Master Thesis

A look at energy procurement strategy at an animal feed company

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MANAGEMENT SUMMARY

The goal of this master thesis is to take a look at the animal feed company's current energy buying behavior and give recommendations regarding the feasibility of applying their raw material procurement strategy to energy. The purchasing of raw materials is done according to the animal feed company's own procurement strategy. Business units buy autonomously but through information sharing and deliberation consensus is found across all. Furthermore the animal feed company tries to outperform the market by being flexible with the timing and length of buying decisions based on a view on the markets. The acquisition of energy has been left out of this scope and has only recently been added to the responsibility of the Purchasing & Trading department.

The following steps have been taken in order to reach a recommendation:

- Literature study regarding procurement.
- Literature study regarding electricity markets.
- Review of the current energy buying practices.
- Review of the energy markets the animal feed company is active in.

The most important results are:

- No business unit fully follows the animal feed company's procurement strategy as information sharing and consensus building are not executed. With regards to being flexible with the timing and length of buying decisions, only the Netherlands applies this part of the strategy to all of its energy procurement. The Polish business unit applies this part of the strategy to procuring gas, while in the Czech Republic only electricity is procured like this. All other business units procure energy at fixed moments in time for a fixed length.
- Most of the European gas and electricity markets allow for energy to be procured according the animal feed company's strategy. This translates into having a forward market which offers enough liquidity on different maturities. Only the gas market in Spain and Portugal currently lacks liquidity, but as their suppliers offer many different contracts, an OTC construction allowing for the company's strategy to be applied is feasible. The energy markets the animal feed company is active in outside of Europe do not allow for the animal feed company's strategy to be applied. Because no forward contracts are available and/or because the markets have unique characteristics that make information sharing redundant.
- Significant savings can be made by switching heating source at several factories. Locations that might offer savings are a factory in the Netherlands that uses diesel, a factory in Poland that uses LNG and two factories in Spain that use fuel oil. We draw these conclusions from a comparison with locations that use gas.

The most important recommendations are:

- Fully switch to applying the animal feed company's procurement strategy in Europe. This means starting to share information and testing market views amongst the European business units. Furthermore bringing all BU's together in one contract leading to an increase of buying power. There are contract forms available that allow for the business units to retain their autonomy. This seems to be a possibility as several suppliers are present in the same countries as the company.
- Look into switching heating sources at the more expensive locations. Switching fuel requires an investment in the boilers but for some locations the costs per ton are much higher than when using gas.

PREFACE

This thesis marks the conclusion of my time as an intern at the animal feed company and as a student at the University of Twente. During these last months I have learned an incredible amount. Not only about energy markets and procurement but the internship also gave me a much needed introduction into the workings of a company. The company is a fantastic organization with a lot of very passionate professionals and my experience there will be an example for me throughout my career.

I would like to thank my supervisors at the animal feed company Ben Tacken and Arno Willemink. I am grateful to my first supervisor Ben Tacken for giving me the chance be a part of the company. The time you spent explaining the workings of the markets and giving me perspective on future career paths will be very valuable to me. I would also like to extend my gratitude to my daily supervisor Arno Willemink. You have been like a mentor to me not only because of your teachings with regards to my thesis. But I have also learned a great deal from you as a person. I don't want to sound too soft but I truly look up to you.

Equally important has been the guidance provided by Berend Roorda. I was very much in doubt about where I wanted to graduate. I am very grateful for you helping me find the animal feed company. During my internship you have proven to be a source of reassurance and inspiration.

Reinoud Joosten, my second supervisor at the university, thank you for the veracity at which you checked my work. Clearly a lot of effort has gone into helping me improve my writing, this was sorely needed. Furthermore, I would like to thank you for the flexibility you have shown, helping me at such a short notice.

My thanks also go out to the rest of the purchasing team. With a special mention for Kevin and Maarten. Kevin I really enjoyed our discussions. I had a lot of fun during our rides to work, and thanks for showing me where to buy a 'supertje speciaal'. Maarten you are only mentioned because you helped me with excel this one time and I promised.

Furthermore I would like to thank my family. Mom and Dad thanks for being patient with me throughout my studies and supporting me during all of my extracurricular activities. Anne, Lenny and Jeppe, thank you for all of your love.

Lin thank you for putting up with me the last few months. You are all kinds of fantastic. I know I have not been the best version of myself during my graduation. Despite that, these past few months living with you have been truly wonderful. I am very excited about the prospect of my life together with you.

Machteld I still miss you every day. You were my best friend. Throughout your life you have helped and supported me. Your passing has changed me. I am confident though that you would have been proud as these changes were very much needed.

Bas Klok,

Utrecht, 2017.

CONTENTS

1. PROJECT OUTLINE

In this first chapter I give an outline of the project. The chapter starts with an introduction to the animal feed company, its joint ventures and the purchasing & trading department. It will continue with a portrayal of the current situation at the animal feed company. Next up is the research objective. In Section 1.4 I describe the steps that I take to the reach the research objective. The research questions that arise will be discussed. After this I describe the information sources that will be used. The final section covers the outline of the report.

This chapter is structured according to the research design outline designed by Verschuren and Doorewaard (Verschuren & Doorewaard, 2010).

1.1. ABOUT THE ANIMAL FEED COMPANY

The animal feed company is an animal feed producer operating in almost 50 countries worldwide. It was founded in 1911 and remained in the care of a family ever since. Through acquisitions and autonomous growth it has become the third largest producer of animal feed in The Netherlands and is one of the top 15 producers in the world. Its headquarters are located in Ede. Figure 1 shows the countries the animal feed company is active in, in either production or export.

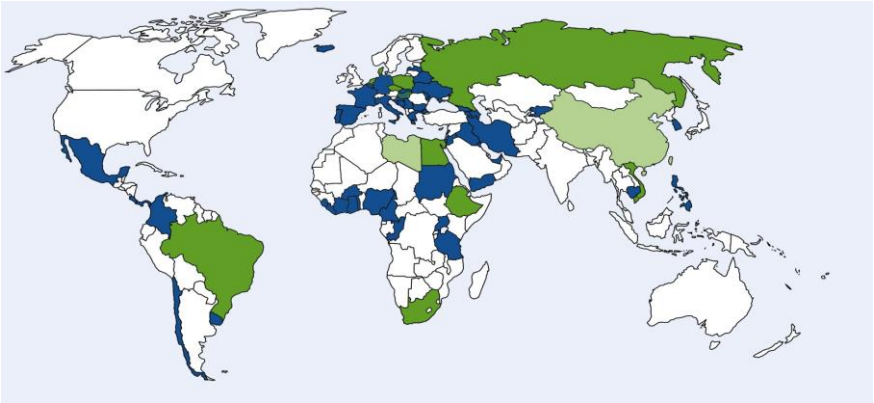

FIGURE 1: GLOBAL PRESENCE OF THE ANIMAL FEED COMPANY, PRODUCTION IN GREEN, EXPORT IN BLUE.

The animal feed the animal feed company mainly produces animal feed for ruminants (cows), pigs, broilers (chickens bred for meat) and layers (chickens bred to lay eggs). Feed is produced in three forms: compound feed, concentrates and premixes. Compound feed contains all nutrients an animal needs. Concentrates do not contain grains, these are mixed in by the farmer. Premixes only contain very specific nutrients, the farmer mixes in the bulk of the feed. Premixes constitute only 3% of the final product. Table 1 contains a number of key figures of the animal feed company.

Turnover	€2.800.000.000
Number of employees	>4200
Number of employees in NL	>600
Number of export countries	50
Number of production countries	15
Number of production locations	>50
Annual Feed production	≈ 6.000.000 tons
Annual Feed production in The Netherlands	≈ 2.000.000 tons
Annual Premix production	≈ 250.000 tons
Feed equivalent of Premix production	≈ 8.300.000 tons

TABLE 1: KEY FIGURES OF THE ANIMAL FEED COMPANY (2016).

Organization

Each country practically operates as an autonomous business unit. Each business unit does sales, procurement, production and hiring. However their autonomy is limited by their obligation to report and cooperate with the headquarters in Ede. The headquarters support most types of business decisions. For instance in procurement, each local business unit buys from local suppliers, but frequent deliberations with headquarters and other business units lead to companywide consensus regarding strategy. Some operations are centralized in the headquarters like M&A and product development.

The purchasing and trading department

This project was commissioned by the purchasing and trading department at the headquarters in Ede. This department is responsible for the procurement of raw materials for The Netherlands, the procurement of foreign currencies and the coordination of the procurement of raw materials globally. Raw materials are divided into two groups: the Macros and the Micros. Macros can roughly be described as the bulk goods, these consist of proteins (soymeal, rapemeal etc.), grains, oils & fats and grain byproducts. Micros are the specialized materials like vitamins, amino acids and minerals. The quantities acquired are one possible distinction between these two groups, another is the market structure. The macros, in general, are traded in liquid markets with a broad range of available forward contracts. Information about these markets is widely available. The micros, even though they are also traded globally, are not as widely traded and are bought OTC. As information about these markets is very limited, a buying decision is a very different process.

Energy markets

The main topic of this project will be the procurement of energy. The company's energy buying can be divided in electricity and heating sources. Each plant uses both power and a heating source. The heating source is usually gas but also coal, fuel oil, biomass and LNG are used. The energy markets have unique characteristics that make buying it a different ball game than buying general commodities.

Electricity can be traded like any commodity in some countries but its characteristics are very different. The first difference is the inability to efficiently store it, therefore the link between the spot and forward prices that exists in other commodity markets does not exist (Geman, 2005).

A second characteristic is that transportation of electricity costs electricity and as a result electricity markets are inherently local. However, recently an increase in transport capacity between countries has led to price convergence in certain regions in the world (Geman, 2005).

Electricity is produced from many different sources, therefore prices are heavily dependent on the type of installed capacity in a market. Finally, the value chain in electricity markets can be organized in many different ways, having a profound effect on pricing (Geman, 2005).

The natural gas market is becoming increasingly global. In the past transportation of natural gas was only financially viable through pipelines because of its very low energy density, however pipelines require very large investments. LNG technology changed the landscape of the natural gas market dramatically. The liquefaction of natural gas makes the energy density comparable to crude oil, therefore transportation in tankers becomes viable. This makes for example Middle Eastern, Australian and American natural gas available across the globe (Heather, 2015).

Another peculiarity of the natural gas market is the existence of long term oil linked contracts. Because of these contracts natural gas prices are heavily influenced by oil prices. Recently the lows in oil prices have slowed the rise of LNG. But investments in regasification capacity have continued and LNG is becoming a part of more markets (Heather, 2015).

1.2. CURRENT SITUATION

As mentioned in Section 1.1 the animal feed company grew rapidly in the past decades. This growth comes from new business ventures and the acquisition of existing companies. When the company starts up a business unit in a new country, the responsibility of buying energy is left to the business unit. When the company acquires an existing company their procurement strategy is adapted to match the animal feed company's global strategy. However, the purchasing of energy is not included in this integration. Because of this Ben Tacken suspects there might be discrepancies between the procurement strategy and the actual buying of energy.

The animal feed company buys raw materials in a unique way. The family believes the purchasing department can beat the market. This translates into being very flexible with the amount of raw materials purchased at any time. When prices are expected to lower, buying decisions are delayed, depending on their current position they could even buy on spot. When prices are expected to rise, forward contracts are signed to profit from the current low prices. This means that the purchasing and trading department is constantly gathering market information and formulating a vision on market behavior. Because of the global presence of the company, expertise in the procurement team and internal information sharing the company believes it can, on average, outperform the market and therefore has an edge towards the competition.

This project is about energy procurement. The demand for energy is very certain and contracts with suppliers contain a bandwidth that guarantees that demand is always met. This reduces the buying decision to when and for how long are prices locked in. Information regarding the energy purchasing of the animal feed company is currently not being shared globally and purchasing decisions are made autonomously. The purchasing and trading department wants to know whether their approach on raw material procurement is also applicable to energy purchasing. This project is aimed at finding an answer to that question. Other important questions that arise because of this are; how do the business units buy energy? What are the characteristics of the markets the business units buy energy in? The current situation is visualized in Figure 2. It is important to note that this project will not draw conclusions with regard to the validity of the company's belief it is possible to outperform the markets.

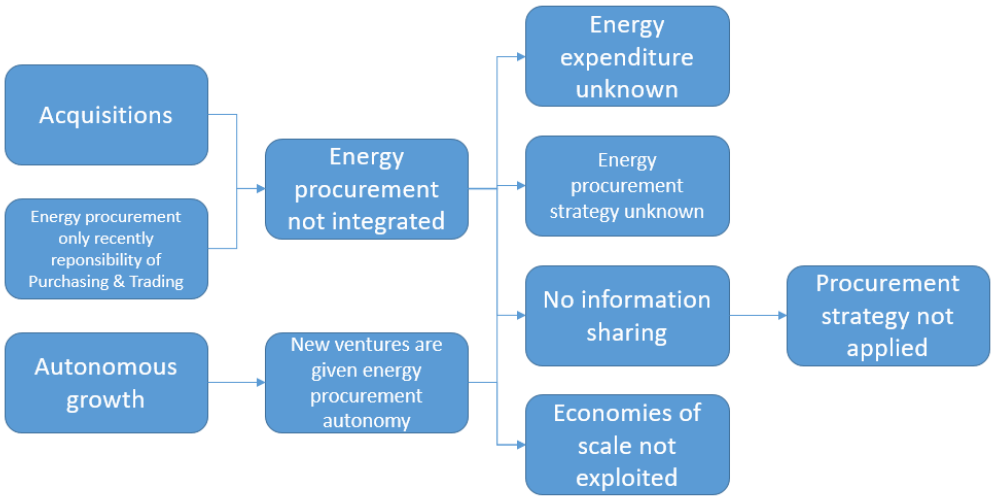

FIGURE 2: PROBLEM TREE.

1.3. RESEARCH OBJECTIVE

It is now time to define the objectives of this project. The goal of this research is to answer the following question:

Is it possible to apply the animal feed company's current approach to purchasing energy on a global scale, while keeping in mind the characteristics of each market the company operates in?

1.4. RESEARCH FRAMEWORK

In this section I define the stages this project will follow, visualized in Figure 3. In stage A, I will create an understanding of how energy is currently procured by combining theory on procurement, information from the business units on current practices and the animal feed company's approach procurement. In stage B, I will combine theory on energy markets with information on the actual markets company is active in to create an understanding of the feasibility of applying the company's approach to procurement in these markets. In the third and final stage, stage C, I will combine the understanding of the company's current energy procurement with the understanding of the markets the company is active in to formulate a recommendation with regards to the research objective.

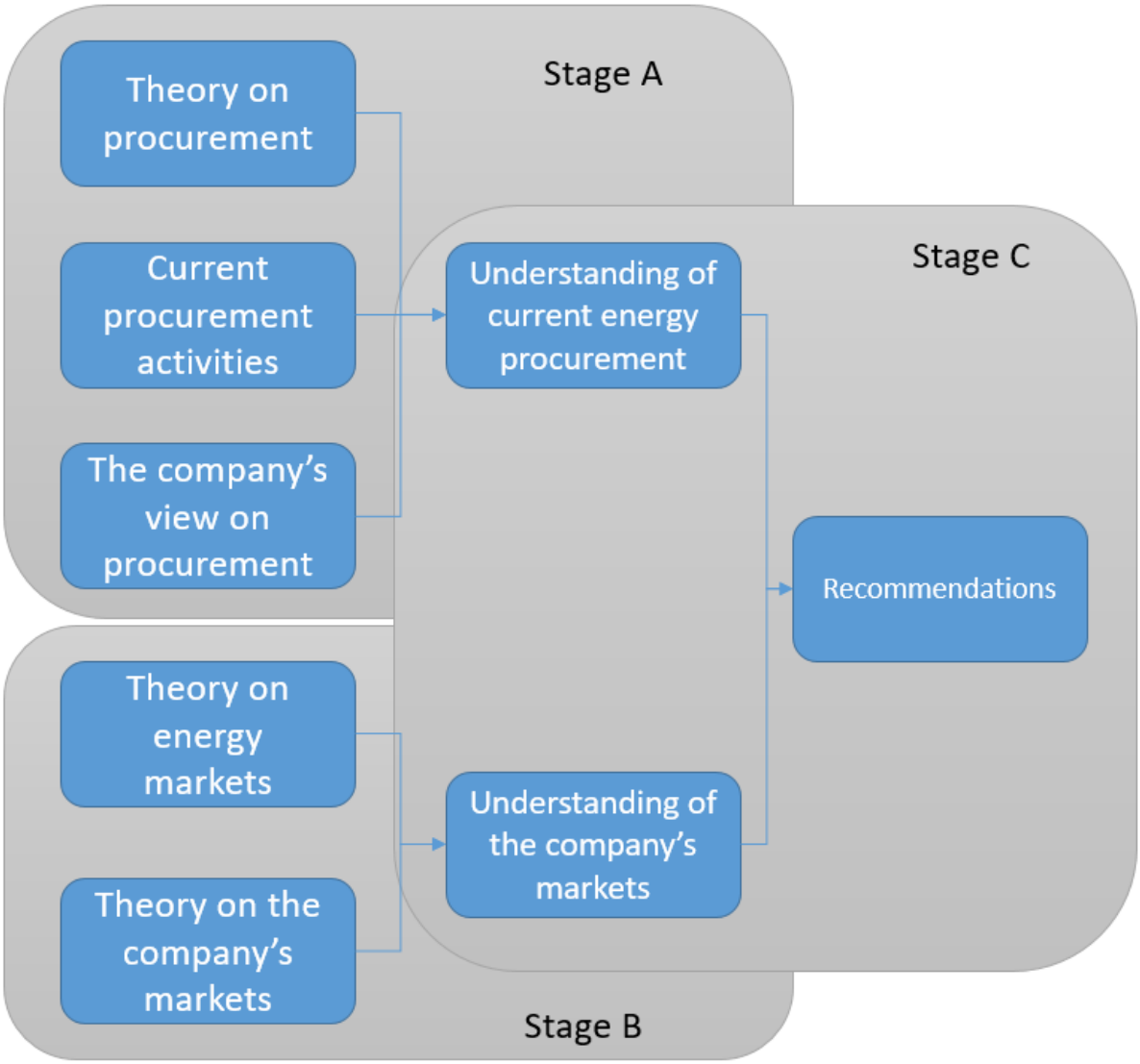

FIGURE 3: RESEARCH FRAMEWORK.

1.5. RESEARCH QUESTIONS

In this section we define the research questions that have to be answered in order to reach the objectives as defined in Section 1.4. The objective has been defined as finding an answer to the main research question:

> *Is it possible to apply the animal feed company's current approach to purchasing energy on a global scale, while keeping in mind the characteristics of each market the company operates in?*

In order to reach this objective the following five sub-questions have to be answered:

1. How can the animal feed company's current approach to purchasing energy be characterized according to literature?
2. How can energy markets be characterized according to literature?
3. What are the requirements/preconditions the animal feed company has regarding energy procurement?
4. What are the relevant differences in energy purchasing behavior between the countries the animal feed company operates in?
5. What are the relevant differences in the markets the animal feed company operates in?

1.6. INFORMATION SOURCES

In this section we will define types of analysis and information sources for each research question, this is summarized in Table 2.

(Sub-)Question:	Source(s):	Analysis:
Is it possible to apply the animal feed company's current approach to purchasing energy on a global scale, while keeping in mind the characteristics of each market the company operates in?		
How can the animal feed company's current approach to purchasing energy be characterized according to literature?	Theory on energy procurement, BU's, operating managers, purchasing departments	Content analysis and interviews
How can energy markets be characterized according to literature?	Theory on energy markets	Content analysis
What are the requirements/preconditions the animal feed company has regarding energy procurement?	Purchasing and Trading department	Interviews
What are the relevant differences in energy purchasing in purchasing behavior between the countries the animal feed company operates in?	BU's, operating managers, purchasing departments	Interviews
What are the relevant differences in the markets the animal feed company operates in?	Reuters, theory on energy markets, reports	Content analysis

TABLE 2: INFORMATION SOURCES.

1.7. REPORT OUTLINE

This report is structured with a logical reading order in mind. The structure is as follows:

In Chapter 2 “Energy Procurement” I discuss procurement according to the animal feed company and place the animal feed company’s approach to procurement in several frameworks provided by literature. I answer the following sub-question:

1. How can the animal feed company’s current approach to purchasing energy be characterized according to literature?

In Chapter 3 “Electricity Markets” I dig into the characteristics of Electricity markets. Topics like market structure, spot pricing, forward pricing and supply structure are imperative in order to understand the fundamentals of the markets the animal feed company operates in. I answer the following sub-question:

2. How can energy markets be characterized according to literature?

In Chapter 4 “Energy Procurement the animal feed company” it’s time to look into the animal feed company itself. First I will define the animal feed company’s approach to energy procurement. Next I will summarize how each business unit makes buying decisions. This chapter concludes with an overview of the discrepancies between the animal feed company’s favored approach and the reality. I answer the following sub-questions:

3. What are the requirements/preconditions the animal feed company has regarding energy procurement?
4. What are the relevant differences in energy purchasing behavior between the countries the animal feed company operates in?

In Chapter 5 “Energy Markets the animal feed company” the specifics of the markets the animal feed company operates in will be discussed. For each market I will conclude whether its structure allows for the animal feed company to apply its preferred approach to energy procurement. I answer the following sub-question:

5. What are the relevant differences in the markets the animal feed company operates in?

In Chapter 6 “Conclusions & Recommendations” I give brief answers to all of the research questions and make recommendations.

2. ENERGY PROCUREMENT

In this chapter we gain a better understanding of the animal feed company's approach to procurement. After describing their approach based on interviews and experiences throughout the internship, we put them into context using literature. We use several frameworks to characterize the purchasing practices. This chapter answers the following research question:

1. How can the animal feed company's current approach to purchasing energy be characterized according to literature?

This chapter is structured in the following way: in Section 2.1 we talk about the animal feed company and the way it procures its raw materials. In Section 2.2 we provide context for this approach. In Section 2.3 we dig a little deeper and talk about commodity procurement. We conclude this chapter by summarizing what we have learned in Section 0.

2.1. PROCUREMENT BY THE ANIMAL FEED COMPANY

As mentioned before, the animal feed company is a family owned business. It is owned and led by the a family. Because of this decision making is centralized to a very small group of people. This is very different compared to publicly owned companies where leadership is controlled by a very diverse group of shareholders. The family believes that they can outperform the market by being flexible with the timing of their procurement.

This means that the purchasing department is not bound by strict regulations. It can, if it is deemed prudent, buy all raw materials on spot for several years. Or, it could buy everything a year in advance. For this, an important metric is the length of exposure. The length is measured dividing the total contracted raw materials by the monthly demand. Buying decisions are based on views on the market. Basically, if prices are expected to rise, exposure is lengthened by signing a forward contracts. If prices are expected to go down, raw materials will be bought later, or the length of exposure is shortened by selling forward contracts or raw materials.

A buyer in the purchasing and trading department of the animal feed company is constantly gathering information to formulate a view on the markets. Information ranges from fundamental supply and demand data to technical analysis of historic prices. This information comes from a wide range of organizations to which the department is subscribed to but also public reports like the USDA report. Every week the department holds conference calls with buyers from other business units around the world to share information and views. Buyers attend conferences very often to expand their networks and therefore improve their access to information. All of these activities consist of the bulk of workload for a buyer as the actual purchase is a matter of a few phone calls.

The performance of the purchasing and trading department is measured using historic replacement values. Replacement values are the difference between the contracted prices and current forward prices. These values are important throughout the company as the most cost efficient recipes for feed are also calculated using replacement values. Historic replacement values are the difference between contracted prices and the spot price on the day the raw material is consumed. Buyers are remunerated at the end of the year based on personal goals and an overall departmental goal.

the animal feed company's approach to procurement is not the only way procurement is done. It is important to put the animal feed company's approach in perspective. In the next section we use content analysis to do so.

2.1.1. CONCLUSIONS

In this section we learned the following things:

- Procurement at the animal feed company is based on the belief that they can outperform the market by being flexible with the timing and length of buying decisions.
- Information is continuously gathered on the markets to support their views on the markets. Their positions are then adjusted to match this view. This information gathering is supported by information sharing within the company as the different business units share their views regularly.
- Performance is measured using a purely financial metric. This metric is the difference between the replacement value and the contracted value.

2.2. PROCUREMENT A GENERAL LOOK

Over the years much literature on procurement has become available. In this introduction we give an overview of the possibilities and explain which frameworks we will apply. For this we use a literature review reviewing 138 publications on procurement in a manufacturing context written in the period 1973-2013 (Hesping & Schiele, 2015). Hesping and Schiele identified five distinct levels of looking at procurement. Figure 4 is a visualization of these levels based on an earlier framework (Gonzalez-Benito, 2005). They argue that the first two levels, as presented by Gonzalez-Benito, should be extended to five because different strategies are applicable simultaneously within the same firm for different product groups and suppliers.

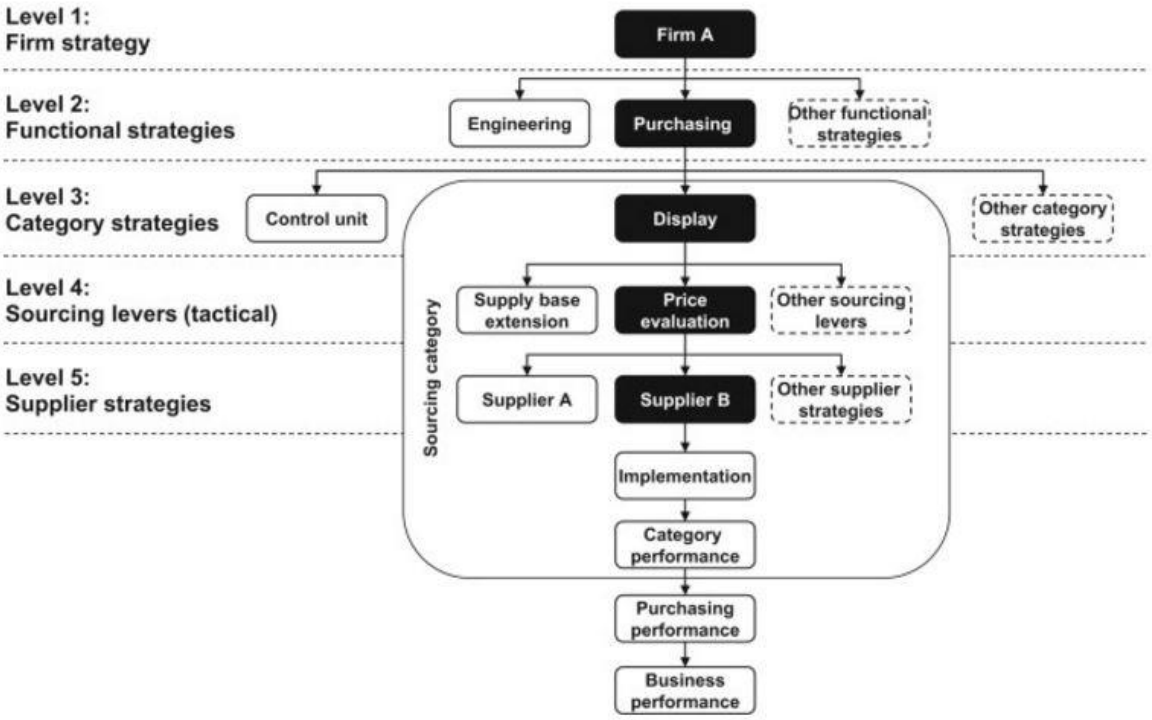

FIGURE 4: FIVE LEVELS OF PROCUREMENT STRATEGY (HESPING & SCHIELE, 2015).

The first level, *firm strategy*, contains literature about the different roles of procurement within different types of firms. For instance the difference in procurement between companies focusing on quantity as opposed to differentiation. The second level, *functional strategies,* encompasses theories on the role of the department within the company. Information sharing, cooperation and influence on company strategy are topics discussed in this group. *Category strategies* refers to articles that distinguish between types of product groups. Distinctions based on many variables are available, the widely known Kraljic's supply matrix that uses supply risk and profit impact to define four different types of strategies (Kraljic, 1983). *Sourcing Levers*, the fourth level, take category strategies one step further. These are articles that dig into category strategies on a tactical level. The final group, *supplier strategies*, describes ways to manage supplier relationships.

For the purpose of this report we want to give some context to the procurement strategy of the animal feed company. Therefore, there is no need to get too specific, nor is there need to comment on the corporate strategy of the animal feed company. Therefore, we discuss a framework from the second level (functional) and a framework from the third level (category). In the next subsection (2.2.1) we talk about the integration of procurement department using a framework developed by Cousins, Lawson & Square (2006). In Subsection 0 we look at an extended Kraljic matrix as proposed by Caniëls & Gelderman (2005).

2.2.1. Integration of the procurement function in a company

To gain insight in the functional strategy of the animal feed company we will use a typology developed by Cousins, Lawson & Square (2006). This typology is based on a survey of 151 companies based in the United Kingdom. Each company is graded on four metrics based on their answers. A cluster analysis on these grades revealed four distinct types of procurement functions. It should be mentioned that no statistical relationship was found between company performance and the groups.

The first metric each company is graded on is *strategic planning*. This metric represents the extent to which the procurement department is involved in strategic planning. The second metric is *purchasing status*. This represents how the management views the procurement department. The third metric is *internal integration*. This represents the extent to which information flows from and to the procurement function but also whether the procurement function is aligned with the supply chain. The fourth and final metric is *purchasing skills*. This represents the extent to which advanced performance measures are used to assess performance of the procurement department. The assumption being that in the past performance of procurement was measured financially and in terms of product quality. As procurement over time became more sophisticated with practices like supplier integration, coordination and development more sophisticated performance measures are needed.

After each company has been scored on the four metrics a cluster analysis has been performed on the results. From this analysis four groups were identified. Figure 5 shows the average scores of each group. The first group are the *strategic purchasers*, they embody the most sophisticated procurement department. They are highly regarded by management and actively involved in strategic decision making. They are fully integrated with many departments and use the latest procurement technology and theory to continuously improve themselves. The second group are the *capable purchasers* compared to the strategic purchasers they are just as skilled, however in terms of status, strategic planning and integration they score a bit lower. Next are the *undeveloped purchasers,* this group are also characterized by high scores on purchasing skills, however they score even lower on the other three metrics. They are typically reactionary to the needs of the organization instead of leading the way in integration. The fourth group are the *celebrity purchasers* they are regarded highly by

management, however their sole focus is on reducing costs rather than strategic thinking. Suppliers are selected based on availability and price. No attempts are made at to integrate or coordinate with suppliers.

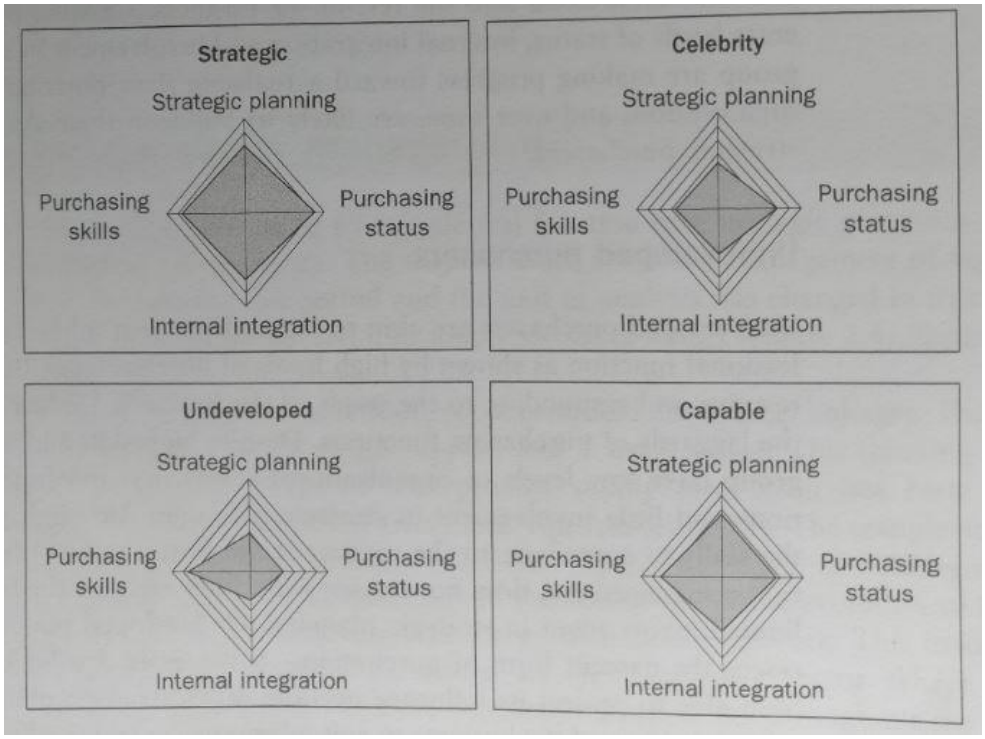

FIGURE 5: TYPOLOGIES OF PROCUREMENT FUNCTIONS (COUSINS, LAWSON, & SQUARE, 2006).

Now it is time to look at the purchasing and trading department of the animal feed company. The group with which the department shows the most similarities is the celebrity purchasers. They are held in high regard by the management as they are seen as strategically crucial. Performance is measured based on financial performance therefore, according to the definition of Cousins, Lawson & Square (2006) the score on purchasing skills would be low. Information sharing between other departments does occur so for this metric they would most likely deviate from the rest of the group. It is hard to determine the extent to which they are involved in strategic planning.

As mentioned there was no statistical relationship between company performance and the groups. This means that it could be that the animal feed company does not need to apply sophisticated supplier coordinating strategies as this does not give them a strategic advantage. In the next section we will talk about product categories and matching procurement strategies, this will give us greater insight as to why the animal feed company organized itself this way.

2.2.2. IMPROVED KRALJIC SUPPLY MATRIX

In the previous section we concluded that the animal feed company does not apply very sophisticated supplier management theories. In this section we want to give an explanation as to why this is. For this we will use a framework from the strategic level (Hesping & Schiele, 2015).

The most widely used framework is the Kraljic supply matrix (Kraljic, 1983). In this framework a distinction between product groups is made based on two characteristics, profit impact and supply risk. This leads to four product groups: *strategic products* with high profit impact and supply risk, *leverage products* with high profit impact and low supply risk, *non-critical products* with low profit impact and supply risk and *bottleneck* products with low profit impact and high supply risk. For each group a strategy is proposed to manage supply.

In this report we will use an improved version of the Kraljic supply matrix (Caniëls & Gelderman, 2005). One of the main criticisms on the Kraljic matrix is the rigidity is of the framework, it does not take into account movement from one product group to another as a result of actions by either supplier or buyer. Based on a survey of 250 Dutch procurement professionals Caniëls and Gelderman identified 9 commonly used strategies. Figure 6 shows a visualization of these strategies and their place in the matrix.

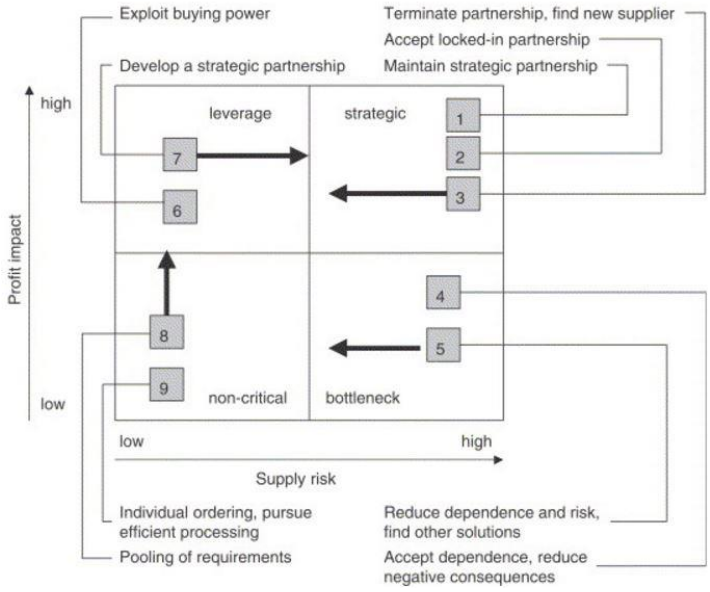

FIGURE 6: IMPROVED KRALJIC SUPPLY MATRIX (CANIËLS & GELDERMAN, 2005).

Most of the product the animal feed company procures are commodities and have very low supply risk, this holds for the Macro side of the department. For some of these products the animal feed company is a very large buyer, the animal feed company applies the *exploit buying power* strategy for these products. When the animal feed company has very little leverage towards suppliers because of small size their strategy resembles the *individual ordering* strategy. For both of these strategies administrative efficiency of the purchasing department is key.

When you look at the buying of energy it is clear that in general the supply risk will be very low. Developing a strategic partnership has no strategic advantage. Therefore the same strategies could be applied depending on the leverage the animal feed company has in each market. However, a third strategy could also prove interesting: *pooling of requirements*. Utility suppliers no longer necessarily have a national presence but increasingly operate across borders and sometimes even have a global

presence. This creates the opportunity for the animal feed company to pool their requirements and increase their relative power towards the suppliers.

From this framework we can clearly see why the animal feed company does not apply sophisticated supplier strategies. Within the product groups the animal feed company operates in there is no strategic advantage to applying these strategies, any investment of time and money in these strategies are therefore a loss. Now we have a grasp on how the animal feed company's strategy fits within the literature, however we have not discussed the most important part of their strategy. This is the risk they take with the timing of their procurement. This is unique to commodity procurement because of the standardization of the products, the global aspect of the markets and the very liquid forward and sport markets. Therefore we will take a closer look into the commodity markets in the next section.

2.2.3. Conclusions

In this section we have learned the following things:

- Procurement can be looked at in many different ways (Hesping & Schiele, 2015). The first level, *firm strategy*, contains literature about the different roles of procurement within different types of firms. The second level, *functional strategies*, encompasses theories on the role of the department within the company. *Category strategies* refers to articles that distinguish between types of product groups. *Sourcing Levers*, the fourth level, take category strategies one step further. The final group, *supplier strategies*, describes ways to manage supplier relationships.
- When looking at the animal feed company's purchasing and trading department from a functional perspective (Cousins, Lawson, & Square, 2006) the following things stand out: low sophistication in supplier management, high regard from management, information sharing between the department and the rest of the organization exists. Therefore they can be classified as *celebrity procurers*, however they do deviate from this group because of information sharing.
- When looking at the animal feed company's purchasing and trading department from a product group perspective (Caniëls & Gelderman, 2005) some things stand out: The products they procure have relatively low supply risk, they have high leverage for some products and low leverage for other products. The strategies they apply are *exploit buying power* and *individual ordering* for products where they have respectively high and low leverage. For both of these strategies administrative efficiency of the purchasing department is key.
- the animal feed company's required energy sources generally have low supply risk. Therefore *exploit buying power*, *individual ordering* and *pooling of requirement* strategies are applicable. Creating a strategic partnership does not seem to have any benefits.

2.3. COMMODITY PROCUREMENT

As mentioned the animal feed company is active in the commodity markets. In this section we go into detail about the workings of the commodity markets. Throughout this report many terms related to commodity trading will be used, these terms need to be explained. First we give an overview of possible commodity procurement strategies according to Cousins et al. (2008) and place the animal feed company in this framework. After this we have to take time to explain some of the terms used. In Subsection 2.3.2 we explain the difference between spot, forward and future contracts. We continue in 2.3.3 with a discussion on the pricing of forwards contracts. In conclusion we talk about forward curves, a type of graph that the animal feed company uses very often.

2.3.1. PURCHASING STRATEGIES FOR COMMODITIES

As mentioned in Section 2.1 the animal feed company believes being flexible with their timing and length of buying decisions based on their expertise allows them to outperform the market. In this section we will use a framework presented by Cousins et al. (2008) to put the animal feed company's strategy into context.

According to Cousins et al. there are four principal strategies within commodity procurement. The first strategy is called *private deals*. Long term agreements are used to avoid the open market. This is a viable strategy in markets where growing of crops takes a very long time, for instance in the wood market. *Backward integration* is the second strategy. Instead of buying the commodity the customer buys the source. This strategy is viable when there is resource scarcity, in the cement industry there is little to no discovery of new sources of limestone. Therefore cement producers usually buy quarries to bar competitors. The third strategy is called *Opportunistic buying*. This basically means that when prices are low materials are bought either physically and stored or with forward contracts. This strategy is viable in a market with highly standardized and actively traded products as information availability is key to making a well informed decision. The fourth and final strategy is: *hedging on the futures market*. The difference with opportunistic buying is that after buying the commodity, this position is hedged using the future markets. This strategy leads to the supply being guaranteed while the company can still profit from lowering prices. The downside is that the company is of course vulnerable to rising prices.

It is clear to see that the animal feed company falls into the *Opportunistic buying* category. They buy supply when they feel prices are at the lowest level and take on enough length to a point where they believe prices will have lowered again. the animal feed company is active on the futures market but only to a very small extent and not with the intention to hedge against price drops. It should be mentioned that it is common practice to limit the freedom of a purchasing department by creating a bandwidth within future supply must be procured, this is not the case for the animal feed company.

2.3.2. COMMODITY SPOT, FORWARD AND FUTURE MARKETS

As mentioned in this section we will explain the difference between trading on the spot, forward and future markets. Spot trading is trading where transaction of ownership either takes place immediately or has minimal lag due to technical restrictions. This does not mean that the commodity is physically delivered. The location of the commodity is not fixed. It could be at the producer or for instance at a port. Once a spot transaction has taken place the ownership and responsibility have transferred. There are four risks associated with spot trading (Geman, 2005):

- *Price risk:* The risk prices change over time. For instance a farmer planting in March and harvesting/selling in august experiences price risk.
- *Transportation risk:* The risk the commodity deteriorates, but also the risk of a war or strike.

- *Delivery risk:* The quality of the product might not be right, this is discovered upon delivery hence the name.
- *Credit risk:* The risk one of the party does not uphold his/her end of the bargain.

Forward and Future contracts are developed to negate some of these risks. Forward contracts are over the counter (OTC) agreements. It is agreed that at a certain time in the future ownership of a commodity is transferred for an agreed upon price. Furthermore quality and delivery terms are agreed upon, negative deviation from this will result in a penalty for the seller, positive deviation is usually a gain for the buyer. This type of contract mitigates price risk and delivery risk (Geman, 2005).

Future contracts are standardized contracts that are traded on an exchange and handled by a clearing house. They are standardized in terms of quality and delivery, making liquidity possible. A clearing house takes on the counterparty risk of both parties and acts as an intermediate. As opposed to forward contracts, future contracts are settled daily. Both parties deposit a margin that is used to compensate for price changes. If the margin of one party has decreased below a certain threshold it is asked to deposed additional margin, this is called the margin call. Daily settlements and margins reduce the credit risk for the clearinghouse. Future contracts are used by many speculators to gain exposure on the commodity markets without experiencing the strain of physical delivery, as contracts are usually canceled before delivery. This type of contracts mitigates price risk, physical risk and credit risk (Geman, 2005).

2.3.3. Spot-forward relationship in a storable commodity

The relationship between the spot and forward price can be explained using an arbitrage argument. This starts by looking at the forward price at maturity this should equal the spot price. If the forward price is greater than the spot price one could sell the forward and buy on spot. If the forward price is lower than spot this works the other way around. The mathematical definition of the forward price using annual rates is (Geman, 2005):

$$f^T(t) = S(t)[1 + (r - y)(T - t)]$$

Where $f^T(t)$ is the forward price of a forward with maturity T at time t. $S(t)$ is the spot price at time t. r is risk free rate and y is the convenience yield. The convenience yield represents the benefit or costs of having the physical commodity in store. The benefit could be having certainty of supply, like having a safety stock. The convenience rate is defined as $y = y_1 - c$ where c is the cost of storage and y_1 the benefit. We can therefore write (Geman, 2005):

$$f^T(t) = S(t)[1 + \underbrace{r(T-t)}_{\substack{\text{Cost of financing} \\ \text{the purchase of } S}} + \underbrace{c(T-t)}_{\substack{\text{Cost of storage} \\ \text{during } (t,T)}} - \underbrace{y_1(T-t)}_{\substack{\text{Pure "benefit" from holding} \\ \text{the physical commodity}}}$$

Because of arbitrage the equation must hold. If the left hand side is higher than the right hand side you could sell the forward and create the perfect hedge by taking a loan and using that money to pay for the commodity and storage. At maturity you could pay off the loan from the proceeds and pocket the difference. If the left hand side is lower the same strategy works in reverse.

2.3.4. FORWARD CURVES

Another commonly used concept is the forward curve. This is a graph that shows the price of forward contracts with the x-axis being time to maturity. The forward curve can either be in *backwardation* or *contango*. Figure 7 shows a forward curve in *backwardation* (Geman, 2005). The lower case t between brackets in the Y-axis should be 0 as time to maturity, capital T, is varied on the X-axis. In this situation the forward prices closer to maturity are higher, this means there is more benefit to holding the commodity are higher than the costs. In mathematical terms this means that $r + c < y_1$. In reality forward prices are determined by supply and demand. This means demand relative to supply for spot and shorter term maturity forwards is very high, while demand relative to supply for forward contracts with higher time to maturity is lower (Geman, 2005).

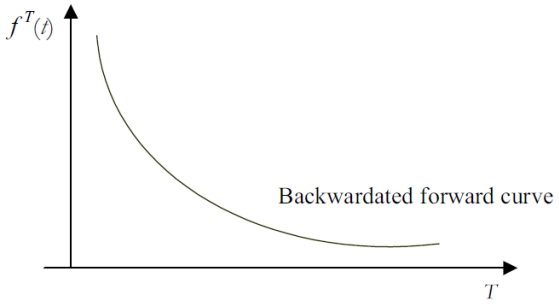

FIGURE 7: FORWARD CURVE IN BACKWARDATION (GEMAN, 2005).

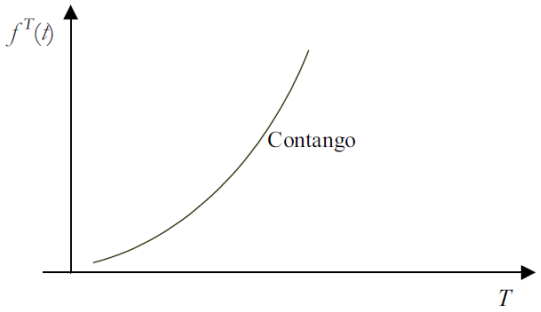

FIGURE 8: FORWARD CURVE IN CONTANGO (GEMAN, 2005).

When a forward curve is in *contango* prices of forward contracts closer to maturity are lower than prices of forward contracts with longer time to maturity, this means there is more benefit to using forward contracts than holding the physical commodity. In mathematical terms this means that $y_1 < r + c$. Figure 8 shows a forward curve in contango (Geman, 2005). The lower case t between brackets in the Y-axis should be 0 as time to maturity, capital T, is varied on the X-axis.

the animal feed company uses forward curves to assess supply and demand circumstances in the future. They compare the supply and demand circumstances the forward curves insinuate with their own views. If they expect the market to be even tighter than the forward curves show, they could decide to buy forward contracts. If it's the other way around they will decide to wait.

2.4. CONCLUSIONS

In this chapter we have learned the following things:

- Procurement at the animal feed company is based on the belief that they can outperform the market by being flexible with the timing and length of buying decisions. Information is continuously gathered on the markets to support their views on the markets. Their positions are then adjusted to match this view. This information gathering is supported by information sharing within the company as the different business units share their views regularly. Performance is measured using a purely financial metric. This metric is the difference between the replacement value and the contracted value.
- When looking at the animal feed company's purchasing and trading department from a functional perspective (Cousins, Lawson, & Square, 2006) the following things stand out: low sophistication in supplier management, high regard from management, information sharing between the department and the rest of the organization exists. Therefore they can be classified as *celebrity procurers*, however they do deviate from this group because of information sharing.
- When looking at the animal feed company's purchasing and trading department from a product group perspective (Caniëls & Gelderman, 2005) some things stand out: The products they procure have relatively low supply risk, they have high leverage for some products and low leverage for other products. The strategies they apply are *exploit buying power* and *individual ordering* for products where they have respectively high and low leverage. For both of these strategies administrative efficiency of the purchasing department is key.
- the animal feed company's energy sources generally have low supply risk. Therefore *exploit buying power*, *individual ordering* and *pooling of requirement* strategies are applicable. Creating a strategic partnership does not seem to have any benefits.
- the animal feed company falls into the *Opportunistic buying* category (Cousins, Lamming, Lawson, & Squire, 2008). They buy supply when they feel prices are at the lowest level and take on enough length to a point where they believe prices will have lowered again.

3. ELECTRICITY MARKETS

In the previous chapter we have gained an understanding of the the animal feed company's approach to procurement. In order to successfully procure commodities with the 'opportunistic' strategy the animal feed company uses a thorough understanding of the markets. In this chapter we discuss the markets and answer the following research question through content analysis:

2. How can energy markets be characterized according to literature?

We answer this question for electricity since this commodity represents the largest expenditure for the animal feed company. This chapter is structured in the following way: in Section 3.1 we talk about electricity spot markets. In Section 3.2 we continue with the components of an electricity market. Forward prices for electricity are defined differently than forward prices for other commodities, this will be discussed in 3.3. The structure of the supply side of a market has an enormous impact on the spot and forward prices of electricity we therefore complete this chapter with a discussion on the supply side in 3.4.

3.1. ELECTRICITY SPOT MARKETS

The electricity spot markets have two unique features compared to other commodities. Firstly electricity is generally not economically storable. An exception is hydro energy but this represents a very small part of total electricity production and is subject to geographical restrictions. The capacity of conventional batteries is only a fraction of consumption in an electricity market. On top of that storing electricity costs electricity. This means that sometimes in order to supply enough energy for the total demand very expensive sources of electricity have to be used. (Geman, 2005)

The second unique aspect of the electricity markets is that supply always has to match demand. This aspect is a direct result of the non-storability of electricity. If supply exceeds demand the network could get damaged, this could lead to high costs. If demand exceeds supply parts of the network would suffer from outages. Therefore matching supply and demand is a very high priority for power exchanges.

Electricity spot prices are known for their volatility, this is in line with the *theory of storage* as proposed by Geman (2005). The most important implications of the *theory of storage* can be summed up as followed:

- The volatility of a commodity tends to be inversely related to the level of global stocks. Since electricity cannot be stored generally, volatility in the markets is exceptionally high.
- The price of a commodity and its volatility are positively correlated since both of them are negatively related to the inventory level. The inventory level of electricity is generally non-existent, however if we look at the match between supply and demand, if supply is lower than demand prices for electricity increase dramatically.
- The volatility of forward prices tends, everything else being equal, to decrease with their maturity. Regardless of the non-storability of electricity, the further away maturity is, the more time the markets have plan the right amount of supply. Therefore, volatility is lower if time to maturity is longer.
- An inventory-dependent convenience yield has become in the recent literature a popular-state variable for the explanation of the different shapes of forward curves. This implication has no relevance to the spot price, it has a major implication on forward prices. Normally the market will resolve arbitrage between storing commodities and buying forward contracts, however in the case of electricity this link does not exist.

Finally we address the characteristics of the demand and supply side of an electricity market. Demand is very predictable and if accounted for cyclicality relatively stable. Furthermore demand is very inelastic this adds to more spot price volatility, as price incentives must be enormous to refrain from buying or buying more than needed. The supply side has two faces, for long term contracts it is very price elastic, if prices high enough extra generating capacity will be found, if prices are too low plants are shut down. However, this is not the case for the short term, generally it difficult to activate or deactivate capacity ad hoc. Furthermore, a supply side outage will lead to large price spikes.

Everything we have discussed so far regarding electricity spot markets is relevant for liberalized markets. However, electricity markets can be structured in many different ways with different degrees of government interference. The structure of a market has great influence on pricing, therefore having a greater understanding of the possible variations and their effects will support the animal feed company in decision making. This is the topic of the next section.

3.1.1. CONCLUSIONS

In this section we have learned the following things:

- The characteristics of the electricity spot markets all lead to very high volatility. The main reason is that electricity is currently not economically storable but the inelasticity of demand and short term supply add to this.
- The spot-forward relationship based on the convenience yield does not exist for electricity. This is also because of the non-storability, the market cannot resolve arbitrage. There is a relationship between spot and forward prices as forward contracts are settled at maturity. When a forward contract moves closer to maturity the forward price will converge to spot price and become more volatile.

3.2. ELECTRICITY MARKET STRUCURE

In completely liberalized markets, spot electricity prices are very volatile and are set by the market participants. However, there are very few fully liberalized markets in the world and it is very likely that the animal feed company operates in other types of markets. In this section we will give an overview of the ways electricity markets may differ. We will start with the different types of activities that have to be performed in an electricity market. There are four (Geman, 2005):

- *Generation:* Power is produced by either burning through feedstock most commonly coal, gas, oil or enriched uranium. Or, it is produced from a renewable source most commonly solar, wind or hydro. The types of generation influence pricing greatly as does the number of suppliers.
- *Transportation:* Power transportation is a natural monopoly because currently the only possible way of transporting it is through a network. This means that in a geographical area only one network exists that gives the owner a competitive advantage.
- *Distribution:* This entails selling power to the users, billing and metering. The ownership of the distribution function and number of distributors influence pricing.
- *Trading:* This is done at an exchange and entails providing a platform at which generators and distributors meet. Sometimes an exchange also acts as a clearing house to reduce counterparty risk. This function is not present in every market as prices are set by governments or because there is only one supplier/distributor.

The terms *bundled* and *unbundled* are used to describe whether a market is liberalized or not. A fully bundled market means that the generation, transportation and distribution functions are owned by a

single entity. A fully unbundled market means that the generation is controlled by several supplier, transportation is either owned by all participants or none, distribution is controlled by several distributors and there is an active exchange. The process of moving from a bundled to an unbundled market is called *unbundling* (Geman, 2005).

On top of this the government plays a crucial role in each electricity market because of the importance of electricity. Government influence comes in many forms. The most common form is ownership of some or all parts of the value chain. Another way the government influences the market is by taxing or subsidizing certain types of generation, a well-known example of this is the European emissions trading system (ETS). Governments are also known to affect pricing, the most extreme examples are governments that set prices outright but price caps are also very common. Many more forms of government influence exist but we will not go into detail, for each the animal feed company market the government influence will be discussed.

At an exchange standardized electricity contracts are traded. Pricing these contracts is done slightly differently from other commodities. The prices for these contracts are commonly used as reference when negotiating a price for an OTC contract with a distributor. Therefore, it is important to understand what types of contracts are available and how they are traded. This is the topic of the next section.

3.2.1. Conclusions

In this section we have learned the following things:

- There are four distinct activities in an electricity market: generation, transportation, distribution and trading. The type of generation and amount of generators influence pricing. The ownership of transportation influences pricing. The amount of distributors influence pricing as a concentration of this activity leads to a monopoly that in turn leads to leverage toward suppliers and consumers. The existence of an exchange indicates a liberalized market. The activity and types of offered contracts at the exchange influence pricing and whether the animal feed company can apply their approach to procurement.
- There are many forms of possible market structures. Bundled structures indicate a concentration of ownership while unbundled markets indicate a number of suppliers and distributors, an active exchange and shared ownership or independence of the distribution function.
- Government intervention comes in many forms from ownership to taxing/subsidizing to pricing.

3.3. ELECTRICITY FORWARD CONTRACT PRICES

Even though electricity cannot be stored there is a relationship between the spot price and forward price of electricity since forward contracts are settled either financially or physically at maturity. Because of this it is important to understand how spot prices arise in liberalized markets.

Spot markets can be divided into two groups: exchanges and pools. At an exchange all participants continuously put in bid and ask offers and the last trade is quoted as the latest price. In a pool a single buyer, the system operator, takes in all offers of suppliers and creates the supply function (also called merit order or power stack). Figure 9 shows the supply function of the ECAR an exchange in the US. It represents the marginal costs of generating one MWh on the Y-axis, the X-axis represents cumulative capacity of each supplier. The most efficient suppliers like nuclear power, hydro power and other renewables are usually the lowest prices while the prices on the right are the more expensive sources these are usually fossil based. After creating the supply function either a demand curve is made from market bids or estimated using historic data. The spot price is the marginal price at the intersection of the supply and demand curves.

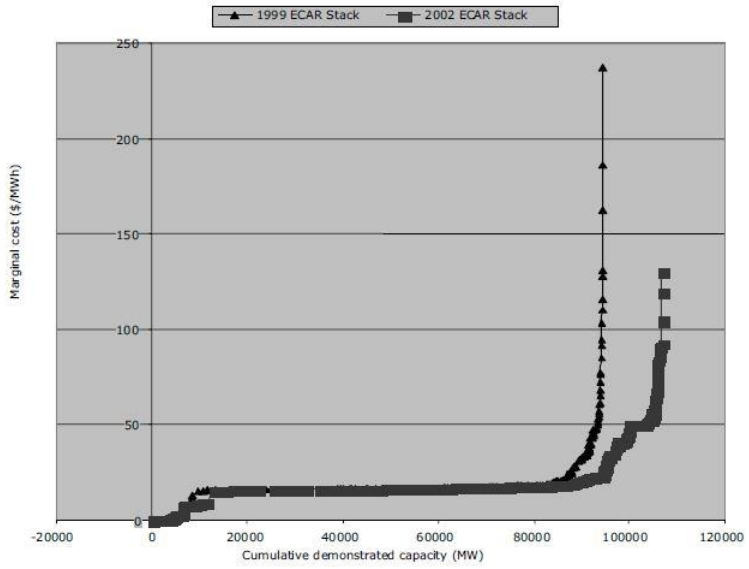

FIGURE 9: ECAR SUPPLY FUNCTION IN 1999 AND 2002 (GEMAN, 2005).

Even though both systems operate very differently it is important to note that the spot prices they yield are always at or close to the highest price of the active generators. Now we have an understanding of electricity spot prices and we can continue with forward prices. In Subsection 2.3.3 we discussed the mathematical definition of the forward price in terms of spot price, risk free rate and the convenience yield:

$$f^T(t) = S(t)[1 + (r - y)(T - t)]$$

However as electricity is not storable the convenience yield is zero, however forward prices are not equal to the future value of the spot price. Therefore another factor comes into play. Geman (2005) defines this as a risk premium:

$$F^T(t) = E_p[S(T)/F_t] + \text{Risk premium}$$

$F^T(t)$ represents the forward price at time t for a contract with maturity T, $E_p[\frac{S(T)}{F_t}]$ represents the expected spot price at maturity given the information at time t (F_t). The risk premium can be written as $\pi(t,T)$ and varies over time with maturity T and can have a different sign for different values of $T - t$. Geman & Vasicek (2001) have shown, based on 7 years of spot- and forward prices, that the risk premium is positive for months with relatively high demand, for instance this could be winter and summer months. Furthermore they have shown that the risk premium is higher for contracts closer to maturity. This result is confirmed by Bessembinder & Lemmon (2002).

In this section we saw that the forward price is based on the markets expectation of the future spot price and a risk premium based on expected demand and time to maturity. Since the spot price is based on the highest price of the active generators we will look into the supply side of the electricity markets in the next section.

3.3.1. CONCLUSIONS

In this section we have learned the following things:

- Regardless of the way spot prices are created the spot price will be close to the highest marginal costs of the active generators. The marginal costs of electricity is very dependent on the raw materials used to generate it. Therefore, the type of installed capacity in a region and spot prices of the raw materials are important factors for the spot price.
- Forward prices are based on the markets expectation of the future spot price and a risk premium based on expected demand and time to maturity. Therefore forward prices are dependent on the installed capacity in a region and forward prices of raw materials.

3.4. SUPPLY SIDE

In the previous section we concluded that the spot price is the highest price of the active generators. In this section we will look at the effect *installed capacity* has the price of electricity. The installed capacity of a market is the total number of generators available. In a perfect competition spot prices will be equal to the marginal costs of producing one more MWh (Goolsbee, Levitt, & Syverson, 2013). The marginal costs are:

$$MC = \frac{dTC}{dq}$$

Fixed costs disappear when differentiating over q. In the electricity markets MC are assumed to be constant for all levels of production for a single plant, the main reason for this is increase overhead as production increases is assumed to be relatively low, most of the costs incurred are due to the costs of the raw materials. Hence, the marginal costs are influenced greatly by the costs of the raw materials and the efficiency at which a plant can generate electricity. Therefore, spot prices are influenced greatly by the costs of raw materials used by the price of the highest active generator. (Goolsbee, Levitt, & Syverson, 2013)

Unfortunately electricity markets are not perfect competitions. Entry barriers are high due to high required investments and there are large differences in marginal costs between suppliers. Participants have an incentive to give prices that are only slightly below their more expensive competitors. For instance if marginal costs for generating in a gas fired generator are 10, a coal fired generator that might have marginal costs of 5 is likely to quote a price at 9.99. Because of this electricity prices are not influenced by the costs of one raw material, but by the costs of several.

Looking at the installed capacity of a market gives a better understanding of the price behavior in a certain market. Unfortunately things are bit more complicated because of transportation capacity between countries. This gives distributors the option to buy electricity in a connected country. This causes electricity prices between countries to converge to the point they are equal if transportation capacity is sufficient. Figure 10 illustrates this as the orange and purple lines have converged over time as transportation capacity has increased between the Netherlands and Germany (Thomson Reuters, 2017).

FIGURE 10: DUTCH (ORANGE), BELGIAN (GREEN) AND GERMAN (PURPLE) YEAR AHEAD ELECTRICITY PRICES (2014-2016) (THOMSON REUTERS, 2017)

One final element that should be discussed is the European Emission Trading System (ETS). The EU has introduced this system in order to limit the emissions of CO2. Each supplier is given a certain amount of allowances for free. If they exceed their allowance they have to buy more in an open market, if they do not use their allowances they are allowed to sell it. Even though they are given their allowance for free the price of CO2 certificates are priced in the electricity price, this is because they treat it as opportunity costs (Sijm, Neuhoff, & Chen, 2011). This has an effect on the supply function as not every source generates the same amount of CO2. In general coal fired generation, especially lignite, produces the highest amount of CO2, while gas fired produces the least (of the CO2 producing sources). The price level of CO2 allowances therefore has a great effect on the electricity prices but also on the drivers of electricity prices as it could switch the order of the supply function.

3.4.1. CONCLUSIONS

In this section we have learned the following things:

- Raw material prices influence the price of electricity as the spot price is set at the offer of the highest active generator. This especially holds true for the forward market as the spot market is very volatile. The installed capacity gives a good understanding of which raw materials affect the market the most

- Interconnection capacity between countries allow electricity to flow from the cheaper markets to the more expensive markets. Because of this, the installed capacity of the cheaper countries will also influence pricing in the more expensive country.
- The European ETS has an effect on the supply curve and therefore on the effect raw material prices have on the electricity price. Switching between generating plants becomes more of a reality as the cheaper coal generation becomes relatively more expensive compared to gas generation.

3.5. CONCLUSIONS

In this chapter we have learned the following things:

- The characteristics of the electricity spot markets all lead to very high volatility. The main reason is that electricity is currently not economically storable but the inelasticity of demand and short term supply add to this.
- The spot-forward relationship based on the convenience yield does not exist for electricity. This is also because of the non-storability, the market cannot resolve arbitrage. There is a relationship between spot and forward prices as forward contracts are settled at maturity. When a forward contract moves closer to maturity the forward price will converge to spot price and become more volatile.
- There are four distinct activities in an electricity market: generation, transportation, distribution and trading. The type of generation and amount of generators influence pricing. The ownership of transportation influences pricing. The amount of distributors influence pricing as a concentration of this activity leads to a monopoly which in turn leads to leverage toward suppliers and consumers. The existence of an exchange indicates a liberalized market. The activity and types of offered contracts at the exchange influence pricing and whether the animal feed company can apply their approach to procurement.
- There are many forms of possible market structures. Bundled structures indicate a concentration of ownership while unbundled markets indicate a number of suppliers and distributors, an active exchange and shared ownership or independence of the distribution function.
- Government intervention comes in many forms from ownership to taxing/subsidizing to pricing.
- Regardless of the way spot prices are created the spot price will be close to the highest marginal costs of the active generators. The marginal costs of electricity is very dependent on the raw materials used to generate it. Therefore, the type of installed capacity in a region and spot prices of the raw materials are important factors for the spot price.
- Forward prices are based on the markets expectation of the future spot price and a risk premium based on expected demand and time to maturity. Therefore forward prices are dependent on the installed capacity in a region and forward prices of raw materials.
- Raw material prices influence the price of electricity as the spot price is set at the offer of the highest active generator. This especially holds true for the forward market as the spot market is very volatile. The installed capacity gives a good understanding of which raw materials affect the market the most
- Interconnection capacity between countries allow electricity to flow from the cheaper markets to the more expensive markets. Because of this, the installed capacity of the cheaper countries will also influence pricing in the more expensive country.
- The European ETS has an effect on the supply curve and therefore on the effect raw material prices have on the electricity price. Switching between generating plants becomes more of a reality as the cheaper coal generation becomes relatively more expensive compared to gas generation.

4. ENERGY PROCUREMENT OF THE ANIMAL FEED COMPANY

In the previous chapters we have given context to the animal feed company's procurement strategy both from a strategy and a market perspective. It is now time to look into how energy is currently bought at the animal feed company. As mentioned the animal feed company has a very clear approach to commodity procurement and applies this throughout the company to raw material procurement. However, energy procurement is left to each business unit, because of this the purchasing and trading department believes discrepancies between the procurement strategy and the actual buying of energy arise. In this chapter we will answer the following research questions:

3. What are the requirements/preconditions the animal feed company has regarding energy procurement?
4. What are the relevant differences in energy purchasing behavior between the countries the animal feed company operates in?

This chapter is structured in the following way. In Section 4.1 we define the preconditions the animal feed company sets towards the energy procurement. After this we give a description of the current buying behavior of the 7 largest business units of the animal feed company in Section 4.2. We conclude this chapter in Section 4.3 by comparing the approach of the animal feed company with the actual practices of the business units and see if the assumption that there are discrepancies is correct.

4.1. THE ANIMAL FEED COMPANY'S APPROACH TO ENERGY PROCUREMENT

In Section 2.1 we have discussed the animal feed company's approach procurement in general. In this section we will briefly discuss the animal feed company's approach to energy procurement. In broad lines the approach is the same. Being flexible with the timing and length of buying decisions based on a well-founded view will lead to better financial performance on the long term. Being flexible means waiting to buy energy when prices are expected to go down and the other way around. Being flexible also refers to the length of the exposure towards energy.

A buying decision is based on a view on the market. This view is formulated based on information retrieved from the market itself, reports and through information sharing within the company. Information sharing is key as it enables the buyers to compare their own views with those of others. Furthermore, it enables the creation of consensus. Since information sharing is viewed as critical buying responsibility should remain decentralized as this guarantees commitment to information sharing.

As discussed in Chapter 3 the energy markets, especially the electricity markets differ from the commodity markets the animal feed company procures its raw materials from. Because of this the markets the animal feed company operates in should accommodate 'opportunistic' buying, for instance a forward market should be present. If the market does not allow 'opportunistic' buying, information sharing and gathering is wasted energy. In the next chapter, Chapter 5, we will talk about the individual markets. In this chapter we will continue with an overview of the current buying behavior of the seven largest business units, to get a grip on the current situation.

4.1.1. CONCLUSION

In this section we have learned that:

- the animal feed company's approach to energy procurement is also the same as their approach to procurement in general: being flexible with the timing and length of buying decisions based on a well-defined view on the market leads to higher returns in the long run, information sharing is key

toward creating a well-informed view on the market, decentralization leads to higher a commitment towards information gathering and sharing. The only difference is the markets itself, they should allow for 'opportunistic' buying, otherwise information sharing and gathering is wasted energy.

- Based on these views three preconditions regarding energy procurement can be formulated:
    - Each business unit acts autonomously
    - Buying decisions are based upon a view on the market
    - Information is shared within the company to support market views

4.2. THE ANIMAL FEED COMPANY'S CURRENT ENERGY BUYING BEHAVIOUR

In this section we discuss the current buying practices of the seven largest business units of the animal feed company. This information is gathered through company data and interviews. For each business unit we describe the types of energy consumed for each production location, the types of contracts used and how a buying decision is reached.

4.2.1. THE ANIMAL FEED COMPANY IN THE NETHERLANDS

The animal feed company has eight production locations in the Netherlands. In seven locations gas is used as a heating source. In Andel red diesel is used. Figure 11 shows the distribution of energy costs for each energy source. All electricity data for 2016 is an estimate based on the first six months. For gas and Red Diesel this is seven months.

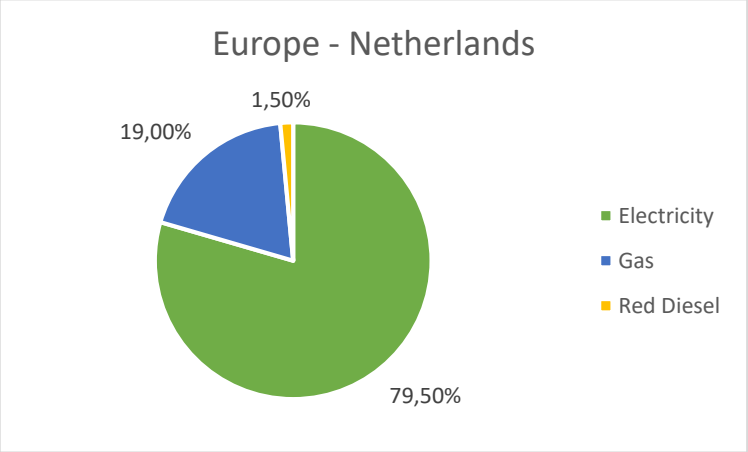

FIGURE 11: DUTCH ENERGY COSTS DISTRIBUTION IN 2016.

In The Netherlands energy is bought when prices are deemed low. There is no set of rules that the purchasing department follows. A buying decision is based on a consideration of the demand side, supply side, energy commodity prices, technicals and more indicators. Currently a two year contract is signed with E.ON where peak and off-peak prices can be fixed in the calendar years 2017 and 2018, the reference market is the APX. Off-Peak was fixed the moment the contract was signed for 2017 and 2018.

Figure 12 shows the historical prices for Dutch baseload power for 2017 and 2018, the yellow line represents the moment prices were fixed. Off-peak prices are calculed using baseload and peakload prices and a conversion factor based on the number of peakload hours in the relevant period of time, therefore we use the baseload as a reference.

Figure 13 shows the historical prices for Dutch peakload power for 2017 and 2018, the yellow line represents the moment prices were fixed. Currently 50% of total consumption is fixed the rest is bought on spot, final prices are based on the average day ahead prices in the relevant period.

FIGURE 12: DUTCH 2017(ORANGE) AND 2018(PURPLE) BASELOAD PRICES, THE YELLOW LINE REPRESENTS THE FIXING DATE. (THOMSON REUTERS, 2017).

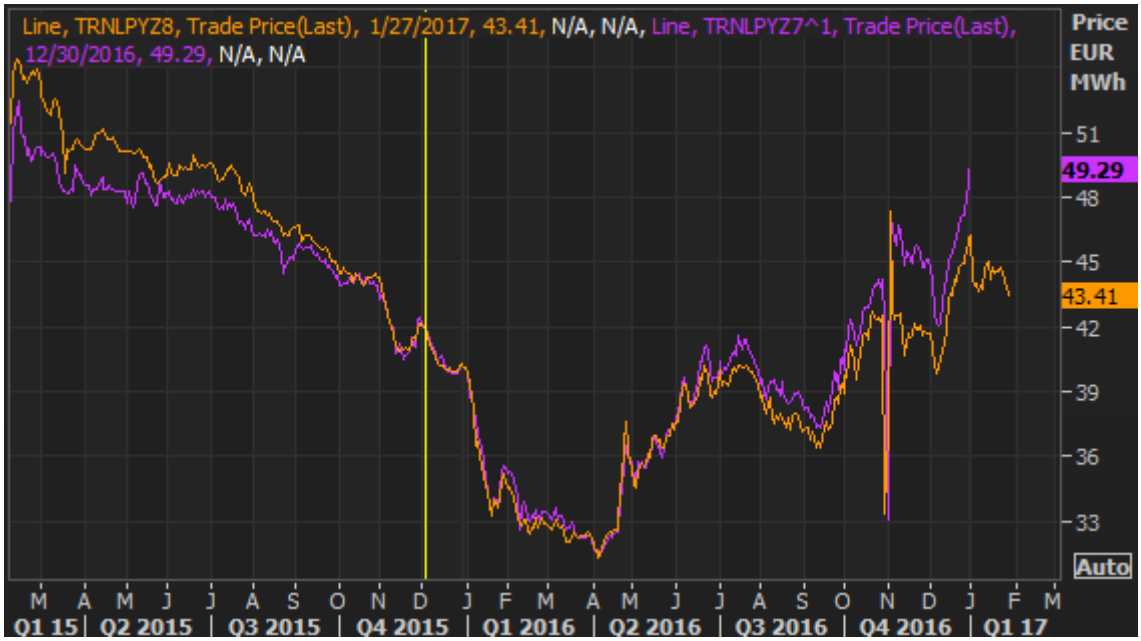

FIGURE 13: DUTCH 2017(ORANGE) AND 2018(PURPLE) PEAK LOAD PRICES, THE YELLOW LINE REPRESENTS THE FIXING DATE (THOMSON REUTERS, 2017).

Gas is bought in the same way, markets are monitored and when an acceptable price level has been reached prices will be locked in. Currently gas needs have been covered until the end of 2017. A contract locking in prices for 2016 and 2017 had been signed in December 2015. Figure 14 shows the prices for the 2016 and 2017 gas contracts, the yellow line represents the moment prices were locked in.

FIGURE 14: DUTCH YEAR FORWARD GAS PRICES 2016(ORANGE) AND 2017 (PURPLE), THE YELLOW LINE REPRESENTS THE FIXING DATE (THOMSON REUTERS, 2017).

4.2.1.1. CONCLUSION

Energy buying behavior in the Netherlands can be summarized as follows:

- Energy buying in The Netherlands is according the approach of the animal feed company. A position is extended when prices are deemed low. A buying decision is based on supply, demand, technical analysis, feedstock (in the case of electricity) and any other indicators that help to create a vision on the market. Currently electricity has been bought for the most part until the end of 2018. Gas has been bought until the end of 2017.

4.2.2. THE ANIMAL FEED COMPANY IN POLAND

In Poland most factories use gas as a heating source. One location uses LNG and another location uses a different type of gas, denoted as 'other gas'. Figure 15 shows the proportion of the total energy expenditure each energy source is responsible for. All data presented for 2016 are estimates based on 9 months of data. Furthermore all Polish data given in euros is estimated using the average exchange rate for its respective year.

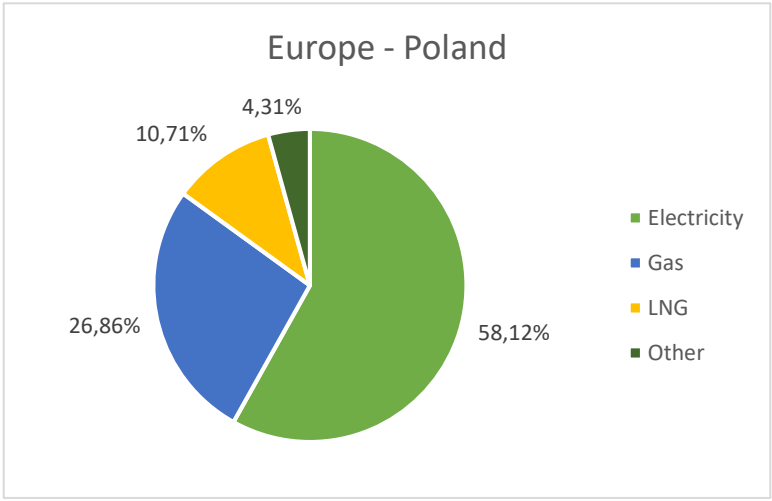

FIGURE 15: POLISH ENERGY COSTS DISTRIBUTION IN 2016.

In Poland power is bought one year at time, from January till December. Throughout the year, year ahead prices are monitored and a contract is signed at a time when prices seem favorable. Several offers will be requested from suppliers and the most favorable offer is accepted. The reference market is the Polish Power Exchange (POLPX). Figure 16 shows polish year ahead power prices, the yellow lines represent the period in which the price was fixed for 2016.

FIGURE 16: POLISH YEAR AHEAD POWER PRICES (2014-2016) (THOMSON REUTERS, 2017)

The Polish gas market has been liberalized in March 2016. This means gas is no longer sold by one supplier but is traded on an open exchange. Since then the animal feed company has signed one contract that runs until September 2017. The contracts is signed with PGNiG which is the old supplier, they still offered the best prices. In the future they plan to use the same strategy, when prices seem favorable several offers will be considered.

4.2.2.1. CONCLUSION

Energy buying in Poland can be summarized as follows:

- In Poland electricity is bought one year at a time even though further ahead contracts are available. Contracts can be signed any time of the year. Markets will be monitored and a contract signed when prices are deemed favorable. Gas is bought in the same way however position is not necessarily extended one year at a time. Currently electricity is bought until the end of 2017. Gas has been bought until September 2017. The business unit in Poland follows the the animal feed company approach only partly as flexibility is shown with the timing of buying but not with the length of exposure towards electricity.

4.2.3. THE ANIMAL FEED COMPANY IN SPAIN

In Spain the animal feed company has ten production locations. Eight of those use gas as their heating source. The remaining two still use Fuel Oil. Figure 17 is a pie chart that shows the proportion of the total energy expenditure each energy source is responsible for. This is an estimates based on 9 months of data.

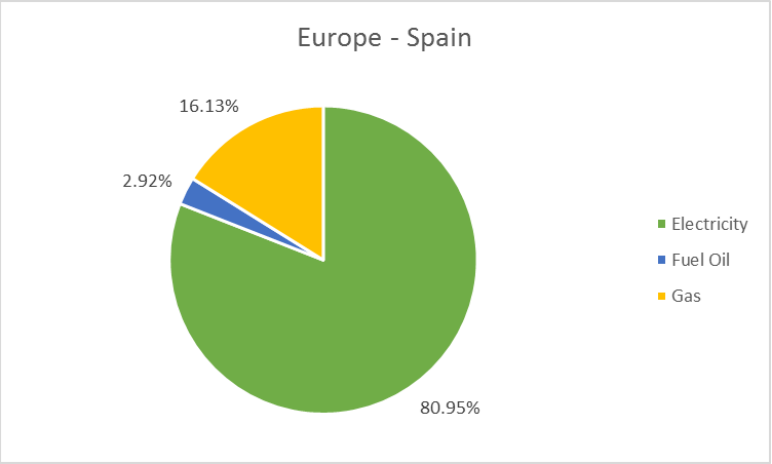

FIGURE 17: SPANISH ENERGY COST DISTRIBUTION IN 2016.

The animal feed company Spain signs a contracts for electricity and gas for a year, from September till August. Starting from April (May for gas) new contracts are negotiated with multiple providers. In Spain the company is assisted by a consultant during this process. This consultant costs €10200,- a year, he supports in the negotiation and billing of 17 different energy contracts. The contacts are signed in July. The providers offer many types of contracts: fixed prices, market prices, an option to fix prices for several periods and so on. In previous years the animal feed company never signed contracts for a longer duration than one year. This is a policy implemented by the previous owners. For the past ten years Endesa has been the supplier for Electricity. For gas, they recently signed a contract with a new supplier, Union Fenosa Gas. Fuel oil is always bought on spot. There are several suppliers, they always buy from the suppliers that offer the best prices.

Figure 18 shows the year ahead prices for electricity in the Iberian market, the MIBEL. It shows that in the past years there has been an uptrend in spring with a peak in approximately June. This is the time contract negotiations for the animal feed company in Spain end. In the previous year's prices from February till April seem to have been lower. It should be noted that the animal feed company negotiates Sep till Aug contracts and this graph shows Jan – Dec contracts. There should be a price difference between these contracts because the contracts start at a later time, however both contracts cover an entire year so seasonality effects should be accounted for in the same way.

FIGURE 18: IBERIAN YEAR AHEAD POWER PRICES SEASONALITY CHART (2014-2016) (THOMSON REUTERS, 2017).

4.2.3.1. CONCLUSIONS

The energy buying behavior of the animal feed company in Spain can be summarized as follows:

- The business unit in Spain does not follow the animal feed company's approach regarding energy procurement. From May (April for gas) until July offers for October – September contracts are considered for both Electricity and Gas. A consultant assists the animal feed company during this process and handles billing throughout the year. From the seasonality charts no clear seasonality advantages were detected in this period. Fuel Oil is bought on spot from different local suppliers, whichever offers the best price.

4.2.4. THE ANIMAL FEED COMPANY IN PORTUGAL

In Portugal all plants use Fuel oil as heating source. Figure 19 shows the distribution of energy expenditure per source in 2016. These are estimates are based on 9 months of data.

In Portugal electricity is bought one year at a time, contracts run from January until December. Contracts are signed in December, but proposals are evaluated in October and November as well. Currently their supplier is Iberdrola, however they evaluate offers from around six suppliers each year. In Portugal most of the suppliers are Spanish companies. The reference market is the MIBEL, this is the same as the market in Spain. However, prices for Spain are usually a bit higher.

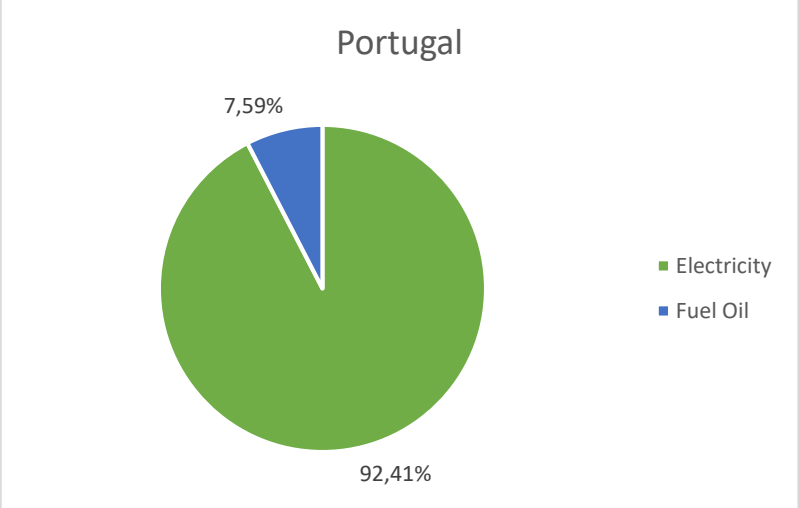

FIGURE 19: DISTRIBUTION OF PORTUGUESE ENERGY COSTS (2016).

Figure 20 shows year the year ahead prices for baseload in Portugal in a seasonality chart. There is no clear seasonality and prices in q4 are not necessarily lower.

FIGURE 20: PORTUGUESE BASELOAD YEAR AHEAD PRICES (2013-2016) (THOMSON REUTERS, 2017).

Fuel oil is bought on spot at supplier called Creixoauto. Because of the low oil prices in 2015 and 2016 heating with Fuel Oil has been very cheap. However, in Portugal emission laws are becoming stricter, this means the animal feed company will be forced to switch to another heating source. According to the animal feed company in Portugal this will most likely be gas. The gas market in Portugal, like the electricity market, is the same as the Spanish market.

4.2.4.1. CONCLUSIONS

the animal feed company's energy buying behavior in Portugal can be summarized as follows:

- The business unit in Portugal does not follow the animal feed company's approach to energy procurement. From October until December offers are evaluated and negotiated for electricity. A contract is signed in December. From the seasonality charts no clear seasonality is detected in this period. Fuel oil is bought on spot through one supplier. It is very cheap but it is expected that due to environmental regulations the use of fuel oil will no longer be possible.

4.2.5. THE ANIMAL FEED COMPANY IN THE CZECH REPUBLIC

the animal feed company operates two production locations in the Czech Republic. Both of these locations use gas as heating source. Figure 21 shows the distribution of the energy costs. All data presented in this report for 2016 are estimates based on 9 months of data. All costs are estimated in Euros based on monthly exchange rate closes.

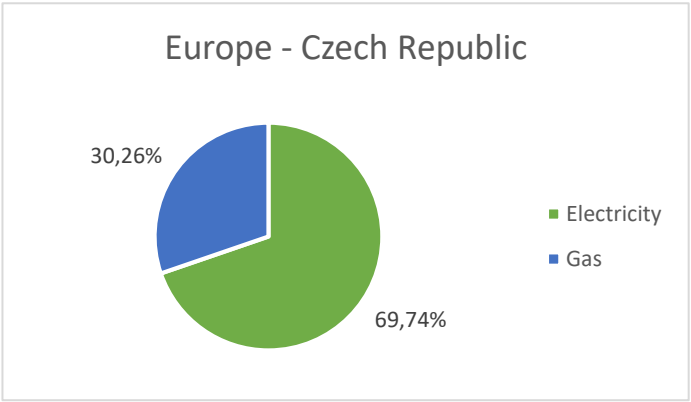

FIGURE 21: DISTRIBUTION OF ENERGY COSTS CZECH REPUBLIC 2016.

Before 2016 power was bought one year at a time, contracts ran from January to December and were signed at the end of the third quarter. The current contract has been signed with RWE, it started in January 2016 and runs for two years. This contract is flexible. Prices can be locked in for months, quarters and years. They use the PXE as

reference market and pay a fixed premium of 1.08 euros per MW. In 2016 they locked in prices for each quarter, Figure 22 shows the quarter ahead prices for the PXE, the vertical yellow lines represent the dates prices for the next quarter where locked in. Consumption exceeding contracted amounts is settled at spot prices.

FIGURE 22: PXE QUARTER AHEAD PRICES Q4 2015 - Q4 2016 (THOMSON REUTERS, 2017).

Gas is bought in year contracts and the supplier is RWE. Each contract runs from January until December and contracts are usually signed in September. The reference market is the Central European Gas Hub (CEGH). Figure 23 shows the year ahead prices for the CEGH, the yellow vertical line represents the date the contract for 2016 was signed. The CEGH started to quote prices in 2015, therefore earlier prices are not available.

FIGURE 23: CEGH YEAR AHEAD PRICES 2015 – 2016 (THOMSON REUTERS, 2017).

4.2.5.1. CONCLUSIONS

The energy buying behavior of the business unit in the Czech Republic can be summarized as follows:

- The business unit in the Czech Republic buys electricity according to the approach of the animal feed company, gas is bought on a fixed date. Currently a flexible contract until December 2017 has been signed, prices can be locked in for months, quarters and years with the PXE as reference. Buying decisions are made based on market information. Gas is bought one year at a time and contracts are signed in September.

4.2.6. THE ANIMAL FEED COMPANY IN VIETNAM

In Vietnam the animal feed company has seven production locations. One uses Fuel Oil (Binh Dinh) as heating source, consumption and cost data were unavailable. The other six locations use biomass (rice husks). Usage of Biomass is not the only option. In the past coal has been used to heat the boilers, however currently the use of rice husk pellets is much cheaper. Figure 24 shows the distribution of energy costs in 2016. These numbers are based on data from the first nine months of 2016

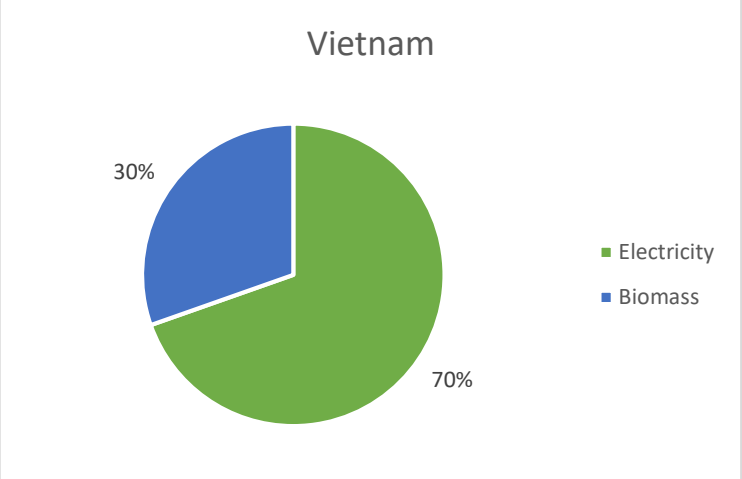

FIGURE 24: DISTRIBUTION OF ENERGY COSTS IN VIETNAM (2016).

Electricity is bought from EVN. EVN is a state-owned company and prices are regulated by the government. As a result consumers can only buy on spot.

Rice husk pellets are bought from many local suppliers. It is a byproduct of the rice industry but it is not processed on a large scale. Since production has increased a lot the animal feed company is constantly looking for new suppliers. A new supplier will be asked to provide a small amount at first, if the quality is acceptable contracts for longer periods are signed. When quality criteria are not met the contract is terminated.

4.2.6.1. CONCLUSIONS

The energy buying behavior of the animal feed company in Vietnam can be summarized as follows:

- The business unit in Vietnam does not buy energy according the approach of the animal feed company. Electricity is bought on spot. Prices are regulated by EVN, a state-owned company. Rice husks are bought from several local suppliers. These suppliers change constantly. A new supplier will sell on spot, when the quality proofs to sufficient, longer contracts are signed.

4.2.7. THE ANIMAL FEED COMPANY IN SOUTH AFRICA

the animal feed company has three factories in South Africa. Each factory in South Africa uses coal as a heating source. Figure 25 shows the distribution of energy costs per source in 2016, these numbers are based on data from the first 9 months of 2016. Furthermore, all South African data given in euros is estimated using the closing exchange rate for its respective month.

In South Africa there is only one electricity supplier. This is the state-owned company Eskom. Prices are fixed and buyers consume on spot. Coal is always bought on spot from a trader who buys it directly from the mines. Data on sales were unfortunately unavailable. Prices for coal are not regulated and therefore floating.

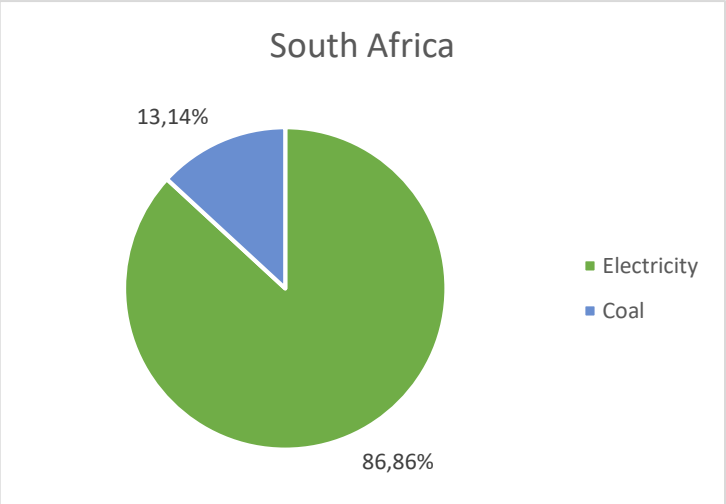

FIGURE 25: DISTRIBUTION OF ENERGY COSTS IN SOUTH AFRICA (2016).

4.2.7.1. CONCLUSIONS

The Energy buying behavior of the animal feed company in South Africa can be summarized as follows:

- The business unit in South Africa does not buy energy in accordance with the approach of the animal feed company. Electricity is bought on spot. Prices are set by parliament. It is not possible to sign forward contracts. Coal is bought through a trader. Unfortunately information on past trades was unavailable.

4.3. CONCLUSIONS

In this chapter we have learned about the current procurement behavior of the animal feed company's business units. To conclude this chapter we will summarize these practices and compare them with the animal feed company's approach to energy procurement. At the end of Section 4.1 we summarized the approach of the animal feed company as follows:

- the animal feed company's approach to energy procurement is also the same as their approach to procurement in general: being flexible with the timing and length of buying decisions based on a well-defined view on the market will lead to higher returns in the long run, information sharing is key toward creating a well-informed view on the market, decentralization leads to higher a commitment towards information gathering and sharing. The only difference is the markets itself, they should allow for 'opportunistic' buying, otherwise information sharing and gathering is wasted energy.

The practices are summarized in Table 3: summary of the animal feed company's energy procurement practices. Currently the animal feed company's approach to procurement is only followed in the Netherlands. Poland and the Czech Republic follow them partly. As a result these are also the only countries that formulate a view, however this view is not supported by any form of information sharing. In the next chapter we will look at the markets each business unit operates in and find out whether it is possible to use 'opportunistic' buying.

Business unit	Risk taking: Timing	Risk taking: Length	Formulating view	Information sharing	Autonomous
Netherlands	Yes	Yes	Yes	No	Yes
Poland	Yes	Only for gas, electricity is bought one year at a time	Yes	No	Yes
Spain	No, contracts are always signed in spring	No, length is always one year	No	No	Yes
Portugal	No, electricity contracts are always signed in december, fuel oil is bought when stock is low	No, electricity length is always one year, fuel oil is always bought on spot	No	No	Yes
Czech Republic	Only for electricity, gas is bought in september	Only for electricity, gas is bought one year at a time	Only for electricity	No	Yes
Vietnam	No, electricity is always bought on spot	No, electricity is always bought on spot	No	No	Yes
South Africa	No, electricity is always bought on spot, information on coal trades was unavailable	No, electricity is always bought on spot, information on coal trades was unavailable	No	No	Yes

TABLE 3: SUMMARY OF THE ANIMAL FEED COMPANY'S ENERGY PROCUREMENT PRACTICES

5. ENERGY MARKETS OF THE ANIMAL FEED COMPANY

In Chapter 4 we saw that most of the business units do not apply the animal feed company's approach to procurement. In this chapter we look at the markets the animal feed company operates in order to find out whether the animal feed company's approach can be applied here. We also look at the markets of the business units that follow the animal feed company's approach because this will give the purchasing and trading department in Ede a basic understanding of those markets. We talk about the gas markets in these countries only if applicable to the business unit. In this chapter we will answer the following research question:

5. What are the relevant differences in the markets the animal feed company operates in?

This chapter is structured in the following way. In Section 5.1 each market the animal feed company operates in is discussed. As prices converge in Europe the reality of a single European market comes closer this is discussed in Section 5.2. We summarize our findings in Section 5.3.

5.1. THE ANIMAL FEED COMPANY'S MARKETS

In this section we look at all the energy markets the animal feed company is active in. We discuss the markets in each of the seven business units we have discussed before. Spain and Portugal have a single market for both electricity and gas, therefore we discuss them at the same time in Section 0. We conclude this section by adding a column to Table 3 to indicate whether the animal feed company's approach can be applied to these business units.

5.1.1. THE NETHERLANDS

5.1.1.1. THE DUTCH ELECTRICITY MARKET

Figure 26 shows year ahead prices for electricity in The Netherlands, Belgium and Germany. The Netherlands is a net exporter of power to Belgium and a net importer of power from Germany. Because of limited transport capacity, power is traded at a premium in Belgium and The Netherlands (European Commision, 2014).

FIGURE 26: YEAR AHEAD POWER PRICES OF THE NETHERLANDS (ORANGE), BELGIUM (GREEN) AND GERMANY (PURPLE) BETWEEN 2014-2016 (THOMSON REUTERS, 2017).

Figure 27 shows the installed capacity in The Netherlands in 2014 (European Commision, 2016). Carbon generation accounts for 86% of total generation. Roughly half of this is coal based generation the other half is gas. There is very little installed renewable capacity.

Figure 28 shows the distribution of actual energy generation by source (European Commision, 2016). It should be noted that on top of this roughly one sixth of total consumption is imported from Germany, this is mostly baseload consumption. Because of this, coal and biomass generation is relatively low, considering 43% of total capacity is coal (and biomass). Nuclear power is very cheap and installed capacity is therefore used fully. Wind and solar account for a smaller percentage due to weather dependency. The largest source for generation is gas, for the most part this is used for generation for peak supply.

Forward base prices in The Netherlands are influenced a lot by forward gas, coal and CO2 prices. The effect of gas on peak prices will be even greater.

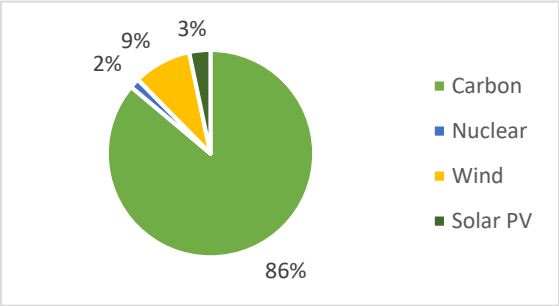

FIGURE 27: INSTALLED POWER GENERATION CAPACITY IN THE NETHERLANDS IN 2014 (EUROPEAN COMMISION, 2016).

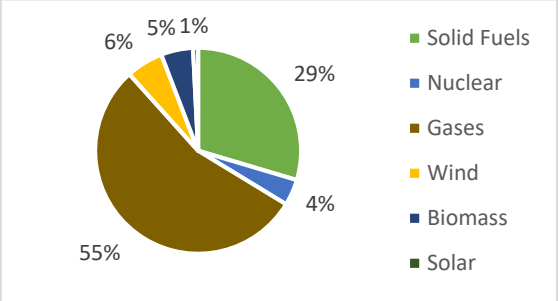

FIGURE 28: DISTRIBUTION OF POWER GENERATION BY SOURCE IN THE NETHERLANDS IN 2014 (EUROPEAN COMMISION, 2016).

5.1.1.2. THE DUTCH GAS MARKET

In the Netherlands gas is traded on the Title Transfer Facility (TTF). Trading started in 2003, but for the first years hardly any trading was done. This changed in 2007 when the Dutch government committed itself to turning the TTF into the 'gas-roundabout' of Europe. Since then the traded volume has increased significantly to the point where the TTF starting to rival the traded volume at Europe's most liquid gas hub the UK's National Balance Point (NBP). The TTF offers contracts with very high time to maturity with relative good liquidity. Figure 29 shows the time to maturity offered versus its liquidity of several European gas hubs. TTF's liquidity is lower for shorter time to maturity, but it offers the longest time to maturity in Europe. Liquidity is expected to continue to grow as TTF is increasingly used to hedge financial risks by market participants throughout continental Europe, while the other continental European hubs are used to procure physical supply (Heather, 2015).

Because the TTF is used by market participants across Europe as a risk management hub, the price level does not reflect the supply and demand of just the Dutch market, but of the European market as a whole (Kreijkes, 2017). The European, and also the global, gas market is currently in a major transition. Historically the European market consisted of many regional markets where most supply is imported through pipes from Russia, Norway and North Africa. This is transforming into a single market because of increased interconnectivity and the rise of LNG. Natural gas used to flow from suppliers outside of Europe to consumers inside Europe. Currently, because of upgrades to the old network, gas can also flow in the other direction. To be more specific, from the coasts to the inland. This new flow is supplied by LNG. LNG technology increases the energy density of natural gas to the point where it becomes feasible to transport in by water. This opened up supply from countries with major gas reserves that previously could not sell because of transportation costs, these are countries like the US, Canada, Australia and many countries in the Middle East (Franza, 2016).

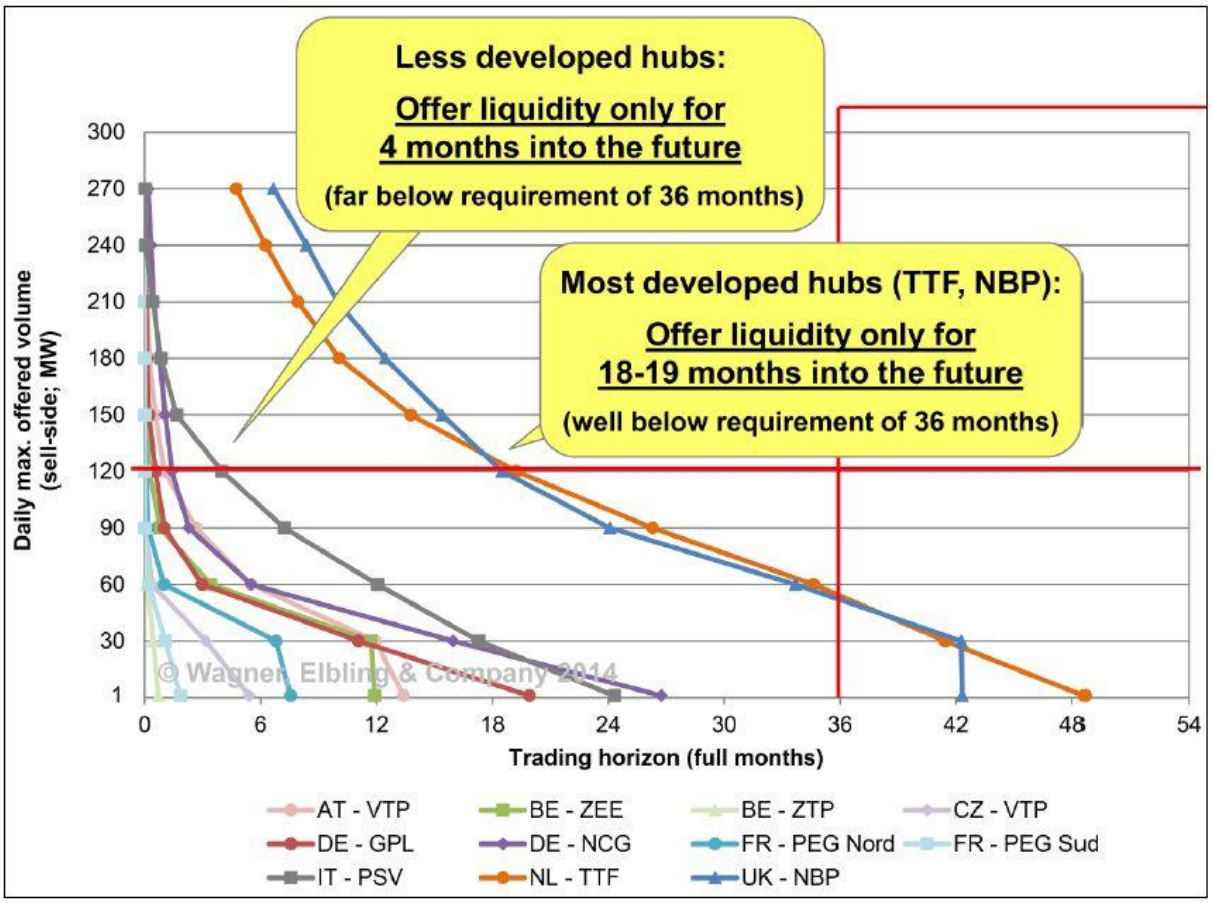

FIGURE 29: DAILY TRADED VOLUME VERSUS TRADING HORIZON OF THE MAJOR EUROPEAN GAS HUBS (HEATHER, 2015).

What does this mean for the price of natural gas? In order to understand this one more characteristic of the natural gas market should be explained, oil linked contracts. An oil linked contract bases the price of gas on a basket of oil products. These are usually extremely long term contracts, 20 to 25 years, with a minimum amount of gas to be consumed. Gas exporters only offered these types of contracts. Currently, a large part of the European supply is still supplied through these types of contracts, but because of the rise of LNG and the trading hubs an increasing share of the market is now gas priced. The existing oil linked contracts now create a cap on gas prices, if gas prices are higher than the prices of oil linked gas the contracts allow consumers to buy more of the oil linked gas. On the other hand since a very large part of supply is based on oil linked contracts gas prices in the liberalized market are correlated with oil prices.

5.1.1.3. CONCLUSION

In this section we have learned the following things:

- The Dutch electricity market allows for the animal feed company to procure electricity according its approach. Forward contracts for Dutch electricity are traded on the APX, this is not a very liquid market contracts are traded a few times a day. However, contracts with many different maturities are available. Most of power generation is based on fossil fuels and the installed capacity is relatively mixed. Base load is mostly coal, gas, nuclear and renewables, this deviates from installed capacity and actual generation due to imports from Germany. This means forward baseload prices will be influenced by forward coal, gas and CO2 prices. Peak generation is based on gas, therefore forward Peak prices will be influenced by forward gas prices.

- The Dutch gas market allows for the animal feed company to procure gas according its approach. Forward contracts for gas are traded on the TTF. This is a very liquid market where contracts are traded with a lot of different maturities. Gas prices are currently very correlated with oil prices because of oil linked contracts. However because of the rise of LNG and improved interconnectivity there is a shift of trading towards the liberalized market. Then supply and demand will determine prices.

5.1.2. POLAND

5.1.2.1. POLISH ELECTRICITY MARKET

The Polish power market is in the process of being liberalized. There is an exchange the PolPX, most of the contracts signed use this as the reference market. The PolPX offers contracts with a maturity up to two years, liquidity however is still a bit lacking (Jacek Kaminski, 2010).

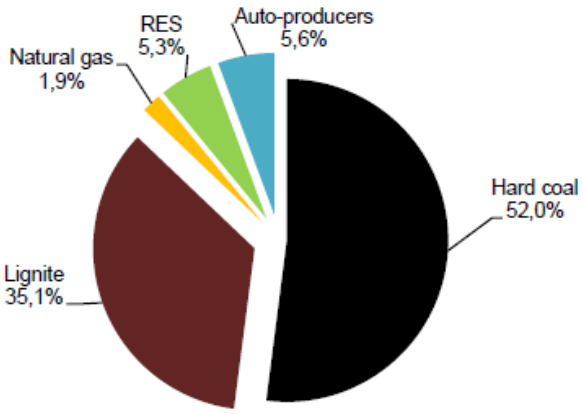

FIGURE 30: ESTIMATE OF POLISH POWER SUPPLY (GAWLIK, 2016).

Figure 30 shows an estimate of the polish generation capacity (Gawlik, 2016). Lignite is a less energy rich form of coal. RES are renewable sources. Auto-producers is an estimate of the power generated outside of the grid. This graph clearly shows the polish power market is almost entirely based on coal generation. Coal generation produces the most CO2, therefore the price of CO2 contract will have a big effect on prices in Poland.

Under normal circumstances the price of coal should also have a large effect on the price level. However, Poland is entirely self-sufficient with regards to coal production and nearly all of the coal mines are government property (Jacek Kaminski, 2010). Furthermore, most of the power plants are also government property. As a result, polish prices do not act in the same way as other European markets. Figure 31 shows year ahead prices for the Polish, Dutch and German markets. Clearly, Dutch (purple) and German (green) prices behave in the same way, furthermore the premium between the Dutch and German power is declining due to improved transport capacity. The Polish market (Orange) acts completely different, for instance while the other European prices fluctuated greatly and showed an uptrend in 2016, Polish prices were relatively constant.

The European Union strives for completely liberalized energy markets in Europe, because of this Poland is liberalizing its market. However, progress is slow. Extra transport capacity is being built, there is a relatively liquid exchange, but the privatization of the coal mines and power plants is slow (Gawlik, 2016). Therefore in the near future Polish power prices will be influenced more by government policy than the market. There will be an effect from the prices of CO2.

FIGURE 31: YEAR AHEAD POWER PRICES FOR POLAND (ORANGE), NETHERLANDS (PURPLE) AND GERMANY (GREEN) (THOMSON REUTERS, 2017).

5.1.2.2. POLISH GAS MARKET

Trading gas only started in Poland started in 2014, prices are quoted on an index called POXG (Heather, 2015). The Polish hub is called the Virtual Point Gas-system (VPG) but is rated as inactive by Heather. There are plans to form a regional gas hub with the Czech Republic, Slovakia and Hungary. But this is still in the planning phase.

Figure 32 is a map of the Polish gas network in 2015. Dotted lines represent planned connections. Dotted lines next to an existing line represent planned reversible connections. Poland is well connected to Russian gas in the east but connectivity is poor with the rest of Europe. In 2011 The Polish government introduced a plan to improve the connection with EU countries, this plan includes 5 improved pipelines and an LNG regasification plant.

FIGURE 32: POLISH GAS NETWORK IN 2015 (HEATHER, 2015).

In the past most of supply came from Russia and all of the connections we non-reversible. This means all of supply was contracted with oil indexed contracts. Since 2014 the connection with Germany has been made reversible. This means the influence of gas indexed gas has increased since then. Currently 60% of supply comes from Russia and 25% comes from national production (Heather, 2015).

Figure 33 shows Polish and Dutch year ahead prices (in PLN). Before September 2014 there was no activity and since then gas has been traded at a premium to Dutch gas. The premium decreased because the very low oil prices, making oil index gas very attractive. If the oil prices continue to rise gas prices in Poland will rise as well. This effect is strengthened by the low transport capacity with the rest of Europe.

FIGURE 33: YEAR AHEAD GAS PRICES POLAND (ORANGE) AND THE NETHERLANDS (PURPLE) (THOMSON REUTERS, 2017).

5.1.2.3. CONCLUSIONS

In this subsection we have learned the following things:

- The Polish electricity market allows for the animal feed company's approach to energy procurement to be applied. Forward contracts for electricity are traded on the PolPX, this is a relatively liquid market contracts are traded with different maturities.
- Polish electricity generation is based almost entirely on coal. There is very low connectivity with other countries. The market is regulated because most of the value chain is owned by the government. Prices are quoted as if a free market, but since the prices for the feedstock are set between government owned entities the effects of the global coal market on power prices is limited.
- The Polish gas market allows for the animal feed company's approach to energy procurement to be applied. Forward contracts for gas are traded on POXG, liquidity is very low, however since they use TTF as a reference market prices are quoted with a high frequency.
- In the past gas supply came from Russia and for a small part from local supply. Currently connection with the rest of the EU have been made reversible and capacity is increased. Therefore gas in Poland is currently sold at a premium to TTF, this premium is very low due to low oil prices. The premium is expected to decrease as transport capacity between neighboring countries is increased.

5.1.3. The Iberian peninsula

5.1.3.1. Iberian electricity market

The Spanish electricity market is integrated with the Portuguese market to a large extent. Prices are quoted on the same exchange, although electricity in Portugal is traded with a small premium. Figure 34 shows the total installed capacity in the Iberian Peninsula (Energias de Portugal, 2015). From 2010 and onwards supply has stabilized due to a drop in investments after the crisis in 2008. This means that after a longer period of economic growth electricity prices might be a bit higher due to delayed investment in supply.

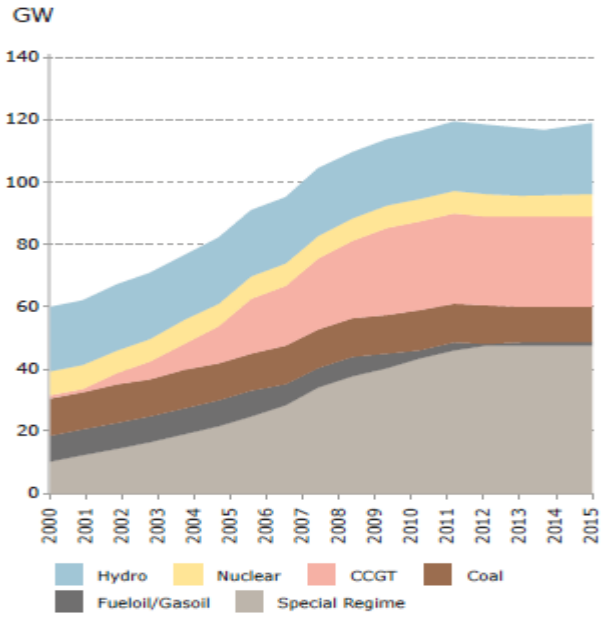

Figure 34: Installed capacity Iberia (Energias de Portugal, 2015).

Roughly one third of the total possible supply can be attributed to 'Special regime'. These are renewable sources, three quarters of this is wind, the rest is sun and cogeneration (biomass). This means that short term prices are greatly influenced by the weather, however long term prices should remain unaffected. The weather risk for the short term is even greater because one fifth of possible supply comes from hydro generation. Extended periods of dry weather and wind conditions are critical when making short term buy decisions. Two fifths of the possible supply comes from fossil fuels with gas being the major component. Gas, coal and CO2 prices are important for long term decisions but compared to the other major European the animal feed company markets CO2 has a smaller effect on pricing due to the small share of coal generation.

Figure 35 shows the actual generation of power by source in 2014 (European Commision, 2016). Wind, hydro and nuclear make up a larger part of actual generation than of installed capacity. This is because these sources are relatively cheap and will therefore always be utilized if possible. Coal fired plants are also utilized more while gas fired plants are used less. The same reasoning can be applied here.

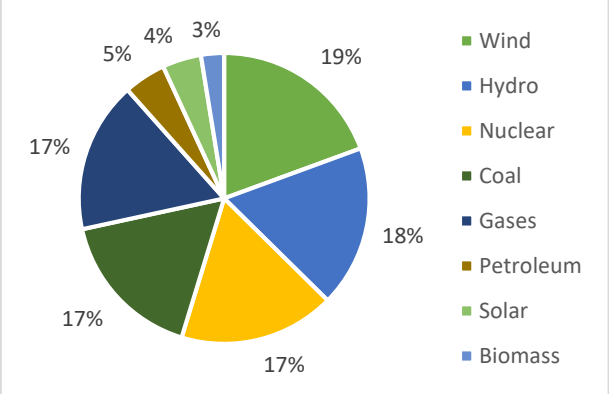

Figure 35: Actual generation in Iberia (2014) (European Commision, 2016).

Figure 36 shows historical year-ahead prices for Spanish, Dutch and German power. It is clear Spanish power reacts to the same drivers as the other countries. These drivers are coal, gas and CO2 prices. However, Spanish prices are less volatile, this is because a very large part comes from wind, hydro, nuclear and solar. These sources have relatively stable long term prices. It is also clear that Spanish power is traded at a premium, this is because there is limited transport capacity between Spain and France, and therefore the rest of Europe.

FIGURE 36: YEAR AHEAD PRICES OF SPANISH (ORANGE), DUTCH (PURPLE) AND GERMAN (GREEN) POWER. (THOMSON REUTERS, 2017).

5.1.3.2. IBERIAN GAS MARKET

The Spanish gas market, like many gas markets in Europe, is very underdeveloped. There is a joint gas hub with Portugal (Mibgas) but it is still under development. They started quoting prices in May 2016, but the frequency of trading is still very low. Figure 37 shows the prices quoted in the past, liquidity is clearly very low and the prices are higher. This premium arises due to the very limited transport capacity between France and Spain and the almost non-existent trading activity in the PEG sud, the southern French gas hub (Heather, 2015).

FIGURE 37: HISTORICAL MONTH AHEAD PRICES OF IBERIAN(ORANGE), BRITISH(GREEN) AND DUTCH(PURPLE) GAS (THOMSON REUTERS, 2017).

Figure 38 shows the suppliers of the Iberian gas market (Energia, 2015). In recent years half of total supply originates in Algeria. It mainly comes in through two pipelines out of Morocco, but also in the form of LNG. 10% comes from France, the rest of supply comes in the form of LNG from several countries. Iberia has a total of seven regasification points. The total regasification capacity offers room for increased LNG imports. The amount of gas imported through the pipelines from Algeria has taken a flight in the past years due to the low oil prices, as these contracts are linked to the oil price. However, the supply from Algeria will drop significantly in the coming years, due to a decrease in production and an increase in local consumption (Aissaoui, 2016). Therefore, the share of LNG and gas from France will increase. The demand for gas been in decline since 2008, because of this some gas has even been exported to other hubs in Europe in the form of LNG.

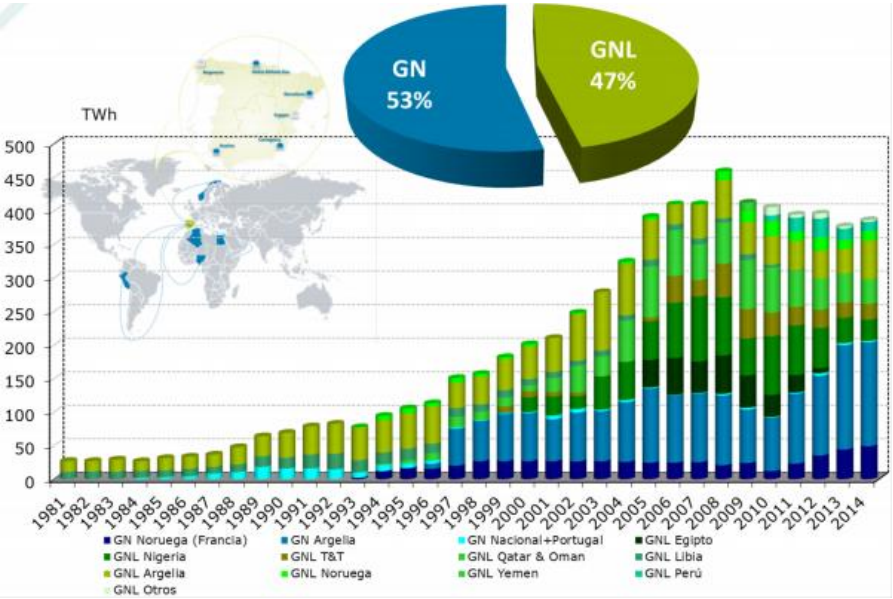

FIGURE 38: IBERIAN GAS MARKET SUPPLY (ENERGIA, 2015).

5.1.3.3. CONCLUSION IBERIAN MARKETS

In this subsection we have learned the following things:

- The Iberian electricity market allows for the animal feed company's approach to energy procurement to be applied. Power is traded at the MIBEL, there is a lot of liquidity and forward prices are available in many different maturities.
- The Iberian power market has very diversified generation capacity. In descending order of importance its mix consists of gas, hydro, wind, coal, nuclear and some other renewables. Spot prices are very volatile and dependent on weather conditions. Forward prices however will be influenced by coal and CO2 prices for baseload and gas prices and CO2 for peak load. Power is traded at a premium to the rest of Europe because of limited transportation capacity with France.
- The Iberian gas market currently does not allow for the animal feed company's approach to energy procurement to be applied. Gas in Iberia is traded at the MIBGAS, this market has only started quoting prices recently. In the past many trades were gas for gas. Liquidity is still low and access to different types of maturities is limited.
- Half of the Iberian gas market is supplied by gas from Algeria, these are oil linked contracts. The other half of supply is very diverse, most of it comes in from many suppliers in the international LNG market and some of it comes in though pipes from France. It is estimated supply from Algeria will decrease greatly, Iberia will therefore be more dependent on LNG imports and gas from France.

Gas in Iberia is currently traded at a premium to the TTF due to low liquidity in the gas hub and low transport capacity to and from France. When trading at the hub increases and the global LNG market expands even more this premium might become smaller.

5.1.4. The Czech Republic

5.1.4.1. The Czech power market

Figure 39 shows the year ahead prices for the Czech, German and Dutch markets. The Czech price is exactly the same as the German price, this is because there is excess transport capacity between these markets. This means the installed capacity and type of consumption in the Czech Republic are not very interesting by itself.

Figure 39: Year ahead prices power for Czech Republic (Orange), Germany (Green) and The Netherlands (Purple) (Thomson Reuters, 2017).

Figure 40 shows the distribution of energy sources of the installed capacity of Germany, the Czech Republic and Austria (European Commision, 2014). Austria was added because the transport capacity between this country and the Czech and German networks is also very good. Combustible fuels represent all carbon sources, in the case of these countries these are coal fired plants for the most part. Nearly half of their power supply is carbon based. Renewables make up 45%, and the rest is nuclear.

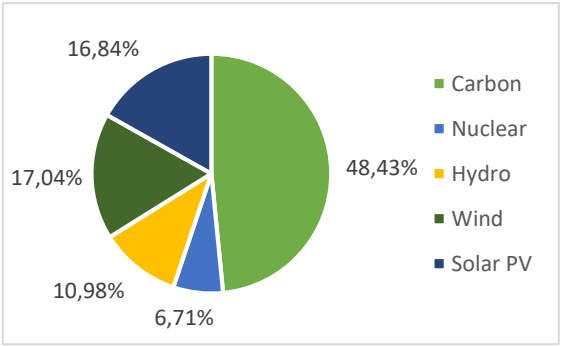

Figure 40: Installed capacity distribution in Austria, Czech Republic and Germany in 2014 (European Commision, 2016).

Figure 41 shows the sources of power generation in these countries in 2014. Biomass and gas have been split out of carbon in this graph. Due to the low marginal costs coal based and nuclear plants make out a much larger portion of actual generation. Gas generation is mostly used for peak generation. Because of weather dependency the renewable sources wind and solar are a much smaller part of actual generation. This is reinforced by the fact that even though power supply in Germany has changed dramatically, the network has not been adapted to this change in supply. A lot of the potential of renewables is lost.

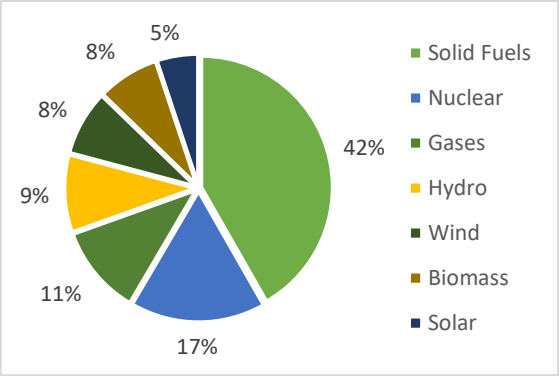

FIGURE 41: POWER GENERATION DISTRIBUTION BY SOURCE IN AUSTRIA, CZECH REPUBLIC AND GERMANY IN 2014 (EUROPEAN COMMISION, 2016).

Since coal generation is very CO2 intensive, forward power prices in the Czech Republic will be influenced by coal and carbon prices. Gas prices will have an influence on peak prices but this effect is limited due to the low installed capacity.

5.1.4.2. THE CZECH GAS MARKET

Trading at the gas hub in the Czech Republic (CEGH) has only picked up in the past two years, before this activity was very low (Heather, 2015). Figure 42 shows the year ahead prices for gas at VOB and gas at TTF. Before 2014 no prices were quoted, but since liquidity was relatively high. There is no premium between gas at the CEGH and the TTF because there is enough transport capacity between the Netherlands and the Czech Republic.

FIGURE 42: CZECH YEAR AHEAD GAS PRICES AT VOB (ORANGE) VERSUS DUTCH YEAR AHEAD PRICES AT TTF (PURPLE) (THOMSON REUTERS, 2017).

5.1.4.3. CONCLUSION

In this subsection we have learned the following things:

- The Czech electricity market allows for the animal feed company's approach on energy procurement to be applied. The PXE is a very liquid market that offers forward contracts with many different maturities.
- Since connectivity between Germany and Austria currently has overcapacity, prices in these countries are the same. In decreasing order of importance the installed capacity consists of coal, wind, solar, gas and nuclear. The actual generation is dominated by coal and biomass generation in the coal fired capacity. Together with Nuclear these sources provide base generation. The renewable capacity is uncertain and is used when possible, any differences between supply and demand will be compensated with gas. Forward base prices will be influenced mostly by forward coal and CO2 prices and to a lesser extent by gas. Forward Peak prices will be influenced mostly by gas and to a lesser extent CO2.
- The Czech gas market allows for the animal feed company's approach on energy procurement to be applied. The CEGH is a very liquid market that offers forward contracts with many different maturities.
- The transport capacity between the Czech Republic and the Netherlands is sufficient, therefore gas is traded at the same price.

5.1.5. VIETNAM

5.1.5.1. VIETNAMESE ELECTRICITY MARKET

Currently the electricity market in Vietnam is heavily regulated. 60% of installed capacity is owned by state owned Electricity VietNam, EVN. EVN also controls the entire transportation network and the distribution of electricity. The price for power is heavily subsidized, although how much is unknown. In 2011 the price for one MWh was 60 USD while marginal costs were estimated at 95 USD per MWh (Khanh, 2011).

In recent years efforts have been made to increase installed capacity in Vietnam. The major reason is the expected increase in future demand. Consumption is estimated at 31.1 TWh in 2001 and 100 TWh in 2010, for 2030 the projections range from 506 – 559. However, foreign investments in new capacity were low in recent years because of the low fixed prices. EVN revenues were too low as well to support domestic investments. Because of this electricity prices have been steadily rising in recent years and are expected to continue to rise (Khanh, 2011).

The Association of Southeast Asian Nations (ASEAN) has started an energy market integration project. One of the goals is increased cross border capacity to support cross border electricity trading and floating prices. There is still a very long way to go because an important prerequisite, the unbundling of generation, transportation and distribution does not exist in Vietnam (Yanrui Wu, 2012).

Figure 43 is a visualization of the planned distribution of installed capacity according to the Vietnam power development plan issued by the ministry of energy (GIZ Gmbh, 2016). Planned capacity consists of 20% renewable energy of which 2/3 will be solar and 1/3 will be wind. The share of hydro will go down. Most of the investments will go into coal based generation, roughly 40% of installed capacity will be coal based. 15% will be gas based generation.

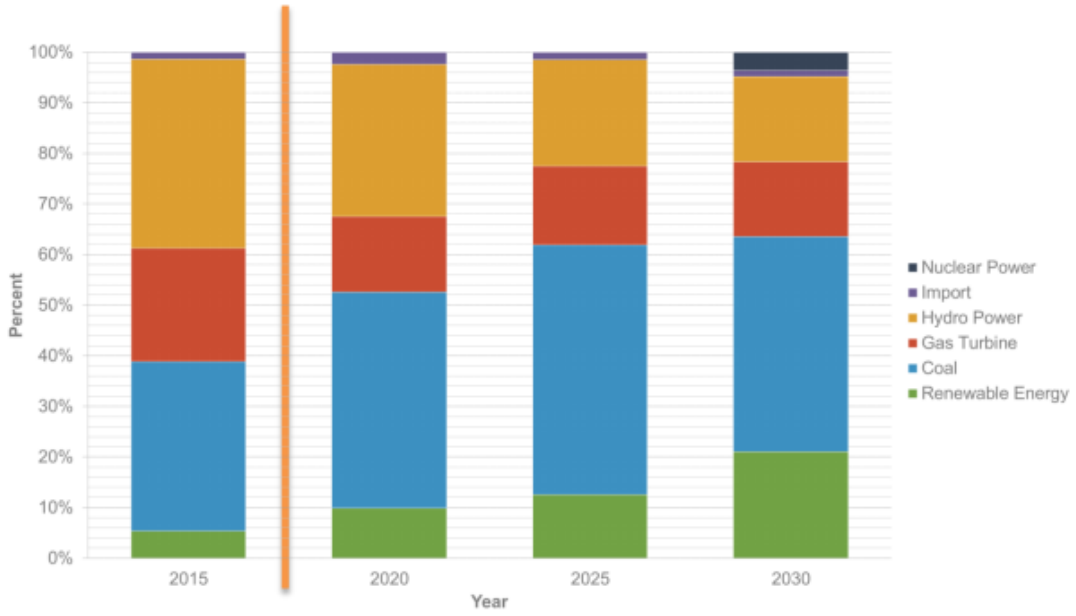

FIGURE 43: INSTALLED CAPACITY FORECAST VIETNAM (GIZ GMBH, 2016).

Figure 43 shows the estimated power generation by source, this also comes from the Vietnamese ministry of Energy (GIZ Gmbh, 2016). The expected generation from coal is much higher than installed capacity, the same goes for gas and nuclear. The expected generation from renewables and hydro is smaller. This means that in a fully developed market with a floating price coal prices will be the major driver of the power price.

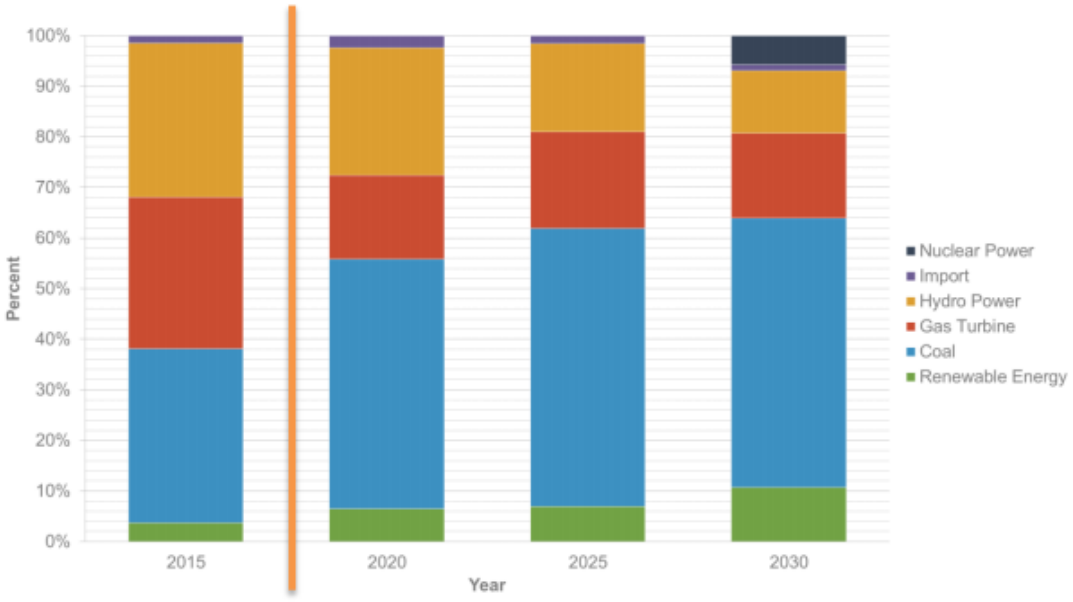

FIGURE 44: POWER GENERATION FORECAST (GIZ GMBH, 2016).

5.1.5.2. CONCLUSION

In this subsection we have learned the following things:

- The Vietnamese Electricity market does not allow for the animal feed company's approach on energy procurement to be applied. Electricity can only be bought on spot, there has been talk of unbundling the market but no progress has been made.
- The installed capacity in Vietnam consists of Hydro, Coal and Gas in decreasing order of importance. The shares of each source are roughly equal when looking at actual generation. This has no effect on pricing however, EVN sets the prices. Prices are expected to rise in the future to support investment in new capacity.

5.1.6. South Africa

5.1.6.1. South African power market

The electricity market in South Africa is completely regulated by the government. The state-owned company controls 95% of installed capacity (42.000 MW), the entire transport network and roughly 50% of distribution. The other 50% is distributed by local municipalities, they sell Eskom power at a premium. Many proposals have been made to the government to unbundle the supply, but the government has not moved to do so (Khan, 2016).

Since 2008 the country suffers from rolling blackouts. These planned outages are necessary because supply is unable to cope with demand. Investments in supply have been lagging behind growing demand. The main reason for this is are the artificially low prices for power, price increases were not allowed by the government. Because of this investing in extra capacity would not pay off. Figure 45shows the normalized prices for electricity versus inflation from 1987 until 2015 (Moolman, 2015). Prices have grown below inflation until 2008, in 2008 an electricity crisis started in South Africa because investments in new generation capacity were low in the years before, as this was not profitable due to low prices. From 2008 and on prices have increased steadily because money need to be found to invest in new capacity. It is expected that prices will continue to rise.

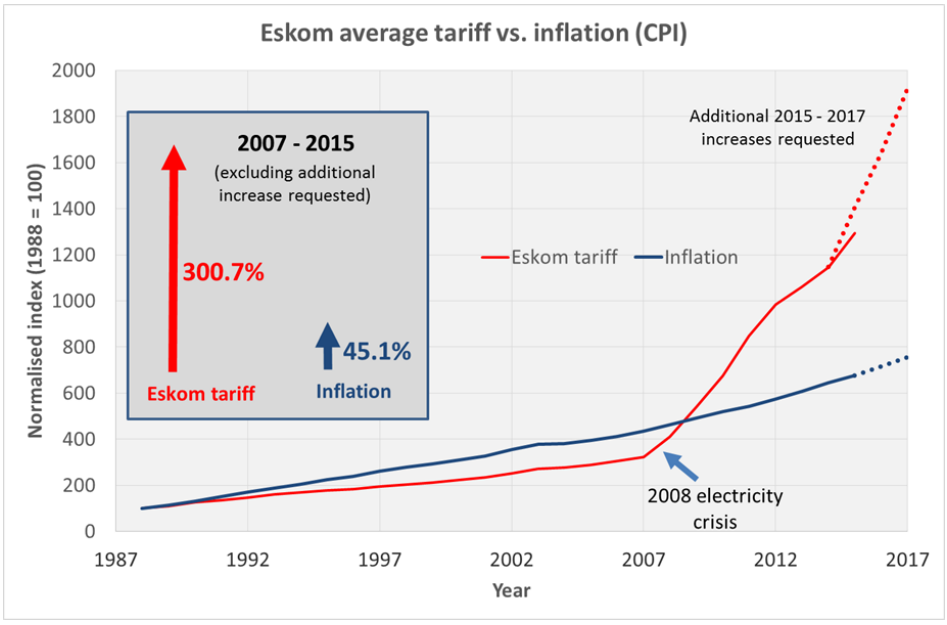

Figure 45: Normalized energy costs (red) versus normalized inflation (blue) in South Africa (Moolman, 2015).

Figure 46 shows the types of installed capacity in South Africa (Eskom, 2016). Almost all installed capacity are coal fired plants. Because this is all baseload the share of coal generated power will be even greater. The total installed capacity is roughly 42.000 MW. Currently 10.000 MW of extra coal based capacity is under construction, as well as 2.000 MW of hydro.

Figure 47 shows the planned installed capacity of South Africa in several scenarios as presented by the department of energy (Vietnamese Department of Energy, 2016). The department of energy wants to decrease the dependency on coal. There is a lot of criticism on the current plans, mainly because they are deemed too ambitious (Kenny, 2015).

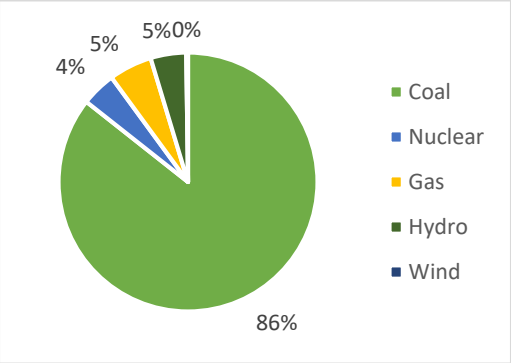

FIGURE 46: DISTRIBUTION OF INSTALLED CAPACITY IN SOUTH AFRICA IN 2016 (ESKOM, 2016).

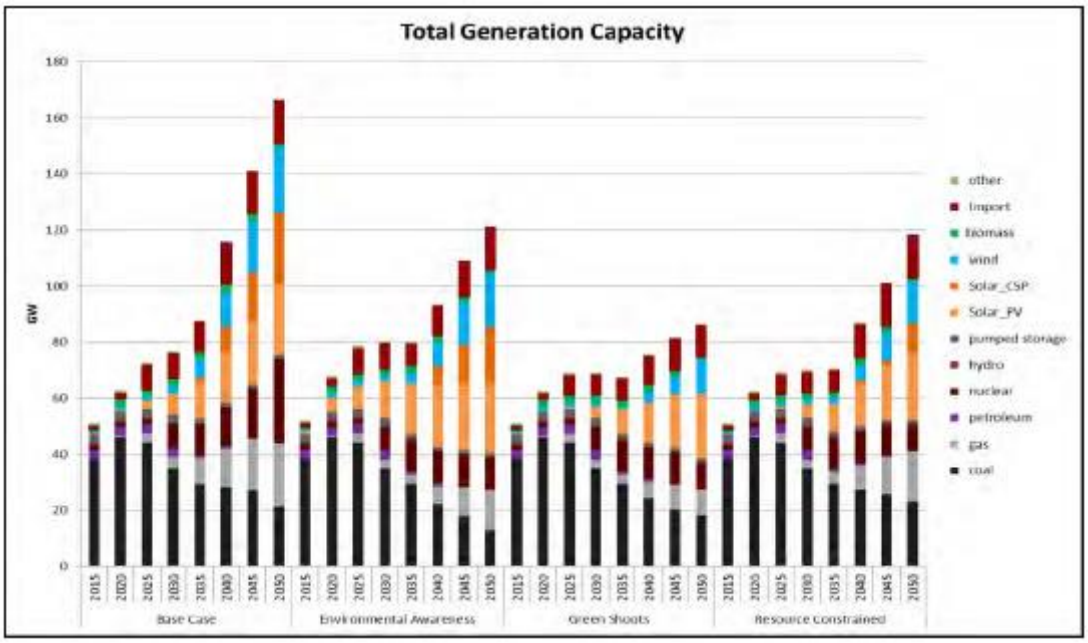

FIGURE 47: PLANNED INSTALLED CAPACITY SCENARIOS SOUTH AFRICA (VIETNAMESE DEPARTMENT OF ENERGY, 2016).

Unfortunately it is currently irrelevant what the mix of installed capacity is as long as buying is only possible on spot, prices are fixed and prices are controlled by parliament. In this scenario the animal feed company has no option but to buy as is. If plans are made in the future to unbundle Eskom and liberalize the market the animal feed company should revisit this topic.

5.1.6.2. CONCLUSION

In this subsection we have learned the following things:

- The South African electricity market does not allow for the animal feed company's approach on energy procurement to be applied. No forward market exists and currently no plans for unbundling are made.
- Installed capacity in South Africa is dominated by coal. Supply is sometimes not able to match demand, because of this there are rolling blackouts. Prices are not floating, therefore the

dependency on coal is not reflected. Prices are set by parliament and are expected to rise in the coming years to support investment in generation capacity.

5.1.7. Conclusion

We have now discussed every energy market the animal feed company's seven largest business units are active in. The results can be found in the last column of Table 4. In each of the European electricity markets 'opportunistic' buying is possible. the animal feed company should try to implement their approach in the other European Business units. This includes information sharing on a regular basis. In Vietnam and South Africa forward buying is impossible because of the way the markets are structured, therefore formulating a view and gathering market information will not amount to a competitive advantage. Perhaps the business unit in South Africa should be included in the information sharing because South Africa is a major player in the global coal market.

For gas 'opportunistic' buying is possible for the Netherlands, Poland and the Czech Republic. For Portugal and Spain it might be possible but that is dependent on the flexibility of the suppliers, the MIBGAS does not offer enough liquidity to be a reliable reference market. However, the European Union is working towards a single liberalized European gas market, this means that over time the move towards gas priced gas and liquid balancing hubs will continue. the animal feed company should look into applying their approach to all of the European Business units. This includes information sharing on a regular basis. For Spain and Portugal this would mean that a supplier needs to be found that would allow the animal feed company flexibility with regards to price fixing.

Business unit	Risk taking: Timing	Risk taking: Length	Formulating view	Information sharing	Autonomous	Market structure allows opportunistic buying
Netherlands	Yes	Yes	Yes	No	Yes	Yes
Poland	Yes	Only for gas, electricity is bought one year at a time	Yes	No	Yes	Yes
Spain	No, contracts are always signed in spring	No, length is always one year	No	No	Yes	Only for electricity, forward contracts for gas are not liquid.
Portugal	No, electricity contracts are always signed in december, fuel oil is bought when stock is low	No, electricity length is always one year, fuel oil is always bought on spot	No	No	Yes	Only for electricity, forward contracts for gas are not liquid.
Czech Republic	Only for electricity, gas is bought in september	Only for electricity, gas is bought one year at a time	Only for electricity	No	Yes	Yes
Vietnam	No, electricity is always bought on spot	No, electricity is always bought on spot	No	No	Yes	No, electricity can only be bought on spot
South Africa	No, electricity is always bought on spot, information on coal trades was unavailable	No, electricity is always bought on spot, information on coal trades was unavailable	No	No	Yes	No, electricity can only be bought on spot

Table 4: Conclusion Section 5.1.

The European Union is implementing policy towards a single European electricity market. We have seen in this section that progress has been made and prices are converging. It is widely expected that this trend continues and the premiums disappear between countries. Therefore, it is important to look at the installed capacity of the EU as a whole to getter a better understanding of the price drivers of the European single market. We will discuss this in the next section.

5.2. THE SINGLE EUROPEAN ELECTRICITY MARKET

In the previous section we concluded that Europe is moving towards a single electricity market. Even though this is currently not a reality, price convergence is already happening. Furthermore, several regions already consistently have the same prices for electricity. In Subsection 5.1.4.1 we saw that Czech power prices have converged to German and Austrian prices. In Subsection 5.1.1.1 we saw that the Dutch prices have almost converged to the German prices and thus the Czech and Austrian prices. Another example of a region with a single market is the Nordic region consisting of Denmark, Sweden and Norway. These countries even use the same exchange, the Nordpool.

As the EU keeps working towards a single market the total installed capacity and actual generation in the EU will be a truer reflection of the price drivers of European electricity prices. Figure 48 shows the total installed capacity of the 28 European countries from 1990 to 2014 (European Commision, 2016). Over the years carbon based capacity has increased, but since 2012 this increase seems to have halted. Hydro and Nuclear have remained constant. The most common renewable sources wind and solar are becoming increasingly important.

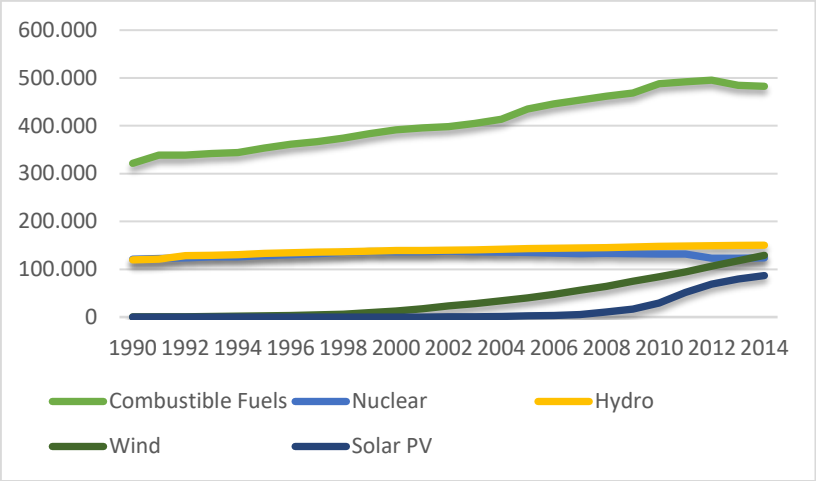

FIGURE 48: INSTALLED CAPACITY EU28 (MW) (EUROPEAN COMMISION, 2016).

Figure 49 show the actual generation sources of electricity in the EU from 1990 to 2014 (European Commision, 2016). Even though installed capacity of carbon based generation has increased, actual generation has decreased significantly. Especially gas fired generation. Nuclear generation has remained constant while renewable generation has increased dramatically. It should be noted that hydro is included in renewables. Wind and solar generation are responsible for this increase.

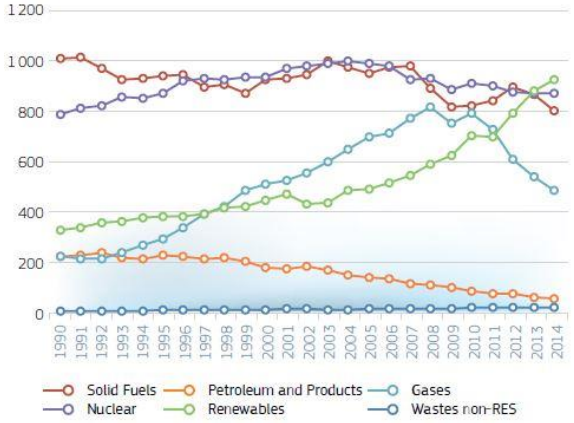

FIGURE 49: ACTUAL GENERATION EU28 (TWH) (EUROPEAN COMMISION, 2016).

Currently, as we have explained in Section 3.3, coal and gas prices would be the main determinants of electricity prices in the European single market. This is because these generators would still be most likely be at the intersection of the supply and demand curves. However, until the single market is achieved there will be changes to the supply.

Two forces will be at the basis of these changes: subsidies to renewables and the ETS (Buchan & Keay, 2016). It is very likely that the subsidies towards renewable generation will stay constant or increase in the coming years. Combined with an increase in efficiency this will ensure continued investments in renewable generation. On top of this the total emission allowances in the ETS will decrease. Therefore the cost of CO2 emissions is expected to increase. As coal generation emits much more CO2 it's very likely that fuel switching will take place. This will increase the competitiveness of gas based generation. Furthermore, since solar and wind generation is greatly influenced by weather conditions a stable market is dependent on flexible backup generation. Gas fired generation is very suitable to this role as gas turbines are extremely flexible. As opposed to coal fired generators who need 24h to warm up before being able to supply at full efficiency. Therefore it is very likely that gas prices will be the main influencer of European electricity prices when the single market is achieved.

5.2.1. Conclusions

In this section we have learned the following things:

- Europe is moving towards a single market. Germany, Czech Republic and Austria already have the same prices as do the Scandinavian countries. As interconnectivity is improved electricity prices across Europe will converge.
- Currently coal, gas and CO2 prices would all influence the price but in the future a more prominent role for gas is expected because of increased dependency on flexible supply and the higher CO2 prices.

5.3. CONCLUSIONS

In this chapter we investigated whether the market structure of the markets the animal feed company is active in allows for the animal feed company's approach to procurement to be executed. Furthermore we talked about the European electricity market since prices in Europe are converging and the EU is striving towards a single market. The findings of Section 5.1 can be summarized as follows:

- In each of the European electricity markets 'opportunistic' buying is possible. the animal feed company should try to implement their approach in the other European Business units. This includes information sharing on a regular basis. In Vietnam and South Africa forward buying is impossible because of the way the markets are structured, therefore formulating a view and gathering market information will not amount to a competitive advantage. Perhaps the business unit in South Africa should be included in the information sharing because South Africa is a major player in the global coal market.
- For gas 'opportunistic' buying is possible for the Netherlands, Poland and the Czech Republic. For Portugal and Spain it might be possible but that is dependent on the flexibility of the suppliers, the MIBGAS does not offer enough liquidity to be a reliable reference market. However, the European Union is working towards a single liberalized European gas market, this means that over time the move towards gas priced gas and liquid balancing hubs will continue. the animal feed company should look into applying their approach in all of the European Business units. This includes information sharing on a regular basis. For Spain and Portugal this would mean that a supplier needs to be found that would allow the animal feed company flexibility with regards to price fixing.

The findings of Section 5.2 can be summarized as follows:

- Europe is moving towards a single market. Germany, Czech Republic and Austria already have the same prices as do the Scandinavian countries. As interconnectivity is improved electricity prices across Europe will converge.
- Currently coal, gas and CO2 prices would all influence the price but in the future a more prominent role for gas is expected because of increased dependency on flexible supply and the higher CO2 prices.

6. CONCLUSIONS & RECOMMENDATIONS

In this chapter we will answer the research questions and give recommendations.

6.1. CONCLUSIONS

1. **How can the animal feed company's current approach purchasing energy be characterized according to literature?**

Procurement at the animal feed company is based on the belief that being flexible with the timing and length of buying decisions based on a well-defined view on the market will lead, on average, to higher returns in the long run. Therefore the purchasing and trading department is given relative freedom with regards to the timing of their buying and the 'length' of their exposure. Information is continuously gathered on the markets to support their views on the markets. Their positions are then adjusted to match their views. This information gathering is supported by information sharing within the company as the different business units share their views regularly. Performance is measured using a purely financial metric. This metric is the difference between the replacement value and the contracted value.

In order to place the animal feed company's purchasing strategy in context we looked at it from several perspectives. We used an empirical typology by Cousins et al. (2006) to look at the animal feed company's Purchasing & Trading department from a functional perspective. We identified the department as *celebrity procurers.* The following characteristics of the department lead to this conclusion: low sophistication in supplier management, high regard from management, information sharing between the department and the rest of the organization exists.

We also looked at the animal feed company's Purchasing and Trading department from a product group perspective (Caniëls & Gelderman, 2005). Some things stand out: The products they procure have relatively low supply risk, they have high leverage for some products and low leverage for other products. The strategies they apply are *exploit buying power* and *individual ordering* for products where they have respectively high and low leverage. For both of these strategies administrative efficiency of the purchasing department is key.

Finally we looked at the animal feed company from a commodity procurement perspective (Cousins, Lamming, Lawson, & Squire, 2008). The animal feed company's buying behavior falls into the *Opportunistic buying* category. They buy supply when they feel prices are at the lowest level and take on enough length to a point where they believe prices will have lowered again.

2. **How can energy markets be characterized according to literature?**

Raw material prices influence the price of electricity as the spot price is set at the offer of the highest active generator. This especially holds true for the forward market as the spot market is very volatile. The installed capacity gives a good understanding of which raw materials affect the market the most.

Forward prices are based on the markets expectation of the future spot price and a risk premium based on expected demand and time to maturity. Therefore forward prices are dependent on the installed capacity in a region and forward prices of raw materials.

Interconnection capacity between countries allows electricity to flow from the cheaper markets to the more expensive markets. Because of this, the installed capacity of the cheaper countries will also influence pricing in the more expensive country.

The Emission Trading System in Europe has an effect on the supply curve and therefore on the effect raw material prices have on the electricity price. Switching between generating plants becomes more of a reality as the cheaper coal generation becomes relatively more expensive compared to gas generation.

3. What are the requirements/preconditions the animal feed company has regarding energy procurement?

the animal feed company's approach to energy procurement is the same as their approach to procurement in general: being flexible with the timing and length of buying decisions based on a well-defined view on the market lead to higher returns in the long run, information sharing is key toward creating a well-informed view on the market, decentralization leads to higher commitment towards information gathering and sharing. The only difference is the markets itself, they should allow for 'opportunistic' buying, otherwise information sharing and gathering is wasted energy.

Based on this the following three preconditions can be formulated:

- Each business unit acts autonomously.
- Buying decisions are based upon a view on the market.
- Information is shared within the company to support market views.

4. What are the relevant differences in energy purchasing behavior between the countries the animal feed company operates in?

The differences are summarized in Table 5.

Business unit	Risk taking: Timing	Risk taking: Length	Formulating view	Information sharing	Autonomous
Netherlands	Yes	Yes	Yes	No	Yes
Poland	Yes	Only for gas, electricity is bought one year at a time	Yes	No	Yes
Spain	No, contracts are always signed in spring	No, length is always one year	No	No	Yes
Portugal	No, electricity contracts are always signed in december, fuel oil is bought when stock is low	No, electricity length is always one year, fuel oil is always bought on spot	No	No	Yes
Czech Republic	Only for electricity, gas is bought in september	Only for electricity, gas is bought one year at a time	Only for electricity	No	Yes
Vietnam	No, electricity is always bought on spot	No, electricity is always bought on spot	No	No	Yes
South Africa	No, electricity is always bought on spot, information on coal trades was unavailable	No, electricity is always bought on spot, information on coal trades was unavailable	No	No	Yes

TABLE 5: SUMMARY OF THE ANIMAL FEED COMPANY'S ENERGY PROCUREMENT PRACTICES.

5. What are the relevant differences in the markets the animal feed company operates in?

The only relevant characteristic for 'opportunistic' buying is whether the market allows forward buying and offers enough liquidity on its forward contracts. If this is the case buying decisions can be executed without being hindered by the market.

In each of the European electricity markets 'opportunistic' buying is possible. The animal feed company should try to implement their approach in the other European Business units. This includes information sharing on a regular basis. In Vietnam and South Africa forward buying is impossible because of the way the markets are structured, therefore formulating a view and gathering market information will not amount to a competitive advantage. Perhaps the business unit in South Africa should be included in the information sharing because South Africa is a major player in the global coal market.

For gas 'opportunistic' buying is possible for the Netherlands, Poland and the Czech Republic. For Portugal and Spain it might be possible but that depends on the flexibility of the suppliers, the MIBGAS does not offer enough liquidity to be a reliable reference market. However, the European Union is working towards a single liberalized European gas market, this means that over time the move towards gas priced gas and liquid balancing hubs will continue. The animal feed company should look into applying their approach to all of the European Business units. This includes information sharing on a regular basis. For Spain and Portugal this would mean that a supplier needs to be found that would allow the animal feed company flexibility with regards to price fixing.

Is it possible to apply the animal feed company's current approach to purchasing energy on a global scale, while keeping in mind the characteristics of each market the animal feed company operates in?

Unfortunately the electricity markets in South Africa and Vietnam do not allow the animal feed company to apply its approach to energy procurement. Furthermore, the heating sources used in these countries are procured from markets that are either unique to the country (rice husks in Vietnam) or unique to the company (coal in South Africa). The procurement of energy in these countries should be done locally. Information sharing on a global scale gives no competitive advantage. Because of this the answer to this question should be strictly 'no' since the animal feed company's approach cannot be applied globally.

We have seen that the markets in Europe allow for the animal feed company's approach to be applied. In the case of electricity the approach is already applied in the Netherlands and the Czech Republic. The business units in Poland, Portugal and Spain procure electricity in a fixed period for a fixed period. The Iberian market does allow for 'opportunistic' buying as forward contracts are available with sufficient liquidity. The Polish market also allows for 'opportunistic' buying, but it should be noted that the price behavior differs significantly from the rest of Europe due to its market structure. Currently no information sharing is happening with regards to electricity procurement. If the animal feed company's approach is to be applied periodical deliberations should be organized where the European business units share their views on the electricity markets.

We have also seen that the markets in Europe allow for the animal feed company's approach to be applied in the case of gas. The approach is currently applied in the Netherlands and Poland. The business units in the Czech Republic and Spain procure gas in a fixed period for a fixed period. Portugal currently uses Fuel Oil as a heating source but it's expected that this will not be possible in the future. The Czech market allows for 'opportunistic' buying. The Iberian market does not offer a lot of liquidity for forward contracts but suppliers do offer flexibility. Currently no information sharing is happening with regards to gas procurement. If the animal feed company's approach is to be applied periodical deliberations should be organized where the European business units share their views on the electricity markets.

6.2. RECOMMENDATIONS

Based on the main research question our recommendations are as follows:

- With regards to electricity procurement, the animal feed company's approach should be applied across Europe. This means that Poland, Portugal and Spain should start making buying decisions based on their own views on the markets. Furthermore, information sharing should be implemented across Europe this will increase the quality of the market views. It should be noted that some of the current contracts expire in 2019, therefore there will be a period of transition.
- The animal feed company's approach regarding electricity cannot be applied to South Africa and Vietnam because the market structure currently does not allow it. In both countries electricity can only be bought at spot prices. Therefore, the current strategy suffices. In Vietnam plans are made to liberalize the market, when this happens the animal feed company should implement its approach and add Vietnam to its information sharing.
- With regards to gas procurement the animal feed company's approach should be applied across Europe with exception of Portugal. This means that the Czech Republic and Spain should start making buying decisions based on their view of the markets. Furthermore, information sharing should be implemented across Europe, this will increase the quality of the market views. It should be noted that some of the current contracts expire in 2019, therefore there will be a period of transition. The plants in Portugal currently do not allows for gas to be used.
- The animal feed company's approach cannot be applied for the heating source in South Africa. This business unit is the only one that used coal as a heating source. The South African market is completely liberal so 'opportunistic' buying can be applied using both physical stock and forward contracts. However, information sharing within the company will not lead to a competitive advantage as none of the other business units have insights in this market.
- The animal feed company's approach cannot be applied for the heating source in Vietnam. This business unit uses rice husks. The Vietnamese market is completely liberal so 'opportunistic' buying can be applied using physical stock and OTC forward contracts with suppliers. However, information sharing within the company will not lead to a competitive advantage as none of the other business units have insights in this market.

During this project we created an overview of the current energy expenditure of the animal feed company. This gave a lot of useful insights. We drafted reports based on these insights, these can be found in the appendixes. The most important findings can be summarized as follows:

- The efficiency of the animal feed company as a whole decreased because of a very large increase in production in Vietnam, this is a very electricity inefficient country. Electricity in Vietnam is very cheap. However, the costs of electricity per ton of feed are much higher than average. It could be worth looking into the inefficiency of the plants in Vietnam as electricity prices are projected to increase in the coming years.
- The Andel plant in the Netherlands uses red diesel as a heating source. The average costs per ton of feed where roughly 4 times as high in 2016 as opposed to the average of the plants using gas. In Andel roughly 37.500 tons of feed are produced yearly. It could be worth looking into switching to using gas as a heating source.
- One of the plants in Poland uses LNG. The average costs per ton of feed for LNG were roughly twice as high in 2016 as opposed to the average of plants using gas. The plant produced 216.000 tons of

feed in 2016. It might be impossible to connect this plant to the natural gas network but it is worth looking into.

- In Spain fuel oil is used in two factories. The average costs per ton of feed produced using fuel oil where 20% higher in 2016 as opposed to the average of plants using gas. In 2016 80.000 tons of feed was produced in the factories using fuel oil. It could be worth looking into switching to using gas as a heating source.
- The business unit in Portugal uses fuel oil as heating source. Currently, the costs per ton are much cheaper than the costs per ton of feed produced with gas in Spain. However, it is expected that due to environmental regulations the use of fuel oil is no longer possible. When this becomes reality a switch to gas would allow for Portugal to be added to the information sharing network across Europe.

REFERENCES

Aissaoui, A. (2016). *Algerian Gas: Troubled trends, troubled policies.* Oxford: The Oxford Institue for Energy Studies.

Bessembinder, H., & Lemmon, M. L. (2002). Equilibrium Pricing and Optimal Hedging in Electricity Forward Markets. *Journal of Finance 57*, 1347-1382.

Buchan, D., & Keay, M. (2016). *EU energy policy – 4th time lucky?* Oxford: Oxford Institue for Energy Studies.

Caniëls, M. C., & Gelderman, C. J. (2005). Purchasing strategies in the Kraljic matrix - A power and dependence perspective. *Journal of Purchasing and Supply Management 11*, 141-155.

Cousins, Lawson, & Square. (2006). An empirical taxonomy of purchasing functions. *International Journal of Operations & Production Management 26*, 775-794.

Cousins, P., Lamming, R., Lawson, B., & Squire, B. (2008). *Strategic supply management, principles theories and practice.* Harlow: Pearson Eduation Limited.

Energia. (2015). *Spanish Gas market.* Energia.

Energias de Portugal. (2015). *Iberian Data.* Energias de Portugal.

Eskom. (2016). *Fact Sheet: Generation plant mix.* Eskom.

European Commision. (2014). *European Energy Markets in 2014.* Brussels: European Commision .

European Commision. (2016). *Energy statistics.* Brussels: European Commision.

Franza, L. (2016). *Outlook for the LNG imports into the EU to 2025.* The Hague: Clingendeal International Energy Programme.

Gawlik, K. K. (2016). *Hard coal in the fuel-mix of Poland: the long-term perspective.* Krakow: De Gruyter.

Geman. (2005). *Commodities and commodity derivatives.* Chichester: John Wiley & Sons Limited.

Geman, H., & Vasicek, O. (2001). Forwards and futures on non-storable commodities: the case of electricity. *RISK*.

GIZ Gmbh. (2016). *Vietnam Power Development Plan for 2016 - 2030.* Dusseldorf: GIZ Gmbh.

Gonzalez-Benito, J. (2005). A theory of purchasing's contribution to business performance. *Journal of Operations Management 25*, 901–917.

Goolsbee, A., Levitt, S., & Syverson, C. (2013). *Micro-economics.* New York: Worth Publishers.

Heather, P. (2015). *The evolution of European traded gas hubs.* Oxford: The Oxford Institute for Energy Studies.

Hesping, F. H., & Schiele, H. (2015). Purchasing strategy development: A multi-level review. *Journal of Purchasing and Supply Management, Volume 21, Issue 2*, 138–150.

Jacek Kaminski, M. K. (2010). The prospects for hardcoal as a fuel for the Polish power sector. *Energy policy*, 7939-7950.

Kenny, A. (2015). *The rise and fall of Eskom - and how to fix it.* Johannesburg: South African Institute of Race Relations.

Khan, T. L. (2016). Review of proposals for practical power sector restructuring and reforms in a dynamic electricity supply industry. *Renewable and Sustainable Energy 62*, 326-335.

Khanh, N. Q. (2011). *Study on the Impact of Electricity Tariff Increase on the National Economy of Vietnam.* Jakarta: Economic Research Institute for ASEAN and East Asia.

Kraljic, P. (1983). Purchasing management must become supply management. *Harvard Business Review 83509*, 109-117.

Kreijkes, M. (2017). *Looking under the hood of the Dutch energy system.* The Hague: Clingendeal International Energy Program.

Moolman, S. (2015, March 20). *Infographic: Eskom tariff increases vs inflation since 1988 (with projections to 2017)*. Retrieved from Poweroptimal: http://www.poweroptimal.com/infographic-eskom-tariff-increases-vs-inflation-since-1988/

Sijm, J., Neuhoff, K., & Chen, Y. (2011). CO2 cost pass-through and windfall profits in the power sector. *Climate Policy, vol 6, no 1*, 49-72.

Thomson Reuters. (2017). Thomson Reuters Eikon.

Verschuren, & Doorewaard. (2010). *Designing a research project.* The Hague: Eleven International Publishing.

Vietnamese Department of Energy. (2016). *Integrated energy plan.* Hanoi: Department of Energy.

Yanrui Wu, X. S. (2012). *Energy Market Integration East Asia: Theories, Electricity Sector And Subsidies.* Jakarta: Economic Research Institute for ASEAN and East Asia.

7. APPENDICES

The appendices have been removed at the behest of the company as they contain sensitive information. They can be requested at the company.