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Analysis of the Potential for a Commodity Trader in the Bioethanol Market

By

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Abstract

The main objective of this thesis is to assess the current ethanol market and to try to identify whether there exists a decent fit between ethanol and Transammonia, which is a commodity trader, to consider adding it as a trading product. Ethanol is produced from raw materials that are also used for producing food; resulting in a negative relation with the Food Price. This negative relation causes critics and powerful public opinions that in turn shows very high involvement of governmental institutes. Nevertheless, many governments around the world have increased, or started, mandated ethanol volumes. By implementing such programs, countries become less dependent on fossil fuels. The new mandates are resulting in an increase of the worldwide ethanol trade which is currently mainly supplied by either Brazil or the United States. Due to this worldwide trade, many market players, varying from all different sizes, are active in the ethanol market. Understanding adjacent markets and other influencing factors are crucial for these players. Influencing factors, like the price of raw materials that are used to produce ethanol, show fairly high correlation ratios with the market price of ethanol. Also the influence of the weather and the political involvement is significant for the ethanol market price and must therefore be closely monitored by any company involved in trading ethanol.

For Transammonia, ethanol could provide a business opportunity and shows several interesting synergy opportunities with their existing products. Transammonia has a strong and extensive network in Europe and the United States and is therefore highly capable of combining fertilizer with ethanol trade in these regions. This trade is based on the backhaul principle and will reduce transport costs significantly. By combining UAN and ethanol trade between Europe and the United States, significant costs reductions occur. This fact and the proven expertise in trading a seaborne bulk commodity, results in high synergy effects and could finally result in higher profits. Nevertheless, Transammonia must keep in mind that there are a few barriers for trading this product. The main barriers that are applicable to Transammonia are the lack of knowledge in the product and the high involvement of governments, which can lead to uncertainty. However, if skilled and knowledgeable traders are attracted to Transammonia, ethanol could definitely be an interesting product for them to add to their portfolio.

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Chapter 1 Introduction

1.1 Problem Scope

Increasing concern about the long-term global oil supply, oil dependence and environmental impact of fossil fuels is stimulating the search for renewable fuel alternatives. Bio-fuels are such an alternative and they appear as bio-diesel and bioethanol and are both commonly used as, or blended with, conventional gasoline. Bioethanol has by far the largest share of this market. In Brazil for instance, the newer cars can drive on gasoline, biofuel blends or pure bioethanol. The use of bioethanol has a lot of advantages. The fact that ethanol is biodegradable and that ethanol emits lower greenhouse gases after combustion than conventional fuel, are the two most important advantages. The United States and Brazil are the largest bioethanol producers and consumers. On a smaller scale, the European Union has agreed to use blended fuel with at least 10% of ethanol ("Blended Fuel") in the near future. This percentage is part of an extensive alternative fuel program that stimulates the use of alternative fuels far beyond the year 2020.

The effort by several governments to reduce emissions and increase more sustainable transport solutions, will impact the demand for bioethanol on a worldwide scale. Therefore an enormous growth of the bioethanol market is projected. However, this growth of the bioethanol market could be limited by the world's food demand. Sugar cane, corn and grains that are used to produce ethanol are also used to feed the growing world population. This competition between ethanol and food production has been identified as a major problem by critics. This dilemma could be solved once an alternative bioethanol process technology, that uses plant waste, becomes commercially viable.

A thorough analysis of the ethanol market is required to assess its potential as a strong alternative for fossil fuel. Assuming that a sizable and mature market exists, it could be interesting for commodity traders to add ethanol to their trading portfolio. Therefore it needs to be determined whether this market fits the characteristics of such a company. The main requirements and entrance barriers of the bioethanol market need to be identified. This can be done by concentrating on the trade and transport aspects of the applicable areas.

1.2 Justification of Research

Since decades, governments and other institutes worldwide argue which energy source is capable of supplying the continuous increase of energy demand of the world economy. Fossil fuels as an energy source are put to the test due to their exhaustible mining fields and high emissions during combustion. Several attractive alternatives are already on the market but require subsidies or high investments to compete with the current products. One of these alternatives is bioethanol. The main objective of this study is to identify the future of bioethanol. The potential and main weaknesses of this product are identified by assessing the worldwide ethanol market. The main findings of this assessment will give a clear indication about the future of bioethanol. In the second part of this study a case study will be introduced. The case study will combine the results from the market assessment with the knowledge, business operations and in-house expertise of Transammonia. By looking at the possible synergy effects between ethanol and Transammonia, this study will give a clear insight in the potential benefits of ethanol. Therefore, this thesis will deliver a good understanding in the ethanol market and its potential fit with the rest of Transammonia's businesses. The results will also support future investments decision concerning trade, transport and warehouse capacity of bioethanol for Transammonia.

1.3 Research Question

In order to assess the current and future bioethanol market and to identify the potential fit of bioethanol for Transammonia, this study is structured in such a manner that it will answer a main research question and several sub-questions. The main research question is:

Is increasing demand for bioethanol in Europe affecting ethanol transport from the US and Brazil and is there potential for Transammonia to enter this market?

To support the main research question, 5 sub-questions will be answered in several chapters during the study. The important sub-questions are divided as follows:

1. What are the main possible future energy sources and what is the role of bioethanol with respect to growth expectations and trade volumes?

2. What are the main characteristics of the bioethanol market?

3. What are the main actors that influence the pricing of bioethanol and how relevant are the logistic and transaction costs in the value chain?

4. How can the business model of Transammonia be described and what are the strengths, weaknesses and possible threats?

5. What are the entry barriers, trade limitations or other requirements in the bioethanol market that may prevent Transammonia from entering this market?

1.4 Methodology

In order to conduct this research, multiple outlooks from well-known institutions and companies are used to estimate reasonable bioethanol trading volumes and the trading patterns. To get a thorough insight in the market, many ethanol analysts and chemical market specialists will be consulted. News articles, journals and other literature will be used to add strength to the foundation that this research is based on. The relation and the influence of external factors will be partially explained by applying Pearson's correlation theory. The strength and weaknesses that must be found in the case study are obtained by applying an adjusted version of Porters five forces model. This model will explain the market position of Transammonia.

1.5 Structure

The introduction of this study is given in chapter 1. It consists of the problem scope, research question, methodology and the structure. Chapter 2 of this study will give an extensive overview of the energy market as it can be seen today. Compressed natural gas, hydrogen, electricity and biofuels will be reviewed as possible alternatives for conventional fossil fuels. Besides the technical possibilities, the influence of governments will show that certain alternatives might have a higher chance of success than others.

Chapter 3 will completely focus on the worldwide bioethanol market. The chapter starts with a brief introduction and explains the product. Subsequently, the present ethanol trading patterns and volumes are shown. After that, the vessels and the applicable contracts which are used for transporting ethanol between continents, are described. Following the transportation part, the main ethanol production locations and the actual products that are traded are identified. A brief section is reserved to point out the ethanol blending issue, which is currently a big problem for Europe's ethanol import. Chapter 3 ends with showing the price volatility of ethanol. This volatility will be explained by introducing several external factors and describe how they are able to influence the ethanol price. These factors are several raw materials, weather and worldwide ethanol policies.

In chapter 4 the analysis from chapter 3 will be applied and a case study will be introduced. In this case study a commodity trading company, Transammonia, will be linked to ethanol. The objective of this case study is to identify the potentials of ethanol trading and the main barriers that will occur if Transammonia adds ethanol to its portfolio. In order to identify the benefits, the case study looks at synergy effects that are possible with vessel sharing on several ocean and inland waterway transportation legs. The case study will research if ethanol, UAN and sulphuric acid could be combined on several transportation legs. If so, chartering vessels on time charter bases might be beneficial. By combining these products, higher utilisation rates will be possible and benefits are created. The main barriers will be identified by comparing the properties of the ethanol market, which were identified in chapter 3, with the strengths and weaknesses of Transammonia. These strengths and weaknesses are obtained by using Porters five forces model. The thesis will end with chapter 5, which consists of a summary and conclusion. The conclusion gives a well substantiated recommendation whether or not ethanol could be a good business opportunity for Transammonia.

Chapter 2 The Alternative Energy Market

The petroleum era dominates the world economic activity. The world as we know it today has an ever increasing need of global energy. The use of petroleum and other liquids will possibly grow to 92 million barrels per day by the year 2020 and 110 million barrels per day by the year 2035 (EIA, 2010). This enormous need results in increasing costs of energy services and keeps putting pressure on the energy supply security. Besides the increasing demand of energy on one side, 5.6% growth last year, the other is concerned about climate change, air pollution and diminishing oil reserves. The current energy world faces enormous uncertainty. There exists a strong concern among policy makers regarding the high energy prices and volatility in these prices. This may cause price spikes and even may create a destabilizing effect on the economy. High volatility in crude oil prices could reduce oil competiveness and could create an incentive to adopt alternative energy sources (Vedenov *et al*., 2006)

Since the global economic crisis in 2008-2009, the market is re-establishing again but uncertainty stays. Analysts are scared of a second recession and full global economic recovery is currently ruled out (Berge & Jordà, 2010). The global economic development and recovery determines the prospect of the overall energy market for the short term but governmental power will determine the future of energy in the long term (IAE World Outlook 2010). It will be determined by the way governments will react on climate change at one side and energy security on the other. The battle between both policies is increasingly growing and political involvement keeps on pushing boundaries.

There are several policies and mandates that will have an impact on the future of energy supply. During the United Nations G-20 conference in Copenhagen, some important policies were dealt with. The first policy has set a non-binding objective on limiting the increase of global temperatures to two degrees Celsius above pre-industrial levels. This policy is struggling with a slow start but by putting additional effort in the policy, the required levels are reachable (Stern & Taylor, 2010). The second important policy includes a goal of mobilizing a fund between industrial countries for mitigating and adaption in developing countries of $100 billion per year by 2020. This initiative will increase the level of ambition and capacity of developing countries to be more concerned with climate change (Huhtala & Ambrosi, 2010). The overall but non-announced policies about reducing greenhouse gas emissions and plans to phase out fossil-fuel subsidiaries are increasing popularity. Still, these measures are non-binding and are dealt with in a cautious manner.

To be able to reduce emissions and be more aware of climate change, new energy solutions are required. These new solutions need to be renewable and sustainable at the same time, to act as a real option to replace current fossil fuels. There is a broad pallet of options that is able, or partially able, to supply the required energy levels. Possible energy sources that one day might substitute fossil fuels partially or even completely are nuclear power, compressed natural gas, energy from biomass, geothermal power, radiant energy, hydroelectricity, tidal en wave power, wind power and solar power. All of these alternative energy sources have there pros and their cons. Some might be in their early stage of development and others are already used on a significant scale. It will be the interaction between the industry, technological possibilities and the governmental policies that will determine the leading resource (Dresselhaus & Thomas, 2001).

The next part of this chapter will focus only on substitutes for current fossil fuels that can be used in cars, trucks, trains and buses. Energy alternatives, like nuclear fuel or solar power, require significantly more alterations in the present infrastructure to be fully operational and will be therefore be neglected as options. The four alternatives that will be mentioned in this research require only small and realistic adjustments. The current engines and the infrastructure require minor alterations before they could become operational. Besides that advantage, the present technology of the products that will be assessed is good enough, or almost good enough, to be directly competitive with the conventional energy sources. According to the European Commission (2005a), by introducing new technologies in transport the potential benefits are significant. If today's most advanced technologies were fully integrated, the EU could save 20% of its energy consumption compared to projections for 2020. These technologies operate with different energy sources. The real energy sources that can substitute gasoline and diesel are CNG (compressed natural gas), hydrogen, electricity and biodiesel. The next paragraph will explain briefly the potential, the advantages and disadvantages of the several products.

2.1 Compressed Natural Gas

The first substitute is called Compressed Natural Gas and is already being used in some countries. It basically consists of methane. This alternative is a fossil fuel but it emits much lower levels of greenhouse gases. It is therefore more environmentally friendly and acts as a clean alternative for private and commercial use in cars, trucks, buses and trains. Due to the increase of gasoline and diesel prices, CNG becomes more attractive for private and small commercial use. The exponential increase in natural gas vehicles keeps on increasing and because of the higher fuel price, it becomes more common for normal combustion engines to be altered into bi-fuel engines. These engines allow owners to switch between CNG and gasoline. The main advantages of CNG engines are cheaper fuel type, lower greenhouse gas emissions and CNG is more sustainable for the engine. The main disadvantages of CNG are higher fuel consumption, the fuel tanks requires a bigger and heavier tank than conventional gasoline or diesel, and the conversion to run on CNG requires a fairly high investment.

The main barrier of implementation of natural compressed gas has a financial character. The capital cost of a gas powered car exceeds the costs of the alternatives. Producers are not willing to take the risk to lower the costs per production by using mass production, since the required demand cannot be guaranteed (EEG, 2011). Besides this problem, the costs to alter the infrastructure and build CNG filling stations require a lot of investments. At the end, these investments need to be earned back and so the price will reflect these high investments.

2.2 Hydrogen

Hydrogen is the second option that might act as a substitute. Hydrogen is a universal energy carrier that must be derived from other fuel sources. This pathway can in principal be made CO_2 free because the CO_2 intensity depends on the energy mix for hydrogen production. Hydrogen can be derived from various fuel sources like natural gas, biomass, water, waste and solar power. Countries try to reduce their dependence on foreign fuel sources by deriving hydrogen from their own existing or new domestic and clean resources. It is also possible to use ‘green’ resources to produce electricity and by using electrolysis, hydrogen can be obtained. This option is therefore sustainable, renewable and due to zero emissions, its environmental friendly (Clark *et al.,* 2005). According to the European Commission (2005b) there are five main barriers that must be solved before hydrogen becomes interesting. The first hurdle that must be passed concerns the relative costs between conventional fuel and hydrogen. The production costs of hydrogen due to expensive equipment and the cost of the hydrogen itself must be decreased substantially. The second barrier involves the relative performance between a hydrogen powered vehicle and a conventional powered vehicle. The performance and infrastructure must be comparable or even better to become interesting at a higher cost. Thirdly, the same investment that creates a barrier with CNG has to do with the storage of hydrogen. An extensive network of refuelling stations and storage areas are paramount before hydrogen becomes a success. This network requires a lot of investment and therefore a certain demand must be guaranteed before the first initial investments will take place. The fourth barrier that must be dealt with in order to introduce hydrogen in transport requires low-cost renewables in electricity generating or in the case of high-performance fuel cells. The according prices for natural gas and biofuels must be low in order to succeed. The environmental legislation must be applicable on the whole world because local restrictions will not be able to open the market (Steenberghen & López, 2008). The policies that are applicable with hydrogen will set the future market prospect and act as the last barrier. The commitment of the industry depends heavily on the policies set by the government. Stakeholders will only invest in new technology if the future market prospect is clear. At this point, this is definitely not the case.

2.3 Electricity

The summary report of the High Hill Level Group for Hydrogen and Fuel Cells showed in June 2003 that hydrogen and fuel cells could become the sustainable energy system of the future. The first two advantages of electricity as a resource are that it is a universal energy carrier and it can be produced from all primary energy sources. It can be derived from nuclear power; geothermal power; hydroelectricity; tidal and wave power; wind power; and solar power. The third advantage is that the energy needed for electric vehicles can be covered by the existing generating system, with normal market build up (EEG, 2011). This means that there is no additional generating capacity needed for the expected vehicle fleet on the road for the next 15-20 years. Another advantage of electricity is that the production can in principal be made CO_2 free because the CO_2 intensity depends on the energy mix for electricity production. In that case, electricity can be sustainable, renewable and emission free.

The main barrier for electrical powered vehicles is battery life. The battery, which acts as the energy source, keeps on improving but cannot meet the performance of conventional engines. New battery types like high-temperature, nickel-metal hybride and lithium based batteries are capable of delivering a performance of 250 km. A second barrier for electrical power vehicles is that electric and hybrid vehicles still need support from public authorities to keep developing till the market reaches the size that it can develop naturally (Van Mierlo & Maggetto, 2007). This results in an unfair and skewed market.

2.4 Biofuels

A wide range of biomass can be used to produce biofuels. Currently there are two well-known and commercial dominant biofuels, called biodiesel and bioethanol. Biofuels are one of the most promising and important alternatives for gasoline and diesel because they can replace this petroleum based fuels in today's vehicles without alteration. Even though the benefits of biofuels are difficult to measure, the impact of these benefits is substantial (IAE, 2004). Biofuels have the potential to improve energy security, decrease greenhouse gas emissions, reduce pollution, improve vehicle performance and improve rural economic development. Since the concern about oil dependence and the reduction in greenhouse gas emissions are increasing, biofuels have become a high priority in many countries. Within the United States, the European Union and other developed countries around the world, biofuel policies are becoming popular. Mandated ethanol volumes, represents an important component of the total worldwide ethanol demand (Anderson & Cobe, 2010).

According to a study from the International Energy Agency (Haug, 2003), the costs of producing biofuels is much lower in countries and regions that are situated outside the US and EU. In Latin America for example, the cost of producing ethanol in Brazil is about half the cost compared with the production in a European country. Other low labour costs countries like China and India have begun producing biofuels in significant volumes after seeing the potential of the product (Coelho, 2005). Several barriers of biofuel implementation, in especially Europe, can be identified. First of all, there exists an uncertainty surrounding the feedstock availability. Secondly, the availability of information is mixed for investors in Europe. This is partially caused by the conflicts surrounding the benefits of biofuel. Hereinafter, there is not yet a common European standard for biofuels. This common standard is necessary in order to get the approval of liquid biofuels by engine manufacturers and the public (Steenberghen & López, 2008).

2.4.1 Biodiesel

Biodiesel is a chemical mixture that can be made from animal fat and vegetable oils. It can exist as a blend with conventional diesel or as a pure product. The main benefits of this product are that it is biodegradable and it improves air quality due to low sulfur, carbon monoxide, and hydrocarbon emissions. Besides these benefits, there are also economical benefits like the increase of domestic agricultural products to supply the vegetable oil or animal fat. Current research is done to produce biodiesel and jet fuel from marine biomass, or micro algae. Currently, this process is very expensive due to high energy consumption and low yield but it might become an interesting opportunity (EEG, 2011).

The current disadvantages of biodiesel are its high production costs; negative properties with respect to cold weather influences because the oil tends to mold; and biodiesel tend to create a power loss between 1-10% (Marchetti *et al.*, 2007).

2.4.2 Bioethanol

Bioethanol is produced from sugar-producing plants, mainly sugar cane and sugar beets, but can also be produced from starch-producing plants, like corn and wheat. Current ethanol production is mainly produced from sugarcane in Brazil and corn in the United States. There are two types of ethanol, named hydrous and anhydrous ethanol. Hydrous ethanol is used in beverages whereas anhydrous ethanol is used as a fuel type or as an additive in existing fuels. Anhydrous bioethanol, which does not consist of water, can act as a perfect blending component in gasoline or it can act as an additive called ETBE (Ethyl Tertiary Butyl Ether) in fuels. The main advantages of bioethanol is the high energy density; ethanol blends, up to 15%, are compatible with existing engines; and the distribution can be done via existing refuelling infrastructure (Lucon *et al.,* 2004).

The next chapter will go more in depth on anhydrous bioethanol and will focus on market prospects, trading patterns, market players, trade volumes and market prices.

2.5 Conclusion

To conclude this chapter, it can be said that there are several realistic options to substitute the current fossil fuels. The options that are discussed in this chapter all have their advantages and disadvantages. The main barrier for switching to a certain alternative is the high investment in infrastructure that is required to get the alternative operational. Some alternatives may be cleaner and may have more potential in the longer future than others. Nevertheless, this research will only focus on bioethanol as the real option to substitute conventional fuels in the near future. The main reasons for this focus can be found in the governmental support it receives and the easiness of implementation.

Chapter 3 Anhydrous Bioethanol

3.1 Introduction of Anhydrous Bioethanol

Traditionally Brazil has always been the market leader in producing ethanol due to the early ethanol stimulating programs. As mentioned in chapter 2, ethanol can be distinguished in fuel ethanol and potable ethanol. The main importer of fuel and potable ethanol was the United States. In the last couple of years things have changed dramatically. The United States have increased their production of domestic fuel ethanol, or anhydrous ethanol. The main reasons for this increase can be found in the extreme currency fluctuations and the historic level of the sugar price. Due to this increase, the balance in worldwide supply and demand has changed. Last year, this change has led to a switch in the ethanol trade. The United States has swung from a net importer of anhydrous ethanol to a net exporter of anhydrous ethanol. Even the number one ethanol producer Brazil is importing anhydrous ethanol from the United States (Jessen, 2011). Although there was a switch, Brazil remains market leader in the ethanol market.

Bioethanol is a form of renewable energy and is made from plant matter and residues (Demirbas, 2006). The plant matter and residues can come from agricultural crops, like grain, maize, sugar cane, sugar beets and other sorts of fruit with a high fructose level (Acharya, 2008). As mentioned in the previous chapter, there are two types of bioethanol named hydrous ethanol and anhydrous ethanol. The hydrous ethanol, undenatured, is potable ethanol and is mainly used in spirits, liquors and other beverages. The hydrous ethanol volumes that are being traded worldwide are just a fraction of the total ethanol that is globally traded. Anhydrous ethanol, denatured, is responsible for the main part of the ethanol volume. Anhydrous ethanol refers to the ethanol with extremely low water content. Due to this low water content, anhydrous ethanol is very useful as an alternative fuel or as a fuel additive in conventional fuels, the so-called ETBE. This research focuses mainly on the anhydrous ethanol since it is responsible for the major part of the ethanol trade. Therefore, ethanol in this research is assumed to be anhydrous ethanol or bio fuel ethanol.

At this point, bioethanol is only capable of competing with conventional fuels due to high subsidiaries. Governments all over the world believe that anhydrous ethanol is the realistic option that will act as the alternative for the conventional fossil fuels in the near future. Therefore many governments stimulate the use of ethanol. Governments use several policies to make ethanol an attractive alternative. The policies that are used are taxation-based policies, agricultural-based policies, subsidies and fuel mandates (Smith, 2008). The European Union has set a policy that implies that before 2020, 10% of the transport sector must run on renewable energy (European Commission, 2010). This policy will have a tremendous impact on the demand of ethanol that is coming from Europe (Pelkmans *et al.*, 2010). Due to the increasing demand of bioethanol, the ethanol sector will change substantially. The demand, that will increase rapidly, must be supplied by Brazil and the United States.

The potential and advantages of ethanol are well known in Brazil. Brazil is one of the biggest bioethanol producers. More than 30% of the world fuel ethanol production in 2010 came from Brazil (F.O. Licht, 2011). The domestic consumption and adaption to ethanol is unheard of. Today more than 80% of Brazil’s current car-production has flexible-fuel capability and almost all gas stations offer a 25% ethanol/gasoline blend (Balat & Balat, 2009). Next to Brazil, the United States was responsible for nearly 57% of the worldwide fuel ethanol production (F.O. Licht, 2011). While Brazil is using sugar cane and sugar beets, the US is using corn, wheat and grain as the base raw material for producing the ethanol. The bioethanol demand in Europe is rising due to governmental influences, but production is relatively low, compared with Brazil and the United States. Europe was responsible for 5% of total world fuel ethanol production. The intra Europe trade is expanding and shows a lot of potential but the current stimulating program from Europe, and its current production, is far from big enough to cope with the predicted demand. Imports from Brazil and the United States are necessary to supply the future demand (Balat & Balat, 2009).

3.2 Trading Patterns

According to the fixing reports from various brokers, SUCDEN's (2010) internal report and F.O. Licht's report (2011), there are several main trading routes for ethanol which can be identified. The main trading routes are displayed in Illustration 1 and the main countries that are involved are summed up in Table 1.

Illustration 1

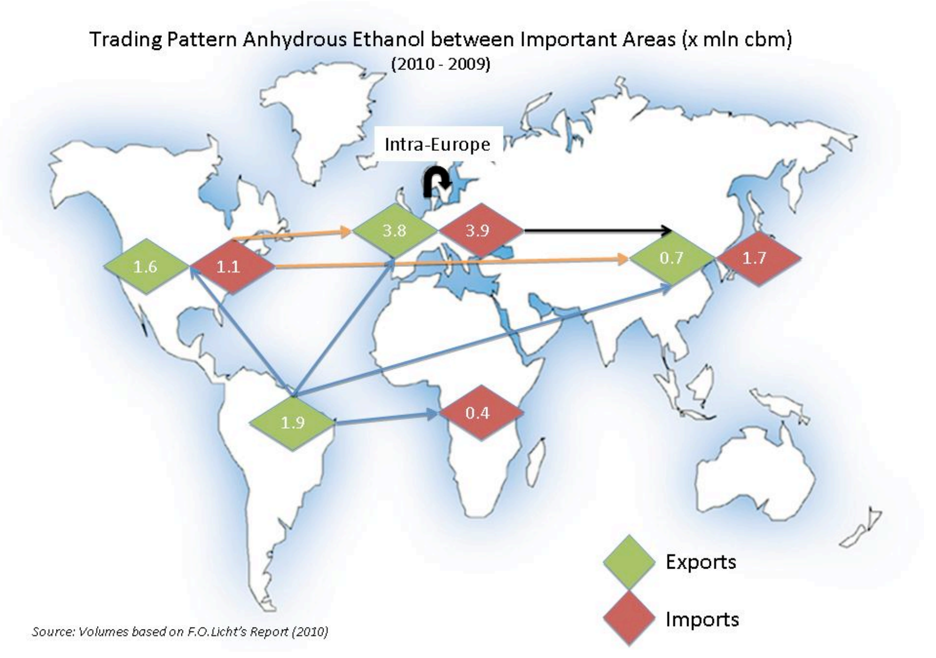

Table 1

Main Ethanol Trading Routes			
Port of Departure	**Geographical Area**	**Port of Destination**	**Geographical Area**
Brazil	South America	Arabian Gulf	Middle East
Brazil	South America	Japan	Asia
Brazil	South America	South Africa	Africa
Brazil	South America	The Netherlands	Europe
Brazil	South America	The United States/Canada	North America
The Netherlands	Europe	Japan	Asia
The United States	North America	Arabian Gulf	Middle East
The United States	North America	Brazil	South America
The United States	North America	Japan	Asia
The United States	North America	The Netherlands	Europe

Source: F.O. Licht (2010)

Historically the main trunk routes of ethanol are located between the United States and Europe and between Europe and Brazil. Due to governmental pressure and incentives from 'green' institutes, the consumption of ethanol keeps increasing. This increase is resulting in a more global ethanol market. Looking at the latest figures that are published by analysts, the Arabian Gulf area and the Asian market are increasing their demand for ethanol. Part of this is being served by their increasing domestic production, China for example, but the biggest chunk of the demand needs to come from either the United States or Brazil. Europe has always been one of the biggest importers of ethanol and according to analysts from SUCDEN, they will keep this position in the near future. An important development in Europe comes from countries that are located in the western part of the European continent. The ethanol production in France, Germany and the Netherlands keeps on rising to meet part of the European demand. The production has been increased to be less dependent on Brazilian and US ethanol. Against the trend from the last couple of years, the total production in these countries went down (F.O. Licht, 2011). According to analysts, the high sugar price in the beginning of 2011 is responsible for this decrease.

The volumes that are traded between the United States and Europe are increasing due to the high sugar price. Mainly corn-based ethanol coming from the US is increasing market share and is much cheaper than the ethanol supplied from Brazil. Next to the pure ethanol trade between the two continents, the route between the United States and Europe carries a lot of E90 and E95. This ethanol gasoline blend pays only a 6.5% duty and is increasing market share. This way of disguising the real product is allowed because this blend does not have its own product code yet. According to an analyst at Dropet[1], this blend has killed the domestic ethanol market in Europe almost completely. Europe is currently working on a special product code to solve this problem. For European countries it is really important to fix this problem since Europe loses a lot of tax income and domestic ethanol production is hurt due to this loophole. Once this product code is approved by the European Union, this blend will probably disappear. After the code will be applicable, there is no gain by importing a blend since blending costs money and does not generate any benefits in the form of tax incentives anymore. In paragraph 3.7.1, this blending issue will be further explained.

The route between Brazil and Europe is also a major ethanol trunk route. An important part of Europe's ethanol imports are coming from Brazil. According to fixing reports from several brokers, the main part of these shipments is shipped through the port of Rotterdam. From Rotterdam the ethanol is either processed or directly distributed to supply Europe's demand.

Ethanol volumes that are transported from Brazil, the United States or Europe to the Asian continent are increasing. Ethanol consumption has increased in the last decades in the Asian continent. Countries like China, Japan, Indonesia, Philippines and South Korea are showing more concern in environmental issues. Mandates across several countries in Asia are creating new demand for foreign ethanol and also for domestic ethanol. The increase of domestic production, to cover this new demand, is considered by a lot of Asian countries. China is already developing new production plants to produce domestic ethanol. For other countries like Japan, it is really hard to become a large scale ethanol producer. The reason lies in the high opportunity costs of farmland and the high farm prices for potential feedstock

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[1] *Dropet is an independent online platform where users can exchange positions of fuel and industrial grade alcohol around the globe. Dropet facilitates global trade of ethanol by providing key players channels to communicate and exchange information.* http://www.dropet.com/home.php

in Japan (Steenblik, 2007). Japan is constrained by these factors and is forced to import ethanol from Brazil or the United States. In the future, China and the European region could supply Japan's demand (FAPRI, 2010a).

The route between the US and Brazil has always been from the south to the north. Brazil has always been the main worldwide producer and exporter of ethanol. The ethanol that is produced in Brazil is based on sugar cane or sugar beets and these raw materials are much cheaper to grow than the raw materials that are used in the United States for the ethanol process. Therefore the production of ethanol in Brazil is much cheaper than the production in the United States. This trade has always been a difficult route because the US government tries to protect domestic production. US government sets the tariff on ethanol on a level that it becomes impossible to compete with domestic ethanol. Currently trade organizations are trying to mitigate this tariff or get rid of the complete protection plan. There has always been a nice small market that runs on EPA (Environmental Protection Agency) certificated ethanol from Brazil. This EPA ethanol gives credit on carbon accounts of companies, so sometimes it makes sense for companies in the United States to pay a higher price and import the EPA ethanol from Brazil.

In the last year things have changed dramatically. The trade between the United States and Brazil has shifted to a north to south trade. This trading route is something that has never been seen before. The reason for this lies in the high price for sugar. Currently the sugar market has changed dramatically. According to Bloomberg[2], the prices in the beginning of 2009 were around the $14 per lb of raw sugar. Nowadays, a lb of raw sugar sells for nearly $26. This is an increase of almost 85% in 2 years. While the sugar price is sky high, Brazil's domestic demand of ethanol is growing while the production of ethanol is falling. Production of ethanol is falling because it becomes more interesting for sugar mills to sell the sugar instead of using the sugar to produce ethanol since the ethanol becomes too expensive. Due to this situation, Brazil is importing ethanol in some periods, especially during inter-harvest periods. During the inter-harvest, supply is very low anddemand remains the same, resulting in an ever bigger imbalance between supply and demand (Farinelli *et al.*, 2008).

A special trade route that is worth mentioning, according to a Steensland[3] analyst, is the route between Brazil and the United States via dehydration plants in the Caribbean. The US government has put high tariffs on foreign ethanol to protect their own domestic ethanol production. Due to these high tariffs on foreign ethanol, US ethanol importers have created a loophole to avoid this tariff. A part of the Brazilian ethanol is imported into the Caribbean, such as Jamaica, El Salvador or Trinidad-Tobago. These countries are part of the Caribbean Basin Initiative trade agreement or CBI[4]. This trade agreement allows importing goods from these countries into the United States without paying any duties. The ethanol that is imported

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[2] *Bloomberg is a major global provider of 24-hour financial information. The Bloomberg terminal can be used to monitor and analyze real-time and historical financial data. The system provides i.e. financial news, price quotes, analyst coverage and facilitates the placement of trades. http://www.bloomberg.com*

[3] *Inge Steensland is a specialized gas, chemical and products ship broker. Services comprise chartering, S&P, post fixture and research. http://www.steensland.com/*

[4] *Caribbean Basin Initiative is intended to facilitate the economic development and export diversification of the Caribbean Basin economies. The CBI provides beneficiary countries with duty-free access to the US. Market for most goods. http://www.ustr.gov/trade-topics/trade-development/preference-programs/caribbean-basin-initiative-cbi*

into the Caribbean enters as hydrous ethanol. Once arrived in the Caribbean, the hydrous ethanol is transported to dehydration plants. After the hydrous ethanol is processed into anhydrous ethanol, it is being imported into the US. Due to the CBI agreement, the Brazilian anhydrous ethanol is now free of duty.

3.3 Traded Volumes

It is extremely difficult to identify the real ethanol trade volumes that are shipped to the European continent. Even the well-known institutes that keep track of the trade volumes mention that there exists a high rate of inaccuracy on the numbers that they provide (F.O. Licht, 2011; SUCDEN, 2010; FAPRI, 2010a). Due to this inaccuracy, the published numbers from the institutes differ a lot. The main reason for this inaccuracy is the increase of blended ethanol, which is mainly imported by the European Union. F.O. Licht estimates that the total blended volume, or E90, is around the 700 million litres per year. This rough estimate is also being confirmed by an analyst from SUCDEN but it still remains an estimate. By blending the ethanol with gasoline, higher taxes can be avoided. Due to this blending, analysts are unable to identify accurate numbers of imported ethanol. To deal with this inevitable inaccuracy, this research will make statements based on published reports with a possible inaccuracy from all specialised institutes that assess the ethanol market on a daily bas.

2008-2010

A significant part of the domestic ethanol in Brazil and the United States is destined to meet their domestic demand. Nevertheless, a major part of total word ethanol production is being shipped to foreign countries. According to the F.O. Licht report (2011) the total world export of ethanol went down from 11.3 billion litres in 2008 to 9 billion litres in 2010. This was the result due to low export numbers in Brazil. Brazilian export numbers went from 5.1 billion litres in 2008 to 1.9 billion litres in 2010. This negative effect was mitigated by the increase of export in Europe. Europe went from 2.8 billion litres in 2008 to 3.9 billion litres in 2010.

As for the ethanol imports, a similar situation occurred. The total world import of ethanol went down from 10.2 billion litres in 2008 to 7.9 billion litres in 2010. This time, the decrease was mainly caused by the United States. US imports went from 2.2 billion litres in 2008 to 500 million litres in 2010. This negative effect was mitigated a little due to the import increase in Germany and the Asia/Pacific region. German imports went from 800 million litres in 2008 to 1.3 billion litres in 2010. The Asia/Pacific region went from 1.2 billion litres in 2008 to 1.7 billion litres in 2010.

2010-future

The future prospects of the ethanol demand are very hopeful. Analysts expect a continuous growth in the next 10 years. This growth is mainly caused by the mandates that are active in several countries. The European Union, the United States, Brazil and also China have implemented mandates and other biofuel stimulating policies. Besides these mandates, the continuous increase of the oil price also stimulates consumers to switch from conventional fossil fuels to alternative fuels, like ethanol. According to Demirbas (2007), these mandates and policies will result in a worldwide ethanol demand that will exceed 125 billion litres by the year 2020. This means a growth of almost 50% of the current worldwide ethanol demand. An increase of 50% in ethanol demand results also in a significant increase of import and export volumes.

Due to this extensive increase in future ethanol demand, an ethanol deficit may occur. According to Hart (2011), a potential deficit of worldwide ethanol is expected. Hart expects a deficit of almost 19 billion litres, which only can be supplied by Brazil. Expectations show that Brazil can account for more than 13 billion litres of this future deficit. The rest of the countries will have to supply the rest of the potential deficit together. Individually, there is no country like Brazil that comes even close to supplying the 13 billion according to Hart's analysis (2011).

3.4 Transportation of Ethanol

Ethanol is an IBC Code Chapter 18[5] product which means that, by regulations, one does not need a chemical tanker with IMO (International Maritime Organization) capacity to move ethanol. However in practice, according to Steensland and Transammonia, a chemical vessel is used. In fact, sophisticated chemical vessels are used and the majority of the volumes from Brazil are moved on young and fully or partial stainless steel vessels. According to the Transammonia chartering department and several fixing reports, 90% of the ethanol is being transported by chemical tankers or CPP (Clean Petroleum Product) tankers. The chemical tankers can have a capacity up to 50 segregated or individual tanks. Chemical tankers are specially equipped to control each of the individual tank environments within the hull of the tanker. This feature is required since there are products that need to keep heated or warm, while other products need to be kept on extremely low temperatures to maintain their quality. Complicated vessels, like chemical tankers, are expensive to charter but are paramount to transport products which require special treatment during the voyage. Ethanol can also be transported by CPP tankers. CPP tankers are less complicated and therefore cheaper to charter.

According to the fixing reports, the average size of an ethanol load varies between 5,000 and 50,000 cbm (cubic meters). Due to economies of scale and the increase of future demand, Transammonia analysts think that these volumes will increase in the near future. Depending on the route and the cargo size, the current tankers that are moving these cargoes vary between 100 and 200 meters in length and have a deadweight tonnage between 5,000 and 50,000 MT.

The tanks inside the chemical vessels need a special coating to protect both the product and the vessel. Many products that are being shipped are aggressive and could be capable of dissolving normal steel. The coatings that are used vary between pure stainless steel, zinc based coatings or epoxy based coatings. Stainless steel coatings are easy to clean and cheap but are not strong enough to carry all chemicals. The zinc based coating is very strong and is therefore applied in many tanks. The main disadvantage of zinc based coatings is the cleaning procedure. It takes at least a couple of days to clean a zinc based tanker. The epoxy based coatings are cheap and easy to clean but if an aggressive product stays to long in the tank, it might eat away a part of the coating. This will result in a polluted product and damage to the tank. Epoxy based coatings are only used for short distance voyages or for trips with non aggressive products. Ethanol is mainly transported by tankers with either a zinc based coating, epoxy based coating or a combination of the two.

The tank history of a vessel is very important for all parties involved, especially the charter department. According to regulations, contracts clauses and laws, special requirements must be met to transport 'clean' products. Potable products or hydrous ethanol for example, is only allowed in tanks that have a tank history with at least 1 up to 3 cargoes that are listed on the FOSFA (Federation of Oils, Seeds and Fats Associations) list of acceptable previous cargoes (2008). This tank history is not only required for potable products, also other

[5] IBC Code Chapter 18 contains products which have been evaluated and found not to present significant safety or pollution hazards. Three bands are identified for blends.(1) 75% or more petroleum oil and are subjected to Annex I of MARPOL; (2) more than 1% but less than 75% petroleum oil and are subjected to Annex II of MARPOL; (3) 1% or less petroleum oil and product is carried as Annex II cargo. http://www.ipta.org.uk/biofuel_blends.htm

chemical products require clean tanks. Clean tanks are required to avoid old cargoes polluting new products that are stored in the tanks. According to Steensland, it is not common for anhydrous ethanol, or fuel ethanol, that the previous cargo requires listing in the FOSFA list. The history requirements are written in the contract and the vetting companies make sure that the data is up to standard.

As briefly mentioned, cleaning of the tanks before loading new products into the tanks is crucial. Every fixing report contains a pre-wash and a cleaning clause. These clauses inform the ship owner what is required to transport the cargo. By doing all sorts of tests in every tank of the vessel, the level of safety is being measured. This can be done by special agents but many big oil companies have their own vetting companies. These vetting companies have their own regulations and are concerned about the health of the vessel. Vetting companies will check all parameters and requirements set by the company. If the vessel does not comply with the rules that are set in the contract, the vessel is not allowed to load or discharge the cargo. Normal cleaning procedures can take 2 days or up to more than a week. This depends on the type of coating that is used and the type of cargo that was transported.

The price of transporting a certain amount of ethanol depends on the freight market. The freight market works just like any other market with supply and demand. According to Transammonia, ethanol is a fairly easy product to carry and many tankers can be used to ship the cargo. Also the total amount that is transported is small compared with other liquid cargoes. Due to the flexibility of the vessel options and the small amounts of cargo, the supply side is rather high. The current demand to ship ethanol is increasing, but the supply is still higher than the demand. This leads to reasonable freight rates.

Table 2

Ethanol Freight Rates (29-06-2011)

Departure	Arrival	Volume (cbm)	Rates ($/cbm)	Trend
USAC	ARA	10,000	Hi 40 - Low 50's	weaker
USG	ARA	10,000	Low 50's	weaker
USG	MPFE	10,000	Low 50's	steady/weaker
USG	N.Brazil	10,000	Hi 50's	steady
USAC	MPFE	10,000	Mid/Hi 70's	steady
USAC	Caribs	10,000	Mid/Hi 40's	steady
USAC	Brazil	10,000	Low 60's	steady
Brazil	EC Mex	10,000	Mid/High 50's	steady/firmer
Brazil	USAC/USG	15,000	Hi 40's - Low 50's	steady
Brazil	Feast	15,000	Low 80's	steady
Brazil	AG	15,000	Mid/High 70's	steady

Source: Clarksons (2011)

The actual costs to transport ethanol from port of departure to the port destination are influenced by many factors. The trading route is very import. In Table 2[6] the ethanol freight

[6] *The abbreviations that are used in the table are explained in the Appendix*

rates that were applicable in the last week of June 2011 are summarized. These prices have an indicative purpose and are meant for traders and brokers to fix the vessel. The actual fixtures will differ, depending on the relationship between both parties; the vessel type that is used to ship the cargo; and the time span that is set to arrange the vessel.

To identify how relevant the transportation costs are, two hypothetical fixtures are made. The first fixture is a cargo volume of 10,000 cbm and is going from USAC (United States Atlantic Coast) to ARA (Amsterdam-Rotterdam-Antwerp). This route is the main trunk route for ethanol between the United States and Europe. The second fixture is a cargo volume of 10,000 cbm and is going from USAC to MPFE (Main Ports Far East). This route has a longer distance and is less common. The price of a cbm of T2 FOB ethanol is for both fixtures $850. The percentages are based on voyage charter and neither insurance costs nor other costs are included in the total price.

For the first fixture the freight rate is $52 per cbm. This results in a transportation cost between USAC and ARA of $520,000. The total cargo for the first fixture is worth $8,500,000. This implies roughly that for a volume of 10,000 cbm the transportation cost is nearly 6% of the total costs. The percentage is based on voyage charter and insurance costs are not included in the total price.

For the second fixture the freight rate is $76 per cbm due to the longer distance. This results in a transportation cost between USAC and MPFE of $760,000. The total cargo is worth $8,500,000. For the second fixture, the transportation cost account for more than 8%.

According to the percentages obtained from the two fixtures, it is obvious that the transportation costs represent a significant part of the total costs. Trading companies can increase their margin if they, or their charter department, can fix cheap vessels. Cheap vessels are attractive due to the bigger margin, but the level of safety is priority for most companies. Because the level of safety is important, the price of a young chemical tanker is higher than the price of an old CPP vessel. The difference is caused by the difference in the level of safety, technology on board and the quality of the tanks.

Freight rates also depend on bunker prices, distance to sail, availability of capacity supply and customer relations. An interesting tool that can decrease the freight rate is by shipping larger quantities. Larger quantities will result in economies of scale. This means that the larger the volume, the lower the freight rate per cbm. Apart from the economies of scale, larger quantities will also give the charterer more bargaining power when the freight rate is being negotiated.

3.4.1 Charter Contracts

There are three possible options to charter a vessel. There is the voyage charter; the time charter; and bareboat time charter or charter on demise. When a vessel is voyage chartered, the charterer hires the vessel for a single voyage. This is called the spot market. The complete crew, bunkers and supplies must be provided by the ship owner. Voyage chartering can be compared with taking a cab. The taxi cab and the driver are provided by the taxi company, or the owner, to bring the customer from and to the required locations.

When a vessel is time chartered, the charterer hires the vessel for a certain period of time. The complete crew, bunkers and supplies must be provided by the ship owner. If the charterer wants to choose its own crew, bunkers and supplies, it must charter the vessel on a bareboat time charter contract. In that case, the charterer hires a complete empty vessel. It can be compared with hiring a rental car on holiday.

According to the Transammonia charter department, around 60-80% of the contracts that are used to ship ethanol are based on voyage charter contracts. A small portion is done on time charter basis because only the major players have the capital and the volumes to fill up time charter vessel. Either they fill up the complete vessel with one particular product or they ship several products at the same time. Since there is a lot of capacity in the market, shipping on time charter basis is not very common.

The last option to ship ethanol is based on a COA contract. COA stands for “contracts of affreightments”. COA is used to describe the contract between the charterer and the ship owner. The ship owner agrees to ship an agreed volume of goods for a specific and agreed rate, the freight rate. COA can be compared with sending a package with the postal service.

There can be a clear pattern identified when looking at the types of contracts that are used in voyage based contracts. Institutes like ASBA[7] and Intertanko[8] have drawn voyage charter templates that can be used by its members, respectively ASBA II and INTERTANKVOY. These contracts are used most of the time, especially between smaller and medium sized players. The major players have drawn their own voyage charter contracts. The two major oil companies BP (British Petroleum) and Shell have respectively BEEPEEVOY 2 and SHELLVOY 4. It does not matter which contract is used between both parties, as long as the parties that are involved agree on the contract that will be used.

The contract templates drawn by ASBA and Intertanko are meant as a stable and trustworthy basis of a voyage contract. In every voyage, a slightly different version of this template is used. This must be the case because almost every voyage is different because of a different charterer, different volumes, different products and different destinations. This means that every time the contract is actually signed, a lot of sections are altered or sections are added into the contract. These alterations and new sections are called clauses. There are many clauses like a pre-washing clause, cleaning clause, special insurance clause, piracy clause and special cancellation clause. There are many more, and depend on the needs and requirements set by the parties involved.

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[7] *ASBA is the Association of Ship Brokers and Agents and is located in Englewood Cliffs, NJ, USA. http://www.asba.org*

[8] *Intertanko is the International Association of Independent Tanker Owners and is located in Oslo, Norway. http://www.intertanko.com*

3.5 Market Players

The ethanol market is a mature market and there are many companies involved in ethanol trading. Like with most mature markets that have many players, the margins are small and the competition is fierce. According to the fixing reports from various brokers, the main players can be split into two groups. The first group consists of pure commodity traders. This group's core business is trading. Besides ethanol, most companies have dozens of other products that they trade. Several big commodity traders are Cargill, Vitol and Gunvor. The second group that trades ethanol consists of companies with a different core business than trading. These companies can either be oil companies or companies that own several nodes in the ethanol supply chain. The biggest players in this market are the oil companies like BP, Shell or Statoil. Noble is part of the Noble group which owns large parts of the complete supply chain of ethanol. The main players are listed in Table 3 and the table gives a quick indication about what kind of players operate in the ethanol trade. Some caution is required when interpreting and reading the table since the list is based on the annual company revenue. The annual revenue does not reflect the profit of the company and also does not directly show the size of the company. Besides that, the group two companies generate the most part of their revenue from other activities than trading ethanol.

Table 3

Main Ethanol Market Players					
Name of firm	**Headquarters location**	**Country**	**Revenue 2010 (X**	**Revenue 2010 ($)***	**Employees**
Abengoa	Seville	Spain	5.6 billion EUR	8.1 billion USD	26,500
ADM	Decatur	United States	61.7 billion USD	61.7 billion USD	29,000
Alcotra	Les Acacias	Switzerland	x	x	x
Astra (trading)	Loverval	Belgium	x	x	400
BP	London	United Kingdom	309 billion USD	309 billion USD	80,000
Bunge	New York	United States	45.7 billion USD	45.7 billion USD	33,000
Cargill	Minneapolis	United States	108 billion USD	108 billion USD	131,000
Copersucar	Sao Paulo	Brazil	x	x	x
Cosan	Sao Paulo	Brazil	9.1 billion USD	9.1 billion USD	45,000
Gunvor	Geneva	Switzerland	65 billion USD	65 billion USD	x
Harvest Energy	Calgary	Canada	3.9 billion USD	3.9 billion USD	710
Louis Dreyfuss	Rotterdam	The Netherlands	x	x	34,000
Morgan Stanley	New York	United States	31.6 billion USD	31.6 billion USD	62,000
Murex	Dallas	Texas	x	x	x
Nestle	Vevey	Switzerland	110 billion CHF	130.1 billion USD	281,000
Noble	Hong Kong	Hong Kong	56.7 billion USD	56.7 billion USD	11,000
Nort Sea Group	Dordrecht	The Netherlands	x	x	350
Petrobras	Rio de Janeiro	Brazil	213 billion USD	213 billion USD	77,000
Repsol	Madrid	Spain	60.3 billion EUR	87.1 billion USD	30,000
RWE	Essen	Germany	53.3 billion EUR	77 billion USD	71,000
Shell	The Haque	The Netherlands	368 billion USD	368 billion USD	101,000
Statoil	Stavanger	Norway	530 billion NOK	99.1 billion USD	30,000
Vertical	London	United Kingdom	x	x	x
Vitol	Rotterdam	The Netherlands	195 billion USD	195 billion USD	2,700
Transammonia	**New York**	**United States**	**8,5 billion USD**	**8,5 billion USD**	**400**

* according to exchange rate on the 5th of July 2011

Source: Table was produced by using annual reports from various listed companies (BP, Shell, Nestle,..)

Privately held company data obtained from company's website or www.forbes.com

3.6 Production Locations

The main ethanol exporting countries are Brazil and the United States. The ethanol that is exported from Brazil is produced from sugar cane and the ethanol from the United States is mainly produced from corn. Besides the raw base material that is used, the main difference between the countries is the capacity of the ethanol production plants. According to Bloomberg, the number of ethanol plants that exceed 100 million gallons of ethanol production per year is significantly higher in the US than in Brazil, respectively 30 and 5. Table 4 shows the world fuel ethanol production for the most important producing countries in 2010. According to Demirbas (2007), the total world fuel ethanol production will exceed 125 billion by the year 2020. This is mainly generated by the worldwide mandated volumes.

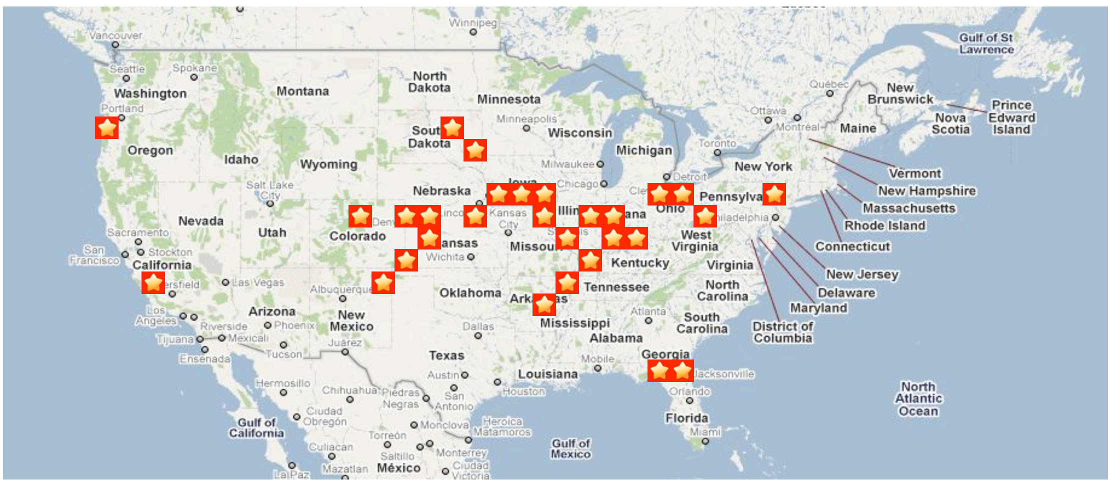
Table 4

World Fuel Ethanol Production (mln liters)				
Country	**2010**	**2009**	**2008**	**2007**
United States	50,076	40,121	34,065	24,597
Brazil	26,198	24,897	24,497	18,998
European Union	4,454	3,935	2,777	2,159
China	2,050	2,050	1,900	1,840
Other	4,076	2,937	2,375	1,997
Total world	86,854	73,940	65,614	49,590

Source: F.O. Licht (2010)

The US production facilities are mainly located in the middle of the US, also known as "the corn belt". According to RFA (2010), Iowa, Minnesota, Nebraska, Illinois and South Dakota are the states where the main ethanol plants are located. The yellow stars in Illustration 2 indicate the ethanol plants that exceed a production volume of 100 million gallons of ethanol a year. According to Bloomberg, almost 200 ethanol plants are up and running in the United States alone. These plants vary heavily in size. Most of these ethanol plants feed on corn and wheat crops.

Illustration 2



Source: Google Maps & Bloomberg (2011)

The Brazilian production facilities are located in the regions Mato Grosso, Mato Grosso do Sul, Minas Gerais, Goias and in the Sao Paolo region. The yellow stars in Illustration 3 indicate the main ethanol production plants in Brazil. The bigger stars represent plants with a volume larger than 100 million gallons a year. The smaller stars represent a volume between 50 and 100 million gallons a year. The part of Brazil, where most ethanol production plants are located, is famous for its suitable environment to grow sugar cane crops. As a result of this, ethanol production plants were constructed among these crops and almost all ethanol plants feed on sugar cane. Due to the onsite processing possibility, transportation costs of sugar cane remain fairly low. If the sugar cane is destined for ethanol, the sugar cane is almost directly processed into ethanol after harvesting. Besides the difference in raw material and the production plant size is also that the infrastructure of Brazil is completely different compared with the United States. The quality and scale of the US highways are much more suitable for carrying high volumes of corn than the highways in Brazil for carrying sugar cane. Besides the highway, the United States has a comprehensive railway network and inland waterway system to move commodities around the country. Brazil is dependent on its poor highway infrastructure.

Illustration 3

Source: Google Maps & Bloomberg (2011)

Europe is investing a lot of money in new projects to produce ethanol. Currently the main countries where ethanol plants are located are the Netherlands, the United Kingdom, Austria and France. Several other countries have their own projects but the capacity of these small plants is not of any significance yet. This might change in the future. Due to the increase of mandated demand of ethanol, it becomes an interesting opportunity to invest in ethanol plants. It would also result in less dependency on the foreign ethanol products. In the near future we probably might see new and even larger ethanol plants arising all around Europe.

3.7 Traded Products

According to Bloomberg, where prices are based on information from Platts[9], there are currently 3 main ethanol products listed for worldwide ethanol trade that is bound to go to Europe via the port of Rotterdam. These 3 products are ‘Ethanol T1 FOB Rotterdam’, ‘Ethanol T1 CIF Rotterdam’ and ‘Ethanol T2 FOB Rotterdam’. There are some other smaller derivatives and ethanol related products traded but this research does not take those products into account. Prices to other continents also are listed but not mentioned in this research.

The abbreviation FOB stands for “Free on Board” and is a common abbreviation used as a trade term for goods that must be delivered by the seller on board a vessel designated by the buyer. “Free” means that the seller has the obligation to deliver the goods to a designated place for transfer to a carrier. The rest of the transportation leg is the responsibility of the buyer. The other abbreviation CIF stands for “Cost, Insurance and Freight” and is used as a trade term for the obligation of the seller to deliver the goods to a port of destination and the seller must provide the buyer all the documents necessary to obtain the goods from the carrier. Here, the seller is responsible for the whole transportation leg. Both FOB and CIF are commonly used for all kinds of seaborne products.

The FOB price of ethanol is in theory always lower than the price of CIF ethanol. If for example a trader buys FOB ethanol in Brazil and sells it as CIF ethanol in Asia, the costs of the transport and insurance are imbedded in the CIF price. The costs of the voyage, transportation and insurance, are carried by the trader. If the same trader would buy FOB ethanol in Brazil and sells it as FOB ethanol in Asia, the buyer himself must pay for the transportation and the insurance. Hence, the price of FOB is theoretically always lower than CIF.

As for the abbreviation T1 and T2, these codes are only used for ethanol that is bound for European markets. T1 stands for unpaid duty ethanol. This means that once the product arrives at the designated port of arrival within Europe, mainly Rotterdam, the buyer needs to pay the duty to get the ethanol into the EU market. T2 is used for European domestic ethanol or any other foreign duty paid ethanol that has been imported into Europe. T1 ethanol becomes T2 ethanol as soon as the duty has been paid.

There are different duties applicable on ethanol. It depends on whether the ethanol is hydrous or anhydrous ethanol. As explained at the beginning of this section, hydrous ethanol is used for human consumption, like in beverages. The anhydrous ethanol is not consumable but it is used as an energy source or as a fuel additive. The current duty on foreign hydrous ethanol into the European Union is €102/cbm and for anhydrous ethanol it is €192/cbm.

The T1 price for ethanol is in theory always lower than the T2 price, since the buyer has to pay duty to import the ethanol. For T2 ethanol the duty has already been paid and is imbedded in the price. An exception to this theory could be, when the domestically produced ethanol from Europe is cheaper than T1 foreign ethanol. Then the price for T2 could be lower than the price for T1.

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[9] *Platts is a leading global provider of energy and metals information and a foremost source of benchmark price assessments in the physical energy markets. http://www.platts.com*

3.7.1 Blending Issue

As explained in the previous paragraph, T1 ethanol is the European trade code for the imported ethanol with an unpaid duty. T2 ethanol is the trade code for European or domestically produced ethanol. Also known as the imported ethanol for which the duties are already paid. A European ethanol importer needs to pay €192/cbm for anhydrous ethanol and €102/cbm for hydrous ethanol. The duty that is levied on ethanol resulted in an interesting reaction from the importing parties. There is a loophole to avoid paying these high taxes. This loophole is called blending. To avoid the high taxes, the importers of anhydrous ethanol blend the ethanol before it arrives in a European port. The anhydrous ethanol is mixed with conventional gasoline and due to this mix a completely new product is produced. This product has a tax levy of 6.5%, which is lower than the anhydrous ethanol tax. The difference is large enough to cover the blending expenses.

According to IPTA[10] (International Parcel Tankers Association), there are four options to blend the ethanol before shipping the product into Europe. The first option is called blending a shore and is done prior to the ships manifold. Secondly, the blending is done during loading and is called “loading on top”. As a third option, the IPTA recognizes blending during discharge. This means that a second product is being injected into the pipeline during discharge. The last option to blend ethanol with gasoline is during the voyage. Currently there are no regulations for blending on board but due to the increased concern of possible waste streams there probably will be applicable legislation in the near future (IPTA, 2011).

The duty that is levied on ethanol blends is significantly lower than the duty that is levied on pure ethanol. According to the European legislation, the current duty that is levied is 6.5% for both types of blends. The blends consist of a high percentage of ethanol and a very small percentage of gasoline. By blending anhydrous ethanol with conventional gasoline, E90 or E95 is created. E90 stands for a mixture that exists of 90 percent ethanol and 10 percent gasoline and E95 stands for 95 percent ethanol and 5 percent gasoline. According to Dropet, most of the T1 market has been dissolved in Europe due to the extensive use of this loophole. According to F.O. Licht (2010) and a trader from SUCDEN, the estimated volumes of E90 that arrives every month in Europe is between 50,000 and 60,000 cbm. This means that there is an annual import of around 700,000 million litres of blended ethanol.

Currently, new laws and tax incentives are being developed to deal with this loophole. This new law will probably levy the same tax on E90 and E95 as is levied on pure anhydrous ethanol, which is €192/cbm. Once this new law is implemented, it makes no sense for importers to import blended ethanol products since there are costs involved for blending.

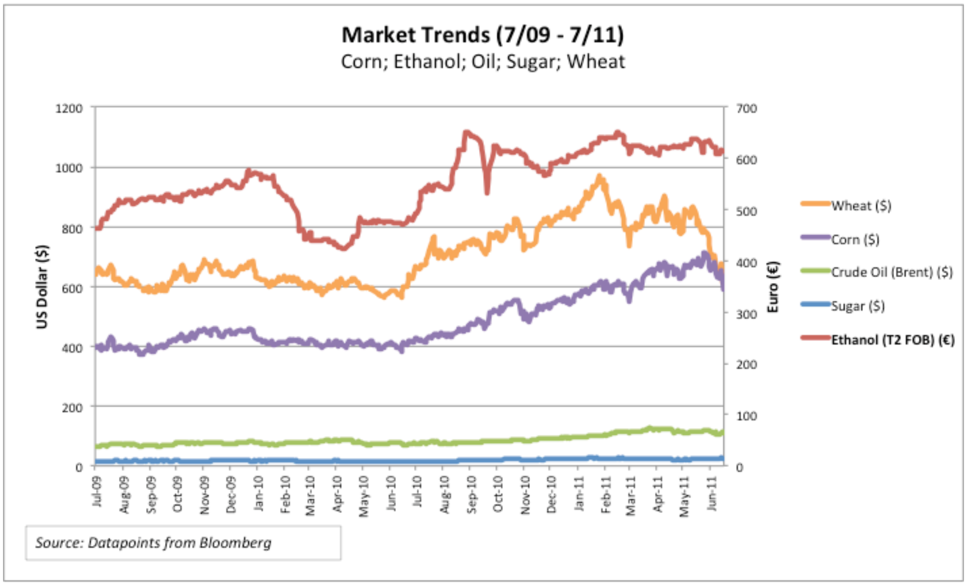
[10] International Parcel Tankers Association is internationally recognized as the Non-Governmental Organization dedicated to serving the needs of the IMO classified chemical and product tanker fleets. http://www.ipta.org.uk/

3.8 Product prices

The ethanol price behaves in a very volatile manner and depends on many factors. According to Pindyck (2004), price volatility reflects the volatility of the current and expected future volumes of production, consumption and inventory demand. These three variables are influenced by many different factors. Factors that could influence the volumes of production are weather conditions, technological improvements and the price of the raw material that is used to produce ethanol. Factors that influence the consumption are economical growth, population growth and tax incentives to stimulate the use of ethanol. Inventory demand is mainly influenced by the price of ethanol and the uncertainty about future trading flows. The rapid increase of the ethanol demand has raised concerns about ethanol's impact on price levels and the volatility of agricultural commodities. In the beginning of 2009, the price of US corn nearly doubled and then sharply declined. Analysts were blaming the increase of the ethanol fuel demand (Zang *et al*., 2009). Understanding and predicting price leadership between ethanol and other commodities that are influenced may lead to better policies. A persistent change in volatility can increase the risk of exposure of ethanol for agricultural producers and ethanol refiners. It also may alter hedging decisions and incentives to invest in ethanol production. If these price relations are better or fully understood, it could help the current debate about food versus fuel (Gardner & Abbott, 2011).

After assessing the ethanol market, there are 4 important products that show some sort of strong affiliation with ethanol or that could influence its price. There are many more products that could influence or have a relation with ethanol but for this research the products corn, crude oil, sugar and wheat are identified as the most important ones. These products were chosen since three of them are used as a raw base material to produce ethanol. Crude oil is researched because ethanol is a direct substitute for crude oil derivatives like gasoline and diesel. Chart 1 shows the market trends from the last 2 years for all 5 products.

Chart 1



By running Pearson's correlation analysis[11] on all products with the Ethanol T2 FOB Rotterdam prices that are published between July 2009 and July 2011 by Bloomberg, Table 5 with the according correlations was produced.

The correlations in Table 5 show the relationship between ethanol and other product prices. By using the correlation method, relationships between variables can be measured. It must be noted that this relationship between the variables can be directly linked but may also be indirectly linked. The causes underlying the correlation, if there are any, may be indirect and unknown. Therefore the correlation coefficient does not show the causal relationship. In other words, correlation does not directly imply causation between the variables. The correlation coefficients that can be calculated are between the values +1, zero and -1. The value +1 means that there exists a strong positive relation between the two variables. Zero means that there is no relationship between the two variables and when the value is -1, there exists a strong relationship between the variables but in the opposite direction.

Table 5

Correlations to T2 FOB Ethanol	
Product	**Correlation**
Corn	0.7453
Crude Oil (Brent)	0.6197
Sugar (white)	0.7791
Wheat	0.8241

Source: Based on datapoints from Bloomberg

In addition to Pearson's correlation the dataset was also exposed to a time series analysis. The idea behind the time series analysis is to detect a pattern in the dataset. Patterns can be used to predict future values from the used dataset (Keller, 2008). The dataset that was used to detect a pattern in this research was Bloomberg's price for T2 FOB ethanol from January 2008 till the end of June 2011. Despite the fact that ethanol is produced from agricultural products that are influenced by seasonality, there were no useful results and therefore no patterns identified. The market price of ethanol seems to fluctuate too much to identify any useful patterns that may help predicting future ethanol prices.

---

[11] *The Pearson's correlation, r, is used to find the correlation between at least two variables. Range of the correlation: -1≤r≤+1. Correlations above 0.80 are considered pretty high. The correlation can be calculated by using the Pearson's correlation formula, which is:* $r = \frac{N \times \sum XY - (\sum X)(\sum Y)}{\sqrt{\left[N\sum X^2 - (\sum X)^2\right]\left[N\sum Y^2 - (\sum Y)^2\right]}}$

N = number of observations

X = value of product X (here Ethanol)

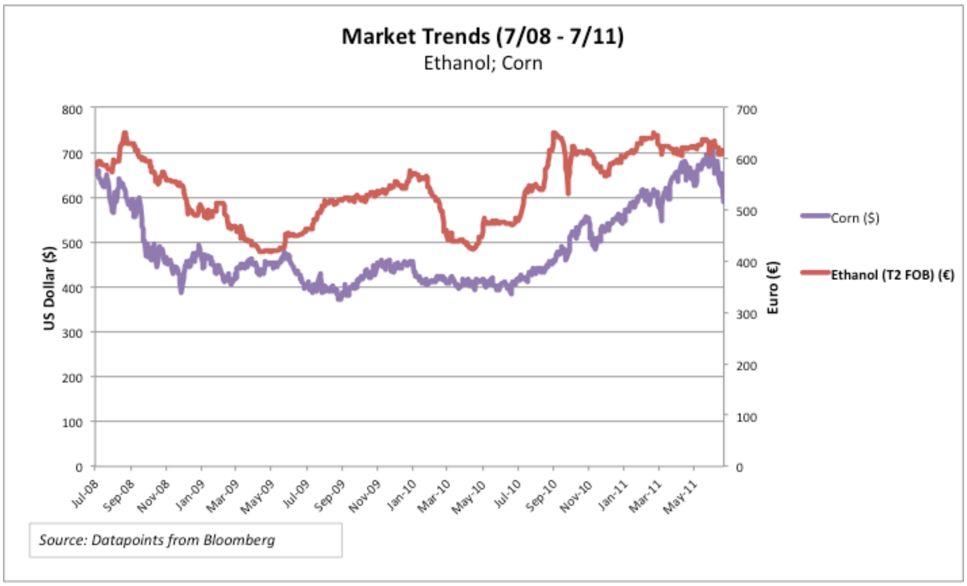
Y = value of product Y (here Corn; Crude Oil; Sugar; and Wheat)

3.8.1 Corn

Corn is a starch product and is used as raw material to produce ethanol, especially in the United States. Since the price for corn has increased significantly the last year, the question of the ongoing effect of government ethanol policies on corn prices remains a topic for discussion. This discussion among market analysts, industry participants and policy makers is even strengthened because the policies for ethanol may also have an influence on related markets and industries. There are analysts that suggest that relaxing or even removing the ethanol or ethanol related provisions would have little or no effect on the current corn prices (Anderson & Coble, 2010).

As mentioned earlier, US ethanol is responsible for a large part of the total world ethanol supply. Therefore, the price of corn and the fluctuation of this price should be partly visible in the ethanol price. Chart 2 shows the market trends of ethanol and corn. The correlation coefficient between July 2009 and July 2011 for corn to ethanol is 0.7453 according to the calculations. This coefficient shows that there exists a positive relation between the corn and ethanol prices. According to the theory behind the Pearson's correlation, this relation is strong but not extremely high. It is therefore important, when speculating about the ethanol price, to take the corn price into account but not completely rely on it.

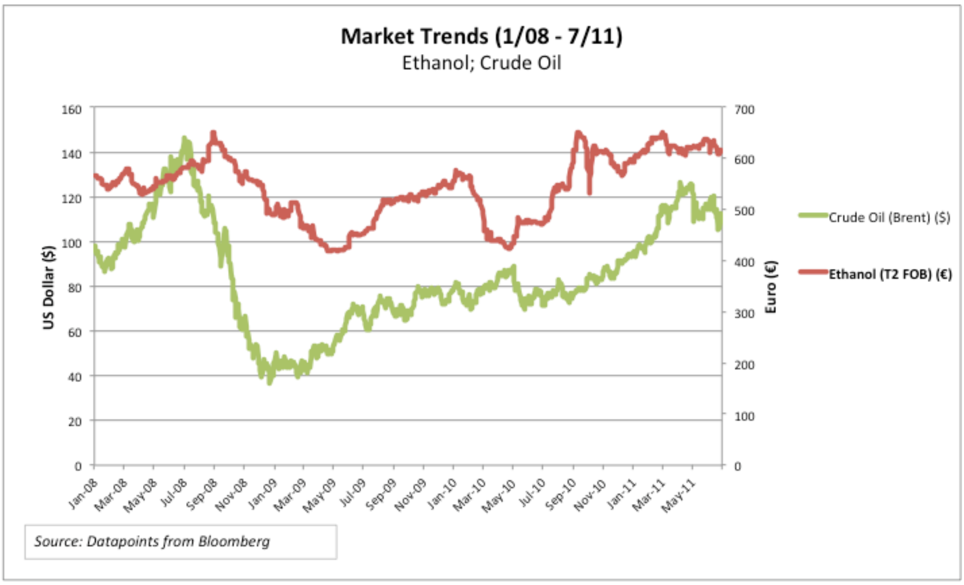
Chart 2



3.8.2 Crude oil

Crude oil is the most important energy source of the global economy. The current world economy depends and relies heavily on crude oil. When crude oil is being refined, it is being separated into the following products: petroleum gas, naphtha, gasoline, kerosene, gas oil, lubricating oil, fuel oil and solid residuals. Every industrial sector is somehow reliable on one of these products. The main angle for the relationship between crude oil and ethanol is gasoline. Gasoline is mainly used as fuel in cars, trucks and buses. Since ethanol is currently identified as the best substitute of gasoline, a higher gasoline price will increase the demand for ethanol. So if the price of crude oil increases, the price of gasoline will also increase since it is a by-product. When the gasoline price increases, the demand for gasoline will drop and the demand for ethanol will increase. When the demand of ethanol increases, the price of ethanol will also increase. Chart 3 shows the market trend of ethanol and crude oil. The correlation coefficient, between July 2009 and July 2011, for crude oil to ethanol is 0.6197 according to the calculations. The reason that the coefficient is not that high, may be due to the delay that occurs between the moment that the price of crude oil rises and the moment the price of ethanol is influenced. This delay is caused by the extra step that is identified as the price and demand of gasoline. To summarize, there exists a relation between the crude oil price and the price of ethanol but this relation is too weak to take into account when speculating on ethanol prices.

Chart 3



3.8.3 Sugar

The most effective raw material for producing ethanol is raw sugar. Sugar is either being obtained via sugar cane or via sugar beets. Brazil, the world biggest ethanol producer, uses mainly sugar cane for the production process. Just like with corn, the fluctuations of the price of sugar should be partly visible in the price of ethanol. The correlation coefficient, between July 2009 and July 2011, for sugar to ethanol is 0.7791 according to the calculations. This result is comparable with the correlation coefficient of corn. This number shows that there exists a semi-strong and positive relation between the price of sugar and the price of ethanol. Chart 4 shows the graphical relationship between the ethanol and the sugar price. It is therefore important for traders to take the sugar price into account when speculating about ethanol prices.

The current sugar market supports this theory because the current sugar prices have been extremely high since the end of 2010. These high prices are not beneficial for Brazil's domestic ethanol production. Due to the high sugar price, ethanol producers are not willing to produce ethanol; instead they are selling the sugar as an individual product because this results in higher yields compared with the margins they can get on the production of ethanol. According to Trammochem[12] traders, the Brazilian domestic production of ethanol keeps on decreasing while the domestic demand keeps increasing. This results in an imbalance on the Brazilian ethanol account, resulting in ethanol imports from foreign countries to fill the gaps, especially from the United States. Due to this imbalance in Brazil, pressure on the US ethanol market is also increasing. This example clearly shows that there exists a strong relation between the sugar price and the ethanol price.

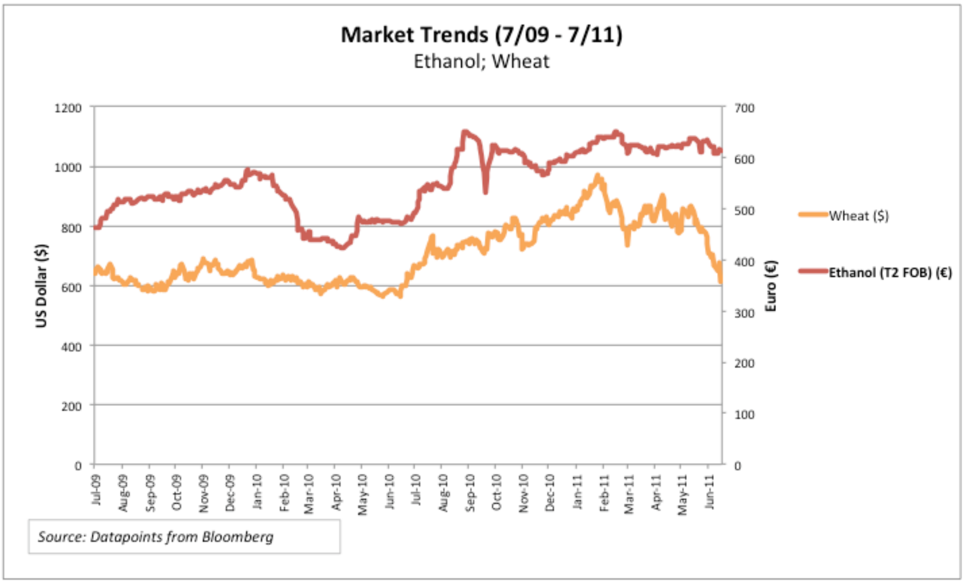
Chart 4

[12] *Trammochem AG merchandises and trades in petrochemicals. Main products are MTBE, benzene, methanol and olefins. Trammochem traded anhydrous ethanol till 2008. Together with Transammonia, Trammo Gas and Sea-3, it forms the Transammonia Group.*

3.8.4 Wheat

The same relation as shown with corn is applicable for wheat. Wheat is a starch product and is also used as a raw material to produce ethanol, especially in the US. Therefore, the price of wheat and the fluctuation of this price should be partly visible in the ethanol price. Chart 5 shows the market trend of ethanol and wheat. The correlation coefficient, between July 2009 and July 2011, for wheat to ethanol is 0.8241 according to the calculations. The coefficient between wheat and ethanol is surprisingly the highest. The 0.82 value, and therefore the relationship, is considered to be pretty high according to the theory. As Pearson's theory explains, the relationship between two variables has not to be causal and the relation can be indirect or even unknown. Whatever the relationship might be, apart from it being a raw material, the price of wheat is an important factor that must be taken into account when traders are speculating about ethanol prices.

Chart 5



3.8.5 Weather

According to market specialists, the weather is one the most important factors that influence the ethanol market. Weather conditions are a major influence on the total crop production in the agricultural sector. If the weather conditions are in favour of the crops, the crop yields are high. But if the weather is not in favour of the crops, crop yields are low and crops may even be lost.

A bad weather season can be anything from too much rain, extreme drought or even strong winds can tear down and destroy crop production. Bad weather influences total crop production and therefore also the total supply of agricultural products. In ceteris paribus, if the supply of these products decrease, the price automatically will rise.

How does the weather influence ethanol as a tradable commodity and does a trader need to be aware of this unpredictable variable? Since ethanol is produced from raw materials like sugar cane, corn and wheat, the weather conditions have a major impact on the ethanol price. Due to bad crop yields, the prices of the raw base materials would be high and the final product price of the ethanol would also be high. Therefore a very strong relation exists between the weather and the ethanol price. It could be very beneficial for ethanol traders to understand the impact of the weather. These traders should also be aware of the weather history that occurred during the last crop periods.

3.8.6 Policies

During the period between 2001 and 2006 there was a bio-fuel boom due to several factors. In this period the oil price increased rapidly and subsidiaries on ethanol in both the United States and Europe were significantly increased. The ban on major competitors of ethanol for gasoline additives was identified as the last factor that created the bio-fuel boom (Hertel *et al.,* 2008). Due to a steep increase of the oil price in the 2003, going from $31 to over $41 per barrel, a strong shift in the ethanol production occurred. Governments wanted to be less dependent on foreign oil and stimulated the production of ethanol. World ethanol production rose from 18.5 billion litres per year in 2001 to roughly 60 billion litres per year in 2007, which is an increase of more than 220% (Steenblik, 2007). In the United States the corn based ethanol production went from 3 billion gallons in 2002 to nearly 12 billion gallons in 2009. This is an increase of 300% in 9 years (FAPRI, 2010b).

The initiatives that were started in around 2003 caused a worldwide snowball effect. Almost all developed countries have or are trying to get mandates for renewable fuel policies into place. All these policies are resulting in mandated volumes and creating an upward trend in the demand of ethanol. As mentioned, many countries are dealing with this issue however this section will mainly focus on the United States, the European Union and Brazil. These three players are responsible for most of the ethanol trade and give a clear indication of the impact of mandated volumes on the future ethanol market.

The United States

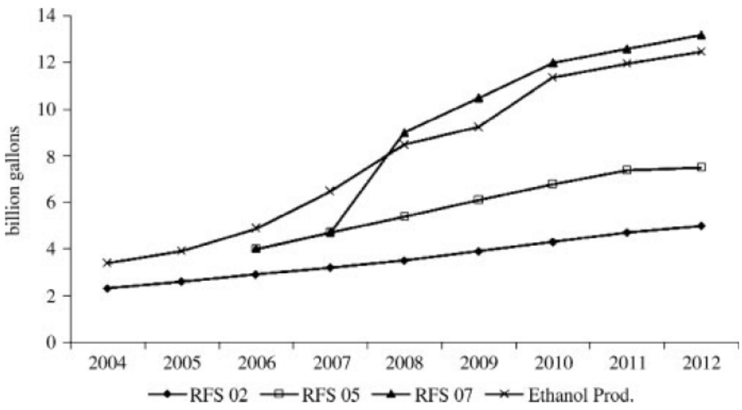
In the United States the Environmental Protection Agency, or EPA, is responsible for developing and implementing regulations concerning renewable fuels. These regulations ensure that the total transportation fuels that are sold in the US contain a minimum volume of renewable fuel. The Renewable Fuel Standards, or RFS program that was used were developed in collaboration with the industry and its stakeholders.

The first renewable fuel volume mandates in the United States were created under the Energy Policy Act, or EPAct, of 2005. The mandated volume consisted of 7.5 billion gallons of renewable fuel that require blending with conventional gasoline by 2012.

Under the Energy Independence and Security Act, or EISA, of 2007 the RFS program was expanded (Chart 6). The most important notion was the increase of volume of renewable fuel that must be blended into transportation fuel. The new program forces the volume to go from 9 billion gallons in 2008 to 36 billion gallons in 2022 (EPA, 2010).

After the instalment of the RFS program, RFS2 was being introduced. RFS2 lays a foundation to achieve significant reductions of greenhouse gas emissions. The foundation exists of increasing the role of renewable fuels and reducing the volume of imported petroleum. It also encourages the development of the United State's renewable fuel sector.

Chart 6



Source: Anderson & Coble, 2010

The European Union

In December 2009, the European Parliament adopted a new directive on renewable energy. This so called "EU Renewable Energy Directive" is intended to replace the former measures that were adopted in 2001. The Directive was tabled by the European Commission in January 2008. The European Commission encourages the industry, governments and NGO's (Non-Governmental Organizations) to increase the use of biofuels.

The Directive requires the European Governments to increase their renewable energy amount from 8.5% to 20% by 2020. Besides this measure, the Directive also requires a minimum of at least 10% of transport energy that must come from renewable energy sources (European Parliament, 2010). Similar to the United States, the European Union expects a lot from biofuels in the near future. The main input must be delivered by the ethanol sector. The increase of this new ethanol demand, caused by the mandated volumes, will have a huge positive impact on the ethanol market (Banse *et al.,* 2007).

Brazil

Brazil is frontrunner when it comes to ethanol policies. In 1975, Brazil's first ethanol policy called ProAlcool, was launched to reduce the country's dependence on foreign crude oil imports. This program was both an energy security program and an agricultural price support program (Xavier, 2007). It increased production of a perfect substitute for gasoline and it also guaranteed the sugar profitability after the sugar oversupply in 1974. Excess supply was used to produce ethanol instead of having an oversupply of sugar and therefore the price of raw sugar remained at a profitable level.

The first step of ProAlcool was to increase the number of ethanol distilleries. Secondly, the government used state oil company Petrobras to make infrastructure investments to distribute ethanol and keep the consumer price of ethanol lower than the price of gasoline. During the second oil crisis the ethanol program was expanded. The Brazilian government signed agreements with major car manufacturers to increase the production of ethanol fuel vehicles which resulted in an increase of domestic demand. The program had a small dip during the low oil price in the mid 80's. After deficits were solved the program was reinvented at the end of the 90's. Many flex fuel cars were produced and highly promoted. This last boost still helps today's sugarcane industry's expansion (Xavier, 2007).

Nowadays, the Brazilian government corrects its anhydrous ethanol blending mandates according to the expected sugarcane harvest. A minimum of 20% blend is forced by law but usually the mandated percentages for anhydrous blends vary between the 20% and 25%. If for example the mandate is set for 25% and then the blend mandate drops with 5%, it will reduce the anhydrous demand by nearly 7 million gallons per month. Instead of blending the anhydrous ethanol with gasoline and creating an oversupply, the Brazilians start producing pure anhydrous ethanol which can be used as direct fuel in flex fuel cars (Jessen, 2010). This adaption for volume fluctuations shows the flexibility and the experience that Brazil has with bioethanol, which currently is one of their primary fuel sources,

Besides the three mandates mentioned above, countries like China and Indonesia have also adopted biofuel mandates which encourages the production and consumption of ethanol (Dillon *et al.,* 2008). In 2001, two major ethanol programs were launched by China's government. These programs were given an additional boost when China's Renewable Energy Act was passed in February 2005. The Chinese Government has set their target ambitiously. This means that 10% of the nation's energy must come out of renewable energy source by 2020 (Balat & Balat, 2009). China's instruments to promote biofuels include research, subsidies, tax, price limits, quotation limits and changes by law. If all the mandates in Brazil, the United States, Europe and China are in place, the expected ethanol demand could grow to exceed 125 billion litres by the 2020 (Demirbas, 2007). The actual demand may be even higher since these estimates were done in 2007. Since that period a lot of new initiatives were started and active mandates were expanded. These expectations are a good sign of an established and highly sustainable ethanol market.

3.8.7 Competition with Feedstock

The concern for competition between ethanol production and the available feedstock is increasing. Available agricultural land is becoming scarce and expensive. Crops are destined for either ethanol or feedstock production. Many critics argue that due to the production of ethanol, food prices are rising (Gardner & Abbott, 2011). Ethanol production consumes a large part of the worldwide feedstock and puts more pressure on food prices. Especially with the increase of mandated ethanol volumes, concern of the negative relationship with the food price keeps expanding. For Trammochem, this highly sensitive relation was one of the reasons why they stopped trading the product in 2008. Due to increased concern, governments of multiple countries became more involved and automatically attracted negative press along the way.

One part of experts and analysts argue that the ethanol production has a negative effect on food prices. In the US for example, the increase of ethanol production was a cornerstone of President George W. Bush's energy policy. Farmers answered by growing more corn to supply the increased demand for corn. Even though the supply went up, the prices in the US of livestock feed and other corn dependent food products kept rising (AP, 2007).

Next to that negative relation, the increasing part of the corn harvest is meant for mandated ethanol production. Even thoughtechnology makes it possible to grow more corn per acre, next year 24% of the total corn harvest will be used to produce ethanol. Analysts argue that this will be visible in an increase of the US food price (Weise, 2011).

On the other hand, there are the pro-bioethanol parties. This other part of experts and analysts argue that the influence of future ethanol production will not play a significant role in the development of the food price. According to Young (Wald, 2006), corn products have always been used for non-food purposes, including liquid products that help oil wells drill. Young points out that it is an exaggeration to conclude that non-food use of crops will make the worlds poor go hungrier. Young did confirm that due to vegetable oils that act as a substitute for diesel, the price for canola oil had increased. Inevitably there is a relation between markets so there is some interaction, but this is not as strong as argued by the opposite parties.

A feasible solution to increase the production of ethanol and keep the food prices at a reasonable level is in plain sight. By applying a different production method, different kinds of base raw materials can be used to produce the same quality ethanol. This production process is called "lignocelluloses". Instead of using crops that are used as a feedstock, waste materials can be used as a raw material. Municipality waste, agricultural by-products and forestry by-products can form the base of the ethanol production. This new technique can resolve a lot of waste problems but more importantly, it does not compete with the current feedstock and therefore does not increase food prices (Hahn-Hägerdal 2006). At the moment this process is too expensive and needs to be further developed to be fruitful on a large scale.

According to an ethanol production plant in the American state Iowa, it is not only ethanol that is produced during a corn based ethanol process. The products that come out of the production process are one third ethanol, one third CO_2 and one third DDGS (Dry Distillers Grains with Solubles). Small amounts of corn oil are also extracted from the production process. These by-products are actually used for food processing. The CO_2 is used to carbonate sodas. The DDGS and corn oil are used to feed livestock and therefore in essence are producing food. It is thus only one third of the corn that is used for ethanol production with the rest going to food production. This extremely important and never mentioned fact should be taken into account when the relation between ethanol and feedstock is researched or discussed.

3.9 Conclusion

To recap, the main properties of the ethanol market were identified in this chapter. Anhydrous ethanol is used for fuel ethanol. This product is not potable and mainly used as a pure fuel source or as an additive to conventional fuels. It is mainly produced in Brazil and the United States, therefore the main trading patterns are from Brazil to Europe and from the United States to Europe. There is also a part of the production that is shipped to the Far East and the Arabian Gulf. The total worldwide trade that is imported and exported was around 9 billion litres in 2010. To avoid high taxes for foreign ethanol destined for Europe, importers blend the ethanol with 10% of conventional fuels. Due to this loophole, the duty drops from €192 to €102 per cbm. Currently new legislation is being issued to deal with this loophole. Chemical tankers or CPP tankers are used to transport ethanol. These tankers vary from 5,000 to 50,000 MT. The vessels are mainly contracted via the spot market and therefore mainly voyage charter contracts are used. Nevertheless, the main players with enough volumes operate with time charter contracts. The price of ethanol is very volatile and is being influenced by many factors. This chapter showed the relation between ethanol and four other products. Three of these products are used as raw base materials and have a high correlation with the ethanol price. The wheat price showed the highest correlation with a value 0.82. Crude oil was also mentioned but showed no strong relation with the ethanol price. The weather and the involvement of governments were identified as strong external factors that determine the price of ethanol. The chapter ended with the growing concern among critics about the competition between ethanol and the food price. Since both ethanol and food use the same raw materials there exists a negative relation between the two and many critics argue that the government should stop or lower the support for ethanol production. It remains questionable to what extent ethanol impacts the actual food price.

Chapter 4 Case Study: Transammonia

4.1 Introduction

In the previous chapters the energy market and the ethanol market were extensively discussed. Several characteristics and external factors that can influence the price volatility of ethanol were identified. In this case study, the findings from the previous chapters will be applied on a real life case and will lead to a tailor made recommendation for Transammonia, which is a commodity trading company.

The main objective of the case study is to identify where synergy effects or business opportunities may present themselves when ethanol is added to Transammonia's existing trading portfolio. Multiple angels will be used to determine this in the case study. The first angle that will be researched is the by-product angle. A by-product could be a reason to step into a new product since most of the contacts are already in place and thus Transammonia is already familiar with the economic factors that influence a trading decision, such as supply and demand and political factors. The second angle and also probably the most promising angle is the backhaul approach. A backhaul solution means that for existing and common voyages with all kinds of product, ethanol can be used as cargo for the return voyage and result in higher vessel utilisation rates resulting in lower transport costs per ton of product.

Since the ethanol market is extensively discussed in chapter 3, there is a comprehensive background that will be used for identifying the synergy effects and opportunities. Besides the opportunities, the main barriers that might occur when stepping into the ethanol market will be identified and discussed. Before the interfaces between ethanol and the commodity trader are shown, our case subject Transammonia as a company will be thoroughly described in the next paragraph.

4.2 Transammonia

Transammonia is an international merchandising and trading firm that markets, trades, distributes and transports fertilizer and commodities (including pet coke and coal), ammonia, liquefied petroleum gases (LPG), and petrochemicals (chiefly aromatics). The history of Transammonia spans 46 years. The company was founded in 1965 with the intention of specializing in the international trade of ammonia, thus forming its name from "transporting ammonia". In subsequent years other products were added like fertilizers in 1976, liquefied petroleum gases in 1978, petrochemicals in 1987, methanol in 1992 and petcoke in 2009. Transammonia owns and operates propane storage and distribution facilities in New Hampshire and Florida, as well as an ammonia terminal in Illinois. Transammonia has participated in projects in which it financed construction of production, transportation and logistical facilities. Transammonia employs over 400 people operating in offices in 31 cities around the world. Transammonia's headquarters are located in New York but its main office, or nerve centre for the Fertilizer division which currently provides more than half of its revenue, is located in Altendorf in the canton of Schwyz, Switzerland. This Swiss main office will move to the city of Zurich from the beginning of November 2011.

During the fiscal year ended December 31, 2010, sales consisted of 31 million metric tons of products, with revenues of $8.5 billion. 2010 sales are shown in Table 6.

Table 6

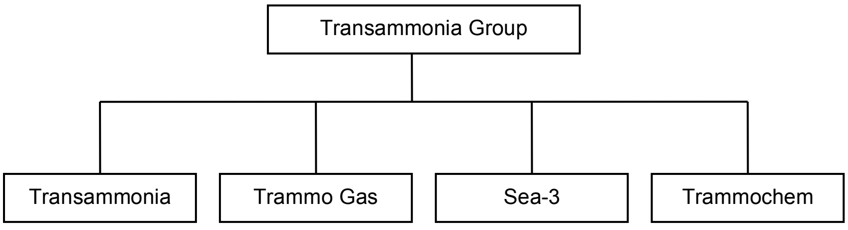
Transammonia Sales 2010 (millions)				
Product	**Physical (mt*)**	**Futures & Swaps (mt)**	**Total (mt)**	**Revenue ($)**
Fertilizer	15.1	1.4	16.5	3,800
Ammonia	3.3	0.0	3.3	1,200
LPG	2.9	4.8	7.7	400
Petrochemicals	3.4	0.1	3.5	3,100
Total	24.7	6.3	31.0	8,500

*metric tons
Source: Transammonia 2011

4.2.1 The Transammonia group

Diagram 1 shows the corporate structure of the Transammonia group. The group consists of 4 individual companies named Transammonia, Trammo Gas, Sea-3 and Trammochem.

Diagram 1



Source: Transammonia 2011

Transammonia

Transammonia is the world's leading independent marketer and transporter of anhydrous ammonia. Transammonia ranks with the largest private and government producers of ammonia in terms of tonnage sold in international trade. Transammonia's ammonia trade in 2010 was 3.3 million metric tons. Transammonia purchases ammonia from nearly 50 suppliers located in 14 countries and sells to customers located in 33 countries. It controls a fleet of gas tankers of varying capacities in order to support its international trade. Transammonia has a major presence in the U.S. domestic ammonia market. It has product available at various terminals around the country. Transammonia delivers ammonia by barge, railcar and truck.

Transammonia sold 6 million metric tons of urea worldwide in 2010, as well as 2 million metric tons of other nitrogenous fertilizers. Sulfur sales in 2010 were 3 million metric tons. Transammonia controls a fleet of sulfur rail cars dedicated to deliveries to its contract customers in the United States.

Transammonia's 2010 volume of 1.8 million metric tons of sulfuric acid traded makes it the largest trading company in this field. In the United States, Transammonia controls 25,000 tons of sulfuric acid storage on the Mississippi River in Louisiana, with the capacity to load trucks, railcars and barges with a variety of grades of acid.

In 2010, Transammonia sold nearly 1 million tons of Petcoke. Petcoke is a carbonaceous solid product derived from oil refineries. Transammonia also trades about 2 million tons of NPK (nitrate phosphorus potassium) and other Phosphates per year. NPK and Phosphates are used as fertilizers all around the world.

Trammochem

The Trammochem division trades in petrochemicals and methanol. Trammochem is headquartered in Altendorf, Switzerland and shares its offices with the Fertilizer & Commodity headquarters there. It has division offices the United States, Singapore and China. Trammochem trades olefins, aromatics, methanol and pygas worldwide. The traded volume in 2010 was 3.5 million metric tons.

Trammo Gas

Trammo Gas is located in Houston, Texas, and trades LPG in the U.S. market. Propane accounts for the majority of the volume, but Trammo Gas also trade ethane, butane, iso butane and natural gasoline. In 2010, Trammo Gas traded approximately 7 million metric tons of products. Trammo Gas operates two gas carriers under long term time charter contracts. They are engaged in the worldwide transportation of LPG for third parties. LPG products are traded and merchandised by Trammo Gas & Sea-3.

Sea-3

Sea-3 is the largest importer and distributor of propane in the Northeast United States trough its propane terminal in Newington, New Hampshire. In 2010, the Newington terminal sold 315,000 metric tons of propane. The total capacity of the facility is 51,000 metric tons. As a vital link in the Northeastern energy picture, Sea-3 is a source of portable energy to homes ands businesses that are not connected to a natural gas utility network. Besides that, Sea-3 provides a practical alternative to increasing electricity prices and unstable oil supplies. Sea-3 also participates in gas marketing on the Gulf Coast and other areas of the United States. Sea-3's annual volume is about 350,000 metric tons per year. Sea-3 of Florida owns a 50,000 metric tons propane terminal at the Port of Tampa. This is centrally located in the heart of the state's industrial west coast. Sea-3 of Florida supplies propane to the western and central positions of the state.

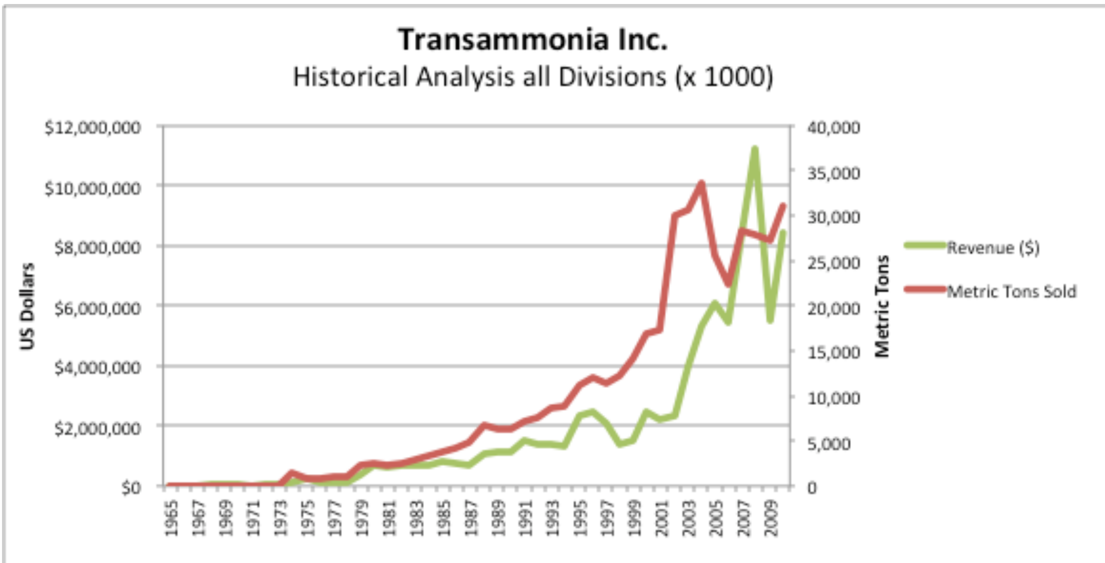
As can be derived from the previous part, Transammonia is a well established and experienced commodity trader. They have a fairly big trading floor, an in-house chartering department, strong back offices and dozens of agents around the world that constantly keep track of the market.

4.2.2 History and Growth

Chart 7 shows Transammonia's historical analysis of all divisions of both the yearly revenue and the total metric tons sold in each fiscal year. Since Transammonia was founded, in 1965, both the revenue and the total metric tons sold have increased rapidly. This increase in both revenue and volume was accompanied with a steady but slow increase of employees. The number of employees of Transammonia today is low compared with its competitors in the business.

The metric tons sold showed an exponential growth between 1990 and 2004. During this period the total metric tons sold increased from nearly 6.3 million tons to 33.6 million tons. After 2004 there was a small period where the metric tons decreased to 22.3 million tons in 2006. Since 2006 the graph shows an increasing trend again and also for the fiscal year 2011 Transammonia's management expect a higher volume than 2010.

Chart 7



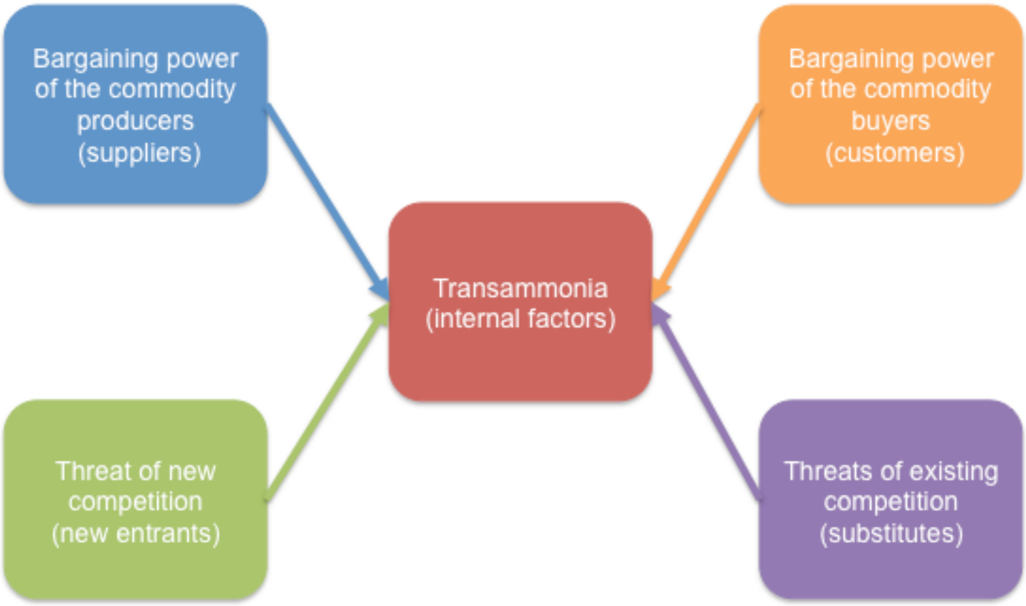
Source: Transammonia's In-House Data 2011

The revenue that has a correlation of 0.85 with the metric tons sold shows a similar pattern. There can be one clear exception identifiedbeing the spike that occured during the 2008 year. During this year the commodity price of a lot of products that are in Transammonia's portfolio showed extreme rare volatitilty and rapid increase. As explained before, volatility creates opportunties for traders to increase margins and thus increase revenue and if played well also an increase in profits. According to the data, Transammonia created an incredible revenue stream of 11.2 billion dollars during this year, which is also known as the commodity bubble. After the bubble burst in 2009, many trading companies went bankrupt or encountered high losses. Transammonia's revenue dropped that year from 11.2 billion to almost 5.5 billion while the traded volume remained almost similar, around 27.5 million tons.

4.2.3 Strengths, Weaknesses and Threats

To asses the strengths, weaknesses and threats within Transammonia's operations, Porter's five forces model is used. This model is based on five forces that influence the competitive intensity of a market (Porter, 1979). Porter created the model after his displeasure with the conventional SWOT[13] analysis from that time. The model is slightly adjusted to fit Transammonia's business structure and this version makes is more useful to assess Transammonia's strengths, weaknesses and threats. The five forces that are taken into account are the bargaining power of the commodity producer; bargaining power of the commodity buyer; threat of new competition; threat of existing competition; and internal factors. Diagram 2 shows the forces in the adjusted model.

Diagram 2



Source: Robin Zwiers 2011 (Model based on Porter 1979)

After consulting several employees of Transammonia with significant years of experience with the company, a clear picture of the strengths, weaknesses and possible threats could be constructed. In the next section the strengths, weaknesses and threats are explained using Porters adjusted model. The factors that were identified are coming from a general assessment and were mainly focused on the office of Transammonia in Switzerland, therefore these factors may not be applicable for all offices within the Transammonia Group.

[13] A SWOT analysis is a planning method that is used to identify the strengths, weaknesses, opportunities and threats of a business venture. The method was invented by Albert Humphrey in 1960's.

4.2.3.1 Bargaining Power of the Commodity Producer

The actual bargaining power of the commodity producer compared with Transammonia's bargaining power depends completely on the market situation. The market situation reflects the balance between supply and demand of a product. Depending on the position of the balance, either the producer or Transammonia will have the upper hand or the benefit during price negotiations. According to economic market theory, if the market price is high due to high product demand, Transammonia has low bargaining power since there is high competition. In this situation, Transammonia becomes a price taker. If the market price is low due to low product demand, Transammonia has some bargaining power. The producer will be willing to sell at lower prices. This theory is not applicable to the market where Transammonia operates. In nearly every situation, the market price will set the final price. There is almost no room for negotiations and there is definitely no room for any discounts. Even long term strong relations between the producer and the trading house will not make a big difference. The only advantage that a long term relationship holds is the fact that the producer will first contact the trading house with the best relationship and therefore the advantage will not be a cheaper product, but rather the advantage of actually having the privilege to trade or buy the product.

The first strength of Transammonia that can be identified is their strong relationship with many producers. Transammonia is listed as a high ranked trading house on many producer lists. This position is crucial to attract products and therefore business. They have established this position due to their reliability over the last decades. Their reputation in the market is almost flawless due to their constant performance in all types of market situations. Reliability is crucial to perform on the long term according to Transammonia's management. Thereliability rating is maintained by the high liquidity of Transammonia's financial situation. Transammonia is well known for its stable financial position and can rely on a large credit base provided by banks. Apart from the high reliability rate and guaranteed performance, prepayment of product possibilities from the beginning of Transammonia's days have resulted in good relationships between producers and Transammonia. A lot of the products that are traded by Transammonia come from the Baltic States. These countries were always low on cash. Due to prepayments of products by Transammonia, producers could agree on contracts with third parties and finance these raw materials. This prepayment tool required a lot of trust in counterparties but also resulted in strong business relationships. The relationship that was created with the prepayment tool is still very useful today.

A form of bargaining power producers might have can be that major producers are able to sell their product directly to the end users. Some companies are big enough to skip the traders and sell the commodity themselves. If producers are also acting as traders they can keep part of the margin between production costs and product price in-house and this will result in more bargaining power. It should be noted that producers are producers and do not have the same expertise as the well established trading houses.

As shown in this section, the bargaining power of the commodity producer highly depends on the market situation and is very small. There is little or no room for negotiations because the market price sets the final price. This market price can be in favor of the producer or in the favor of Transammonia but bargaining power has little influence on the final price.

4.2.3.2 Bargaining Power of the Commodity Buyer

Similar to the previous case, the bargaining power between the commodity buyer and Transammonia highly depends on the market situation. It is the balance between supply and demand that determines the advantages for either party. Nevertheless, the bargaining power of the buyers is a little bit stronger compared with a producer. The bargaining power of a buyer depends on its size. A big and solid buyer will be able to get a better price because this buyer will receive a lot of offers from the many trading houses to through which to buy their product. Due to all these offers they can easily pick the cheapest. Hence, the price will be lower than the market price.

Apart from the size of the buyer, their location can influence its bargaining power. There is a major difference between countries with respect to loyalty, reliability and trading ethics. These differences result in lower prices for respectable countries and higher prices for countries that are not trustworthy. For example, Chile is a respectable and trustworthy country which has a good bargaining position and receives normal market prices. Peru, one country located above Chile, is not respectable and trustworthy. Due to this, the prices for the same commodity are higher for buyers in Peru compared with buyers in Chile, therefore the location influences the bargaining power of a buyer.

The lower risk of non payments is another reason why the major buyers are more interesting for Transammonia. Major buyers have higher liquidity so the risk that they are unable to pay is much lower, hence the major buyer has some power because their price will be a little bit lower than for a smaller buyer.

A second strength that can be identified for Transammonia has to do with their broad product portfolio and how they can offer all products required in the agricultural fertilizer sector. Due to this extensive portfolio, Transammonia becomes a one stop shop. Buyers with various product demands can be served completely by Transammonia and do not need to contact any other competitors. This is convenient for the buyers and results in loyal customers for Transammonia.

The third strength of Transammonia is its extensive network. This network, with more than 30 offices worldwide results in quick deals and fast moving products. The network also embraces good relations with warehouses, transportation modes and external consultants that guarantee a smooth process. These aspects are very attractive and it is therefore very pleasant for a buyer to do business with Transammonia.

4.2.3.3 Threat of New Competition

Almost everyone with a little bit of market knowledge can start a commodity trading company and just start trading, however to become a real competitor, a new entrant requires much more than a little bit of market knowledge. If a company wants to become a significant player in the market, it requires worldwide contacts, high investments to attract skilled people, financial support to prepay and finance certain deals and chartering knowledge. Due to these requirements it is fairly difficult to enter a commodity market as any real threat.

There is one more advantage that Transammonia has gained due to their experience in the fertilizer trading business. This is the experience and the courage to take the risk that is involved with trading a flat priced exposure product. Flat price exposure means that there is no option to hedge the risk of the product. Many trading houses like Glencore and Noble tried to enter fertilizer market but left it after a couple of years because this high risk profile did not stroke with their experience. The fact that Transammonia is has the experience and is able to deal with these high risks, is another strength that can be identified.

Even though there is a certain level of expertise required to enter this market, there are some threats of new competition. The first threat of new competition comes from Transammonia themselves. Transammonia have trained a lot of traders and gave them the opportunity to grow in the business. A few of these traders have left the company and have started their own trading houses. It is almost impossible to avoid this problem and every trader has a special clause in their employment contract trying to protect against this or at least halt the immediate start up after their employment ends however after a certain period of time, they are able to begin their own businesses. This is a threat of new competition that is very common in the industry. The fact remains that people can leave after gaining some short, medium or long term trading experience to start their own businesses can be identified as both a threat and weakness for Transammonia.

The second threat of new competition comes from existing traders in companies that are active in other products and sectors. These companies see an opportunity in the fertilizer market because the market offers high volatility in prices. When markets have high price volatility, they become very interesting for traders to become active in because the possible margins increase. High margins are interesting but result in higher risk. As mentioned earlier, a lot of companies have entered the market but also left again due to the high risk and the absence of possible hedging. This said, many established trading houses still try to enter the market by contracting experienced traders. This is a serious threat for Transammonia.

The third big threat for new competition comes from the producer’s side. Current major producers are trying to land a foot in the market. These producers see a good opportunity to increase profit and get a better insight in the market by starting trading divisions. These producers will trade their own product but also become active in other products within the market. Because these major producers have a lot of money, they are willing to invest enormous amounts in attracting skilled traders or takeover complete trading houses. Because producers are producers and are not skilled in trading, they are forced to invest heavily in skilled labour. In summary, these major producers are a severe threat for Transammonia.

It also works the other way around. Once Transammonia enters the ethanol market as a new competitor, the current market players will notice this. Existing market players in the ethanol market will take Transammonia very serious due to their strong track record and profitable history. As explained before, the ethanol market is a mature competitive market and it is very hard to do something about new competitors. It is therefore that the existing market players will and must accept the presence of Transammonia. The current market players can only deal with them by out performing and keep their business relations close by. So existing market players are not pleased with the possible presence of Transammonia but they must accept and deal with it in their own way.

4.2.3.4 Threat of Existing Competition

The threat of existing competition for Transammonia is very low. For a long time, this market is operated by dozens of trading houses. In comparison with most of the competition, Transammonia has a significant market share. In the UAN business they have at least 25% of the total market, which results in substantial market power. In the sulfur and the sulfuric acid business Transammonia is also market leader. The high market share on several business fronts are also a strength of Transammonia since market share leads to market power and market power can result in better business opportunities and thus higher profits.

Other than the fact that Transammonia has a lot of market power, the fertilizer market has always been very stable. Companies enter and companies leave the market but the market remains more a less the same with respect to the total players and market power distribution. Due to this reason and the historical background of Transammonia, there is not a direct threat from the existing competition.

4.2.3.5 Transammonia Internal Operations

Not only the external factors create strengths, weaknesses and threats for Transammonia, internal factors are also contributors to overall business performance. Internal operations result in either strengths or weaknesses within the company. There are also several threats that might influence business performance.

Transammonia has dozens of strengths but there are two important strengths that deserve additional explanation and are noteworthy.

The first strength includes the good working environment within the company. This is a result of a different vision than is common in the trading world. Transammonia management places emphasis on group effort instead of personal achievements. The commodity world is becoming more complex and it becomes harder to identify personal achievements due to all the resells and complicated trade structures. Transammonia management decided to switch from a personal performance approach to a more group performance approach several years ago. Deals are made as a company and the reward system has also been altered. Employees feel like they are working in a family and this results in good employee relationships. Also the relationship between the chartering department, traffic department and traders is close and works smoothly. For a commodity trading company this is extremely rare. These strong relationships result in employees working with and for each other to reach the best possible overall company result. Among the trading companies in this sector, the positive working environment is well-known. Transammonia is an attractive company and many traders want to work for them. Due to this reason, only high skilled and good fertilizer traders are working for Transammonia.

The positive working atmosphere is not only a result of the good relations among the employees but also the freedom that employees are given helps. Every new employee gets enough time and space to prove themselves and are not constantly checked and corrected by superiors. This may result in some losses but overall the flexibility and performance of the company increases substantially. This approach also gives employees the freedom to determine their own office hours. As long as they perform, management will support them. This creates an extremely comfortable working environment and stimulates employees even more to perform. This working ethos is the second strength of Transammonia and as mentioned before, this strength is very rare and is even known to be rare outside the company.

The two aforementioned strengths result in extremely good performance and are the reasons why Transammonia is currently one of the best fertilizer trading companies in the world.

Due to the good performance Transammonia is growing substantially. This growth is causing some negative side effects that are applicable due to several weaknesses and might even result in threats if they are not dealt with. Due to the increase in size of the company it becomes paramount to have a human resource department. The absence of this HR department is identified as a weakness. As a result of this absence, there is hardly any communication between offices regarding the positioning of skilled people. This lack of HR communication is only getting worse as the size of the company increases. This will lead to inefficiencies and lost opportunities if not dealt with. This threat has been recognized and currently the management is trying to set up an HR department.

Besides the HR weakness, there is a lack of academic background on a broader base at Transammonia. Most of the employees that are working at Transammonia have no academic background. These employees are very good at their work but only have a particular knowledge. This is not directly a threat but can be identified as a weakness. Additional educational programs and trainings can increase employee's hard and soft skills. Training and workshops could be useful in time management, accounting, financial services and social skills. Besides skilled knowledge, overall broader knowledge of employees could increase performance.

The last threat is a result of a recent development. By adding new products outside the fertilizer market to the trading portfolio, the threat of diversification arises. Because the fertilizer traders do not have the knowledge about the new products, new people need to be attracted. These people are coming from other companies where different standards and working ethos exists. It is crucial that these new employees get familiar with the standards of Transammonia with respect to risk management, communication and working ethos. If Transammonia does not deal with this threat it might become a problem.

So the main strengths of Transammonia are the strong relationship with it customers, both buyers as producers; Transammonia's broad trading portfolio; the extensive network of offices and agents worldwide; and the extremely good working environment and ethos. The main weaknesses that could be identified in this paragraph are the impossibility to avoid skilled labour going to the competition; the absence of a human resource department; and the lack of academic background of part of the employees. As far as the threats go, these were mainly identified as existing traders becoming competitors; producers becoming traders and direct competition; the absence of a HR department could lead to inefficiencies and opportunity losses; and due to new products a diversification of standards among traders might occur.

4.3 Barriers and Opportunities of Ethanol

The next section of this case study will be about the problems and opportunities that might occur if Transammonia starts trading ethanol. It will describe the former experience of Transammonia with the product, the approaches that are normally used when a new product is suggested and ends with two possible arguments why ethanol could be a good fit. All the experiences and solutions that are identified are based on interviews and meetings with experts that work either for Transammonia or have a connection with Transammonia.

4.3.1 Barriers

Till 2008, Trammochem used to trade ethanol. After a couple of years Trammochem stopped trading ethanol and dropped the product. According to their traders, there were several reasons why ethanol was taken out of the portfolio. The reasons for their decision during that period could automatically become possible barriers for Transammonia to step into the current ethanol market.

The first reason was the lack of knowledge in both the influence of the weather and market knowledge of the Brazilian sugar market. As explained in chapter 3, there exists a strong relation between the weather and the price of ethanol. It is beneficial and maybe crucial to know the influences of the weather on the future ethanol prices if a trader wants to take a position in the ethanol market. The lack of knowledge about the Brazilian sugar market can also easily be explained. Sugar cane is a raw base material of ethanol and thus crucial for its production. Trammochem had only one agent located in the Brazilian region and it showed clearly that one person is was not enough to fully cover the complexity of the Brazilian sugar market. Local market knowledge is crucial for understanding the market and since Transammonia currently is not extensively Brazilian oriented, this might be a barrier.

The second reason for Trammochem to stop the ethanol operations was caused by the increase of governmental influences. As explained in chapter 3, the governmental influence on ethanol is extremely high. This has to do with the strong relation with food and also with the sustainable character of the product. There exists a negative relation between the price of food and ethanol. This negative relation results in negative publicity. The sustainable character of ethanol also increases public concern; it may be positive but still attracts attention to the ethanol market. Due to the increase of public and governmental attention, more and more regulations are applicable and standards are introduced. Too many standards and uncertainty about regulations were the second reason for Trammochem to stop trading ethanol. According to FAPRI (2010b), the same problems and uncertainty among ethanol legislation as in 2008 remain in place. This uncertainty will definitely be a barrier for Transammonia to enter the ethanol market.

The lack of synergy with other products was the third reason for Trammochem to stop trading ethanol. According to Wind & Robertson (1983), possible synergy effects should be a key component of any new product strategy. It is essential and saves a lot of costs if multiple products in a portfolio generate synergy effects. In the Transammonia product pallet there are some product possibilities to establish synergy effects. The products UAN (Urea Ammonia Nitrate) and sulfuric acid might generate synergy with ethanol. These product and their opportunities for synergy will be discussed at the end of this chapter. There is no clear evidence that the lack of synergy could become a barrier at this point.

Besides the barriers that can be identified from previous experiences, there are two other barriers that are worth mentioning and are applicable to Transammonia.

The first barrier that was mentioned by several experts of the market is the requirement for vertical integration. It is very common in this business that the ethanol trade is supported by supply chain power. This supply chain power can be achieved by increasing vertical integration. The major players that own, operate and trade their own ethanol have no intention nor need to supply it for trade. During the research in the United States, it became clear that there are some producers of ethanol that are willing to sell ethanol to third parties. These producers produce enough volume of ethanol to maintain an interesting ethanol stream to foreign markets. This is the only realistic option for Transammonia to deal with the lack of vertical integration. The only link that Transammonia has with the ethanol supply chain is the supply of fertilizer to some of the corn producers. Since Transammonia is not active or involved in the ethanol supply chain, this barrier might create a problem and must be dealt with.

The second barrier occurs once ethanol is added to the portfolio. Currently Transammonia is a little bit understaffed due to new products and the increase of business. Adding another product to the portfolio puts even more pressure on the current employees and therefore new and skilled people are required. Attracting new and skilled people is always a delicate and difficult matter. The process of scrambling new people from the ethanol sector might not be easy and the increase of pressure can become a problem.

4.3.2 Opportunities

Every product that can be classified as a bulk commodity could be an interesting business opportunity for Transammonia. The reason can be found in the three crucial skills that a trading company requires. These skills are finance, freight and trading skill. Even though Transammonia has all three skill sets and decades of experience with trading bulk commodities, not every bulk commodity product is suitable. Due to several reasons one product is more suitable than the other. This sub section will discuss the requirements for new products and describes why sometimes exceptions are made.

4.3.2.1 The "New Product" Approach

During the year a lot of products are being assessed by the Transammonia management and its staff to identify the potential behind the product. Before the product is thoroughly assessed, the product needs to meet certain requirements. Together with consultants and specialists, management has set 6 parameters that must be met before the product gets a fair chance. These parameters are not edged in stone but are merely indicative for all staff as orientation for which products could be a good fit. Transammonia's management has set the following 6 parameters:

1. The commodity has to be physical
2. The commodity should be mainly flat priced exposed (i.e. no sophisticated hedging should be possible)
3. The active players in a new product should not be much larger than Transammonia
4. Transammonia should be able, with proper staffing and sufficient funding, to get to the top 3 in a new product volume-wise, within 3-4 years from start up
5. Product should be non-perishable and not directly food related
6. The sea borne trade of the product should be a significant part of the global production

As mentioned, the parameters act as a rough guideline to identify suitable new products. Every product has its own unique opportunity and that unique opportunity might be strong enough to convince management to step into the product and add it to the portfolio. Even if only two parameters are met, the products could still be a good fit. This was the case with the newest product of Transammonia, coal. Coal did not meet criteria 2 to 4 and still management decided to get into coal trading. The unique reason for adding coal to the trading portfolio can be found in the connections that Transammonia already had established via its petcoke trading operations. Petcoke and coal are very closely related, so all connections were already established and proven to be useful. The connections that must be in place before a product might become profitable are buyers, sellers and distributors. These three components are crucial and must be fully controlled by a trading company to become successful. Eventually the "by-product" background, thus all the established contacts in the coal market, convinced the management to step into coal trading.

If management's 6 parameter assessment is done for fuel ethanol, just like coal, not all of them can be met. Parameter number one will be met since ethanol is a physical product. It is traded as a bulk commodity just like any other product from the Transammonia portfolio. Number two of the parameter list mentions the absence of hedging possibilities. There is an opportunity for companies to hedge ethanol, thus this parameter is clearly not met. The third parameter is also a problem. As showed in Table 3 in paragraph 3.5, Transammonia is a minor player compared with current market players. Parameter 4 is ambitious but in theory it can be possible. After consulting several ethanol experts and Transammonia employees, it is extremely doubtful that this parameter will be met. As far as parameter 5 goes, ethanol is not perishable but, as explained in the previous chapter, it is food related. The last parameter will be met since all volume that is traded is seaborne cargo.

As mentioned before, these parameters are only used a rough guideline. Since most of the parameters are not met, different arguments are required to show a potential fit between ethanol and Transammonia. The next part of this case study will explain and assess two of these arguments that show a reason why ethanol could be a proper fit. The first argument is based on the "by-product" approach and the second argument is based on the "backhaul" possibility with existing products.

4.3.2.2 The "By-Product" Approach

To use the "by product" approach as an argument for trading ethanol, the connection between a currently traded product and ethanol must be identified and assessed. The closest products that touch the ethanol market are fertilizers. There are several different types of fertilizers and Transammonia trades almost all of them but for convenience this research uses the term fertilizer. As mentioned earlier in this research, ethanol is produced by using agricultural products like sugar cane and corn. Fertilizer is used to increase the yield of corn and sugar cane crops, so people could argue that there is a strong connection between fertilizers and ethanol. In theory this is because by applying fertilizer crop yields increase and thus the output of ethanol increases; perfect synergy. Due to this strong relation, people might think that these contacts used for fertilizers could also be used for ethanol trade. In theory this is right, but it is a bit more complex and does not really work like that. The problem here is that Transammonia does not sell fertilizers to the end users but rather to the importers, wholesalers or retailers. These customers are not directly in contact or involved with the ethanol producers, with the exception of a few. A typical supply string for a shipment of fertilizer from the Baltic States to the United States would be:

Russian producer → Transammonia → US importer → Cooperative → Farmer

The position of Transammonia in the string is to act as a middle man between the Russian producer and the US importer. There are two more nodes in the string that prevent direct contact with the farmer or corn producer that might sell the corn for ethanol production.

The typical string for the purchase of US corn ethanol to the European market would be:

Farmer → Cooperative → Ethanol producer → Transammonia → European importer

Again Transammonia acts as a middle man, this time between the Ethanol producer and the European importer. This is just like the fertilizer string, two nodes that prevent direct involvement with the farmer that uses the fertilizer.

If both strings are compared, it shows that Transammonia's fertilizer customers are not directly involved with producing ethanol. If there was an ethanol string in place, the Transammonia customers would not be directly involved in the fertilizer sector. This absence of involvement shows that the by-product angle is not present. In practice the customers have some sort of relation with ethanol producers but not strong enough to speak of a by-product classification.

After having researched this topic, it showed that especially in the United States the weak link between fertilizer agents and ethanol producers is actually fairly strong. Most market players are well connected and have overlap in several sectors. Transammonia has several agents in the United States that have significant connections in the ethanol sector. These connections could be used as an entrance to the US ethanol market but are not strong enough to directly step into the market.

Because the network of agents and offices of Transammonia in South America is much smaller than in the United States, penetrating the Brazilian ethanol market will be much more of a problem compared with the US market. The fact that Transammonia has only a few agents in Brazil and has little market knowledge, is the reason that the next section of this research, the backhaul model, is only focused on the US ethanol market. Nevertheless, for

Transammonia the Brazilian market is not as attractive as the US ethanol market but Brazil is extremely important for the ethanol sector and should not be neglected.

To conclude, the by-product angle of ethanol is not very strong with the existing products that Transammonia has in its portfolio. The US ethanol market shows the highest potential for a decent fit but the connections that are in place there with the market are not strong enough to completely rely on this approach.

4.3.2.3 The "Back Haulage" Approach

The backhaul phenomenon refers to a situation where the volume of transported goods is not in balance between one or more locations. This implies that the cargo between two or several destinations flows mainly in one dominant direction (Demirel *et al.,* 2010). At least since the discussion by Pigou and Taussig (1913) about joint costs, the "backhaul" problem is one of the main classical research problems in transportation economics. Imbalance in freight transport flows is a very common phenomenon and many trading companies all around the world have to deal with it. Naturally this problem implies additional transport costs. First of all there are the direct costs because of the empty return, or ballast leg. Ballasting means that there is no cargo on board and ballast water is used to keep the vessel steady during the return trip. Ballasting does not generate any kind of revenue and will only produce costs. Secondly there is also opportunity costs associated with the ballasting leg. The company that is responsible for the cargo supply will always commit to the maximum transport capacity required for a round trip. Due to this ambition, they will always face a logistical problem, the so called back haulage problem. The opportunity costs associated with returning empty highly depend on the shipping direction (Wilson, 1987). For example, if a vessel returns partly or completely empty to the port of origin, that vessel has very low opportunity costs of transporting additional goods in that direction. The company responsible for the cargo supply is then enticed to undercut the price set by any fully loaded vessel. This mechanism puts a downward pressure on freight rates in the direction of the excess supply of transport services (Behrens & Picard, 2011).

There are several reasons that explain a trade flow imbalance. The first reason that can create a cargo flow imbalance between locations has to do with market size of the product in question. This reason for trade imbalance is very common all around the world (Lee *et al*., 2006). The size of a market is determined by both the supply and the demand side of a product. For instance in the ethanol market, Brazil and the United States are two major production locations. From these two locations enormous quantities of ethanol are being transported to locations that require ethanol, Europe for example. This means that there is an imbalance of ethanol trade between Brazil and Europe and the United States and Europe. This imbalance results in a back haulage problem for a vessel that only transports ethanol because the vessel will go fully loaded to Europe and needs to ballast its way back.

A second reason that creates a cargo flow imbalance between locations has to do with the technical aspects of a vessel (Demirel et al., 2007). A lot of vessels are limited to carry multiple products or several cargo types. For example, special chemical tankers that are used to transport LNG (liquefied natural gas), so called LNG carriers, are extremely expensive and are specially built to transport that product. These vessels are capable of transporting LNG because the tanks are kept under extremely cold temperatures and high pressure conditions. It is therefore impossible for a LNG carrier to carry other products than LNG. This technical limitation results in a cargo flow imbalance because the port of destination cannot provide cargo for the backhaul of the LNG carrier.

As explained in paragraph 3.4, the requirements to transport anhydrous ethanol are fairly low. The transport can be done with chemical tankers or even with CPP tankers. According to Transammonia, chemical tankers are used all around the world for all kinds of different products. Certificates that are provided by the tank builder determines what kind of chemicals are allowed in the tanks. Besides the tank's certificates, the tank history plays also an important role. The FOSFA lists, as explained in paragraph 3.4, shows what kind of product is allowed for a possible next cargo.

On the FOSFA list, dozens of allowed and approved product types are listed. Among other allowed products, there are two products listed that are currently being traded by Transammonia. The first product is called UAN (Urea Ammonia Nitrate) and is a solution of urea, ammonia and nitrate. UAN is being used as a liquid fertilizer. The second product is called Sulfuric Acid and is principally used in car batteries, ore processing, fertilizer manufacturing and oil refining. These two products may be the key that will answer the case study objective. The next paragraph will research the opportunities that are possible when UAN or Sulfuric Acid is being combined with a backhaul of anhydrous ethanol.

4.3.2.3.1 Sulfuric Acid and Anhydrous Ethanol

The first product that could be an interesting opportunity for Transammonia to combine with ethanol trade is Sulfuric Acid. Sulfuric acid is principally used in car batteries, ore processing, fertilizer manufacturing and oil refining. Currently, large volumes of sulfuric acid are being transported from either the Far East to Chile or from Europe to Namibia. Smaller volumes are being transported from the Far East to Brazil or from Europe to Brazil. The sulfuric acid in Europe is shipped from ports in either the Baltic States or from the Black Sea region.

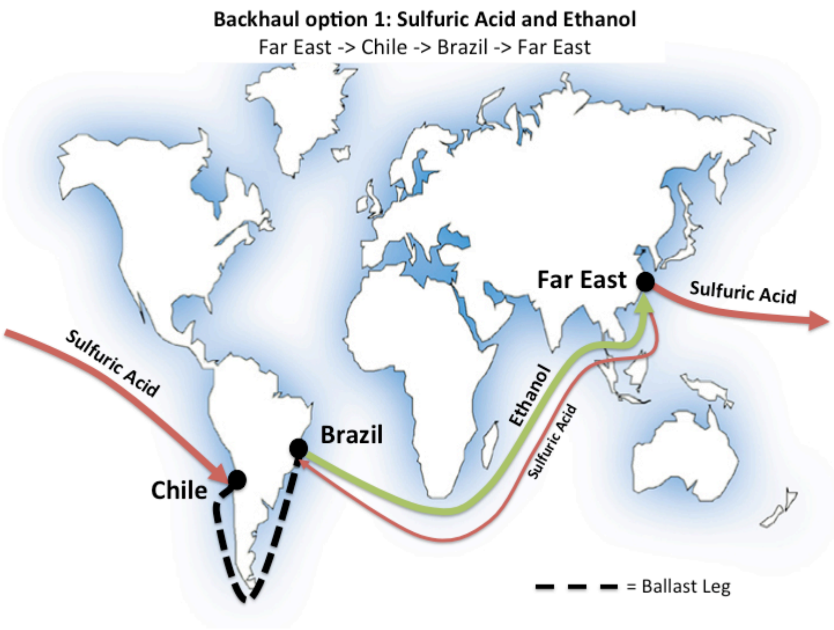
The main volumes of sulfuric acid are being transported to the South American continent. This means that there could be an opportunity to combine this with a cargo destined from the South American continent back to Europe. A large part of the total ethanol trade is bound from Brazil to Europe. Since Brazil is situated in the South American continent, ethanol could be the perfect opportunity to act as back haulage cargo. If this combination would be possible, the vessel that is used will have a high utilisation rate due to both legs being filled with cargo, either ethanol or sulfuric acid.

From the Far East, two routes are possible. The first route starts with a leg of sulfuric acid from the Far East ports to Chile via the Pacific Ocean. Once it arrives in Chile, the sulfuric acid is discharged and the tanks are cleaned. From Chile, the vessel will ballast around Cape Horn to a port in Brazil. In Brazil the ethanol cargo is loaded into the tanks. From Brazil the vessel will go around the Cape of Good Hope, through the Malacca Strait to deliver the ethanol to the Far East ports.

The second route starts with a leg of sulfuric acid from the Far East through the Strait of Malacca and around the Cape of Good Hope to Brazil. In Brazil the sulfuric acid is discharged and the tanks cleaned. After cleaning, the ethanol is being loaded into the tanks and the vessel will sail the same route back to the Far East.

This first route results in a ballast leg from Chile to Brazil which is not beneficial since it does not create revenue and only add costs. Even still this will be the main route when combining sulfuric acid with ethanol since the main volumes of sulfuric acid are traded from the Far East to Chile and not from the Far East to Brazil. Both routes are drawn in Illustration 4.

Illustration 4

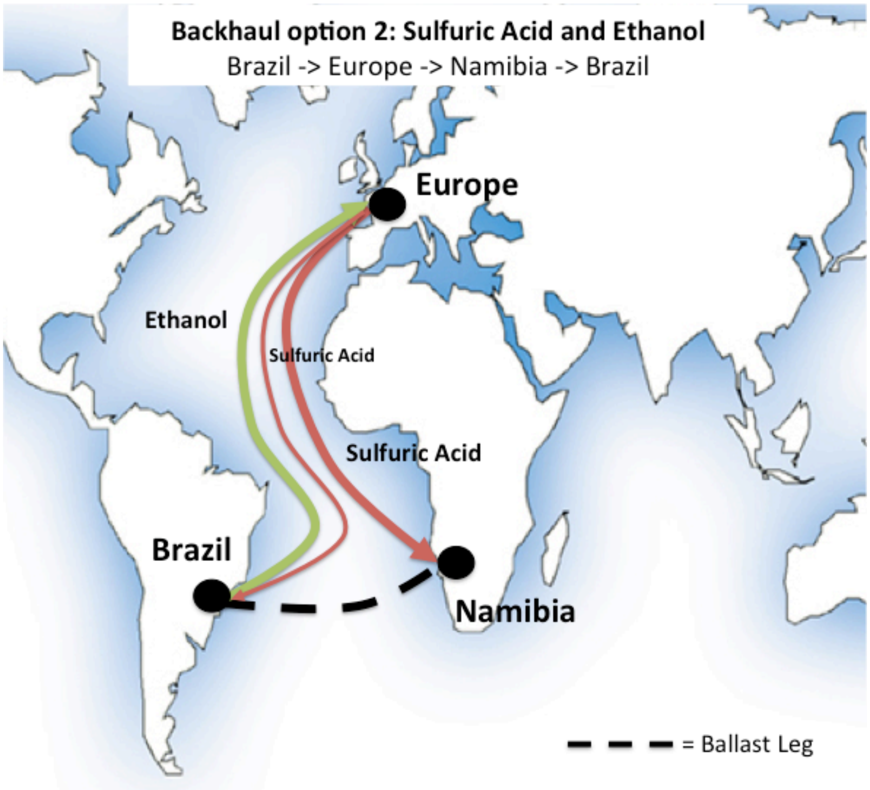


From Europe there are also two routes possible to combine ethanol with sulfuric acid. The first route starts somewhere in Europe, either in the Baltic States or in the Black Sea region. From there the sulfuric acid is transported via the Atlantic Ocean, directly to Namibia. In Namibia the sulfuric acid is discharged and the tanks are cleaned. Between Namibia and Brazil the vessel will ballast. Once the vessel arrives in Brazil, the ethanol is loaded into the vessel's tanks and sails back to Rotterdam, the main port of Europe's ethanol imports.

The second route is directly between Europe and Brazil. The vessel will depart with sulfuric acid from the Baltic or the Black Sea and heads directly to a Brazilian port. In Brazil the sulfuric acid is discharged and the vessel cleaned. After cleaning, the ethanol will be pumped into the vessel tanks and it sets sail back to the European continent to discharge the cargo in Rotterdam.

The first route with the ballast leg is the main route due to the high volumes. The ballast leg between Namibia is not beneficial but will be compensated by the large volumes that are transported. Both routes are drawn in Illustration 5.

Illustration 5



4.3.2.3.2 UAN and Anhydrous Ethanol

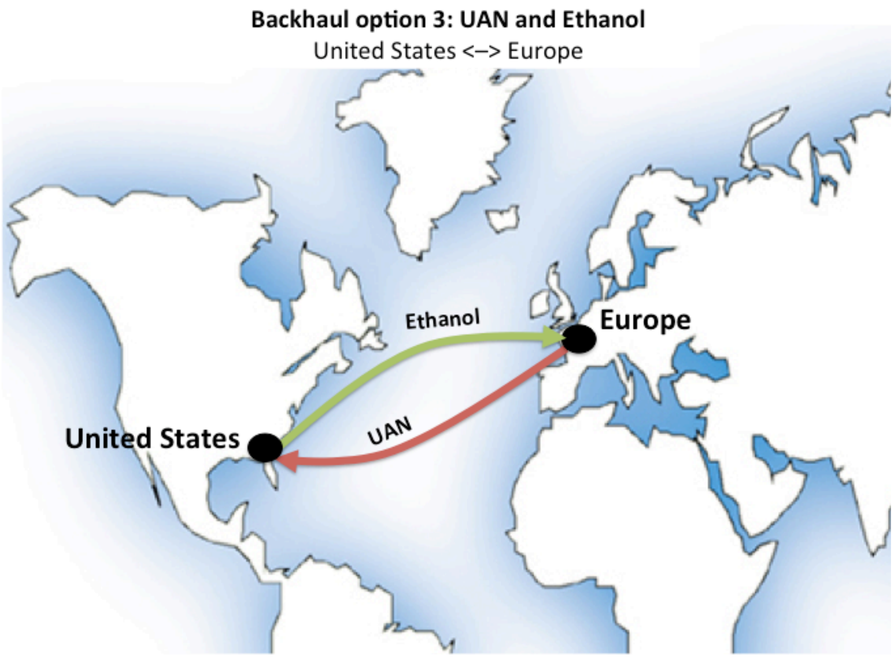
The second product that could be an interesting opportunity for Transammonia to combine with ethanol trade is UAN (Urea Ammonia Nitrate), a solution of urea, ammonia and nitrate. UAN is being used as a liquid fertilizer. Currently Transammonia trades high volumes of UAN from Europe, both from the Baltic States and the Black Sea region, to the United States.

Since Transammonia has a well established network in the United States, the chance of combining this UAN trade with ethanol is probably the most likely option in the near future. This has to do with the good connections in the United States, easy access to the major ethanol plants due to the extensive road networks and the trade patterns show similarity. The volumes that are transported between the two continents on a monthly basis covers enough ground to be interesting. According to Transammonia, 50,000 tons of UAN is shipped from the Baltic Countries and the Black Sea region to the United States. According to UAN importers in the US, it must be mentioned that there is a difference between the shipping patterns of UAN and ethanol. Due to crop cycles, peaks for both products occur during a different time period. UAN has a steady shipping pattern during the year but a high increase of product during spring. The peak for ethanol is not during spring but rather after the harvesting period being late summer. This difference during the peak must be handled with care.

The main routes for UAN go from the Baltic States and the Black Sea region to either the East Coast of the United States, like New York, or to the Gulf area, like Tampa, New Orleans or Houston. According to several fixing reports, the ports of Houston, New Orleans and New York are already being used as export ports for ethanol destined for Rotterdam, so there is an opportunity for direct cargo for the backhaul to Europe.

The route drawn in Illustration 6 shows that the vessel will load UAN in either the Baltic States or in the Black Sea region. After loading, the vessel goes directly via the Atlantic Ocean to the United States. Discharge of UAN will be done in either New York or a port in the Gulf. In the same port as discharge, the tanks will be cleaned. After cleaning, the tanks are filled with ethanol and the vessel travels back to Rotterdam, to supply the European market with ethanol.

Illustration 6

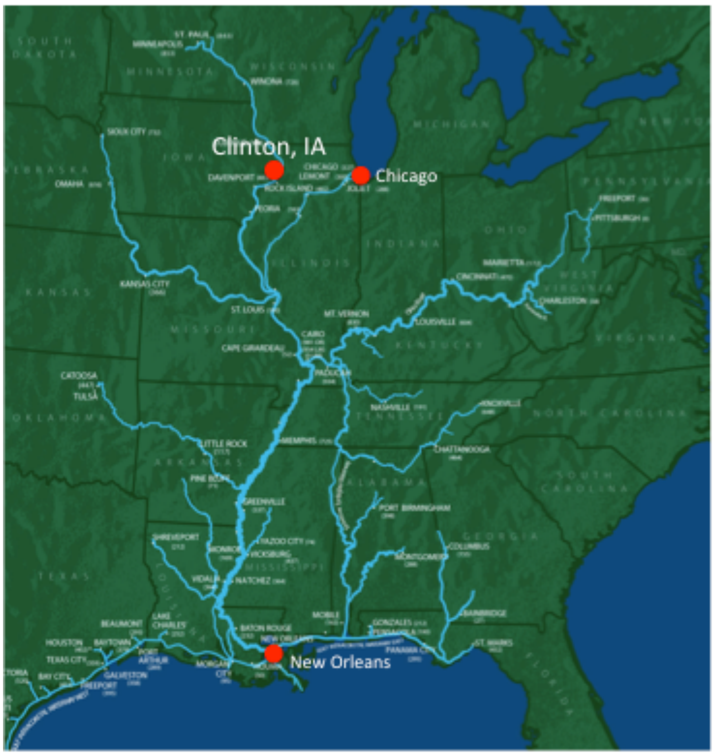


The possible synergy effect between UAN and ethanol ocean transport is confirmed by many after several meetings and interviews the writer conducted. There is no technical restriction between the two products with respect to the vessels and tanks that are used. The main issue that may cause a restriction is the cleaning cost. After transporting UAN to the United States, the tanks must be cleaned in order to meet the requirements to hold ethanol. Due to the high volumes per vessel, the cleaning cost per ton is low enough to make it economical feasible to transport UAN, clean the vessel and ship back ethanol on the backhaul of the trip.

United States Inland Waterway Leg

Because the actual market of UAN and ethanol is in the Midwest of the United States and not at the coastline, a large part of the transportation happens by barge via the Mississippi river. Ocean vessels are discharged in New Orleans where the products are loaded onto river barges. Barge combinations in the United States can consist of 35 barges per tow downstream and 15 barges per tow upstream due to lock restrictions. The barges have a capacity of 1,500 tons and are being pushed on the river. In order to reach synergy effects with a backhaul cargo instead of an empty and dedicated barge, the cleaning cost are crucial. The cleaning costs must be lower than the cost of transporting a dedicated barge back to its origin for new cargo. As explained before, on the ocean leg this is not an issue because the volumes are large enough. The volume of an inland barge is much lower and most critics argue that the high cleaning price of a barge will avoid the synergy effect. Thus, the cleaning costs per ton of cargo will be too high to make the synergy effect beneficial.

Illustration 7



Source: Map from http://www.kirbycorp.com

In order to be able to give a realistic and extensive explanation of the proposed backhaul option and possible business opportunity in the US ethanol market, further local research was done by the writer. The research was focused on a terminal in Clinton and shows a micro approach of the proposed backhaul option.

Clinton, located in the state of Iowa, is a small river town located on the Mississippi river (Illustration 7). Transammonia leases a warehouse facility from ADM[14] on this location with a total capacity of 35,000 tons of dry product. This terminal is used to distribute several types of dry fertilizer to customers in Iowa and several surrounding states.

Apart from a dry warehouse, there is a 10,000 tons liquid storage tank that can be used to store either ethanol or UAN. This storage tank is supported by infrastructure that is able to pump liquid products from tank to truck and from liquid barge to tank. Besides the infrastructure, there is a cleaning facility that cleans dry and liquid barges for both Transammonia and ADM. According to the head of the cleaning department, UAN and ethanol are not toxic and are fairly easy to clean so the barges can be cleaned in 5 hours instead of the conventional 10 hours that is required for other liquid products. The costs of cleaning a liquid barge in Clinton will drop from $3,000 to $1,500 due to this significant time reduction. According to Transammonia, the average cleaning cost along the Mississippi is around $6,500 for a liquid barge with normal cargo. If time is halved, so will these costs, resulting in the cleaning of a liquid barge along the Mississippi to cost between the $1,500 and $3,250 mark.

Another important factor that must be taken into consideration when cleaning a barge is waste water. During normal cleaning procedures, river water is used to clean the barge. After the cleaning process, this water will contain traces of product and cannot be dumped in the river. Most products require expensive waste treatment procedures or special installations to deal with the waste water. According to the head of the local cleaning department, the UAN and ethanol waste water can be reused and does not require any expensive cleaning methods.

The findings from the local research mentioned above, shows that there is no technical restriction or limitation of discharging and loading UAN or ethanol. The backhaul option can therefore be an interesting one for gaining synergy effects as long as the costs of the backhaul operation are lower than the operation of the empty barges.

It must be noted that not all liquid products are shipped by regular tow barges. There are also unit tows that are similar with the European inland barges. These barges are fixed with the tow and will never cut loose. This means that the towboat must wait until a barge is discharged or cleaned before it will continue its journey. The synergy effect if these vessels are used is probably a lot lower because they are less flexible than normal tow barges. This combination is not taken into account in the inland waterway backhaul model.

Table 7 shows the transport costs of moving an empty barge to and from Clinton. The cost of moving an empty barge between Clinton and New Orleans is a little above 16,000 dollars. This means a cost of almost 11 dollars per ton. The cleaning cost of a liquid barge in Clinton

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[14] The Archer Daniels Midland Company (ADM) is a conglomerate which processes cereal grains and oilseeds into products used in food, beverages, nutraceutical, industrial and animal feed. ADM is also an important worldwide ethanol player. http://www.adm.com

is between $1,500 and $3,000 and in New Orleans between $3,225 and $6,500. This means that the cleaning cost will decrease the margin with a value between 1 and around 4.5 dollars per ton. Comparing the current freight rate of an empty barge from Clinton to New Orleans with the maximum cleaning cost of $3,000 in Clinton and $6,500 in New Orleans, it shows that the even with the highest cleaning costs, the cost of the backhaul option is still lower than the option when empty barges are used; respectively 10 dollars per ton and 6.5 dollars per ton. This synergy effect is created by the backhaul opportunity. It must be noted that this synergy effect is only really effective for long haulage and will decrease on shorter trips.

Table 7

Cost of an empty barge to/from Clinton, IA					
Destinations	**Total River Miles**	**Empty Cost per Mile**	**Empty Towing Cost**	**Interchange Cost**	**Total Cost**
St.Louis,MO	343	$10.00	$3,430.00	$0.00	$3,430.00
Cincinnati,OH	1029	$11.00	$11,319.00	$1,500.00	$12,819.00
Nashville,TN	755	$11.00	$8,305.00	$1,500.00	$9,805.00
Memphis,TN	730	$11.00	$8,030.00	$0.00	$8,030.00
New Orleans,LA	1334	$11.00	$14,674.00	$1,500.00	$16,174.00

Source: Transammonia 2011

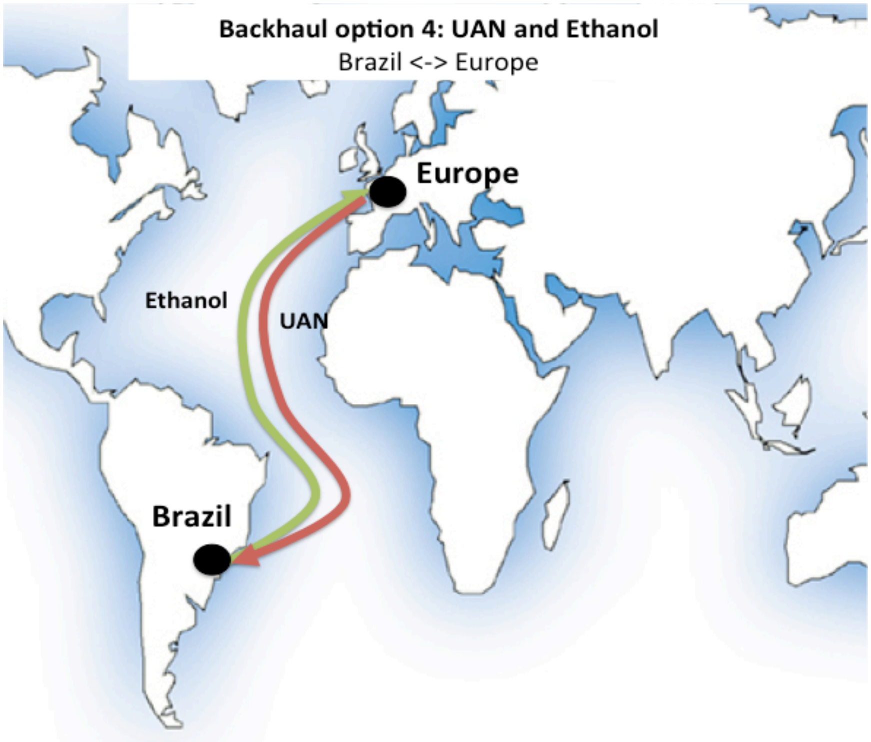
To reach this synergy effect, a constant supply of both products on both locations is paramount. If barges have to wait or barges are cleaned and shipped back empty, the synergy effect dissolves or extra costs are involved. The ethanol volumes that are required to fill the barges from Clinton to New Orleans can either be supplied directly from ADM's ethanol plant or from individual ethanol plants that are located in the region. It depends on Transammonia's strategy and bargaining power which approach will be more beneficial. The UAN volumes come from ocean vessel that discharge in New Orleans.

This micro approach that is focused on the Clinton region can be applied on multiple locations in the United States where UAN is discharged and ethanol may be loaded. The actual synergy effect will depend on the distance between the locations due to the fixed cost of cleaning. A restriction for this model may be the lack of cleaning stations along the river. If there is not a cleaning station available in the vicinity, the synergy effect will be reduced substantially or will not even be possible. It is therefore crucial for Transammonia to assess every location and figure out what kind of facilities there are in place and determine the possible benefits of combining UAN and ethanol trade.

Another hypothetical but fairly realistic option is a combination of UAN and ethanol between Brazil and Europe. By shipping UAN from the Baltic States to Brazil and shipping ethanol from Brazil back to Europe could result in synergy effects. Brazil is known as one of the biggest agricultural countries in the world and consumes high volumes of fertilizer. Currently Transammonia is trading a lot of dry fertilizer to Brazil but there is no market for UAN yet. The reason for this has to do with the reluctance of farmers and other parties to invest in liquid infrastructure. Farmers are not willing to invest in equipment that is required to spray the crops. They are scared of the high investment. Besides the reluctance of the farmers, the government and third parties are not interested in investing in the required infrastructure. Without a decent infrastructure, it is impossible to distribute and use UAN as a fertilizer for the Brazilian market.

In the future if an UAN market emerges in Brazil, this would offer a perfect opportunity to combine UAN with Brazilian ethanol. Brazilian ethanol is seen as the future supplier of worldwide ethanol and will increase substantially in the coming decades (Farinelli *et al,* 2008). Illustration 8 shows the trade route from Europe to Brazil. The string is similar with the string from backhaul option 3, a straight back to back trade between the continent and Brazil. According to specialists, this route could become even more beneficial than the US backhaul because the location of the agricultural sector is much closer to the coastline compared with the US market. This will mean that transportation costs are lower and thus so is the price. Then again, this option requires initial investment which is not likely to happen soon.

Illustration 8



Focusing again only on the ocean leg, both sulfuric acid and UAN show a clear opportunity to combine with ethanol. By trading ethanol, Transammonia will be able to fill a vessel, fully or partially, in both directions. According to the Transammonia chartering department, currently all UAN transportation is done by voyage or spot charters. If there is a guarantee for cargo for both legs, it may be an interesting opportunity to invest in a vessel on time charter terms that travel between the United States and Europe or between Brazil and Europe.

Calculating the benefits that might occur is extremely difficult. It is impossible to define the cost savings that occur if Transammonia contracts a vessel on time charter terms instead of fixing two voyage charters for one leg of UAN to the United States and for one leg of ethanol to Europe. It might even cost more money to time charter a vessel. The reason for this uncertainty lies in the market volatility of freight rates.

In theory, which means that all variables are constant and in favour of the shipper, a vessel on time charter would reduce costs substantially. But the variables that must be fixed are cargo supply and freight rates. To be beneficial, constant volumes of cargo must be transported on every voyage. This means that there must be a steady supply of ethanol cargo going from the United States to Europe and on the return with UAN. The supply of cargo is essential for both the ocean leg as well as for the inland leg. Utilisation ratios are paramount for logistical companies and determine the level of profit. Apart from the volumes, the freight rates of both legs must remain at a certain level. These required freight rates must be such that two legs on a voyage charter basis involve more costs than on a time charter basis.

In real life, the two variables are not constant. The first variable, the supply, can be influenced and maybe held constant. This can be done by setting agreements with the suppliers and producers for fixed amounts of cargo.

The second variable, the freight rate, cannot be influenced by Transammonia. Freight rates depend on the total demand and supply of freight capacity and will never be constant. The freight rates for ocean transport are very volatile and depend on many factors (Kavussanos, 1996; Adland & Cullinane, 2005). There are times that the freight rates are beneficial for the shippers and times that they are not.

Currently the freight rates are so low that it would not be beneficial to step into a time charter contract. It is much cheaper to transport cargo via spot rates. Nevertheless, it might be an option to fix a time charter on low costs and loose some money during the first couple of months. Once the market becomes better, the low time charter contract will save a lot of costs due to the low contract price. This mechanism is based on speculation and can result in high profits if the market becomes better but also in very high losses if the market is not changing any time soon.

To recap, this section showed that by combining UAN and ethanol trade, synergy effects can be created. During both the ocean leg as well during the inland waterway leg, costs per ton can be reduced if the same vessel is used for both products. Especially during the inland waterway leg, the cleaning costs are essential to gain benefits. The cleaning costs must be competitive with the freight rate for empties and the turn around time due to cleaning must be kept as low as possible. Also the constant supply of both products must be guaranteed to make sure that the synergy effect remains. Once a vessel is on time charter, this constant supply of cargo is crucial to exploit the benefits of the backhaul option. If all these parameters are in place, UAN, sulfuric acid and ethanol could create a perfect backhaul opportunity for Transammonia to increase profits.

4.4 Conclusion of the Case Study

The objective of this case study was to identify the potential fit and the opportunities that may occur when ethanol is added to Transammonia's trading portfolio. To answer this question, several steps were made in the case study. The first part of this case study showed that Transammonia is a worldwide commodity trader with a lot of experience and skilled employees. The main part of Transammonia trading portfolio exists of fertilizer products but during the last couple of years petcoke and coal were added to the trading portfolio. This shows the willingness of management to give new products a fair change and also shows the ability to adapt new products that are not directly related with fertilizer products.

To assess Transammonia, Porter's five forces model was introduced. By applying an adjusted version of this model to the business structure and culture of Transammonia, the strengths and weaknesses were identified. The main strengths of Transammonia are the extensive network of agents and offices; the close and good relationships with its customers; and their extremely good working environment helps to improve and stimulate employees to perform. The main weaknesses that were identified during this case study were the fact that skilled labour switched jobs and became competitors; the absence of a human resource department; and also the lack of academic background for several employees is seen as a weakness. Alongside the strengths and weaknesses, the threats from the industry and from Transammonia's own internal operations became clear. The main threats are the possibility that existing traders become new competition because they start their own company; producers become traders and therefore direct competition; the absence of a HR department could lead to inefficiencies and opportunity losses; and due to new products and new traders being added, a diversification of standards among traders might occur.

The second part of the case study identified the main barriers that may prevent Transammonia from entering the ethanol market. The most important barrier is the lack of knowledge of ethanol. Secondly is the influence of the government and the close relation to the food price providing a reason to be sceptical about the product. Also the lack of vertical integration in the ethanol supply chain and understaffed offices may prevent Transammonia from entering this market. A last barrier that was identified was the lack of synergy with existing products but this barrier was only based on market interaction between products. In the opportunity section, there is a synergy effect introduced with existing products by using the backhaul approach. This backhaul approach is the backbone of the potential fit between ethanol and Transammonia. Because the common "new product" approach is not applicable for ethanol and the "by-product" approach seems fairly weak, an extensive local research was done to prove the concept of combining freight. By using the same barges and vessels when UAN and ethanol are transported, a cost reduction can occur. This reduction occurs due to the "backhaul concept". Due to this model, a significant synergy effect can be created.

To prove this model could work for Transammonia, the research focused only on the trade of UAN to the US market and on the trade of ethanol out of the US market, both via the Mississippi. By combining the two products, the total transport costs can be decreased for both the inland barge leg as well as for the ocean transportation leg. For the inland barge leg the cleaning costs are crucial, whereas for the ocean transportation leg the time charter contract will offer the possibility of reducing significant costs. Even though this study was mainly focused on the combination of UAN and ethanol, strong signs indicate that there are also synergy possibilities between sulfuric acid and ethanol.

Chapter 5 Summary and Conclusion

The sustainable image of ethanol was illustrated in this research. If all the mandates in Brazil, the United States, Europe and China are into place, the expected ethanol demand could grow to exceed 125 billion litres by the year 2020. The actual demand may be even higher, since these estimations were done in 2007. Since that period a lot of new initiatives were started and active mandates were expanded. These facts and future outlooks show a good sign of an established and highly sustainable ethanol market.

The main research question of this thesis exists of two separate questions. The first question concerns if the increasing demand for bioethanol in Europe affects ethanol transport from the United States and Brazil. Historically, it was always Brazil that was responsible for the biggest part of the ethanol export. Since 2010, this trend has changed. Due to the high sugar prices and governmental influence, the United States became the main exporter of ethanol. In 2010, the United States even exported ethanol to Brazil. According to future prospects, the world ethanol production will rise from almost 90 billion litres to more than 125 billion litres. Higher and new mandated ethanol volumes, from various countries worldwide, are the main reason for this incredible growth. This significant increase of almost 40 percent will have an impact on ethanol transport. According to experts and ethanol producers, the United States has almost reached its production limits and it will be Brazil that must supply most of the future demand. It must be noted that many countries, like China, are also approving renewable fuel programs that will increase domestic ethanol production. Still, for the near future these volumes will not come close to supply the future world demand. These facts and future prospects will result in a situation were the trading flow patterns of ethanol will finally stabilise like they were during the last decade. This means that the main volumes will come from Brazil, a big chunk will be supplied by the United States and the last part will come from emerging markets. These emerging markets will either export some volumes or use their own production for intra continental trade.

To get a better insight in ethanol prices and the influences from external factors, a correlation study was done with several products. Crude oil, corn, sugar and wheat were compared with the ethanol price. This resulted in correlations of respectively 0.62, 0.75, 0.78 and 0.82. These ratios clearly show that there exists some kind of relation between the products and ethanol. Besides these raw materials, the weather and political involvement have a major impact on the price of ethanol.

The second question of the main research question concerns the main entry barriers for Transammonia to start trading ethanol. In the second part of the thesis a case study was introduced to deal with this question. The case study started by assessing Transammonia using an adjusted Porter five force model. The strengths, weaknesses and threats of Transammonia operations were identified. These factors together combined with the characteristics of ethanol, as described in chapter 3, determine the barriers and possible future opportunities. It became clear that the main barrier of Transammonia with respect to the ethanol market, was the lack with synergy with existing products in the portfolio which prevents easy synergies and network sharing opportunities. Secondly the high government involvement creates uncertainty in the market which prevents traders to take well-founded positions. A third barrier was the absence of product knowledge or capable employees that could make this product profitable. The last barrier identified was the absence of vertical integration in the ethanol market which is common and recommended to be present in the ethanol trading market.

The first barrier showed that there is a clear absence of synergy with existing products. Nevertheless the case study found some synergy possibilities and focused on transportation with two existing products. These products are the liquid fertilizer UAN and sulfuric acid.

Transammonia has an extensive and strong network of agents and customers in the United States in place. For this reason the search for a possible synergy effect was mainly focused on the North American UAN market. By introducing a backhaul approach for a route from Europe to the United States with UAN and a backhaul from the United States to Europe with ethanol, a synergy effect was identified. The synergy effect that was identified exists due to the vessel sharing capabilities of the two products and ethanol, the so called backhaul option. This synergy effect was visible for UAN for both the inland waterway and the ocean transportation legs. For sulfuric acid, only the ocean transportation leg was researched and identified.

As a final conclusion, the absence of knowledge is the main barrier that will prevent Transammonia from stepping into the ethanol market and can be solved by investing in people. The fit between Transammonia and ethanol will rely completely on attracting skilled and experienced people. New employees with knowledge about the ethanol market are crucial to make the trading of this product into a success. This main barrier and the uncertainty of the product, can only be dealt with via good people. Transammonia's comprehensive network, financial background, strong back office and chartering department are definitely able to make this product into a trading success. Therefore, the advice for management coming from this research is to invest heavily in new skilled people because the rest of the barriers will be dealt with by the current Transammonia operations.

Further Research

To get a better understanding of the influence of external factors on the ethanol price, further research is recommended. The research for this paper has illustrated that there exists a strong relation between the weather conditions during the year and the crop yields, and thus the price of ethanol. To get a better insight in this relationship, more data and especially more accurate data is needed from various production locations. By assessing the Brazilian and United States ethanol production locations and the weather during the crop period, useful correlations and insights may come up. These insights can be extremely useful for ethanol traders.

Secondly, Brazil is pointed out as the main supplier of the future ethanol demand. Where the United States is not able to increase market supply, the Brazilians can. It is therefore recommended for Transammonia to look into the business opportunity and synergy effects that may occur in the Brazilian ethanol market.

The last angle of further research can be found when sulfuric acid and ethanol are combined in a trade route. As explained, sulfuric acid is also transported with the same vessels and shows signs of a perfect backhaul product for ethanol. By applying the same backhaul concept as used in this research, it should be worthwhile to look into it. The focus must lie on the Brazilian side of the supply chain, since that will be the bottle neck of the scale of efficiency.

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Appendix

Common Trading Routes Abbreviations		
Abbreviation	**Full name**	**Equal to**
AG	Arabian Gulf	PG, MEG
ARA	Amsterdam - Rotterdam - Antwerp	
EC Mex	East Coast Mexico	
Feast	Far East	
MEG	Middle East Gulf	PG, AG
MPFE	Main Port Far East	
PG	Persian Gulf	AG, MEG
USAC	United States Atlantic Coast	USEC
USEC	United States East Coast	USAC
USG	Unites States Gulf	
USWC	United States West Coast	