Erasmus University Rotterdam

MSc in Maritime Economics and Logistics

2014/2015

An analysis of Eco-Ships and the variables that determines the perspective of Greek consumer's for the Eco-ships

by

Konstantinos Ventouris

Acknowledgements

Abstract

Motivated by the economic slowdown, increasing fuel prices and global warming, the key to business sustainability is the "green economy" investments that create green jobs and help protect the environment. The ecological dimension of maritime transport can provide a solution. The ships that use renewable energy exclusively or partially be made more environmentally friendly and pocket. Therefore, investing in "green" business, while earning three fronts, namely the three elements of sustainability: environment, economy, work. Furthermore, the "weakening" of the planet we inhabit is obvious, which justify the increasingly intense pressures on shipping companies in Greece to develop and implement environmentally friendly practices ("eco-friendly") in their ships, irrespective of their type of shipping activity. As a result, inevitably the time of the conventional polluting ships will pass in the near future irreversibly.

For the above reasons I will analyze the characteristics and application of eco-ships in the shipping activity. It is a theoretical approach of the innovative perspective of environmentally friendly ships, which is almost unknown at present, but it gaining ground as an alternative method for reducing environmental costs in an uncertain economic climate that modern shipping companies are operating. Moreover I will examine the variables that determine consumer's perspective (knowledge of eco-ship, willingness to pay a more expensive ticket, etc.) of a green ship in the Greek coastal shipping market through a regression model with data derived by a questionnaire.

Table of Contents

Acknowledgments
Abstract
Table of Contents
List of Tables
List of Figures
List of Abbreviations

1. Introduction

2. Literature Review

3. Marine Pollution

4. EcoShips

5. Methodology and Data

6. Results & Conclusions

7. Bibliography

8. Appendix

List of Tables

List of Figures

List of Abbreviations

Chapter 1 Introduction

1.1 Background

Maritime transportation has always been the moving force of world trade. For centuries sea, was the main and fundamental route for any individual who wanted to travel or trade to any country. The massive growth of the maritime transport enables scientific research and innovation to flourish. Larger and safer vessels with enormous capacity and high speed that are ruling the oceans. Big ports with large capacity and fast cargo handling operations and excellent infrastructure and hinterland expansion. However these massive growth to this sector also brought negative results. Increase in toxic emissions, increase in marine pollutions by ships and ports, decrease in the quality of eco-system and many more severe consequences to the environment. Due to this fact, the hesitation that governments and international organizations use to show regarding environmental issues has ceased. More and more regulations and legislation are issued regarding the environmental pollution and also more and more eco-associations and non-governmental organizations for the protection of the environment are appearing. All these facts couldn't let the maritime industry untouched.

Shipping companies, shipyards, ports, logistic companies and maritime related companies are changing their policies and practices into more eco-friendly. Specifically some of them are using the ''eco-friendly'' policy as a main element of their competitiveness. From this new trend, eco-ships have appeared.

The eco-ships are in their early beginnings with a few companies investing on them and few shipyards and scientist that are actually experiment and developing new technologies that may ensue sustainability, seaworthiness, safety and autonomy. Most of the operational eco-ships that exist at the present are small with low capacity and inadequate performance. But the definition ''eco-ships'' includes a variety of ships that are using renewable energy (partially or fully), eco-fuels, ecological materials etc. Moreover the way that consumers are actually thinking about the eco-ships is unknown.

This thesis is attempting to analyze all the characteristics of eco-ships. That includes, technical characteristics, environmental practices, legislative framework, market characteristics, available and future technologies and potentials. Additionally from the consumers perspective this thesis is attempting to study and analyze the variables that determines the consumers' perspective about the eco-ships through a statistical model that will process the data in order to derive accurate and clear results. By ''perspective'' I mean the level of knowledge that consumers have about an eco-ship or their willingness to pay a more expensive ticket for the use of an eco-ship.

1.2 Research Question

Main research question: Which are the characteristics of Eco-ships and the variables that determine consumer's perspective about them?

The characteristics of eco-ships are various and the theoretical knowledge behind them is not homogenized. I will try to make thorough theoretical research in order to present all the information regarding an ecoShip. Then through a survey using quantitative data I will examine and evaluate the variables that determines consumer's perspective like the level of knowledge about ecoships.

Sub-question 1: How the necessity of eco-ships is derived by examine marine pollution?

With this sub-question the hazards and consequences of marine pollution are highlighted and the immediate need for a change and a solution to this matter is derived. Eco-ships may contribute a lot to the protection of environment.

Sub-question 2: Which are the characteristics of eco-ships and the ways that can be introduced to the market?

By this question the study targets to fully analyze the characteristics of eco-ships and to answer to the first part of the main question.

Sub-question 3: Which variables determines the consumer's perspective about eco-ships?

In this question the empirical approach of this research takes place. A variety of variables and answers where the participants of the survey have given are analyzed

> ➢ **Sub-question 3a:** What is the level of awareness/knowledge of the existence of eco-ships?
> ➢ **Sub-question 3b:** What is the level of willingness to pay a higher ticket for the use of eco-ships?

By this two sub-questions the two key components of the consumer's perspective are highlighted, analyzed and explained.

1.3 Research design & nature of results

The survey aims to examine the perspective and the way that consumer's think about the eco-ships. It also aims to contribute to the willingness of the general consumer joint the use of environmentally friendly ships benefiting the environment, even if you pay a higher fare than usual, locating primarily in how is updated on the subject and if not whether it wishes to become. The success of this research and the accurate, valid and reliable results are essentially based on the sample size. Specifically, the larger the sample, the smaller the sample error (sampling error). Moreover, the results are more reliable and precise as the size of the sample grows. Therefore, it will allow the export of more general and more objective conclusions. In order to that research and derive accurate results I will create a questionnaire. The questionnaire refers to the wider consumer public and will provide some clarifying information to those addressed on why the survey will be conducted, and will consists of two sections. The first section (A) will consist of questions about general information of the profile of the participant who may answer the questionnaire and the second section (B), by questions related to consumer preferences and especially if he knows what are the ecoships and whether he is prepared to give preference to green passenger ships services versus conventional passenger ships by paying a higher fare.

After the completion of the survey (questionnaires) all the data of the questionnaires are processed and analyzed in order to derive results. A regression model is used, using the data of the questionnaires. There are twelve variables like (age, education, profession etc.), of which their relation is checked through the regression model and their relation between these variables and the two main questions (awareness of green ships, willingness to pay a higher fare). The results are illustrated through charts, diagrams and tables. For this study I have used both qualitative and quantitative data and therefore my results would be realistic and theoretical.

In the 3rd and 4th chapters of the thesis the theoretical approach of the topic is presented. The information presented is derived through an analysis of qualitative data like scientific articles, books, thesis, conventions and others in to able to present an accurate analysis of marine pollution and green ships.

The 5th chapter of the thesis is constituted by the empirical analysis and the analysis of the quantitative data from the consumers. By the regression model I derived conclusions regarding the knowledge of the passengers for the existence of green ships, their willingness to pay a higher fare and the relation between some elements like age, education, profession and wage with these two questions.

1.4 Thesis overview

➢ <u>Chapter 2:</u> Investigates the literature review. The present research that is related with the topic and the common or uncommon results and conclusions about the eco-ships, their characteristics and practical application

➢ <u>Chapter 3:</u> I indicate and analyses the all the elements and aspects of marine pollution. The consequences of marine pollution, the risks resulting from marine pollution, and the characteristics of the main sources and causes of pollution of the marine environment are presented in depth. Specifically, dangerous cargoes and goods and types of contaminants from the development of shipping are analyzed. Also a reference about the role of ports and their part on this matter is presented.

➢ <u>Chapter 4:</u> In this chapter is presented the development of eco-ships worldwide. In more detail the main points of this chapter are :

a)   The concept of the green passport,

b)   The purpose to build a green ships,

c)   The incentives for the design and operation of green ships,

d)   The conditions to assess a ship as green,

e)   The comparative costing analysis of a green ship,

f)   The advantages of green ships,

g)   The future of green ships and examples of green ships.

➢ <u>Chapter 5:</u> At the third chapter the theoretical background of this thesis is completed and leaves space for the research part to generate practical results and answers. All the data derived from the questionnaires are analyzed and presented though graphs and diagrams. Then the variables are assess through the regression model in order to find their relation. Also the relation between the variables and the two main questions is calculated:
   - ✓ How willing is the wider traveling public to pay a higher fare in order to use passenger ships with friendly practices to environment.
   - ✓ The level of knowledge of the passengers regarding the existence of green ships.

➢ <u>Chapter 6:</u> At this chapter results and observations are presented.

- ➢ Chapter 7: This chapter includes the bibliography used for this study

- ➢ Chapter 8: This chapter contains the appendices. The appendices are consisting the variables used for the model, the frequency tables, the questions of the questionnaires and other information regarding the practical part of the regression model

Chapter 2 Literature Review

This chapter investigates the literature review which is related with this study. The results and conclusions of the previous researchers are presented. Unfortunately the amount of published scientific studies related with the topic of this thesis is limited. I was able to gather only three scientific related studies with my topic. The fact that my topic is researched in depth means that there is a lot of space for further research. Below all four of the literature studies are presented and analyzed.

The first paper that was accessed is the Operational Options for Green Ships by Salma Sherbaz and Wenyang Duan (2012). The authors are highlighting the environmental issues and rising fuel prices from which the need for energy-efficiency and eco-friendly practices is derived. According to the authors from this fact the green ship concept has born and has become an incentive. This paper provides a thorough investigation of eco-ships applications, principles, ways to be introduced to the market and operational characteristics. A reference is made about the energy efficiency operational indicator which is a voluntary indicator developed by IMO in order to measure the energy-efficiency of the ships. Next the operational options are analyzed. The consequences to the environment by the long time that ships spends in port together with the improperly weather routing are also calculated and remedies are presented. Some other operational options that may be optimized like slow steaming and trim optimization which may contribute to the reduction of carbon dioxide emissions and provide a safer and more convenient journey are presented. Moreover, the proper cargo management, the proper propeller and hull maintenance and the ballast optimization are effective methods to increase energy-efficiency according to this study. Furthermore, the authors stressed some challenges like academic qualifications of crew before induction, on-board training and crew motivation that must be solved in order the eco-ships to be sufficiently manned and operational. The conclusions of the authors are that most of the operational options presented have great potential to contribute to the reduction of the emissions and requires limited amount of investment. This study is providing valuable information about the eco-ships and their characteristics but still some fundamental questions are not touch upon. Thus, although all of the points that authors have highlighted are truly important regarding the energy-efficiency matter, they haven't succeeded to stress out the commercial exploitation of these of vessels. This is the basic gap that we meet in every research project; meaning that the paper does not precede with the research on the practical application yet alone their economic viability as projects.

Another approach was attempted by Hong He-ping (2013). *The Development Trend of Green Ship Building Technology*. This study analyzes the development of green ship building technology and defines the main scope behind this industry. According to the author, the object of eco-shipbuilding is to minimize the toxic emissions during manufacturing, operation, design and lay up of ships in order to contribute to the protection of the environment and to make the ships cost and energy efficient.

''The scope of green shipbuilding includes green ship and green shipyard'' (Hong He-ping, 2013). In order to achieve this target the selection of marine equipment, the optimization of marine systems, the selection of materials for the design and the improvement of building techniques are the key elements. Specifically, the marine equipment should focus on high efficiency and low energy consumption and emissions (e.g. LNG as a fuel, electric propulsion). The materials selected for the construction of green ships should be recyclable, reclaimable, innocuous and inoffensive. Regarding the building techniques, innovation and application of high efficient technology will save energy and will reduce pollution. According to the author, eco-ships are the future of shipping industry. Eco-ships will not only be protective to the eco-system and the marine environment but will also create more protective-safer work conditions to builder and operators. He concludes that we should dedicate ourselves by all of our means into green shipbuilding for ecological equilibrium and the happiness of people, and moreover we should highlight the importance of green manufacturing. This study highlights the advantages of the green ships and their construction methods but does not include the financial perspective which is the main reason where green ship and green shipbuilding has a slow progress due to the high cost and also that the marine pollution relatively small (approximated to be 3%). Once again the gap is viable and it is exactly was the current tries to bridge. Eco-ships are obviously better for the environment but can they survive in high competition routes, how bigger investment they need as new-buildings, what price premium are consumers willing to pay for them and last but not least are they already familiar with the concept? These are some questions that demand an answer that cannot be found in the current assessed study.

The third that was investigated was written from O. Sulaiman, A. H. Saharuddin, and A. S. A. Kader (2013). *Towards sustainable green ship technology*. This paper is using a risk-based approach to analyze pollution, onboard ship systems and current practices regarding environmental issues. The examination process of this paper involves hazard identification, risk analysis, options, cost benefit and recommendation by matching the system requirements with the environmental issues and the legislative framework. The eco-ship concept is addressed by analyzing technology, demand, dynamic system design of ships, marine awareness and channel accommodation. This paper also presents information about ship's life cycle and material properties that matching with the environment. Phenomenon like corrosion for instance has led to severe consequences and environmental degradation especially by the methods and materials used to prevent corrosion. Moreover, authors deal with the matter of preventive measures in ship design and operation that may help the environment. This study presents the major environmental impact areas and environmental issues that have become a ''blessing'' through opening new window of green technology. Then is presenting the behavior of IMO that is changing over the years to the benefit of the environment and in fact has become very strict with a variety of eco-regulations. Other maritime related conventions are also presented. The authors are also analyzing the current ship design practices and the potential to be improved together with the ship design policy. They analyze and describe consequences and procedures of ballast water discharge, antifouling and scrapping procedures. Then the environmental

performance of each of these tasks is assessed and possible optimizations measures are proposed. The study concludes that it is important for the key players in the industry (companies, regulators, pilots, operators etc.) to cooperate and share their knowledge and experience in order to develop clean and green practices. Moreover, the regulators and the international organizations should revise and review rules and laws that are taken too light in order to protect the environment properly. At last, cooperation in general between all the sides of the industry should be pursued in order to fully and properly response the call of nature for protection.

Given that the existing literature review does not answers the questions raised from the current thesis, the project attempts to bridge the gap and investigate in what way eco-ships could become the best choice for the ship-owners beyond the environment.

Chapter 3 Marine pollution

3.1 Introduction

In the economic science the environment is considered as a complex financial element that offers various services. Even if it is a very special financial element, after it provides for us the systems of survival which ensures our existence, do not cease however to constitute a financial element. As with other financial elements, that we wish to prevent his unjustifiable scorn, in order to continue to satisfy both, our aesthetic and survival needs. (Tietenberg, 1999)

The economic side of climatic changes, the comprehension of nature of these changes and their way of confrontation, requires the examination of the following data:

•   The repercussions of demand of energy and evolutionary tendencies of emissions in the economic growth of befalling decades, included the composition and the energy intensity of growth in developed and in the developing countries.

•   The repercussions and the effectiveness of the National and International policies and regulations in the reduction of the emissions with an economically effective way (cost-effective way) but also in the promotion of a fair and sustainable global economy, included the effects and the repercussions of the initiatives for investments of cleaner technology.

• The calculation of finances that will involve the locomotion worldwide in an economy of low emissions of carbon dioxide, with medium-term and long-term prospect but also the tracing of repercussions of timetables of action and choices of policies.

• The calculation of dynamics of different adoptive approaches in the climatic changes.

The marine environment constitutes the main aquatic volume of our planet, occupying more from the 2/3 of earth's surface. The sea offers an exceptional wealth of natural resources and for this reason played always decisive role in the growth and the progress of civilizations. However, the development of societies and the growth of industrial, financial and shipping activities forced big pressure in the marine ecosystems, as the overfishing and the destructions of coral reefs that are directly related with the climatic change and the pollution. The transfer of big quantities (dangerous) and big number of passengers via the marine roads constitutes an innately dangerous activity, even when it is used modern technology. Without a doubt, the marine transports constitute the more important and bigger piece of chain of world transports of all goods and this because the growth of marine transports is powerfully connected and directly dependent with the world trade. The pollution of seas constitutes today one of the most important environmental problems of our planet. The pollution may be referred in the open sea and/or in the coastal regions, with the first be owed mainly by the distribution of petroleum products and other toxic and dangerous goods

and the submarine nuclear trials and the second mainly in the tourist growth, the coastal building and constructional activity,

The sewerages, the flows of agricultural and industrial waste and the disposal of various other materials. Concretely, the team of experts of UNO (GESAMP, Group of Experts on the Scientific Aspects of Marine Environmental Protection) defines the marine pollution as the "Import from the person in the marine environment of (included also estuaries of rivers) substances and energy, directly or indirectly, resulting in poisonous consequences, as damage in living organisms, dangers for the human health, hindrance of marine activities included fishery, reduction of quality for the use of marine water and the reduction of sea water attractiveness". (GESAMP Report and Studies, 2007]

The marine transports have the second higher degree of danger after air transports. This forced the International Maritime Organization (IMO) to conduct an extensive study of accidents onboard and their causes in anthropogenic and natural environment. The results of the study shows that, the 80% of accidents is owed to the human factor. However, the most important burden of the seas, is caused by the petroleum products, due to the marine accidents during their transportation and more seldom from problems in installation of excavation systems and treatment of oil. The last decades, due the importance of the problem, there has been established a line of laws and international conventions, which are referred in the protection of seas, on readiness issues for the confrontation of incidents of pollution and in compensation and re-establishment of caused damage. (Walker, Livingstone 2013)

3.2 Hazard and causes of marine pollution

The pollution that emanates from the international marine transports, as the hazards, which are related with the regularly increasing numerically but also in capacity movement of commercial ships all over the world, have been connected, almost exclusively, with the aquatic element. The last decades have been important efforts in order to determine the phenomenon of marine pollution and in consequence the protection of the marine environment .The marine pollution as a separate problem, even if it is almost impossible scientifically to be separated from the pollution of biosphere in its entirety, it began to constitute field of special research mainly afterwards the end of second world war, although the first estimates were presented sporadic in the time interval of two wars. More specifically, the systematic analysis and permanent research for the marine environment were focused in the beginning of 70's after a series of accidents of tankers which pealed the alarm, perhaps for the first time so much intensely, and forced the coastal states to turn their interest in the repercussions, short-term and long-term, to the marine environment. The intensifying of the marine commercial competition with the regularly increasing attendance and the developing world, began to bring in the limelight the questions that are related with the safety of marine transports, as the protection of the marine and atmospheric environment. (Katsimpardis, 2007)

Today it could be expressed the opinion that the pollution and consequently the protection of marine environment constitutes the more important but also most expedient piece for scientific research and analysis from the moment where the study of marine pollution is a relatively new field of research. The marine space is objective of direct growth of human activities but also recipient of their consequences. This can be also confirmed from the fact that the protection of marine environment is covered by a capable number of international and regional conventions but also inter-country agreements.

The factors that practised important role in the fast growth of marine pollution are the following:

(a) The intense urbanization,

(b) The concentration of capable number of industrial activities in limited geographic regions,

(c) The use of oil as basic source of energy,

(d) The vast increase in the marine transports of oil and other dangerous chemical cargoes,

(e) The technological progress,

(f) The use of fertilizers and pesticides,

(g) The phenomenon of demographic explosion in the developing countries,

(h) The phenomenon of overconsumption in the industrial countries.

However the marine transport is considered a mild form of transport regarding the environment, cost-efficient in the use of energy, safe and critical for the world trade. (Walker, Livingstone 2013)

3.3 Main sources of marine pollution

Comparing the pollution that is attributed to the marine transports, with the pollution that is caused by the overland industrial installations, it is observed that the pollution attributed to the overland installations contributes the second smaller percentage in the total marine pollution that is caused by human factor (GESAMP, 1990)

The 77% of marine pollution derived from anthropogenic activities it is attributed in the waste that comes from the land (land based discharges) and the atmospheric pollution (atmospheric inputs). The navigation (maritime transport) is liable for to12%, while the remaining 11% is caused by discharges of (dumping) pollutant substances in the marine environment. The next table 3-1 depicts the percentage of each one of the basic sources marine pollution (UNEP, 1990: The State of the Marine Environment).

Sources of Marine Pollution	
Source	**Contribution in percentage (%)**
Waste from land	44
Emissions of atmospheric gases	33
Maritime activities	12
Excavations of undersea deposits	1
Dumping	10
Total	100

Table 3-1: Sources of marine pollution (UNEP, 1990)

The bibliographic reports with regard to the sources and the forms of marine pollution are differentiated to a great degree with such way so that is created confusion, provided that certain forms of marine pollution falls the one in the other, e.g. The pollution from the commercial ships may include the pollution from radioactive materials, when these are transported by nuclear boats, but also these two together is likely to be defined as pollution from discharges.

3.4 Types of pollutants derived by the development of the shipping industry

The types of polluters that enters the environment causing marine or atmospheric pollution are:

1. the oil in all of its forms and his derivatives
2. chemical and liquefied gases,
3. the dangerous goods in bulk and packaged form
4. the wastes (garbage),
5. the sewages,
6. ballast water,
7. antifouling paints,
8. The emissions of exhaust,
9. The emissions of evaporation of cargoes,
10. Chlorofluorocarbons-CFCs,
11. Components that includes bromium, fluorine and carbon and is used for fire-fighting
12. Noise

In terms of quantity and obvious presence, the most important pollution that is owed in the navigation is oil and its substances. The components of oil, that are soluble in water as well as the refined products, contain unions that are toxic for the marine flora and fauna. The consequences in the ecosystems of rocky and sandy coasts, where the oil

does not come off easily, are significant. However, the most serious that may happen in the long term in the trophic chain of humanity is the phenomenon of accumulation of cancer-causing aromatic hydrocarbons from the consumption of shells and more generally hunters of superior trophic chain (e.g. .tuna, salmon). The oil is the pollutant element that received the bigger publicity in international level, because often it is most visible and obvious because it floats in the surface of the sea. Until today the oil slicks that have been created due to accidents, have caused local damage in the marine and coastal environment of Mediterranean. From the 268 accidents that have been recorded by the Regional Centre of Direct Intervention for the Confrontation of Pollution in Mediterranean Sea (REMPEC) for the period 1977-1995, more than 3/4 was related with oil transportation. (Walker, Livingstone 2013)

According to elements that were produced by the American national academy of sciences (US National Academy of Sciences) at 1990, from the total annual quantity of 568.800 tons that entered the sea by all causes of marine pollution, the amount of 121.000 tons was by ship accidents, 36.000 tons were by cargo-handling operations in port, while the more important cause of pollution was founded by the usual operations of ships, that are liable for more than 70% of the outflow of petroleum products in the sea. The quantity of chemical and liquefied gases that are transported by sea is considerably smaller than petroleum products, it is however more hazardous for the environment, because they are toxic and via the trophic chain they can threaten the human health or even lead to downgrading of marine environment. The garbage and more specifically the discharges of non-bio-degradable substances like plastic, creates very serious danger for marine life. The coasts and the beaches fills from flown waste, which in a small percentage comes from vessels, while their majority comes from the land. The discharge of sewage in the sea is in general prohibited, except if the discharge is conducted be the use of proper processing system. Increasing scientific and governmental interest is noticed for the ballast and its products of subsidence (Ballast water), provided that it can transport and transmit a big variety of marine micro-organisms, illnesses and infections. The probabilities that the ballast water and its sediments may contain marine organisms that can act negatively in the local marine population in the region where they will be discharged are significant (alien species).

The use antifouling paints and the special coverings that they help in the reduction of resistance, and consequently they lend lower the factor of friction for the movement of the ship, have offered important reduction of operational expenses (economy in fuels), but high concentrations of TBT (tributyltin) in the marine environment. TBT it is a substance which is included in the toxic chemical compounds, and in the persistent organic pollutants, which is liable for irreversible damages in aquatic and living world.

The navigation contributes also in the total quantity of atmospheric pollution via the emissions of exhaust. As the Committee of European Community realizes, the pollution of air from oceangoing boats is regularly augmentative, due to the fact that it is consumed more fuels for the cover of permanently increasing needs of more rapid

transport, more goods, in large distances. In consequence, the regularly increasing contribution of oceangoing shipping in the regional and world atmospheric pollution, establish a new factor, which the modern international and local environmental law is called to face effectively. International shipping activity contributes roughly 7% of total NOx emission in the world scale and 4% of SO2. (Legislative History of Articles 1)

The Committee of European Community calculates that, despite the existing international (in the frame of IMO), but also domestic lawful efforts and policies, the emanating from the marine space atmospheric pollution will have balanced on 2020 the corresponding land pollution inside the European Union, which is decreased progressively in the past few year. (Katsimpardis K., 2007)

3.5 Technical and operational measures used to reduce C02 emissions

The more important technical measure is the Energy Efficiency Design Index (EEDI) for new vessels that it will require a minimal level of energy efficiency per possibility of figurative work of/mile (e.g. ton mile) for various types of ships and scale of sizes. With the per five-year period progressive tightening, EEDI will stimulate the technological growth of all factors that influences the efficiency in the consumption of fuels from the vessel. From the operational perspective, it has been developed the obligatory program of energy efficiency of vessel's operation, Ship Energy Efficiency Management Plan (SEEMP) in order to assist the international shipping industry to achieve economically effective improvements in the efficiency of operations with the use of Energy Efficiency Operational Indicator (EEOI) as a tool of monitoring and comparative evaluation.

The reduction of speed is one from the available operational choices that may result to direct decrease of emissions without cost, provided that the charterers will commit and ensure the decrease in speed. In July of 2011 the IMO examined a plan of modifications in the Annex of VI MARPOL in order to establish from 1/1/2013 the EEDI obligatorily for certain types of new vessels and the SEEMP obligatorily for every type of vessels. (Devanney, 2010)

Chapter 4 Eco ships

4.1 Introduction

The world shipping is accountable for the 3% of pollutants worldwide, generating enormous quantities of particles of coal in the atmosphere that overloads coastal areas. Given the fact that the volume of trade will continue to grow it is consequently expected an increase of the pollutants derived by vessels, for which are already discussed the establishment of stricter specifications. From the other hand, the instability and the increase of oil prices, renders the future of marine transports to be uncertain .The exploitation of modern technology and renewable sources of energy will contribute in the configuration of viable solutions in the sector of transport of goods. (Bansal P, Roth K., 2000, Vol.43, No (4))

New tendency is created in the shipbuilding industry, which desires ecological vessels, but also more cost efficient. The new sovereigns of the oceans will be friendly to the environment and will sail with the use of renewable or eco-friendly energy like solar, wind etc. More and more are manufactured with the aim to be independent by coal and to reduce the marine pollution .Combining the "green" label with the saving of money, the new "ecological" ships constitutes the future of shipbuilding industry. The leading countries in the industry are China and Korea with a rate of constructed ecological vessels that reaches 60% of the world market. The Community of European Shipyards Associations (CESA) began to conceive the situation, after it dedicated a big part of June's 2011 report on the eco-ships. Besides, countries like Germany they have begun the manufacture of ecological ships, for touristic or commercial purposes, while the Japanese are designing an original oil-tanker that will use both solar and wind energy for its movement.

As CESA report states, the global economic crisis have abolished almost 50% of the shipbuilding industry, while it showed how vital is the need to transform the ships in order to become eco-friendly and sustainable. It is not coincidence that the EU has just offered 200 mil euro for the research on this particular sector, aiming to suppress entirely the use of coal and to eradicate CO_2. Therefore having as a motive the economic recession, the increase of fuel prices and the greenhouse phenomenon, the vessels should become friendlier to the environment but also more cost efficient. New technologies and also technologies which have been forgotten for decades come again in the light aiming to build ships that uses renewable forms of energy exclusively or partially. The eco-ships with the use of new technologies are trying to decrease the environmental pollution using friendly practices. This subject notes high interest, mainly the last decade, with a lot of companies proceeding to order new eco-ships. Moreover it is worth to mention that around this idea of an eco-ship a whole new sector has been created with private advisory companies, shipping companies, enormous governmental projects and universities with related programs of study.

4.2 The framework of future's policy for an effective integration of environmental dimension to the policy of maritime transportation

The basic directions of the future's policy for the transports have been already placed, while it has been undertaken a sustainable prospect, which must be reinforced in the future. For the essential inclusion of environmental dimension in the future planning of European policy of transports and more specifically for the growth of marine transports the following elements are required:

- The existence of explicit political will and determination for the support and concretization of political choices that has been formulated in a line of mature programmatic texts of the last years, as the White Bible for the Policy of Transports, Green Bible for the Future Shipping Policy of European Union, the Strategy of Lisbon, the Strategy for the Sustainable Growth, Fifth and the Sixth Action plan of Community for the Environment and the Thematic Strategy for the Marine Environment.

- The encouragement of the states-member to strengthen their policies and redesign their investments to the direction of supporting the marine and combined transports, where important role is held in the growth of harbor infrastructures and in the interconnection of ports with the hinterland and the Trans-European and Pan-European Networks of Transports.

- The priority in the growth of qualitative shipping with concrete specifications and qualitative characteristics, where the competitiveness is faced in the base of benefit of figurative services of high quality, while the cost constitutes a sovereign but not exclusive factor.

- The aid of political cohesion for the environment and policy of transports, with the undertaking of concrete, quantified objectives and the explicit engagement of states-member and involved institutions for their concretization. In parallel with the benefit of capable motives to the shipping industry, the promotion of self-committed agreements with the institutions of shipping could constitute a suitable tool to this direction.

- The aid of individual elements and processes that refers to the application of legislative regulations in the field of maritime transports, included also the control of their application, since the sufficient and essential application ensures in an important degree the effectiveness of the system.

- The improvement of access for the institutions of organized interests that are involved in the transport sector, in the planning and the reception of measures for the maritime area, aiming to highlight the individual interests and to achieve better policy, but also the essential improvement of conditions for their

concretization. Moreover, emphasis should be given in the growth of additional measures that will aim to collaborate the institutions, achieve better comprehension for both sides, while special concern owes to be taken for their co-ordination.

- ♣ The promotion of the "maritime cluster" concept, as a mean for the confrontation of big challenges, the promotion of competitiveness of the sector, but also the intensification of viable growth with the adoption of environmental acceptable solutions from the whole shipping and harbor community and the strengthening of environmental conscience.

- ♣ The growth of research in the field of marine environment and maritime transports, with the exploitation of the platform provided by the Seventh Program Frame for the Research and the Innovation, in a proper way in order to promote the scientific knowledge and to create a solid scientific background, which will constitute basic surge in the designing and the concretization of policy and individual actions. The promotion of the use of new technologies in the shipbuilding industry, the fuels and the logistics operations, are called to supplement the approach.

- ♣ The discovery of satisfactory solutions for a series of issues related with the maritime transports, e.g. the management of residues that is produced by ships and the reduction of airy emissions.

- ♣ The ensuring of solid and capable economic base of policy, the strengthening of Union's arsenal in regard to relative programs and actions and the reinforcement of environmental protection and the safety of maritime transports. (Platias, 2008)

These elements constitutes important conditions for an effective incorporation of environmental dimension in the maritime transport policy. Their satisfaction and their relation with each other will indubitably determine the degree and the quality of incorporation and consequently the success of system to this direction. The European policy, as the policy of states-member, is called consequently to focus the efforts and the available means to this objective, while the planning should correspond with clarity and plenitude, but also to incorporate as surge of planning structural weaknesses and resistances, that could constitute obstacles to this course. (Platias, 2008)

4.3 A brief reference to Eco Ports and the PERS system

The "green ports" is a new tendency that has been shaped hardly the last decade with basic aim to limit the pollution in the areas that occupy their installations, in the hinterland that influences, in the friendly for the environment use of energy and in their marine area of responsibility. The Community legislation imposes (from 1/1/2010) in the

commercial ships that find moored in Community ports, either to use fuel with particularly low content in Sulphur (0,1%km), either to be connected with an exterior provision of electric energy (where relative infrastructure exists), annihilating thus at the duration of mooring their emissions.

In the EU, this period the port of Hamburg (green capital for 2011), the third bigger commercial port of Europe, began the implementation of different administrative practices that aim to decrease the emissions of carbon dioxide for 40% until 2020.

The network of Eco Ports is consisted by European ports which have evaluated their environmental performance according to the Ecoport Self Diagnosis Method (SDM) of the European Sea Ports Organization (ESPO). The criteria of evaluation have been determined by ESPO, based on the recorded environmental performance that European ports demonstrate and the main conditions of systems of environmental management, as the international standard ISO14001 and the system of environmental management of the ports PERS (Port Environmental Review System).

The PERS has been established in the area of European ports, while it has been developed from the ESPO specifically for port activities, aiming to effectively manage the ports, while the organization of the environmental management system of ports according to the PERS, is certified by independent institution certification Lloyd's Register.

Image 4-1: Certification of European ports based on the evaluation of their environmental performance

4.4 Innovative technologies of Eco ships

- *Aeolian energy*

Aeolian energy is the energy that is produced by the exploitation of wind. This energy is characterized "mild form of energy" and it is included in the "clean "sources, as it is commonly defined, the sources of energy that do not emit or do not causing pollutants. The most ancient form of exploitation of Aeolian energy was the sails of the first sail-boats and much later the windmills on land. It is named Aeolian because in the Greek mythology Aeolus was the god of wind.

The Aeolian energy constitutes today an attractive solution in the problem of electric production. To "fuel" is abundant, decentralized and free. Airy greenhouse and other pollutants does not released, and the repercussions in the environment are small compared to the electricity factories that generates electricity by conventional fuels. Aeolian energy can be used with various ways in vessels in order provide additional thrust. These ways are:

  - The traditional sails
  - Solid Sails and form of fin
  - Eagles
  - Engines of type "Flettner"
  - Fertilization with air

- *Systems of Recuperation of Released Heat*

This system recovers the thermic energy of exhaust and transform it to electrical. The energy that remains can be used for other uses onboard, e.g. boiler. The recuperation of Released Heat it can reach 15%-20% of the main engine's power. (Wartsila 2009)

- *Use of Liquefied Natural Gas (LNG)*

With the use of liquefied natural gas (LNG) as fuel the catalysis of energy is decreased, due to the lower demand for electric energy and heating of the ship. The bigger energy saving is emanated from the obliteration of requirement of segregation and heating of heavy oil (HFO). The Cold (-1620C) LNG may also used for refrigeration of systems of air conditioning, in order to economize the force of corresponding compressors. The saving of the total energy can reach 4% for one formal RO-RO carrier. (Wartsila 2009)

- *Solar Energy*

Solar collectors installed in the deck of the ship can produce electric energy for use in electric engine thrust or in the auxiliary systems of the ship. Depending on the available space on deck, the solar collectors can decrease the total consumption of fuels for 3,5% for tankers, 2,5% for RO-RO carriers and 1% for passenger ferries. (Wartsila 2009)

A trial of this technology, constitutes the ship "Leader Aunga", a car carrier of 60.213GT which was developed by the "NYK" and "Nippon Oil Corporation". The vessel is equipped with 328 solar collectors and it has been used for the trial of thrust systems that partly functions with solar energy. The produced energy was measured that it corresponds to 0,05% of the thrusting power of the vessel and to 1% of the daily requirements of energy, like cooking and the lighting of accommodation. (NYK, 2009)

- *Type of Fuel*

With the use of gases of fuels is achieved appreciable reduction of the emitted CO_2.The LPG and LNG are fuels of hydrocarbons with low emissions of carbon and the resulting reduction of CO_2 per Kwh, is approximately 20% lower from HFO. Except gases of fuels the use of bio-fuel, as fuels in the naval engines, constitutes a possibility of reduction in CO_2 emissions. This possibility is at the present moment restricted. This is due to technological factors but also due to the cost and the lack of availability as well as other factors that are related with the production and the use of bio-fuel. (Wartsila 2009)

4.5 The ecological footprint

The ecological footprint compares the demand of human species to the nature and the faculty of biosphere to regenerate and to repeat the product of demand in proportional pace. For this purpose, it is attempted the estimation of productive ground and aquatic regions in the frames of which becomes the production of resources that is required for the existence of the corresponding human population and for the absorption of his waste, taking into consideration the present technology. Henceforth, the term ecological footprint has been extended and constitutes a general mean of comparison of human way of life, which can may include car driving or the activity of a shipping company, the onboard movement of a ship and the faculty of nature to cover in any way the particular model of existence. (Greenissue magazine, 2011)

4.6 Green passport

The Green Passport, is the recording of pollutant materials of manufacture and equipment of a ship. The Green Passport, consequently, does not constitute ecological certification of harmlessness of his materials on the environment and the health of a person, but exactly the opposite.

It is composed by the shipyard at the manufacturing phase or by the responsible head, and is verified after process of inspection and checking of hazardous materials. It consists a guide for the safe shipbreaking in the shipyards for recycling purposes. Therefore, the process of publication of Green Passport, which covers the recording of pollutant materials (structural and operational) constitutes an important guide/tool for the future recycling.

4.7 Examples of eco-ships

1. **_MSC Cruise_**

It uses units of biological cleaning for the re-use of water onboard, it recycles the 80% of aluminum, plastic and paper used onboard and uses fuels of low content in Sulphur and that make it able to sail in protected areas.

2. **_Hull 069_**

The first catamaran with ecological engine, built from Australian naval company Incat and was delivered in October 2012. Incat, who has big experience in the manufacture of ships with engine saving of fuels, it delivered Hull 069, catamaran of length of 99 meters, capacity of 1.000 passengers and 158 vehicles with engine of combustion of natural gas and oil. Buquebus, is the shipping company seated in Uruguay that will use the ship for the trip from Buenos Aires Argentina to Montevideo of Uruguay. This vessel represents an important step in the use of natural gas as fuel.

3. **_Vidra_**

The first eco-ship in Croatia sails in the waters of Lake Sakantas, in National Park Kopatski Rit, in the Eastern department of country. The boat of capacity of 60 passengers was manufactured in a period of five months from the company of city

Osiek and his cost amounted in the 1.4 mill. Croatian crowns (186.700 Euros) sum that was disposed by the public organism of the National Park Kopatski Rit and from the ministry of Environment of Croatia. The visitors of National Park have the possibility with the electrically driven ship to view the marshy habitats and to be informed about the renewable sources of energy. The ship "Vidra" operates without producing any noise, so the infrequent species of animals and birds that live in the water land are not bothered by the ship.

4. *Celebrity Solstice*

In the cruise ship Celebrity Solstice of subsidiary company Celebrity Cruises, recently were added 216 solar panels for the electrification of lifts and 7.000 lights of type LED. Celebrity Solstice, is energy efficient, designed with aerodynamic specifications for the lesser consumption of fuels. Celebrity Solstice has advanced system of refinement of water. When the water is discharged in the sea it is absolutely clean. Moreover the ship is equipped with special insulation in the windows, which decreases the need for air conditioning, allowing more natural light and consequently, it decreases the consumption of electricity.

5. *Maersk Triple-E*

The new vessels "triple-E" emits in atmosphere 20% less Carbon dioxide compared with Emma Maersk that used to possess the lowest percentage of emissions worldwide and 50% less from the mean of the vessels that are operating in the line of Far East-Europe. Moreover, the consumption of fuel per TEU is 35% less compared to the remainder ships that other companies are expected to receive the next years for the same line. The enormous capacity (18.000 TEU) allows the transport of most possible containers with the smaller possible consumption of fuels and with minimal possible release CO_2. This, in combination with their size and pioneering system of impulse that this vessels uses, constitutes an important factor of improvement of output in economies of scale, creating new data in shipping.

The vessels of this series are not simple biggest in size. They are biggest in length and width that may exist taking into consideration the size of existing ports. Applying pioneering methods of shipbuilding, the capacity of new boats is16% bigger (roughly 2.500 more containers) from Emma Maersk, even if the exterior dimensions do not justify this increase. This difference is owed mainly in the shape of the ship. While the shape of Emma Maersk is formal "V" with decreased capacity in the depth of hull, the shape the new vessels it resembles more with "U". The bridge was shifted to the prow, while the engines are shifted to the stern, increasing with that way the capacity. [120].

Chapter 5 Methodology and Data

(Empirical approach to the consumers)

5.1 Methodology and objectives of the research

The aim of this research is to contribute to the eagerness of the consumers to use eco-friendly ships for the benefit of the environment, even if that means that they must pay a higher ticket than usual, locating mainly how much informed the consumers are regarding the subject and which values determine the willingness and the awareness of the consumers about the eco-ships. To do that I will use descriptive statistics and a linear regression model on survey data. The success of this research but also the conduction of accurate, valid and reliable results are based substantially on the size sample. Specifically, the larger the sample, the less the error would be (sampling error). Moreover, the results become more valid and precise while the size of the sample increases. Consequently, this will allow the export of more general and objectively conclusions. For this research a questionnaire has been used in order to answer the main questions about the values that determines the willingness and the awareness of the Greek consumer.

The data has been collected from the questionnaires that have been distributed on-board of two vessels which are operating in the line of Hgoumenitsa-Bari. Specifically, the shipping company that owns these ships was willing to assist me to acquire the data. The ship's crew was giving the questionnaires to every passenger willing to participate to this research. Then the filled questionnaires were collected and send to me for my analysis. The period where the questionnaires were available onboard for the research was from 02/07/2015 until 02/08/2015. The response was high and the total number of filled questionnaires was 240. The number of the questionnaires wasn't in purpose limited to 240 but the properly filled questionnaires was randomly 240. The questionnaire that referred to the consumers provides certain clarifying information to those who it is addressed regarding the purpose of the research and it is constituted by two modules. The first module (A) is constituted by questions regarding general information on the profile of the participant and second module (B), from questions that concern the participant's preferences and mainly if it knows what is an eco-ship and if he would be willing to pay a higher ticket for the use of an eco-passenger ship against a conventional. (The questionnaire is contained in the Annex)

5.2 Data analysis and process

The process and the analysis of the data acquired by the questionnaires is conducted at the last part of this research. Initially, the questionnaires were examined carefully, in order to detect any errors or values that may be skipped or miss-filled. After the examination of the questionnaires, their assessment and analysis began, with the statistical tool SPSS18.0 (Statistical for Social Science) in order to be possible any further analysis of the answers and the equitable export of conclusions.

5.2.1 Descriptive Statistical Data

The statistical tables and the graphic representations constitutes useful means to present the accurate data, shortly and with clarity. Moreover they may reveal important data characteristics, like their range, shapeliness or the existence of extreme prices.

❖ ***The gender of respondents***

The questionnaires were filled by 240 individuals from which 120 were women (50%) and 120 were men (50%).

Although the sample of individuals was random[1], it appears that they answered equally the same percentage of women and men.

---

1. Definition: A random sample is the sample of population, where the individuals were picked one after another, with the main characteristic, that the remainder individuals of population each time, have the same probabilities to be included in the random sample.

Diagram 5.1: Gender
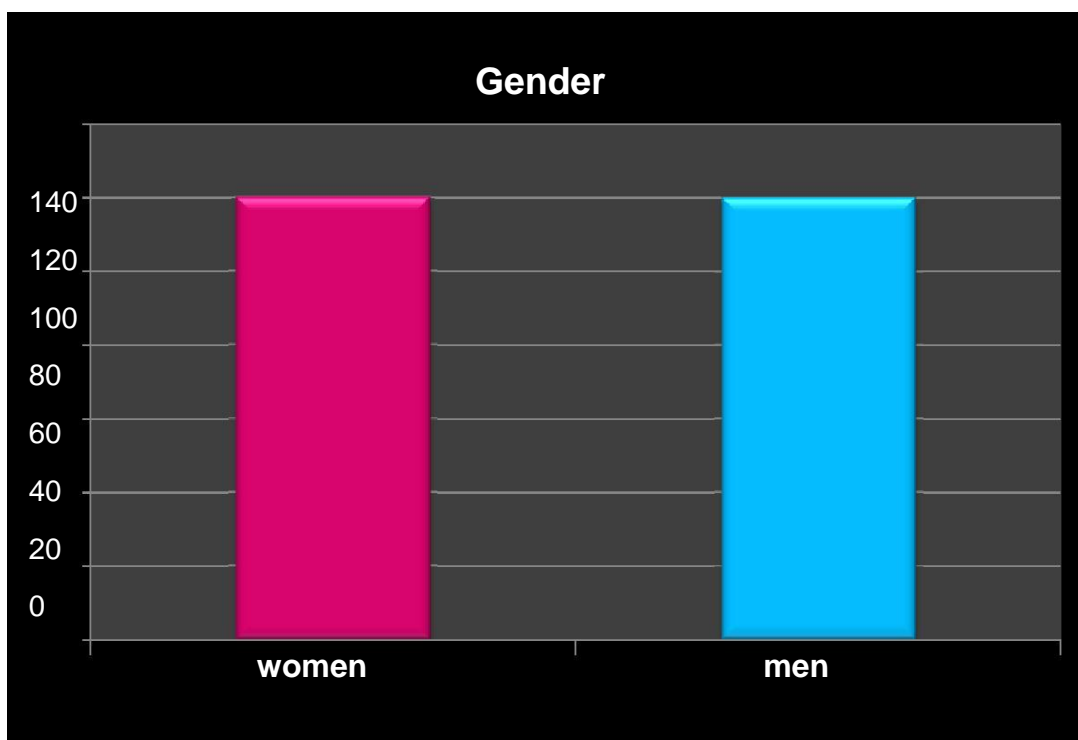
❖ *__Age of respondents__*

Diagram 5.2: Age
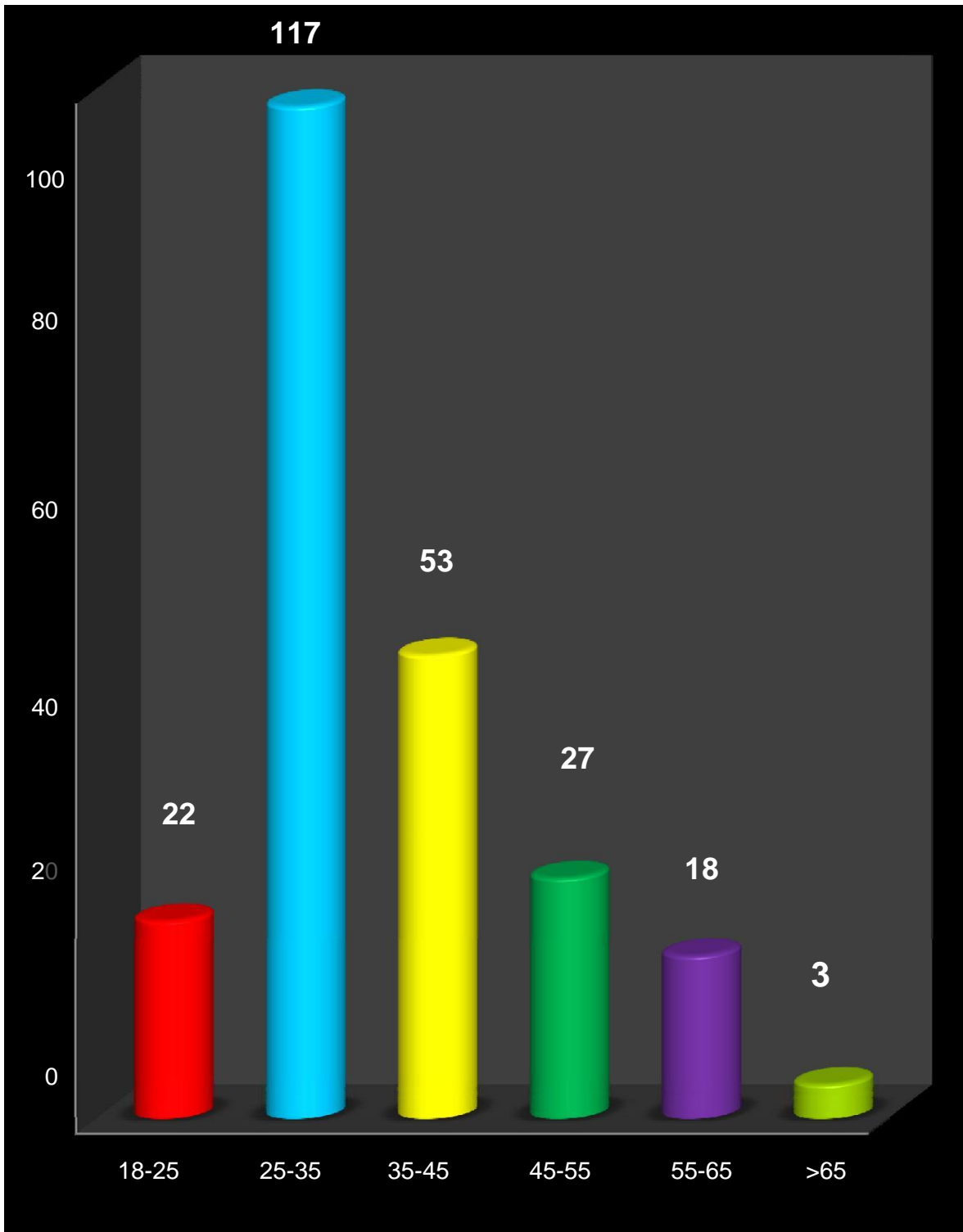
Although, as for the age of individuals that was asked the choice was random, it appears that the bigger percentage of individuals that answered, 117 are 25-35 (49,0%) years old, then 53 (22,0%) are between 35-45 years old and afterwards the next decade, between 45-55 years old answered 27 persons (11,0%). Follow ages between 18-25 years old with 22 (9%) and ages between 55-65 with 18 (8%) and finally only 3 (1,0%) with age above 65 years old. This might be explained because the majority of the passengers traveling these months of the year are most of younger ages.

❖ *Educational Level*

Diagram 5.3: Educational Level
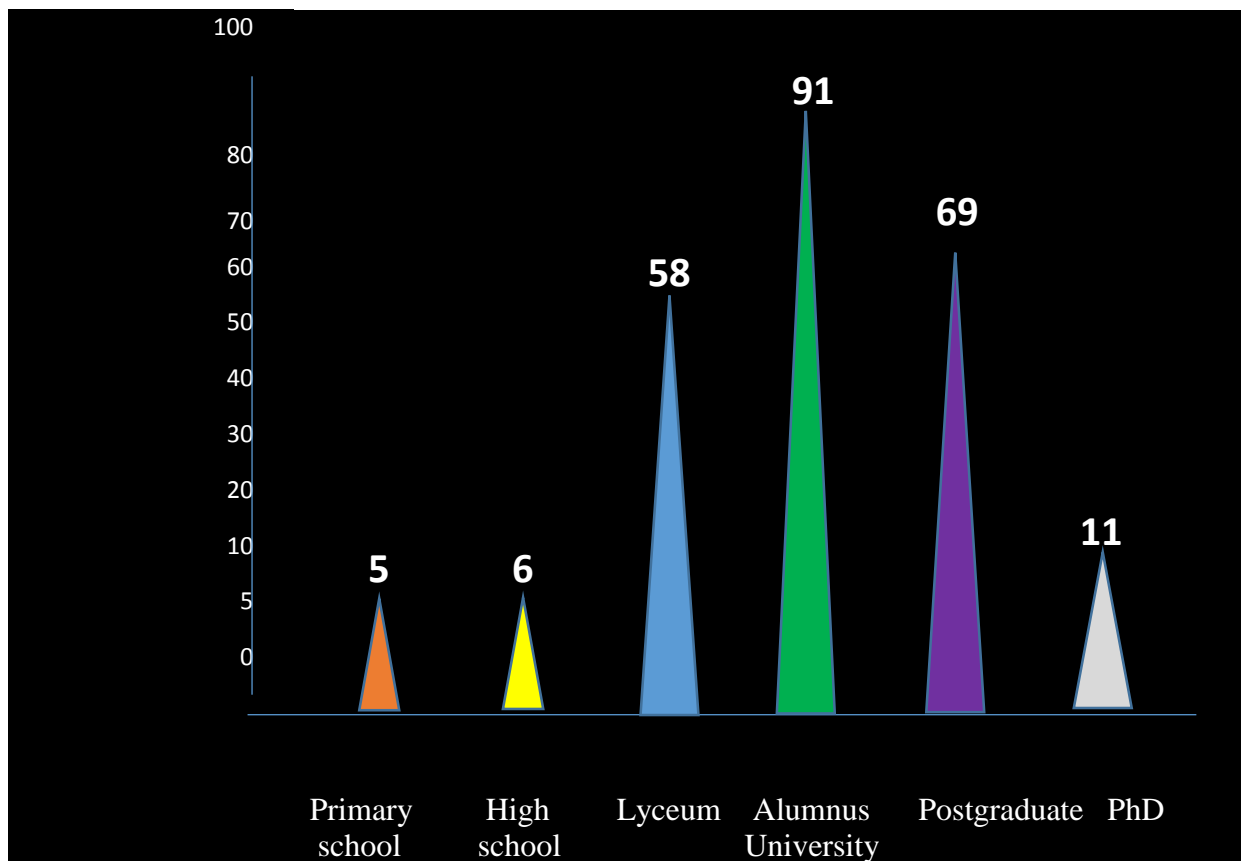
From the random sample the highest percentage of the respondents 38,0% (91) are alumnus of Universities, and it follows the 29,0% (69) are holders of a Postgraduate diploma, with percentage 24,0% (58) graduates of Lyceum, and finally with percentage

of 5% (11) are holders of a PHD. 5 participants (2,0%) are graduates of primary school and 6 participants (2, %) graduates of High school

❖ ***Residence of the participants***

Diagram 5.4: Residence
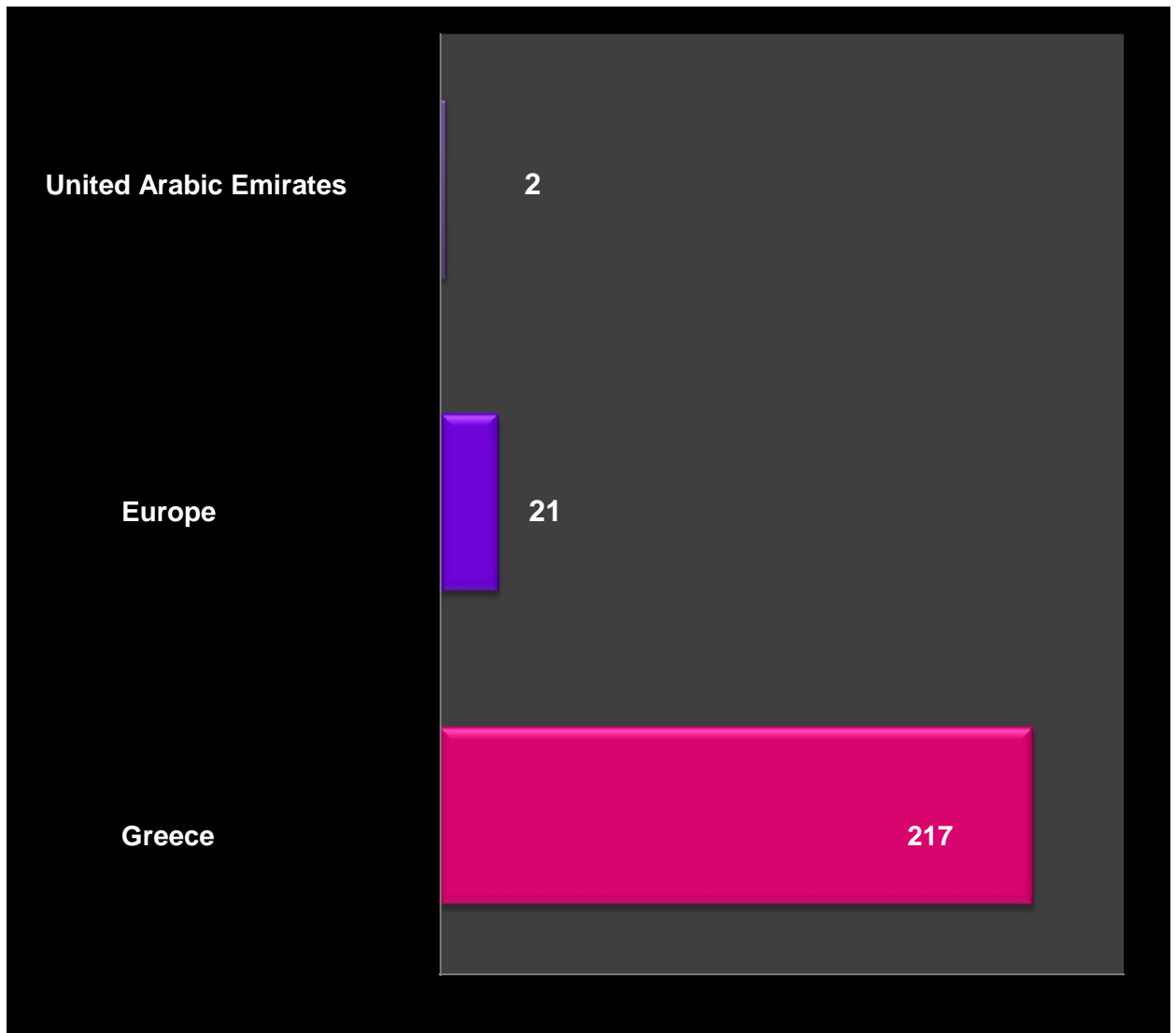
From the random sample the 217 respondents (90.41%) leave in Greece, 21 (8.75%) leave in Europe and 2 (0.83%) leave in UAE

Diagram 5.5: Profession
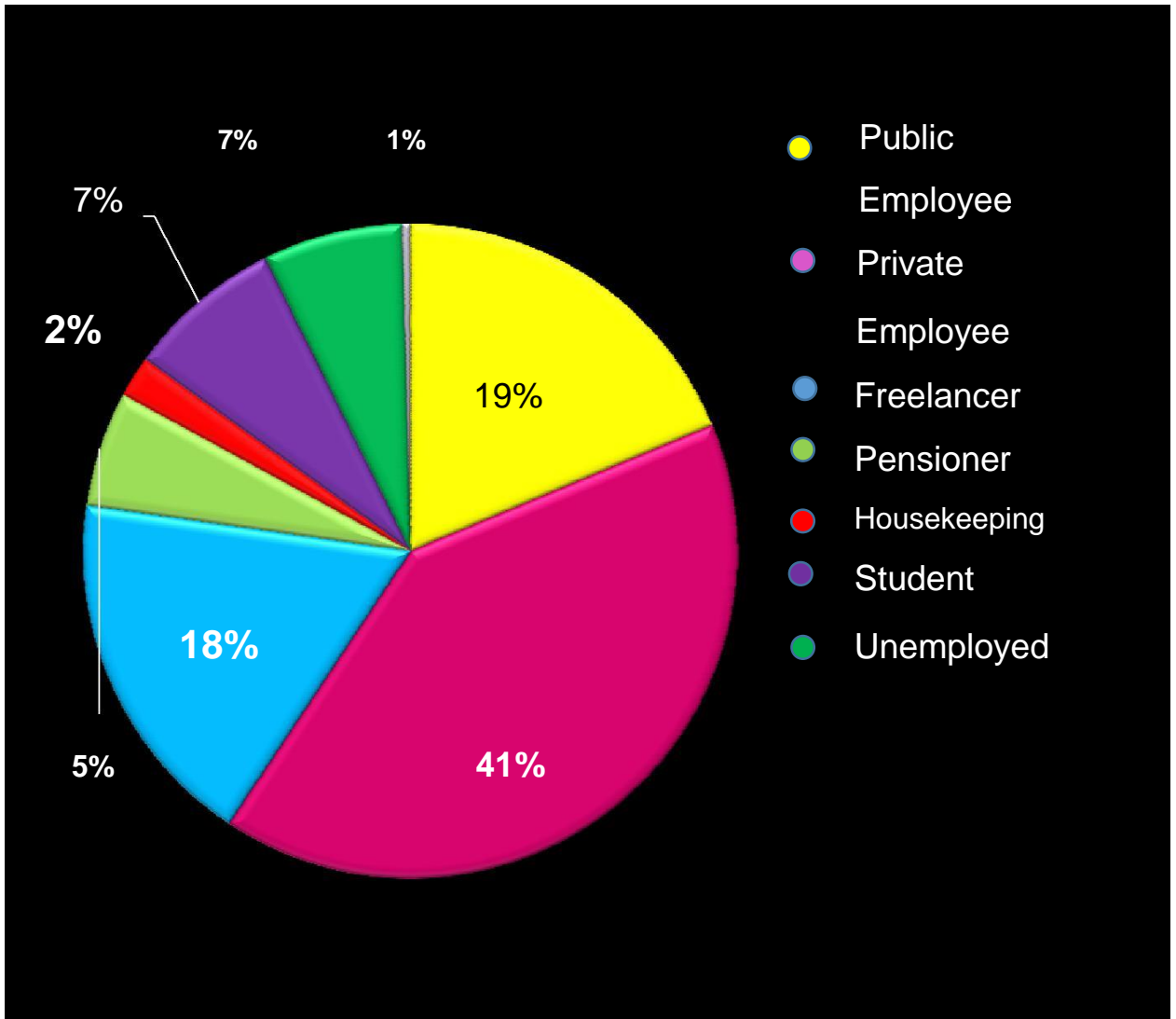
The highest percentage 41% (99) of the participants belong to the category of private employees, then 19% (45) comes from the public sector, 18% (43) are freelancers, 7% (18) are students, 7% (16) are unemployed, 5% (13) pensioners, 2% (4) houseware and the last 1% (2) other professions.

Diagram 5.6: % willing to select eco-friendly service in order to contribute to the protection of the environment
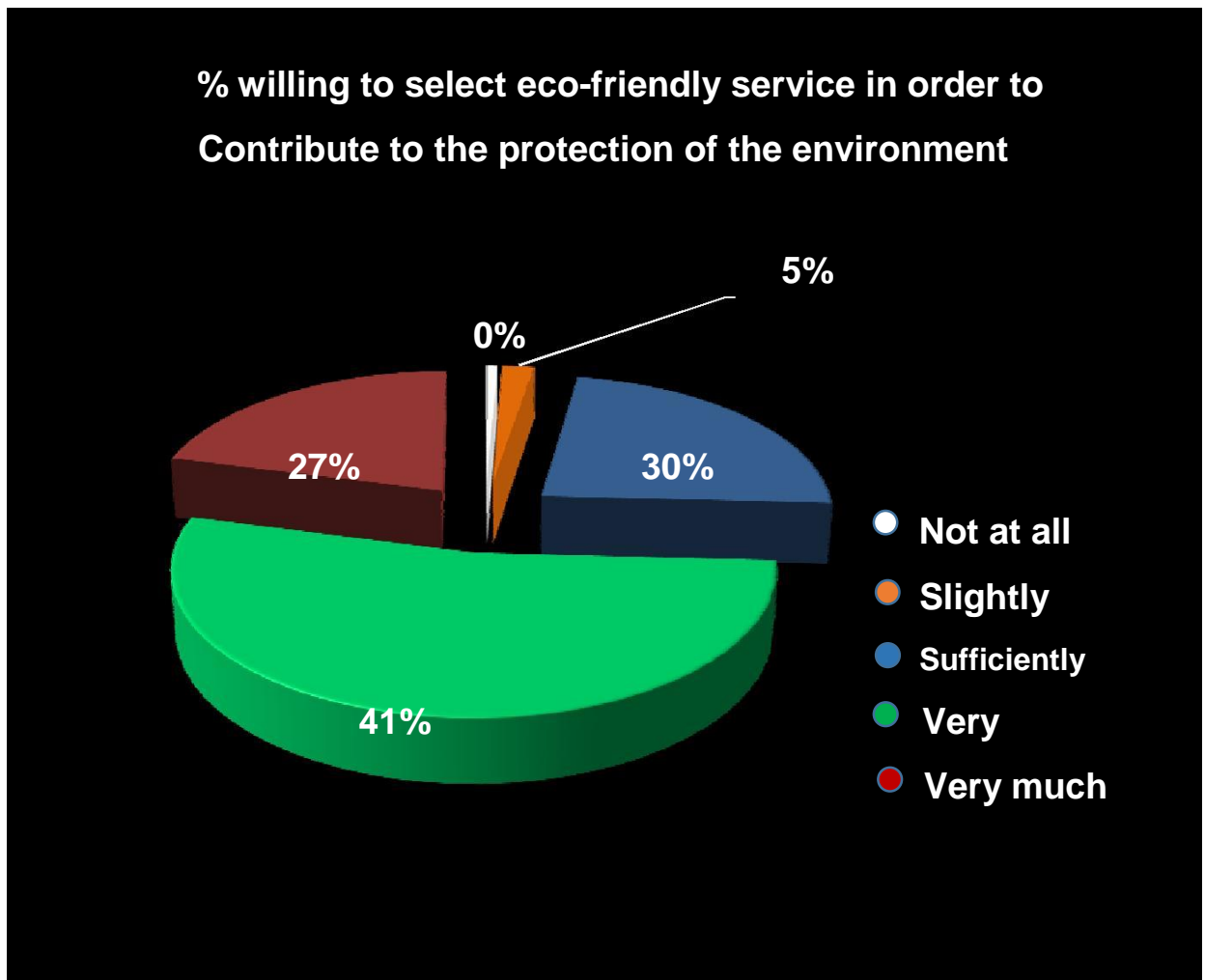
The percentage of the respondents which are VERY willing to choose eco-friendly services in order to contribute for the protection of the environment is 41% (99), 30% (71) are SUFFICIENTLY willing and 27% (64) are VERY MUCH. Respectively, 0.48% (1) is NOT AT ALL and 2% (5) are SLIGHTLY. This is probably due to the environmental sensitivity of the respondents about issues regarding the protection of environment

❖ *% of the respondents that knows, what is an eco-ships*

Diagram 5.7: % of the respondents that knows, what is an eco-ships

% of the respondents that knows, what is an eco-ships

YES
34%

66%

NO
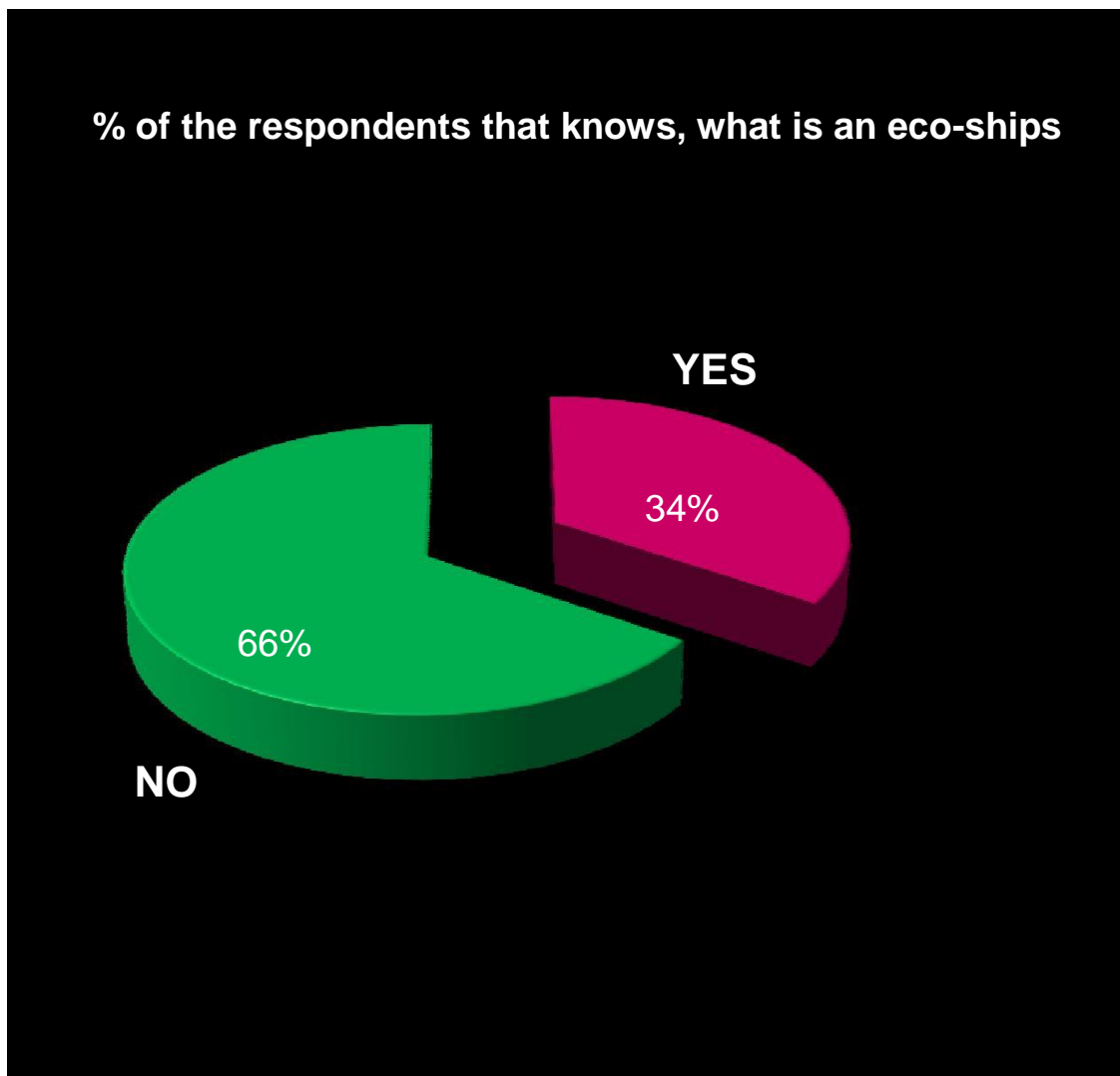
The highest percentage of the respondents 66% (158) replied that they don't know what an eco-ship is, while the rest 34% (82) replied that they know what an eco-ship is. This might be explained by the fact that in Greece the relative subject (eco-ship) is in its infant level and the knowledge of the majority is random even for individuals that related with shipping or maritime activities.

❖ *% of the respondents that knows what a hybrid ships is*

Diagram 5.8: % of the respondents that knows what a hybrid ships is

% of the respondents that knows what a hybrid ships is

YES
33%
67%
NO
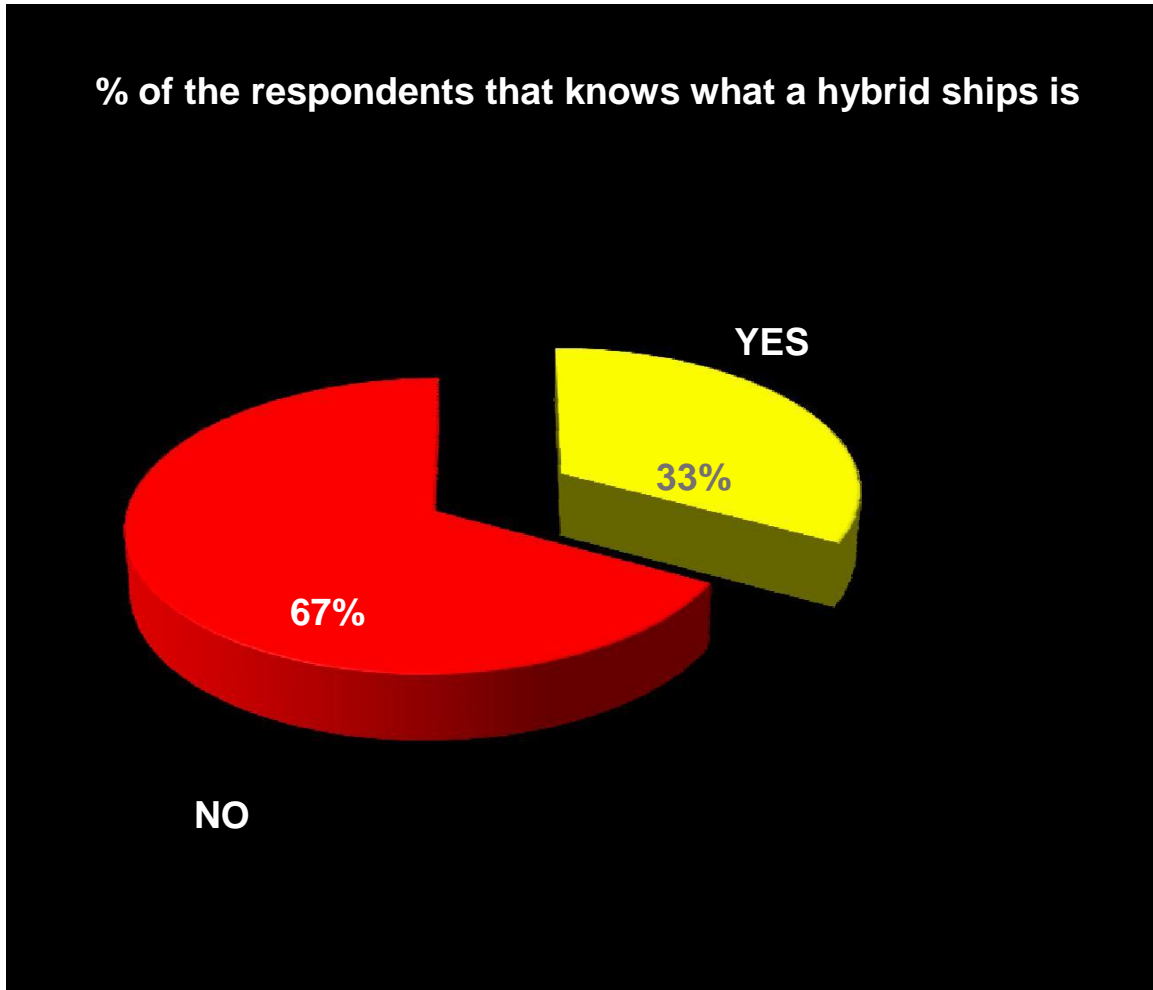
The fact that in Greece and in Europe we are familiarized in a satisfactory degree with the hybrid cars made me to assume that, the participants would make the parallelism with hybrid ship. However, this did not happen and only 79 participants (33%) knew about the hybrid ships. Therefore 3 participants less from those that knew what an eco-ship is, while 161 participants (67%) didn't know what a hybrid ship is which are 3 participants more from those that did not know what an eco-ship is.

❖ _**% of the participants that they know that instead of oil the ships may use alternative forms of energy for their movement.**_

Diagram 5.9: % of the participants that they know that instead of oil the ships may use alternative forms of energy for their movement.

% of the participants that they know that instead of oil the ships may use alternative forms of energy for their movement.

NO 41%   YES 59%
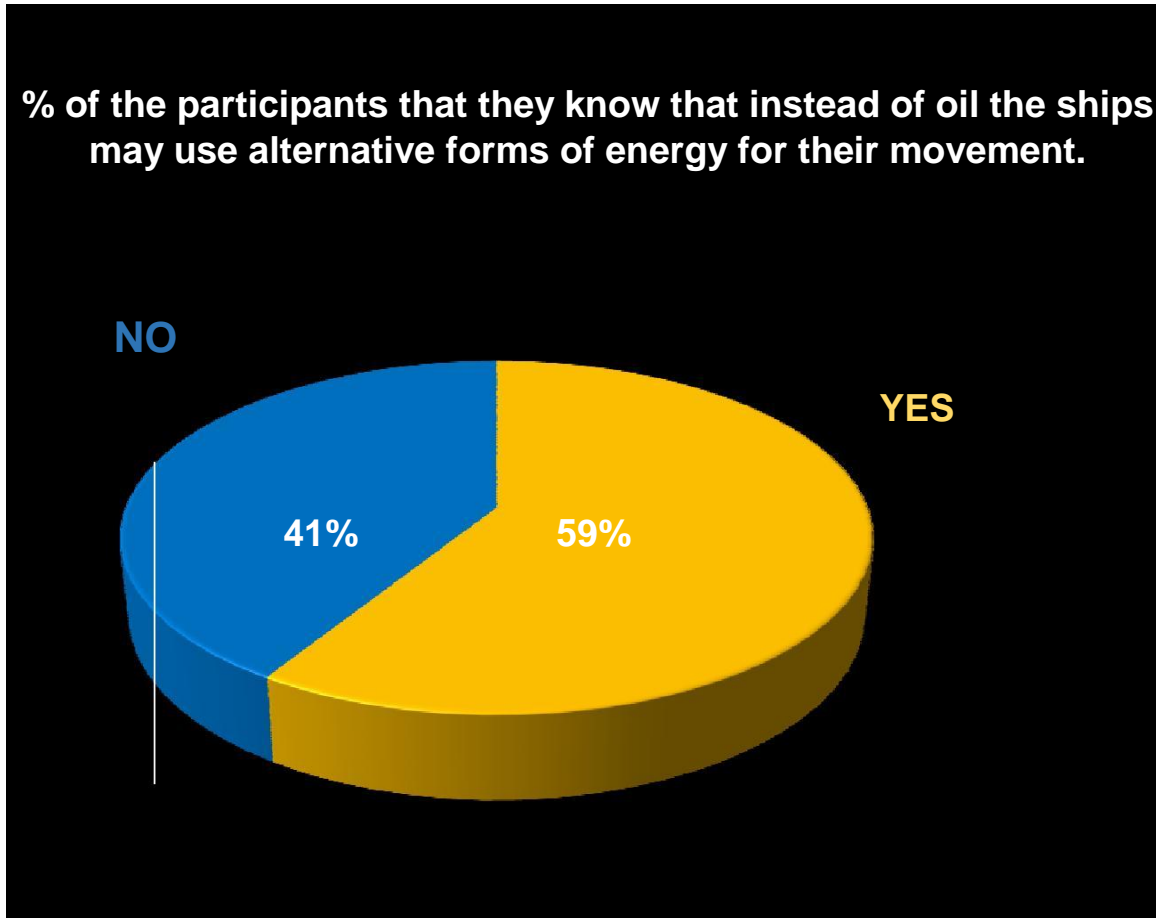
The paradox here is that from the total of 240 participants, 141 (59%) knew that the ships can use alternative forms of energy for their movement, while 99 (41%) they did not know. This might be due to the fact that most of the participants didn't make the parallelism with the eco-ships that are using alternative source of energy and that is why they gave negative answers to the previous two questions

❖ *% that believes that eco-ships provide higher quality of services from the conventional ships.*

Diagram 5.10: % that believes that eco-ships provide higher quality of services from the conventional ships.
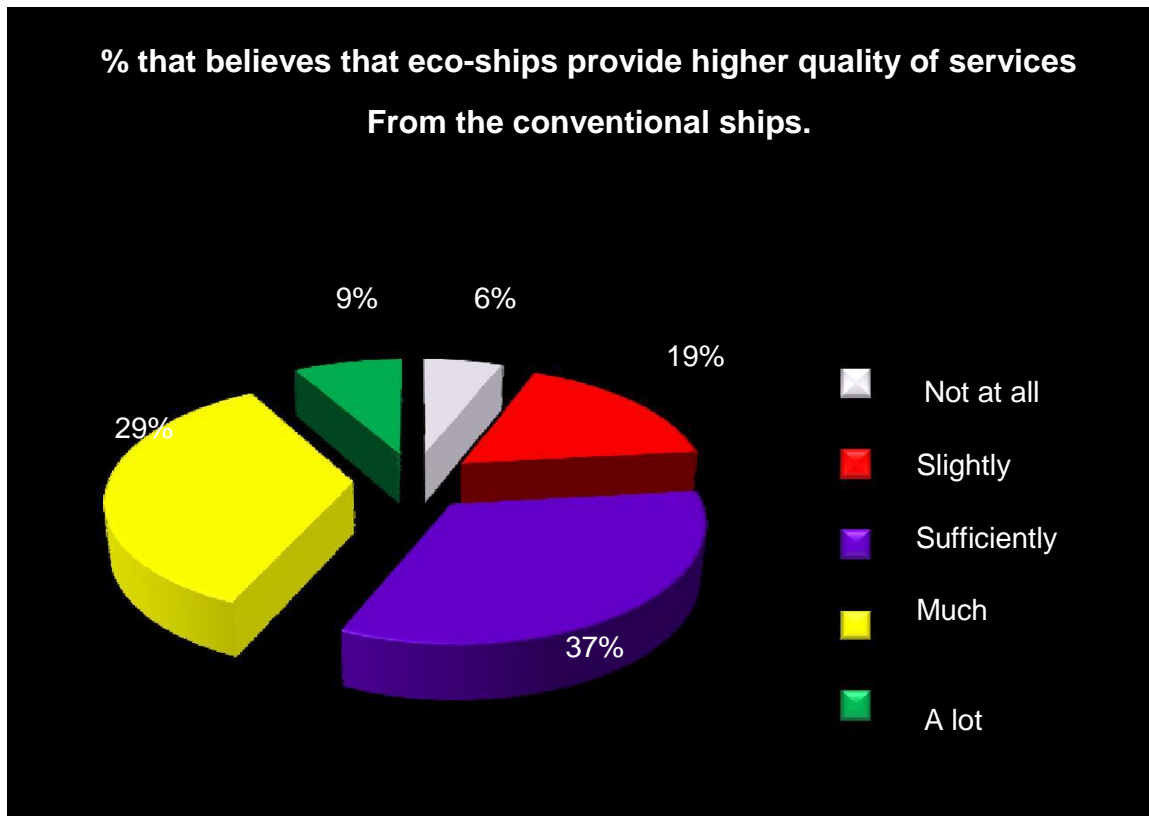
The majority of the participants believe that the services of eco-ships are SUFFICIENTLY better 37% (88) and MUCH better 29% (71) compared with a conventional ship. The rest percentages are, NOT AT ALL 6% (15), SLIGHTLY better 19% (45) and A LOT better 9% (21). These percentages might be explained from the fact that probably most of the participants believe that the eco-ships will provide higher quality of services due to their new technology and innovative means which will not pollute the environment.

❖ *<u>% of the participants that are willing to pay a more expensive ticket to travel with an eco-ship.</u>*

Diagram 5.11: % of the participants that are willing to pay a more expensive ticket to travel with an eco-ship.
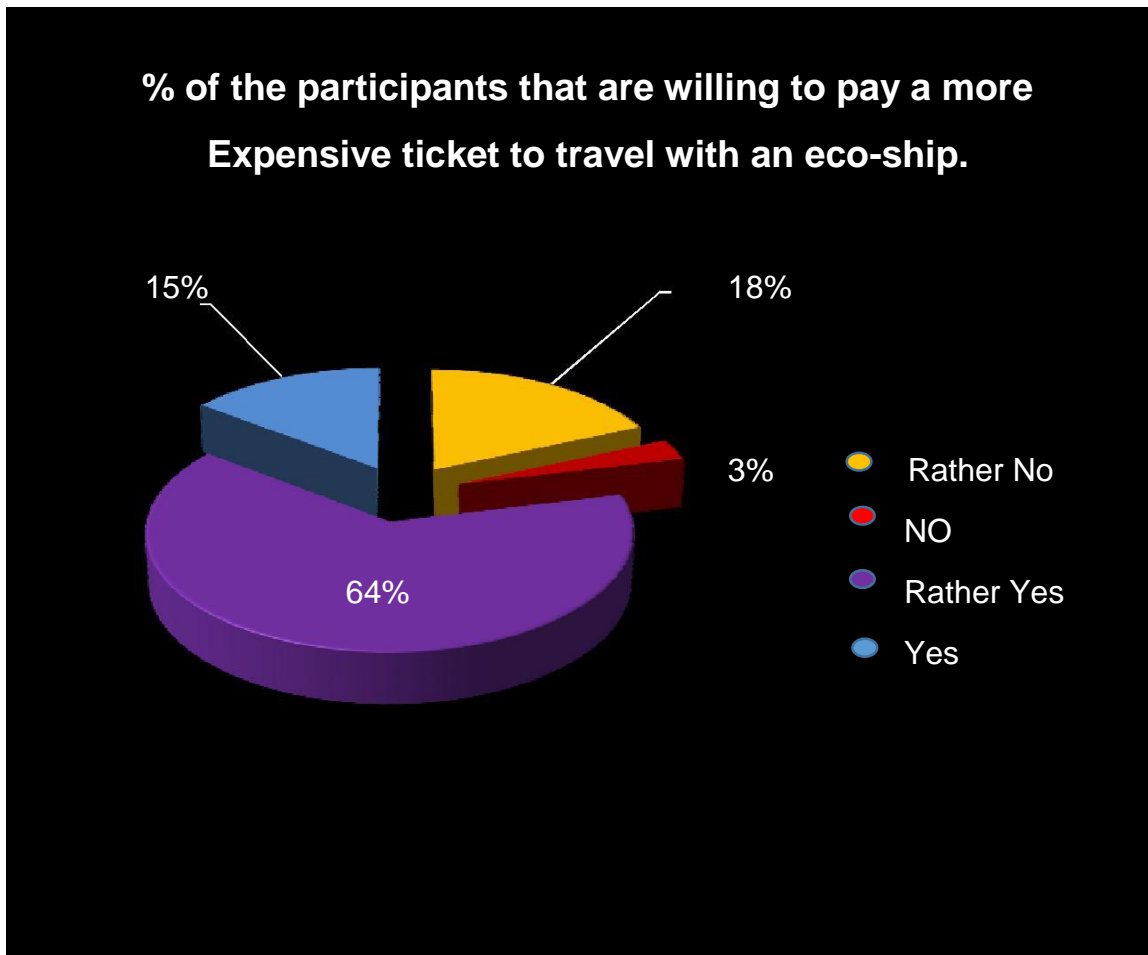
It appears that the biggest percentage of the participants 64% (154) are RATHER YES willing to pay a more expensive ticket in order to travel with an eco-ship, 15% (35) are YES, 3% (7) are NO and PROPABLY 18% (44). This is possibly explained by the also high percentage of participants that are willing you select services friendly to the environment so that it contributes in the protection of environment (see diagram 5.6)

- *% that believes that the global financial circumstances are affecting the decisions taken by the shipping companies regarding investments in new eco-ships*

Diagram 5.12: % that believes that the global financial circumstances are affecting the decisions taken by the shipping companies regarding investments in new eco-ships

From the 240 participants the 101 (42%) replied MUCH, 60 (25%) replied SUFFICIENTLY and 55 (23%) VERY MUCH. The rest 20 (8%) answered SLIGHTLY and 4 of them (2%) NOT AT ALL. This is explained by the fact that in its entirety the positive world economic conditions are influencing all sectors and they are drifting them in a period of blossoming, and vice-versa. The intensity and time space between the sectors are what differs.

❖ **_% that believes that the construction of an eco-ship is more expensive than the construction of a conventional ship._**

Diagram 5.13: % that believes that the construction of an eco-ship is more expensive than the construction of a conventional ship.

% that believes that the construction of an eco-ship is more Expensive than the construction of a conventional ship.

Don't know	Rather No	NO	Rather Yes	YES
49	33	16	103	39
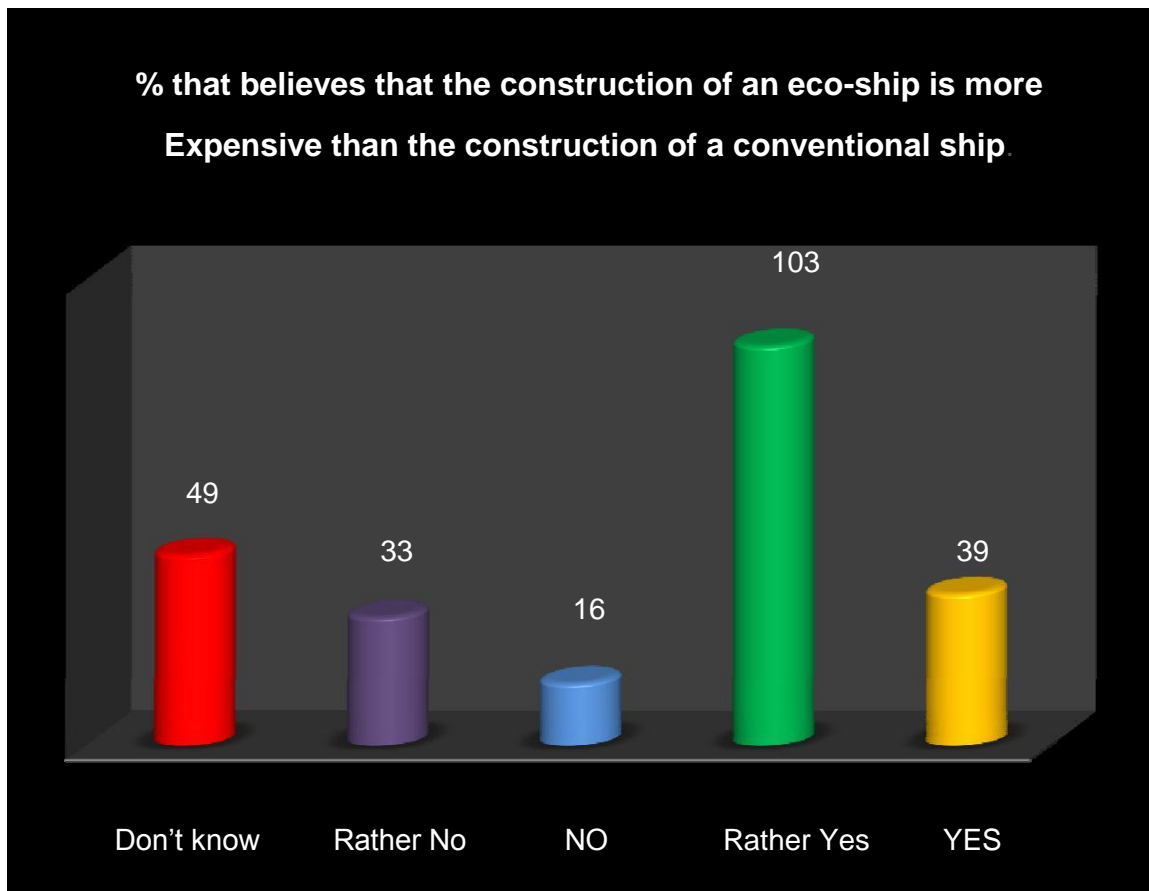
The majority of the participants, specifically the 43% (103) said RATHER YES, 16% (39) answered YES, 7% (16) believes NO and 14% (33) said RATHER NO. The remaining 20% (49) they DON'T KNOW if the construction of an eco-ship is more expensive from a conventional ship. Perhaps the participants that answered RATHER YES (16%) and RATHER NO (14%) believe that these ships either using new innovative and subsequently expensive technologies either that these ships are using more cheaper and traditional shipbuilding technologies.

❖ ***% that believes that the eco-ships that will use alternative fuels would be more energy-efficient :***

Diagram 5.14: % that believes that the eco-ships that will use alternative fuels would be more energy-efficient

% that believes that the eco-ships that will use alternative Fuels would be more energy-efficient

Not at all	Slightly	Sufficiently	Much	Very much
1	5	46	116	72
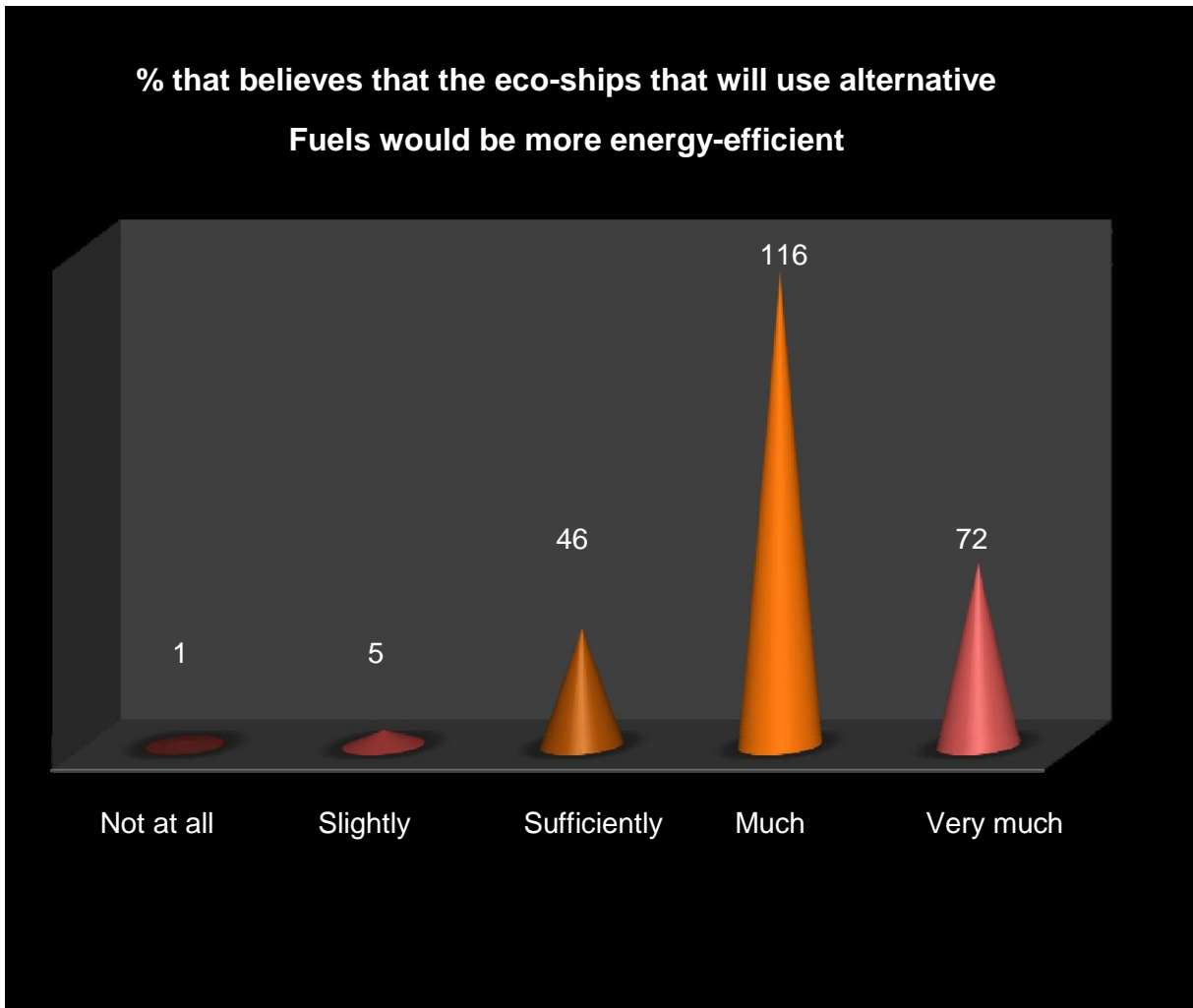
The majority of the participants with a percentage of 48% (116) answered MUCH, 30% (72) said VERY MUCH, 19% (46) SUFFICIENTLY while 2% (5) and 1% (1) answered SLIGHTLY and NOT AT ALL respectively. The energy-efficient and cost-efficient technology that the eco-ship will use might be the explanation to the beliefs of the participants.

❖ _**% that believes that the eco-ships that will use alternative source of energy or fuels will lead to the improvement of the technical knowledge regarding maritime passenger transportation**_

Diagram 5.15: Improvement on the technical knowledge regarding passenger's maritime transportation

Improvement on the technical knowledge regarding passenger's maritime transportation

Not at all	Slightly	Sufficiently	Much	Very much
15	37	38	85	65
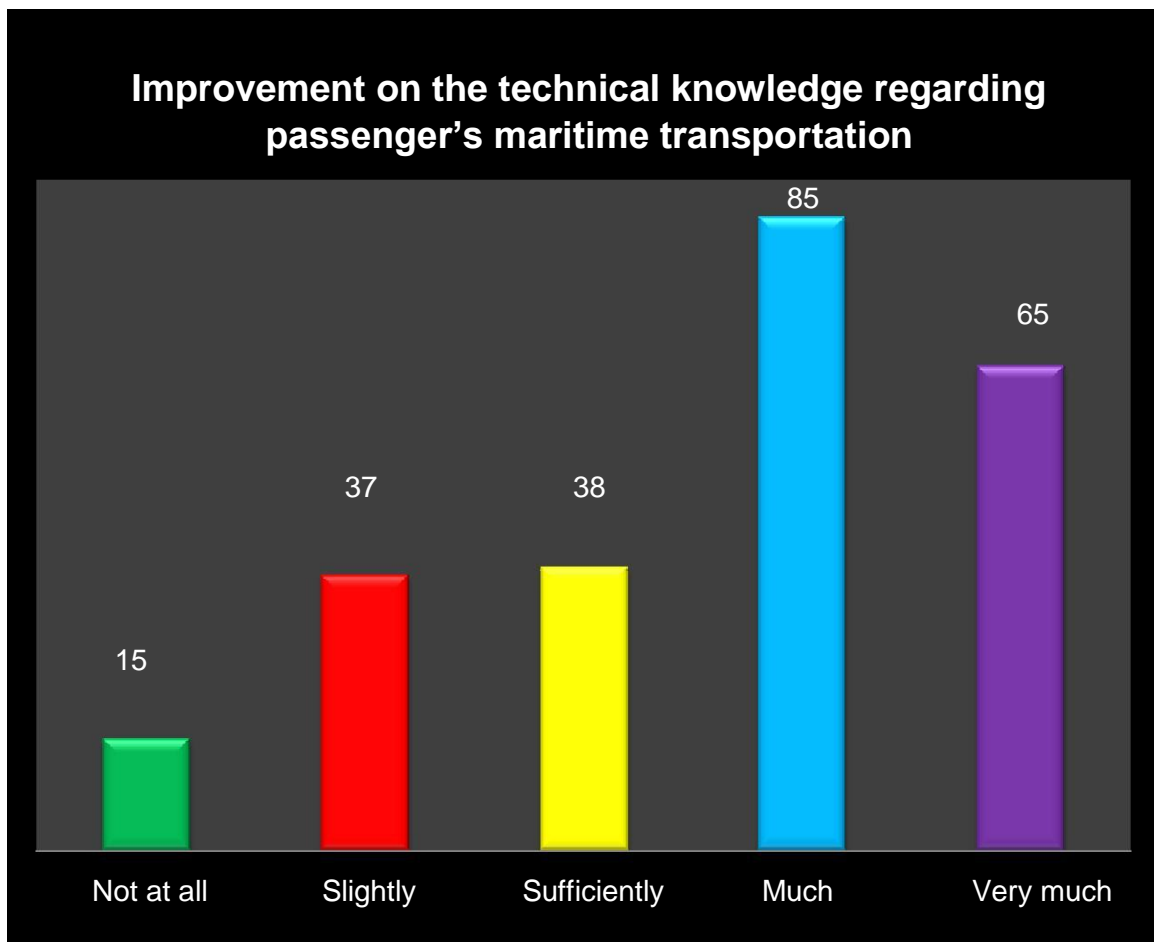
The largest proportion 85 participants (35%) believes MUCH, 65 (27%) said VERY MUCH, 38 participants (16%) answered SUFFICIENTLY, while 37 (16%) said SLIGHTLY and 15 (6%) said NOT AT ALL. This is explained by the high technology that the new eco-ship will use, a technology that would be derived by the investments of the shipping companies to a thorough research, innovation and knowledge.

Diagram 5.16: High quality of maritime transport services by eco-ships

High quality of maritime transport services by eco-ships
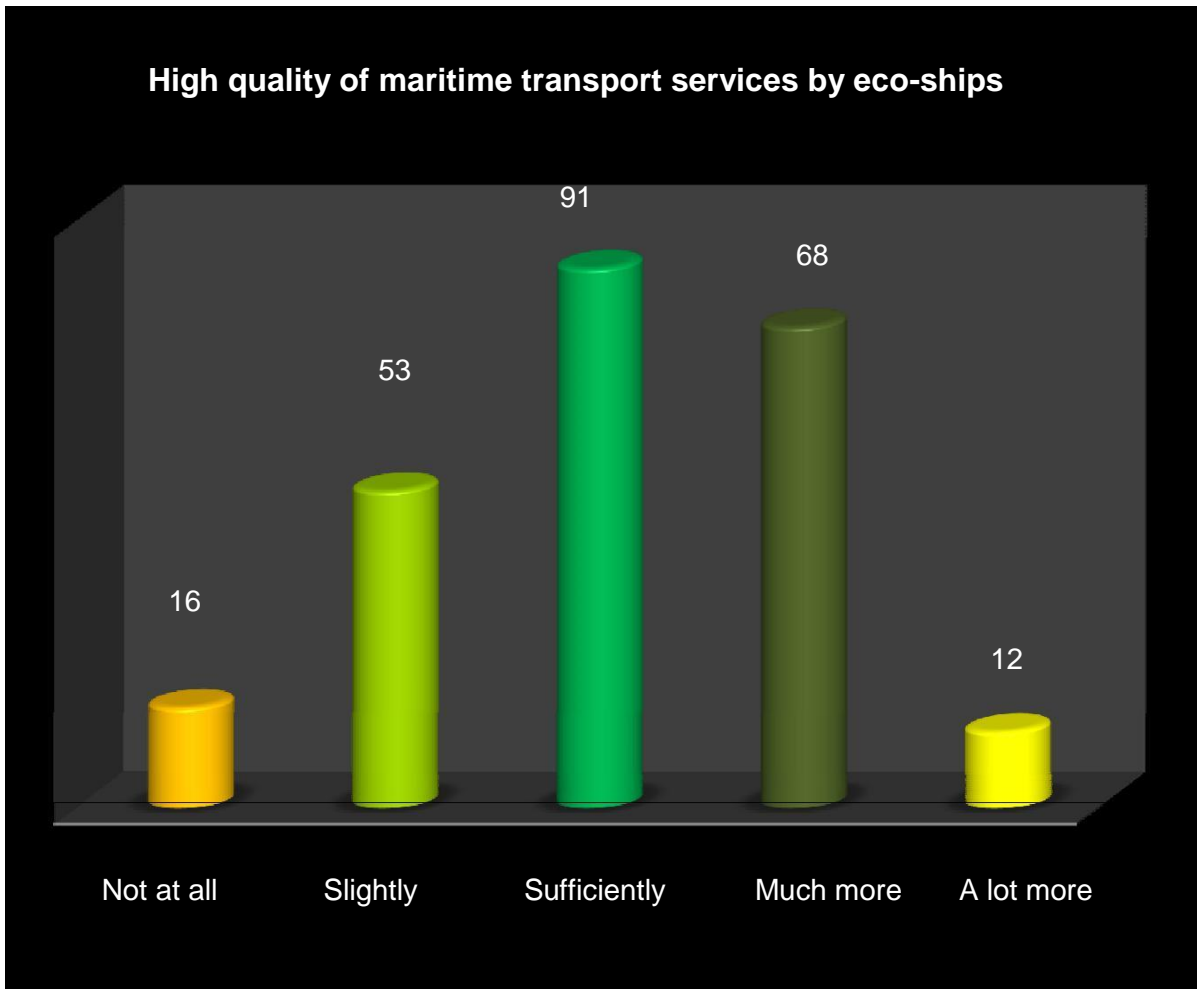
The highest percentage of the participants 38% (91) answered SUFFICIENTLY, MUCH MORE was 28% (68) and SLIGHTLY was 22% (53) while, 7% (16) said NOT AT ALL and 5% (12) said A LOT MORE. The fact that the largest part of the participants 38% believe that the quality of the maritime transportation services will be improved by the use of eco-ships might be explained by the high technology that these ships are using according also to their previous answers.

❖ *% that believes that the eco-ships will assist in the protection of the marine environment.*

Diagram 5.17: Protection of the marine environment

Protection of the marine environment
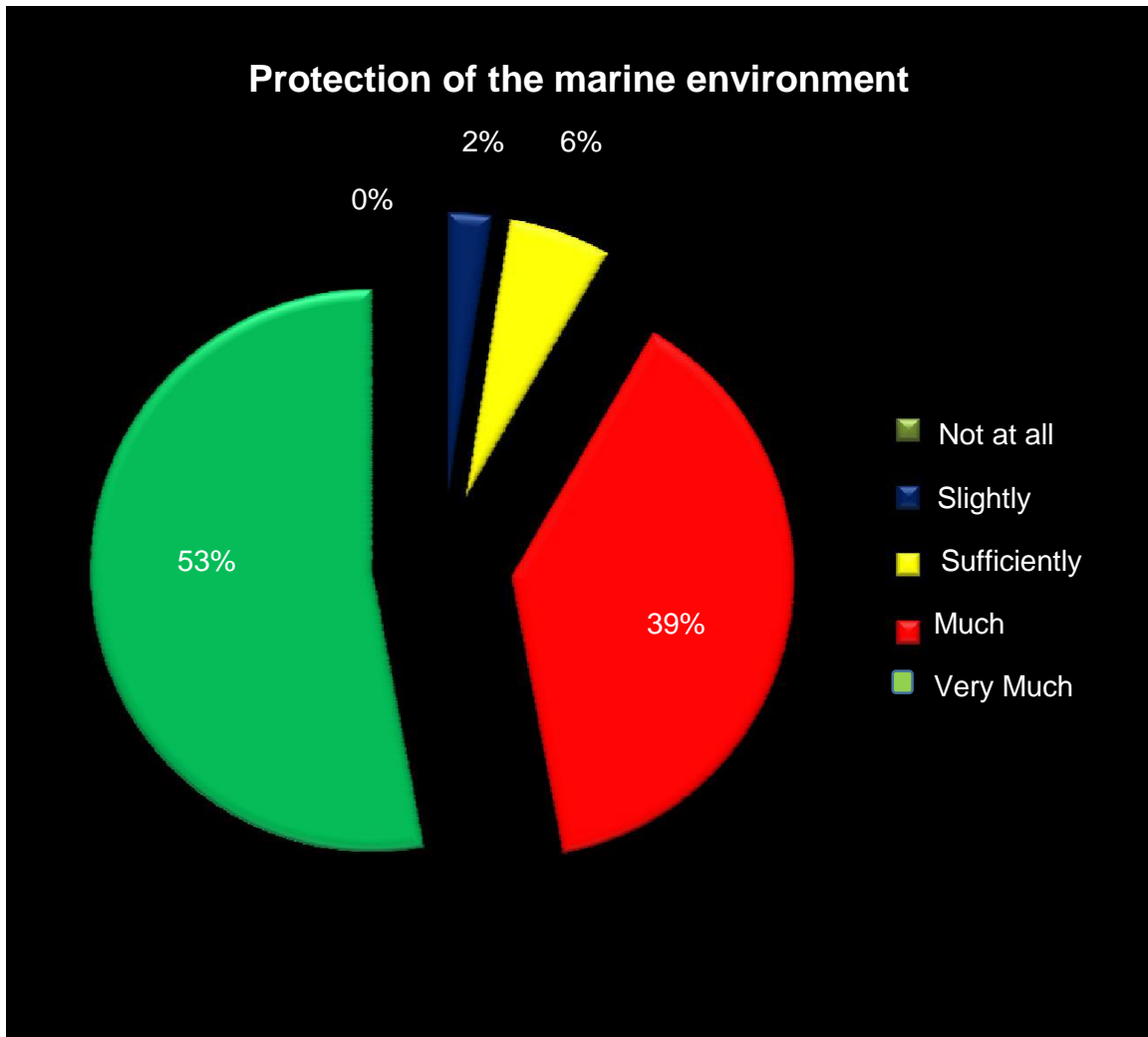
The highest percentage 53% (127) believes that will assist VERY MUCH, 39% (93) answered MUCH and 6% (14) said SUFFICIENTLY while, 2% (6) said SLIGHTLY and no participant 0% said NOT AT ALL. This is obvious because eco-ships are using eco-friendly equipment and practices and therefore seeking the protection of the marine environment.

❖ *% that believes that eco-ships will be a safer mean of maritime transport.*

Diagram 5.18: Improved safety

104 (43%) participants answered SUFFICIENTLY, 41 (17%) answered MUCH more, 69 (29%) answered SLIGHTLY, while 13 (5%) said NOT AT ALL and 13 (5%) said VERY MUCH. These results might be explained from the fact that the eco-ship are something new in the maritime and shipbuilding industry without many examples and experience and therefore there are many questions about their operation and capabilities. For instance, what will happen with an eco-ship that uses solar energy that operates in the Baltic Sea, which is a sea with limited sun light?

❖ *__% that believes that the ticket to use an eco-ship would be more expensive from the ticket for a conventional ship.__*

Diagram 5.19: Higher ticket price

Higher ticket price
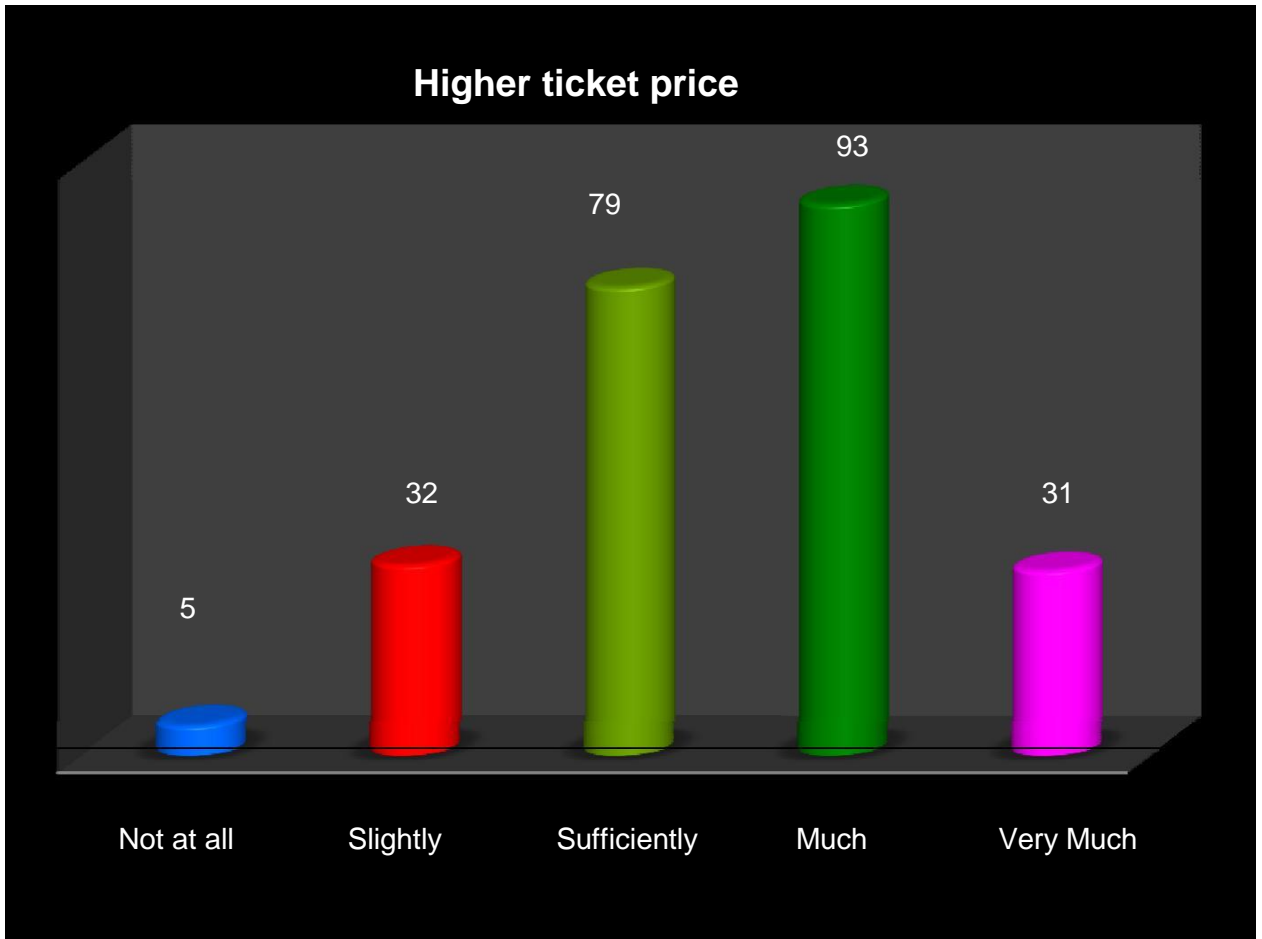
The highest percentage 39% (93) believes that the price of an eco-ship's ticket would be MUCH more expensive, 33% (79) said SUFFICIENTLY more, 13% (32) answered SLIGHTLY while, 13% (31) said VERY MUCH and 2% (5) said NOT AT ALL. This might be explained from the fact that the technology that the eco-ships use is of high standard and the adjustment of the high cost of shipbuilding will be performed via the higher price of ticket for the eco-ships against the corresponding ticket of conventional.

Diagram 5.20: Longer travel time
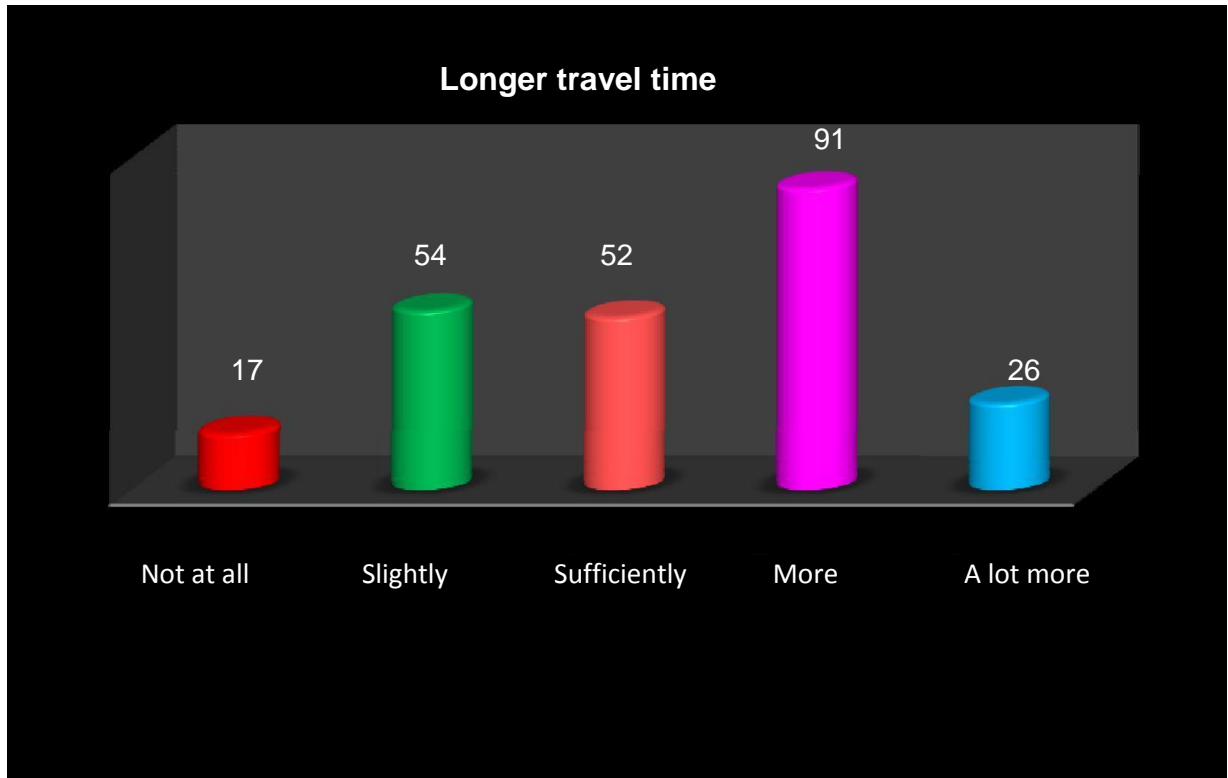
The largest percentage 38% (91) considers that the eco-ships will have MORE longer travel time, SLIGHTLY more said 23% (54), and SUFFICIENTLY more answered the 22% (52), while 26 (11%) participants said A LOT MORE and 17 (7%) said NOT AT ALL. Considering the answers of the 91 participants that said MORE, this might be explained by the force of the wind (which is not stable) or the duration of sunlight hours that will definitely affect the speed of an eco-ship that uses solar or Aeolian energy, while regarding the 54 participants that answered SLIGHTLY, their answers can be based on the alternative forms of movement that very probably will have been foreseen when these vessel facing apnea and cloudiness.

❖ *% that believes that the eco-ships would be affected and dependent by the weather conditions.*

Diagram 5.21: Weather conditions

Weather conditions

Not at all: 19
Slightly: 47
Sufficiently: 55
Much: 55
Very: 64
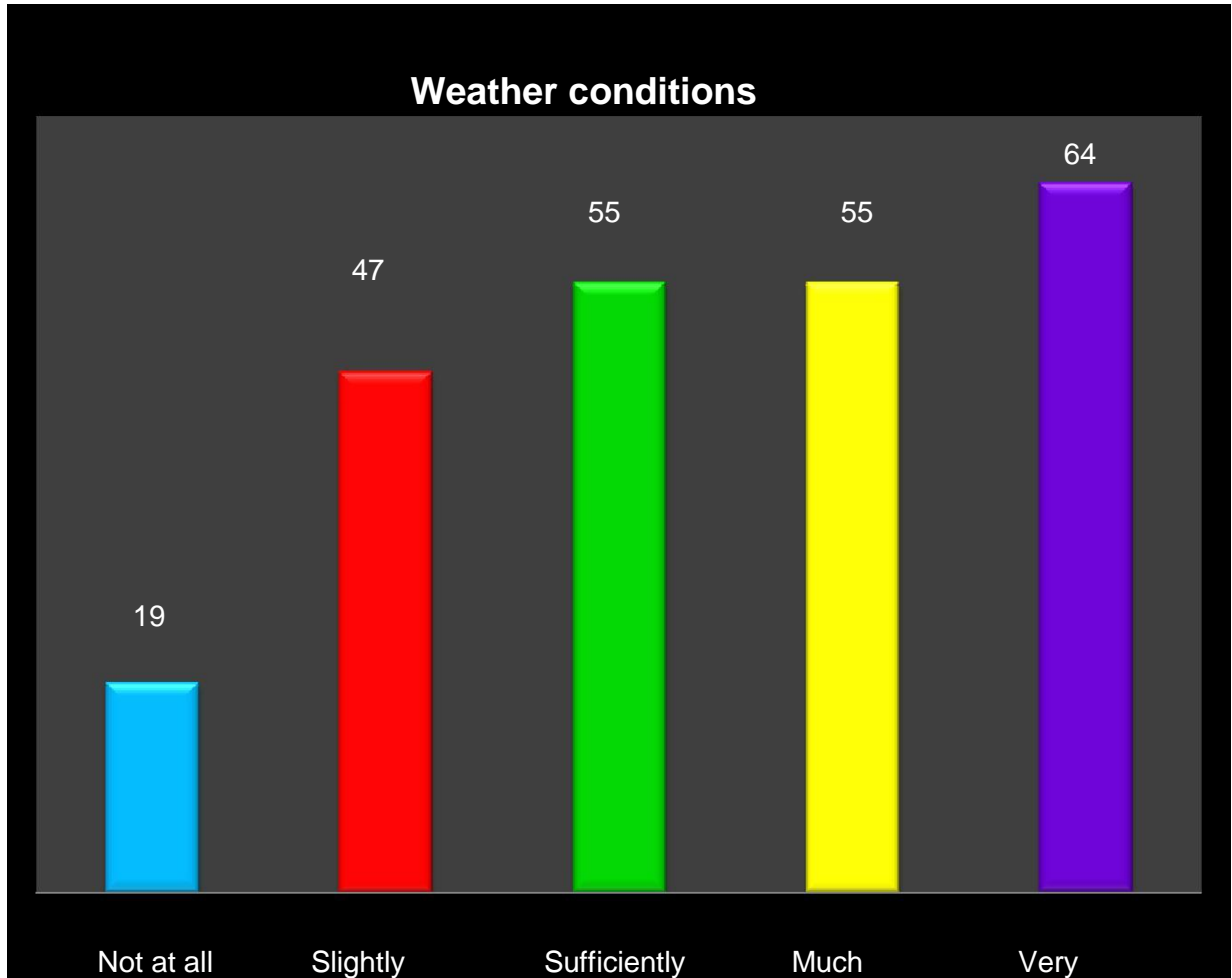
Most of the participants 64 (27%) said VERY MUCH, 55 participants (23%) said MUCH and the same number said SUFFICIENTLY. The rest 20% (47) and 8% (19) said SLIGHTLY and NOT AT ALL respectively. These results are probably explained by the same explanation in the previous diagram 5.20

❖ *% that believes that in a country like Greece the promotion of eco-ships based in Aeolian energy would be easier.*

Diagram 5.22: Easier promotion of Aeolian based eco-ships in Greece
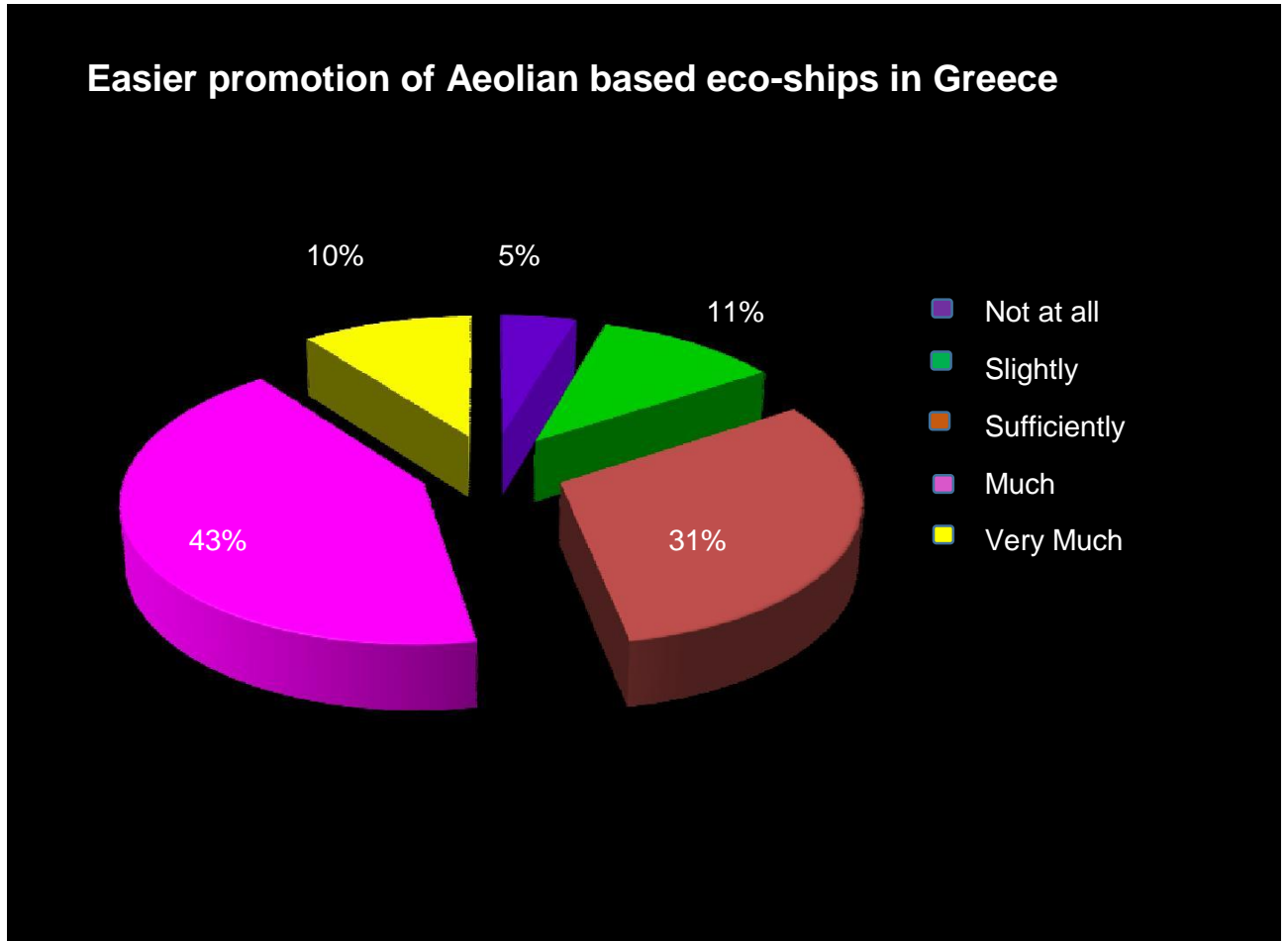
The largest amount of participants 102 (43%) answered MUCH, 75 (31%) participants answered SUFFICIENTLY, 27 (11%) said SLIGHTLY while, 25 (10%) participants said VERY MUCH and 11 (5%) said NOT AT ALL. This is explained by the fact that Greece is a country with a lot of seas like Aegean, the Ionian and Cretan sea and is ''unguarded'' from three directions (EAST, SOUTH, WEST). Therefore the winds are the rulers of the seas and for the eco-ships that using Aeolian power Greece is an ideal routing area.

❖ *__% that believes that in a country like Greece the operation of passenger__*
__ships that are using solar energy (via solar panels) for their propulsion__
__would be easier.__

Diagram 5.23: Solar energy based passenger eco-ships
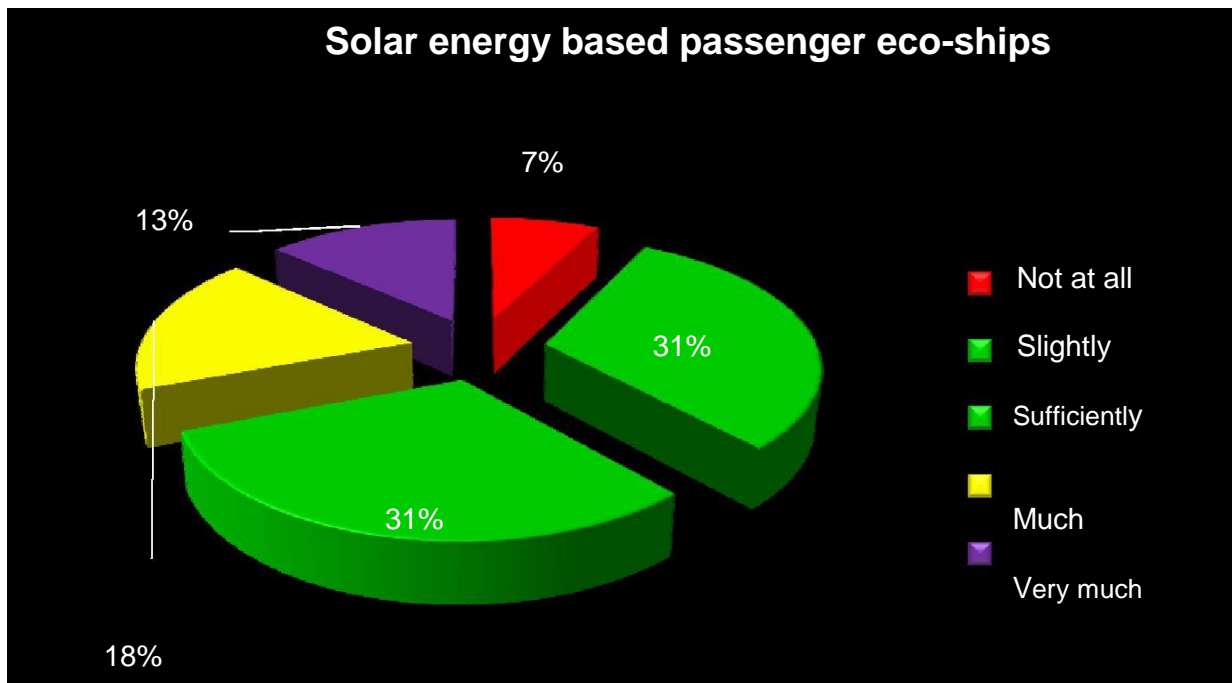
The highest percentages of the respondents 31% (74) and 31% (74) believe that the operation of eco-ships that are using solar energy for their propulsion would be SUFFICIENTLY easier and SLIGHTLY easier in Greece. 18% (32) said VERY MUCH and 7% (18) said NOT AT ALL. These percentages could be explained from the fact that Greece is a country with a lot of sunlight the whole year and therefore these kind of eco-ships would found Greece as the ideal area for operation. The percentage that answered slightly is hard to be explained.

❖ *% that believes that the Greek Ministry of Shipping might contribute through advertisements or other means to the development of ecological consciousness*.

Diagram 5.24: Advertisement and ecological consciousness

Advertisement & ecological consciousness

2%

6%

21%

26%

45%

- Not at all
- Slightly
- Sufficiently
- Much
- Very Much
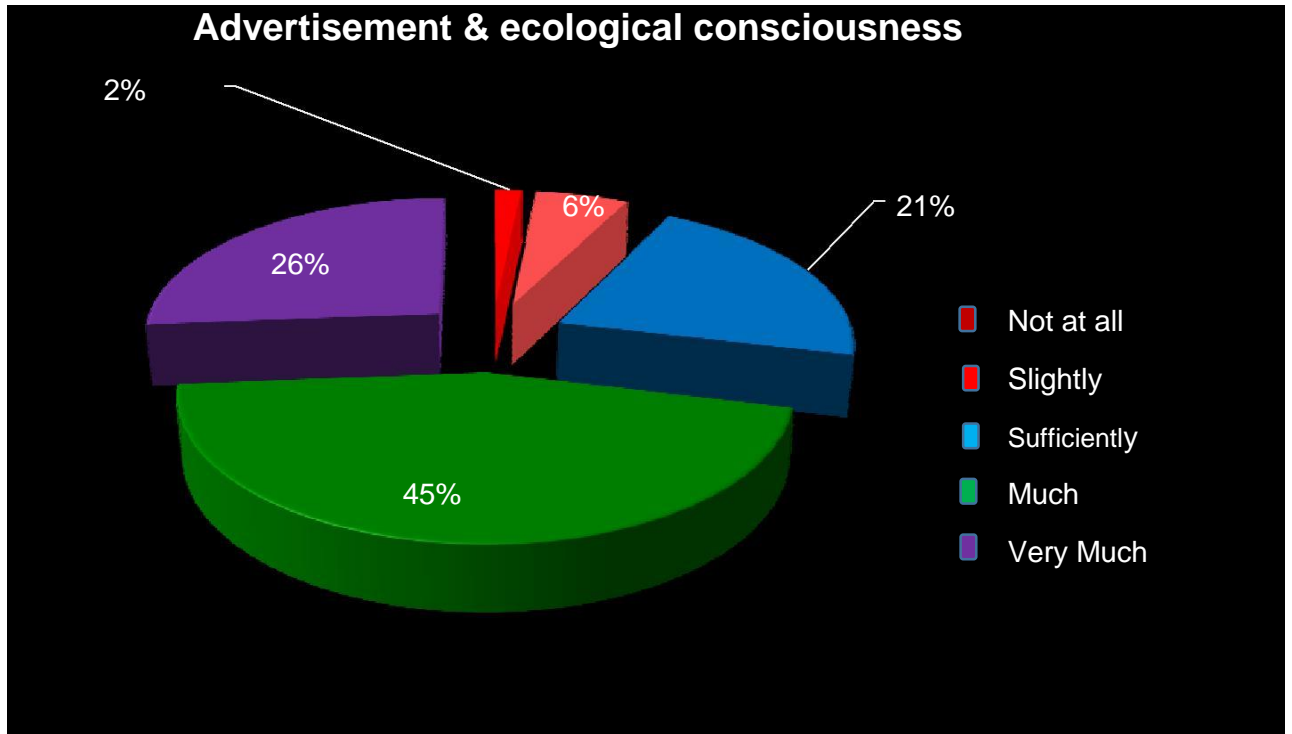
108 (45) participants answered MUCH, 63 (26%) said VERY MUCH and 51 (21%) participants said SUFICIENTLY, while 14 (6%) answered SLIGHTLY and 4 (2%) said NOT AT ALL. It appears that the environmental consciousness is shaped via the government owned mechanism and the media that present it, the public need via simple action to feel that it does something good and that this is approved by the government.

❖ ***% that believes that the shipbuilding of eco-ships by shipping companies is carried in order to show and promote their ecological sensitivity.***

Diagram 5.25: Shipbuilding of eco-ships & ecological sensitivity
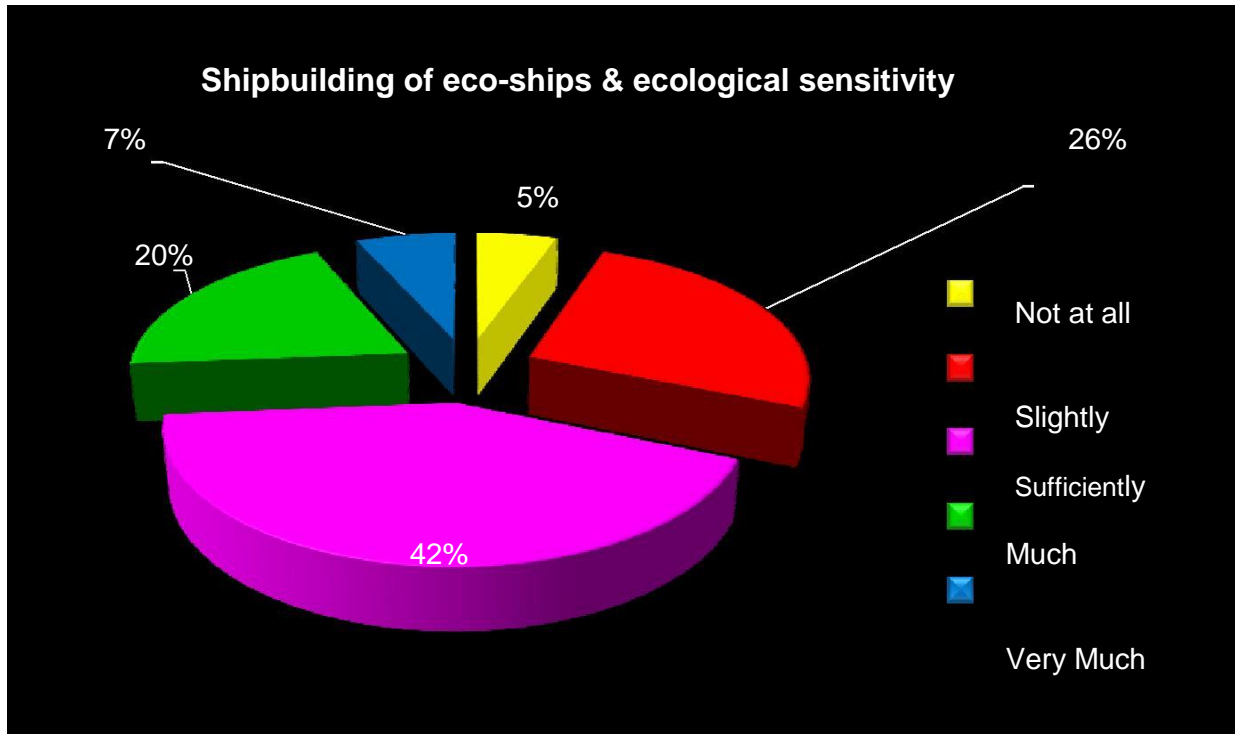
The highest percentage of the respondents 42% (102) respond SUFFICIENTLY, SLIGHTLY was answered by 62 participants (26%) and MUCH was answered by 47 participants (20%). 16 participants (7%) said VERY MUCH and 13 (5%) said NOT AT ALL. In these answers might exist the suspiciousness, that behind the shipbuilding of ecological "green" ships are hidden disposals of projection, as well as interests and expediency of shipping companies.

❖ ***% that believes that eco-ships may contribute positively to the reduction of carbon dioxide emissions.**

Diagram 5.26: Contribution of eco-ships in the reduction of CO2 emissions
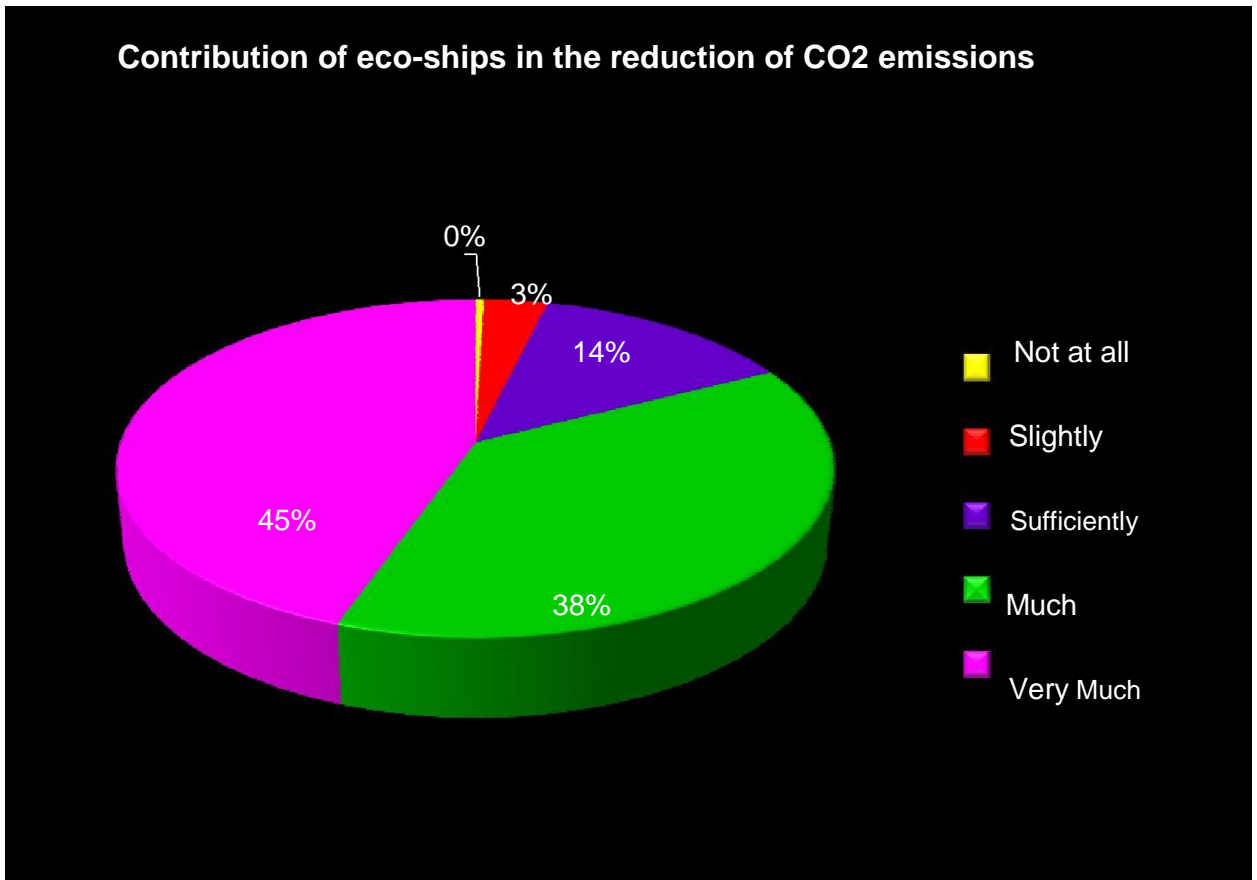
The highest percentage of the participants respond VERY MUCH 42% (107), MUCH said the 38% (91) and SUFICIENTLY said the 14% (33) while, the 3% (8) said SLIGHTLY and 1 participant (0.48%) said NOT AT ALL. It is very legitimate provided that the eco-ships aim in friendly practical applications to the environment with reduction of CO2 and Sulphur.

❖ *% that believes that a ship can be cost-efficient and eco-friendly at the same time.*

Diagram 5.27: Eco-friendly & cost-efficient ship
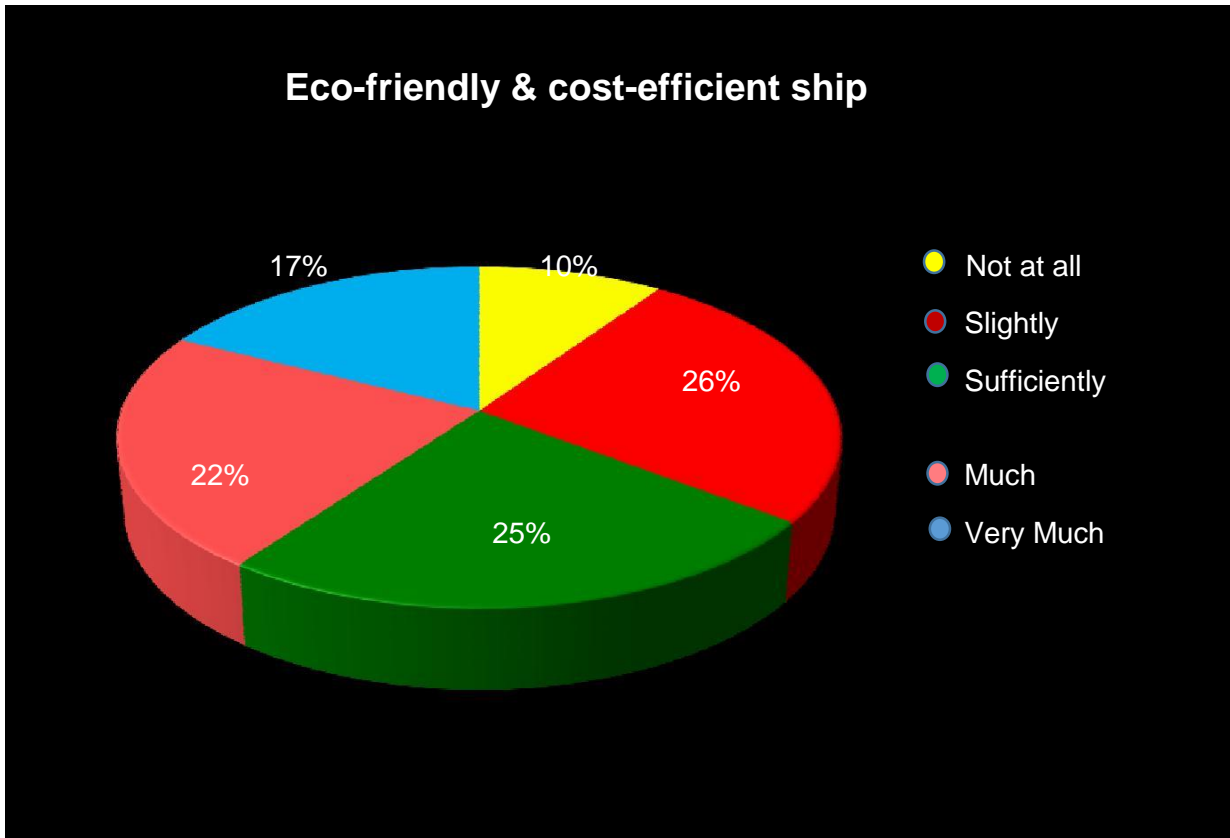
Most of the participants 62 (26%) said SLIGHTLY, 59 participants (25%) said SUFFICIENTLY and 54 (22%) said MUCH while, 42 (17%) answered VERY MUCH and the remaining 23 (10%) said NOT AT ALL. The highest percentages of respondents tend to a positive response probably because Greece has natural resources that if exploited properly can have a practical effect economic and efficient at the same time that is environmentally friendly and cheaper.

❖ *% that believes that it is feasible in the near future the conversion of diesel passenger fleets to fleets using exclusively renewable energy sources*

Diagram 5.28: Feasible conversion of diesel passenger ships to eco-ships

Feasible conversion of diesel passenger ships to eco-ships

43%

57%

YES

NO
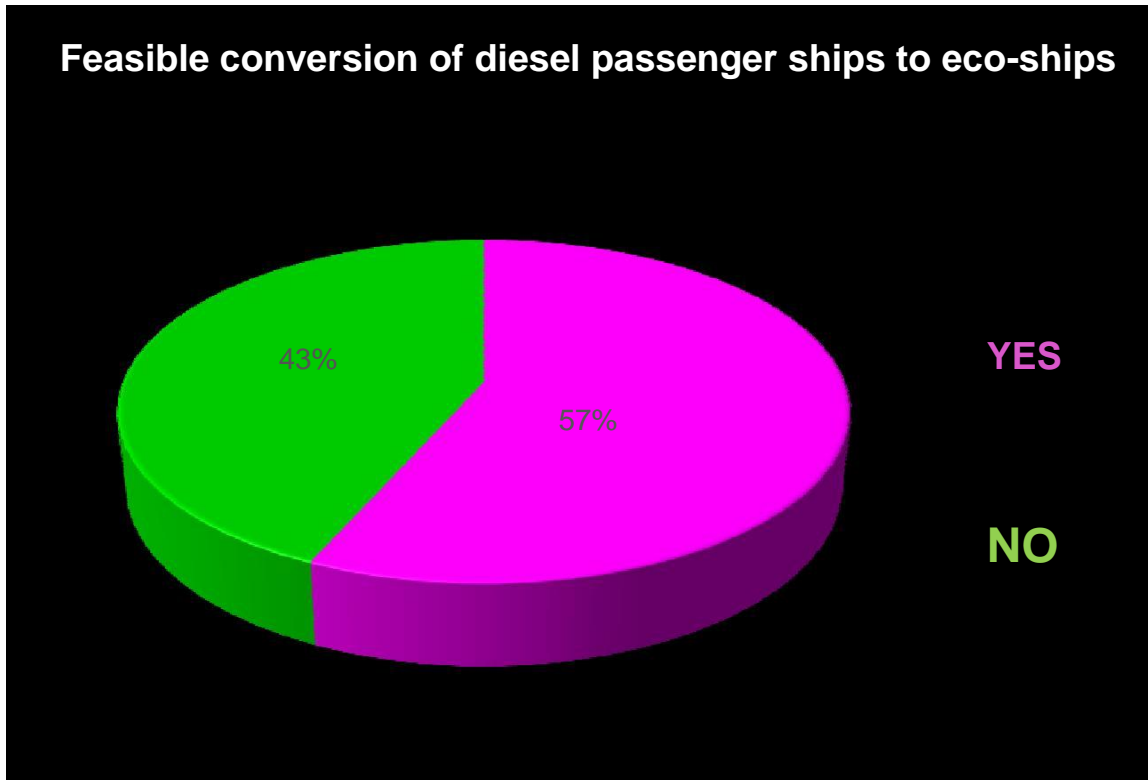
The percentage of respondents who believe that YES is feasible in the near future the conversion of diesel passenger fleets to fleets using exclusively renewable energy sources is 57%, i.e. positive answers from 136 respondents, while the percentage of respondents who gave a negative answer is 43%, i.e. 104 respondents. The hesitation of the responses that were not positive may be based on the economic crisis and the dramatic financial situation in Greece.

5.3 Statistical inference – bivariate Distribution - Relationships

In some statistical applications, data collected relating to two key attributes (variables) of units of the investigational total. These data, are summarized in the form of double entry table (cross tabulation tables). The cross-tabulation tables are tables suitable for the collection and presentation of data referred to two variables. (Mpenos, 1997)

In order to decide how to analyze two or more variables we need to know their measurement scale

5.3.1 Cross - tabulation (Related variables)

➕ For the variable ''Educational level'' and the variable ''knowledge of eco-ships''

The table 5.1 depicts the opinion of participants about whether they know or not what is an eco-ship, on the basis of educational level.

From the total of 240 participants 5 are primary school graduates (2.1%), 6 are gymnasium graduates (2.5%), 58 are high school graduates (24.2%), 91 have a bachelor degree (37.9%), 69 have a master degree (28.8%) and 11 (4.6%) have a PhD.
From the total of 240 participants the 82 knows what an eco-ship is (34.2%) and 158 do not know (65.8%).
Of the 240 respondents no primary graduate knows what an eco-ship is (0%). Of the 240 respondents, all 5 Elementary school graduates do not know what an eco-ship is (3.2%).
Of the 240 respondents, one gymnasium graduate knows what an eco-ship is (1.2%). Of the 240 respondents 5 Gymnasium graduates do not know what an eco-ship is (3.2%).
Of the 240 respondents, 14 High school graduates know what an eco-ship is (17.1%). Of the 240 respondents 44 High school graduates do not know what an eco-ship is (27.8%).
Of the 240 respondents, 30 Alumni Universities know what an eco-ship is (36.6%). Of the 240 respondents 61 Alumni Universities not know what an eco-ship is (38.6%).
Of the 240 respondents, 29 master holders knows what an eco-ship is (35.4%). Of the 240 respondents, 40 master holders do not know what an eco-ship is (25.3%).
Of the 240 respondents 8 PhD Holders know what an eco-ship is (9.8%). Of the 240 respondents, 3 PhD Holders do not know what an eco-ship is (1.9%).

Then we proceed to the following tests: The first is the goodness of fit test during which we assume that the data comes from a fully designated/normal distribution. The second is the test of independence whereby for categorical data which are classified according to two characteristics, we are interested to know if these characteristics are independent. But more generally we see that the second one belongs to the goodness

of fit test in the sense that we experience the good fit of observed frequency in relation to (expected) frequencies arising under a specific null hypothesis. (Kiochos, 1998).

- According with the Chi-Square Test we got:

The value χ^2 is 15,231 at a significance level of 0.009, which is smaller than P (value) = 0.10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 is accepted where the variables are related. It follows that the variable << education level >> and << variable knowledge of eco-ships >> relate to each other and are statistically significant at 10% significance level.

🔸 For the variable << Knowledge of eco-ships >> and the variable << willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment >>

Of the 240 respondents 82 know what an eco-ship is (34.2%) and 158 do not know what an eco-ship is (65.8%).
Of the 82 respondents who know what an eco-ship is (34.2%), the 47 (57.3%) would <u>PROBABLY YES</u> willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.
Of the 82 respondents who know what an eco-ship is (34.2%), the 21 (25.6%) would <u>YES</u> be willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.
Of the 82 respondents who know what an eco-ship is (34.2%), the 13 (15.9%) would <u>RATHER NOT</u> willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.
Of the 82 respondents who know what an eco-ship is only 1 (1.2%) would <u>NOT</u> be willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.
Of the 158 respondents who did not know what an eco-ship is 107 (67.7%) would <u>PROBABLY YES</u> willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.
Of the 158 respondents who did not know what an eco-ship is, 14 (8.9%) would <u>YES</u> be willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.
Of the 158 respondents who did not know what an eco-ship is, the 31 (19.6%) would <u>RATHER NOT</u> willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.
Of the 158 respondents who did not know what an eco-ship is, 6 (3.8%) would <u>NOT</u> be willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.

Of the 240 respondents who either know or do not what an eco-ship is, the 154 (64.2%) would <u>RATHER YES</u> be willing to pay an expensive ticket to travel with Eco-ships for the benefit of the environment.
Of the 240 respondents who either know or do not know what is the ecological 'green' ships, the 35 (14.6%) yes would be willing to pay expensive ticket to travel with ecological "green" ships to benefit the environment.
Of the 240 respondents who either know or do not know what an eco-ship is, 44 (18.3%) would <u>PROBABLY NOT</u> be willing to pay expensive ticket to travel with ecological "green" ships to benefit the environment.
Of the 240 respondents who either know or do not know what an eco-ship is, seven (2.9%) <u>WOULD NOT</u> be willing to pay expensive ticket to travel with ecological "green" ships to benefit the environment.

- According with the Chi-Square Test we got:

The value of x2 is 12,943 at a significance level of 0.005, which is smaller than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 where the variables are related is accepted. It follows that the variable << Knowledge of eco-ships >> and the variable << willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment >> are related and they are statistically significant at a confidence level of 10%.

- For the variable <<Educational Level>> and the variable << the environmental awareness that every individual possess may influences his consuming preferences for the benefit of the environment>>

Of the 58 respondents who are high school graduates the 18 (31%) believe that the environmental awareness that every individual possess may <u>SUFFICIENTLY</u> influences his consuming preferences for the benefit of the environment, THE 27 (46.6%) <u>MUCH</u>, the 12 (20.7%) <u>VERY MUCH</u> and only 1 (1.7%) <u>SLIGHLTY</u>.
Of the 91 respondents who have graduated from Universities, 45 (49.5%) believe that the environmental awareness that every individual possess may <u>MUCH</u> influences his consuming preferences for the benefit of the environment, 23 (25.3 %) <u>VERY MUCH</u>, the 20 (22%) <u>SUFFICIENTLY</u> and only 3 (3.3%) <u>SLIGHTLY</u>.
Of the 69 respondents who have a master degree, 32 (46.4%) believe that the environmental awareness that every individual possess may <u>MUCH</u> influences his consuming preferences for the benefit of the environment, the 21 (30.4%) VERY MUCH, the 14 (20.3%) SUFFICIENTLY and only 2 (2.9%) SLIGHLTY.
Of the 11 respondents who have a PhD, eight (72.7%) believe that the environmental awareness that every individual possess may MUCH influences his consuming preferences for the benefit of the environment and 3 (27.3%) believe SUFFICIENTLY.

- According to the Chi-square test we got:

The value of x2 is 61,379 at a significance level of 0.000, which is smaller than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 where the variables are related is accepted. It follows that the <<Educational Level>> and the variable << the environmental awareness that every individual possess may influences his consuming preferences for the benefit of the environment>> are related and they are statistically significant at 10% significance level.

🔸 For the variable <<Gender>> and the variable << the environmental awareness that every individual possess may influences his consuming preferences for the benefit of the environment>>

Of the 120 respondents 57 men (47.5%) believe that the environmental awareness that every individual possess may MUCH influences his consuming preferences for the benefit of the environment, 37 (30.8%) SUFFICIENTLY, the 20 (16.7%) VERY MUCH and only 6 (5%) SLIGHT.

Of the 120 surveyed women the 59 (49.2%) believe that the environmental awareness that every individual possess may MUCH influences his consuming preferences for the benefit of the environment, 39 (32.5%) VERY MUCH, the 20 (16.7%) SUFFICEINTLY, only one (8%) SLIGHLTY and only one (8%) NOT AT ALL.

- According to Chi-square tests we got:

From the table (5.4b) it appears that the value of x2 is 15,795 at a significance level of 0.003, which is smaller than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 where the variables are related is accepted. It follows that the variable <<Gender >> and the variable<< the environmental awareness that every individual possess may influences his consuming preferences for the benefit of the environment>> are related and they are statistically significant at 10% significance level.

For the variable <<Gender>> and the variable << willingness to choose eco-friendly services in order to contribute to the protection of the environment>>

Of the 120 men respondents, 45 (37.5%) are MUCH willing to choose eco-friendly services in order to contribute to the protection of the environment, 51 (42.5%) SUFFICIENTLY, the 20 (16.7%) VERY MUCH, 3 (2.5%) SLIGHTLY and only one (8%) NOT AT ALL.
Of the 120 women surveyed the 54 (45%) are MUCH willing to choose eco-friendly services in order to contribute to the protection of the environment, 44 (36.7%) VERY MUCH, the 20 (16, 7%) SUFFICIENTLY, and only 2 (1.7%) SLIGHTLY.

- According to the chi-square test we got:

The value of x2 is 24,553 at a significance level of 0.000, which is smaller than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 where the variables are related is accepted. It follows that the variable <<gender >> and the variable << willingness to choose eco-friendly services in order to contribute to the protection of the environment>> are related and statistically significant at a confidence level of 10%.

For the variable <<educational level>> and the variable << the construction of eco-ships cost more than the construction of conventional ships>>

From the 91 with a bachelor degree 44 (48.4%) believes that PROBABLY YES the construction of eco-ships cost more than the construction of conventional ships, the 12 (13.2%) DEFINITELY YES, 17 (18.7%) DON'T KNOW, the 11 (12.1%) believe that PROBABLY NO and only 7 (7.7%) DEFINITELY NO.
Of the 69 having a master degree 32 (46.4%) %) believes that PROBABLY YES the construction of eco-ships cost more than the construction of conventional ships, 12 (17.4%) DEFINITELY YES, the nine (13%) DO NOT KNOW, the 13 (18.8%) believe that PROBABLY NO and only 3 (4.3%) DEFINITELY NO.
Of the 11 PhD holders, 4 (36.4%) believes that PROBABLY YES the construction of eco-ships cost more than the construction of conventional ships, 5 (45.5%) DEFINITELY YES, one (9.1%) DO NOT KNOW, and 1 (9.1%) believe PROBABLY NOT.
We may observe that as the educational level increases the % of knowledge that the construction of eco-ships cost more than the construction of conventional ships also increases.

- According to chi-square tests we got:

The value of x2 is 29,911 at a significance level of 0.071, which is smaller than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 where the variables are related is accepted. It follows that the variable << educational level and the variable << the construction of eco-ships cost more than the construction of conventional ships>> are related and statistically significant at 10% significance level.

- For the variable <<Gender>> and the variable <<the ships that will use mild and renewable source of energy are the solution to a possible financial crisis>>

From the 120 men respondents from the 58 (48.3%) believe that the ships that will use mild and renewable source of energy are SLIGHTLY the solution to a possible financial crisis, 25 (20.8%) SUFFICIENTLY, the 17 (14.2%) MUCH, the 15 (12.5%) VERY MUCH and 5 (4.2%) DEFINITELY NO.
Of the 120 surveyed women, 47 (39.2%) believe that the ships that will use mild and renewable source of energy are SLIGHTLY the solution to a possible financial crisis, 36 (30%) SUFFICIETNLY, the 24 (20%) MUCH, 9 (7.5%) VERY MUCH and 4 (3.3%) DEFINITELY NO.
We note that among the surveyed men and women, women more than men consider that ships that will operate into the future with mild and Renewable Energy is the solution to a global economic crisis.

- According to chi-square tests we got:

The value of x2 is 14,403 at a significance level of 0.006, which is smaller than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 where the variables are related is accepted. It follows that the variable <<Gender>> and the variable <<the ships that will use mild and renewable source of energy are the solution to a possible financial crisis>> are related and statistically significant at 10% significance level.

For the variable <<Gender>> and the variable << eco-ships may positively contribute to the reduction of carbon dioxide emissions>>

From the 120 men respondents, 48 (40%) believe that eco-ships may MUCH contribute to the reduction of carbon dioxide emissions, the 46 (38.3%) VERY MUCH, the 18 (15%) SUFFICIENTLY, the seven (5.8%) SLIGHTLY and 1 (0.8%) DEFINITELY NO.
Of the 120 surveyed women, 61 (50.8%) believe that eco-ships may MUCH contribute to the reduction of carbon dioxide emissions, 43 (35.8%) VERY MUCH, the 15 (12.5%) SUFFICIENTLY, and 1 (0.8%) DEFINITELY NO. We note that among the surveyed men and women, women more than men believe that 'green' ships can contribute positively to the reduction of carbon dioxide emissions.

- According to chi-square tests we got:

The value of x^2 is 8.150 at a significance level of 0.086, which is smaller than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 where the variables are related is accepted. It follows that the variable <<Gender>> and the variable << eco-ships may positively contribute to the reduction of carbon dioxide emissions>>are related and statistically significant at 10% significance level.

For the variable <<Age>> and the variable << the construction of eco-ships cost more than the construction of conventional ships>>

Of the 117 respondents between 25-35 years old, 60 (51.3%) believe that PROBABLY YES the construction of eco-ships cost more than the construction of conventional ships, the 11 (9.4%) DEFINITELY YES, the 20 (17.1%) DO NOT KNOW, 19 (16.2%) believe that PROBABLY NO and only 7 (6%) are DEFINITELY NO.
Of the 53 respondents between 35-45 years old, 21 (39.6%) believe that PROBABLY YES the construction of eco-ships cost more than the construction of conventional ships, the 11 (20.8%) DEFINITELY YES, the 21 (20.8%) DO NOT KNOW, seven (13.2%) believe that PROBABLY NO and only 3 (5.7%) DEFINITELY NO.
Of the 27 respondents aged between 45-55, 7 (25.9%) believe that PROBABLY YES the construction of eco-ships cost more than the construction of conventional ships, six (22.2%) DEFINITELY YES, 10 (37%) DO NOT KNOW, one (3.7%) think PROBABLY NOT and just 3 (11.1%) DEFINITELY NO.
As the age level increases the percentage that knows that the construction of eco-ships cost more than the construction of conventional ships decreases.

- According to chi-square tests we got:

.

The value of x2 is 30,455 at a significance level of 0.063, which is smaller than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is rejected and the alternative hypothesis H1 where the variables are related is accepted. It follows that the variable <<Age>> and the variable << the construction of eco-ships cost more than the construction of conventional ships>> are related and are statistically significant at 10% confidence level.

5.3.2 Cross - tabulation (Not Related variables)

➕ For the variable <<Gender>> and the variable << knowledge of eco-ships>>

Of the 240 respondents 120 were men (50.0%) and 120 women (50.0%).
Of the 240 respondents 82 know what an eco-ship is (34.2%) and 158 do not know what an eco-ship is (65.8%).
Of the 240 respondents 42 are men who know what an eco-ship is (51.2%).
Of the 240 respondents 78 are men who do not know what an eco-ship is (49.4%).
Of the 240 respondents 40 are women who know what an eco-ship is (48.8%).
Of the 240 respondents 80 are women who do not know what an eco-ship is (50.6%)
Of the 120 men the 42 know what an eco-ship is (35.0%) and 78 do not know (65.0%).
Of the 120 women the 40 know what an eco-ship is (33.3%) and 80 do not know (66.7%).
Of the 82 respondents who know what an eco-ship is, 42 are men (51.2%) and 40 women (48.8%). Of the 158 respondents who do not know what an eco-ship is, 78 are men (49.4%) and 80 are women (50.6%)

- According to chi-square tests we got:

The value of x2 is 0.074 at a significance level of 0.785, which is greater than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is accepted, and the alternative hypothesis H1, where the variables are related is rejected. It follows that the variable <<Gender>> and the variable << knowledge of eco-ships>> are not related and are not statistically significant with a significance level of 10%

For the variable << Profession>> and the variable << willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment >>

Of the 240 respondents 45 are public employee (18.8%), the 99 are private employees (41.3%), 43 are self-employed (17.9%), 13 are Pensioners (5.4%), 4 in housekeeping (1.7%), 18 are students (7.5%), 16 are unemployed (6.7%) and 2 in other professions (0.8%).
Of the 45 Public Servants 32 (71.1%) would PROPABLY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment, the 5 DEFINITELY YES (11.1%), 6 PROBABLY NOT (13.3%) and 2 (4.4%) DEFINITELY NO.
Of the 99 Private Employees 66 (66.7%) would PROPABLY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment , 13 (13.1%) DEFINITELY YES, 17 PROBABLY NOT (17.2%) and 3 (3.0%) DEFINITELY NO
Of the 43 Freelancers 23 (53.5%) would PROPABLY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment , 11 (25.6%) DEFINITELY YES, 8 PROBABLY NOT (18.6%) and 1 (2.3%) DEFINITELY NO
Of the 13 Pensioners 9 (6.9%) would PROPABLY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment , 2 DEFINITELY YES (15.4%), two PROBABLY NOT (15.4%) and zero DEFINITELY NO (0%)
Of the four respondents engaged in housekeeping, three (75%) PROPABLY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment, no one DEFINITELY YES (0%), no one PROBABLY NOT (0%) and 1 DEFINITELY NO (25%)
Of the 18 Students, 11 (61.1%) would PROPABLY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment, 3 DEFINITELY YES (16.7%), the 4 PROBABLY NOT (22.2%) and no one DEFINITELY NO (0%)
Of the 16 Unemployed, 9 (56.3%) would PROPABLY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment, 1 DEFINITELY YES (6.3%), six PROBABLY NOT (37.5%) and no one DEFINITELY NO (0%)
Of the two respondents engaged in other Professions the 1 would PROPABLY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment (50%), and the other one would PROBABLY NOT (50%)
Of the 240 respondents who engaged in all the above categories of professions 154 said PROPABLY YES (64.2%), 35 DEFINITELY YES (14.6%), 44 PROBABLY NOT (18.3%) and 7 said DEFINITELY NO (2, 9%).

Table 5.12: profession - YES

Profession	YES		
Public servant	From 45	the	5 (11,1%)
Private employee	From 99	the	13(13,1%)
Freelancer	From 43	the	11(25,6%)
Pensioner	From 13	the	2 (15,4%)
Housekeeping	From 4		No one
Student	From 18	the	3 (16,7%)
Unemployed	From 16	the	1 (6.3%)
Other	From 2		No one

Graph 5.13 Professions that would DEFINITELY YES willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment
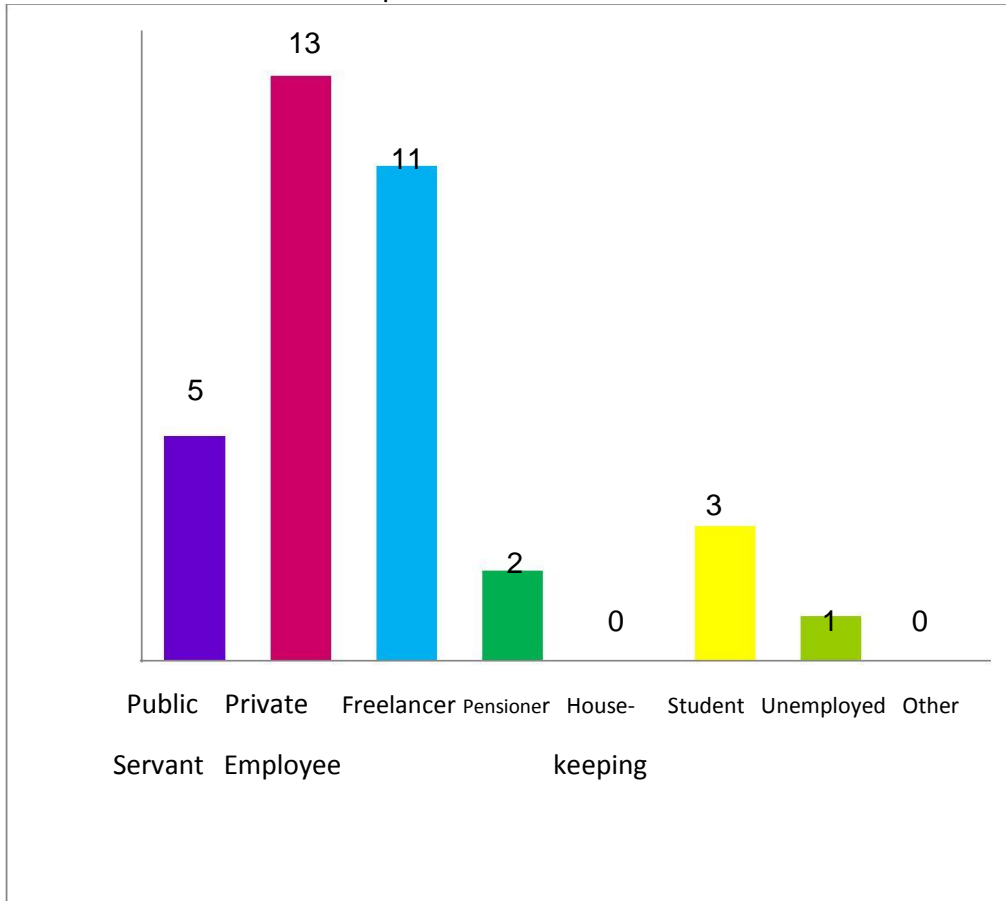
- According to chi-square tests we got:

The value of x2 is 21,812 at a significance level of 0.410, which is greater than P (value) = 0,10, thus the hypothesis H0 of independence between these variables is accepted, and the alternative hypothesis H1, where the variables are related is rejected. It follows the variable << Profession>> and the variable << willing to pay a more expensive ticket to travel with an eco-ship for the benefit of the environment >> are not related and are not statistically significant with a significance level of 10%.

5.4 The objectives of regression analysis and correlation

The first objective of regression analysis is to give value estimates of the dependent variable from the independent variable. The process of assessment is based on "sample regression line" is a line attached to the data. The sample regression line describes the average relationship existing between the variables X and Y, the sampling data.

The equation of this line known as the sample regression equation provides estimates of the average value of Y for each value of x. A second objective of regression analysis is to give measures of the error involved in using the regression line as a mean of assessment. The third objective, pursued at the correlation analysis is to obtain a measure of the degree of interdependence or correlation between variables. The correlation coefficient and the coefficient of determination calculated for this purpose, measuring the intensity of the relationship between the two variables. (Mpenos, 1997)

5.4.1 Estimation using the regression line (least squares method)

This examination will refer to the linear regression analysis, where our aim is to give the equation of the straight line, which is optimally adapted and describes the data.

✦ Simple Linear Regression

Descriptive data on the educational level and knowledge of eco-ships on a sample of 240 adult men and women.

Scatter plot for ecoships (Y) as to education (X)
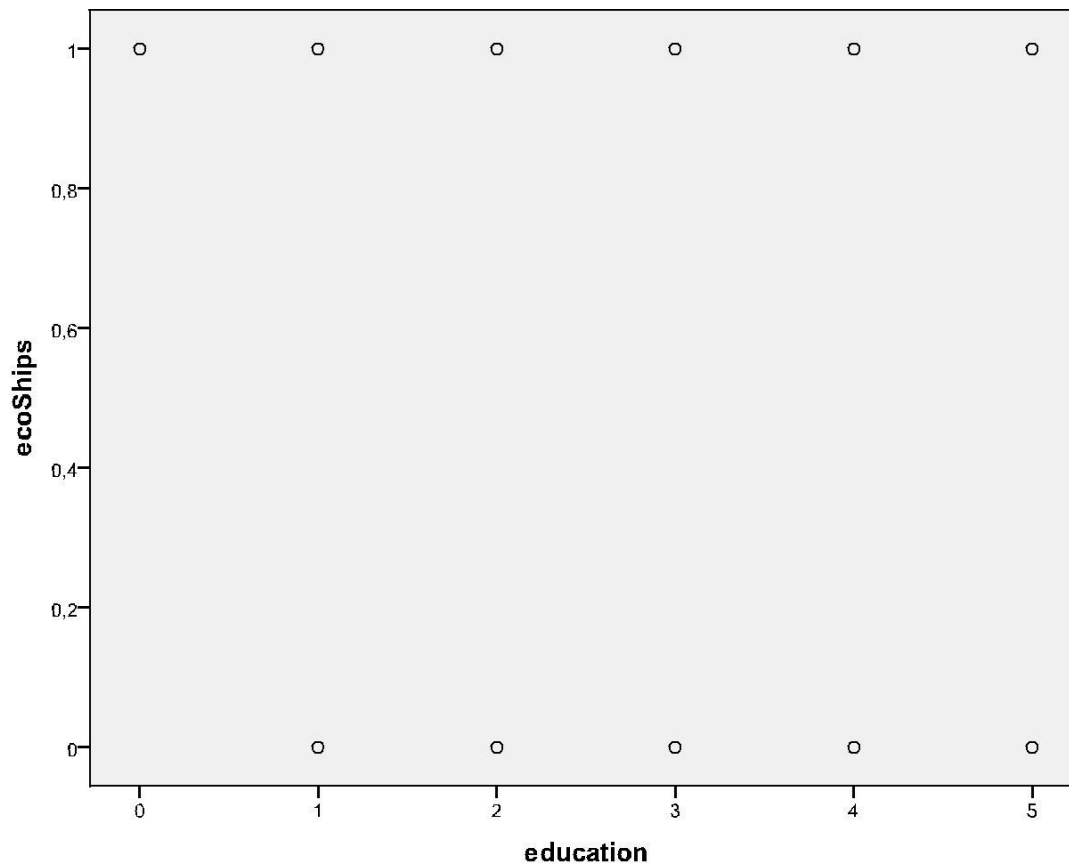
Interpretation:

Points cannot adapt to a straight line. There is no evidence of a linear relationship between variables X and Y. A quadratic relationship, for education (education) and knowledge of the ecological "green" ships (ecoships) does not exist.

- The coefficient of determination (r2) and the corresponding adjusted and the standard error

With the coefficient of determination r2 we can check the value of the simple linear model, which we adapt to the data. The coefficient of determination is the percentage of the variability of the variable Y that is explained by the variable X. The closer the value of r2 is to one, the stronger becomes the linear relationship of dependency of variables

Y and X, i.e. education (education) and knowledge about the ecological "green" ships (ecoships).

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
imen 1 on0	,237^a	,056	,052	,463	,056	14,144	1	238	,000	1,876

Predictors: (Constant), education

Dependent Variable: ecoShips

Coefficient of determination (r2): 0.056 so the linear relationship of the variables Y and X is not very strong.

Adjusted r2: 0.052

Standard error: 0.463

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,028	1	3,028	14,144	,000^a
	Residual	50,955	238	,214		
	Total	53,983	239			

a. Predictors: (Constant), education

b. Dependent Variable: ecoShips

The ANOVA table shows that p-value = 0 so,

H0: p (x, y) = 0, the coefficient of determination is 0

H1: p (x, y) ≠ 0, the coefficient of determination is not 0

So for a = 0.05> 0.00 H0 is rejected and H1: p (x, y) ≠ 0 is accepted. The coefficient of determination is not 0. Therefore, I properly used this model for predicting Y from X and I continue.

Correlations

		ecoShips	education
Pearson Correlation	ecoShips	1,000	-,237
	education	-,237	1,000
Sig. (1-tailed)	ecoShips	.	,000
	education	,000	.
N	ecoShips	240	240
	education	240	240

Commentary: There is a negative correlation between the knowledge about the ecoships and educational level of adult men and women.

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Parti al	Part	Toler ance	VIF
(Constant)	,998	,095		10,487	,000	,811	1,186					
education	-,112	,030	-,237	-3,761	,000	-,171	-,054	-,237	-,237	-,237	1,000	1,000

Dependent Variable: ecoShips

The model of simple linear regression for educational knowledge (education = independent variable), and knowledge of the eco-ships (ecoships = dependent variable) is:

(Ecoships) = 0,998 - 0,112X * education

Where:

0: 0.998 and

1: -0.112

The correlation between education and knowledge of the eco-ships were not statistically significant (t = - 3,76, df = 1, P <0.001) in the studied population. For each maximum level of education the knowledge about the eco-ships reduced by - 0,112

Multiple Linear Regression

In multiple linear regression it is investigated the linear relationship of a dependent variable with more than one independent variable. Assume x1, x2, ..., xp represents p independent variables.

Then, in correspondence with the simple linear regression, the model could be written as: $E(Y_i X_{1i}, X_{2i}, …, X_{pi}) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + … + \beta_p X_{pi}$ or equivalent

$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + … + \beta_p X_{pi} + \varepsilon_i$

where ε_i symbolizes the "real" (errors).

Below the estimated linear model of knowledge of the eco-ships (ecoships = dependent variable) as a function of the other characteristics of individuals age (age = independent variable) and educational level (education =independent variable)

Scatter plot for Ecoships (Y) as to Education (X) and Age (Z)
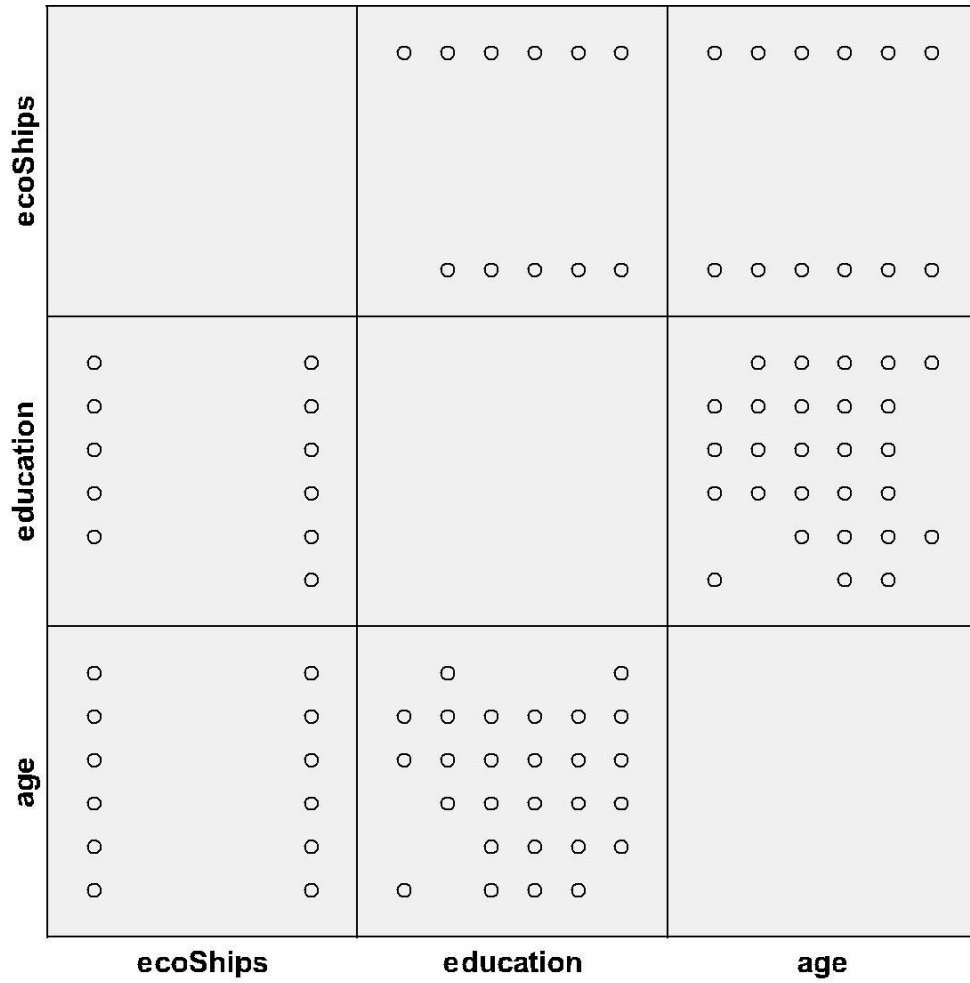
Three-dimensional scatter plot for Ecoships (Y) as to Education (X) and Age (Z)
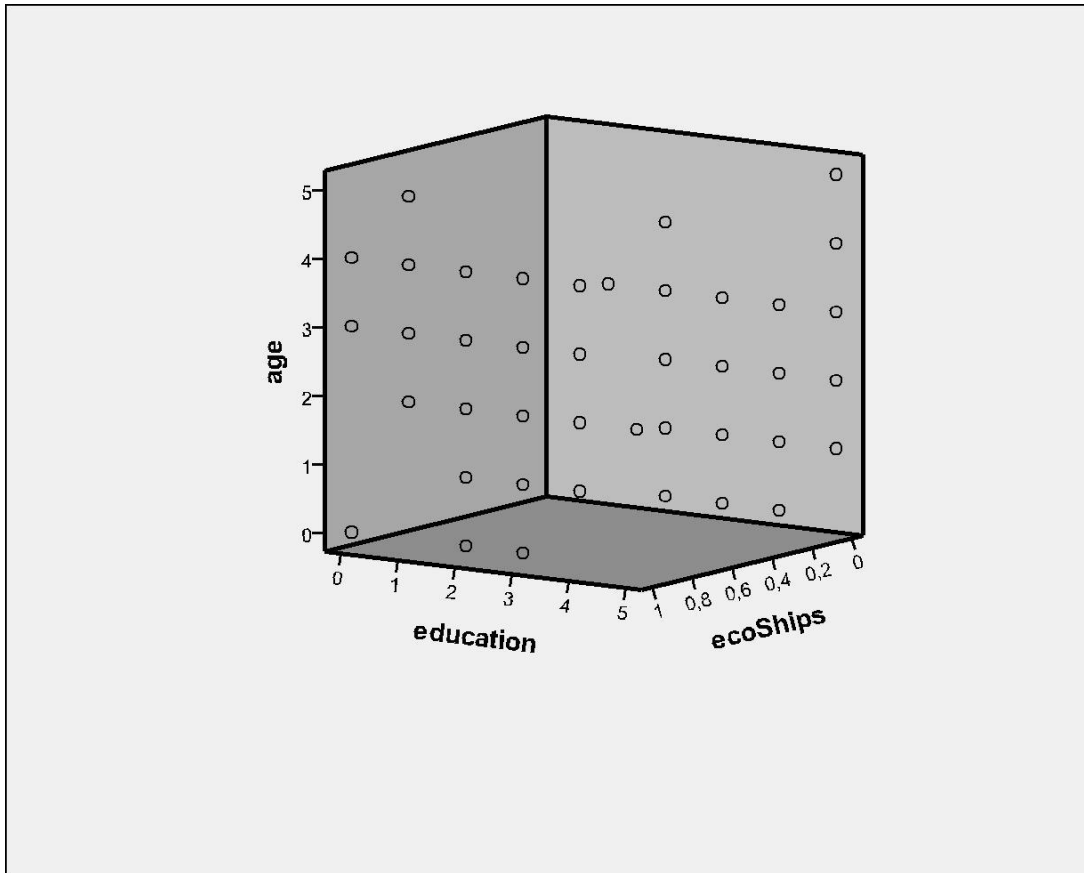
Interpretation: The points does not have a similar level, therefore I wrongly used the model of multiple linear regression.

- The coefficient of determination (r2) and the corresponding adjusted and the standard error

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	,239^a	,057	,049	,463	,057	7,178	2	237	,001	1,871

a. Predictors: (Constant), age, education

b. Dependent Variable: ecoShips

Coefficient of determination (r2) = 0.057 thus, the linear relationship for the variables Y,X and Z is not very strong.

Adjusted r2= 0.049

Standard Error= 0.463

ANOVA[b]

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	3,083	2	1,542	7,178	,001[a]
Residual	50,900	237	,215		
Total	53,983	239			

a. Predictors: (Constant), age, education

b. Dependent Variable: ecoShips

The ANOVA table shows that p-value=0.001 so,

H0: p = 0 the coefficient of determination is 0

H1: p ≠ 0 the coefficient of determination is not 0

So for a = 0.05> 0.001 H0 is rejected and H1 is accepted. Therefore, the two models are acceptable if we accept the H1: p ≠ 0, The coefficient of determination is not 0 on both two models.

Descriptive Statistics

	Mean	Std. Deviation	N
ecoShips	,66	,475	240
education	3,03	1,002	240
age	1,63	1,117	240

The level of least squares regression

The Linear regression coefficients, their statistical significance and statistical multicollinearity criteria are presented in the following table:

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	,969	,112		8,672	,000	,749	1,189					
education	-,110	,030	-,232	-3,634	,000	-,170	-,050	-,237	-,230	-,229	,977	1,024
age	,014	,027	,032	,507	,612	-,040	,067	,068	,033	,032	,977	1,024

Dependent Variable: ecoShips

Y(ecoships) = 0,969 - 0,110X * education + 0,014Z * age

Where:

B0: 0.969

B1: -0.110

B2: 0.014

For each higher level of education the knowledge about the ecological ships reduced by - 0.110 and increased by 0.014 as the age increases.

Multiple Linear Regression - Regression Level

Estimated the linear multiple regression model ecoships (Y) knowledge about the ecological "green" ships (ecoships = dependent variable) as a function of the other characteristics of respondents gender (X), age (Z), the Level of education (S), and occupation / profession (T) (= independent variables).

The scatter plot for ecoships (H) knowledge about the ecological "green" ships (ecoships = dependent variable) as a function of the other characteristics of respondents, gender (X), age (Z), education (S), and profession (T) (= independent variables).
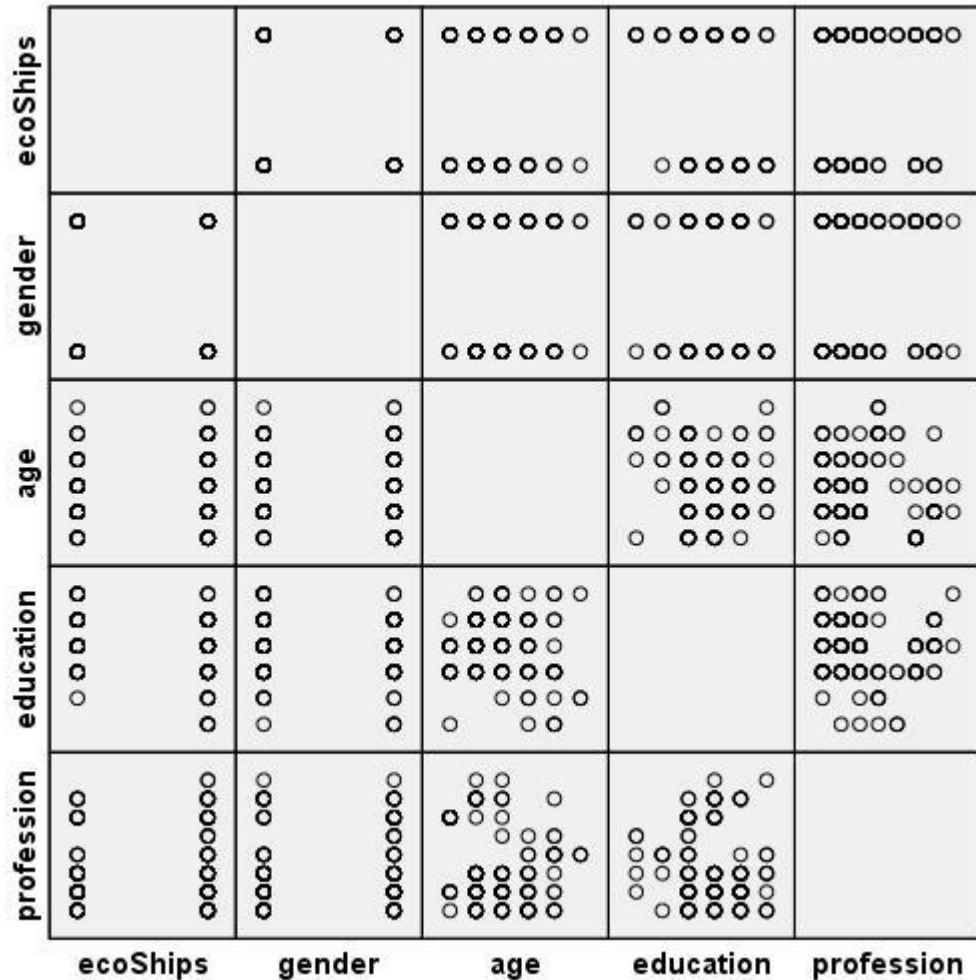
- The coefficient of determination (r2) and the corresponding adjusted and the standard error

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,241[a]	,058	,042	,465

a. Predictors: (Constant), profession, gender, education, age

r2 = 0.058 so, there is no strong linear relationship of dependency of variables Y and X and Z and S and T

Adjusted r2= 0.042

Standard Error= 0.465

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,126	4	,781	3,611	,007[a]
	Residual	50,858	235	,216		
	Total	53,983	239			

a. Predictors: (Constant), profession, gender, education, age

b. Dependent Variable: ecoShips

The table ANOVA depicts that p-value = 0,007 therefore,

H0: p = 0 the coefficient of determination is 0

H1: p ≠ 0 the coefficient of determination is not 0

So for a = 0.05> 0.00 H0 is rejected and H1 is accepted. The coefficient of determination is not 0. I notice a slight change in the degrees of freedom

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	,948	,129		7,355	,000
	gender	,025	,061	,027	,416	,678
	age	,016	,028	,037	,559	,577
	education	-,109	,031	-,231	-3,541	,000
	profession	,002	,017	,008	,116	,907

Dependent Variable: ecoShips

Y = 0,948+0,025X* gender +0,016Z*age -0,109S*education+0,002T*profession

Where:

B_0: 0,969

B_1: +0,025

B_2: +0,016

B_3: -0,109

B_4: +0,002

For each maximum level of education the knowledge about the ecological "green" ships reduces by -0.109 and increases by 0,016 as the age increases, also the knowledge increases by 0,002 as changing profession category and by 0,025 varies the answers given by men.

🔸 Multiple Linear Regression - Regression Level

Estimated the linear multiple regression model ecoTicket (Y) for the willingness pay a higher ticket to travel with ecological "green" ships (dependent variable) as a function of the other characteristics of respondents gender (X), age (Z), the level of education (S), profession (T) (= independent variables).

- The coefficient of determination (r2) and the corresponding adjusted and the standard error

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,196[a]	,038	,022	,876

a. Predictors: (Constant), profession, gender,

education, age

r2 = 0.038 so, there is no strong linear relationship of dependency of variables Y and X and Z and S and T

Adjusted r2 = 0.022

Std. Error = 0.876

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7,212	4	1,803	2,349	,055[a]
	Residual	180,388	235	,768		
	Total	187,600	239			

a. Predictors: (Constant), profession, gender, education, age

b. Dependent Variable: ecoTicket

c. The table ANOVA depicts that p-value = 0,055 therefore,
H0: p = 0 The coefficient of determination is 0

H1: p ≠ 0 The coefficient of determination is not 0

So for a = 0.05 <0.00 H0 is accepted and H1 is rejected. The coefficient of determination is 0.

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,438	,243		1,803	,073
	gender	-,203	,114	-,115	-1,780	,076
	age	-,069	,052	-,087	-1,316	,189
	education	,097	,058	,110	1,664	,097
	profession	,045	,033	,092	1,393	,165

Dependent Variable: ecoTicket

Y = 0,438-0,203X* gender **-0,069Z***age +**0,097***education+**0,045T***profession

Where:

B₀: 0,438

B₁: -0,203

B₂: -0,069

B₃: +0,097

B₄: +0,045

For each answer given from woman to man as to whether they are willing to pay expensive ticket to travel with eco ships to benefit the environment is altered by 0.203

negatively in the answers given by men. That trend shows that women are more willing to pay higher ticket. As the age increases the answers change negatively by 0.069 while as the education level rises the willingness to pay higher ticket changes positively by 0.097. The same trend is followed as we change profession category by 0.045.

Chapter 6 Results- Conclusions

6.1 Results

From this research we found that a proportion of respondents, 34% (82 people) know what are the innovative "green" ships or heard even accidental about them, and proportion of respondents 59% (141 people) knows that ships can alternatively use the sun, wind and other forms of renewable energy for their propulsion. It seems that the respondents in the highest percentage (64%) 54 respondents are more willing to pay expensive ticket to travel with an eco-ship, and 35 respondents (15%) are absolutely certain, and only 7 respondents (3%) are not willing to pay a more expensive ticket to travel with ecological "green" ships. This may also explain the high percentage of respondents who are willing to choose environmentally friendly services to help the protection the environment. But also a large percentage of respondents, 93 respondents (39%) believes that the ecological "green" ships will have a more expensive ticket. This can be explained by the fact that the technology used in these ships is high and the final ticket price will affected by the high cost of construction. Finally, the percentage of respondents who believe that it is feasible in the near future to convert conventional diesel passenger ships to ships using exclusively renewable energy sources is 57%, 136 respondents, while the percentage of respondents who did not believe that will directly convert diesel passenger ships to ships using exclusively renewable energy sources is 43%, 104 respondents. The hesitation of the responses that were not positive may be based on the dramatic financial circumstances in Greece.

Moreover, the variables that determines the willingness to pay a more expensive ticket for the use of an eco-ship are GENDER, AGE, PROFFESION and EDUCATION. The exact amount of change that each of these variables affecting the willingness to pay a more expensive ticket has been presented in the previous pages. The same applies also for the level of knowledge about the eco-ships.

6.2 Conclusions & further research potentials

The "weakening" of the planet we inhabit is obvious, justifying the increasingly intense pressures on shipping companies to develop and implement environmentally friendly practices on their ships, regardless of their type of shipping activity. Undeniable fact is that serving the transport needs implies with a negative impact on the environment. From theory we have found that the largely lawless and reckless development of transport in the past, as well as the dynamics of this situation due to existing patterns and trends, combined with the constant increase in transport demand, hurting, and continue to damage the environment in an irreparable way. Nonetheless, maritime transport is considered a mild form of transport for the environment, very economical in energy use, secure and critical to global trade.

Maritime industry significantly contributes heavily in transportation globally for decades. From an environmental point of view, maritime transport has several advantages such as that consumes relatively small amounts of energy and infrastructure requirements are far lower than those of land transport. Because of their low energy consumption, emissions of carbon dioxide (CO_2) from shipping is always low compared to the transported cargo volume. In particular, marine pollution from this source does not exceed 12-15% of the total percentage of marine pollution.

Regarding the eco-ships, the current market conditions, the prices of fuel oil, but also prices in constructions, make it an unprofitable investment, but in the mid-term and if the market conditions improved, the future seems to belong the 'green' ships. The ecological "green" ships utilize wind and solar energy and so reduces the amount of oil required for their movement. At the same time, together with different technological adaptations we may effectively exploit the oil, resulting in an even greater reduction of fuel and therefore carbon dioxide emissions and sulfur to the environment. Reportedly, however, with the above findings on the issue of further reducing greenhouse gas emissions from the shipping activity of ecological 'green' ships and in particular matters concerning technical proposals to implement friendly practices that relate to energy efficiency ships and that presented by shipping companies do not really exists.

The shipping company that will most likely made in the immediate future orders for ecologically "green" ships will be active years in the shipping industry, the largest percentage of its annual turnover should be spent primarily on training and new investments, should be updated weekly on developments in new technologies and the competitiveness of the company should be based on sustainability, and to save resources in all axes (mainly economic and environmental).

While economic sail is the main reason that a shipping company does not invest in such ventures. This apparent answer which stands for the high cost of construction of ecological 'green' ships, the annual operating cost of maintenance and the lack of compatibility with the existing infrastructure of ports might overlap the true answer which is relying on the interests of industries based on oil consumption. In any case, we may make the suggestion that the new friendly practices for transport at sea transport policy meets the policy for the protection and rational environmental management. The coincidence of environmental integration into transport policy and pursuing development of maritime transport requires deeper integration in the field, while creating the conditions for a new content and an enhanced quality of practical application.

However, the actual status, results and prospects of practical application will ultimately depend on the attitude of those involved in the transport and responsiveness of the shipping market. The design of the system must be done with full knowledge of the maritime reality. In any case, the environmentally friendly applications should be accompanied by a substantial and coherent effort to shift existing production and consumption patterns towards more sustainable direction and to decouple economic growth from the need for transport. Only under such an approach may be carried out a

rationalization of transport and the needs for transport and halting the trends that damage the environment. Therefore, the integration of environmental concerns into transport policy should move towards a comprehensive and integrated approach, which requires the array of a wide range of technical tools and settings.

Chapter 7 Bibliography

7.1 References

1. Tietenberg T., (1999, ´´ Economy of the Environment and Natural resources''. Gutenberg
2. GESAMP Report and Studies No 75, (2007), ´´ Estimates of oil entering the marine environment from sea-based activities ´´. London
3. Katsimpardis k., (2007), Reference to the doctoral thesis entitled "The international regime for the protection of the atmosphere: The case of emissions", Athens. Ant. N.Sakkoula
4. ´´ the state of the marine environment ´´, (1990), Rep.Stud.GESAMP, (39):111 p.
5. ´´ The Law of the Sea: Pollution by Dumping : Legislative History of Articles 1,par.1(5), 210&216 of the United Nations Convention on the Law of Sea ´´ , New York :United Nations , (1985), UN 71.48.18
6. Katsibardis K., (2007), "Maritime transport and atmospheric pollution: International and Community regulatory approaches." "Chios, congress 19-22 April 2007
7. Tuckman, B. W. (1972). Conducting educational research. New York: Harcourt Brace Jovanovich.
8. Filias, B. (1993). Introduction to methodology and techniques of social research
9. Salma Sherbaz*, Wenyang Duan (2012). Operational Options for Green Ships. College of Shipbuilding Engineering, Harbin Engineering University, Harbin 150001, China
10. O. Sulaiman, A. H. Saharuddin, and A. S. A. Kader (2013). *Towards sustainable green ship technology.* University Malaysia Terengganu*. African Journal of Business Management Vol. 7(2), pp. 96-118
11. Hong He-ping (2013). *The Development Trend of Green Ship Building Technology.* GSI Company limited. Bejin
12. The corporate technical journal of the ABB Group (2007). *World of innovation.*
13. Bansal P, Roth K., (2000), '' Why companies go green: a model of ecological responsiveness ''. Academy of Management Journal Vol.43, No(4), pp.717-736]
14. Platias Char., (2008), Dr. Political Science at the University of Bonn "ENVIRONMENTAL DIMENSION IN DESIGN OF EUROPEAN POLICY FOR TRANSPORT IN MARINE AREA". The article is a contribution to prepublication Conference Proceedings volume entitled "Environment and Water Transport", held from Panteion University in Chios in April 2007
15. Wartsila (2009), ´´ Boosting Energy Efficiency, Energy Efficiency Catalogue/Ship Power R&D ´´
16. Jack Devanney, 2010, *EEDI, A Case Study in Indirect Regulation of CO2 pollution*

17. Nippon Yusen Kaisha Company (NYK),(2009)
18. greenissue magazine, 29/04/2011 in environment
19. Benos B., (1997), Descriptive Statistics, Volume A, Stamoulis
20. Kiochos P., (1998), Statistical Inference ,Interbooks, Athens
21. Dr.Martin Stopford,(1997), ´´ Maritime Economics ´´, Routledge, 2ⁿᵈ ed
22. Bansal P, Roth K., (2000), '' Why companies go green: a model of ecological responsiveness ''. Academy of Management Journal Vol.43, No(4), pp.717-736
23. Clark D., (1999) '' What drives companies to seek ISO 14000 certification; '' Pollution Engineering Summer, pp. 14-18
24. '' Why Business needs to green the supply chain '' Bussiness Review, University Of Auckland, (2011), Vol.13, No.1
25. Cordano M.,(1993). '' Making the natural connection: justifying investment in environmental innovation ''. Proceedings of the International Association for Business and Society, pp. 530-537
26. Delft, (December 2009), ´´ Technical Support for European action to reducing Greenhouse Gas Emissions from international maritime transport ´´
27. Cohen, L. and Manion, L. (1992). Research methods in education (3rd edition).London: Routledge.
28. Official Journal of the European Communities, C 138, 17.05.1993, p 1. Decision No. 1600/2002 / EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme for the environment, the Official Journal the European Communities, L 242, 10.09.2002, p. 1.
29. Report of the Commission COM (2006) 314 of 22 June 2006 "Keep Europe moving - Sustainable mobility for our continent - Mid-term review of the 2001 White Bible of the European Commission for transport '
30. (Arthur C. Clarke) ,Green Bible COM (2006) 275 final of 7 June 2006, ''towards a future Maritime, Policy for the Union: A European vision for the oceans and seas. "How inappropriate to call this planet Earth when it is quite clearly an Ocean"
31. October 24, 2006, establishing the second Marco Polo program for the granting of Community financial assistance to improve the environmental performance of the freight transport system (Marco Polo II) and repealing Regulation (EC) No. 1382/2003, Official Journal of the European Communities, L 328, 24.11.2006, p. 1.
32. Panagiotopoulou Ath., (2009), "Customer Service Export of Maersk Coordinator Line
33. Colin H.Walker, Dacid R.Livingstone, (2013), Persistent pollutants in marine ecosystems

Chapter 8 Appendix

8.1 Variables

VARIABLES	DEFINITIONS
ecoships	Knowledge of eco-ships
education	Educational level
ecoTicket	Willingness to pay a higher ticket for the use of eco-ship
environmental awareness influence	the environmental awareness that every individual possess may influences his consuming preferences for the benefit of the environment
gender	Gender
services environmentally friendly	willingness to choose eco-friendly services in order to contribute to the protection of the environment
construction cost of ecoships	the construction of eco-ships cost more than the construction of conventional ships
ecoships solution of crisis	The eco-ships that will use renewable sources of energy may be the answer in a possible crisis
minimize co2	Eco-ship may contribute to the reduction of CO2 emissions
age	Age
Construction cost of ecoships	The construction cost of eco-ships is higher than the conventional
profession	profession

8.2 Frequency tables

Table **1.1** Gender

	Frequency	**%**	**SUM** **%**

	Frequency	%	SUM %
MALE	120	50.0	50.0
Female	120	50.0	100.0
Total	240	100.0	

Table 1.2 Age

	Frequency	**%**	**SUM %**
18-25	22	9.0	9.0
25-35	117	49.0	58.0
35-45	53	22.0	80.0
45-55	27	11.0	91.0
55-65	18	8.0	99.0
>65	3	1.0	100.0
Total	240	100.0	

Table 1.3 Education

	Frequency	**%**	**SUM %**
Primary School	5	2.0	2.0
Gymnasium	6	2.0	4.0
High school	58	24.0	28.0
Bachelor	91	38.0	66.0
Master	69	29.0	95.0

	Frequency	%	SUM %
PhD	11	5.0	100.0
Total	240	100.0	

Table 1.4 Residence

	Frequency	**%**	**SUM %**
Greece	217	90.0	90.0

Europe	21	9.0	99.0
Other	2	1.0	100.0
Total	240	100.0	

Table 1.5 Profession

	Frequency	**%**	**SUM %**
Public Servant	45	19.0	19.0
Private Employee	99	41.0	60.0
Freelancer	43	18.0	78.0
Pensioner	13	5.0	83.0
Housekeeping	4	2.0	85.0
Student	18	7.0	92.0
Unemployed	16	7.0	99.0

	Frequency	%	Sum %
Other	2	1.0	100.0
Total	240	100.0	

Table 1.6 Influence of environmental knowledge and sensitivity

	Frequency	**%**	**Sum %**
Not at all	1	0.0	0.0
Slightly	7	3.0	3.0
Sufficien tly	57	24.0	27.0
Much	116	48.0	75.0
Very Much	59	25.0	100.0
Total	240	100.0	

Table 1.7 willingness to choose eco-friendly services

	Frequency	**%**	**Sum %**
Not at all	1	0.0	0.0
Slightly	5	2.0	2.0
Sufficien tly	71	30.0	32.0
Much	99	7.0	73.0
Very Much	64	27.0	100.0

Total	240	100.0	

Table **1.8** Eco-ships

	Frequency	%	Sum %
YES	82	34.0	34.0
NO	158	66.0	100.0
Total	240	100.0	

TABLE **1.9** Hybrid ships

	Frequency	%	Sum %
YES	79	33.0	33.0
NO	161	67.0	100.0
Total	240	100.0	

TABLE **1.10** Use of renewable energy

	Frequencies	%	Sum %

	Frequency	%	Sum %
YES	141	59.0	59.0
NO	99	41.0	100.0
Total	240	100.0	

TABLE <u>**1.11**</u> Application of eco-friendly practices by Greek shipping companies

	Frequency	%	Sum %
YES	16	7.0	7.0
NO	224	93.0	100.0
Total	240	100.0	

TABLE <u>**1.12**</u> Application of eco-friendly practices by shipping companies worldwide

	Frequency	%	Sum %
YES	32	13.0	13.0
NO	208	87.0	100.0
Total	240	100.0	

TABLE1.13 Construction costs of an eco-ship compared to a conventional

	Frequency	%	Sum %
DON'T KNOW	49	20.0	20.0
Probably No	33	14.0	34.0
NO	16	7.0	41.0
Probably Yes	103	43.0	84.0
YES	39	16.0	100.0
Total	240	100.0	

TABLE 1.14 Eco-ship investment

	Frequency	%	Sum %
Not at all	4	2.0	2.0
Slightly	20	8.0	10.0
Sufficiently	60	25.0	35.0
Much	101	42.0	77.0
Very Much	55	23.0	100.0
Total	240	100.0	

TABLE1.15 Quality of eco-ship compared to conventional ship

	Frequency	%	Sum %
Not at all	15	6.0	6.0
Slightly	45	19.0	25.0
Sufficiently	88	37.0	62.0
Much	71	29.0	91.0
Very Much	21	9.0	100.0
TOTAL	240	100.0	

TABLE 1.16 Willing to pay higher ticket for the use of eco-ship

	FREQUENCY	%	SUM %
Probably NO	44	18.0	18.0
NO	7	3.0	21.0
Probably YES	154	64.0	85.0
YES	35	15.0	100.0
TOTAL	240	100.0	

TABLE 1.17 Energy-efficient eco-ships

	Frequency	%	Sum %
Not at all	1	1.0	1.0
Slightly	5	2.0	3.0
Sufficiently	46	19.0	22.0
Much	116	48.0	70.0
Very Much	72	30.0	100.0
Total	240	100.0	

TABLE 1.18 Improvement of technical knowledge

	Frequency	%	Sum %
Not at all	15	6.0	6.0
Slightly	37	15.0	21.0
Sufficiently	38	16.0	37.0
Much	85	35.0	72.0
Very Much	65	28.0	100.0

			Total	240	100.0	

TABLE **1.19** High quality of maritime transport services

	Frequency	%	Sum %
Not at all	16	7.0	7.0
Slightly	53	22.0	29.0
Sufficiently	91	38.0	67.0
Much	68	28.0	95.0
Very Much	12	5.0	100.0
TOTAL	240	100.0	

TABLE **1.20** Protection of the environment

	Frequency	%	Sum %
Not at all	0	0.0	0.0
Slightly	6	3.0	3.0
Sufficiently	14	6.0	9.0
Much	93	39.0	48.0
Very Much	127	52.0	100.0

	Frequency	%	
Total	240	100.0	

TABLE 1.21 Increased safety

	Frequency	%	Sum %
Not at all	13	5.0	5.0
Slightly	69	29.0	34.0
Sufficiently	104	43.0	77.0
Much	41	17.0	94.0
Very Much	13	6.0	100.0
Total	240	100.0	

TABLE 1.22 Higher ticket price

	frequency	%	SUM %
Not at all	5	2.0	2.0
Slightly	32	13.0	15.0
Sufficiently	79	33.0	48.0
Much	93	39.0	87.0
Very Much	31	13.0	100.0

	Frequency		
Total	240		

TABLE **1.23** Longer travel time

	Frequency	%	Sum %
Not at all	17	7.0	7.0
Slightly	54	23.0	30.0
Sufficiently	52	22.0	52.0
Much	91	38.0	90.0
Very Much	26	10.0	100.0
TOTAL	240		

TABLE **1.24** Weather conditions

	Frequency	%	Sum %
Not at all	19	8.0	8.0
Slightly	47	20.0	28.0

	Frequency	%	Sum %
Sufficiently	55	23.0	51.0
Much	55	23.0	74.0
Very Much	64	26.0	100.0
Total	240	100.0	

TABLE 1.25 Easier promotion of eco-ship that uses Aeolian energy in Greece

	Frequency	%	Sum %
Not at all	11	5.0	5.0
Slightly	27	11.0	16.0
Sufficiently	75	31.0	47.0
Much	102	43.0	90.0
Very Much	25	10.0	100.0
Total	240	100.0	

TABLE 1.26 Easier promotion of eco-ship that uses Solar energy in Greece

	Frequency	%	Sum %

	Frequency	%	Sum %
Not at all	18	8.0	8.0
Slightly	74	31.0	39.0
Sufficiently	74	31.0	70.0
Much	42	18.0	88.0
Very Much	32	12.0	100.0
Total	240	100.0	

TABLE 1.27 Governmental subsidies to the shipping companies

	Frequency	%	Sum %
Not at all	8	3.0	3.0
Slightly	24	10.0	13.0
Sufficiently	63	26.0	39.0
Much	107	45.0	84.0
Very Much	38	16.0	100.0
Total	240	100.0	

TABLE 1.28 Advertisement and ecological consciousness

			Sum

	Frequency	%	%
Not at all	4	2.0	2.0
Sufficiently	14	6.0	8.0
Sufficien tly	51	21.0	29.0
Much	108	45.0	74.0
Very Much	63	26.0	100.0
Total	240	100.0	

TABLE 1.29 Construction of eco-ships and eco-sensitivity

	Frequency	%	Sum %
Not at all	13	5.0	5.0
Slightly	62	26.0	31.0
Sufficien tly	102	43.0	74.0
Much	47	20.0	94
Very Much	16	6.0	100.0
Total	240	100.0	

TABLE 1.30 Reduction of CO_2

	Frequency	%	Sum %
Not at all	1	0.0	0.0
Slightly	8	3.0	3.0
Sufficiently	33	14.0	17.0
Much	91	38.0	55.0
Very Much	107	45.0	100.0
Total	240	100.0	

TABLE 1.31 Eco-friendly ships

	Frequency	%	Sum %
Not at all	23	10.0	10.0
Slightly	62	26.0	36.0
Sufficiently	59	25.0	61.0
Much	54	22.0	83.0
Very Much	42	17.0	100.0
Total	240	100.0	

TABLE 1.32 Direct conversion from diesel to renewable energy

	Frequency	%	Sum %
YES	136	57	57.0
NO	104	43	100.0
TOTAL	240	100.0	

8.3 Regression Tables

Table 5.1a: Education * eco-ship Cross tabulation

			EcoShips		
			0	1	Total
education 0	Count		0	5	5
	% within education	within	,0%	100,0%	100,0%
	% within ecoShips	within	,0%	3,2%	2,1%
1	Count		1	5	6
	% within education	within	16,7%	83,3%	100,0%
	% within ecoShips	within	1,2%	3,2%	2,5%
2	Count		14	44	58
	% within education	within	24,1%	75,9%	100,0%
	% within ecoShips	within	17,1%	27,8%	24,2%
3	Count		30	61	91
	% within education	within	33,0%	67,0%	100,0%
	% within ecoShips	within	36,6%	38,6%	37,9%

4	Count		29	40	69
	% within education		42,0%	58,0%	100,0%
	% within ecoShips		35,4%	25,3%	28,8%
5	Count		8	3	11
	% within education		72,7%	27,3%	100,0%
	% within ecoShips		9,8%	1,9%	4,6%
Total	Count		82	158	240
	% within education		34,2%	65,8%	100,0%
	% within ecoShips		100,0%	100,0%	100,0%

Table 5.1b: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	$15,231^a$	5	,009
Likelihood Ratio	16,547	5	,005
Linear-by-Linear Association	13,407	1	,000
N of Valid Cases	240		

5 cells (41,7%) have expected count less than 5. The minimum expected count is 1,71

Table 5.2a: ecoShips * ecoTicket Crosstabulation

			ecoTicket				Total
			0	1	2	3	
ecoShips 0	Count		47	21	13	1	82
	% within ecoShips		57,3%	25,6%	15,9%	1,2%	100,0%
	% within ecoTicket		30,5%	60,0%	29,5%	14,3%	34,2%
	1	Count	107	14	31	6	158
		% within ecoShips	67,7%	8,9%	19,6%	3,8%	100,0%
		% within ecoTicket	69,5%	40,0%	70,5%	85,7%	65,8%
Total		Count	154	35	44	7	240
		% within ecoShips	64,2%	14,6%	18,3%	2,9%	100,0%
		% within ecoTicket	100,0%	100,0%	100,0%	100,0%	100,0%

Table 5.2b: Chi-Square Tests

			Asymp. Sig.

	Value	df	(2-sided)
Pearson Chi-Square	12,943[a]	3	,005
Likelihood Ratio	12,477	3	,006
Linear-by-Linear Association	,015	1	,902
N of Valid Cases	240		

2 cells (25,0%) have expected count less than 5. The minimum expected count is 2,39.

Table 5.3a: education * environmental awareness influence consumer choices in favor of environment Crosstabulation

			environmental awareness influence consumer choices in favor of environment					
			0	1	2	3	4	Total
education	0	Count	1	1	1	1	1	5
		% within education	20,0%	20,0%	20,0%	20,0%	20,0%	100,0%
		% within environmental awareness influence consumer choices in favor of environmental	100,0%	14,3%	1,8%	,9%	1,7%	2,1%
	1	Count	0	0	1	3	2	6
		% within education	,0%	,0%	16,7%	50,0%	33,3%	100,0%
		% within environmental awareness influence consumer choices in favor of environmental	,0%	,0%	1,8%	2,6%	3,4%	2,5%
	2	Count	0	1	18	27	12	58
		% within education	,0%	1,7%	31,0%	46,6%	20,7%	100,0%
		% within environmental awareness influence consumer choices in favor of environmental	,0%	14,3%	31,6%	23,3%	20,3%	24,2%
	3	Count	0	3	20	45	23	91
		% within education	,0%	3,3%	22,0%	49,5%	25,3%	100,0%

		% within environmental awareness influence consumer choices in favor of environmental	,0%	42,9%	35,1%	38,8%	39,0%	37,9%
4	Count	0	2	14	32	21	69
	% within education	,0%	2,9%	20,3%	46,4%	30,4%	100,0%
	% within environmental awareness influence consumer choices in favor of environmental	,0%	28,6%	24,6%	27,6%	35,6%	28,8%
5	Count	0	0	3	8	0	11
	% within education	,0%	,0%	27,3%	72,7%	,0%	100,0%
	% within environmental awareness influence consumer choices in favor of environmental	,0%	,0%	5,3%	6,9%	,0%	4,6%
Total	Count	1	7	57	116	59	240
	% within education	,4%	2,9%	23,8%	48,3%	24,6%	100,0%
	% within environmental awareness influence consumer choices in favor of environmental	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 5.3b: Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	61,379[a]	20	,000
Likelihood Ratio	22,420	20	,318
Linear-by-Linear Association	2,213	1	,137
N of Valid Cases	240		

20 cells (66,7%) have expected count less than 5. The minimum expected count is ,02.

Table 5.4a: gender * environmental awareness influence consumer choices in favor of environment Crosstabulation

| | | | environmental awareness influence consumer choices in favor of environmental | | | | | |
			0	1	2	3	4	Total
gender	0	Count	0	6	37	57	20	120
		% within gender	,0%	5,0%	30,8%	47,5%	16,7%	100,0%
		% within environmental awareness influence consumer choices in favor of environmental	,0%	85,7%	64,9%	49,1%	33,9%	50,0%
	1	Count	1	1	20	59	39	120
		% within gender	,8%	,8%	16,7%	49,2%	32,5%	100,0%
		% within environmental awareness influence consumer choices in favor of environmental	100,0%	14,3%	35,1%	50,9%	66,1%	50,0%
Total		Count	1	7	57	116	59	240
		% within gender	,4%	2,9%	23,8%	48,3%	24,6%	100,0%
		% within environmental awareness influence consumer choices in favor of environmental	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 5.4b: Chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15,795[a]	4	,003
Likelihood Ratio	16,760	4	,002

Linear-by-Linear Association	12,109	1	,001
N of Valid Cases	240		

4 cells (40,0%) have expected count less than 5. The minimum expected count is ,50.

Table 5.5a: Gender * choose eco-friendly services, Crosstabulation

			choose services environmentally friendly					
			0	1	2	3	4	Total
gender	0	Count	1	3	51	45	20	120
		% within gender	,8%	2,5%	42,5%	37,5%	16,7%	100,0%
		% within choose services environmentally friendly	100,0%	60,0%	71,8%	45,5%	31,3%	50,0%
	1	Count	0	2	20	54	44	120
		% within gender	,0%	1,7%	16,7%	45,0%	36,7%	100,0%
		% within choose services environmentally friendly	,0%	40,0%	28,2%	54,5%	68,8%	50,0%
Total		Count	1	5	71	99	64	240
		% within gender	,4%	2,1%	29,6%	41,3%	26,7%	100,0%
		% within choose services environmentally friendly	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 5.5b: chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24,553[a]	4	,000
Likelihood Ratio	25,633	4	,000
Linear-by-Linear Association	22,084	1	,000
N of Valid Cases	240		

4 cells (40,0%) have expected count less than 5. The minimum expected count is ,50.

Table 5.6a: education * construction cost of ecoShips, Crosstabulation

			0	1	2	3	4	Total
education	0	Count	0	0	1	2	2	5
		% within education	,0%	,0%	20,0%	40,0%	40,0%	100,0%
		% within construction cost of ecoships	,0%	,0%	6,3%	1,9%	5,1%	2,1%
	1	Count	2	0	1	1	2	6
		% within education	33,3%	,0%	16,7%	16,7%	33,3%	100,0%
		% within construction cost of ecoships	4,1%	,0%	6,3%	1,0%	5,1%	2,5%
	2	Count	20	8	4	20	6	58
		% within education	34,5%	13,8%	6,9%	34,5%	10,3%	100,0%
		% within construction cost of ecoships	40,8%	24,2%	25,0%	19,4%	15,4%	24,2%
	3	Count	17	11	7	44	12	91
		% within education	18,7%	12,1%	7,7%	48,4%	13,2%	100,0%
		% within construction cost of ecoships	34,7%	33,3%	43,8%	42,7%	30,8%	37,9%
	4	Count	9	13	3	32	12	69
		% within education	13,0%	18,8%	4,3%	46,4%	17,4%	100,0%
		% within construction cost of ecoships	18,4%	39,4%	18,8%	31,1%	30,8%	28,8%
	5	Count	1	1	0	4	5	11
		% within education	9,1%	9,1%	,0%	36,4%	45,5%	100,0%
		% within construction cost of	2,0%	3,0%	,0%	3,9%	12,8%	4,6%

	ecoships						
Total	Count	49	33	16	103	39	240
	% within education	20,4%	13,8%	6,7%	42,9%	16,3%	100,0%
	% within construction cost of ecoships	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 5.6b: chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29,911[a]	20	,071
Likelihood Ratio	29,704	20	,075
Linear-by-Linear Association	3,637	1	,057
N of Valid Cases	240		

17 cells (56,7%) have expected count less than 5. The minimum expected count is ,33.

Table 5.7a: gender * ecoShips solution of crisis, Crosstabulation

			ecoships solution of crisis					Total
			0	1	2	3	4	
gender	0	Count	17	58	25	15	5	120
		% within gender	14,2%	48,3%	20,8%	12,5%	4,2%	100,0%
		% within ecoships solution of crisis	81,0%	55,2%	41,0%	38,5%	35,7%	50,0%
	1	Count	4	47	36	24	9	120
		% within gender	3,3%	39,2%	30,0%	20,0%	7,5%	100,0%
		% within ecoships solution of crisis	19,0%	44,8%	59,0%	61,5%	64,3%	50,0%
Total		Count	21	105	61	39	14	240

| | % within gender | 8,8% | 43,8% | 25,4% | 16,3% | 5,8% | 100,0% |
| | % within ecoships solution of crisis | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% |

Table 5.7b: chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14,403[a]	4	,006
Likelihood Ratio	15,066	4	,005
Linear-by-Linear Association	11,284	1	,001
N of Valid Cases	240		

0 cells (,0%) have expected count less than 5. The minimum expected count is 7,00.

Table 5.8a: gender * minimize CO2, Crosstabulation

			minimize co2					
			0	1	2	3	4	Total
gender	0	Count	1	7	18	48	46	120
		% within gender	,8%	5,8%	15,0%	40,0%	38,3%	100,0%
		% within minimize co2	100,0%	87,5%	54,5%	52,7%	43,0%	50,0%
	1	Count	0	1	15	43	61	120
		% within gender	,0%	,8%	12,5%	35,8%	50,8%	100,0%
		% within minimize co2	,0%	12,5%	45,5%	47,3%	57,0%	50,0%
Total		Count	1	8	33	91	107	240
		% within gender	,4%	3,3%	13,8%	37,9%	44,6%	100,0%
		% within minimize co2	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 5.8b: chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8,150[a]	4	,086
Likelihood Ratio	9,106	4	,059

Linear-by-Linear Association	6,440	1	,011
N of Valid Cases	240		

4 cells (40,0%) have expected count less than 5. The minimum expected count is ,50.

Table 5.9a: age * construction cost of ecoShips Crosstabulation

			construction cost of ecoships					
			0	1	2	3	4	Total
age	0	Count	2	4	3	7	6	22
		% within age	9,1%	18,2%	13,6%	31,8%	27,3%	100,0%
		% within construction cost of ecoships	4,1%	12,1%	18,8%	6,8%	15,4%	9,2%
	1	Count	20	19	7	60	11	117
		% within age	17,1%	16,2%	6,0%	51,3%	9,4%	100,0%
		% within construction cost of ecoships	40,8%	57,6%	43,8%	58,3%	28,2%	48,8%
	2	Count	11	7	3	21	11	53
		% within age	20,8%	13,2%	5,7%	39,6%	20,8%	100,0%
		% within construction cost of ecoships	22,4%	21,2%	18,8%	20,4%	28,2%	22,1%
	3	Count	10	1	3	7	6	27
		% within age	37,0%	3,7%	11,1%	25,9%	22,2%	100,0%
		% within construction cost of ecoships	20,4%	3,0%	18,8%	6,8%	15,4%	11,3%
	4	Count	5	2	0	8	3	18
		% within age	27,8%	11,1%	,0%	44,4%	16,7%	100,0%
		% within construction cost of ecoships	10,2%	6,1%	,0%	7,8%	7,7%	7,5%
	5	Count	1	0	0	0	2	3

	% within age	33,3%	,0%	,0%	,0%	66,7%	100,0%
	% within construction cost of ecoships	2,0%	,0%	,0%	,0%	5,1%	1,3%
Total	Count	49	33	16	103	39	240
	% within age	20,4%	13,8%	6,7%	42,9%	16,3%	100,0%
	% within construction cost of ecoships	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 5.9b: chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30,455[a]	20	,063
Likelihood Ratio	31,814	20	,045
Linear-by-Linear Association	,572	1	,449
N of Valid Cases	240		

17 cells (56,7%) have expected count less than 5. The minimum expected count is ,20

Table 5.10a: gender * ecoShips Crosstabulation

			ecoShips		
			0	1	Total
gender 0	Count		42	78	120
	% within gender		35,0%	65,0%	100,0%
	% within ecoShips		51,2%	49,4%	50,0%
1	Count		40	80	120
	% within gender		33,3%	66,7%	100,0%

	% within ecoShips	48,8%	50,6%	50,0%
Total	Count	82	158	240
	% within gender	34,2%	65,8%	100,0%
	% within ecoShips	100,0%	100,0%	100,0%

Table 5.10b: chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,074[a]	1	,785		
Continuity Correction[b]	,019	1	,892		
Likelihood Ratio	,074	1	,785		
Fisher's Exact Test				,892	,446
Linear-by-Linear Association	,074	1	,786		
N of Valid Cases	240				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 41,00.

b. Computed only for a 2x2 table

Table 5.11a: profession * ecoTicket Crosstabulation

		ecoTicket				
		0	1	2	3	Total
profession 0	Count	32	5	6	2	45

	% within profession		71,1%	11,1%	13,3%	4,4%	100,0%
	% within ecoTicket		20,8%	14,3%	13,6%	28,6%	18,8%
1	Count		66	13	17	3	99
	% within profession		66,7%	13,1%	17,2%	3,0%	100,0%
	% within ecoTicket		42,9%	37,1%	38,6%	42,9%	41,3%
2	Count		23	11	8	1	43
	% within profession		53,5%	25,6%	18,6%	2,3%	100,0%
	% within ecoTicket		14,9%	31,4%	18,2%	14,3%	17,9%
3	Count		9	2	2	0	13
	% within profession		69,2%	15,4%	15,4%	,0%	100,0%
	% within ecoTicket		5,8%	5,7%	4,5%	,0%	5,4%

4	Count		3	0	0	1	4
	% within profession		75,0%	,0%	,0%	25,0%	100,0%

		% within ecoTicket	1,9%	,0%	,0%	14,3%	1,7%
	5	Count	11	3	4	0	18
		% within profession	61,1%	16,7%	22,2%	,0%	100,0%
		% within ecoTicket	7,1%	8,6%	9,1%	,0%	7,5%
	6	Count	9	1	6	0	16
		% within profession	56,3%	6,3%	37,5%	,0%	100,0%
		% within ecoTicket	5,8%	2,9%	13,6%	,0%	6,7%
	7	Count	1	0	1	0	2
		% within profession	50,0%	,0%	50,0%	,0%	100,0%
		% within ecoTicket	,6%	,0%	2,3%	,0%	,8%
Total		Count	154	35	44	7	240
		% within profession	64,2%	14,6%	18,3%	2,9%	100,0%
		% within ecoTicket	100,0%	100,0%	100,0%	100,0%	100,0%

Table 5.11b: chi-square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21,812[a]	21	,410

Likelihood Ratio	19,226	21	,571
Linear-by-Linear Association	1,393	1	,238
N of Valid Cases	240		

20 cells (62,5%) have expected count less than 5. The minimum expected count is ,06.

8.4 Questionnaires

THE PERPECTIVE OF ECO-SHIPS FOR CONSUMERS

Erasmus University

Maritime and Logistics program

Dear Sir / Miss this research is conducted under the auspices of Erasmus University and the values collected will benefit from the use of absolute confidentiality and under no circumstances will be published separately or will expose participants. Thank you in advance for your cooperation.

* Required

1) Gender of respondent*

• Male

• Women

2) Age of respondent *

• 18-25

• 25-35

• 35-45

• 45-55

• 55-65

•> 65

3) Educational level *

• Primary school

• Gymnasium

• High school

• Holder of a Bachelor

• Holder of a Master

• Holder of Ph.D.

4) Residence respondent * Temporary or permanent

• Greece

• Europe

• Other:

5) Main economic activity of the respondent *

• Public servant

• Private employee

• Freelance

• Pensioner

• Housekeeping

• Student

• Unemployed

• Other

6) Do you think that environmental awareness and sensitivity that each person has can influence consumer choices to benefit the environment? *

Not at all	Slightly	Sufficiently	Much	Very Much
☐	☐	☐	☐	☐

7) How much are you willing to choose environmentally friendly services in order to contribute to protection of the environment *

Not at all	Slightly	Sufficiently	Much	Very Much
☐	☐	☐	☐	☐

8) Do you know what an ecological ''green'' ship is? * Answer YES or NO

9) Are you aware of the existence of hybrid ship? * Answer YES or NO

10) Are you aware that ships instead of oil can use alternative energy for their movement as solar, wind (air), gas etc. .; * Answer YES or NO

11) Are you aware that shipping companies in Greece have taken steps towards the use of environmentally friendly practical applications? * Answer YES or NO

13) Are you aware that shipping companies worldwide have taken steps towards the use of environmentally friendly practical applications? * Answer YES or NO

14) If you answered YES give the name of / shipping companies that you know use practices environmentally friendly applications worldwide

15) Do you think that the construction of ecological "green" ships cost more than conventional? * Building ecological "green" passenger ships

Don't know	Probably Not	No	Probably Yes	Yes
◉	◉	◉	◉	◉

16) Do you believe that global economic conditions influence the decisions of the shipping companies to invest in new ecological 'green' ships? * Building ecological "green" passenger ships

Not at all	Slightly	Sufficiently	Much	Very Much
◉	◉	◉	◉	◉

17) Do you think that the services of ecological "green" ships are of better quality than conventional? * Passenger services

Not at all	Slightly	Sufficiently	Much	Very Much
◌	◌	◌	◌	◌

18) Would you be willing to pay expensive ticket to travel with ecological "green" ships to benefit the environment? * Answer YES or NO

19) To what extent do you think the ecological 'green' ships will be powered by alternative fuels would have resulted in the following: *

Not at all	Slightly	Sufficiently	Much	Very Much	
☐	☐	☐	☐	☐	Greater energy efficeciency
☐	☐	☐	☐	☐	Improvement in technical knowledge
☐	☐	☐	☐	☐	Provide high quality of maritime transport services
☐	☐	☐	☐	☐	Protection of the marine environment
☐	☐	☐	☐	☐	Improved safety
☐	☐	☐	☐	☐	Higher ticket price
☐	☐	☐	☐	☐	Longer travel time
☐	☐	☐	☐	☐	Would be affected by weather conditions

20) Do you believe that in a country like Greece would be easier to promote green 'green' ships based on the wind: * Passenger ecologically "green" ships

Not at all	Slightly	Sufficiently	Much	Very Much
◌	◌	◌	◌	◌

21) Do you think that in a country like Greece the operation of eco-ships that are using solar energy would be easier? *

Not at all	Slightly	Sufficiently	Much	Very Much
◌	◌	◌	◌	◌

22) Please note your opinion on each of the following sentences:

+ The state must subsidize shipping companies to use friendly practical applications for the environment

Not at all	Slightly	Sufficiently	Much	Very Much
◌	◌	◌	◌	◌

+ The Greek Ministry of Shipping can contribute through advertisements so that consumers to shape ecological awareness

Not at all	Slightly	Sufficiently	Much	Very Much
◌	◌	◌	◌	◌

+ The construction of eco-ships by the shipping companies is aiming to promote their environmental sensitivity

Not at all	Slightly	Sufficiently	Much	Very Much
◌	◌	◌	◌	◌

- The "green" ships can contribute positively to the reduction of carbon dioxide emissions

Not at all	Slightly	Sufficiently	Much	Very Much
☐	☐	☐	☐	☐

- A ship can be cost-efficient and eco-friendly at the same time

Not at all	Slightly	Sufficiently	Much	Very Much
☐	☐	☐	☐	☐

23) Do you think that is feasible in the near future the conversion of diesel passenger ships to ships that uses exclusively renewable energy sources? * Answer YES or NO

24) Do you believe that the ships that will use renewable source of energy might be the answer to a possible financial crisis? *

Not at all	Slightly	Sufficiently	Much	Very Much
☐	☐	☐	☐	☐