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NEW ECOLOGICAL ENERGY  
SOLUTIONS AND ITS BUSINESS  
OPPORTUNITIES FOR THE FINNISH  
BOAT INDUSTRY

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**ABSTRACT**

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Many countries throughout the world have promised to reduce their carbon dioxide emissions and the consumers' behavior and attitudes have also become more environment-friendly. In the car industry it has quite quickly been possible to follow the new consumer trends and also to fulfill governments' expectations by making the cars more environment-friendly by activities such as reducing the exhaust emissions. A bigger environmental awareness and the increased fuel price are factors that probably also determines what kinds of boats are being sold in the future.

Since the boat industry is very export oriented and well represented in the Ostrobothnia region, there are several universities in the Vaasa region that are involved in the Boat Programme 2008-2011, established by the Finnish development and innovation organization Tekes. Vaasa University of Applied Sciences has together with VTT Technical Research Centre of Finland and Vaasa University developed a sub-project called Vene-ene, which refers to boats and energy. The aim for this research is to find out business opportunities for new ecological energy solutions that the Finnish boat industry can take into consideration in their business activities.

New ecological energy solutions such as electric- or hybrid engines, solar panels, wind generators, rotating propellers and batteries have been examined. Other environment-friendly options such as installing a software that displays the energy consumption in boats have been examined. 18 people involved in the Finnish boat industry have been interviewed.

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Keywords Ecological energy solutions, Boat industry, Environment

## ABSTRAKT

Författare	Daniel Enkvist
Lärdomsprovets titel	Nya miljövänliga energilösningar och dess affärsmöjligheter för den finländska båtindustrin
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Många länder i världen har lovat att minska på koldioxidutsläppen och konsumenternas beteenden och attityder har också blivit mera miljömedvetna. Bilindustrin har ganska snabbt lyckats följa de nya konsumenttrenderna och att följa regeringarnas förväntningar genom att göra bilarna miljövänligare med aktiviteter som att minska avgasutsläppen. En större miljömedvetenhet och högre bränslepriser är faktorer som antagligen kommer att påverka vilka båtar som säljs i framtiden.

Båtindustrin i Finland är väldigt beroende av exporten och eftersom båtindustrin är väl representerad i Österbotten så har många universitet i Vasa regionen deltagit i Båtprogrammet 2008-2011 som utvecklings- och innovationsorganisation Tekes har startat. Vasa yrkeshögskola har därför tillsammans med forskningscentralen VTT och Vasa universitet utvecklat ett eget forskningsprogram som kallas Vene-ene. Ordet ”Vene” står för båt medan ordet ”ene” står för energi. Målet med denna forskningsrapport är att undersöka affärsmöjligheter för nya miljövänliga energilösningar som den finländska båtindustrin kan ta i beaktande vid utvecklingen av nya båtar.

Nya miljövänliga energilösningar som el- och hybridmotorer, solpaneler, vindgeneratorer, en roterande propeller samt batterier har blivit undersökta. Andra miljövänliga lösningar som biodiesel och en mjukvara som kan kontrollera behovet av energi har undersökts. 18 personer inom båtbranschen har blivit intervjuade.

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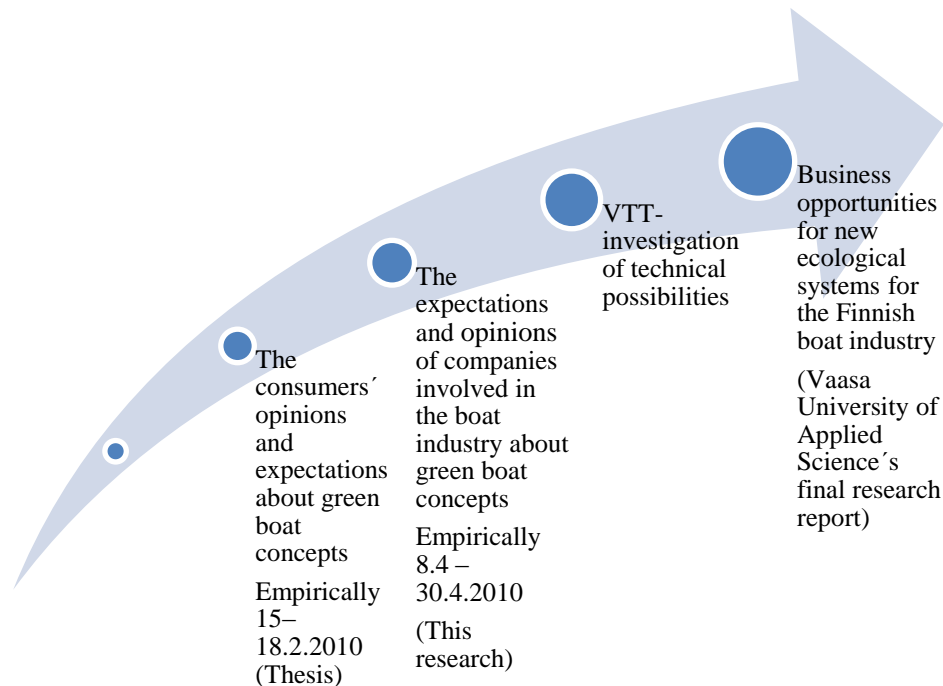
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## 1 INTRODUCTION

Many countries throughout the world have promised to reduce their carbon dioxide emissions and the consumers' behaviors and attitudes have also become more environment-friendly. Other factors leading to a more environment-friendly thinking by the consumers have been the increased price of fuel and tax adaptations for products and services. In the car industry it has quite quickly been possible to follow the new consumer trends and also to fulfill governments' expectations by making the cars more environment-friendly by activities such as reducing the exhaust emissions. A bigger environmental awareness and the increased fuel price are factors that probably also determine what kinds of boats are being sold in the future.

Tekes is a public expert organization when it comes to financing research, development and innovation in Finland. Tekes have established several big research projects and one ongoing project is called Boat Programme 2008-2011. The Boat Programme 2008-2011 supports the boat industry to develop their products, production process and business activities by providing as good expertise as possible. One of the aims with the project is to provide better boats and services for the consumers. (Tekes 2008.)

Since the boat industry is very export oriented and well represented in the Ostrobothnia region, there are several universities in the Vaasa region that are involved in the Boat Programme 2008-2011. Vaasa University of Applied Sciences has together with VTT Technical Research Centre of Finland and Vaasa University developed a subproject out of the Boat Programme 2008-2011. The subproject is called Vene-ene which refers to boats and energy. The main task for VTT in this subproject is to investigate effective and environment-friendly energy solutions and to provide opportunities how they can be adapted in the boat development stage. The main task for Vaasa University of Applied Sciences is to find out business opportunities for new ecological energy solutions that the Finnish boat industry can take into consideration in their business activities.



**Figure 1.** An overview of the Vene-ene research project

### 1.1 Other researches

Because of the Boat Programme 2008-2011 several researches have already been launched about the boat industry in Finland. Before the Boat Programme 2008-2011 was launched, Vesa Kojola wrote his pro gradu thesis about *Future changes in boat sector and the possibilities of collaborative development (2008)*. One of the aims of Kojola's thesis was to describe and analyze changes in the boat industry in customer, marketing and technology environments. Kojola discovered in his research that there are not “enough expertise to efficiently utilize new technology.” Kojola suggested that the boat industry would increase its competitiveness by collaboration. (Kojola 2008.)

A recently launched report has been made by Tero Vuorinen and Tero Kurki at Vaasa Yliopisto, 2010. The title of the report is *Ui tai uppoa – Toimialatutkimus Suomen venealasta* which translated to English means *Swim or Sink – A Research of the Finnish Boat Industry*. The research provides answers to how the Finnish boat industry is performing and how it could perform. In the conclusion of the research it is written about environment issues. The authors state that the boat



production and boat engines have become more environment-friendly. They continue by writing that the energy consumption can be reduced the same way as happened in the car industry. The authors also assume that ecological products might in the future be more appreciated such as a lighter construction or by utilizing solar energy. However, the authors do not believe that any big changes will occur in the consumer behaviors in a close future. The authors finalize their environmental statements by telling that a boat is some kind of a status symbol and green values might reduce the status of owning a boat. (Vuorinen, Kurki 2010.)

KPMG is an organization having an international network of member companies and they are operating by offering audit, tax and advisory services. KPMG launched recently a survey called “KPMG’s Global Auto Executive Survey 2010 – Industry Concerns and Expectations to 2014.” In the survey approximately 200 executives around the world had been interviewed. Some key findings were that 94 % of the executives believe that fuel efficiency will in a near future be the most important factor when consumers make a purchase decision and 80 % believe that environment-friendly solutions will affect the purchase decision. More than nine out of ten executives believe that the sales of hybrid cars will increase within a time period of five years. (KPMG 2010)

Meanwhile this thesis is written from the boat industry’s perspective, Pasi Hyypä will write a similar thesis from the consumers’ perspective. These two researches will be put together and be the base for Vaasa University of Applied Science’s report about business opportunities for new ecological energy solutions to the boat industry. The report will provide the Finnish boat industry with relevant information on what kind of ecological energy solutions they should put emphasis on.

## **1.2 Aim and research problem**

The aim of the research is to investigate the expectations and the prospects of the boat industry’s and the boat equipment companies’ views on new ecological energy solutions.

The research problem for the thesis is how the Finnish boat industry and boat equipment companies think about new ecological energy solutions and its possible business opportunities for the future.

### **1.3 Research questions**

Out of the research problem it is possible to come up with research questions that more specifically will explain what will be investigated. The research questions that will be answered empirically are the following:

- What is the general expectations and prospects for the Finnish boat manufacturers about electric engine solutions in different types of boats (when taking into consideration the advantages and disadvantages of the battery technology)?
- What kind of ecological solutions do the boat industry and the boat equipment companies believe that consumers are interested in the future?
- What will in the future, according to the boat industry and the boat equipment companies be the best business opportunities for boats in the field of new energy solutions?

### **1.4 Limitations of the research**

The interviews will mostly be conducted in the Ostrobothnia region. The results will reflect the views of new ecological energy solutions for companies in Ostrobothnia.

The respondents might not give correct answers to questions like “What ecologic energy solution will provide best business opportunities?” because they are not interested in revealing their competitive strategies. The reliability and validity of the respondents’ answers must be examined.

There will not be any study about business opportunities for new ecological energy solutions to big vessels. The focus will rather be on smaller boats such as motorboats, yachts and workboats.

## **1.5 Benefits of the research**

The thesis about the consumers' perspective of new ecological energy solutions and the thesis about the boat industry's and boat equipment companies' perspective of new ecological energy solutions, together with VTT's investigation about technical solutions will be the foundation of the final report made by Ossi Koskinen at Vaasa University of Applied Sciences. The final report will provide competitive knowledge to the operators in the Finnish boat industry about what kind of ecological energy solutions they should put emphasis on.

Apart from the boat industry and boat equipment companies other operators such as consultancy and designing companies, and boat owners and users will receive a lot of benefits of the research. Designing companies will receive valuable information about the need and the demand of ecological energy solutions and if they should take ecological energy solutions into consideration when designing the boats. Boat owners and consumers will receive more information about what kind of ecological energy solutions are available on the market and what kind of ecological energy solutions are coming to the market.

## **1.6 Structure of the thesis**

Chapter 1 is introducing the topic to the reader. The reader will get a clear picture of the research problem and the aim of the research. The reader will understand the limitations of the thesis as well as the benefits the research is providing for different operators in the boat industry. The theoretical framework begins in chapter 2 by explaining different kinds of boats that are being investigated. Different business opportunities for the different kind of boats will be examined. The chapter continues by explaining different engines that are being used in the boats. Focus will be laid on electric- and hybrid engines and the new possibilities for batteries. Chapter 3 is about the increasing demand of energy in boats. Topics such as solar panels, wind generators, wave energy and circulating propeller will be examined. The chapter continues with a case about Dragon One that is one of the world's first yachts that can produce all electricity it needs. The focus in chapter 4 will be on brand marketing. The empirical framework will begin in

chapter 5 and general information about the boat industry and research methodology will be provided. Analysis of the empirical part will be examined in chapter 6. In chapter 7 the reader will get a conclusion of the research.

## **2 THEORETICAL FRAMEWORK**

The theoretical framework explains the theory about a certain topic. The theoretical framework provides the reader with sufficient information to be able to understand the analysis of the empirical framework.

### **2.1 Boat division and possible business opportunities**

As already explained before, the thesis will only deal with new ecological energy solutions for smaller boats. Vessels are not considered because the companies in the Finnish boat industry are usually SME (Small and medium sized enterprises) companies.

The boats that are being examined are divided into small boats under 5 m, motorboats 4-6 m, motorboats over 7 m, sailing-boats/yachts and workboats. Depending on several factors like speed and size there are different kinds on energy needs.

#### **2.1.1 Small boats under 5 m**

Dinghies, rowing-boats, small rubber boats and outboard motorboats are vehicles classified in this group. The boat owners and users in this group are assumed to mostly use the boat when going to the summer cottage and for short fishing trips. Generally, not any longer trips are being made within this category of boats and that is why the need for energy is not large. If the outboard engine is started manually, no batteries are installed in the boat for the starting motor. Even if an outboard motorboat is equipped with a starter and batteries, the need for energy is minimal, because the number of electrical appliances is little and the outboard engine is charging the battery all the time during the cruise.

It will be explained later but when it comes to quantities being sold, the small boat group is superior. Even though large quantities are being sold it is challenging to make the production profitable and the global competition is hardening all the time in this boat category. Similar boats produced in China can be sold at a third of the price in Finland. When the engine has a hand starter and manual steering

these boats are often not sold in packages because the outboard engine is easy to install afterwards.

For this group of boats, ecological energy solutions have already been for sale several years on the market. Electric outboard engine such as Torqeedo is one example of an already existing electric outboard engine. As a conclusion it can be stated that there is a great potential for ecological energy solutions and there is already a big selection of electric outboard engines on the market. Another statement is that the demand for energy in the boats for electrical appliances is insignificant. (Koskinen 2010a.)

Due to the recent development in technology in fields like electronics, material and battery technology, innovations such as the electric outboard engine Torqeedo have been developed. The Torqeedo Travel electric outboard engine has two horse powers. The performance of an engine is measured in how much power is given for propelling a boat. The power is called propulsive power and it can be expressed in watts or horsepower. (Torqeedo 2010.)



**Figure 2.** A Torqeedo Travel electric outboard engine

A competitor against Torqeedo is the Japanese based company Yamaha. Yamaha have four different electric outboard engines in their product selection. When comparing prices between Torqeedo's and Yamaha's electric outboard engines it can be stated that Yamaha have far cheaper prices. Torqeedo's electric outboard engines are sold for over 1,000 euro while Yamaha's prices are about 199-749 euro depending on the electric outboard engine's size and power. Another electric outboard engine in the same category as Yamaha and Torqeedo is found in Biltema's latest magazine and the price of that specific electric outboard engine is only 149 euro.

### **2.1.2 Planning motorboats, 4-6 m**

Motorboats with a stronger engine and size between 4 and 6 meter can usually be driven very fast. Compared to small boats under 5 meter there are not any electric outboard engines on the market because of the great need of power for the engine and problems in finding a good position for the battery. One main reason for not having an electric outboard engine would be the high price of such engine-/battery solution compared to the price of the combustion engine. The electricity consumption of electric appliances in this category is quite limited and the power in battery is usually enough since the boat is running by a charging outboard engine. One business opportunity that could be examined empirically is if there is a need for placing solar panels in the boats. (Koskinen 2010a.)

### **2.1.3 Motorboats over 7 m**

The speed of motorboats varies and some motorboats have a top speed *under 10 knots* and that means that the boat is not able to plane. For slower motorboats the hypothesis is that there can be several business opportunities for electric propulsion.

For boats with a top speed *over 10 knots*, the main problems for electric propulsion are that the need for power would be very high and the range a boat could cover is quite small. The size and weight of the battery would easily grow too large if the technology of today would be used and if the boat should be able

to cover the same distance as an outboard engine. However, the technology is developing all the time and within some few years there will be electric motorboats on the market that have a top speed over 20 knots, e.g. Nimbus 27 E-power.

A Swedish based company called Nimbus Boats AB proclaimed 22nd of October 2009 that they are developing a motorboat called Nimbus 27 E-power that is only running with an electric engine. The Nimbus 27 E-power will be ready for production and sales in 2015. The top speed of the Nimbus 27 E-power will be 27 knots and when driving 23 knots, the range the electric motorboat can cover is 20 nautical miles. The motorboat has also a small diesel generator that can be used if the engine is out of power. When charging the battery it takes up to 28 hours if it is charged from a standard power point of 230 volt and only about four hours if it is charged from a standard 3 phase of 400 volt. To charge a battery, the costs will be around 5 euro. (Nimbus Boats AB 2009.)



**Figure 3.** Nimbus 27 E-power



Since motorboats in this category are comparatively big, there are several places where solar panels could be installed. Wind turbines could also be installed on the boat but this would be a less practical solution for several reasons. In this category usually the power in the batteries is enough since the battery is automatically charging while the outboard engine is running. The motorboats in this category are usually sold in readymade packages which mean that the propulsion is already installed before the boat is sold. (Koskinen 2010a.)

#### **2.1.4 Sailing-boats/yachts**

One big problem for sailing yachts is the shortage of electricity since the engine is mostly used only in the ports and not while cruising on the seas and oceans. The further a yacht is sailing, the greater probability that the inboard motor have to be started to provide more power to the battery.

One dilemma for the sailor is the electricity consumption of the refrigerator. The demand of electricity for the refrigerator is very large and to be able to bring fresh food and cold drinks for hot summer days, more energy is needed. To solve the problem of the refrigerator, the sailors usually look forward to charge the battery at a port from the national grid. A business opportunity linked with the dilemma of the refrigerator could be to install a separate electric generator in the sailing yacht. The extra energy that charges the battery could be generated from wind power or sun power. Business opportunities that have already been on the market are solar panels, wind generators and a circulating propeller. More information about these electric appliances will be explained later. (Koskinen 2010a.)

#### **2.1.5 Workboats**

All boats used professionally by organizations and companies fall into this group. Examples of the usage of the boats include search and rescue boats, oil and fire controlling boats, fishing boats, boats used by the customs, research boats, transporting boats, icebreakers, coastguard boats and pilot boats. (Alanen 2010, 12.) These kinds of boats can charge their batteries from the national grid since they are usually during the night at the port. Business opportunities for these kinds

of boats can be by assembling solar panels and wind generators. The biggest business opportunity could be to start marketing green values to the buyers. The promotion of green values can be very valuable for the buyers that are usually represented by organizations.

While Koskinen attended the Helsinki International Boat Show he noticed that many organizations were a bit skeptic for new ecological energy solutions. Many boats within this category are driving in difficult weather conditions and the engines must be reliable and durable. Ecological appliances such as solar panels or wind generators could easily be damaged if any parts accidentally are hitting them. The organizations also said that they have not any shortage of energy since the boats are installed with heavy diesel engines that effectively charge the batteries.

### **2.1.6 Conclusions of the boat division**

Before reading the empirical part there are some starting points that should be noticed about new ecological energy solutions and its business opportunities.

- The bigger boat, the greater need for energy
- The faster boat, the greater challenge for electric propulsion
- The need for energy solutions is greater in sailing yachts compared to other boats
- It can be assumed that green values are important for organizations owning boats

## **2.2 Different boat engines**

The following topic focuses on four different types of boat engines which are outboard engine, inboard engine, electric engine and hybrid engine.

### **2.2.1 Inboard engine/outboard engine**

The most common engine being used by boats throughout years is the combustion engine. Even though the combustion engine is harmful for the environment many

great innovations have nowadays made the combustion engine more powerful and less pollutant. However, the values of the consumers have changed since more information about environment issues has been launched. Combustion engines are today the only solution for fast going boats since the power of the electric engine is not good enough for high speeds.

The fuel being used in an inboard engine can either be diesel or petrol. Diesel is mostly used in inboard engines since it is more economical compared to petrol. The power of an outboard combustion engine can be 2-350 horsepower and they can be either two- or four strokes. The engine manufacturers usually produce two different rig sizes, a long and a short one. The engine with a longer rig goes deeper under the water. (Koskinen 2010b.)

### 2.2.2 Electric engine

Electric engine is already a reality in bigger vessels. The electric engine is also coming more and more to boats but there are some challenges, such as higher price and the range a boat can drive, that must be solved before the electric engine will be considered as a real competitor against combustion engines. To purchase an electric engine to bigger vessels for a higher price is not a problem since the electric engine is much cheaper in the long run if the vessel is often used.



**Figure 4.** Azipod electric engine is constructed for big vessels (ABB Oy 2002, 4.)

The benefits for an electric engine are the following:

- A simple technology is being used for electric engines and only little service is needed
- The solution is environment-friendly and especially if batteries are charged by green energy sources
- The electric engine does not pollute the environment at all
- The cruising is smooth for electric engines (Koskinen 2010b.)
- Eliminating smoke and noise
- When using the electric engine for propulsion, the running costs can be 10 times less compared to a diesel engine (Greenline Hybrid 2010, 4.)

### **2.2.3 Hybrid engine**

The hybrid engine is also a new environment-friendly energy solution that is growing in popularity among consumers especially in the car industry although the price is comparatively high. The idea with hybrid engines is to reduce the running costs by installing an electric engine together with a combustion engine. If the electric engine fails, the cruising can safely continue by using the combustion engine. Another hybrid alternative is to let the combustion engine run a generator that provides power to the electric engine. The negative aspect with the later hybrid system, running with an electric engine is that the cruising will end if any problems occur with the electric engine. (Barrel, Kuronen 2010, 33-34.) The negative aspect for both of the hybrid systems is the same as in the car industry that the costs for buying a hybrid engine is quite expensive compared to a combustion engine.

Nanni Kubota have developed a hybrid system whereby the diesel engine provides runs a generator that provides power to the electric engine. The power obtained from the electric engines varies between 6.8 hp and 9.5 hp depending on which electric engine is used. The cruising time for the electric engine is 1-3 hours before the battery has to be recharged. (Pöyhönen 2010, 63.)

The benefits for a hybrid engine are the following:

- A slow and pollution free cruising in ports and near shores
- When driving fast it is more economical to use the combustion engine
- It eliminates the need of different generator appliances
- Reduces the overall pollution
- Increases the safety by being able to cruise in two different propulsive ways. If the power of the battery is empty, the fuel tank will be used
- The battery in the electric engine is being charged while the combustion engine is running (Alanen 2010, 36.)

When using a hybrid engine there are some different activities that can be undertaken. The electric engine can be used when starting the combustion engine. The electric engine can also be charged when the combustion engine is running or when it is connected to the national grid. When driving slowly the electric engine can be the propulsive power. Finally, both of the engines can be used at the same time to get a greater torque. (Pöyhönen 2010, 62-63.)

### **2.3 Batteries**

The development of batteries is an important issue for reducing the pollution in the environment. The need for polluting combustion engines can be reduced by producing efficient and powerful batteries to a competitive price. The batteries can be charged by new ecological energy solutions such as solar energy, wind energy and wave energy.

The batteries are today facing several challenges that must be solved before the sales can boost. It is quite complicated to find a suitable place for bigger sets of batteries. The batteries are often placed in a hot and humid place which has its own challenges because all of the electronics connected to the battery must also endure such conditions. The battery is also expected to be small but still powerful. The equation of the battery is that the higher power that is requested, the bigger size of the battery. A small battery is convenient when constructing and designing the boat. A powerful battery is needed when starting the engine but at the same time the battery must be able to provide a regular flow of energy while the boat is cruising. (Alanen 2010, 22.)

There are several batteries on the market such as lead- and lithium batteries. The problem occurred for lead batteries is the weight. If a lead battery and a lithium battery are having the same weight, the lithium battery is able to store a double amount of power. On the other hand the lithium battery costs about ten times more than a lead battery. Lithium is a very harmful substance and if the battery starts leaking there might be bad consequences. Although there are several obstacles for lithium batteries, they represent the technology of today and before making any judgment it has to be considered that the batteries have recently been developed. The potential for lithium batteries is that motorboats can cruise in speeds up to 20 knots by using lithium batteries. (Barrel, Kuronen 2010, 33-34.)

#### **2.4 Biodiesel**

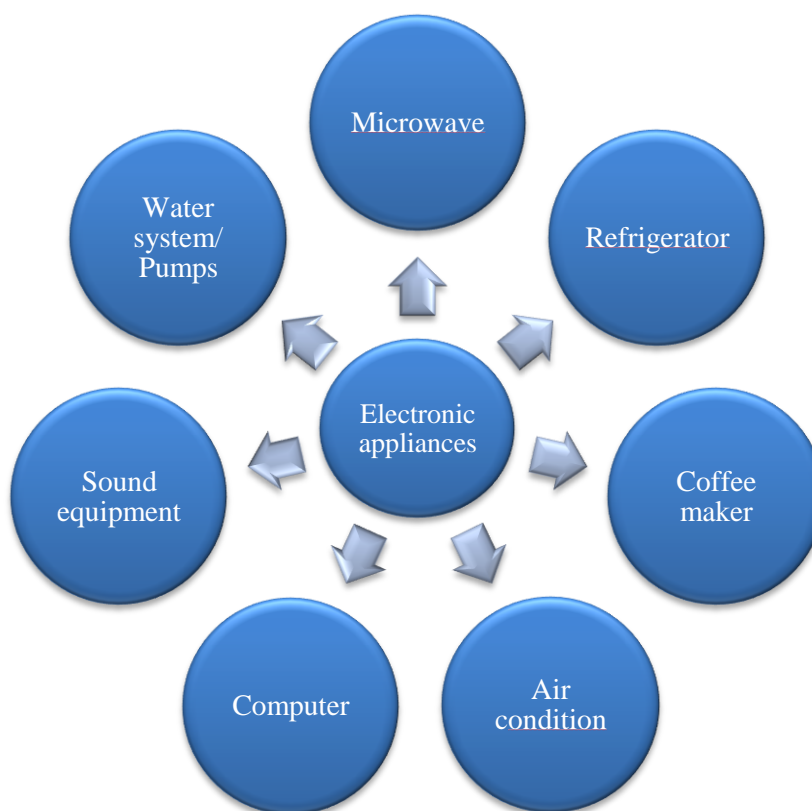
Biodiesel is an alternative fuel produced from renewable resources such as vegetable oils and animal oils. The biodiesel smells differently depending on what kind of raw material have been used. Biodiesel is an alternative that is more environment-friendly and less polluting compared to fossil fuels. (Preseco 2010.)

Neste Oil is the world leader when it comes to investments in renewable fuels. Neste Oil has in Finland established two renewable diesel plants in Porvoo. The renewable diesel plants have a capacity of producing 340,000 metric tons of biodiesel annually. The biodiesel has since 2008 been used by some buses within the capital region in Finland. (Neste Oil 2010.)

Biodiesel has been used in boats for some years in Sweden. The three leading engine operators in Sweden (Volvo Penta, Yanmar and Cummins MerCruiser) said already in 2007 that biodiesel should be avoided in boat engines. The engine will certainly run with biodiesel but there is a risk that the biodiesel will become rotten. A consequence of the rotten diesel is that the diesel becomes thicker and gets stuck in the engine. (Bengtsson 2007, 56-57.)

### 3 ELECTRICITY CONSUMPTION AND PRODUCTION IN BOATS

The need for energy depends on the boat. Small boats are mostly used for short journeys and no electric appliances are needed, while bigger motorboats and yachts used in longer journeys have several different electronic appliances installed. There are a great amount of electronic appliances for boats and they are all the time growing in numbers as well as in the consumption of energy.



**Figure 5.** Examples of electronic appliances used in boats. (Alanen 2010, 4.)

#### 3.1 Ecological energy sources

There are three different ecological energy solutions (solar panels, wind generators and wave energy) that this thesis is putting emphasis on. A brief introduction of the ecological energy solutions will be given as well as their possible weaknesses and strengths.

### **3.1.1 Solar panels**

As explained earlier, solar panels can be used when cruising, but the demand for power when starting the boat is not enough if energy from solar panels is obtained. Today there are several electronic appliances on the market such as lamps and refrigerators that are running when they are connected to solar panels. Solar panels can beside providing energy to electronic appliances also provide energy to the boat's battery. An interesting journey took place in 2007 when a catamaran crossed the Atlantic Ocean by only using solar energy as energy source (Alanen 2010, 15.)

The technology within solar panels has recently had a remarkable development. Solar panels can now be installed in various places and solar panels can even be installed in the sails. In the case with the catamaran that crossed the Atlantic Ocean, the solar panels were installed on the roof. (Alanen 2010, 15.)

It can be stated for the empirical part that there are a lot of potential places and possibilities for solar panels. However, a negative aspect of solar panels is the low amount of electricity they are able to produce. A 30 feet yacht needs for propulsion 24 square meters of solar panels which would cover the whole surface of the boat. Another negative side is the high price for solar panels. To purchase 24 square meters of panels it would depending on the solar panel cost approximately 17,000 euro. (Barrel, Kuronen 2010, 34.)

### **3.1.2 Wind generators**

The history of wind energy started in 1920s in Middle America. Farmers were not connected to the national grid so wind generators were a good solution for being provided with electricity. In 1970s during the oil crises, renewable energy sources such as wind generators started to develop. Today, wind energy is supplying 20 % of Denmark's energy needs. (Ampair 2006, 7.)

Ampair is a company that is specialized on producing wind generators both on land- and marine environment. Wind generators can be a supplement to solar panels and they can be used to charge the battery. According to Ampair the energy



a wind turbine is producing for one day is what a solar panel of equivalent cost is able to produce in one week. The negative aspect of wind generators is the moving parts that can cause damage if they get loose. (Ampair 2007.)

### **3.1.3 Wave energy**

There is an enormous amount of energy in waves. Wave energy is a newly discovered technology and the world's first commercial wave power array is yet to be developed. (Uppsala Universitet 2010.) Wave energy power plants will disturb fishing and maybe also disturb the breeding of sea creatures. (Sweden.se 2010.)

Wave energy has also been developed for boats. A boat called Suntory Mermaid is using wave energy as propulsion. Suntory Mermaid is a 9.5 meter long catamaran weighing 3 metric tons and has a top speed of 5 knots. (Alanen 2010, 19.)

### **3.1.4 Rotating propeller**

It is possible to receive energy from the propeller by keeping the propeller down in a certain angle when sailing. The energy the rotating propeller produces can charge the battery. The propeller is down in the water and because of that it slows down the boat's speed. (Haagensen, Kristensen, Inkinen 2010, 114.)

## **3.2 Case: Dragon One**

In Qingdao in China a yacht called Dragon One is being built that can produce all the energy it needs. The entrepreneur behind this project is Preben Kristensen from Denmark. The yacht has an electric engine that takes the power from a 24 volt battery that weighs 6.2 metric tons. The battery can be charged in five different ways. One way of obtaining energy is to leave the propeller open when sailing. The yacht is also equipped with two silent wind generators and 40 square meters of solar panels. In case the energy is not enough from the ecological sources, there are also two diesel generators that can produce energy. The yacht can also be charged by the grid. (Haagensen, Kristensen, Inkinen 2010, 112-113.)

One interesting solution developed for Dragon One is that a computer can calculate the amount of energy that is needed for ten hours of sailing. The computer calculates the angle of how open the propeller must be in the water for producing enough energy to the battery. The journey may last one hour more but the energy that has been produced is free of charge. Kristensen believes that when the environment awareness is increasing it means that the demand for similar boats like Dragon One also will increase. (Haagensen, Kristensen, Inkinen 2010, 112-114.)

### 3.3 Case: Greenline 33 Hybrid

The Greenline 33 Hybrid motorboat has been developed by three different companies. J&J Design developed the concept, the boat manufacturer Seaway built the prototype while VW marine developed the engine. The boat has a hybrid engine (diesel-electric) and solar panels installed on the roof. The top speed of the diesel engine is 15 knots while the top speed of the electric engine is 6 knots and the maximum range that can be driven with the electric engine is 25 nautical miles. (Greenline Hybrid 2010, 3, 8.)



**Figure 6.** Solar panels are installed on the roof



**Figure 7.** A view of different electronic appliances (TV, lamps and coffee maker) inside the Greenline 33 Hybrid

### **3.4 Case: Fantan Catamaran**

Fantan is an ecological and domestic catamaran produced in Inari in the north of Finland. The body of Fantan is ecological and the body only needs a fifth of power for the propulsion compared to a traditional body. In a near future Fantan aim to only provide electric engines and diesel-hybrid engines for their customers. The top speed for the electric engine will be around 15-16 knots. When driving twelve knots the battery will last for two hours and when driving eight knots the battery will last up to 4-4.5 hours.

Apart from environment-friendliness, the Fantan catamaran is providing convenience to its customers. When using an electric engine the catamaran will be odorless, smokeless and soundless.

Fantan have not any solar panels installed and that is motivated by the fact that the sun does not provide enough power in the northern parts of the world. The solar panels would not be efficient enough for providing power to the battery.



**Figure 8.** A view of the ecological body of the Fantan catamaran

## **4 BRAND MARKETING**

This topic deals with brand marketing when taking the Finnish boat industry and boat equipment companies into consideration. The Finnish boat manufacturers could increase their brands by using new ecological energy solutions.

### **4.1 Definition**

Marketing is defined as “a social and managerial process whereby individuals and groups obtain what they need and want through creating and exchanging products and value with others.” (Kotler, Armstrong 2004, 5.)

A brand is defined as “a name, term, sign, symbol, or design, or a combination of these, intended to identify the goods or services of one seller or group of sellers and to differentiate them from those of competitors.” (Kotler, Armstrong 2004, 285.)

### **4.2 Branding strategy: to build a strong brand**

Buyers find the brand as an important part of the product and a good brand will bring added value to the product. A brand can stand for different features such as quality. A brand can also give advantages for the seller when promoting the product. (Kotler, Armstrong 2004, 285-286.)

There are some analysts that state that a brand is a greater asset for a company than the company's products or facilities. The CEO of McDonald's believes strongly in the brand saying “A McDonald's board member who worked at Coca-Cola once talked to us about the value of our brand. He said if every asset we own, every building, and every piece of equipment were destroyed in a terrible natural disaster, we would be able to borrow all the money to replace it very quickly because of the value of our brand. And he's right. The brand is more valuable than the totality of all these assets.” (Kotler, Armstrong 2004, 291.)

Brand equity is defined as “the positive differential effect that knowing the brand name has on customer response to the product or service.” If a brand has high

brand equity it means that customers are willing to pay more for the brand. (Kotler, Armstrong 2004, 291-292.)

There are four major steps when building a strong brand which include brand positioning, brand name selection, brand sponsorship and brand development. Brand positioning means that the brand can focus on different positions such as the product's attributes, benefits or benefits and values. Brand name selection is about finding a suitable name for the brand because a good name or slogan can be essential to a product's success. Brand sponsorship is about different ways a brand name can be taken. Brand development is about different ways a brand name can be added to other products. (Kotler, Armstrong 2004, 292-297.)

Harley-Davidson's marketing is a good example of successful brand marketing. Harley-Davidson mailed a survey to 16,000 bikers to find out why they appreciated their Harleys. The cleaners and the CEO at a factory had both the same reasons why owning a Harley and the reasons are independence, freedom and power. Harley-Davidson's customers are not only buying good bikes but at the same time they are buying a lifestyle. (Kotler, Armstrong 2004, 177-178.)

According to a customer survey in the Helsinki International Boat Show 2010 it showed that potential boat customers have a positive attitude towards environment-friendly solutions. A business opportunity for the Finnish boat manufacturers could be to increase the brand by taking environment-friendly energy solutions into consideration.

## **5 EMPIRICAL PART**

The empirical part will seek answers to business opportunities for new ecological energy solutions. The empirical part is written from the boat industry's and boat equipment companies' views.

### **5.1 Introduction to the boat industry in Finland**

The boat industry has grown to a major player in Finland in the SME sector. The boat industry is facing challenges such as fast changes in production technologies and international markets but also challenges from countries (both close to Finland and in Far East) with cheap labor. Another thing that must be considered is changes in consumer behaviors when designing products and providing services. (Tekes 2010.)

The boat industry is very dependent on its export. More than 75 % of the sales in 2007 were being exported. Finnboat is an umbrella organization for the Finnish boat industry and trade and their members represent almost hundred percent of the turnover and sales. The turnover of the export in 2007 of Finnboat's members was 270.9 million euro and the total turnover when including sales in Finland was 433.2 million euro. The boats are mainly sold to (starts with the highest turnover): Norway, Sweden, United Kingdom, Italy, Russia, USA, Germany, Holland, Denmark, France, Japan, Estonia, Ukraine, Lithuania, Switzerland, Greenland, Ireland, Romania, Greece, Turkey, Antigua and Barbuda, and Azerbaijan. (Finnboat 2007, 28-29.)

The twelve biggest boat manufacturers in Finland were in 2008 responsible for 90 % of the whole boat industry's turnover.

**Table 1.** The twelve biggest boat manufacturers in Finland in 2008 (Vuorinen, Kurki 2010, 31.)

Company	Turnover (mill. €)	Location	Segment
Bella-Veneet	70	Kuopio	Large motorboats
Nautor	65	Pietarsaari	Large sailing-boat
Konekesko Marine	35- 65(estimation)	-	Large motorboats
Inhan Tehtaat	35 (estimation)	Ähtäri	Small motorboats
Finn-Marin	30	Kokkola, Kalajoki	Large motorboats
Botnia-Marin	30	Maalahti	Large motorboats
Baltic Yachts	25	Pietarsaari	Large sailing-boat
Nauticat Yachts	10	Riihikoski	Large sailing-boat
AMT-Veneet	10	Kontiolahti	Small motorboats
Sarins Båtar	9	Kokkola	Large motorboats
Terhi	7	Rymättylä	Small motorboats
Silver-Veneet	4	Ähtäri	Small motorboats

The three biggest Finnish brands (Buster, Yamarin and Silver) stand for 40 % of the sales in the domestic market. The amount of boats being sold in Finland in 2009 was all in all 4,568 boats and it means that the sales have gone down by 25.5 percent compared to 2008 when 6,134 boats were sold. (Vene 2010b, 16)

There are seven major challenges that the Finnish boat industry is facing today. First of all the boats are produced in low volumes. Secondly there is an undeveloped supply chain and undeveloped capabilities of the sub-suppliers. Thirdly the Finnish boat industry is moving into an assembly based production. The fourth challenge is to make cost efficient solutions to different customer demands. The fifth challenge is about high quality handicraft that is not seen as a competitive sales argument anymore. The sixth challenge is about increased international competition. The seventh challenge is the pressure on shortening the product lifecycle. (Hentinen, Westerholm 2009, 4.)



## **5.2 Research methodology**

The research project about new ecological energy solutions started in the beginning of February and the thesis is scheduled to be ready by 31th of May 2010. In February and March emphasis will be put on information seeking and to write about the theoretical framework.

The empirical work will be conducted by qualitative interviews with different employees and managers in the boat industry and boat equipment companies. All of the respondents have received an e-mail with the research questions attached at least one day before the interview. The interviews for the empirical research took place at the end of March and during April 2010. The interviews were recorded. The empirical part was time consuming since the interviewees were interviewed at their workplace. The aim was to visit about twenty respondents involved in the boat industry.

Other relevant and useful information about the latest trends of green energy solutions were obtained and observed by the teacher Ossi Koskinen and the student Pasi Hyyppä during Helsinki International Boat Show 15.2.2010-18.2.2010.

## **5.3 Validity and reliability**

Validity means how accurate and truthful a finding is. There are no statistical tests whether a finding is valid or not but the finding can be judged if it has been interpreted in a right way. When judging if a qualitative interview is valid the researcher should evaluate if all knowledge about a subject have been exposed and whether the source have been interpreted accurately. The validity is probably very high if the researcher is able to make own statements about the research, explain them to others and if the empirical research is corresponding with the theoretical part. (Lautamäki 2010.)

When investigating the reliability of a qualitative interview the researcher should evaluate whether the same results would have been obtained by different researchers and in different situations. A qualitative interview is not reliable if a

respondent only gives answers that the boss would appreciate. Validity and reliability is dependent on each other because if a research lacks reliability it will also lack validity. (Lautamäki 2010.)

## 6 ANALYSIS OF THE EMPIRICAL PART

### 6.1 The results

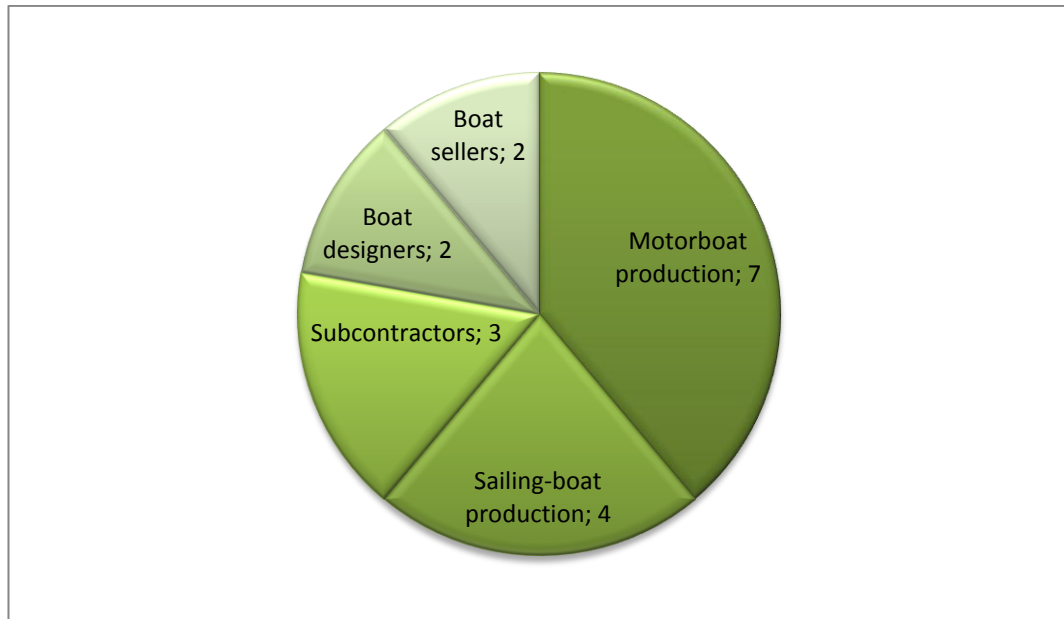
One important thing to notice is that the word *future* is defined to the respondents as 2-5 years in the future. The respondents did not speculate what will happen after five years.

Some of the respondents were not able to answer all of the questions and because of that the response rate is not 100 % for all questions. In some questions about motorboat production or sailing-boat production the opinions of the boat designers have been included since they are involved in the production.

The majority of the respondents indicated that the boats are mostly sold abroad. It was only one of the boat manufacturers that sold most of the boats to Finnish customers.

The global economic crisis that started in the financial sector in America hit the boat industry in Finland very hard. Many of the respondents said that their companies are still suffering from the economic breakdown but on the other hand it is assumed among the respondents that the sales will soon start to increase again.

In the table below it is shown that totally 18 people in the boat industry have been interviewed. The respondents are divided into five categories which are motorboat production, sailing-boat production, subcontractors, boat designers and boat sellers. This great division of players in the boat industry provides a more accurate result for the research. The respondents were randomly chosen and the only criterion was that the company should be located between Kokkola and Vaasa. There were more respondents involved in motorboat production compared to sailing-boat production and that is because one sailing-boat company cancelled the interview and there are more motorboat companies in this region.



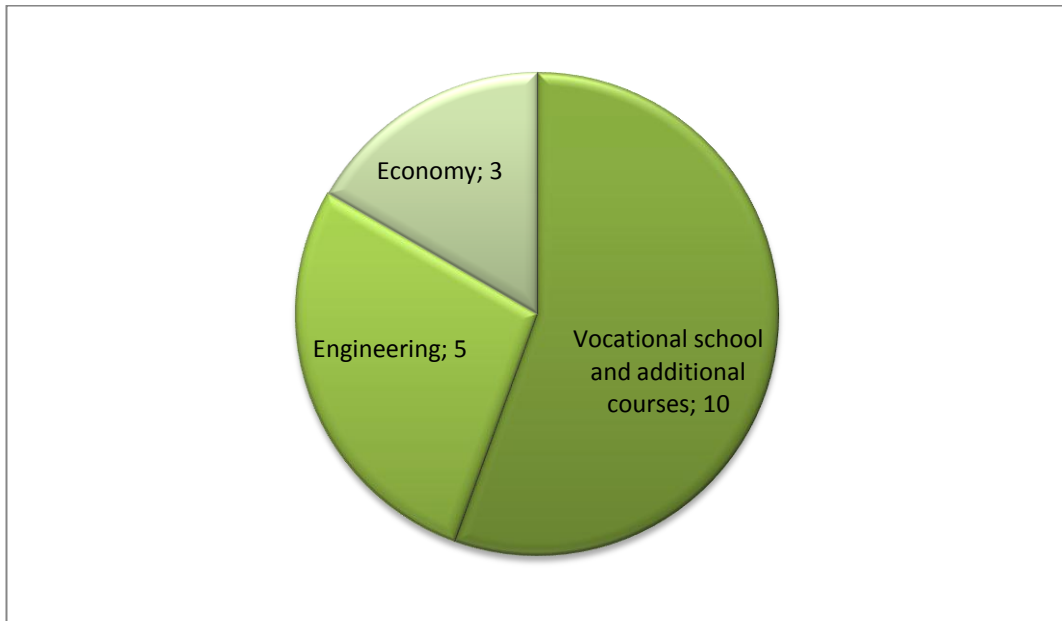
**Figure 9.** Division of the respondents

The aim when choosing the people for the interview was to interview product developers. In smaller companies usually the managing director or sales director was the most suitable person to be interviewed.



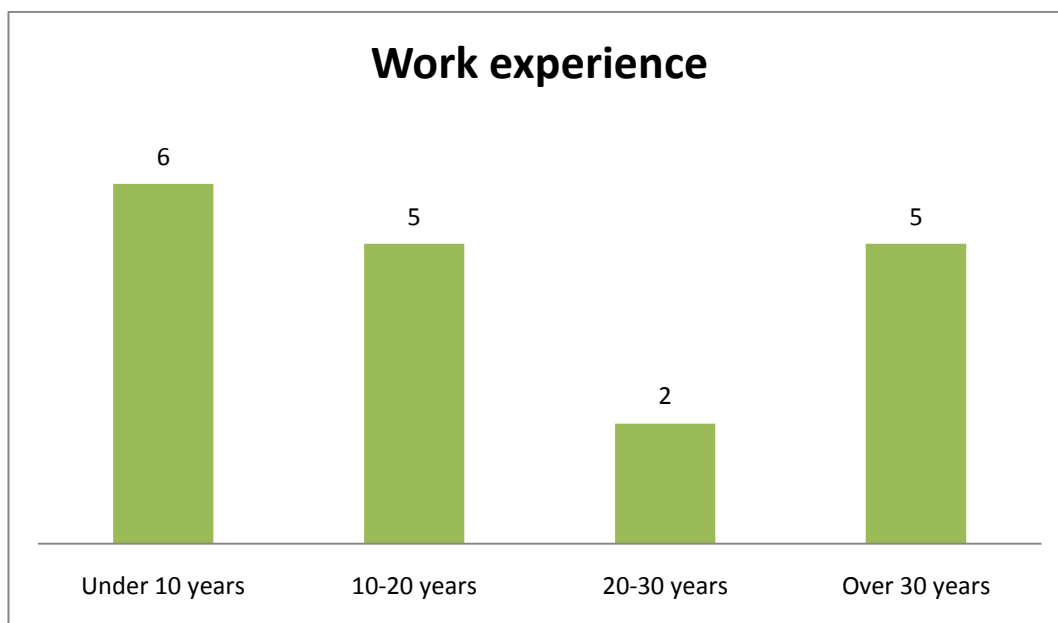
**Figure 10.** The job title among the respondents

The majority of the respondents started their careers in the boat industry straight after vocational school. Less than 50 % of the respondents possess a university degree.



**Figure 11.** The level of education among the respondents

Two thirds of the respondents have been working more than ten years in the boat industry. Five of the interviewees have worked more than thirty years in the boat industry while one third of the interviewees have less than ten years of work experience in the boat industry.



**Figure 12.** Years of work experience among the respondents

## 6.2 Awareness of ecological energy solutions

There are a lot of things to take into consideration when constructing boats. The respondents agreed upon the fact that green thinking is only a small part in the process of constructing a boat. The respondents also said that ecological energy solutions have recently been launched to the market and there is a great uncertainty about issues such as reliability and performance that the respondents would like to know more about.

The respondents were first asked if they have discussed ecological energy solutions or if they already have started to use them in their activities or in the product range. It can be stated that ecological energy solutions are discussed and almost half of the respondents have already been testing some.

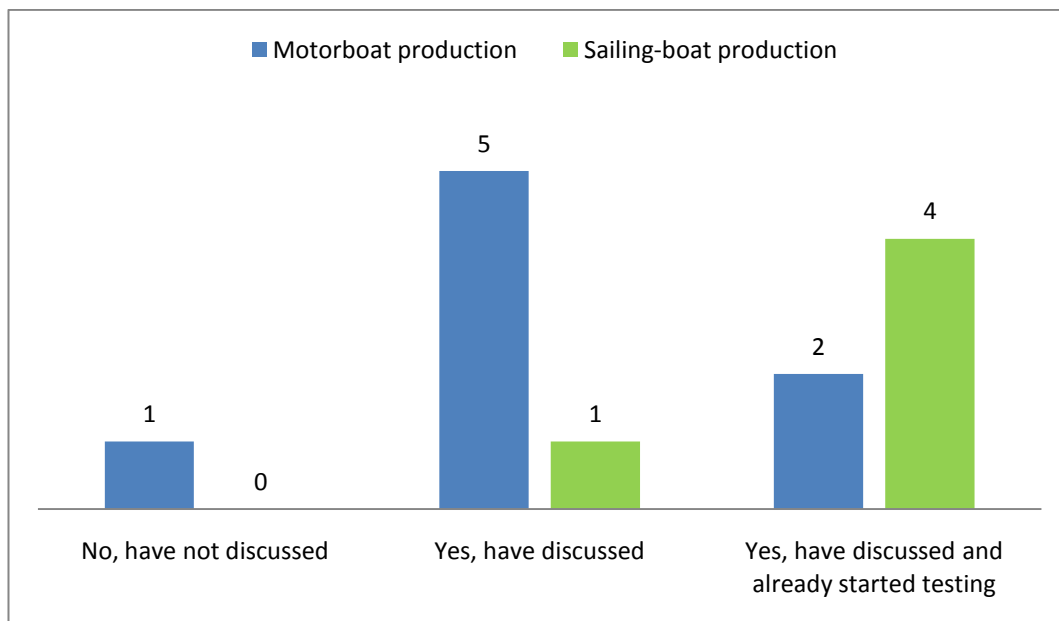
There is a slight difference in the results between motorboats and sailing-boats and it can be explained that the sailing-boat companies have more resources compared to many of the motorboat companies. The sailing-boat companies are interested in electric engines, hybrid engines and alternative sources of power such as solar panels or a rotating propeller while the motorboat companies are

focusing on appliances such as solar panels that can provide power to the battery when the motorboat is in the port.

Many of the smaller companies have told that they do not have the resources to develop and test ecological energy solutions and they rather observe the big players' moves in the field before they do something on their own. There is always a balance the boat companies have to consider when developing new products. Who would like to be first on the market? Are the new products reliable? Can failures in the products affect the brand? Are the customers interested in these issues? Are the customers willing to pay for these products?

The general opinion amongst the boat companies is that the demand of the customers controls the production. If the customers start demanding ecological energy solutions the companies are ready to put a lot of effort in developing more ecological boats.

The boat sellers have not noticed a demand for ecological energy solutions. The customers have put more emphasis on other issues when purchasing a boat. However, the boat sellers pointed out that through regulations the engines have become less pollutant. The subcontractors have not either been discussing ecological energy solutions. The subcontractors are to some extent able to develop the material on their products more environment-friendly.



**Figure 13.** Awareness about ecological energy solutions

### 6.3 The demand for ecological energy solutions

The respondents were asked if they believe that the customers in the future (2-5 years) expect installed ecological energy solutions in the boats. This question revealed a big difference among the respondents in motorboat production and sailing-boat production. The majority of the respondents involved in sailing-boat production said that the customers already today expect ecological energy solutions assembled in the boats and the demand from the customers is increasing all the time. The respondents also pointed out that a sailing-boat is already green even if ecological energy solutions are not installed in the sailing-boats. One of the respondents said that “the interest in a 100 % green sailing-boat without combustion engine has been high among visitors in exhibitions but so far the customers have not been ready to pay for the solutions but it is coming more and more.”

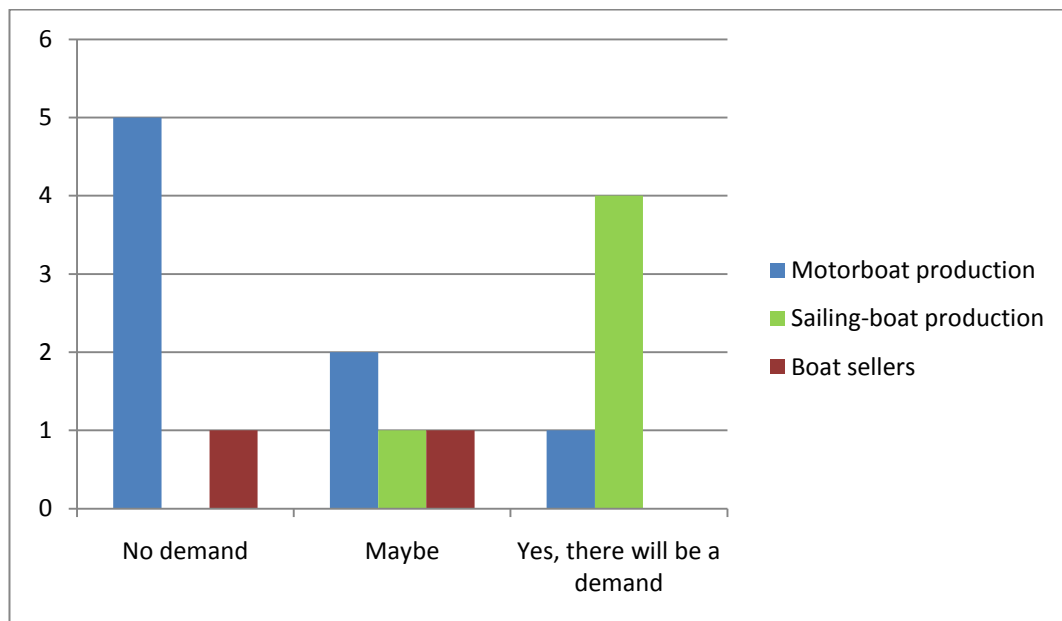
One of the respondents involved in the motorboat production believed that there will be motorboats on the market that will be launched as green motorboats but generally the respondents were quite skeptical that any reliable and cost-efficient product will be on the market within five years that the customers would require.



Many of the interviewees speculated that ecological energy solutions will not play a significant part when customers are making a purchase decision in nearby future. The only way for ecological energy solutions to boost in sales according to the respondents is by law regulations.

The subcontractors do not believe that their customers in the boat industry are expecting any kind of more environment-friendly products. Nor do they believe that ecological energy solutions can bring any new business to their companies. The respondents in the subcontracting category said that they cannot make their products more environment-friendly and that means that it is difficult for the boat industry to demand more environment-friendly products from the subcontractors.

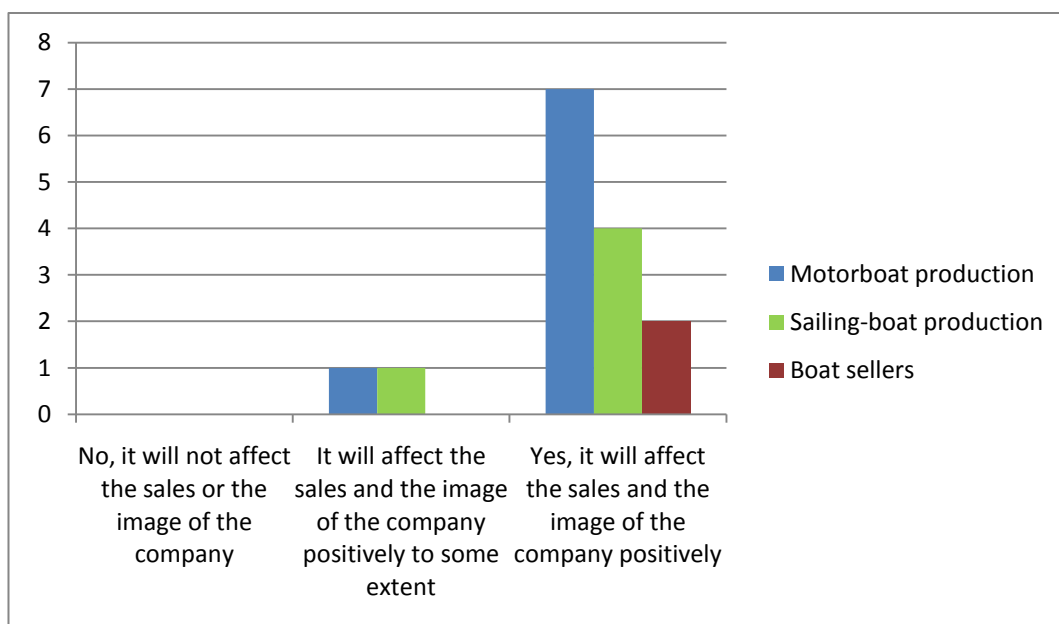
The boat sellers have not noticed any demand for ecological energy solutions among their customers.



**Figure 14.** The assumed demand for new ecological energy solutions within five years

The majority of the respondents believe that environment-friendly activities affect the sales and the image of the company in a positive way. Only two out of fifteen respondents answered that the sales and the image of the company will only affect the sales and the image of the company to some extent.

A general opinion among the respondents is that the designing of a body can provide business opportunities. The body can be designed to be more efficient while cruising and that would lead to smaller need of energy and fuel. If a boat is installed with an electric motor it is essential that energy is not wasted during propulsion.



**Figure 15.** How green marketing is affecting the sales and the image of the company

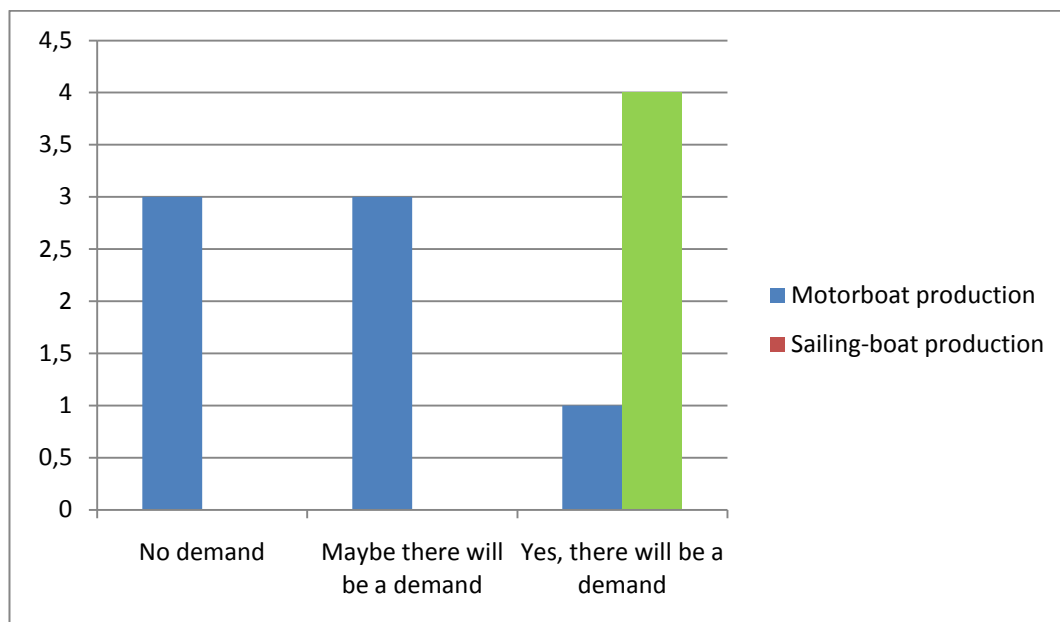
#### 6.4 Carbon dioxide (CO<sup>2</sup>) emissions

The respondents had many ideas how to reduce carbon dioxide emissions in the boat production but when it comes to developing a more eco-friendly boat the ideas were few. However, some of the respondents in motorboat production suggested by reducing the speed of the boats, smaller engines are needed and less carbon dioxide emission is polluting the environment.

#### 6.5 Electric engine and hybrid engine

When it comes to ecological energy solutions such as electric engines and hybrid engines there is a big difference between the respondents. All of the respondents in the sailing-boat production believe that they have to provide alternative

solutions to their customers. Most of the respondents in the motorboat production do not believe that they have to offer electric- or hybrid solutions to their customers within a period of five years. The solutions are said to be in the stage of development and they are still not enough reliable and cost-efficient.



**Figure 16.** The assumed demand for electric engines and hybrid engines

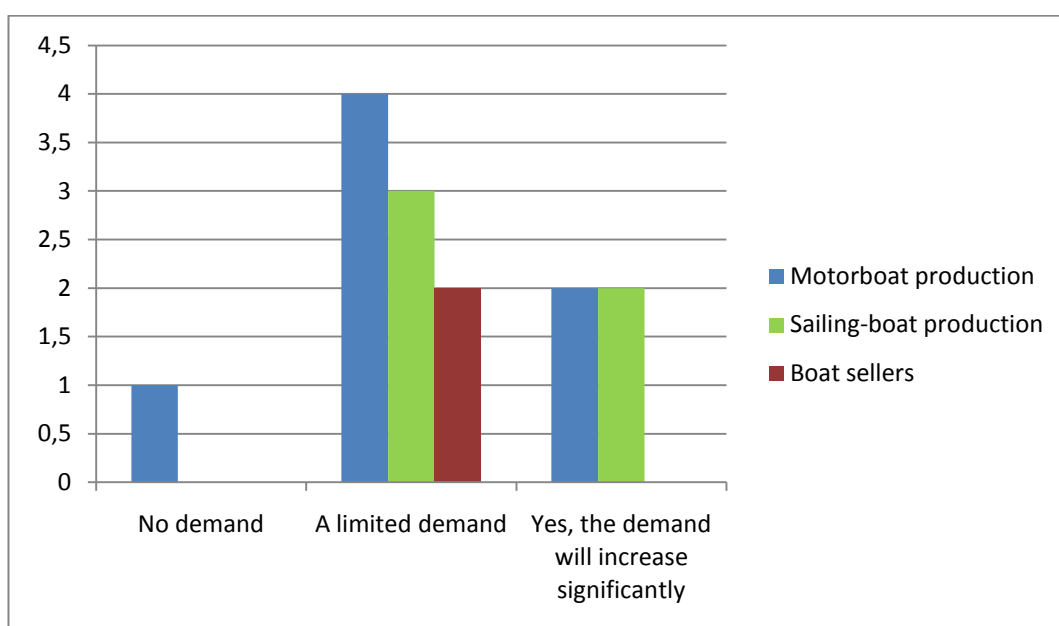
## 6.6 Solar panels, wind generators, lithium batteries and biodiesel

The opinions about solar panels and wind generators are quite divided among the respondents. All of the respondents involved in motorboat production believe that solar panels and wind generators will not be used as a source for propulsion. The respondents believed that solar panels and wind generators can be used in the port. When being at the port there is a demand to use the air condition and the refrigerator. The boat owners are not interested to start the engines in the ports and instead they can use solar panels and wind generators as alternative sources of energy.

The respondents involved in the sailing-boat production have a more positive attitude especially towards solar panels but the common opinion for solar panels is that they should be used as alternative energy source for the battery and not for propulsion. However, solar panels are said to not be enough efficient for

providing the battery with energy. Solar panels cannot be the only energy source in sailing-boats because in that case the sailing-boats will be out of electricity after cruising a short while.

The boat sellers do not believe that wind generators should be installed on the boats. When it comes to solar panels the boat sellers have only seen a small demand. In some boats solar panels have been installed for the air condition when the boat engine is switched off in the port. The main concern is that the solar panels are not able to produce enough energy to the battery.

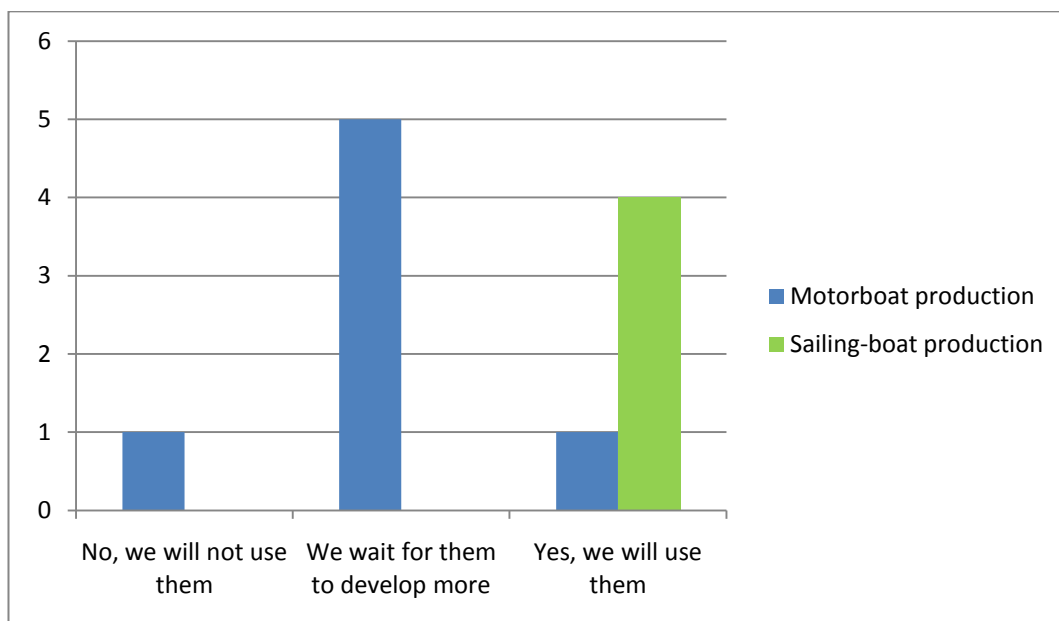


**Figure 17.** The demand for solar panels and wind generators

When it comes to lithium batteries there is a difference between the respondents in sailing-boat production and motorboat production. The respondents in sailing-boat production said that they already had used and tested them. The lithium batteries are said to have a very high efficiency and they are very light compared to the traditional lead batteries. The negative aspect and what prevents the usage of lithium batteries is the comparatively high price against other battery solutions.

The respondents in motorboat production are still waiting for the technology to develop more. The lithium batteries have not been reliable enough when being

tested in heavy conditions. The majority of the respondents also said that the usage of lithium batteries is dependent upon the price.

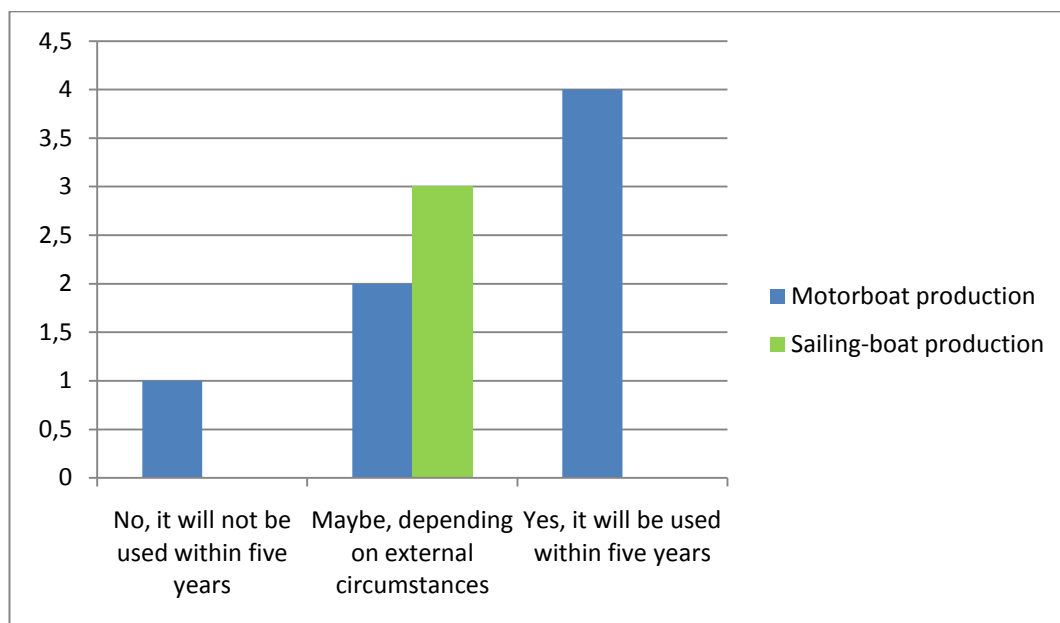


**Figure 18.** The demand for lithium batteries

None of the respondents in the sailing-boat production believes that environment-friendly biodiesel will definitely be used in boats within a period of five years. All of the respondents believe that the usage of biodiesel depends on external factors such as the accessibility. The biodiesel was also questioned whether it is more environment-friendly compared to fossil fuels. When looking at biodiesel in a global perspective, it can be stated that the production of biodiesel wastes a lot of energy.

The answers of the interviewees involved in motorboat production were quite scattered. Some believed that biodiesel will be on the Finnish market within five years while someone believed that it is not coming at all. Half of the respondents were questioning how the biodiesel affects the power of the engine because all of them had heard that the biodiesel reduces the speed of boats with some knots. The respondents also believed that external factors such as the accessibility of biodiesel, law regulations and pricing will affect the supply. One respondent did

also question if the biodiesel is more environment-friendly compared to fossil fuels.



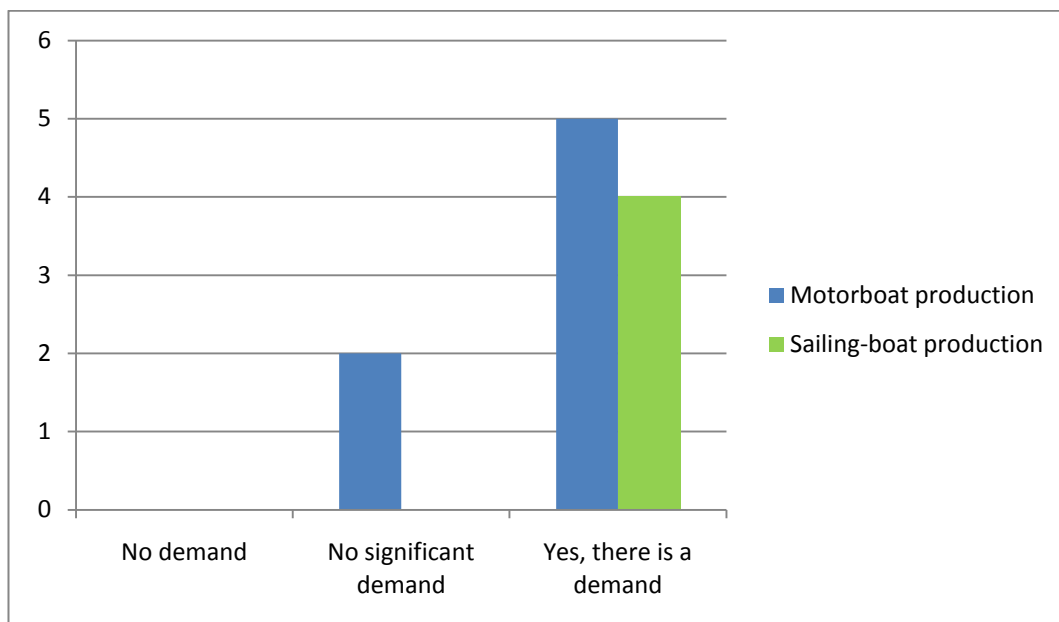
**Figure 19.** The demand for biodiesel

## 6.7 Software

It can be stated that there is a great demand for software that is able to control how much energy is being used at a certain time and that can show how much energy is left in the batteries. There is already software on the market that shows the amount of fuel a combustion engine is consuming. A software would increase the convenience since it would provide the captain with all necessary information. The software is especially popular for the respondents in the sailing-boat category since their companies already have started to develop sailing-boats with either an electric engine or a hybrid engine. It is essential when using an electric engine or a hybrid engine to know how much power is left in the batteries since it could lead to dangerous situations if the electric engine suddenly would be without power when cruising at the sea.

For the respondents in the motorboat category it can be stated that it is more interesting for motorboat manufacturers to have a software controlling the fuel consumption. The electric engine and hybrid engine is not yet a serious alternative

for manufacturers and that is why the need for a software is a bit different compared to the need in sailing-boats. Some of the respondents in the motorboat category indicated that the customers are probably not interested to pay more for getting the software.



**Figure 20.** The demand for a software controlling the energy consumption

## 6.8 Business opportunities for ecological energy solutions

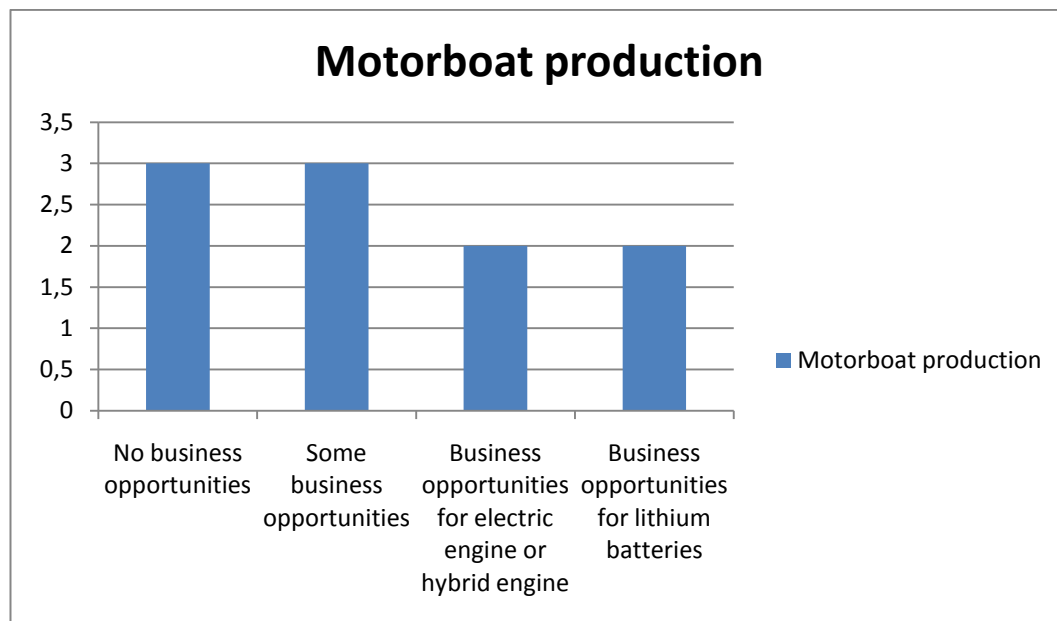
Even if the new ecological energy solutions have their disadvantages they are still assumed to provide new business opportunities for the boat industry. All of the respondents in the sailing-boat category believed that new ecological energy solutions would increase their business within five years. The combustion engine will not disappear within five years but the idea of a green boat is interesting among sailing-boat customers. All of the respondents in the sailing-boat category believed that the electric engine or the hybrid engine will be installed in more sailing-boats. There is especially a demand to use the electric engine when coming to a port or cruising close to the shore. There is no need for an electric engine when sailing on an ocean since the sailing-boat can use the wind energy as propulsion. However, it is not investigated how big market share new ecological energy solutions will have on the market. It is difficult to predict whether the

customers are interested in trying and paying for these new products. New ecological energy solutions will increase the convenience (less noise, less smoke, less fuel consumed etc.) when cruising and because of that the customers might be ready to pay for the products.

Another business opportunity for sailing-boats is to design the body in an efficient way. When a sailing-boat is having an economical design, the sailing-boat need less energy. *The main business opportunity* for sailing-boats will be to install an electric engine or a hybrid engine but other new ecological energy solutions should not because of that be forgotten. Solar panels, wind generators, a rotating propeller, lithium batteries and energy controlling software are all new energy solutions that the sailing-boat industry is aware of. The sailing-boat industry is also dependent on how fast the technology will advance for theses new ecological energy solutions.

When the respondents in the motorboat category were asked what kind of energy solutions will bring most business opportunities for them the answers were not many. Some of the respondents believe that within five years there will not be any new business opportunities at all for ecological energy solutions. Some of the respondents believe that within five years there might be a market for new ecological energy solutions depending on how the technology is progressing and the price level. Some few respondents believe that electric- or hybrid solutions might be an alternative that can bring more money to the company. Some few of the respondents also believe that lithium batteries could increase the business.





**Figure 21.** Assumed business opportunities for new ecological energy solutions for motorboats

Half of the respondents believe that the greatest business opportunity linked with the environment is to design an energy-saving body. A well designed body needs less fuel and reduces the exhaust emissions in the environment.

Even though the idea of green motorboats is not supported among the respondents in motorboat production, there are still business opportunities when it comes to green marketing and brand marketing. Some of the respondents said that including green issues in their marketing could boost their sales and their brand.

The boat sellers assumed that innovations such as combustion engines that are consuming less fuel could bring most business opportunity for them. New ecological energy solutions are not yet believed to provide new business opportunities. The boat sellers said that the customers' environment awareness has increased but still it has not financially lead to any boost in the sales.

### 6.9 Business opportunities for other trends

When it comes to finding other trends that can provide business opportunities for the Finnish boat industry it is difficult to find any correlation between the

answers. The boat industry has been turbulent since 2008 and the customers' buying habits have also changes. The trend in motorboat production in 2008 was to produce convenient and fast going boats but because of the economical crisis that trend has become to produce smaller boats. Three respondents in the motorboat category have noticed a small trend of producing displacement boats. It is difficult to predict if the trend with convenient and fast going motorboats will increase when the economy starts to grow again.

The technology for sailing-boats has been increasing all the time. Product developers for high-tech appliances could establish joint projects with the sailing-boat industry.

Another business opportunity could be to install led lights in the boats. Led lights consume comparatively little energy.

#### **6.10 Further research**

One of the subcontractors said that "it is possible to assemble solar panels on the material they are producing." The boat industry could start discussions with their subcontractors to investigate if they can do some joint projects.

It has been researched about Finnish boat customers' opinions towards new ecological energy solutions. Since the majority of the companies that were interviewed are exporting most of the boats it would be necessary to investigate how the boat customers in other countries are viewing new ecological energy solutions.

## 7 CONCLUSION

The boat industry has faced some serious challenges since 2008 because of the economical crisis. Boats are seen as a luxury product and it is usually those kinds of products that suffer most from downward economic trends. However, the boat industry has noticed the importance of producing boats according to the customer needs.

New ecological energy solutions such as solar panels or hybrid engines have developed and they are soon coming to play a key role for the boat industry. On the other hand the products that are available on the market today are not believed to be enough reliable and cost-efficient.

It needs to be taken into consideration that ecological energy solutions are only a small part of the whole package. New ecological energy solutions can on the other hand make the boat more convenient and be a competitive sales argument. The new ecological energy solutions are yet in a development stage and every company do not have the resources to develop something on their own. New ecological energy solutions are developing all the time and the boat companies must individually choose when they should start using green products. The big boat companies have more resources for product development and among those companies the development has already started. The companies must also choose when they are ready to launch the new ecological products on the boats. When a company sells the first hybrid engines they are also risking their brand if the products are not working properly.

*The biggest trend* in the sailing-boat industry for new ecological energy solutions is to construct sailing-boats with either electric- or hybrid engines. *The second trend* is to find suitable and reliable lithium batteries. *The third trend* is to install renewable energy sources such as solar panels or a rotating propeller that provide the battery with power.

The motorboat industry is still quite reserved towards new ecological energy solutions. However, *the biggest trend* for new ecological energy solutions is to

install solar panels that would provide energy to the battery when the boat is at the port. The motorboat owners would like to use the refrigerator or the air condition even when the boat is not cruising. Some companies have also looked at innovations such as hybrid engines but the companies are still waiting for the price to go down. The motorboat companies are also to some extent interested in lithium batteries but they are not yet believed to endure tough conditions.

The majority of the interviewees were very positive for having a software in the boats that displays the energy consumption. According to the interviewees there is no such software available on the market. The engineering company that develops a reliable and cost-efficient software, displaying the energy consumption would be successful.

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