The Emergence of Eco-Ships: Inevitable Market Segmentation?

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Abstract

Many shipping companies are engaging in "greening" activities, signalling a "paradigm shift" in operations and thinking. The shipbuilding industry has also been developing innovative ships designs which are more fuel efficient and environmentally friendly. Ship owners thus face a dilemma as to whether to invest in new eco-ships or optimise their current fleet.

If such vessels become commonplace it is possible that the gap between eco-ships and inefficient ships will deepen in terms of operational costs and daily hire rates. This could result in a situation where a two-tier shipping market develops, split between companies operating eco-ships and those operating more 'inefficient' ships. This issue thus raises a number of important questions: will eco-ships provide a more competitive approach in the market? Are they a better investment for the future? and as a consequence, is it likely that a two-tier shipping market is developing?

This paper therefore addresses the aforementioned issues and discusses the impact of the development of eco-ships and in the creation of potential market segmentation in the Dry Bulk Sector. The continued depressed market conditions means that such challenges have become urgent and further investigation into the financial implications and competitiveness repercussions of eco-ships is required.

Semi-structured interviews were conducted supported by secondary data analysis to provide further insights into the issue. In conclusion it is suggested that there may already be some elements of a two-tier market developing which are likely to increase as such technologies become more mainstream.

Keywords: Eco-ships, two-tier market, Dry Bulk

1. Introduction

From the 19th century shipping expanded its role in global transport and sea transport remains the cheapest way of moving goods, responsible for between 75% and 90% of world trade (Rodrigue et al, 2009; Marisec, 2012). While shipping is the "life-blood" of global economy, it is a highly capital intensive and highly leveraged industry, dependent on the financial

system and impacted on by factors such as the price of oil. The shipping industry earns around $US 380 billion in freight rates; a figure equals to around 5% of total world trade (Marisec, 2012). However, the global economic crisis from September 2008 led to the collapse of the freight rate markets. In addition, the high price of fuel oil became a concern for the shipping industry which had to find a way to minimise bunker costs. Hence, the shipbuilding industry started to focus on developing more fuel efficient ships, fuel efficient vessels that would reduce emissions. The answer to these challenges were eco-ships, a new generation of vessels which are more fuel efficient and create less pollution. Further, enhanced environmental regulations, higher fuel costs and the need to reduce operating expenses could provide increasingly strong incentives for shipowners to invest in such vessels. Recently, Moody's, as reported by Lloyd's List, have suggested that 'more efficient, greener fleets will have a competitive edge', particularly in the light of the mandatory energy-efficiency design index for new ships included in Annex VI of Marpol (Lloyd's List, 2013). Shipowners must therefore decide whether to invest in these new vessels in order to minimise operating costs and comply with stricter environmental regulations. As for the existing fleet, shipowners will have to optimise the performance of their ships in order to improve efficiency and to comply with new regulatory standards. This will introduce a new type of competition between the two groups of vessels.

The purpose of this paper is, therefore, to address the aforementioned issues and discuss critically the impact of the development and marketability of eco-ships and their role in the creation of potential market segmentation. The research is focused on the dry bulk sector. In relation to this, the paper also explores the challenges that ship-owners are now facing in their investment choice: on the one hand, investing in optimising their existing fleet in order to become more eco-friendly and cost efficient, a calculation that was not a part of the initial cost equation in their investment; on the other hand, investing in eco-ships, expensive and untried with unknown future outcomes on their investment. In the light of the continued depressed market conditions in the industry, such challenges have become even more pressing and pose enhanced reasons for further investigation into the financial implications and competitiveness repercussions of eco-ships. Therefore, we consider two research questions in this paper: 1. **Will Eco-Ships create a two-tier market?** and 2. **Are eco-ships a better investment for the future?**

2. Literature Review

Green-Shipping has become a popular trend during recent decades. Across the shipping industry a "paradigm shift" in operations and thinking has begun to occur. Maritime companies have been changing their strategies and starting to "go green". Along the same lines, shipbuilding industry has been developing innovative ship designs in order to be more

environmental-friendly and at the same time more fuel efficient; the emergence of eco-ships is a fact.

2.1. ECO-SHIPS

The 'greening' of shipping has thus led to the development of eco-ships, a new generation of vessels that will be eco-friendly and at the same time fuel efficient. While there is as yet no specific definition of what an eco-ship is, a new concept was recently introduced for such new ships. At the centre of the concept is the Energy Efficiency Design Index (EEDI), whose purpose is to highlight energy efficiency of ships and thence to target Greenhouse Gas emission reduction. Initially, reductions in Greenhouse Gas emissions were achieved through speed reduction, the eco-speed. The maritime industry, however, decided to face the problem more directly, by reducing emissions through cost-effective innovative technologies. The International Maritime Organization (IMO), has set the standards for EEDI (Chestney, 2011). The International Convention of Maritime Pollution (MARPOL) Annex VI amendments, from January 2013, require all new ships of 400 gross-tonnes and above to be constructed to EEDI standards; and these new ships will constitute the first generation of eco-ships. Further, a Ship Energy Efficiency Management Plan (EEMP) will have to be implemented for all ships. The purpose of the EEMP, among others, is to assist operators of old/existing vessels to improve the energy efficiency of their ships (IMO, 2011a). These technological changes fall into several key areas: hull and propeller optimisation, engine technology and efficiency, renewable energy and ballast water. The first three of these are now discussed, ballast water being less relevant to this discussion.

2.1.1. Hull and Propeller Optimisation

One of the important elements improved in eco-ships is their hull design. The EEDI consists of many innovative changes on ships' designs. While in the past ship design was considered to be a sequential process based on classic design patterns, naval architects are now challenged to develop new designs based on multiple requirements and parameters. Computer Aided Engineering using modern Graphical User Interfaces and techno-economic databases with optimization algorithms are some of the new technologies now used in ship design in order to develop new insights and design alternatives (Papanikolaou et al, 2012). New underwater hull forms, bows and sterns are being developed so as to improve vessels' hydrodynamics. Even aircraft design systems, such as Computational Fluid Dynamics, are now applied to hull design in order to discover the perfect recipe for their optimization (Cochran, 2012).

Energy loss due to bio fouling, which causes hull resistance, is another very important sector concerning naval architects. Molluscs and marine growth are still hull's worst enemies,

despite the existing anti-fouling paints used for coating, which cause reduction to speed and eventually energy efficiency loss and increased GHG emissions. Therefore, new types of anti-fouling paints are being discovered in order to offer more effective protection on a vessel's hull. Studies have shown that after a vessel's dry-docking, where the hull is cleaned and freshly painted, the power demand can be decreased up to 10 per cent (Visser, 2011). Therefore, an anti-fouling coating that can maintain such levels of smoothness on a vessel's hull is an important objective of the EEDI, as it can be applicable to both new-built and existing vessels in order to improve their energy efficiency. Another revolutionary technology that can be installed to both eco-ships and existing vessels, is air lubrication. Naval architects have invented the Air Cavity System (ACS), which reduces frictional resistance between water and hull surface, as the vessel literally floats on air. ACS system technology can reduce a vessel's oil consumption and CO2 emissions by 10% (Johannesson, 2012). Hydrophobic surfaces, ceramic nano-coatings which are erosion and corrosion resistant, and current pressure sensors are some of the technological advancements expected to be seen on eco-ships (Gould, 2011).

Since naval architects are focusing on new designs for ships' hulls, improvements to propellers as well could not be left unexplored. Energy saving can be accomplished by an appropriate propeller as well; by designing new hydrodynamic shapes, by optimizing the appendages and by the application of energy saving devices. Energy saving devices can either recover losses from the propeller slipstream or improve the water flow to the propeller. (Hollenbach and Reinholz, 2011; Sasaki et al, 2009).

2.1.2. Engine Technology and Efficiency Improvement

Since 2005, Marpol Annex VI has set limits on Sulphur Oxide (SOx) and Nitrogen Oxide (NOx) emissions on ship exhausts (IMO, 2005). In 2008, Marpol Annex VI was revised with more stringent requirements. (IMO, 2011b) In the same year, Annex VI designated "Emission Control Areas" (ECA), with requirements for all GHG emissions, including SOx and NOx. (IMO, 2011c) As for NOx emissions, Regulation 13 of Marpol Annex VI proposed a three-tier structure for new engines which would progressively reduce their emission standards, depending on the date of their installation. (IMO, 2011d)

The specifications of new built eco-ships will have to meet the stringent GHG emissions requirements. The new engines will be designed to consume high distillate fuel oils and to comply with the Marpol Annex VI "Tier" requirements as well. However, installing a "Tier II/III" engine which consumes low-sulphur fuel oil is not the end of the story. SOx and NOx emissions are vital, but not the only GHG emissions. On the basis of IMO's EEDI, as discussed earlier, there must be some energy efficiency improvements in the ships' engine as well in order to reduce CO2 emissions. Reducing SOx/NOx emissions does not mean reducing CO2 as well; regarding NOx emissions, in some cases it is actually the contrary. Since reduction of CO2 emissions is roughly equivalent to reduction of fuel oil consumption,

the marine industry is working on engine designs that will be more fuel efficient. The goal for eco-ships' engines is to reach a 30% reduction in fuel consumption per voyage (MAN-Diesel, 2011).

Some of the technological changes which are taking place relate to both engine and auxiliary systems. For example, electronically controlled long-stroke engines with lower Revolutions per Minute (RPM) that can reduce fuel and CO2 up to 7% are now being introduced to eco-ships (Grøne, 2010). Since the GHG emission requirements lead to speed- reduction technologies, auxiliary systems are also re-designed to avoid energy losses. Variable nozzle turbochargers, based on Variable Turbine Geometry, are another technological innovation that can reduce fuel oil consumption and CO2 emissions around 2.5% (MAN-Diesel, 2012). Ships' engine designers are working on new ideas in order to accomplish energy savings. Waste Heat Recovery (WHR). WHR systems can generate electrical energy from ship's exhaust gases; reducing fuel consumption and CO2 emissions by up to 12% and energy requirements by 10%. (Zapfe, 2010)

2.1.3. Renewable Energy

The ever-growing global concern on the adequacy of fuel oil in the future has supported the search for alternative sources of energy. Growing environmental concerns have led to many experimental ships' designs in order to take advantage of the free natural energy. There are many concept designs for eco-friendly ships that make use of wind and solar power, but few of them are likely to be implemented in the near future. One of the most tangible projects, however, that has already been tested and applied in the industry is the use of kites for small bulk carriers. Using kites, when the wind is favourable, ships can use it as an auxiliary propulsion system. Since wind is a free, limitless, powerful and green source of energy, using kites is an attractive technology as it simultaneously reduces operating costs and emissions (SkySails, 2012a). According to studies, on good days fuel consumption can be halved and an average saving of 10-15% on fuel costs achieved over a year. The system can be operated very easily from the bridge by a control panel. The launch and recovery process is semi-automatic and requires only few actions by the crew on forecastle deck (SkySails, 2012b).

3. Industrial Reactions to Eco-Ships

3.1.Will eco-ships create a Two-Tier Shipping Market?

The shipping industry entered 2003 with low expectations. During the Dry Bulk Shipping boom there was a demand expansion for new orders and shipyards developments. The newbuilding industry was caught by surprise, as records for newbuild orders were broken regularly. During that period, owners wanted to take advantage of the increased tonnage demand and order as many ships as possible. The capacity of the established Japanese and Korean shipyards was quickly met and new Greenfield yards in China started taking many

orders. During the 2001 – 2002 period the average number of bulk carrier deliveries was 12.65 million dwt per year, while in the 2003 – 2008 period it jumped to an annual average of 24.3 million dwt (UNCTAD, 2009). Most of these orders were placed at Chinese shipyards which were new to the market and lacked the technical experience. As a result, their ships were not as fuel efficient as the traditional Japanese/Korean-built ones. (Fabi, 2012) However these inefficient vessels ordered during the boom arrived in the market after the crisis with increased operating costs. Some owners thus found themselves in a disadvantageous position despite the fact that they possessed new vessels, simply because the older ones were more fuel efficient.

This situation still exists with freight rates remaining low and the price of oil at extremely high levels. Thus a two-tier shipping market is beginning to emerge, with fuel efficient ships on the one hand and inefficient ones on the other. In 2013 the first eco-ships are likely to enter service and the situation could change entirely. Since eco-ships are expected to be almost 30% more fuel efficient, as explained earlier, the current generation of vessels, even the ones that are now considered as efficient, might find themselves on the weak side of the two-tier shipping market. So a big question arises: Could this be the beginning of a new two-tier, or perhaps a three-tier shipping market? Are we heading towards inevitable market segmentation?

3.2.Are eco-ships a better investment for the future?

In June 2012, the world's most prestigious maritime event "Posidonia" was held in Greece (Posidonia, 2012). At the ship owners' forum, a key issue on the agenda was the emergence of eco-ships. Most of the owners took the view that the shipyards' designs of eco-ships are a marketing gimmick. That at times of market depression when the shipbuilding industry is struggling due to global economic uncertainty, eco-ships have emerged in order to entice companies to order new ships. This view was expressed by owners across the market spectrum: namely dry bulk, tanker and container. At the dry bulk panel forum a chief operating officer suggested that eco-designs are "*a great marketing campaign from the yards"* (McCarthy, 2012). Similarly at the container panel forum, a chief executive said that this push for eco-ships "*was definitely more marketing than anything else*. If the shipbuilding industry claims that yards can now reduce consumption by up to 20% with the existing technology on the new eco-ships' designs, then "t*hey must have been doing a pretty bad job before"*. (Ibid.) He also took the view that instead of promoting new designs, the shipbuilding industry should work on optimising the current fleet instead of ordering new eco-ships simply to satisfy the yards' needs. Finally he stressed that in contrast with the ship builders that need new orders, the shipping market needs no new tonnage as it is already oversupplied (Ibid.). At the tanker panel forums eco-ships were characterised as "*Newbuilding Hype"* (Intertanko, 2012). At the same panel fears were expressed that eco-ships may create a two-tier shipping market that could end up forcing good quality existing vessels to premature scrapping. Furthermore, it

was suggested that eco-ships have a doubtful net benefit to the environment, as their technology has not yet been proven, so the sacrifice of the older fleet could be in vain (Ibid.).

From the above concerns the nature of the dilemma that ship owners are facing between investing in new eco-ships and optimising their current fleet can be seen. On the one hand no one wants to be on the weak side of a potential two-tier shipping market. Conversely shipowners do not want to spend money on an uncertain expensive investment with unknown future outcomes. It all depends on another big question: Will eco-ships be more competitive in the market? Are they a better investment for the future.

4. Methodology

Given the kind of information required, and the wider implications of the subject matter across a number of entities within the shipping industry, data was sought from a targeted group of people, holding certain key positions, allowing them to provide informed viewpoints. In order to provide a basis for research into this area, an exploratory study was carried out using semi-structured interviews with representatives from different sectors of the shipping industry. A shipowner, a shipbroker, a shipping financier and a classification society surveyor were chosen as the participants in this exploratory study as they were judged to offer the best opportunity of retrieving valid information from an array of different perspectives on the matter.

For this research we used the key informant technique which has principally been used in the anthropological sciences. In Campbell's words "the technique of the informant means that the social scientist obtains information about the group under study through a member who occupies such a role as to be well informed but who at the same time speaks the social scientist's language". (Campbell, DT, 1955) In other words, the investigator chooses a number of participants in a social setting to act in an informant role, that is, report not strictly personal information but information about the area in which he is an expert or at least knowledgeable of. The key informants are asked to think in terms of the organisation and represent the opinions of a group rather than their own personal value judgements and feelings. What is more, the requirement of the informant speaking the same language as the scientist alludes to the condition that the former should not only be able but also willing to communicate with the researcher.

Our choice of informants included a number of criteria. First the informants had to have a particular status, a position in the social setting under investigation, which enabled them to possess sufficient knowledge of the issues being researched and second, they had to be capable of, and willing to, communicate with the researcher and provide information about their presumed area of competence. Tremblay (1982) adds the requirement for

communicability, which is the ability to communicate knowledge in an intelligible way with impartiality, the minimization of personal biases from the part of the informant. He recognises, however, that of the five criteria of eligibility only the role in the community can be determined beforehand; the rest are discovered only after the initial contact has taken place. We could argue here, though, that a person's knowledge could also be inferred successfully in the majority of the cases from the position that person holds and as a result it can be considered an important and true prerequisite for the selection of key informants before any kind of contact has been established.

This technique allows for rich and deep qualitative data to be obtained, although its value has also been shown in survey contexts to obtain quantifiable responses and generally in retrieving concrete quantitative data (Tremblay, 1982, Phillips, L.W. 1981).

5. Discussion

5.1.Will Eco-Ships Create a Two-Tier Market?

The first research question examines whether eco-ships are likely to create a two-tier market. On the freight market, charterers bid for the freight/hire of a vessel and the owners either accept or negotiate the terms of the offer. This interaction is usually via a shipbroker, who acts as an intermediary on the negotiations. For this reason the people chosen for interview regarding the first research question were a ship owner and a shipbroker. The initial two questions were similar for both of them with the purpose of highlighting the importance of fuel oil price and its gravity for the vessels' daily fixtures before and after the crisis. Since company's vessels are all on time charter parties, our research was focused on the time charter market.

The shipbroker, made it perfectly clear that for time charter parties the daily hire that a charterer bids in order to fix an employment of a vessel is strongly affected by its daily fuel consumption; since the amount of oil required throughout the employment is on his account. Especially, with the sudden increase of the oil price in recent years, the charterers started paying more attention to the daily bunker consumption of the vessels, making it *"the most important factor in their calculation"*. The ship owner, verified this statement by characterising a vessel's consumption as "*paramount"* regarding its marketing for employment. Charterers ask for a table indicating the various speeds a vessel can steam, together with the analogous fuel oil consumption that corresponds to the speed figure. When a vessel is finally fixed, its performance is committed to this table. When two vessels are competing among each other for employment, the shipowner said that they often hear from a broker characterising them as "*more thirsty or more eco".* Thus in the freight market, the world "eco" does not stand for "ecological", but it is more of a short name for "economical".

From this it would appear that to charterers, in the future eco -ships will appear as a better financial deal. When the shipbroker was asked about the dry bulk shipping boom era and the importance of fuel consumption, he said that since it "*represented only a small portion of the total cost that the charterer had to face"* in a time charter trip, it was not taken seriously into consideration. As a result, the shipbroker highlighted, "*heavy consuming vessels were enjoying a very high and aggressive market and were generating huge profits that were not in line with their consumption"*. Charterers were just as desperate to enter into the "golden" market and ignored the bunker costs. Similarly the shipowner's reply, when he was asked about the importance of fuel consumption on his vessels' fixtures during that period, was straightforward: "*vessels' consumptions never came up during that period"*.

In relation to the period after the 2008 financial crisis and the situation in the freight market for heavy consuming vessels that were ordered during the pre-crisis era the shipbroker indicated that such vessels faced operational problems and financial burdens, since they were delivered at a time when the market reached a low point. Owners that had a wise chartering strategy and secured long term employment at the early stages of the vessels' order did not face significant problems and managed to cash out their investments. There were cases, however, where less reliable charterers defaulted after the market crash due to the high operating costs created by consumption issues. Owners faced huge problems after that as they were left with heavy consuming vessels in a poor market. As for the owners that had not arranged employment in advance for their vessels and waited until delivery, they received charter hires that would not cover the vessel's running expenses and financial obligations, let alone generate any profit. The most distressing situation was for the newly established ship owners during the shipping boom or those with small fleet that invested in low quality Chinese vessels. As the shipbroker stated, these were quite a few and *"they ended up nowadays facing big financial losses and few of them had to even cease operating since the loss led them to sell the vessels at a significant losses or could not meet their loan obligations with the financial institutions".*

The shipbroker confirmed that the crisis created a two-tier market and that only owners that survived it were the ones that had a wise strategy and "*healthy diversification in their fleet"*,. The shipbroker was also asked if this would be the case in a few years with the emergence of eco-ships. He stressed that as both owners and charterers have learned their lessons from the past, "*they are trying to utilize cost efficient vessels and secure long term investment"*. The shipbuilding industry in response to this desire for cost efficient vessels has offered the designs of the eco-ships. The shipbroker indicated that the extremely high price of oil currently being faced has made charterers, who bear the cost of daily fuel consumption, extremely selective on vessels. If bunker prices remain high and the market conditions depressed, then eco-ships in the market could make the situation even worse. As more and more cost efficient vessels come into market, "*the charterers can have the luxury to simply avoid and turn down all heavy consuming vessels",* he said. Finally, he highlighted one more

time that due to the delivery of the inefficient Chinese-built vessels on the market, "*a two tier market has already been created in the dry bulk sector. This market will continue to blossom and as technology moves forward the gap between the eco-ships and inefficient ships will further get deeper in terms of consumption figures and eventually daily hire rates. As a further consequence also, the major charterers will also stop using any inefficient ship and these owners will have no other choice but to also take the risk to sign contracts of employment with less credible counter parts".*

So according to the shipbroker, we are heading towards a new two-tier market. When asked whether he was afraid that the new eco-ships could affect the hires of his old generation vessels he initially pointed out that eco-ships so far "*are just promised specs from order-hungry yards".* Nevertheless, he said, we shouldn't be adamant that they will not be able to deliver. If eco-ships live up to their expectations and burn less fuel, then "*this will impact the market".* However, The shipowner stressed that it will be "*the heavy burners of today that will be marginalised"*, not all the existing vessels. On top of that, given the reduction in bank finance, it will be very difficult to see massive orders of new eco-ships. Moreover, the current dry bulk fleet is around 650 million deadweight, while the order book for new eco-ships so far is around 10 million deadweight; a number constituting only 1.5% of the total dry bulk fleet. "*The way I see it",* he said, "*it is highly unlikely that a proper two-tier market will develop overnight or even the next five years"*. Eco-ships will slowly enter into the market and their first victims will be today's heavy burners. Once they are done with them, then they will "*slowly move to take out the ships that we see as having standard consumption today".* Until that day comes, he was confident that his current fleet, which is considered to be fuel efficient today, "*will be decent in competing in the market for the years to come even against eco-ships".*

It is interesting to compare both points of view on the matter. The shipbroker believes that we are heading towards inevitable market segmentation between eco-ships and inefficient ones. The shipowner agrees that a two-tier market could be created, provided that eco-ships will turn out to be as promising as yards say, but not in the very near future. The reason for this delay is today's poor financial environment which slows-down the emergence of eco-ships. As for the weak side of the two-tier market, the shipowner believes that the ships that have good consumption will not be included. Since today we are experiencing a two-tier market, we already have the weak ones which are the poor-designed heavy consumers. What will change in the market scale in the future will be the addition of eco-ships on the strong side, which will tip the balance further driving the weak vessels out of the market.

This view, based on the interviewees' assumptions depends entirely on one key parameter; the price of fuel oil. If it persists at a high level, then we are heading towards inevitable market segmentation. If not, then the whole situation could be reversed. If the heavy consumers are driven out of the market and the weaker side of the market reduces, could the rest of the old

fleet replace them on the weak side? Could we have a new battle between eco-ships versus today's efficient ones? Such an outcome could only happen in the event of a global economic recovery and a market boom. If the global financial and banking system recovered soon enough to finance a large-scale order of new eco-ships, then a new two-tier market could be created. Given the current situation in the euro-zone, however, this scenario seems to be a fiction. Despite this fact the banker, indicated that since there is no phasing-out date for the old-technology vessels, and taking into consideration the current poor market conditions, "*our prediction is that the world fleet replacement will take time"*. So until the "eco-ships" time comes, replacing most of the current fleet, market segmentation is still far away.

5.2.Are Eco-Ships a Better Investment for the Future?

In relation to the second research question, whether eco-ships are a better investment for the future, the matter is open to discussion from many perspectives. Shipowners face the dilemma of whether to invest or not in new eco-ships and shipping financiers must decide whether to provide the funding. Decisions also have to be made as to whether an existing fleet should be optimised instead of investing in new vessels.

The banker noted, as was also shown in the literature review, that green shipping has emerged "*as a solution for both financial and environmental issues"*. Newer green technologies, however, have not yet been widely accepted by ship owners*, "who are being lukewarm in their reception of eco-ships".* This was attributed to their reluctance for various reasons, such as doubts about the new technology and the absence of the onus of voyage expenses in the time charter market, but identified one as the most decisive: the cash flow. When asked about investing in Green-Shipping, first of eco-ships were considered as an investment for environmental compliance, "*which is generally approved by global society providing incentives to financiers".* Debt scarcity in the banking system for small and medium owners was highlighted, which was triggered by the collapse of the Lehman Brothers in 2008. Since then, banks "*tend to favour big owners over the smaller ones"* and the situation is unlikely to change in the near future as *"banks are preparing themselves for worse to come".*

Nevertheless, according to the banker, investing in Green-Shipping could become a source of finance to ship owners, as it can attract Export Credit interest and create access to climate financial tools. Building an eco-ship in China, for example, can easily attract financing as "*the Chinese Banks are forced to support their National Shipbuilding Industry"*. As the banker quoted, the Chinese banks "*as of year-end 2011, the outstanding loans to the environmental protection, energy conservation and emissions reduction sectors stood at RMB 658.3 billion, up by 33% year-on-year".* As for Europe, the EU is still trying to work on the Green Funding policy, but some guarantees can be offered. At the same time there are some shipping banks focused on Green technology which can also provide debt financing. For the above reasons

the banker believes that "*protecting the environment by investing and financing green shipping makes good business sense".* In addition, he suggested that the owner *"can be ahead of the curve"*, as he is given the chance to be among the first to develop a business culture which aims for top quality management; which will assist in addressing sustainability issues.

Finally, the banker indicated that there is no single source of subsidy or funding available, although there is currently some activity going on that could provide some assistance. New sources of climate finance have been proposed and new financial arrangements among banks have been established that can offer opportunities. Some new innovative models of finance among banks and investors have also been tried, like for instance to "*try to persuade someone outside the industry to stump up most of the $3 million cost of an air lubrication system-in return for a share of the considerable sums of money it would save in the long haul"*. Another source of public finance identified was the budget destined for removal of wasteful subsidies on fossil fuel use. Finally, the banker highlighted that "*policy reforms, institutional development and public outlays can leverage much larger flows of private or multilateral climate finance".* His final observation was that **rules + $ = Green** indicating that in order to turn the shipping industry green you need rules and investment. Regulations are not sufficient by themselves, so, "No Money – No Green".

When the shipowner was asked about his scepticism for investing in new eco-ships, taking into consideration that the future high-distillate oil price will be almost double, he stated that the "c*arriage of goods by vessels is by far the most efficient way to transfer goods. Even if bunkers triple, an ocean going vessel is the cheapest way to move products".* Seaborne trade has always been the cheapest way of transporting goods around the globe. As the shipowner successfully pointed out, it will always be that way as no other transport mean can offer services to the extent that ships do. Therefore, the world will always need ships, at any cost. As for the shipowner's scepticisms on eco-ships, he expressed his concerns about *"how these ships will perform in heavy weather and if the consumption will be as promised in tough conditions".* The new technologies applied to the eco-designs are speed-reduction orientated. Engines are designed with reduced horsepower in order to accomplish higher energy efficiency. The shipowner fears that these de-rated engines can have adverse effects on the vessel's performance in tough weather conditions, leading to higher fuel consumption. On top of that, the ship might slow down more easily in adverse weather situations leading to charter party disputes and speed claims. Finally, he expressed his fears about these ships when it comes to heavy weather situations; whether they will be able to encounter the perils of the sea with a "weaker" engine.

The shipowner then presented another alternative offered to him by a yard instead of an eco-ship: the "semi-eco" ship; a concept that was even new to him. Some yards are now promoting their traditional successful designs, which have undergone some energy efficiency

improvements in order to comply with the upcoming regulations. Instead of withdrawing completely their traditional designs, which are to be replaced soon by the new eco ones, they are still marketing them at competitive prices. They offer the certainty of a traditional ship's design, which eliminates the "heavy weather" issues, plus some reasonable energy efficiency improvements. Therefore, yards can deliver their promises as they have tangible goals, in contrast with eco-designs that have set the energy efficiency bar extremely high, which creates doubts on whether they can deliver. The nature of this dilemma is shown in Table 1 comparing two Supramax Japanese built ships: one for an eco-ship and one for a semi-eco ship.

Table 1: "Eco Ship and Semi-Eco Ship Investment Calculations"

Ship Type	Consumption tonnes/day	Ship Price ($ US)	Equity ($ US)	Loan ($ US)	Daily Hire($ US)
eco	24	29.000.000	14.500.000	14.500.000	11.247,50
semi–eco	26.6	26.000.000	13.000.000	13.000.000	10.638,00

(Source: Authors)

As can be seen a Japanese eco-Supramax today costs $29,000,000, at a suggested consumption of 24 tonnes per day. According to the shipowner's calculations, the average daily hire needed over 20 years in order to break even is $11,247.50. The semi-eco Supramax costs $26,000,000 and its fuel oil consumption is 26.6 tonnes per day. The average daily hire needed in 20 years in order to break even is $10,638,00. Therefore an expensive but more fuel efficient eco-ship, compared to a cheaper but more "thirsty" semi-eco, assuming that both of them live up to their expectations and deliver as promised, the outcome of each investment would be completely different. The fuel efficient vessel would require larger capital cost but would earn higher rates in return; while the more "thirsty" vessel requires less capital cost and would bid at lower rates thus making it more attractive.

So which one is the wise choice? It is hard to tell but the decisive factor is likely to be the price of oil in the future. If the price continues to rise then eco vessel become the better option. 2.6 tonnes/day less consumption at today's $700/tonne levels of fuel means $1,820 less daily operating costs. If the price of oil, however, returned to normal levels, then the market wouldn't mind choosing the "thirsty" semi-eco vessel at a $600 cheaper daily hire. So the shipping industry is a big guessing game and it is all about timing and prediction.

The classification surveyor presented all the alternative options that an owner can choose in order to comply with the new regulations, confirming that existing vessels will be able to use higher distillate fuel oil without requiring significant investments. However, extreme caution is required as it may have harmful effects on the engine if the operating procedures are not followed to the letter. As regards to exhaust gas cleaning systems, these can provide an

alternative option to the owner in order to continue using the cheaper high sulphur fuel oil, the choice depending on various operational factors.

Whether shipowners believe that it makes financial sense to undertake energy efficiency improvements on the existing fleet is a further issue. The view was that such energy efficiency improvements do not make strict financial sense, as "*they may be expensive and may require maintenance and surveillance"*. Nevertheless, everybody has to respect and comply with the new regulation and undergo such energy efficiency improvements. At the same time it was recognised that it provides the opportunity "*to do this in a practical and efficient manner compared to other companies"*.

For the shipping industry, the regulatory timeline is very demanding. As from January 2012 the global sulphur limit cap was set to 3.50%. In 2013 Ballast Water Treatment Systems, EEDI and SEEMP will enter into force. In 2015 the sulphur limit inside ECA areas will become 0.1%, while in 2016 the NOx "Tier-III" regulations will come into force. By 2020, Ballast Water Treatment systems on all ships and the 0.5% global sulphur limit are likely to be in place.

With so many stringent regulations about to come, it may be difficult to adapt many existing vessels to cope with all these changes in a high oil-price future environment. Despite the fact that the market is in a prolonged deep economic recession and nobody can tell with confidence when it is going to emerge from it, it could be argued that this is the perfect time to conduct a large counter cyclical move to more efficient types of ship. Conversely, as the shipbroker stressed, after the 2008 crisis many owners have learned their lessons of ordering largesse, affecting their strategy towards issues such as fleet expansion. So the situation now is that those who have the opportunity and cash to buy today will consider today to be a good time; while those who bought yesterday and are under the stress of debt will feel it is a bad time. So it is an example of "one's man's food is another man's poison". However, investing in eco-ships could be the solution to debt financing issues, as the banker explained, revealing a scenario that makes good business sense to many owners, even the financially weaker ones.

So, are eco-ships a better bet for the future? The consensus was that they are probably a better investment for the future, but not in the near future that the shipping industry has targeted. The shipbuilding industry has set the bar extremely high, promising levels of 30% less fuel consumption, to a point that creates doubts about these new technologies. And, as the shipowner highlighted, there are some fears as well about these technologies. While eco-ships may live up to their promise, the fact is there is still a global financial crisis and a deep market recession.

The shipping industry may be eager to move forward and introduce new technologically advanced vessels; without necessarily embracing the owners' alternative scenario on the matter, that it is a marketing gimmick. It could be the case that some decisive measures had to

be taken for environmental protection purposes and also for the sake of cost-savings at times of austerity. Whatever the case, the majority of the ship owners are unlikely to invest in future technologies at times of crisis and uncertainty. The shipowner was more confident either in optimising his current fleet, or investing in the semi-eco alternative i.e. "playing it safe" for the time being appears to be a more acceptable approach. Eco-ships are likely to be embraced once their time comes. For those who can afford to invest in the first generation, time will tell if they were right and ahead of the curve. As for the rest, the high fuel cost will encourage energy efficiency improvements up to the point which provides a return on their investments. Finally, the shipping industry needs to reconsider and establish a more reasonable regulatory timeline, as the entire maritime industry cannot just turn "green" at such short notice, especially at times of global financial crisis.

6. Conclusion

The aim of this research was to carry out an in-depth examination of the emergence of the new concept of eco-ships and their impact on the shipping world. The research questions were addressed by interviewing four key stakeholders from the shipping industry, with the purpose of sharing their experience and knowledge in search of an answer to each of the research questions. The people chosen were a ship owner, a ship broker, a shipping financer and a surveyor of a classification society.

The first research question of this research was whether the emergence of eco-ships can lead the freight market to segmentation. A ship broker and a ship owner were interviewed on the matter, in order to examine both owners' and charterers' point of view. The ship broker believes that a two-tier market is inevitable, given today's importance of bunker consumption on charterers' calculations. The owner, however, expressed his confidence that the current efficient generation of vessels can stand a chance against the eco-ships which still need time to enter widely and dominate the market. From their responses, it emerged that unless today's unstable global financial situation shows signs of improvement; there won't be enough eco-ships on the market to develop a proper two-tier market.

The second research question considered whether eco-ships will create more competitive market, thus making them a worthwhile investment for the future. The banker presented a number of factors suggesting that investing in eco-ships makes good business sense. When the owner was questioned about his thoughts on eco-ships, he said that he wouldn't be concerned about investing in them, regardless of the initial capital and required future costs, as the world will always need ships, eco or not. He expressed his doubts and fears, however, about the new technologies of eco-designs which discourage investment in them. He would rather invest in alternative opportunities offered today, like the semi-eco designs, which provide a sense of safety in his investment. Finally the ship owner was asked whether it

makes financial sense investing in optimising his current fleet, using alternative options as explained in detail by the classification surveyor, instead of purchasing new eco-ships. He said that even though it does not make strict business sense, the new rules have to be respected and that the opportunity to undetake such energy efficiency improvements in a practical and efficient way would be taken provided they make a return on investment.

Overall it would appear that the shipping industry will take its time and adapt to the new changes in accordance with the global crisis situation. Eco-ships appear to be a better investment for the future, at least in theory, but at the present time few companies can afford to invest in an uncertain future. Perhaps if the newbuilding industry lowers the energy efficiency bar, targeting more tangible goals, then more realistic eco-ships will be an attractive investment for the future. Time will tell if those that invest in the first generation of eco-ships were ahead of the curve.

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