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Eco-labelling for the promotion of wind-assisted propulsion in cargo ships

Roberto Rivas Hermann, Carla K. Smink, Stig Hirsbak, Kirsten Krogh Hansen

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Preface

This report has been written on the basis of the work Aalborg University (AAU) has carried out in the S@IL project (Sustainable Approaches and Innovative Liaisons) with regard to work package 5 on Policy and Legislation.

From July 2012 to June 2015, 17 partners from 7 North Sea Countries have worked on the S@IL-project. The aim of the project was to stimulate and facilitate the transition process towards a sustainable shipping sector with focus on alternative propulsion systems for (freight) sailing, so-called "hybrid sailing concepts".

As part of the work package on Policy and Legislation, AAU has focused on Environmental Ship Indices. It has been investigated how we can develop an eco-label scheme for the promotion of wind-assisted propulsion technology in the shipping industry. Furthermore, we have had a closer look at ports and to what extent ports encourage ship-owners to improve their environmental performance. We have investigated so-called EcoPorts and what requirements they impose on ship-owners. The results of our work are presented in this report.

The report is aimed at people that are interested in the transition process towards a sustainable shipping sector and what role eco-labels can play in this transition.

Aalborg, June 2015

Roberto Rivas Hermann, Carla K. Smink[1] & Stig Hirsbak

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1 Introduction

The environmental performance of the shipping industry is increasingly regulated by international conventions that countries translate into national laws. The International Convention for the Prevention of Pollution from Ships (MARPOL) was approved by IMO in the late 1970s to regulate emissions to water, avoidance of hazards from spills, and solid waste. In addition to MARPOL, other environmental conventions and international regulations are already being enforced. The IMO published voluntary guidelines to comply with CO_2 emissions limits in new ships –the Energy Efficiency Design Index (EEDI) to reduce the CO_2 emissions of the next generation of vessels. During operation, ships sailing in certain geographical areas shall comply with the new MARPOL Annex VI limits of SO_x and NO_x emissions. In the EU, the EU ship Recycling regulation, which entered into force on 30 December 2013, frames ship end of life. This EU specific regulation ensures environmental and health protection in the process of dismantling of ships. Moreover, a number of additional country/ port specific regulations –based on national legislation and not in International conventions-, seek to reduce the environmental impact of vessels in specific domains - as noise, use of pollutant haul paint, etc. (Johansen and Fet, 2011).

Despite this broad regulatory framework based primarily on international conventions, some factors contribute on the shipping industry still being the focus of societal concerns regarding health and environmental hazards. In the first place, the regime of the industry, which allows ships to be registered in countries others than the country of owner, this aspect known as "flagging", allows for example a relaxed enforcement by the flag state of existing international conventions. Then, the difficulties associated to monitor compliance by port-state authorities during the short times a vessel docks on a port-of call. Third, the business model involved in the shipping business which allows the shipping firms to lease vessels in order to fulfil the demand, in occasions these vessels are under standards as the owners have no interest to invest in expensive environmental technologies source. Finally, free riders profit of enforcement gaps with the purpose to reduce operational costs.

1.1 Involving business consumers and end users in environmentally responsible shipping

The shipping industry and environmental NGOs have acknowledged that the challenges, as described in the introduction, cannot solely be solved through legislation or the improvement of enforcement mechanisms. End consumers and business customers (i.e. cargo owners) can drive ship-owners to commit to build and operate greener ships. In other sectors (i.e. food retail) eco-labelling schemes start to be popularized among end-consumers (Howard and Allen, 2010; Thøgersen et al., 2010; Uchida et al., 2014). Indirectly, end-consumers can become a driver through civil society organizations, which demand environmental responsibility to corporations. In this way, business customers can establish organizational changes which take closer look to the business' environmental impact through the value chain, among others: environmental management systems, green procurement programs (Lai et al., 2010).

In the last few years, cargo owners and shipping firms have started to participate in voluntary schemes based in public release of information –e.g. the well-known Clean Shipping Index (CSI) and other type of environmental schemes, which are analysed with more details in this report. Some of these voluntary programs incorporate elements of eco-labelling. For example in the CSI, individual ships are rated according to 22 criteria and this rating is translated into an operational performance label. Business consumers (i.e. cargo owners) can then choose the best performing

vessel based in the information provided by the rating system. CSI is not the only type of voluntary environmental program, which focus is on cleaner ship design and operation. An overview by Pike et al. (2011), highlights other similar programs which seek to promote the adoption of cleaner technology (i.e. to reduce air pollutants emissions) and cleaner fuels. These voluntary programs include a system of incentives (in some cases provided by ports which participate in the programs), in other cases the incentive comes from the market –and business consumers.

Eco-labels and in a broader sense Environmental Product Information Schemes (EPIS) have been introduced as a communication tool with the aim of providing both professional and private consumers, and policy makers with information on environmental characteristics of products and services (Scheer et al., 2008). The introduction of both instruments also reflected a changing perspective in environmental policy towards a more extensive use of so-called marked based instruments. The aim is to encourage supplier and consumer behavior change through market signals rather than through explicit command & control regulation regarding pollution control levels (Rubik, 2005).

The EU Eco-label, a voluntary label, was established by the EU Commission in 1992 was inspired by the mother of all Eco-labels, the German Blue Angel (launched in 1978). The eco-label thinking is expressed in a communication in 1989 from the Commission[2] under the headline prevention by products: *"The minimizing of waste at product level must consist in taking account of the environmental impact of the entire product life cycle. It must be ensured that products placed on the market make the smallest possible contribution, by their manufacture, use or final disposal to increasing the amount or harmfulness of waste and pollution hazards."* The communication therefore proposes an introduction of a Community ecological labeling scheme, which was launched through a Community regulation in 1992, is still existing and known as the EU Eco-labeling scheme (http://ec.europa.eu/environment/eco-label)

The intention of the eco-label is to identify and to promote products and services, which have a reduced environmental impact throughout their production cycle and to give the consumer an environmental choice. The intention is to award products and services superior to legislation. The minimum criteria to be met should, as a main rule, cover around one third of the market and/or ensure visibility on the market. It is assumed that if the consumers prefer the eco-labeled product, then the rest of products suppliers will also be encouraged to participate in an eco-label scheme. As result, after three years the minimum criteria will be raised, assuming that e.g. more than 50% of the market can meet the criteria. The EU label schemes should in that sense be working like a pull and push mechanism.

In ISO terminology, the EU Eco-label scheme and Blue Angel are a Type I label – a business-to-consumer label, meaning an environmental labelling programme that is "a voluntary, multiple-criteria-based third party programme that awards a licence, which authorizes the use of environmental labels on products indicating overall environmental preferability of a product within

[2] A Community strategy for waste management. Communication from the Commission to the Council and to Parliament. SEC (89) 934 final, 18 September 1989

a particular product category based on life cycle considerations[3]". Type I labelling is part of the ISO 14020 series of standards (see Appendix A). Several eco-labels are based on this series of standards, and therefore, some European countries and group of countries have launched similar eco-labels, an example is the Nordic Swan[4] in Scandinavia.

ISO (International Standards Organisation) has since 1999 published two other types of Labels, namely Type II and Type III labels (Appendix A for more detailed explanations about these categories of eco-labels).

Type II labels "Self-declared environmental claims" are the most widespread. A Type II Self-declared environmental claim is a statement, symbol or graphic that indicates an environmental aspect of a product, a component or packaging[5].

Type III labels, a business to business label also called "EPD's – Environmental Product Declarations" is a pure LCA based type of labelling, but open up for relevant environmental information not covered of LCA data e.g. if a product has been awarded the EU Eco-label.[6]

Figure 1 illustrates examples of mandatory and voluntary EPIS schemes. The mandatory schemes are referring to EU CE conformity marking and symbols and sentences with regards to dangerous chemicals. The voluntary schemes are the ISO types of labelling and other voluntary schemes not meeting ISO label requirements, which is the case for the nearly all schemes within the shipping sector.

[3] 14024:1999 clause 3.1 - Environmental labels and declarations – Type I Environmental labelling – Principles and procedures

[4] http://www.nordic-ecolabel.org/

[5] 14021 clause 3.1.3 NOTE An environmental claim may be made on product or packaging labels, through product literature, technical bulletins, advertising, publicity, telemarketing, as well as through digital or electronic media such as the Internet. Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling) (ISO14021:1999)

[6] ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

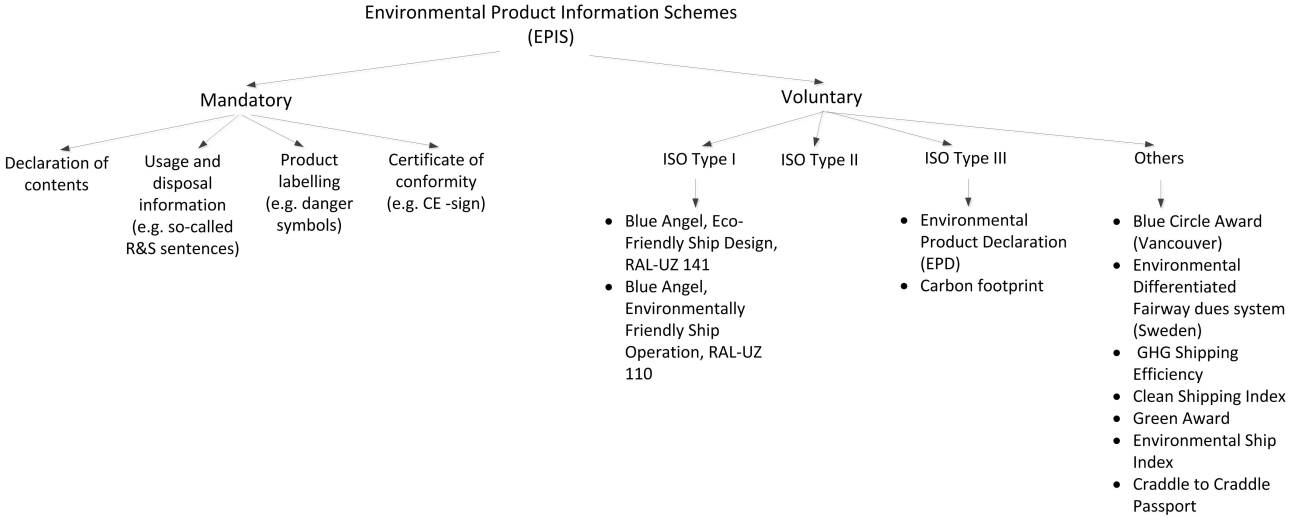

Figure 1 Classification of Environmental Product Information Schemes (EPIS) and relation with the shipping industry

1.2 Scope of the report and structure

As stated above, market actors (e.g. end-consumers, business customers, and banks) can become a driver that demand environmental responsibility from shipping companies. These market regulations, i.e. the ways in which market actors (those actors that have a commercial relationship to a company) exert pressure on companies with regard to their environmental performance (Smink, 2002, p. 84), can be a useful way to encourage a greening of industry. Information is an important condition for the promotion of green markets. Eco-labels can play an important role in providing the market this information. However, it is not easy to develop an eco-label, especially not in a globalised industry like the shipping industry. This report addresses the question:

How to develop an eco-label scheme for the promotion of wind-assisted propulsion technology in shipping?

This main question is divided in two sub-questions:

- *What could be the focus areas of an eco-label scheme to promote wind-assisted propulsion technology?*

- *To what extent do ports encourage ship-owners to improve their environmental performance?*

The report is structured as follows: the authors review existing voluntary and eco-label schemes for promoting cleaner shipping in order to provide insights to the first question (section 2). In the case, the authors discuss on general design characteristics of the Ecoliner (section 3) and benchmark these design characteristics against the verification criteria of "The Blue Angel", which is a type I scheme that awards the eco-label in the categories of "Eco-friendly ship design" and "Environmentally friendly ship operation" (section 4.1). At the outset of this benchmark analysis and relying on the general principle for eco-label design Type II- ISO 14021, the authors suggest ECO-SAIL as a new type of eco-label which focus is on the use of wind-assisted propulsion on ships. The role of incentive providers (among them ports) is looked in relation to the proposed ECO-SAIL eco-labelling scheme (section 5).

2 Overview of existing maritime transportation eco-labelling schemes

In this section we discuss the general characteristics of voluntary schemes and product eco-label relevant for the shipping industry. The databases of the Global Eco-labelling Network (GEN) and Eco-label Index (www.eco-labelindex.org) provided a comprehensive list of labels. We identified several eco-labelling schemes, which are relevant for maritime cargo transportation. In Figure 1 we grouped them accordingly to if they are consistent with the ISO 14020 series of standards. In Appendix B we provide a presentation of each scheme.

The detailed description of the different eco-labels presented in Appendix B shows that the actors in the shipping industry (e.g. ports, shipping companies, cargo owners) have settled several voluntary schemes, which do not follow the requirements of ISO 14020 (Type I, II or III). The common characteristic in these schemes is that they have technical criteria for assessing the environmental performance of individual ships. Ship-owners voluntarily participate in the schemes by submitting the data requested by the schemes. As A result the organization behind the scheme grades the ship according to the technical criteria (the responsible for the grading is a port as in the case of the blue circle award, an independent NGO in the case of the clean shipping index, etc.). In response to this grading, the ship/ship-owner receives incentives, which are meant to motivate investments in cleaner technologies. The incentives can be diverse: from reduced port-fees (in the case if the environmental differentiated fairway dues system in Sweden) (see also section 5), reduced prices by services delivered by maritime service firms participating in the scheme, to the possibility to attract more business to business customers who also have access to the database and are willing to contract the services of shipping with good environmental performing shipping firms (as in the case of the Clean Shipping Index, CSI).

Eco-label schemes that are not based on ISO 14024 are not widely diffused in the shipping industry and thus they overlap in many areas. For example, a shipping company can be part of the CSI to gain a good reputation among some cargo owners from Northern Europe, but at the same time participate in the Green Award scheme (promoted by some ports around the world). As the shipping companies are key actors in the supply chain (by delivering transportation and logistical services), then cargo owners willing to green their supply chain could have more challenges to identify those shipping companies with a better environmental performance, if the variety of green ship voluntary schemes is complex. A different scenario would be if the schemes were based in international accepted standards as ISO 14020.

However, only three eco-labels are inspired according to the ISO 14020 series of standards but these do not have the same diffusion and acceptance as the voluntary schemes that are not based on the ISO 14020 series of standards. The Blue Angel (Type I) and the Cradle-to-Cradle Passport (Type II) are the only labels with a direct relation to the shipping industry. The Blue Angel eco-label offers two kinds of awards for ships: one is meant for ship design (and applies for new ships) and the second is for the operation of already sailing ships. The Cradle-to-Cradle (C2C) Passport is an industry self-declaration from the shipping company Maersk, which claims “Recyclability” of the ship. Here the distinction between both types of eco-labels becomes evident, while type II is linked to one particular shipping firm, the type I eco-label is open to all shipping companies willing to have their ships labelled with the Blue Angel eco-label. In principle the Blue Angel should have a better acceptance in the shipping industry supply chain, e.g. cargo owners willing to green their supply chains would prefer contracts with shipping firms which fleets are Blue Angel certified. However this is not the reality, in the section 4 we explain what could be an alternative for an eco-

label based on the ISO 14020 series of standards and what would make it more accepted scheme (internationally and along the supply chains relying on maritime transportation).

3 Ecoliner: multi-purpose cargo vessel

To prepare this section, the authors reviewed technical reports elaborated as part of the other work-packages in the SAIL project, in particular the technical and economic feasibility studies of the hybrid-propelled vessel Ecoliner. Some of these reports are publically available through the consortium website www.nsrsail.eu, other documents are available internally for members of the consortium.

3.1 The technical specifications, sailing route and type of cargo

The Ecoliner (Figure 2) is a desk ship designed by Dykstra naval architects[7] (The Netherlands). The Ecoliner, a multipurpose cargo and bulk vessel, combines a Diesel engine (3000 kW) along with four sailing rigs (Dynarig mast, with a capacity of 4000 m^2, 8000 deadweight tonne (DWT) and maximum speed of 12 knots). The speed can reach up to 18 knots depending of the climatic conditions (i.e. waves, wind and current).

The propulsion system also counts with an engine and propeller in order to secure constant speed but also to increase the wind in contact with the sails. Hence, the vessel secures less fuel consumption as compared as if only relied on engines to achieve the same speed. The combination of both technologies, wind-assisted propulsion along with the engine also reduces the emissions from the vessel. A computer simulation takes into account several climatological criteria and speeds of sail and concluded that the average fuel consumption rate for the Ecoliner is 6,9 ton/day, with larger variations expected depending on the weather conditions. In comparison engine propulsion alone consumed 10,7 ton/day. The Ecoliner includes four sailing rigs, which provide a combined area of approximately 4000 m^2; one person controls these rigs automatically from the bridge. The material is Dacron, a sailcloth relatively inexpensive and with a proven lifetime of over 100 000 miles without deterioration (see Appendix C for more design specifications).

[7] http://www.dykstra-na.nl/

Figure 2 A sketch of a sailing Ecoliner vessel. Source: Dykstra Naval Architects (2013)

Since no prototype of the vessel is sailing at the moment, the desk studies suggest three suitable routes for the prospect Ecoliner:

- A clockwise round-trip of the North Atlantic
- Europe- South America
- US west coast- Japan

3.2 Value proposition of the Ecoliner

The value proposition of the Ecoliner is the reduction of the total costs (fuel costs +operational costs OPEX + capital costs CAPEX) when comparing to a vessel sailing exclusively through diesel engine propulsion. The CAPEX+ OPEX for the Ecoliner is higher than a conventional vessel running on fuel for all increasing speeds. However, this higher CAPEX cost is compensated by the lower fuel costs for the Ecoliner at increasing speeds. In consequence, the use of less fuel also means less pollutant emissions as SO_X, NO_X and greenhouse gases (Figure 3).

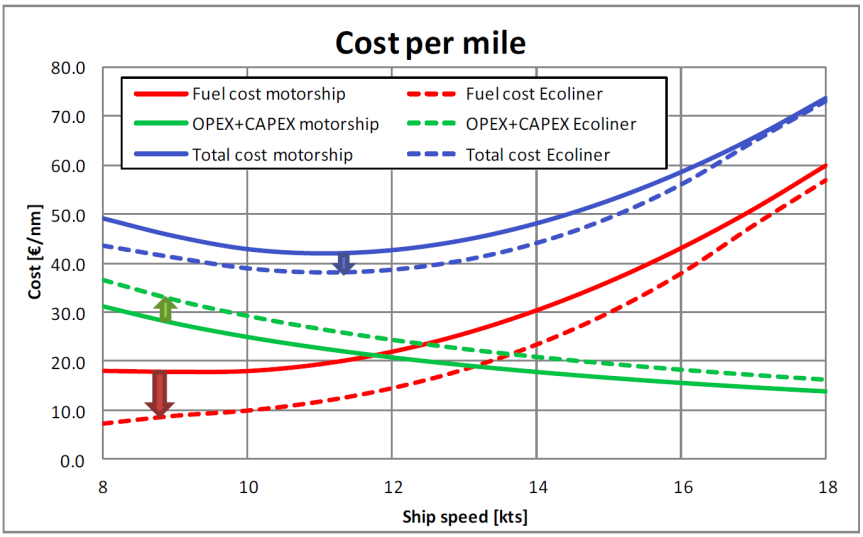

Figure 3 Cost per mile as a function of speed for a motor ship and the Ecoliner. Source: Dykstra Naval Architects (2013)

4 Eco-label scheme for promoting wind-assisted propulsion

According to the analysis presented in section 2, the Blue Angel is the only Type I eco-label scheme based on the ISO 14020 series of standards. In section 3 we present a benchmark analysis of the Ecoliner multipurpose cargo vessel in relation to the Blue Angel eco-label. We consider that a comparison between the Blue Angel and the Ecoliner is valuable as this is one type of vessel with expected good environmental performance and thus with the potential to raise the interest of actors in the supply chain, however we also analyse the shortcomings of the Blue Angel for ships as the Ecoliner. Based on the outcomes of the benchmark analysis, in section 4.2 we propose a labelling scheme based on ISO type I.

4.1 Benchmark analysis: the Ecoliner and the eco-label Blue Angel

The Blue Angel is the only European Type I Eco-label that is awarding an Environmental Label for Environmentally friendly Ship Operation[8]". The goal of awarding the Blue Angel eco-label for environmentally friendly ship operation is to reduce emissions and pollutant discharges from ocean-going ships into the marine environment. The Blue Angel eco-label may be granted for all ocean-going types of ships, provided that they comply with the requirements. The Blue Angel Standard is managed by four entities (Blue Angel, 2015):

1. The Environmental Label Jury is an independent decision-making body composed of representatives from environmental and consumer associations, trade unions, industry, trade, crafts, local authorities, science, media, churches and federal states

[8] Basic Criteria for Award of the Environmental Label Environmentally Friendly Ship Operation RAL-UZ 110, Edition January 2010 (First edition was from 2002)

2. The Federal Ministry for the environment Nature conservation and Nuclear Safety is the owner of the label. It regularly informs the public about the decisions of the Environmental Label Jury
3. The Federal Environment Agency with its "Eco-labelling, Eco-declaration and Eco-procurement" department acts as office of the Environmental Label Jury and develops he technical criteria of the Basic Award Criteria for the Blue Angel
4. RAL[9] gGmbH is the label-awarding agency

RAL has chosen a "flexible" approach because the basic criteria are to be taken into account for all types of new and existing ships. For this reason, the Blue Angel is as an ideal platform or model for developing basic criteria to promote hybrid sailing technologies, which is the purpose of this report. RAL has set criteria for issuing the Blue Angel eco-label according to two categories: "Eco-friendly ship design" (RAL-UZ 141) and "Environmentally friendly ship operation" (RAL-UZ 110). In Appendix C we present a list of these criteria for both categories.

4.1.1 Environmental-friendly ship design

The criteria for "Eco-friendly ship *design*" are proposed for new ships and cover four categories:

- Environmental protection in ship design
- Structural protection from accidental environmental pollution,
- Reduction of operation-related emissions
- Criteria for tanker constructions.

The first three categories apply to the Ecoliner; however only in one of them the Ecoliner design could make a difference from conventional vessels, and thus become an attractive option for ship-owners/operators wishing a new ship according to the Blue Angel criteria. The Ecoliner design highlights lower fuel consumption as compared to similar only fuel-powered vessels. This characteristic is eventually rewarded through the category "Reduction of operation-related emissions". In particular, five aspects deal with the emissions originating from the use of fuels: Sulphur emissions (SO_2), Nitrogen Oxide (NO_x) emissions, particulate emissions, Carbon Dioxide (CO_2) emissions, reducing emissions during time in port. The requirements for these aspects indicate compliance with IMO standards (i.e. MARPOL Annex VI, but also non-enforced standards as the Energy Efficiency Design Index (EEDI) and Environmental Operation Design Index (EODI). Hence, the assessment of whether a ship deserves the award is based on the emission threshold of the given ship, irrespective of which kind of technology is used to achieve that aim, e.g. if the ship uses sails or engines running on LNG. This threshold approach does not contribute as incentive for the development of alternative ship designs, which integrate e.g. wind propulsion.

4.1.2 Environmental ship operation

The Blue Angel eco-label in the category "Environmental friendly ship *operation*" is aimed for ships already in operation, and the requirements for delivering this label are grouped in three categories:

[9] RAL is the German Institute for Quality Assurance and Certification (www.ral-guetezeichen.de)

- Policy and management of the ship-owning company
- Ship design and ship equipment
- Ship operation management and ship operation technology.

Some issues are relevant when comparing the requirements from the Blue Angel eco-label with the design characteristics of the Ecoliner (Appendix C, Table 6): the first category focuses on the ship operator and not on the ship design. Hence, if the ship operator has a proper environmental management system, personal management system and personal development; here the Ecoliner does not make a difference with other conventional ships, for example a ship that eventually runs on HFO[10] engines. A similar situation occurs with the second category, "Ship design and ship equipment", where focus is on the hull protection (i.e. only the parameter on hull stress monitoring applies to the Ecoliner): if a ship runs on diesel engines proves that is designed according to this criterion, it will also gain points as if the Ecoliner proves this criterion. It is in the third category, "Ship operation management and ship operation technology", where the Ecoliner could have a relative advantage over conventional ships, in particular three criteria (SO_X, NO_X, and CO_2 emissions). These three criteria require compliance with IMO standards, MARPOL Annex VI for SO_X and NO_X, and the Energy Efficiency Operational Indicator (EEOI) for CO_2 emissions. The challenge for the Eco-liner's wind-assisted propulsion technology is that these criteria focus on emissions thresholds based on engines that run on fossil fuels.

4.2 The SAIL proposed labelling scheme: ECO-SAIL

The intention of the labelling scheme is to promote environmental friendly ship design and operations by providing a market driven incitement for ship cargo companies to implement hybrid technologies on existing and new ships.

Based on these premises, the following shall be conditions for issuing the eco-label:

- The ECO-SAIL label should be an ISO type I label – based on life cycle thinking and a third party operation. The main reason is that the EU Eco-label regulation is built upon a Type I approach, and thus provides additional access to the Global Eco-labelling Network (GEN). The Type I approach will give the ECO-SAIL label a fair chance to be recognized.
- An international ECO-SAIL label should be aligned with the objectives of the two Blue Angel eco-labels for shipping. The first of these objectives deals with the design of eco-friendly ships: "implement as many environmental innovations as possible for reducing releases into the marine environment already during the planning phase for a sea-going ship". The second Blue Angel eco-label deals with ship operations[11] and the objective is "to reduce emissions and pollutant discharges from ocean-going ships into the marine environment". Both categories of the Blue Angel are based on comprehensive background material (see Appendix C)
- An independent and impartial Jury from trade, cargo, port, retail and researchers shall develop the criteria set.

[10] Heavy Fuel Oil.
[11] Blue Engel: Environment-conscious Ship Operation | RAL-UZ 110

- The label shall be demand driven e.g. though alliances with big European retail chains and organization like Fairtrade

5 Demands made by ports

As described in the introduction, it has been acknowledged that a more environmental-friendly shipping industry cannot solely be achieved through legislation or the improvement of enforcement mechanisms. End consumers and business customers can drive ship-owners to commit to build and operate ships in a more sustainable way. In this section, we focus on the role ports can play in this regard. Shipping has an environmental impact both in ports, as well as in the immediate vicinity of the ports. Examples of these impacts are noise from ship engines and machinery used for loading and unloading and exhausts of particles, CO_2, NO_x and SO_2 (OECD, 2011). Ports have a responsibility in ensuring a clean environment in port areas. A maritime eco-label, as the proposed ECO-SAIL (see former sections of this report), enables ports (and other stakeholders) to encourage ship-owners to improve their environmental performance and by this improve the environmental performance of ports. Many ports around the world have committed themselves to improve their environmental performance. As we will analyse in this section, some ports cooperate with shipping companies to also reduce environmental pollution from ships, other ports focus solely on activities in the port area.

In this report, we have chosen to investigate ports that join EcoPorts[12], a label that ports can achieve to show they have some kind of environmental management system. By means of analysing their website, we will investigate to what extent these ports make demands on ships with regard to their environmental performance.

5.1 Eco-ports

According to the EcoPort website the vision of EcoPorts *"has been to create a level playing field on port environmental management in Europe through the sharing of knowledge and experience between port professionals."*(EcoPorts, 2015a)

EcoPorts were established in 1994, and since 2011 it has been integrated in the European Sea Ports Organization (ESPO). The aim of the network is to exchange views and best practices across Europe in order to improve the environmental performance of the sector. In order to join the network the port must complete a SDM (Self Diagnosis Method). The EcoPorts SDM, is a checklist, against which the ports can self-assess the environmental management program of the port in relation to both European and international standards. Any port completing this SDM will be accepted into the EcoPort network. According to EcoPorts (2015) this is done as an award for providing the data. Thus, the EcoPorts SDM[13] is a type II label (see also section 2). However, a port can obtain additional credit by submitting the SDM for analysis and obtaining a PERS (Port

[12] http://www.ecoports.com/

[13] The fact that certification is not necessary and the network membership is based on self-assessment is a weakness. As we recommended with regard to the ECO-SAIL label, it is preferable to have a label based on third party operation and with an independent and impartial jury.

Environmental Review System[14]) certification, which is a port-sector specific environmental management standard. PERS verifies that the ports' environmental management programme is in line with the requirements set by the EcoPorts PERS. PERS certification is valid for 2 years and can be independently certified by Lloyd's Register (EcoPorts (2015a).

At the time of writing (June 2015) there are 71 ports registered in the EcoPort network, see Figure 4.

Figure 4 EcoPorts as of March 2015 (EcoPorts, 2015b)

All the ports have completed the SDM and 20 ports have a PERS certification (EcoPorts (2015a). Next to PERS certification, some ports do also have ISO 14001[15] and/or EMAS[16] certification. Number of certified ports and the combinations of certifications is shown in Table 1.

Table 1 Number of Ecoports with certifications as by June 2015. Source: EcoPorts (2015b)

Certification	Number of ports
No certifications (SDM only)	20 ports
PERS	20 ports
ISO 14001	38 ports

[14] See for more information on PERS certification: http://www.ecoports.com/templates/frontend/blue/images/pdf/PERSBrochure2011.pdf

[15] The ISO 14001 standard specifies the requirements of an Environmental Management System (EMS) for companies or organisations. It can be used by any company/organisation regardless of its activity or sector. See for more information: http://www.iso.org/iso/home/standards/management-standards/iso14000.htm

[16] The EU Eco-Management and Audit Scheme (EMAS) is developed by the European Commission for companies and other organisations to evaluate, report and improve their environmental performance. See for more information: http://ec.europa.eu/environment/emas/index_en.htm

EMAS	5 ports
PERS + ISO 14001	6 ports
ISO 14001 + EMAS	5 ports
PERS + ISO 14001 + EMAS	1 port

5.2 Eco-port strategies

The number of EcoPorts changes, but at the time of our assessment (June 2015) there were 71 EcoPorts listed on the website; http://www.ecoports.com/map. Every website was visited and the first step was using their own search engine – simply searching for "environment", "sustainability" or "environmental". If no results came up a manual search was carried out. In the cases where environment/sustainability was identified on the website a manual skimthrough of documents to assertain the level of enviromental involvement. The results can be placed into five categories:

1. No result (i.e. website not available (in English))
2. No apparent focus on environment
3. Some mention of environment
4. Focus on the environment, but no apparent inclusion of ships in their strategies
5. Focus on the environment, and inclusion of ships in strategies

8 out of 71 ports do not have an English version of their website. These ports have not been analysed any further. 22 out of 71 ports fall within the second or third category. Some ports show a copy of their (PERS/ISO 14001) certification without any further comments; other ports in these two categories have a general description on sustainability and Corporate Social Responsibility (CSR) without going into detail how they as a port work on these sustainability issues. Among the ports in these categories, there are also ports that do have ISO14001 certification.

The ports in the fourth category (36 ports) are more specific about their environmental activities. The environmental strategy of these ports can be labelled "comply with existing regulations" or "move beyond compliance". An example of the first strategy is the implementation of a Port Waste Plan, since ports in the European Member States are, under the European Directive (2000/59/EC), required to make a Port Waste Plan. An example of the latter strategy is the use of electric vehicles in the port estate in order to reduce greenhouse gas emissions. However, common to both strategies is that these ports solely focus on the environmental performance within the port estate. The ports in this category are typically very clear about what environmental aspects they monitor (typically air, water, noise and waste pollution).

Out of the 71 examined ports, five ports make demands on the environmental performance of ships. Common to all these ports is that they apply lower port fees for ships with lower pollution. JadeWeser Port (Germany) (SDM registration only), for example, applies lower port fees for ships with lower sulfur emissions; they apply the Environmental Ship Index (ESI) (see appendix B for a description of this label) to provide financial incentives for ships that protect the environment (JadeWeserPort, 2015). JadeWeser Port is also involved in developing international standards for the use of cleaner fuels such as LNG. Unfortunately, there is no information available regarding the level of discounts or which level of sulfur emission or ESI points will prompt the discounts. Also the ports of Bremen/Bremerhaven (PERS certified) have introduced the ESI. Since 2012, ship-owners are paying lower charges if they despatch highly environmentally friendly vessels in

Bremen and Bremerhaven (Bremenports GmbH, 2013). In the ports of Bremen/Bremerhaven, it is the top 25 vessels that will receive a discount, see Table 2.

Table 2 Summary of available discounts at Ports of Bremen (Port of Bremen, 2010)

Measurement	Level to achieve discount	Discount
Environmental Ship Index	30-40 points	5 % discount
Environmental Ship Index	≥40 points	10 % discount

The sulfur content of the fuel and the nitrogen emissions of the vessels have been taken into account in the port charges of the Port of Turku (Finland) (ISO 14001 certified) since 2006. For granting a reduction of the charge[17] it is required that the port is given an acceptable certificate or specification of the sulfur content of the fuel and nitrogen emissions of the vessel. The price reductions are also applied in waste management (Port of Turku, 2015).

Both the Port of Gothenburg (ISO 14001 certified) and the Port of Stockholm (ISO 14001 certified) state very clearly on their website, that – in conjunction with the new more stringent sulfur regulations that apply from 1 January 2015 – they have revised their discount systems[18]. In Gothenburg, the port charge has been differentiated according to the Clean Shipping Index (CSI) (see also section 2) and the ESI. The port also awards ships that make the switch to LNG. The port discounts are summed up in Table 3.

Table 3 Summary of available discounts at Port of Gothenburg. (Port of Gothenburg, 2015)

Measurement	Level to achieve discount	Discount
Clean Shipping Index	Green standard	10 %
Environmental Ship Index	≥30 points	10 %
Switch to LNG		20 % through to December 2018

In the Ports of Stockholm the environmental rebates are the following (Ports of Stockholm, 2015a):

- A funding contribution of € 108.495 will be offered to every vessel that carries out restructuring work to enable the vessel to connect to electricity at the quayside. This applies for the quays where Ports of Stockholm offers quayside electricity connection capabilities
- The port fee for LNG vessels will be discounted by € 0,0054 per unit of gross tonnage. For a vessel calling at Stockholm every second day the rebate will be around € 54.247 annually

[17] Details of the price reductions to be granted can be found here: http://www.portofturku.fi/portal/en/charges/
[18] The Port of Stockholm has applied differentiated fees since the 1990s and the Port of Gothenburg since 1998.

- The discount for reduced emissions of nitrous oxide will follow the seven-level scale applied by the Swedish Maritime Administration. For a normal-sized vessel operating daily calls this will mean a discount of between € 325.486 to € 433.981 annually, depending on the amount of nitrous oxide emissions.

In that sense, the Ports of Stockholm goes a step further than some of the other ports in this category.

Next to the differentiated fees for ships, the port of Gothenburg states it will be carbon neutral by 2015. At the time of writing, their website does not state whether it has been achieved yet (see also the environmental report of the port[19]). Even though the carbon neutrality seems to only apply to the port estate, their environmental work does happen in collaboration with the terminals, shipping companies and the land based transport operators. The port does also reward and compensate for green investments. Also the ports of Stockholm have some very concrete overall environmental targets that not only focus on the environmental activities in the port estate, but also include ships (Ports of Stockholm, 2015b):

- Energy consumption will be 50 percent less by 2025
- Zero fossil fuel carbon dioxide emissions by 2025
- All purchasing of goods and services will have environmental requirements by 2016
- Reduced material consumption and increased proportion of recycled material in buildings and facilities
- Reduced environmental impact in choice of materials
- No hazardous substances in buildings and facilities by 2020
- 100 percent of all materials must be sorted at source and the proportion of waste sent to landfill will successively diminish
- *Ensure that the major shipping company customers operating via ports of Stockholm use Ports of Stockholm's environmental improvement services by 2020*[20]
- Increase the number of environmental improvement services by 100 percent by 2020

5.3 Conclusions

In this section we have analysed to what extent ports that are members of the EcoPorts network make demands on ships with regard to their environmental performance. In total 71 ports are registered in the EcoPorts network, but since 8 of the ports don't have an English version of their website, we have analysed 63 ports. By means of an assessment of the website of these ports we come to the realisation that 34 % of ports (22 out of 63 ports) do not have apparent focus on environment or only some mention of the environment on their website. For the purpose of our study, these ports have not been analysed any further. In total 41 ports focus on the environment on their website and 5 of these ports do also include ships in their strategies.

Since we only executed an analysis of the website of the ports that join the EcoPorts, we can not conclude that 34 % of the registered EcoPorts do not have apparent focus on the environment; we

[19] www.portofgothenburg.com/about-the-port/sustainable_port/sustainability
[20] Text in italics by the authors of this report.

can only wonder why ports decided to join the EcoPorts network but not decide to share information on their environmental strategies on their website.

On the other hand 65 % of the ports that join the EcoPorts (41 out of 63) do focus on the environment and of these ports 8 % (5 out of 63) do make demands on ships with regard to their environmental performance. Common to these 5 ports is that they apply differentiated fees for ships.

Out of the 5 ports that make demands on ships with regard to their environmental performance, one ports does only have a SDM registration, one port is PERS certified and three ports are ISO 14001 certified. But there are also ports in the EcoPorts network that are ISO 14001 and/or EMAS certified, but do not mention the environment on their website. Thus, there does not seem to be a correlation between having a certified environmental management system or the EcoPort label and promote the environment on the website.

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Appendix A: ISO 14020 standard on environmental labels and declarations

The authors referred to the ISO 14020 series of standards on environmental labels and declarations, which are international recognized benchmark against which business can prepare environmental labelling, which are increasingly used in products and in advertising. We present in this section a short introduction the ISO 14020 series of standards on Environmental labels and declarations. This description will be the background for analysing which labelling scheme will be best for a ship like the Ecoliner.

According to the ISO 14020 series of labelling standards, an Environmental label and an environmental declaration are defined as a claim, which indicates the environmental aspects of a product or service[21]. ISO 14020 includes 9 principles and principle 1 expresses very well the expectation to claim "*Environmental labels and declarations shall be accurate, verifiable, relevant and not misleading"*[22].

14024:1999 Environmental labels and declarations – Type I environmental labelling

A Type I environmental labelling programme is a voluntary, multiple-criteria-based third party programme that awards a licence, which authorizes the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations[23]. A good example is EU Eco label scheme[24] (the Flower) and the Nordic Eco label[25] (the Nordic Swan). The Global Eco labelling Network (GEN) is organization for ISO type I schemes (see http://www.globaleco-labelling.net).

ISO 14021:1999/AMD 1:2011 Environmental labels and declarations – Type II environmental labelling

An environmental claim is a statement, symbol or graphic that indicates an environmental aspect of a product, a component or packaging[26]. Type II is the most widespread used type of labelling and in this the category you will find many misleading claims. The standard sets some examples of what is considered as a misleading claim (Table 4). In order to prevent misleading environment market claims the Nordic Ombudsmen issued in 2005 new guideline on ethical and environmental marketing claims[27]

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[21] ISO 14020:2001 Environmental labels and declarations – General principles clause 2.1
[22] 14020 clause 4.2.1
[23] 14024 clause 3.1
[24] http://ec.europa.eu/environment/eco-label/the-eco-label-scheme.html
[25] http://www.nordic-eco-label.org/
[26] 14021 clause 3.1.3 NOTE An environmental claim may be made on product or packaging labels, through product literature, technical bulletins**,** advertising, publicity, telemarketing, as well as through digital or electronic media such as the Internet.
[27] http://www.consumerombudsman.dk/Nyheder-fra-FO/Media-releases/newnordicguidelineet?tc=9E6C43D351DE4F29B6F4570D45826A9F

Table 4 Examples of misleading and preferred claims according to ISO 14021:1999/ AMD 1:2011

Misleading claim	Preferred
"This new and improved product is better for the environment" "This product uses green electricity"	"This product uses 20% less electricity in normal use than our previous model".
"This product is ozone-friendly"	"This product has replaced its aerosol ingredients with an alternative that does less to harm the ozone layer"

The standard sets criteria for each claim labelled in the product. Figure 5a and Figure 5b list all the claims having criteria within the standard. The most well known claim in the standard is the Mobius loop (Figure 1c). Figure 1d claims recycled content and the symbol used in the packaging of aluminium cans.

(a)

7.2 Compostable
7.3 Degradable
7.4 Designed for disassembly
7.5 Extended life product
7.6 Recovered energy
7.7 Recyclable
7.8 Recycled content
7.9 Reduced energy consumption
7.10 Reduced resource use
7.11 Reduced water consumption
7.12 Reusable and refillable
7.13 Waste reduction

(b)

- Biomass
- GHG
- Offsetting
- Disposal and recycling
- Renewable material
- Renewable energy
- Sustainable
- Product "carbon footprint"
- Carbon neutral

(c)

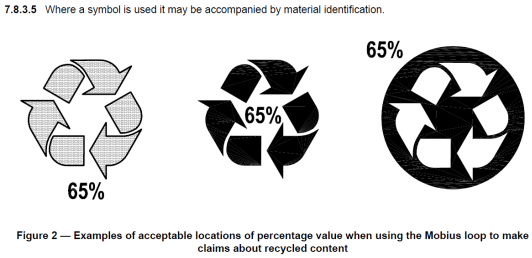

Figure 2 — Examples of acceptable locations of percentage value when using the Mobius loop to make claims about recycled content

(d)

Figure B.1 — Recycling — Aluminium cans (ISO 7001 — PI PF 063)

Figure 5 Types of claims that could be used in Type II eco-labels. (A) According to ISO 14021:1999 and (B) According to Amendment 1:2011 (c) Mobius loop (d) recycled content claim found in aluminium cans

ISO 14025:2006 Environmental labels and declarations — Type III environmental declarations

A Type III environmental declaration is providing quantified environmental data using pre-determined parameters and, where relevant, additional environmental information[28]. Type III is a pure LCA based type of labelling, but open up for relevant environmental information not covered of LCA data e.g. if a product has been awarded the EU Eco-label.

The requirements of Type III will expand in 2016 because the influence of the EU Commission and the Joint Research Centre. The main consequence is Type III eco-labelling will be linked to an open source generic LCA data and Product Category Rules for a number of product groups e.g. building material (with materiel overlap with ship building – steel and wood, etc.) and become implemented step by step through the Environmental Footprint approach which is in the test stage, but soon will be in the implementation stage.

[28] 14025 clause 3.2 NOTE 1 The predetermined criteria are based on the ISO 14040 series of standards, which is made up of ISO 14040 and ISO 14044. NOTE 2 The additional environmental information may be quantitative or qualitative

Appendix B: Relevant eco-label schemes for cargo maritime transportation

Schemes based on ISO 14020 series of standards (Type I, II or III)

The Blue Angel

The respected German eco-label "Der Blaue Engel" has two categories dealing with shipping. The label is given by a non-for-profit consortium involving representatives from the Federal Ministry of Environment, Nature Conservation, Building and Nuclear Safety, the certification organization RAL, the Federal Environmental Agency and the Environmental Label Jury (an independent decision making body formed by civil society representatives). Both categories have a set of quantified criteria in order to apply for the label. Given the widely diffusion of the eco label "The Blue Angel " among the public, ships with this label can benefit of greater market appeal.

The first category in The Blue Angel on shipping is about Ship design and construction. It is awarded to eco-friendly ship designs that implements environmental standards during the design and construction of the ship. The scope includes four points:

- Environmental protection in ship design
- Structural protection form accidental environmental pollution
- Reduction of operation-related emissions
- Criteria for tankers

The requirements are in line with applicable international regulations of safety. A great emphasis is put in the third point, which includes the installation of environmental technology, which is not required by law (example Sulphur and Nitrogen Oxides reduction equipment in some areas), but is a requirement to obtain the eco-label.

The second subcategory within The Blue Angel is Ship Operation. It is awarded to individual ships that during operations demonstrate reduction in emissions to both air and water. Ships with German and foreign flags can receive the eco label and have to fulfil a set of criteria, which includes:

- Policy and management of the ship-owning company
- Ship design and ship equipment
- Ship operation management and ship operation technology

In the third point the following environmental aspects are addressed:

- Air emissions
- Solid waste
- Wastewater

- Liquid emissions (i.e. bilge oil, ballast water, lubricating and hydraulic oils, cleaning agents)
- Noise and sound emissions

Environmental Product Declaration

Environmental Product Declaration is a verified document based in the ISO 14025 standard (environmental declarations). The declaration is for specific products and the set of criteria to be assessed are listed in the EPD international system. All products issuing an EPD are also listed in the website (Figure 6a). A vessel, for instance could apply for an EPD label provided that it complies with all the award criteria. Earthsure is the EPD for North America, and is administered by the Institute for Environmental Research and Education (IERE). Earthsure is based on an LCA. In order to ensure that similar products are assessed in comparable ways, IERE publishes category rules for each product (PCR). In case no PCR exists, the applicant has to make sure to prepare the PCR as part of the application process.

(a)

(b)

Figure 6 Environmental Product Declaration (a) Logo of the international EPD system, which lists all the products that issue and environmental product declaration (b) Earthsure is the EPD eco-label in North America

Schemes not based on ISO 14020 series of standards

Other voluntary schemes relate to maritime transportation but are not based on the ISO 14020 series of standards. These three schemes share the similarity that authorities categorize ships according to an environmental parameter (SO_X and NO_X in the case of the Swedish system), and then reward the ships that fulfil or surpass the threshold included in the environmental parameter. The reward is typically a reduction in port-due fees (as the case of the Swedish and Canadian scheme), a simplification in the paperwork and a fast-track process for port-calls (in the case of the US scheme).

Other eco-labels directly related to maritime transportation have a focus on emissions reduction (NO_x, SO_x and CO_2), with an exception the Clean Shipping Index which also includes operational criteria which are not only emissions (i.e. hull paint, or bilge water handling). This kind of voluntary schemes is the most popular among ship-owners and cargo owners (Wuisan et al., 2012). In the same way, NGOs (as the North Sea Foundation) actively promote these schemes as market instruments to convince ship-owners to invest in green technology.

Cradle-to-Cradle passport (Maersk):

This is an example of Type II environmental labelling. Cradle-to-Cradle passport is an inventory of the materials used for the construction of ships (specifically the Maersk Triple-E class). The inventory allows proper locating the ship's recyclable components so the recycling process is carried. According to the ISO 14021 standard, Cradle-to-Cradle will be an example of the environmental claim "Designed for disassembly".

Blue Circle Award

The program awards shipping companies with vessels calling into the Port of Vancouver. The shipping firms have to apply to the award with each individual vessel once a year or during each port call. The port authorities published harbour fees categorize the vessels calling into port into bronze, silver and gold. These fees are reduced as compared to the normal price requested to vessels not falling into these categories. The requirements to be granted the blue circle award is demonstrated efforts to reduce the emissions, or the quality of fuel.

The scheme is part of the air component within the Port Metro Vancouver EcoAction Program – which has similar initiatives for land, water, noise monitoring, habitat enhancement and marine mammals.

Environmental differentiated fairway dues System

The system is an addition to the fairway due fees which are normally paid according to each vessel gross tonnage, and loaded/ unloaded cargo. One aspect of environmental differentiation is the sulphur fee, where the sulphur content is calculated according to the percent by mass. When this figure is between 0-0,2 %, the fee is 0 Swedish Krone (SEK); when the % is between 0,21-0,5 the fee is 0,20 SEK per unit of vessels gross tonnage. Above 0,51 % of sulphur the fee is 0,70 SEK.

Another aspect of environmental differentiation are Nitrogen Oxide emissions, whose fee is calculated in a similar way as for the sulphur oxide emissions. The goal of the scheme is incentivize the ship-owners to install environmental technology to reduce the emissions of both SO_X and NO_X.

Shipping Efficiency - A to G GHG Emission Rating (ISO Type II)

The A-G GHG Emissions Rating provides a systematic and transparent means of comparing the relative theoretical efficiency and sustainability of the existing fleet of approximately 70,000 existing ships (including the majority of the world's container ships, tankers, bulk carriers, cargo ships, cruise ships and ferries) by measuring a ship's theoretical CO2 emissions per nautical mile travelled.

A vessel's GHG Emissions Rating is presented using the standard European A - G energy efficiency scale and relative performance is rated from A through to G, the most efficient being A, the least

efficient being G. ShippingEfficiency.org is an initiative launched by the Carbon War Room and Right Ship. Learn more: Shipping Efficiency - A to G GHG Emission Rating website

Clean Shipping Index

The Clean Shipping Index is a Swedish-initiated eco-label and clean ship database, which seeks to facilitate business customers to find the best environmentally performing vessel. The vessels listed in the database shall comply with a set of 22 environmental criteria, which includes for example, how well the vessel performs in terms of emissions to air, water, etc. After filling an online questionnaire for each vessel, a third party verifies that the vessel performance is in line with the introduced values. Then the vessel is listed in the online database, and is benchmarked with similar vessels (i.e. a cargo ship with a cargo ship). The potential business customer (a cargo owner willing to purchase a ship service) can have access to the database and can decide to fleet with the best performing shipping liner. The Clean Shipping project is behind the index as a non-for-profit organization, participant pay a membership fee, which is intended to cover operational costs.

Green Award – the pride of oceans

The Green Award is a scheme that certifies that a vessel has an environmental and safety performance above the regulatory thresholds. The scheme is open to tankers, bulk carriers, chemical tankers, container ships and also inland barges. It is managed by a private foundation, which is formed by a Committee, a Board of Experts, a Board of Appeal and a certifying Bureau Green Award. Key actors of the shipping industry are represented in all these bodies, for example SIGTTO, INTERTANKO, INTERCARGO but also NGOs (North Sea Foundation).

A given ship can become awarded the Green Award after a certification by the Bureau Green Award. The survey includes safety and environmental criteria. Once a vessel is certified with the green award, it is listed in an online database (publically available). These vessels can obtain fees reductions in associated ports (i.e. Rotterdam, Hamburg). Associated marine service providers (i.e. environmental and safety consulting firms) also provide reduction in services. By January 2015, a total of 244 ships hold a green award. http://www.greenaward.org/greenaward

The Environmental Shipping Index (ESI) (ISO Type II)

The Environmental Shipping Index is a voluntary scheme focused on air pollution by ships. It is an initiative launched by the Wold ports climate initiative. The environmental criteria addressed by the index are SO_X and NO_X emissions and greenhouse gases. The index is calculated with an algorithm where all three criteria are taken into account. The values range from 0 to 100. A 0 value implies the ship complies with applicable standards, and a value of 100 is a ship with the best performance above applicable standards. The data is provided by the ship-owners, and an audit is subjected at the request of an incentive provider. In these cases, independent auditors are requested to carry the audit. Several major ports around the world provide incentives to ships registered in the scheme.

http://esi.wpci.nl/Public/Ships

Schemes indirectly related to shipping transportation and not based on ISO 14020 series of standards

Several eco-label schemes include a quantitative analysis of the product/ organization environmental impact and are backed-up by a national/ international recognized organization. In these cases transportation is included in the quantification of emissions, or other type of environmental impact. These eco-labels schemes certify if a product or organization is CO_2 neutral or engages in offsetting emissions. They share the similarity that the quantitative assessment is done through an LCA or carbon footprint analysis. The first example in Figure 7 is the Carbon Neutral Award, which is given to businesses (rather than products). The labelling process involves four steps: an audit to define the annual carbon footprint. Then this assessment provides a conclusion whether the firm needs to offset some of the emissions, the certifying agency then provide some options for offsetting, and if accepted them the business can obtain the label. The last step involves publicizing the company achievements and using the label. The label is issued by a consultant organization, which relies on standardized ISO methods for the LCA analysis and the issuance of the eco-label.

The second example in Figure 7 is Carbon Neutral Product Label, which is an Australian based eco-label (but can be issued to products from other countries). The certifying body is a for-profit organization Carbon Reduction Institute. The label can be issued to both products and organisations; the process of labelling involves a similar process as the Carbon Neutral Label.

The third example in Figure 7 is the Carbon Reduction Label. The scheme is administered by the Carbon Trust, an independent third party, which among other commitments advices firms about sustainability. The eco-label can be of two types: Reducing CO_2 label (which indicates that a firm takes the measures to reduce the carbon footprint), and CO_2 measured label, which indicates that the product(s) or service(s) are carbon neutral. The carbon footprint analysis is based in the British Standard PAS 2050.

(a)

(b)

(c)

Figure 7 Global reaching carbon neutrality eco-labels incorporating transportation in the LCA or carbon footprint analysis. (a) Carbon Neutral Label (b) Carbon Neutral Product Labelling (c) Carbon Reduction Label

Appendix C: Selected design specifications of the Ecoliner

Main particulars	
Length o.a.	138,00 m
Length p.p.	135, 50 m
Length w.l.	138, 00 m
Beam mld.	18, 20 m
Depth main deck	10, 20 m
Ballast draft	4, 50 m
Draft max	6,50 m
Performance (engine-only condition, range and speed will differ when using sails only or when motor sailing)	
Range	25 days
Design speed	12 kts
Capacities	
Cargo hold No1	3 950 m^3
Cargo hold No2	4 730 m^3
Cargo hold No3	4 320 m^3
Cargo hold total	*13 000 m^3*
Main propulsion	
4 Dynarig masts, total of approx.. 4000 m2	
4 hydraulic yaw systems, yaw radius of 180^0	

Appendix D

Table 5 Blue Angel, Eco-Friendly ship design. RAL-UZ 141

Category	Type of specific criteria
Environmental protection in ship design	Protection of bunker tanks On board use of materials
Structural protection from accidental environmental pollution	Redundant power systems Emergency towing system Hull stress monitoring
Reduction of operation-related emissions	Sulphur dioxide emissions Nitrogen oxide emissions Particulate emissions Carbon dioxide emissions Reducing emissions during time in port Refrigerants Extinguishing agents Waste avoidance Waste disposal and waste incineration Black water (sewage) treatment Grey water treatment Bilge water treatment Ballast water treatment Use of lubricating and hydraulic oils Application of antifouling products on the hull Application of antifouling products on seawater cooling systems Corrosion protection measures Use of dosage systems for cleaning agents
Criteria for tanker constructions	Protection of cargo tanks Use of an online loading computer Installation of a gas detection system Inert gas systems on takers Inerting of ballast water tanks and void spaces Emissions from the cargo during loading and unloading Tank design Cargo traces in wash water Cargo tank residues

Table 6 Blue Angel, Environmental friendly ship operation requirements. RAL-UZ 110

Criteria	Obligatory requirements
Policy and management of the ship-owing company	
Environmental management	Implementation of the international safety management (ISM) code And ISO 14001
Personnel management	Different requirements regarding the crew on board the ship: • The crew is part of the collective agreement provisions of the International Worker's Federation • The crew's certificate of competence is issued by a country on IMO's white list of standards on training, certification and watchkeeping • Environmental training
Personnel development	Training based on IMO STCW-95-Code. Additional requirements include systemic identification of additional areas for training, training once every two yeas on current developments related to legal provisions relevant to the ship, ship handling simulator
Ship design and ship equipment	
Hull stress monitoring	*Optional* installation and operation of a hull stress monitoring system to monitor the stress on the ship's structure
Emergency towing system	Valid for tankers 20000 dwt or more according to SOLAS Convention. Applicable for ships constructed on or after Jan. 1st 2010
Ship operation management and ship operation technology	
Sulphur dioxide emissions	Compliance with MARPOL Annex VI rules regarding sulphur content in marine fuels (e.g. shall not exceed 1,5%). Additional requirements regarding the use of scrubber and emission monitoring instrumentation. Possibility to use scrubbers if these are of the type closed-loop.
Nitrogen dioxide emissions	Compliance with MARPOL Annex VI regarding NO_X emissions.
Carbon dioxide emissions	Recording ship operational efficiency according to EEOI, development of a ship energy efficiency management plan (SEEMP), provision of technical data of the ship and ship operation consumption data for research on energy efficiency
Other climate-relevant and ozone depleting emissions	Compliance with MARPOL Annex VI, regulation 12 on the installation of systems which contain substances with an ozone-depleting potential –ODP or CFC
Waste disposal	Compliance with EU Port reception facility directive 2000/59/EC, which requires ships to dispose their waste on land
Waste incineration	Gas exhaust values as defined by MARPOL shall be met for waste incineration. Ships carrying more than 15 persons shall keep a Garbage Record Book
Black (sewage water)	Compliance with MARPOL Annex IV as specified in MEPC 159/55. In addition, chlorine and halogenated compounds shall not be used
Grey water	Similar requirements as for black water
Bilge water	Compliance with MARPOL Annex I, the residual content of bilge shall not exceed 15 ppm
Use of antifouling paints on the hull	Compliance with the IMO "International convention on the Control of Harmful Anti-fouling systems on ships"
Ballast water treatment	The ship is not required to comply with the IMO Ballast Water Convention as this is not yet entered into force. The shipowner shall however keep a ballast water management plan in accordance with IMO resolution A. 868 (20).
Lubricating and hydraulic oils, biodegradable	As there are no international binding obligations, the Blue Angel label requires the use of biodegradable lubricating and hydraulic oils in accordance with the criteria for lubricants RAL-UZ 64 or hydraulic fluids RAL-UZ 79 in all on board systems approved by the manufacturer.
Cleaning agents	Cleaning agents should be used in a diluted form through a system that delivers well-dosed portions. An optional requirement sets extra points if

	the systems operate with biodegradable lubricating and hydraulic oils.
Sound emissions	Requires compliance with IMO code on Noise levels aboard ships, and the IMO Code on high speed craft (HSC-code). A additional requirement, Blue Angel suggest regular maintenance and servicing work for a check of sound levels.
Environmentally sound recycling	The shipowner and operator shall comply with the requirements set in the Hong Kong convention , in particular with the provisions set in MEPC 179 (59) of 17 July 2009 –Guidelines for the Development of the Inventory of Hazardous Materials.

Source: Basic criteria award for the environmental label