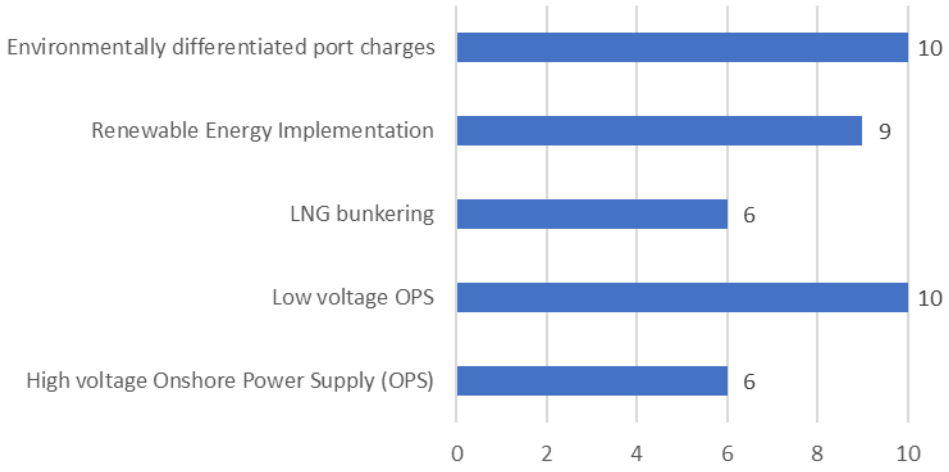

Figure 15. Green practices at ports.

One of the leading green practices among the researched ports is establishing differentiated port charges to reward more sustainable vessels. Copenhagen Malmö Port has grouped different kinds of ships and established different associated charges to the groups. As Petra König says: ‘’ What we look at is what kind of costs we have for each kind of ships, for example, cruise ship has much more waste to handle than the car ship would have, so the car ship would get a lower fee than a cruise ship.’’ Such an approach does not allow flexibility in costs and does not pose incentives for more sustainable cruises compared to less sustainable ones but differentiates vessels across the groups.

Along with the differentiated fees, ports are actively implementing renewable energy. The Port of Aalborg and Copenhagen Malmö Port have established solar panels on top of the one of the port’s buildings. Generated electricity is used to hit the shower water in all the changing rooms for personnel. Additionally, the port uses electrical crane, which generates electricity, when the container is lowered. So, the port extracts that energy and sells electricity to the grids. Another crane, which runs on diesel, is complemented with a transformer, making diesel generate electricity, which makes the crane electrically run. This mechanism leads to a more stable diesel consumption, despite how the crane is driven. More stable consumption ends up in a more stable level of emissions that eliminates their exponential growth.

The ports shared information about sustainability and environment projects, they are currently involved in and/or plan on the future agenda. Bergen port reports its current projects to be connected with the improvement of air quality in port, developing a comprehensive air emission modelling and a tool for air quality risk assessment. These projects are strongly correlating with the stated in the survey, top priority Air Quality/Pollution of the port. The future projects are including the achievement of ISO 14001 certification, which is also the reason why this Thesis is extensively focusing on EMS tools. The port of Bergen, Oslo and Flåm report to be working on EPI project throughout 2018 (Cruise Industry News, 2017). As the Manager of Port Operations of the Port of Flåm admits, the EPI implementation will introduce reduced port charges for the ships improving their footprint. The port of Flåm reports a close collaboration with the municipality to improve air quality in the fjord. Additionally, together with ferry company The Fjords, the port is working on building infrastructure for a fully electric carbon fibre ferry ‘’Future of

the Fjords'' that will sail between the villages of Flåm and Gudvangen, starting in 2018 (Diab International, 2018).

Environmental Manager of the Port of Aalborg Brian D. Rasmussen mentioned in the interview that the port has been extensively working on establishing solar panels on its office buildings and reducing electricity consumption through establishing LED lines. The port is also having a collaboration with five recycling companies, three of them are situated in the port area and two are in the city area. The port is to provide the companies with plastic for reuse and other waste materials. Additionally, Brian D. Rasmussen told about the future projects of the port: '' We are doing a collaboration project with a cement factory […] and a company producing isolation for houses. Those are the companies that are orientated to run a sustainable chain and provide a product made using recycled materials. The port provides them with waste to recycle and use as an alternative fuel instead of coal that they are using now. ''

The port of Oslo reports its focus on shifting cargo transportation from road- to sea-transport as ''it is by far the most energy and environmentally efficient way to transport cargo''. Additionally, the port of Oslo has been a part of Norway's largest contaminated seabed clean up action, Ren Oslofjord Project since February 2006.

As Environmental Controller Daniela Fjellman reports, the port of Gothenburg has been working on installing more OPS, developing the environmental discount on port dues, creating a wetland for wildfowl in an area that has been used for deposition of dredging spoils. It has planned to build a new intermodal terminal that will reduce emissions due to more transportation by train. In the future, the port will be replanting eelgrass meadows due to construction of a new port terminal.

In January 2018 Helsinki port has introduced new environmental incentives to the port fees. The fairway to one port is planned to be deepened to allow larger ships to get an access to the port. This will lower the air emissions in a long run, according to Aino Rantanen. The port authority is also concerned about meeting the requirements of upcoming legislations (regarding ship-generated waste, ballast waters, global sulphur limits), so the port needs to prepare to those.

7. Discussion

In general, to demonstrate their commitment to improving environmental performance the researched ports in Nordics along with some ports of Eastern and Central Europe prefer certifying their EMS to ISO 14001 international standard rather than choosing alternative instruments. No studied ports have used PERS or EMAS to implement their EMS.

The Figure below shows, what place the ports have on the hierarchy developed by Darbra et al.:

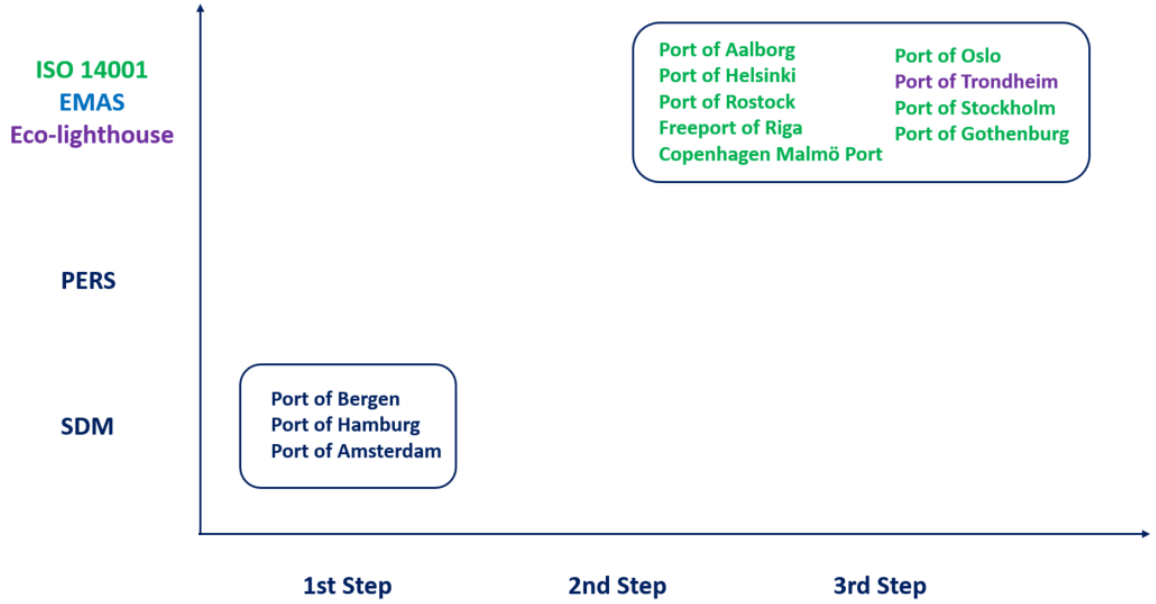

Figure 16. Mapping the ports based on the hierarchy developed by Darbra et a. (2004).

The reason for giving a preference to ISO 14001 is that its requirements are not strict enough, compared to the alternative standards. ISO 14001 is too general and does not require a proof of legislative compliance, but only the willingness to comply. It only builds an organizational structure, while the rest is up to the port to decide, including developing the system of environmental performance indicators and setting goals for environmental improvement. Additionally, ISO 14001 does not require the ports to conduct a preliminary environmental review of their current performance. This contradicts the literature on implementing EMS in ports, which underlines that in order to develop efficient practice, the

crucial background environmental parameters should be researched, supplemented when necessarily with more specific environmental monitoring (Wooldridge et al., 1999).

For large complex ports, like the Port of Bergen, ISO 14001 seems to be the best choice as it is flexible and easier to implement and, as a bonus, wider known due to the global coverage. However, there is big concern that ISO 14001 is only good as a green marketing strategy for declaring the commitment and ambitions or as a fulfilment of an implicit industry requirement, rather than an instrument that is actually decreasing environmental impacts. ISO 14001 international standard is process-driven, not result-driven: it only aims to decrease impacts in the future, while it should set concrete environmental targets and push ports towards meeting them in present. Therefore, it is up to the port, to what extent it should commit: in the end the port can choose only to comply with the minimal requirements and turn the EMS adoption into the bureaucratic process of achieving ISO 14001 certification. Most of the points listed above are also applicable to EMAS, although the scheme does set more specific requirements, including the proof of legal compliance. Additionally, both ISO 14001 and EMAS certifications can be achieved by any organization, despite its actual environmental impact: both the fossil fuel company and renewable energy company can be certified with ISO 14001 and EMAS. This casts a doubt on the reputation and credibility of the certifications.

In Figure 16 Eco-lighthouse standard is placed on a par with international giants. The research has shown that both ISO 14001 and EMAS are not industry-specific instruments, while national Eco-lighthouse scheme and PERS are posing the requirements specially developed for ports. This serves as the main advantage of the last two tools and should be taken into account, while choosing EMS tool. At the same time, PERS is considered as a preliminary alternative to ISO 14001, which is a substantial disadvantage of the standard. Additionally, Eco-lighthouse is mainly focusing on SMEs rather than large organizations.

The following graph illustrates ports' total scores across seven ''Instruments for Communicating Environmental Ambitions'' performance indicators. Here, the ports certified with ISO 14001 have high scores, as a consequence of ISO 14001 requirements, aiming to enhance internal communication through employees' involvement and external communication of required documents to the public.

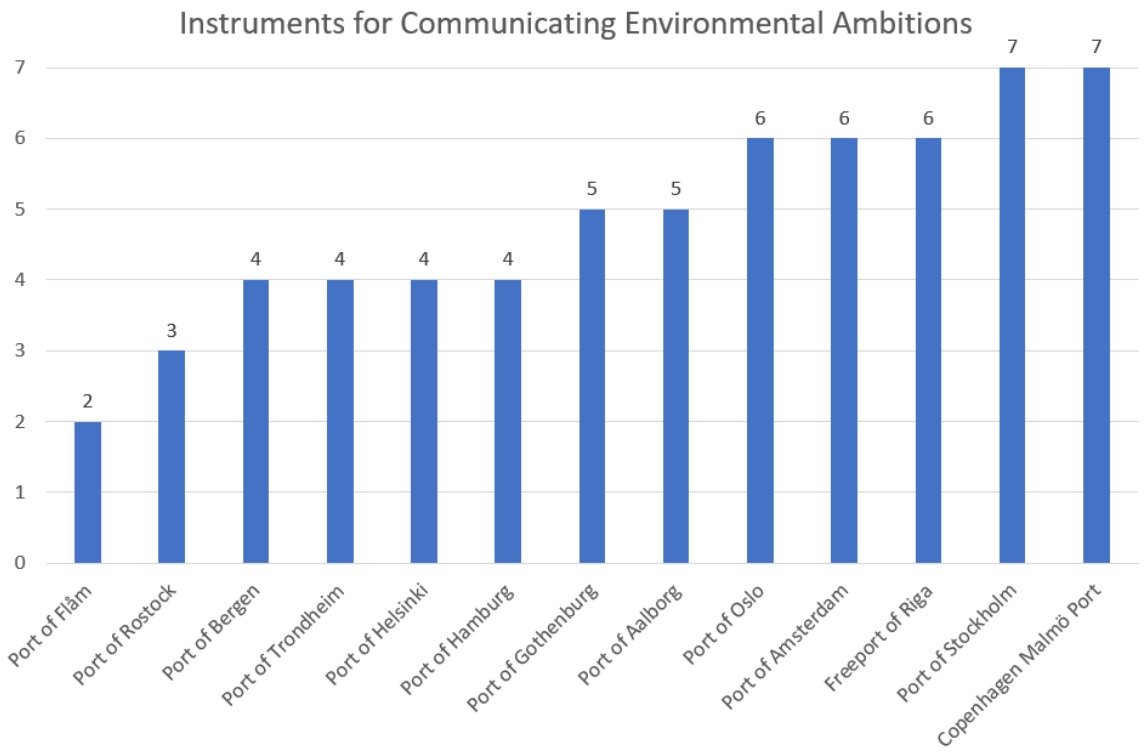

Figure 17. Summary of Ports Scores Across ‘’Instruments for Communicating Environmental Ambitions’’ performance indicators

Most of the ports within this study clearly underestimate internal communication in its ability to create awareness and raise the competence among port employees. Although the staff environmental training and involvement is an explicit requirement of ISO 14001, even certified ports miss out on this dimension. Meanwhile, the Copenhagen Malmö Port experience shared by Petra König reveals that it is possible to provide effective training sessions to all employees, spending for it only six days a year. Such an event can be very fruitful for the port, as it does not only ensure the compliance with the ISO 14001 standard requirement but also initiates environmental projects with the help of workers, whose everyday routine can be directly connected with some unnecessary environmental impacts, which the port managers will never identify on their own. Environmental workshops will help to distinguish the weak points and promote organizational culture of considering every routine step for potential environmental improvement, as it is the case in the Port of Aalborg. Both Petra König and Brian Dalby Rasmussen emphasized the importance of internal communication as well as close relationships between all port employees and Environmental

Manager not to let the employees' ideas stay unspoken. Therefore, large ports might need to have more than one employee responsible for environmental and sustainability development.

Moreover, the importance of internal and external communication and collaboration with stakeholders, such as local communities, municipalities and businesses is emphasised by some ports in their environmental policies. In total, researched ports have very high scores on Environmental Policy performance indicators. Many of them are not only communicating their environmental priorities, but also underlining the commitment towards demonstrating better performance than required by legislation. Additionally, most of the researched ports regularly issue environmental sustainability reports or reviews, which topics are correlating with the seven core subjects discussed in Chapter 5.3.1. Therefore, in case the port authorities, who do not publish sustainability reports, are willing to do so, it is highly recommended to look into the ISO 26000 guidelines.

Quotations from the interviews with port representatives and EcoPorts Coordinator Sotiris Raptis evidence the practical importance of building connections with other ports and local companies as well as joining already established networks. Networking helps making the ports' best problem-solving experiences reusable, ensures faster decision making, reduces the loss of know-how and stimulates innovation in ports. The only EMS tools, providing an opportunity for networking is SDM and PERS. Most of the Norwegian subject ports (ports of Oslo, Trondheim and Flåm) are not a part of EcoPorts network. Taken that EcoPorts network membership is free of cost, it is essential that the ports take an advantage of this opportunity.

As the research has shown, shipping emissions account for 50 per cent of total NOx emissions in Bergen area and a large amount of greenhouse gases. A large part of it is sourced by cruise vessels docked at port. Excessive NOx emissions worsen air quality and can be a particularly harmful pollutant for human health. However, the emissions released during the cruise season are transported to the inhabited areas near the sea coast. When it comes to the air quality in Bergen city, the harbour does not worsen it even when the quality of air is very low in summer time. However, the situation can dramatically change in light of a change in wind direction and weather conditions.

Interviewees agreed that Onshore Power Supply is a very efficient technology in reducing emissions from vessels docked in port. As for Bergen, the air quality in the city will not be improved by mitigating emissions from cruise vessels as the main contributor to air pollution here is traffic. At the same time, Chapters 3.3 and 3.4 widely discuss the impact of greenhouse gas emission on the environment, human health and wellbeing; and OPS could make a positive difference as a global climate change mitigation technology.

At the same time, there is a wide range of problems associated with it. First of all, the ships are different by design and size, which means that the ports have to be flexible to provide each vessel with an OPS connection. Second, OPS is a very expensive solution, which will stay unused outside the cruise season and might be used by a limited number of vessels as not all of them can take an advantage of OPS at port at the moment. Additionally, this technology does not mitigate emissions, while the vessel is manoeuvring like the catalyst does, for example. All interviewees agreed that OPS is a cost-inefficient and an immature solution to adopt now.

7.1 Recommendations

It has already been discussed that the Port of Bergen does not contribute to the pollution in the Bergen city centre to a large extent, therefore, the OPS for cruise ships would not solve this problem as its primary cause is emissions from traffic. However, OPS would have helped to mitigate climate change by not releasing greenhouse gases from cruise vessels hotelling at port. The problem of climate change is highly interconnected with air quality and will directly and indirectly impact human health. Therefore, it is essential that port authorities ensure port operations and shipping companies to release as least greenhouse gases as possible. At the same time, the cost of OPS implementation is very high, and the municipality is only recommended to invest into OPS for cruise vessels, if the subject of mitigation is the climate change and not the air quality in the city.

Figure 16 shows that the Port of Bergen is at the first stage of implementing an EMS, i.e. the port authorities are aware of the environmental impact from Bergen Port operations. The port's Environmental Manager has filled out an SDM Checklist, which serves as a ''wake up call'' for port authorities. Although the vision of the port is connected to the topic of the

environment, in order to implement an EMS to ISO 14001 international standard, the port needs to make its environmental policy accessible to public. Additionally, a publicly available environmental review should be generated as the Port of Bergen does not fulfil this ISO 14001 requirement either.

The Port has a high score on the performance indicators regarding the environmental personnel at port. However, there is only one Environmental Manager onboard. For such a large port, it is highly recommended to have more environment- and sustainability-oriented resources in house in order to ensure efficient internal dialog with all port employees and communicating environmental sustainability values to them. Moreover, the employees' involvement and training are the explicit requirements posed by ISO 14001 standard certification that the port is aimed to achieve.

The Figure below shows the strategy for the Port of Bergen EMS implementation:

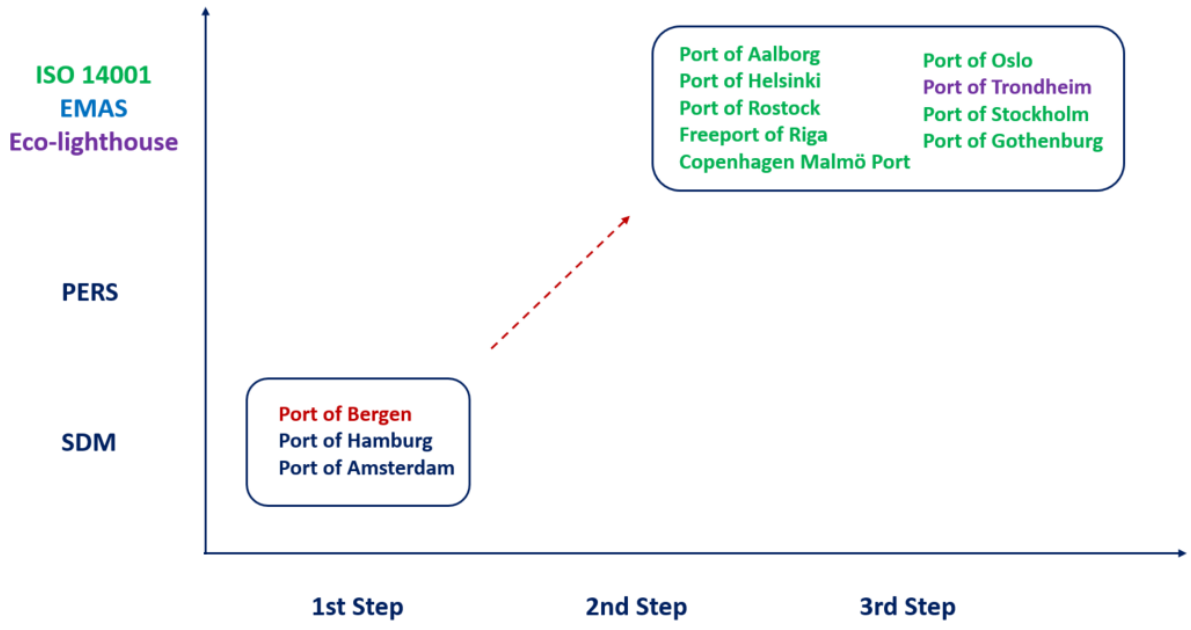

Figure 18. EMS Implementation Strategy for the Port of Bergen.

Here the Port of Bergen is suggested to skip the second step of achieving PERS certification as the port is considered as environmentally mature to implement an EMS to ISO 14001 without a delay.

It is essential that neither the Port Authority, nor the Hordaland Kommune perceive ISO 14001 standard certification achieved by the port as a guarantee of an improved environmental performance. It is important to understand that the standard provides the practical tool to manage environmental responsibilities at port and it is up to the port, how much of an improvement it wants to achieve. Therefore, it is highly recommended to not only develop an EMS certified to ISO 14001, but also consider adopting Eco-lighthouse national scheme. Despite the fact that it is developed for SMEs, the scheme requirements are more strict and aimed to improve the performance at the organization through the unique port sector specific requirements. Additionally, a big advantage the scheme has is insuring the legal compliance with Norwegian and international regulation, which ISO 14001 is missing on.

8. Conclusion

Environmental management has been an important issue in many European ports. There are numerous environmental impacts associated with port operations. Unfortunately, a single environmental management tool that could have solved all of them does not exist. Decreasing impacts requires a complex approach that consists of many aspects such as continuous environmental performance monitoring, implementing environmental improvement targets, creating a management plan, monitoring best practices through networking in a port sector and adopting them, communicating environmental values to all employees to act as a team in achieving common environmental goals.

Environmental management system is a flexible tool that can combine all these aspects. The discussed EMS tools have differences, but they are designed to pursue the same goal – the improvement of environmental performance by an organization. At the same time, the EMS does not dictate a level of environmental performance that must be achieved – the port itself should be tailored to its own individual objectives and targets. As long as the EMS standard certification is efficiently and ethically used, the ports have all the chances to improve their environmental performance with its help.

9. Appendices

9.1 Appendix 1: Guidelines on implementing EMS to EMAS

To obtain EMAS certification organization is required to implement the following steps (European Commission, 2013):

1. Contact its local Competent Body who will provide a customised technical support and an information regarding available funding opportunities (European Commission, u.d.). For Norway the Competence Bodies can be found at the Norwegian Environment Agency, The Brønnøysund Register Centre, Norwegian Accreditation (European Commission, u.d.).

2. Conduct an environmental review of the organization including an assessment of its current environmental performance, direct and indirect aspects impacts, set the prioritizing criteria for these aspects, results of evaluation of previous accidents.

3. Plan an EMS by defining an environmental policy and an environmental programme - an action plan with concrete measures transiting organisation's environmental policy into the achievement of specific objectives.

4. Implement an EMS, ensuring the compliance of the internal organizational structure and processes to the objectives and targets stated in an environmental policy. Just as in ISO 14001 Implementation and Operation stage, EMAS focuses on an active employee involvement through an interactive internal communication and training programmes; delegation of concrete tasks and responsibilities to the departments and individuals, launching effective operational control.

5. Check the effectiveness of EMS through an internal environmental audit: establishment of management control panel with environmental performance indicators, assessment of EMS performance, taking corrective actions to improve performance.

6. Ensure sustainable improvement of the environmental performance through the regular top management review regarding the consistency of the organisational approach and its capability to meet set environmental targets.

7. Prepare and publish an environmental report that clearly communicates the progress of organizational environmental performance to stakeholders.

8. Achieve an EMS verification and validation from an independent environmental verifier accredited or licensed by an EMAS Accreditation / Licensing Body of a Member State. The verifier will examine the organization's compliance to the EMAS Regulation. He/she will verify environmental review, policy and report; assess the compliance to environmental regulations, as well as validate the EMS and internal audit through the assessment of documentation, visits to the organisation and interviews with staff.

9. After EMS and environmental report are verified, an organization submits the required documents to the Competent Body for registration.

10. After the registration is complete, organisation can use EMAS logo with a registration number during the validity of registration to promote its environmental commitment, for instance, in the annually updated reports. The registration is valid for three years, after that time organization needs to apply for a renewal.

9.2 Appendix 2: Moving from ISO 14001 to EMAS

Source: (European Commission, 2011)

9.3 Appendix 3: Environmental Sustainability at Ports Survey

Environmental Sustainability at Ports

This survey is a part of a research project aimed to identify the degree of environmental sustainability at cruise ports in Northern Europe. Your participation and collaboration will make a huge difference for the research and will be highly appreciated.

The results from this survey will be used for research purposes and may be included into a Master's Thesis that will be available online.

If you have any questions associated with the research or survey, please, contact valeriia.denisova@student.nhh.no

Certified EMS

Description (optional)

Does the port have a certified environmental management system (EMS)?

- [ ] PERS
- [ ] ISO14001
- [ ] EMAS
- [ ] Registered for a Self Diagnosis Method
- [ ] No EMS
- [ ] Other...

Environmental Policy

Description (optional)

Does the port authority have an environmental policy?

- ( ) Yes, and it is available to the public
- ( ) Yes, but it is used internally only
- ( ) No, we do not have an environmental policy
- ( ) Other...

Environmental Report

Description (optional)

Does the port regularly publish an environmental review or report?

- ○ Yes, and the report/review is available to the public
- ○ Yes, and it is used internally in the port
- ○ No
- ○ Other...

Environmental Personnel

Description (optional)

Does the port have a designated environmental personnel?

- ○ Yes
- ○ No
- ○ Other...

Environmental Personnel

Description (optional)

Does key personnel have assigned environmental responsibilities?

Long-answer text

How many people represent environmental personnel?

Short-answer text

Green Practices at Port

Description (optional)

Please, choose the green practice available at the port at the moment

- [ ] High voltage Onshore Power Supply (OPS)
- [ ] Low voltage OPS
- [ ] LNG bunkering
- [ ] Renewable Energy Implementation
- [ ] Environmentally differentiated port charges
- [ ] Environmental training programs for port employees
- [ ] Other...

Environmental Monitoring Program

Description (optional)

Is environmental monitoring carried out in the port?

- ( ) Yes
- ( ) No
- ( ) Other...

List the issues that are monitored at the port, please

- [ ] Waste and Recycling
- [ ] Energy Consumption
- [ ] Air Quality
- [ ] Noise Pollution
- [ ] Sediment Quality
- [ ] Carbon Footprint
- [ ] Soil Quality
- [ ] Marine Ecosystems and Biological Diversity
- [ ] Terrestrial Habitats
- [ ] Water Quality
- [ ] Water Consumption
- [ ] Other...

Cruise Ships

Description (optional)

How many cruise calls did the port have in 2016-2017?

Long-answer text

Are there any separate measures used to mitigate pollution from cruise vessels?

Long-answer text

Are there any special requirements introduced for the cruise vessels? (e.g., prohibition to discharge scrubber and grey water, only allowing fuels with low sulphur content, etc.)

Long-answer text

Is OPS available for cruise vessels docked in port?

Long-answer text

Port Priorities

Description (optional)

Does the port have an environmental agenda?

- ○ Yes
- ○ No
- ○ Other...

Could you tell more about ongoing environmental projects that have been run in the port?

Long-answer text

Could you describe the environmental projects that are planned in the upcoming years?

Long-answer text

Port Priorities

Description (optional)

Please, rank these topics according to the priorities set at the port

	Dust	Develop...	Waste fr...	Port Wa...	Air Qual...	Relation...	Noise P...	Energy ...	Water Q...	Dredging
1st Prior...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2nd Prio...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3rd Prio...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4th Prior...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5th Prior...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6th Prior...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7th Prior...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8th Prior...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9th Prior...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10th Pri...	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Contact Information

Description (optional)

Name of the Port

Short-answer text

Full Name of the Respondent

Short-answer text

Job Title at the Port

Short-answer text

Email

Short-answer text

Contact Phone Number

Short-answer text

9.4 Appendix 4: Notes from the Interview with Petra König

1. What are your responsibilities as an environmental manager? Are you responsible for the whole EMS in port / both ports?

As an environmental manager my responsibilities are divided into the following parts:

- ISO14001 Environmental Management System

- Permits and legislation to be able to operate

- Strategic future planning for the port – what trends are coming in the future and what we need to be prepared for, what kind of fuel the ships will be running on in the future and what this means for the port

- I am sort of a hot-line from colleagues with all the questions (what we are doing right now - is this okey? We have a customer and he wants this product – is it in line with our permits or do we need to somehow contact environmental authorities? How much fuel consumption do we have per year?

Everybody can call, not just top management, but also general employees.

2. How are two ports structured in terms of environmental responsibility and environmental personnel?

- It is just me responsible for both ports in terms of environmental management and we have one system for both

3. How is this working in practice? Is it possible taken the different indicators and environmental impacts of the ports?

- When the company was created the idea was that all personnel should be able to work on both sides, but that did not really work – some employees, if they are hired in Copenhagen, they work on a Danish side, if they were hired in Malmö, they work on a Swedish side. But for us, who is more in a management position, we work on both sides, and

we try to work in the same way on both sides to make sure there is an atmosphere of one company.

4. Do you think that EMS is more evolved in Copenhagen than in Malmö or vice versa?

- We work on it in the same way on both sides, we have the same routines, the intranet where everything is located. Some of the routines may look a little bit different on each side, but they are described in detail in both systems.

5. Would you say that all the employees in port are well aware of the environmental impact associated with their work?

- We work a lot with raising awareness within the company, so they are quite aware, they come to me and tell me they are not feeling comfortable with something functioning this way or that way, because it is having an environmental impact, they would like to make it different, change something to decrease environmental impact. So there is quite a big awareness, they are very proactive, they have a lot of comments, ideas, they can find potential of improving the things so that the impact is reduced.

- Twice a year we have a 3-day program, which every employee attends at least for one day. This is the same program all 3 days, as we cannot take everyone out of production and then everybody gets to choose which date they attend. The goal here is that everybody within the company should have attended one of the days. This is where the management can explain the economic and financial situation in the company, discuss the news, everyone has different stations with different themes, and environment is always one of the themes. I always try to find new topics: it can be our environmental goals, EMS that we have just updated, changed quite drastically and improved a lot. So, there is always some kind of a theme and at the same time I am out meeting the different groups at the different terminals and we look together at what kind of environmental impacts we have here and I make workshops with them, where they can contribute with their own thoughts and we try to work on it together: ‘’how can we solve this, so this will become better’’ – it makes us think outside of the box sometimes.

6. New cruise quay will be built soon in Visby Quay, however, you probably know that cruise ships docked in port make up for a large portion of air pollution. How will it be

mitigated? How is it mitigated in CMP now? Was OPS for cruise vessels an issue on environmental agenda of the port? What was the plan regarding it?

- OPS is a solution, which is discussed at many different levels in many different organizations and it is studied from many different aspects. I don't know how to summarize the debate that has been going on for 10 years. OPS has a big value when it comes to reducing air pollution from the ships at berth. The problem with it is that it is extremely expensive to install, both in the ports, but also for the cruise ships – you have different kind of equipment on board to be able to charge in different ports internationally, and this equipment needs to be built as a transformer station, which is quite complex and very expensive. The question also is: '' what kind of electricity that we should deliver and what is it that the ships want?'' Then there is also a fact that energy companies have a problem supplying so much electricity at one time for just a few hours and then the ship leaves, they are not able to meet the peak that these cruise ships demand. There is a lot of issues that need to be solved do that OPS becomes something widespread. I know that in Stockholm they have OPS, but they told me now, they don't need it: I don't know, how many cruise ships come, but it's about 2 per cent which use it. And you have to look at the structure: while Port of Stockholm is a municipal port, CMP is a private port. So, for us it is not possible to make such a huge investment where we will not have any return for many years ahead. So, our owners will not really appreciate it.

So, what we do is when we build a new quay and it is kind for implementing, we will have a construction in place.

7. Could you explain, why it is more expensive not just for the port, but also for the cruise ships?

- What I heard at the different seminars and conferences: they have to build a connection point on the ship, they also need to remove 4 or 5 of the cabins for machinery, so that they can accept electricity – some kind of a station within the ship. For them this is a huge investment of several million dollars plus they loose income from the cabins that they loose. There is also have been a long discussion about the price of electricity. The cruise ships, of course, compare the electricity price with the diesel or oil that they run on otherwise. And for the port the expense, of course, will be the whole infrastructure we have

to establish at port. One more point: ships look very different and we don't know where the cruise ships, for example, have the connection point, so we will have to have something flexible on the quay, which can move 200- 300 meters along the ship, so we can actually connect with the ship. We can't have the wires lying on the quay, because we are driving around, handling waste and packages. And then you have to have an energy company that has to make an investment into the transformation station, because we are not the one who is selling electricity, this is an energy company - they are the ones who are making the money, we only pay for a huge investment cost. So, there is nothing here we would have been selling and making money on. But, of course, it is one of the best solution for the air pollution and many people think that OPS is a good way of mitigating noise pollution, but there are studies that show that when the ships are in port, if they are connected to OPS, it does not decrease the noise pollution very much. The ventilation system, the pump station and things onboard are actually the ones that make the noise in port, this is not the engine. But what we are saying is that here in the North we have a second Sulphur directive from EU – the Sulphur emissions have decreased dramatically from the past year. They are talking about the NOx permits that are coming now – we should decrease the NOx emission. I think, there is a lot of fuel that the ships should have used, but it is a little bit expensive for them, they run on a cheaper one, which is less environmentally friendly. I think there is a lot you can do before OPS is a final solution, which, of course, will lead to the good results in reducing air pollution.

8. Do environmentally differentiated port charges apply to the cruise vessels too?

- What we have done in CMP is grouped different kinds of ships, we do not distinguish cruise ships between each other, e.g. cruise ships are presented as one kind of ship, and then you have car ships and container ships and so on. So, we differentiate them this way.

9. Are they also having different charges?

- Yes, between different kinds of ships we also have different charges. What we look at is what kind of costs we have for each kind of ship, for example, cruise ship has much more waste to handle than then the car ship would have, so the car ship would get a lower fee than a cruise ship.

10. How many cruise calls did the port have in 2016-2017?

- Copenhagen had around 300 per year

- Malmo has 6 per 2016 and none per 2017. This is not really a cruise port yet. We are looking into different solutions. What happened was that we had a number of ships in 2015 and 2016 and they said they would come back in 2017 but will have slightly bigger ships and then it turned out that we couldn't bring in the bigger ships in Malmo due to the way the port is designed. So, we spent a year on different kinds of simulations, on how the ships can come in and dock and we found a way. So, next year 2018 we will start having cruise ships again and I think, 12 have been booked so far.

11. Could you tell more about the renewable energy implementation at port?

- We looked into different methods of using renewable energy, and I know that environmental authorities want us to use as much wind as possible. For us this is a problem due to the safety distance across each windmill, which means we cannot operate close to and this is not an option for us.

- We have also looked more into solar: we have solar panels on top of one of the building, to hit the water for shower in all the changing rooms for personnel.

- We have crane which is electrical: when you lift container, it demands energy and you have an electricity consumption. When you lower the container, the energy is generated. So, we extract that energy and sell electricity to the grids. We also have another crane, which runs on diesel, but we added a transformer to it, which makes diesel generate electricity, which means that the crane itself is electrically run. This means that the diesel consumption is more constant – it does not matter, how they drive or use the crane. When you have more stable consumption, you have more stable emission level as well as, eliminating the exponential growth of emissions.

12. Could you tell more about the projects CMP is a part of? (Like Neptunes)

- Neptunes is a project which we are running together with Amsterdam and Rotterdam, Gothenburg, Stockholm, port of Turku, Port of New South Wales in Australia, Port of

Vancouver - we are a number of ports from the different countries and what we are looking at is the noise pollution generated from ships when they are in port. We have a number of complaints - and for larger ports like Rotterdam, Amsterdam this is a real problem – the complaints are about the noise pollution from the people that live close by and what we are doing together is that we are looking at how many complaints we have, the monitoring that we have done, what kind of values we have, do we have any good examples of how these problems have been solved? For example, in Copenhagen before the cruise season starts, we always have a meeting with all the residents in the area to tell them this is a number of ships coming this year – this is how we are trying to work. In Copenhagen we have two different cruise quays: one which is downtown and another one which is further out. For example, we will have a ship coming and this is the one that we know is noisy since we had it before – and we put it to the quay which is further from the city, otherwise we would have put it as close to the city as possible.

- We also listen to the residents. For example, they tell us they are very annoyed with a PA system – with the loud speakers. Then we spoke with the cruise ships, the captains and tell them that they should not use the loud speakers when they are outdoors on the ship. However, then there were more complaints saying that they are still using loud speakers and we found out that every time they have a new passenger on the ship, they have to conduct the safety training – and a part of it is being out on a deck and using the loud speaker. And we come back to the residents, saying that this is a part of the safety routine and they have to do it according to laws, otherwise, they cannot operate and then they say – ‘’Oh, okey, then we know why.’’ This is a very good way of creating acceptance that there is a certain amount of noise from the ships. We are looking at the good practices, like changing the sound of the reversing machines, they don’t have a loud P-P-P sound anymore, it was changed. We are trying to collect all these good examples and write the reports, which we can then send to the ship industries and authorities to show the possible solutions to common problems in ports.

- As a port we don’t have any mandates to demand anything from the ships. We cannot tell them: ‘’ You cannot come into the port, if you sound more than this and that’’ In Sweden, for example, we have an ‘’open port’’, which means we cannot deny an access to any ship into the port. So, for us it is a little bit difficult as we are not an authority in any

sense apart from the safety requirements, e.g. fires, explosions, things like that, but not noise or air pollution. There are other authorities that can do it. That is why we are trying to raise an awareness reporting to those authorities so that they can start putting demand on these ships.

9.5 Appendix 5: Notes from the Interview with Heidi Neilson

1. Do cruise ships make up for the biggest share of air pollution in port?

- We are in a different situation from Bergen. It depends on what kind of emissions you are talking about. If this is NOx emissions, which is a high discussion in regard to air quality, the cruise ships in Oslo have 22 % of our NOx emissions, while our international ferries have 35 %, and all the cargo has below 20 % of our air emissions regarding NOx. Also, these emissions are summer time in our city and Bergen has air pollution problem, which is mainly in winter.

2. Do you know if wind conditions affect the pollution in port? Does wind move emissions into the city or, vice versa, outside of it?

- We have the main wind direction from the city towards the port and harbour area into the ocean or into the fjord. The highest NOx emission in Oslo is from the road traffic, which is 82 %, while everything from the port, including cruise, ferries, cargo - everything is 9% of the NOx.

3. Are there any projects mitigating the pollution from ships, including cruises, in port?

- I think it is important that when you talk about mitigation, you have to be quite particular with what you want to solve. It is important for me to stress that when you are talking about air quality and NOx emissions, OPS only reduces when it is at berth, the NOx emissions are also high when the ships are manoeuvring in and out of the quay before it is at berth. So, that means that if you have a catalyst or a new machinery, you can actually reduce NOx emissions at sailing, manoeuvring and also when you are at berth – you can reduce emissions up to 80 %. This is why it is important to be precise when you are talking about

mitigation, what effects you want to have. CO2 and climate gas emissions then OPS does this more effectively. But if you want to reduce as much NOx emissions as possible in an area, where the ships actually emit NOx, then a catalyst, which is an old technology really, that has been used for years and years, actually has better results. There was more focus on OPS because it is a clean technology and it is a solution which is very liked by politicians. If you ask them, they are also quite sure that this is a 0-emission mitigation, but it is not really, because all passenger ships have boilers onboard, which they use to produce hot water for the hoteling and they are seldom electrified, although the ship is on OPS. It Is also important to stress that NOx emissions from boilers is lower than the machinery that you use to manoeuvre – it is a different type of machinery, so it has lower NOx emissions, but it is not 0. This is why it is important to choose which mitigation, and which result you want to tackle. If you want to reduce global gas emissions, then OPS is an important measure. If your focus is on air quality, the catalysts have not been lifted up as a good mitigation in regard to passenger ships. In Norway we have NOx fund. All ships that travel between Norwegian ports pay a fee into the fund and then they can apply for technology like a catalyst onboard, and they will get support to invest that on their ships, which has effected and reduced the NOx emissions quite a lot. So, the NOx fund, if this is air quality, NOx emissions that you really want to focus on, NOx fund is a good place to look into. There is a few of the vessels in the port of Bergen, who has different technologies on the ships in regard to reducing NOx emissions, but the cruise vessels, they are difficult. We have tried really hard through our consultants to find, what type of technology they actually have onboard, because we were told that some quite new ships have catalysts on the machines, so this means that they really are reducing NOx emissions, but we really do not know which ships will have this technology, because this is not written down in the description of the ship or if they have a facility of OPS – that is not registered either in any register, that Veritas or DNV has in their records, so it is really difficult to know how many of the ships who actually will come to Oslo or Bergen will have an OPS or catalyst. It seems like quite a few of new ships install catalysts and what they also do is that they keep space for OPS, so it is possible to install at a later stage.

4. This is what I wondered about as I figured out that the goal is to provide OPS for cruises before 2015(?). I wonder if it was a success for Oslo?

- We don’t have OPS for cruises, only for local Color Line ferries. There is only one port in Europe that has an OPS for cruise ships and this is the port of Hamburg. This is Altona, the port where AIDA cruises have their home port- that’s the only one. And this was a huge investment and the port itself has not paid for this solution – it is a cooperation between the city and EU funding. We have looked into what it is going to cost if we were to build an OPS to supply two big cruise ships simultaneously – it costs at least around 110 million NOK for a facility that can supply cruise ships. Plus if you need to have a big building in our port, you will also have to think about architecture, so the price is going to go up. It is a poor investment in regard that it is a 6-7 month season, so it will be a facility that will not be used for anything the other half of the year. For all the ports, that have looked into business cases, this is a really poor business case and it is very few ships that can use it and there is a discussion – is it because ships cannot use OPS, because ports do not build the facilities – is this the reason why they don’t have it onboard and they say: ‘’we don’t need to have it onboard, until we can use it’’, and the ports say: ‘’ we don’t have any customers that can use it, so we are not going to build a facility that will cost us more than a 100 million NOK without knowing that our customers are going to use it.’’ In Norway it is a discussion of who should start first. Our view is that if this is important for the city during the summertime, when the cruise ships are here, when the air pollution is not at the stage dangerous for health, then somebody else needs to take this investment and it has to be other funding.

5. Talking about, who is going to start first – it seems like Bergen port has this ambition. Do you think that they have a chance to implement such a system? Can it be feasible and cost-efficient?

Well, Hamburg has gone first, and they have spent 2 years trying to get the facility to work properly. The reason is that onshore power systems are complicated for large ships and it is not an easy solution, it is a really costly investment and it is also due to the fact that the ships are of different sizes, lengths, heights and even though the plug is of an international standard and you can plug it in, you still need the facilities on the quay to be possible to connect to al types of ships and for those 8 hours that they are in a port area and the

emissions that they emit into the air, it is a discussion if it is a useful way of money to reduce CO2 emissions and there is a lot other different solutions that you have to work with first that will give you a higher result quicker than a very costly investment as an OPS for cruises. But if the cruise line is going to invest into it, they will need several ports that they can connect to for it to be valuable for them. I am quite sure that OPSs is not a necessarily a solution for all types of ships, you have to focus on where the emissions are higher and what type of emissions you want to reduce. Of course, the port wants to facilitate and have the infrastructure, but I am not 100 % convinced that all the cruise lines will have an OP infrastructure, even there was a facility here in Oslo, last year it could maybe be 10 calls in use, this year just 15 calls through the whole season 10y0 calls, when in Bergen they have almost 300 calls from cruise lines, so maybe it is a better business case for them, I am not sure. Even has to answer that. At the moment, I am not convinced that this is a good investment, because the most important thing about OPS is that it reduces climate gas emissions, it is a global issue and to reduce CO2 emissions – there are many other mitigations that you can do before cruises are going to give a good result. Sometimes it is not smart for us, environmentalists, to push through a very costly mitigation which will have a small affect compared to using the same funding for other mitigations that could have a higher impact. I have been working with NGOs for years. The main target and what we all want to is to reduce emissions, but it is always important to ask: ‘’Okey, what does it cost? What is the effect? How can we reduce as much emissions as possible? With what type of technology? Which one is the smartest one to use? ’’ In regard to NOx emissions and local air emissions, catalyst is a good solution, but it has not been talked up, it has not been discussed, because it is looked upon as an old technology, while OPS is much more sophisticated and interesting, why are you talking about the catalyst? it is an old technology. But it actually works. So, OPS seems more like a very political issue. If it was a technology that was easy to supply and there was a market for it, somebody could actually sell the equipment with everything that you have to facilitate to give an OPS to the ship and they could organise all the selling and power would be smooth, then perhaps. As it looks today, it is not a good business case for anyone. It is a high cost and low effect, unfortunately. If we want to reduce NOx emissions, it would be very interesting to know if they have a catalyst onboard, if they maintain it properly, so it has an 80 % effect when it is in use, because if

they do have that technology onboard, they are actually reducing just as much emissions as an OPS, because they are reducing at sailing and at manoeuvring as well, not only at berth.

6. This is very interesting, because what I am trying to figure out is if it is actually cost-efficient.

- Oh, there is nobody, absolutely nobody, who found it cost- efficient. This is one of the main barrier not being implemented on a higher scale. As Hamburg said: ‘There is no way we could have cut it at home. It is really really a bad business case.’’ So, what they said to the city was: ‘’If this is important to you, then you have to find funding for it, because the port does not have the funding for it.’’ What I can share with you is that I know that Copenhagen did quite a good enquiry in this regard, because they have built a cruise terminal just a year or two back, so they had this discussion and looked into the potential.

- It is also a matter of how long the cruise ships are at berth, in Oslo they are at berth approximately 8 hours. In Bergen and Copenhagen, they have turnover, so Copenhagen looked into it quite carefully and discussed the business case and the conclusion was that it is a poor business case, municipality has to have an own company, they have to start a new company with own investments for it to be possible. I can send you the information about their investigation, because they have done a great job on the cost efficiency area, so that would have been interesting for you to read.

9.6 Appendix 6: Notes from the Interview with Brian Dalby Rasmussen

1. I was very surprised with the fact that there are 8 people representing environmental personnel at port. Are they all primary involved into environmental work?

- 50 per cent of my time is dedicated for an environmental work. The other 7: one of them is my boss, rest are middle-level managers. We have no single person fully dedicated to environmental improvement, my percentage is highest, others dedicate about 10 - 20 per cent of their time for smaller improvement projects. For example, when we build a new

facility in port, we brainstorm about how we could improve this project to make it environmentally better than the normal facility standard we used. So, we have a lot of people involved into various kinds of environmental tasks, it is just the work is spread out among all 8 people.

2. How is environmental monitoring carried out in the port?

- There is no data on environmental monitoring in port. Our focus was on electricity consumption, electricity savings, heating, waste reduction. The port of Aalborg is considered as an ordinary company with a bigger scope and a role of an integrator. We play an independent role, trying to improve the conditions, pushing other industries in the same directions, trying to push employees to cycle to work, etc. 6 years ago we created an industrial network, group of 25 companies, and now we are 170 companies – members of this network. We work a lot to share our practices within this network and inspire other companies to decrease their environmental impact. We are working with partners and local community to spread the word.

3. What about your own employees? Do you have training programs for them, so they know, how they can help?

- We do, yes, and we have a short line of comment internally in the company. When some of my colleagues have good ideas, there is a short way to my desk and the ideas are collected and processed. It is my job to take these ideas, either implement them or let them die loudly – if it is a bad idea. For example, we have made solar panels on one of the office buildings. We are trying to push people to come forward with ideas.

4. Could you give some examples of implemented ideas, please?

- For example, we have green areas in front of the office buildings, and on the way out of the office we put the recycling rubbish bins, which can be used by the drivers without getting off the car. It was a move to fight the problem of truck drivers throwing away the garbage out of the window. One of our employees came up with this idea, when he was on vacation and saw a similar system abroad, he took a picture of it and came to Environmental Manager with it. We tested it and it was a big success, we had to empty the recycling tube twice per week, i.e. it collects a lot of garbage that is no longer in the nature.

- Other employees, who work with the cranes, had an idea of reducing energy consumption. When cranes stand by they are connected to the grid and they use a lot of electricity for hitting and keeping all the systems stand by. The engine of the crane is heated to 80 degrees all the time. The guy maintaining the crane said that if we put a timer on the engine we can may be heat it to 20 degrees, when we need a crane, we would have pushed the button, and the crane is heated for 20 minutes to the needed temperature. Crane is standby all the time, it might be used for 1000 h a year and rest it is just heated with electricity to standby. He got this idea to reduce electricity consumption, when crane is standby. The money was saved already after 2 months, so as energy use. So, we try to promote the culture of doing things smarter, because your workday is a subject for improvement, if you are using one kind of a machine, think, how you can use it more efficiently.

- We are supposed to take black ang grey water from the cruise ships, it is no longer allowed to pollute sea with it, so we had to establish the black and grey water facilities. We talked to Copenhagen Malmö Port to figure out how they do it in Copenhagen. We also went to Skagen Havn, because we know they have just established this kind of facility in port. The had the first two-three cruise vessels discharged at that time. So, we wanted to visit them, because they have got a recent experience in handling this issue. So, we bought a bottle of red wine, had a cup of coffee, saw their equipment, found out the names of the suppliers, etc. We tried to pull out every source of information to settle our own system as good as possible.

5. Is there any improvement in terms of air quality associated with shipping?

- We don’t have data on air quality, but a little on noise pollution. Most ships don’t use shore power, they have diesel generator running all the time and residents living near port area, they anticipate the noise levels from the port activities and vessels. Therefore, all the noisy ships are hided, put to the industrial quays and not the city quays. Most of the port activities have been moved out 40-45 years ago, we established a completely new industrial port area, just ten kilometres east from the city. So, we don’t have any complaints about air quality, noise, anything like that. We haven’t worked a lot with the emissions from the ships, also because as a port there are limited things we can do to reduce emissions.

6. Is the port state owned or privately owned?

- It is a stakeholder company. The only stakeholder is municipal government. It is like an ordinary company. I don't consider myself to be employed in a private company.

7. What about the number of cruise calls you had last and this year?

- 28 calls in 2016

37 calls in 2017

42 calls in 2018

8. Can you tell more about the current environmental projects that are run in port at the moment?

- We have two areas, where we changed the lines to LAD tore reduce electricity consumption. We have just finished a 20kWatt peak solar panel on the office building. We have a collaboration project with 5 recycling companies, 3 of them are situated in the port area, 2 are in the city to provide them with plastic for reuse and other waste materials. We are doing a collaboration project with a cement factory in January and a company producing isolation for houses in February, those are the companies that are orientated to run a sustainable chain and provide a recycled product. And we provide them with waste that we are not able to recycle to use as an alternative fuel instead of coal that they are using now.

9. Have you planned any future projects for the upcoming years?

- We are now implementing four systems: integrated quality, risk, environment and CSR in one system that is going to be certified with ISO 90001. The systems are implemented together with a consultancy agency.

9.7 Appendix 7: Notes from the Interview with Aino Rantanen

1. First of all, could you tell me about environmental measures that are implemented in the Port of Helsinki?

- We have a different system in Finland compared to other countries, because we have environmental permits. By law we are treated in the same way as industrial plants, so we have the permits to operate according to the Environmental Protection Law. Environmental permits set a lot of limits and monitoring requirements, so there are a lot of environmental issues that we already monitor by the permits. Is there something specific that you would like to know?

2. Yes, could you tell me about the estimates of pollution from the cruise ships in Helsinki, if you have got them?

- We do not have the estimation for the cruise vessels, because we had around 245 cruise calls in 2016 and we have about 8500 calls all together, so the cruise calls are a very small amount from our traffic. We calculated our overall emissions from all port operations in one harbor and we have three different harbors, so I do not have the calculation about the cruise ships separately.

3. What about the total measure? For example, if we are talking about the pollution in the city of Helsinki, is it a high margin that comes from the port?

- No, I would say that it is not a high portion of the city emissions, because there are energy plants in Helsinki area and they are still running on coal, so they are the producers of high amounts of the emissions in Helsinki. So, I think that shipping numbers are quite low compared to that. But I can send you our air emissions calculations as of this year 2016.

4. How much time do cruise ships spend in port?

- Of course, it varies a lot: there are some cruise vessels that stay for around 4 hours, but I think, average time is from 8 to 10 hours, as for international cruises. If we are talking about passenger vessels, because we have a lot of traffic in passenger vessels other than international cruises, they also have a very short time.

5. And what is the source of energy they use, while docked in port?

- They are burning their own fuel, as for international cruise vessels. As for passenger ferries, there is one OPS connection in Southern harbor for ferries that operate between

Helsinki and Stockholm. They spend a day in Helsinki and use the OPS while docked. We don't have an OPS for cruises.

6. How do you measure air quality in port?

- We are obligated to monitor air quality, so that there are measuring stations around Helsinki area and one of these measuring stations is in out harbors every second year. It stands there for a whole year and then calculates the emissions online all the time. We have had quite good results, the air quality in the harbor is normally a lot better than the other parts of the city, because harbor is an open area and air changes quite a lot, therefore, emissions don't stay there that much.

7. What about wind direction in harbor?

- I think, it changes quite a lot, I don't know what the average wind direction is. We have 3 different harbors and they are situated quite differently from each other geographically.

8. Do you think OPS is a cost-efficient way of reducing pollution?

- Depends on several issues. Whether it is a new built vessel, how the port is situated compared to the power stations. In many cases it is not, but also depends on what the price of other fuel type is. Personally, I hope that biofuels make more appearance in upcoming years and many of these environmental issues can be confronted with different fuel types. At some point, OPS is a good way, but it is not an easy fix, it doesn't go everywhere, and is very very costly. For example, we have a lot of passenger and cargo traffic between Helsinki and Tallinn and a lot of that includes a short turn around time. The vessels stay only for an hour or two hours in ports, there is no time to hook up with any OPS, plus I don't think it is efficient for the engines either, to cool them down for an hour only and then put them up. So, there is a question of what kind of questions it is suitable for. It is complicated. If you have an infrastructure, and it is easy to connect it to the power station in the city and the vessels are going to stay overnight there, anyway, it is very costly to build the system and now, when the oil price is low, there is a very little economic incentive for other energy sources. When the oil price goes up and electricity price goes down, there is an economic incentive to invest in OPS.

9.8 Appendix 8: Notes from the Interview with Andrej Vatterrott

1. Does the policy include the set of environmental goals?

- Yes, some goals have been defined to make environmental aspects quantifiable

2. Is there a designated environmental staff at port, e.g. Environmental Manager/ Engineer? What is the number of environmental personnel representatives at port?

- There are employees working with environmental, however environmental aspects are not concentrated in a dedicated department but organised decentralised.

3. If not, who is assigned with the environmental responsibilities?

- The final responsibility is with our managing directors.

4. Is there an environmental training program run in port (since it is a part of an ISO14001 requirement)?

No Reply.

9.9 Appendix 9: Notes from the Interview with Sotiris Raptis

The membership of Ecoports is cost free. Ports need to complete a check-list of 206 questions. Once they complete a questionnaire, they become members of Ecoports and get an access to Ecoports tools: SDM comparison (?), SDM Review and PERS, the only port specific environmental management standard.

Costs

The SDM, access to the tools and membership is cost free.

SDM Compartition costs 100 Euros, SDM Review costs 600 Euros and PERS Certificate, assessment and application for the assessment costs 1200 Euros. The assessment for the PERS is carried out by the third independent party Lloyds Register.

Benefits

The fact that the number remains so high is a factor proving that the members are happy with the network. It is a good mechanism of searching information and best practices among the ports of different size and different geographic location. If you look at the Annual Environmental review, most of the large ports in Europe are the members of the Ecoports. We also have medium- sized and small ports, and this is important, because larger ports have resources and the capacity to deal with environmental issues and implement good practices. The network facilitates the flow of information also to smaller ports, who are able to see what larger ports do and implement it also in their businesses.

I would call SDM a wake- up call as it enables port to identify what is needed to improve its environmental management and port can continue and get a standard certificate which is a sign that it has in place a proper EMS. The fact that the number remains sable is a proof that members are happy with the network and environmental managers actively participate in a network.

Network

The numbers have increased significantly 2011 – less than 30, over last 5 years – went up to 93.

Using tools is not mandatory, for Ecoports it is important that they participate in Ecoports network, share information, share good practices with other port, so that Ecoports can better communicate the concerns and priorities of European ports. The basis of our annual environmental report is the top 10 environmental priorities of the port based on the answers of the member ports. And for the ones who want to advance, PERS exists.

PERS

Takes into consideration the characteristics of a sector and is supposed to prepare a ground for getting an ISO 14001 certificate. The whole assessment for PERS is based on documents and some policy statements signed by the port representatives. At some point it is more difficult than ISO, at another point, it is easier than ISO. It depends. One of the main objective is to prepare the ground for ISO and EMAS, but other certificates don’t take into

account the special characteristics of the port sector. For example, in PERS the activities of businesses located in the port area are taken into account so that the port authority is responsible indirectly for their decisions. There is a big discussion about decarbonizing the industry and the ports. Here it is important to look at the port of Rotterdam, which is responsible for 20 per cent of Dutch ghg emissions. The port has published a study, which looks at different pathways to almost zero carbon emissions not only for the port itself, but also for the industries that are located in the port area. In the end, the port is indirectly responsible for other industries as a land owner. PERS also looks at the activities that are not directly linked to port business, for example, power plants that are located in the port area. The port authority has to report what it could do when it comes to other industries located in the port area, like chemical industry, power plants. And this is also a part of the PERS assessment.

Cruise Ships

PERS certificate does not address directly shipping emissions, the main focus is on the port activities, meaning, building the port's development plans. The infrastructure and all the stuff.

Steps to implement EMS under PERS

SDM is a first step, the wake-up call and then by completing the SDM they self assess themselves to identify the main challenges to improve their environmental management. They can also apply for SDM Compartition, which is the comparison of their individual score against the EU average and then they can apply for a review that identifies weaknesses, strengths in the run up to obtain the PERS certificate.

9.10 Appendix 10: Notes from the Interview with Anna Despard Asgard

Could you tell me about Miljøfyrtårn? How it started, when and what is so special about its purpose and goals?

- You can find exact dates on our page. My name is Anna Despard Asgard, I am a Senior Advisor here at Miljøfyrtårn, I have been here since 2011, I have background in IT and political studies, so I was involved into the development of the portal, but my main responsibility has been certification and verification of Miljøfyrtårn companies. We started as some kind of local initiative, bright idea with 2 or 3 employees from the municipality of Kristiansand. They were contacted by a local businessman, who had become concerned about environment, and looked into the improvements within his own company, cleaned environmental issues like waste disposal and employee HSE in his business and then he went to the municipality and said: ‘’Look, I have done all these things, improved my environmental profile, worked hard to make my business eco-friendly, no I would like to get some kind of proof for what I have done. So, that was the first Eco-Lighthouse diploma. Still when the business becomes a part of Eco-Lighthouse, they get a diploma that they can display permanently, and this is a decorative thing and a certificate that is valid for 3 years. So, those people in municipality thought that they might expand it and first it was only local, and they improvised in terms of the criteria they were setting and how they were setting. It was quite informal in the beginning, but gradually it became a separate entity and around 2000 we were supported by the ministry of environment, but then it stopped, and we became an independent non-for-profit foundation. The company grew slowly and in when I joined in 2011, it was right about the time when the number of certificates started to rise steeply due to the 2 factors:

1. We introduced the Miljøfyrtårn web-portal, to which all the certified enterprises, certifiers, contact people, municipality, etc. had a user access. It means we could track and see the certificates and history of how long the enterprise has been certified, when the certification expires; they also do the climate environmental reporting in the portal, so we have all the information and documentation collected in one place. This also includes certification and re-certification, how they are fulfilling the Eco-Lighthouse criteria. That was one factor.

2. Another one is the introduction of the head office model. The key principle is that each location should have only one certificate: if you have 10 shops, then each shop should have one certificate, if you have a head office then, the head office is Eco-Lighthouse and other sub-divisions are Eco-Lighthouse. Then we introduced new rules in 2011-2012: if the

organization is very centralized, then a lot of the criteria are being fulfilled at the head office, not other locations, so we kinda lift the criteria that are fulfilled in the head office and we check them there, and we don't have to spend time checking them in other locations. It makes it more organized, it is a better EMS, adapted to the large organizations and municipalities, because you don't spend time checking criteria fulfilled somewhere else. It also means that the head offices are actually implementing a lot of environmental measures for all the subjects.

The core of our system is one certificate per location, but we have developed the way in which the system operates. When you want to become an Eco-Lighthouse, you have an Eco-Lighthouse consultant, who helps you identify the main environmental impacts of your organization. Then we have pre-defined criteria for all industries. This is a core difference between us and ISO 14001 and EMS.

How many different industries do you cover then?

- I think, it is 70 different industries. We have a basic building block of general criteria, which everybody has to implement. A lot of it is based on HSE, internal control system, which is paragraph 5 – compulsory. If you become an Eco-Lighthouse, you fulfil the criteria, you have basic building blocks of an internal control system. We are also helping new enterprises, because most of our enterprises are small- and medium-sized businesses, so if you are a small organization and you are wondering how to implement the legal framework, you can use the industry criteria and you know you have basic blocks of an internal control system. This is also insuring that environmental management system is working. You can say we are not a new management system to the one, you already have, it is integrated into the internal control system that your enterprise has to have anyway. We also have a lot of measures for work safety, we are kinda building on the involvement of the employees and rights of the employees. We are also concerned with health. Of course, many things that are good for the environment, are also good for health, for example, encouraging employees to cycle to work. So, there are general industry criteria – basic block, they are predefined and if you are a hotel, for example, you fill in the criteria for a hotel, if you have a restaurant on the ground floor of your hotel, you also add the restaurant criteria to your hotel criteria.

What, if you are a port? What would be the criteria?

- Yes, we have criteria for port authority.

Is it possible to get an access to the list of criteria that is compulsory for all the industries and for the ones that are developed specifically for ports?

- Yes, it is possible. I am not sure, if it is in English.

That's no problem.

- Our criteria are, of course, look into satisfying legal requirements. This is a big part of criteria portfolio. We also have a very strong cooperation with Tilsynsmuligheter, so we have a mutual way f reporting to each other: if they discover smth, they tell us and if we discover smth, we will inform them.

- So, when you become an Eco-Lighthouse, you have a consultant, who helps you to identify the main environmental aspects, that you know which criteria you are using and also to implement Eco-Lighthouse into your organization. When you are ready, you are fulfilling most of the criteria or all the criteria, because all the criteria must be met at the certification, before you contact the certifier, you should know you fulfil all of them. Then certified comes and gives a feedback on what else needs to be done and then you do it, document it and get your certification, if everything is in order. Normally it is a 3 years certificate and by the end of this time you get an automatic notification through the web-portal that now you need to prepare for recertification. Then you use a web portal to generate a list of all the criteria you are recertified by. Then, you contact your certifier, he comes and checks and if everything is okay, you get your recertification.

Is the web-portal including the network, allowing all the certified enterprises to communicate and share the knowledge and experience between each other?

- The portal is a database, but also a user interface for the enterprise, certifier, consultant and, of course, we are developing the portal and overseeing who has an access. So, if any enterprise or certifier or consultant breaks our terms, we can exclude them from

the portal and then they will not be able to do anything connected to Eco-Lighthouse. We don't have a formalized network, maybe, this is something we should have, because we almost have 5500 certificates by now.

Do you know the number of certified enterprises?

- I am actually not sure.

You told me about one core difference between EMS and what are the other differences?

- There are many differences. I can start from the fact that Eco-Lighthouse has grown up organically. Both EMAS is a very good system, I know this because we have been working on European recognition and we researched EMS system and the way it is implemented. The core difference is that Eco-Lighthouse has developed as a local idea about environment especially for SMEs. EMAS was initially developed as a European initiative, and then implemented in the countries. Additionally, EMAS and ISO are extremely expensive. Eco-Lighthouse is a user-friendly approach and it is also not quite as expensive as EMAS and ISO. Why is it not that expensive? First, because our certifiers are not accredited, but they are licenced. This is a big difference, because accreditation is an international system and for ISO and EMAS the certifiers need to be accredited and it is a long and costly process. This means that the companies offering accredited certifications, they charge a lot. We are ISO 9001 certified, this is a quality certification. They certify us as an enterprise. It is formal and very document based. It is quite theoretical, not so practical, while Eco-lighthouse approach was set to have practical measures that the enterprise can set into motion immediately, so that the enterprise sees that they need to sort the rubbish, track energy use, etc. I think, we pay between 10000 and 20000 NOK every time ISO certifier comes, and she comes each year, while with Eco-Lighthouse certification it costs 6000 - 9000 NOK. So, it is not a low cost, but an affordable cost.

On your website there are loads of services with many price tags and it is hard to understand what you need to do and how much it is going to cost when you get certification?

- This is because for the first time you get certified, you need a consultant. If you are a large organization, you have internal resources, you can send somebody to be trained as an Eco-lighthouse consultant and then you will get an internal consultant. This is a better choice

if you have enough people and you have enough human resources inside, otherwise you are buying an external consultant, helps to set the system up so that you won't need a consultant at recertification, for example, but some choose anyway to hire a consultant for some hours to help them check that they are fulfilling the criteria before the certifier comes. Our criteria are supposed to be well formulated that they are understandable for everyone. A lot of the criteria are set on legal requirements, but then we take the legal one and translate it into understandable Norwegian. So, the enterprises don't need to read and understand the legal formulation to see what is required, they can read the Eco-lighthouse requirements, fulfil it and they are also fulfilling government legislation.

- Also, the certifier does not certify on behalf of Miljøfyrtårn, this is important, because they are certifying on behalf of municipality, where the location is. So, in Oslo the certifier will certify on behalf of the Municipality of Oslo. They are connected to the municipality and they issue the certificate in the name of the municipality of Oslo.

Does it make it a state certification?

- No, it Is an independent party certification, which doesn't have anything to do with the state. The municipality has a certification authority, if you like. We work with municipalities all over Norway, right up north we have less than we would like. Oslo is the biggest concentration of our certificates.

You told me that you are working on international recognition, so what are the plans for the future?

- We have become recognized by EU as an environmental management system. We are the first organization outside of EMAS. This allows Eco-Lighthouse certified enterprises to bid on par with ISO and EMAS certified companies in Europe.

10. References

Aalborg Port. (2017, November 29). *Miljøpolitik*.

Acciaro, M., Vanelslander, T., Sys, C., Ferrari, C., Roumboutsos, A., Genevieve, G., Lam, J. S. L., Kapros, S. (2014). Environmental sustainability in seaports: a framework for successful innovation. 480-500 . Hentet fra https://www.tandfonline.com/doi/abs/10.1080/03088839.2014.932926

Amaral, S. S., Carvalho Jr., J. A., Martins Costa, M. A., Pinheiro, C. (2015, September 9). An Overview of Particulate Matter Measurement Instruments . (P. Avino, Red.) *Atmosphere, 6*, 1327-1345. doi:doi:10.3390/atmos6091327

Antão, P., Calderón, M., Puig, M., Michail, A., Wooldridge, C., Darbra, R. M. (2016, June). Identification of Occupational Health, Safety, Security (OHSS) and Environmental Performance Indicators in port areas. *Safety Science, 85*, 266-275. Hentet fra https://www.sciencedirect.com/science/article/pii/S0925753516000412

Ariely, D., Kamenica, E., Prelec, D. (2008, September). Man's search for meaning: The case of Legos. *Journal of Economic Behavior & Organization*, *67*(3-4), 671-677. doi:https://doi.org/10.1016/j.jebo.2008.01.004

Asgari, N., Hassani, A., Jones, D., Nguye, H. H. (2015, June). Sustainability ranking of the UK major ports: Methodology and case study. *Transportation Research Part E: Logistics and Transportation Review, 78*, 19-39. Hentet fra https://www.sciencedirect.com/science/article/pii/S1366554515000150

Badino, A., Borelli, A., Gaggero, T., Rizzuto, E., Schenone, C. (2012). Noise emitted from ships: impact inside and outside the vessels. *Procedia - Social and Behavioral Sciences, 48*, 868-879. doi:https://doi.org/10.1016/j.sbspro.2012.06.1064

Bailey, D., Plenys, T., Solomon, G. M., Campbell, T. R., Feuer, G. R., Masters, J., Tonkonogy, B. (2004, March). HARBORING POLLUTION: The Dirty Truth about U.S. Ports. Hentet fra

https://assets.nrdc.org/sites/default/files/ports.pdf?_ga=2.239786947.1797270112.1528478951-1968415760.1525613095

Bailey, D., Solomon, G. (2004, October-November). Pollution prevention at ports: clearing the air. *Environmental Impact Assessment Review, 24*(7-8), 749-774. Hentet fra https://www.sciencedirect.com/science/article/abs/pii/S0195925504000745

Bateman, S. (1996). Environmental issues with Australian ports. *Ocean & Coastal Management, 33*(1-3), 229-247. Hentet fra http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.467.2443&rep=rep1&type=pdf

Beer, M., Nohria, N. (2000). *Cracking the Code of Change.* Harvard Business Review. Hentet fra http://ceewl.ca/12599-PDF-ENG.PDF#page=89

Bell, M. L., Samet, J. M., Dominici, F. (2004). *TIME-SERIES STUDIES OF PARTICULATE MATTER.* Annual Reviews. Hentet fra http://www.biostat.jhsph.edu/~rpeng/UCLAWorkshop/docs/ARevPH.pdf

Bergen havn. (2018). *Cruise Statistics*. Hentet fra https://bergenhavn.no: https://bergenhavn.no/en/cruise-en/cruise-statistics/

Bergen og Omland havnevesen. (2009). *Strategiplan 2009 – 2024.* Bergen. Hentet fra http://www3.bergen.kommune.no/havnevesenet_/ekstern/09-6304_Strategiplan_2009-2024.kbo.pdf

Bloomberg. (2016). Global Sustainable Investment Review. Hentet fra http://www.gsi-alliance.org/wp-content/uploads/2017/03/GSIR_Review2016.F.pdf

Bloomer, B. J. (2009, May 5). Observed relationships of ozone air pollution with temperature and emissions. *Geophysical Research Letters, 36*(L09803). doi:doi:10.1029/2009GL037308

Brekke, K. A., Nyborg, K. (2005, June 14). Moral hazard and moral motivation: Corporate social responsibility as labor market screening. Hentet fra

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.569.2148&rep=rep1&type=pdf

Brunekreef, B. (1997, November). Air pollution and life expectancy: is there a relation? *Occupational & Environmental Medicine, 54*(11), 781–784. Hentet fra https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1128948/?page=1

Burnett, R. T., Dewanji, A., Dominici, F., Goldberg, M. S., Cohen, A., Krewski, D. (2003, July). On the relationship between time-series studies, dynamic population studies, and estimating loss of life due to short-term exposure to environmental risks. *Environmental Health Perspectives, 111*(9), 1170–1174. Hentet fra https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1241570/

Buruaem L. M., Castro, I. B., Hortellani, M. A., Taniguchi, S., Fillmann, G., Sasaki, S. T., Varella Petti, M. A., Souza, Sarkis, J. E., Bícego, M. C., Maranho, L. A., Davanso, M. B., Nonato, E. F., Cesar, A., Costa-Lotufo, L. V., Souza Abessa, D. M. (2013, September 20). Integrated quality assessment of sediments from harbour areas in Santos-São Vicente Estuarine System, Southern Brazil. *Estuarine, Coastal and Shelf Science, 130*, 179-189. doi:https://linkinghub.elsevier.com/retrieve/pii/S0272771413002710

Buruaem, L. M., Hortellani, M. A., Sarkis, J. E., Costa-Lotufo, L. V. (2012, March). Contamination of port zone sediments by metals from Large Marine Ecosystems of Brazil. *Marine Pollution Bulletin, 64*(3), 479–488. Hentet fra https://www.ipen.br/biblioteca/2012/17871.pdf

Butt, N. (2007, September). The impact of cruise ship generated waste on home ports and ports of call: A study of Southampton. *Marine Policy, 31*(5), 591-598. doi:https://doi.org/10.1016/j.marpol.2007.03.002

Chatzinikolaou, S.D., Ventikos, N.P. (2014, October). Assessing Environmental Impacts of Ships from a Life Cycle Perspective . *Journal of Geophysical Research*. Hentet fra https://www.researchgate.net/publication/280313109_Assessing_Environmental_Impacts_of_Ships_from_a_Life_Cycle_Perspective

Cheng, B., Ioannou, I., Serafeim, G. (2011). Corporate Social Responsibility and Access to Finance. *Strategic Management Journal*. Hentet fra https://dash.harvard.edu/handle/1/9887635

Crifo, P., Forget, V. (2012, June 25). The Economics of Corporate Social Responsibility: A Survey. Hentet fra https://hal.archives-ouvertes.fr/hal-00720640/document

Cruise Industry News. (2017, October 20). *Norwegian Ports Launch Environmental Port Index*. Hentet fra https://www.cruiseindustrynews.com: https://www.cruiseindustrynews.com/cruise-news/17965-norwegian-ports-launch-environmental-port-index.html

Daamen, T. (2007). SUSTAINABLE DEVELOPMENT OF THE EUROPEAN PORT-CITY INTERFACE.

Darbra, R. M., Ronza, A., Casal, J., Stojanovic, T. A., Wooldridge, C. (2004, March). The Self-Diagnosis Method: A new methodology to assess environmental management in sea ports. *Marine Pollution Bulletin, 48*(5-6), 420-428. doi:https://doi.org/10.1016/j.marpolbul.2003.10.023

Darnall, N. (2001, November). Adopting ISO 14001: Why Some Firms Mandate Certification while Others Encourage It. Hentet fra http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.405.3368&rep=rep1&type=pdf

Delad energi. (2017). *Industrial & Urban Symbiosis in Malmö*. Hentet fra deladenergi.se: deladenergi.se/in-english/

Denktas-Sakar, G., Karatas-Cetin, C. (2012, December). Port Sustainability and Stakeholder Management in Supply Chains: A Framework on Resource Dependence Theory. *The Asian Journal of Shipping and Logistics, 28*(3), 301-319. Hentet fra https://www.sciencedirect.com/science/article/pii/S2092521213000035

Diab International . (2018). *Brødrene Aa's Future of the Fjords will sail 18 nautical miles between the villages of Flåm and Gudvangen, entirely on batteries*. Hentet fra

https://www.electrans.co.uk: https://www.electrans.co.uk/brodrene-aa-builds-carbon-fibre-e-ferry/

Dimson, E., Karakaş, O., Li, X. (2012, December 17). Active Ownership. Hentet fra http://www.people.hbs.edu/kramanna/HBS_JAE_Conference/Dimson_Karakas_Li.pdf

Dinwoodie, J., Tuck, S., Knowles, H., Benhin, J., Sansom, M. (2012, February). Sustainable Development of Maritime Operations in Ports. *Business Strategy and the Environment, 21*(2), 111-126. Hentet fra https://onlinelibrary.wiley.com/doi/full/10.1002/bse.718

DNV GL. (2017). *Sustainable Development Goals: Exploring Maritime Opportunities.* Hentet fra https://www.rederi.no/globalassets/dokumenter-en/all/fagomrader/smi/dnv-gl-sdg-maritime-report.pdf

Dominici, F., Peng, R. D., Bell, M. L., Pham, L., McDermott, A., Zeger, S. L., Jonathan M. Samet, J. M. (2006, March 8). Fine Particulate Air Pollution and Hospital Admission for Cardiovascular and Respiratory Diseases. *JAMA, 295*(10), 1127-1134. doi:doi:10.1001/jama.295.10.1127

Eco-Lighthouse. (2009). *EMS Factsheet Eco-Lighthouse Programme.* Hentet fra http://ec.europa.eu/environment/emas/pdf/StepUp/EMAS_BIO_EMSFS_Eco_Lighthouse_FINAL_Feb.pdf

Eco-lighthouse. (2017). *General Industry criteria*. Hentet fra http://eco-lighthouse.org/wp-content/uploads/2017/06/00-General-industry-criteria-040517.pdf

Eco-lighthouse. (2018). *About Eco-lighthouse*. Hentet fra https://eco-lighthouse.org: https://eco-lighthouse.org/about/

Eco-Lighthouse. (2018). *Industry Criteria*. Hentet fra https://eco-lighthouse.org: https://eco-lighthouse.org/industry-criteria/

EcoPorts. (2016, April). *ESPO / EcoPorts Port Environmental Review 2016.* Hentet fra https://www.espo.be/media/news/ESPO_EcoPorts%20Port%20Environmental%20Review%202016.pdf

EcoPorts. (2017). *Sustainability Report 2017.* EcoPorts. Hentet fra https://www.espo.be/media/2017.11.08%20Sustainability%20report%202017%20Review%20final.pdf

EcoPorts. (2017). Top 10 environmental priorities of European ports for 2017. Hentet fra https://www.ecoports.com/assets/files/common/publications/ESP-2177__Update_Top_10_environmental_priorities_-FINAL.pdf

EcoPorts. (2018). *EcoPorts About us*. Hentet fra https://www.ecoports.com: https://www.ecoports.com/about

EcoPorts. (2018). *EcoPorts Network.* Hentet fra https://www.ecoports.com: https://www.ecoports.com/network

EcoPorts. (2018). *Port Environmental Review System (PERS): the only port sector specific environmental management standard*. Hentet fra https://www.ecoports.com/pers: https://www.ecoports.com/pers

EcoPorts. (u.d.). *ECOPORTS TOOLS.* Hentet fra https://www.ecoports.com/assets/files/common/brochures/ESP-2035_ECOPORTS_DEF-tools.pdf

Edvardsen, A., Lambrechts, L. (2017, February 18). Her er tallene som viser hvor mye cruiseflåten forurenser med 300 anløp til Bergen denne sesongen. *BERGENS TIDENDE*. Hentet fra https://www.nersc.no/sites/www.nersc.no/files/2017-02-18_Bergens_Tidende-TGW.pdf

Endresen, Ø., Sørgård, E., Sundet, J.K., Dalsøren, S.B., Isaksen, I.S.A., Berglen, T.F., Gravir, G. (2003). Emission from international sea transportation and envi-ronmental impact. *Journal of Geophysical Research, 108*. Hentet fra https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2002JD002898

EPA. (2016, September 8). *Nitrogen Dioxide (NO2) Pollution*. Hentet fra https://www.epa.gov: https://www.epa.gov/no2-pollution/basic-information-about-no2

EPA. (2017, February 1). *Learn About Environmental Management Systems*. Hentet fra https://www.epa.gov: https://www.epa.gov/ems/learn-about-environmental-management-systems#what-is-an-EMS

Esakki, T. (2017). *Green Marketing and Environmental Responsibility in Modern Corporations.* IGI Global. Hentet fra https://books.google.no/books?id=z-ruDQAAQBAJ&pg=PA184&lpg=PA184&dq=emas+green+marketing&source=bl&ots=15OrjLGdA5&sig=r84M7dIfvGVUz9H1eJvL8MJvSoE&hl=en&sa=X&ved=0ahUKEwjhweTQ5fPXAhXEK5oKHYtPAioQ6AEIODAC#v=onepage&q=emas%20green%20marketing&f=false

ESPO. (2018). *OUR ORGANISATION*. Hentet fra https://www.espo.be: https://www.espo.be/organisation#espos-role

European Commission. (2011, December). *EMAS - Factsheet*. Hentet fra http://ec.europa.eu/environment/emas/pdf/factsheets/EMASiso14001_high.pdf

European Commission. (2013, November 7). *Are environmental management systems just greenwash?* Hentet fra http://ec.europa.eu/environment/integration/research/newsalert/pdf/349na3_en.pdf

European Commission. (2013). COMMISSION DECISION. *Official Journal of the European Union*. Hentet fra https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D0131&from=EN

European Commission. (2014, August). *From ISO 14001 to EMAS: mind the gap*. Hentet fra https://www.emas.de: https://www.emas.de/fileadmin/user_upload/06_service/PDF-Dateien/UGA_Infosheet_From-ISO-14001-to-EMAS.pdf

European Commission. (2016, March). *EMAS and the revised ISO14001*. Hentet fra http://ec.europa.eu/environment/emas/pdf/factsheets/EMAS_revised_ISO14001.pdf

European Commission. (2017, December 6). COMMISSION DECISION (EU) 2017/2285. *Official Journal of the European Union* . Hentet fra https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017D2285&from=EN

European Commission. (2017). *EMAS & ISO 14001*. Hentet fra http://ec.europa.eu: http://ec.europa.eu/environment/emas/join_emas/emas_iso_14001_en.htm

European Commission. (2017). *Legal compliance*. Hentet fra http://ec.europa.eu: http://ec.europa.eu/environment/emas/emas_for_you/premium_benefits_through_emas/legal_compliance_en.htm

European Commission. (2017). *WHAT IS EMAS?* Hentet fra http://ec.europa.eu: http://ec.europa.eu/environment/emas/index_en.htm

European Commission. (u.d.). *Competent Bodies*. Hentet fra http://ec.europa.eu: http://ec.europa.eu/environment/emas/emas_contacts/competent_bodies_en.htm#c-norway

European Commission. (u.d.). *How does it work?* Hentet fra http://ec.europa.eu: http://ec.europa.eu/environment/emas/join_emas/how_does_it_work_step1_en.htm#layout-body

Eurosif. (2016). European SRI Study. Hentet fra http://www.eurosif.org/wp-content/uploads/2016/11/SRI-study-2016-HR.pdf

EY. (2016). *Value of sustainability reporting.* Hentet fra http://www.ey.com/Publication/vwLUAssets/EY_-_Value_of_sustainability_reporting/$FILE/EY-Value-of-Sustainability-Reporting.pdf

Fang, Y., Naik, V., Horowitz, L. W., Mauzerall, L. (2013). Air pollution and associated human mortality: the role of air pollutant emissions, climate change and methane concentration increases from the preindustrial period to present. *Atmospheric Chemistry and Physics, 13,* 1377–1394. Hentet fra

http://wws.princeton.edu/system/files/research/documents/mauzerall_air_pollution_and_associated_human_mortality.pdf

Fann, N., Kim, S. Y., Olives, C., Sheppard, L. (2016). Estimated Changes in Life Expectancy and Adult Mortality Resulting from Declining PM2:5 Exposures in the Contiguous United States: 1980–2010. *Environ Health Perspect*. Hentet fra https://ehp.niehs.nih.gov/wp-content/uploads/2017/09/EHP507.alt_.pdf

Fernandez-Kranz, D., Santaló, J. (2010). When Necessity Becomes a Virtue: The Effect of Product Market Competition on Corporate Social Responsibility. Hentet fra http://www.csringreece.gr/files/research/CSR-1290072276.pdf

Fethallah, W., Chraibi, L., Sefiani, N. (2016). Assessment Tool for Social Responsibility Performance According to the ISO 26000. *International Journal of Industrial and Manufacturing Engineering, 10*(10). Hentet fra https://waset.org/publications/10006460/assessment-tool-for-social-responsibility-performance-according-to-the-iso-26000

Fiore, A. M., Naik, V., Leibensperger, E. M. (2015). Air Quality and Climate Connections. *Journal of the Air & Waste Management Association,, 65*(6), 645-685. doi:DOI: 10.1080/10962247.2015.1040526

Flammer, C. (2015, November). Does Corporate Social Responsibility Lead to Superior Financial Performance? A Regression Discontinuity Approach. *Management Science, 61*(11), 2549-2568. doi:https://doi.org/10.1287/mnsc.2014.2038

Freeport of Riga. (2017). *Environmental Protection* . Hentet fra www.rop.lv: www.rop.lv/en/about-port/environment/protection.html

Friedman, M. (2007). The Social Responsibility of Business Is to Increase Its Profits. I H. M. Zimmerli W.C., *Corporate Ethics and Corporate Governance* (ss. 173-178). Berlin: Springer. Hentet fra https://link.springer.com/chapter/10.1007/978-3-540-70818-6_14#citeas

German EMAS Advisory Board. (2013). *The EMAS logo: A guide with examples of use for excellent environmental protection.* Hentet fra http://ec.europa.eu/environment/emas/pdf/EMAS_Logo_Guide.pdf

González, P., Sarkis, J. (2008). Environmental management system certification and its influence on corporate practices: Evidence from the automotive industry. doi:https://doi.org/10.1108/01443570810910179

Grech, A., Bos, M., Brodie, J., Coles, R., Dale, A., Gilbert, R., Hamann, M., Marsh, H., Neil, K., Pressey, R. L., Rasheed, M. A., Sheaves, M., Smith, A. (2013, October 15). Guiding principles for the improved governance of port and shipping impacts in the Great Barrier Reef. *Marine Pollution Bulletin, 75*(1-2), 8-20. doi:https://doi.org/10.1016/j.marpolbul.2013.07.013

Greenstone, M., Nilekani, J., Pande, R., Ryan, R., Sudarshan, A., Sugathan, A. (2015, February 21). Lower Pollution, Longer Lives: Life Expectancy Gains if India Reduced Particulate Matter Pollution. *Economic & Political Weekly, L*(8). Hentet fra http://scholar.harvard.edu/files/rpande/files/lower_pullution_longer_lives.pdf

Grifoll, M., Jorda, G., Espino, M., Romo, J., Garcia-Sotillo, M. (2011, October 11). A management system for accidental water pollution risk in a harbour: The Barcelona case study. *Journal of Marine Systems, 88*(1). Hentet fra https://www.sciencedirect.com/science/article/pii/S0924796311000431

Gupta, A. K., Gupta, S. K., Patil, R. S. (2005, May). Environmental management plan for port and harbour projects. *Clean Technologies and Environmental Policy, 7*(2), 133-141. Hentet fra https://link.springer.com/article/10.1007/s10098-004-0266-7

Haase, D., Larondelle, N., Andersson, E., Artmann, M., Borgström, S., Breuste, J., Gomez-Baggethun, E., Gren, Å., Hamstead, Z., Hansen, R., Kabisch, N., Kremer, P., Langemeyer, J., Rall, E. L., McPhearson, T., Pauleit, S., Qureshi, S., Schwarz, N. (2014, May). A Quantitative Review of Urban Ecosystem Service Assessments: Concepts, Models, and Implementation. *Ambio, 43*(4), 413–433. Hentet fra https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3989520/

Hamburg Port Authority . (2018). *Heading for new shores*. Hentet fra https://www.hamburg-port-authority.de/en/hpa-360/philosophy-and-strategy/

Hammar, M. (2018). *ISO 14001 Requirements and Structure*. Hentet fra https://advisera.com: https://advisera.com/14001academy/knowledgebase/iso-14001-requirements-and-structure/

Harrald, J. R., Stephens, H. W., Van Dorp, J. R. (2004, January 28). A Framework for Sustainable Port Security. *Journal of Homeland Security and Emergency Management*. doi:https://doi.org/10.2202/1547-7355.1029

He, Z., Morrison, R. J. (2001, March). Changes in the Marine Environment of Port Kembla Harbour, NSW, Australia, 1975–1995: A Review. *Marine Pollution Bulletin, 42*(3), 193-201. doi:https://doi.org/10.1016/S0025-326X(00)00142-9

Health Canada. (2013). *CANADIAN SMOG SCIENCE ASSESSMENT.* Ottawa. Hentet fra http://publications.gc.ca/collections/collection_2014/sc-hc/En88-5-2-2013-eng.pdf

Health Effects Institute. (2003). *Revised Analyses of Time-Series Studies of Air Pollution and Health.* Hentet fra https://www.healtheffects.org/system/files/TimeSeries.pdf

Hiranandani, V. (2014, April). Sustainable development in seaports: a multi-case study. *WMU Journal of Maritime Affairs, 13*(1), 127-172. Hentet fra https://link.springer.com/article/10.1007/s13437-013-0040-y

Høiskar, B. A. K., Sundvor, I., Johnsrud, M., Haug, T. W., Solli, H. (2017). *Tiltaksutredning for lokal luftkvalitet i Bergen.* Hentet fra https://www.bergen.kommune.no/bk/multimedia/archive/00313/15-2017-Tiltaksutre_313884a.pdf

Iannelli, R., Bianchi, V., Macci, C., Peruzzi, E., Chiellini, C., Petroni, G., Masciandaro, G. (2012, June 1). Assessment of pollution impact on biological activity and structure of seabed bacterial communities in the Port of Livorno (Italy). *Science of the Total Environment, 426*, 56-64. Hentet fra https://www.sciencedirect.com/science/article/pii/S0048969712003944

International Maritime Organization. (2004). *Regulations for the Prevention of Pollution by Sewage from Ships - REVISED ANNEX IV OF MARPOL 73/78.* Hentet fra http://pmg-assets.s3-website-eu-west-1.amazonaws.com/140729annexiv.pdf

ISO 14001 Certification . (2018). Hentet fra ISO14001.com.au: http://www.iso14001.com.au/iso-14001-certification.html

ISO. (2010). *An easy-to-use checklist for small business.* Hentet fra https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/pub100329.pdf

ISO. (2007). *Guidance on Social Responsibility.* Hentet fra http://iso26000.jsa.or.jp/_files/doc/2007/iso26000_wd3rev2.pdf

ISO. (2010). Publicizing your ISO 9001: 2008 or ISO 14001: 2004 certification. Hentet fra https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/publicizing_iso9001_iso14001_certification_2010.pdf

ISO. (2014). Discovering ISO 26000. Hentet fra https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/discovering_iso_26000.pdf

ISO. (2015). *Terms and definition in ISO 14001:2015 – where did they originate from?* Hentet fra https://committee.iso.org/files/live/sites/tc207sc1/files/Terms%20and%20definitions%20in%20ISO%2014001_2015%20-%20where%20did%20they%20originate%20from.pdf

ISO. (2017). *The ISO Survey of Management System Standard Certifications 2016.* Hentet fra https://isotc.iso.org/livelink/livelink/fetch/-8853493/8853511/8853520/18808772/00._Executive_summary_2016_Survey.pdf?nodeid=19208898&vernum=-2

ISO. (2018). *ISO 14000 family - Environmental management*. Hentet fra https://www.iso.org/iso-14001-environmental-management.html

ISO. (2018). *ISO 14001 Environmental Management Systems - Revision*. Hentet fra https://www.iso.org: https://www.iso.org/iso-14001-revision.html

ISO and GRI. (2014). *GRI G4 Guidelines and ISO 26000:2010 How to use the GRI G4 Guidelines and ISO 26000 in conjunction.* Hentet fra https://www.iso.org/files/live/sites/isoorg/files/standards/docs/en/iso_26000_gri_g4_.pdf

Jeffery, B. (2003, November 6). *Meeting ISO 14001 requirements*. Hentet fra https://www.thefabricator.com: https://www.thefabricator.com/article/shopmanagement/meeting-iso-14001-requirements

Johnson, D. (2002, July). Environmentally sustainable cruise tourism: a reality check. *Marine Policy, 26*(4), 261-270. Hentet fra https://www.sciencedirect.com/science/article/pii/S0308597X02000088

Kan, H., London, S. J., Chen, G., Zhang, Y., Song, G., Zhao, N., Jiang, L., Chen, B. (2007, April). Differentiating the effects of fine and coarse particles on daily mortality in Shanghai, China. *Environ Int., 33*(3), 376-384. doi:doi: 10.1016/j.envint.2006.12.001

Khoo, I. H., Nguyen, T. H. (2011, July). *STUDY OF THE NOISE POLLUTION AT CONTAINER TERMINALS AND THE SURROUNDINGS.* Long Beach. Hentet fra https://www.metrans.org/sites/default/files/research-project/09-09_Khoo_METRANS_final_report_0_0.pdf

Kim, J. H., Lim, D. H., Kim, J. K., Jeong, S. J., Son, B. K. (2005, February). Effects of Particulate Matter (PM10) on The Pulmonary Function of Middle-School Children. *Journal of Korean Medical Science, 20*(1), 42–45. doi:doi: 10.3346/jkms.2005.20.1.42

King, A., Lenox, M., Terlaak, A. (2005). The strategic use of decentralized institutions: Exploring certification with the ISO 14001 management standard. *Academy of Management Journal, 48*(5), 1091-1106. Hentet fra

http://mba.tuck.dartmouth.edu/pages/faculty/andrew.king/docs/King_Lenox_Terlaak.pdf

Kinney, P. L. (2008, November 8). Climate Change, Air Quality, and Human Health. *American Journal of Preventive Medicine , 35*(5), 459–467. Hentet fra https://www.ajpmonline.org/article/S0749-3797%2808%2900690-9/fulltext

Klemm, R. B., Mason Jr., R. M., Heilig, C. M., Neas, L. M., Dockery, D. W. (2000). Is Daily Mortality Associated Specifically with Fine Particles? Data Reconstruction and Replication of Analyses. *Journal of the Air & Waste Management Association*, 1215-1222. doi:DOI: 10.1080/10473289.2000.10464149

Kotter, J. P., Schlesinger, L. A. (2013, April 26). Choosing Strategies for Change. Hentet fra http://projects.iq.harvard.edu/files/sdpfellowship/files/day3_2_choosing_strategies_for_change.pdf?m=1444230821

Krewski, D. (2009, January 22). Evaluating the Effects of Ambient Air Pollution on Life Expectancy. *The New England Journal of Medicine*. Hentet fra https://www.nejm.org/doi/pdf/10.1056/NEJMe0809178

Kuznetsov, A. (2014, June). *Port Sustainability Management System for Smaller Ports in Cornwall and Devon.* Hentet fra https://pearl.plymouth.ac.uk/bitstream/handle/10026.1/3136/2014Kuznetsov10368454PhD.pdf?sequence=1&isAllowed=y

Kuznetsov, A., Dinwoodie, J., Gibbs, D., Sansom, M., Knowles, H. (2015). Towards a sustainability management system for smaller ports. *Marine Policy, 54*, 59-68. Hentet fra http://www.academia.edu/25578030/Towards_a_sustainability_management_system_for_smaller_ports

Lam, J. S. L., Van de Voorde, E. (2012). Green Port Strategy for Sustainable Growth and Development. *Transport Logistics for Sustainable Growth at a New Level*. Hentet fra https://www.polyu.edu.hk/lms/icms/ifspa2012/Papers/M25.pdf

Leduc, M. (2001). *The marine Diesel engine*. Hentet fra http://www.dieselduck.info/: http://www.dieselduck.info/machine/01%20prime%20movers/diesel_engine/diesel_engine.02.htm

Liao, C. H., Tseng, P. H., Cullinane, K., Lu, C. S., (2010, September). The impact of an emerging port on the carbon dioxide emissions of inland container transport: An empirical study of Taipei port. *Energy Policy*, *38*(9), 5251-5257. Hentet fra https://www.sciencedirect.com/science/article/pii/S0301421510003897

Loh, L., Thomas, T., Wang, Y. (2017, November 17). Sustainability Reporting and Firm Value: Evidence from Singapore-Listed Companies. *Sustainability* .

LRQA. (2018). *Port Environmental Review System (PERS)*. Hentet fra http://www.lrqa.nl: http://www.lrqa.nl/normen-en-schemas/pers/

Lucialli, P., Ugolini, P., Pollini, E. (2007, September). Harbour of Ravenna: The contribution of harbour traffic to air quality. *Atmospheric Environment, 41*(30), 6421-6431. Hentet fra https://www.sciencedirect.com/science/article/pii/S135223100700430X

MAAPE. (1993). *Oxides of Nitrogen.* Hentet fra http://webarchive.nationalarchives.gov.uk/20070403011328/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4102962

Margolis, J. D., Elfenbein, H. A., Walsh, J. P. (2011, June 21). Does it Pay to Be Good...And Does it Matter? A Meta-Analysis of the Relationship between Corporate Social and Financial Performance. Hentet fra https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1866371

Martino, M. D., Errichiello, L., Marasco, A., Morvillo, A. (2013, October). Logistics innovation in Seaports: An inter-organizational perspective. *Research in Transportation Business & Management, 8*, 123-133. Hentet fra https://www.sciencedirect.com/science/article/pii/S2210539513000370

Mcdonnell, W. F., Nishino-Ishikawa, N., Petersen, F. F., Chen, L. H., Abbey, D. E. (2000). Relationships of mortality with the fine and coarse fractions of long-term ambient PM10 concentrations in nonsmokers . *Journal of Exposure Analysis and Environmental Epidemiology, 10*, 427-436. Hentet fra http://www.scientificintegrityinstitute.org/JEAEE090100.pdf

Minnesota Department of Health. (2015). *MINNESOTA CLIMATE AND HEALTH PROFILE REPORT 2015.* Minnesota Department of Health. Hentet fra http://www.health.state.mn.us/divs/climatechange/docs/mnprofile2015.pdf

Mohee, R., Surroop, D., Mudhoo, A., Rughooputh, B. K. (2012, June). Inventory of waste streams in an industrial port and planning for a port waste management system as per ISO14001. *Ocean & Coastal Management, 61*, 10-19. Hentet fra https://www.sciencedirect.com/science/article/pii/S0964569112000245

Moran, P. J. (1991, September). The effects of dredging on the larval settlement and community development of fouling organisms in Port Kembla Harbour, Australia. *Water Research, 25*(9), 1151-1155. doi:https://doi.org/10.1016/0043-1354(91)90209-9

Musser, L. (2013, October 2). *Environmental Certifications Offer Tangible Benefits for Ports*. Hentet fra https://www.aapaseaports.com: https://www.aapaseaports.com/index.php/2013/10/02/environmental-certifications-offer-tangible-benefits/

National Research Council. (1998). ACUTE TOXICITY OF NITROGEN DIOXIDE. I *Assessment of Exposure-Response Functions for Rocket-Emission Toxicants.* Washington, DC: the National Academy of Science. Hentet fra https://www.ncbi.nlm.nih.gov/books/NBK230446/

Neptunes. (u.d.). *Everything about project 'NEPTUNES'*. Hentet fra www.neptunes.pro: www.neptunes.pro/about/

Organisation for Economic Co-operation and Development. (2018). *Environmental impacts of ports*. Hentet fra http://www.oecd.org:

http://www.oecd.org/greengrowth/greening-transport/environmental-impacts-of-ports.htm

Orru, H., Ebi, K. L., Forsberg, B. (2017, October 28). The Interplay of Climate Change and Air Pollution on Health. *Current Environmental Health Reports, 4*(4), 504–513. doi:doi: 10.1007/s40572-017-0168-6

Pataki, G., Crotty, E. (u.d.). *Understanding and Implementing an Environmental Management System.* Hentet fra https://www.dec.ny.gov/docs/permits_ej_operations_pdf/p2emsstep2.pdf

Pentinen, P. (2004). Acute Respiratory Health Effects of Particulate Matter: Effects of Size, Composition and Sources. Hentet fra http://epublications.uef.fi/pub/urn_isbn_951-27-0029-8/urn_isbn_951-27-0029-8.pdf

Performance Review Institute. (u.d.). *ISO 14001:2015 Interpretations and Evidence of Conformance*. Hentet fra http://www.priregistrar.org: http://www.priregistrar.org/iso-140012015-interpretations

Peris-Mora, E., Orejas, J. M. D., Subirats, A., Ibáñez, S., Alvarez, P. (2005, December). Development of a system of indicators for sustainable port management. *Marine Pollution Bulletin, 50*(12), 1649-1660. Hentet fra https://www.sciencedirect.com/science/article/pii/S0025326X05003048

Plumlee, M., Brown, D., Hayes, R. M., Marshall, R. S. (2015). Voluntary Environmental Disclosure Quality and Firm Value: Further Evidence. *J. Account. Public Policy, 34*, 336–361. Hentet fra http://daneshyari.com/article/preview/1005809.pdf

Port of Gothenburg. (2012). *Code of Conduct.* Gothenburg. Hentet fra file://corp.corpcommon.com/users/E215294/MY%20Documents/Master's%20Thesis/Benchmarking%20Analysis/Environmental%20Reports/Gothenburg/code-of-conduct-the-port-of-gothenburg.pdf

Port of Gothenburg. (2018). *Sustainable Port.* Gothenburg. Hentet fra https://safety4sea.com/wp-content/uploads/2018/04/Port-of-Gothenburg-Sustainability-report-for-2017-2018_04.pdf

Port of Helsinki. (2018). *Values, tasks and objectives.* Helsinki. Hentet fra https://www.portofhelsinki.fi/en/port-helsinki/company/values-tasks-and-objectives

Port of Oslo. (2017). *Rewards environmentally friendly cruiseships*. Hentet fra https://www.oslohavn.no: https://www.oslohavn.no/en/news/2017/Rewards+environmentally+friendly+cruiseships.b7C_wlLK2T.ips

Ports of Stockholm. (2016). *Annual Report and Sustainability Report.* Hentet fra http://www.portsofstockholm.com/siteassets/trycksaker/ports_of_stockholm_2016.pdf

Potoski, M., Prakash, A. (2005, September 1). Covenants with weak swords: ISO 14001 and facilities' environmental performance. *Journal of Policy Analysis and Management, 24*, 745-769. Hentet fra https://onlinelibrary.wiley.com/doi/abs/10.1002/pam.20136

Puig, M., Wooldridge, C., Darbra, R. M. (2014, April 15). Identification and selection of Environmental Performance Indicators for sustainable port development. *Marine Pollution Bulletin, 81*(1), 124-130. Hentet fra https://www.sciencedirect.com/science/article/pii/S0025326X14000873

Raman, M., Lim, W., Nair, S. (2012). THE IMPACT OF CORPORATE SOCIAL RESPONSIBILITY ON CONSUMER LOYALTY. *Kajian Malaysia, 30*(2), 71–93. Hentet fra http://web.usm.my/km/30(2)2012/KM%2030%20(2)%20ART%204%20(71-93).pdf

Rambøll. (2017). *UTSLIPP TIL LUFT OG SJØ FRA SKIPSFART I FJORDOMRÅDER MED STOR CRUISETRAFIKK: KARTLEGGING OG FORSLAG TIL TILTAK.* Hentet fra https://www.sdir.no/globalassets/sjofartsdirektoratet/regelverk-og-int.-arbeid---dokumenter/forurensing-fra-skipsfarten-i-verdensarvfjorder/ramboll-rapport-utslipp-til-luft-og-sjo-fra-skipsfart-i-norske-fjorder_2017.pdf?t=1517875200035

Rangan, K., Chase, L. A., Karim, S. (2012, April 5). Why Every Company Needs a CSR Strategy and How to Build It. Hentet fra http://www.hbs.edu/faculty/Publication%20Files/12-088.pdf

Rijsenbrij, J., Wieschemann, A. (2011). Sustainable Container Terminals: A Design Approach. I *Handbook of Terminal Planning* (ss. 61-82). Hentet fra https://link.springer.com/chapter/10.1007/978-1-4419-8408-1_4

ROSTOCK PORT GmbH. (2018). *ROSTOCK PORT GmbH*. Hentet fra www.rostock-port.de: http://www.rostock-port.de/en/rostock-port/hero.html

Saengsupavanich, C., Coowanitwong, N., Gallardo, W. G., Lertsuchatavanich, C. (2009, January). Environmental performance evaluation of an industrial port and estate: ISO14001, port state control-derived indicators. *Journal of Cleaner Production, 17*(2), 154-161. Hentet fra https://www.sciencedirect.com/science/article/pii/S0959652608000772

Saxe, H., Larsen, T. (2004, August). Air pollution from ships in three Danish ports. *Atmospheric Environment, 38*(24), 4057-4067. Hentet fra https://www.sciencedirect.com/science/article/pii/S1352231004003413

Schenone, C., Pittaluga, I., Repetto, S., Borelli, D. (2014). *NOISE POLLUTION MANAGEMENT IN PORTS: A BRIEF REVIEW AND THE EU MESP PROJECT EXPERIENCE*. Beijing. Hentet fra https://pdfs.semanticscholar.org/0ed5/ebb766cbbea7577f14fc93c2f2a702d405ad.pdf

Scholtens, B. (2014, January). Indicators of responsible investing. *Ecological Indicators, 36*, 382-385. doi:10.1016/j.ecolind.2013.08.012

Schottli, J. (2018). *Maritime Governance And South Asia: Trade, Security And Sustainable Development In The Indian Ocean.* World Scientific Publishing Co. Hentet fra https://books.google.no/books?id=BsJUDwAAQBAJ&printsec=frontcover#v=onepage&q&f=false

Schwartz, J., Dockery, D. W., Neas, L., M. (1996). Is Daily Mortality Associated Specifically with Fine Particles? *Journal of the Air & Waste Management Association, 46*(10), 927-939. doi:DOI: 10.1080/10473289.1996.10467528

Schwartz, J., Neas, L. (2000, January). Fine Particles Are More Strongly Associated than Coarse Particles with Acute Respiratory Health Effects in Schoolchildren. *Epidemiology, 11*(1). doi:DOI: 10.1097/00001648-200001000-00004

Scott, M. J., Rosenberg, N. J., Edmonds, J. A., Cushman, R. M., Darwin, R. F., Yohe, G. W., Liebetrau, A. M., Hunsaker, C. T., Bruns, D. A., DeAngelis, D. L., Hales, J. M. (1990, September 9). Consequences of climatic change for the human environment. *Climate Research*, 67-79. Hentet fra https://www.int-res.com/articles/cr/1/c001p063.pdf

Silva, R. A., West, J. J., Zhang, Y., Anenberg, S. C., Lamarque, J. F., Shindell, D. T., Collins, W. J., Dalsoren, S., Faluvegi, G., Folberth, G. (2013). Global premature mortality due to anthropogenic outdoor air pollution and the contribution of past climate change. *Environmental Research Letters, 8*(3). Hentet fra http://iopscience.iop.org/article/10.1088/1748-9326/8/3/034005/meta

Sroufe, R. P., Melnyk, S. A., Vastag, G. (1998, September). Environmental Management Systems As A Source of Competitive Advantage. Hentet fra http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.203.5983&rep=rep1&type=pdf

Stieb, J. A. (2009, July). Assessing Freeman's Stakeholder Theory. *Journal of Business Ethics, 87*(3), 401–414. Hentet fra https://link.springer.com/article/10.1007/s10551-008-9928-4

Sustainable Cruise project. (2011). *Sustainable Cruise*. Hentet fra http://ec.europa.eu: http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=3933#PD

Trondheim Port. (2014). *Strategiplan 2014–2017.* Trondheim. Hentet fra http://trondheimhavn.no/uploads/dokumenter/om-oss/Strategiplan+2014-2017.pdf

Trozzi, C., Vaccaro, R., Nicolo, L. (1995, July 8). Air pollutants emissions estimate from maritime traffic in the italian harbours of Venice and Piombino. *Science of The Total Environment, 169*(1-3), 257-263. Hentet fra https://www.sciencedirect.com/science/article/pii/004896979504656L

Tselentis, V. S. (2008). Marina Environmental Review System: A methodology to assess environmental management in recreational ports. *European Research Studies, 11*(1-2), 47-56. Hentet fra https://search.proquest.com/openview/4100d22b9689c3dd5492a1cd607a468e/1?pq-origsite=gscholar&cbl=60370

United Nations. (1948). Universal Declaration of Human Rights .

Waste & Resources Action Programme. (2015, March). Your Guide to Environmental Management Systems. Hentet fra http://www.wrap.org.uk/sites/files/wrap/WRAP%20EMS%20guide%20Mar2015.pdf

WBK & Associates Inc. (2003). *SULPHUR DIOXIDE: ENVIRONMENTAL EFFECTS, FATE AND BEHAVIOUR.* Hentet fra https://open.alberta.ca/dataset/7d1569bc-5e5c-450e-a31d-9b25838df6c4/resource/8e81da9e-0d55-45dd-9eb7-9cdfa22f0637/download/2003-sulphurdioxideeffectsfatebehaviour-2003.pdf

Weiß, P., Bentlage, J. (2006). *Environmental Management Systems and Certification.* The Baltic University Press . Hentet fra https://uu.diva-portal.org/smash/get/diva2:604281/FULLTEXT01.pdf

Whitelaw, K. (2004). *ISO 14001 Environmental Systems Handbook* (Vol. 2). Elsevier Ltd. Hentet fra http://www.uobabylon.edu.iq/sustainabilty/files/ISO%2014001%20Enviromental%20Systems%20Handbook.pdf

WHO. (1997). *ENVIRONMENTAL HEALTH CRITERIA: Nitrogen Oxides.* Geneva. Hentet fra http://www.inchem.org/documents/ehc/ehc/ehc188.htm#PartNumber:9

WHO. (2000). Particulate matter. Hentet fra http://www.euro.who.int/__data/assets/pdf_file/0019/123085/AQG2ndEd_7_3Particulate-matter.pdf?ua=1

WHO. (2000). *Sulfur dioxide.* Copenhagen. Hentet fra http://www.euro.who.int/__data/assets/pdf_file/0020/123086/AQG2ndEd_7_4Sulfurdioxide.pdf

WHO. (2003). *Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide.* Bonn. Hentet fra http://www.euro.who.int/__data/assets/pdf_file/0005/112199/E79097.pdf

WHO. (2005). *Air Quality Guidelines Global Update.* Hentet fra http://www.euro.who.int/__data/assets/pdf_file/0005/78638/E90038.pdf

WHO. (2018). *7 million premature deaths annually linked to air pollution*. Hentet fra http://www.who.int: http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/

Wolf, T., Pettersson, L. H., Esau, I. (2016, August 9). *Spredning og konsentrasjonsdannelse av NO2 og PM2.5 i Bergen sentrum - et studie med vekt på bidrag fra skip i havna.* The Nansen Environmental and Remote Sensing Center . Hentet fra https://www.nersc.no/sites/www.nersc.no/files/NERSC370-BOH-Luftkvalitet-090816-v1_0.pdf

Wooldridge, C. F., McMullen, C., Howe, V. (1999, July). Environmental management of ports and harbours — implementation of policy through scientific monitoring. *Marine Policy, 23*(4-5), 413-425. doi:https://doi.org/10.1016/S0308-597X(98)00055-4

World Bank Group. (1998, July). Airborne Particulate Matter. Hentet fra https://www.ifc.org/wps/wcm/connect/59cfb38048855493b35cf36a6515bb18/HandbookAirborneParticularMatter.pdf?MOD=AJPERES

Xing Y., Xu, Y., Shi, M., Lian, Y. (2016 , January). The impact of PM2.5 on the human respiratory system. *Journal of Thoracic Disease, 8*(1), E69–E74. Hentet fra https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4740125/

Yau, P. S., Lee, S. C., Ho, K. F. (2012, December). Speed Profiles for Improvement of Maritime Emission Estimation. *Environmental Engineering Science, 29*(12), 1076–1084. doi:doi: 10.1089/ees.2011.0399