Trading Energy

Team 1 – Existing Markets

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1.1 Size and Importance (Tomke)

1.1.1 Share of oil in the total energy consumption

When Colonel Edwin L. Drake stroke oil in 1859, he did not imagine that one and a half centuries later the oil price would be one of the key factors influencing the world economy (Erdöl-Vereinigung, 2005, p. 5). A look on the share oil has in worldwide energy consumption (Figure 1) points out why it has such a striking effect. In 2008, oil has with 41.6% by far the highest share in the total final consumption. The daily oil production averaged in 2010 to 81,820,000 barrel which is equivalent to 4.75km³ a year. Although its share in the consumption declined over the last years, its absolute value is still rising and more and more oil is mined every year.

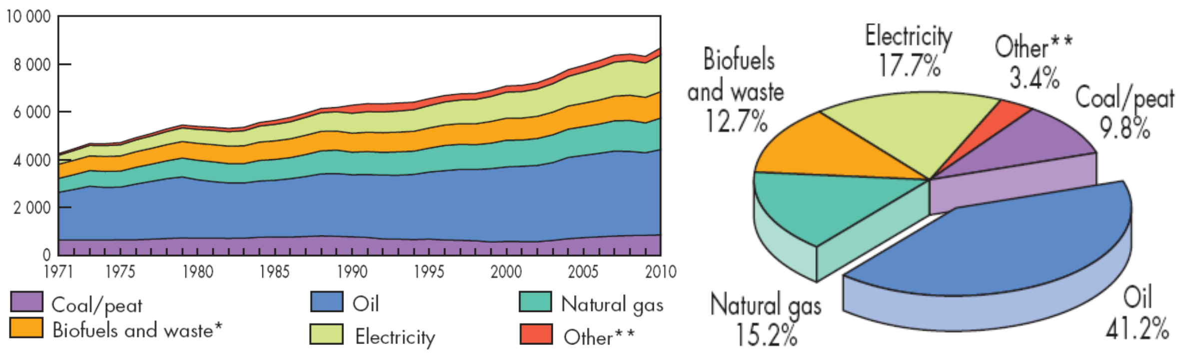

Figure 1: a) Evolution from 1971 to 2010 of world total final consumption by fuel (Mtoe) b) 2010 fuel shares of total final consumption (International Energy Agency, 2012, p. 28)

1.1.2 What do we use the oil for?

When oil has such a high share in our fuel consumption, it is apparent that we encounter it in many affairs of our daily live. The most important operating range of oil is the transport sector, as Figure 2 visualizes. In 2010, almost two thirds of the oil produced was used to keep us and our things mobile. Oil is the basis for gasoline, diesel, other distillates, jet fuel and liquefied petroleum gases (Bryan, 2011). Also the industry needs oil as a fuel, 9% of the total oil consumed is needed in their often energy-intensive production processes. A fair amount of oil, in Figure 2 labeled as “other”, is used as fuel in the agricultural sector, for commercial and public services and residential purposes since many heating systems run with this fluid. But besides its popular combustible characteristics, oil is traded to serves in a variety of non-energy uses. In 2010, 17.1% of the entire oil consumed was used as a raw material and under further processing formed to goods like e.g. plastics, detergents, fertilizers and medicines.

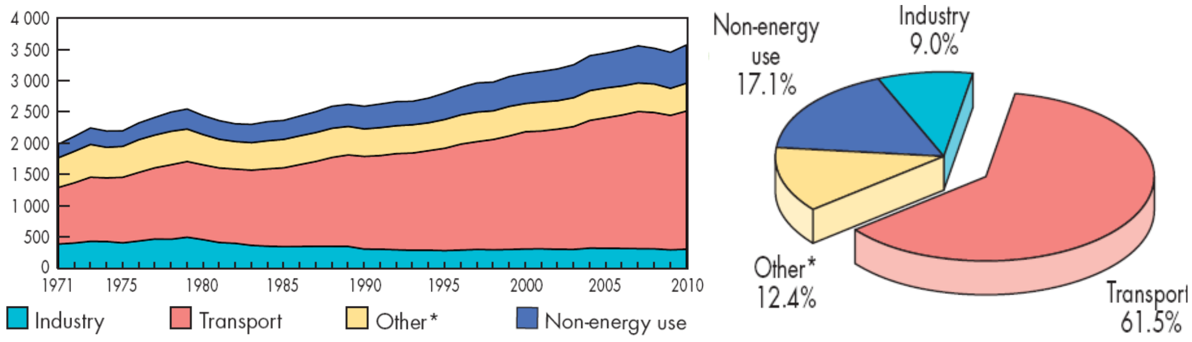

Figure 2: a) Total final consumption from 1971 to 2010 by sector (Mtoe) b) 2010 shares of world oil consumption by sector(International Energy Agency, 2012, p. 33)

1.1.3 The oil(price) – key factor in the world's economy

"For many years, oil exports (crude oil plus refined products) have been the leading commodity in world trade - comprising 13 percent of total commodity trade by value in 2006"(Smith, 2009, pp. 146-147). Almost all nations are strongly influenced by developments in the oil market, either as a producer or consumer - or both. Thus a sudden rise in the oil price can strongly affect world's economy. This coherence is visualized in Figure 3. It shows that spikes in the oil price precede global recessions. The reasons for the oil price volatility are following presented in a chronological order.

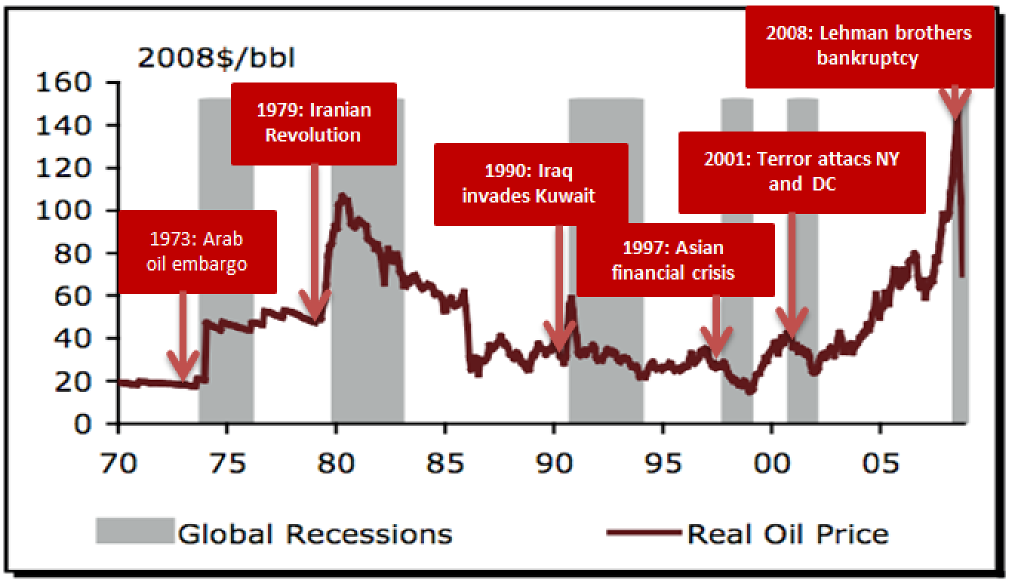

Figure 3: Oil price, important events and recessions based on (Rubin & Buchanan, 2008, p. 4), modified.

1.1.3.1 Short history of the oil price

The oil price and its ups and downs produced many headlines in the last thirty years. It does not simply reflect the existing reserves in Earth's crust but is very sensitive to political and economic crises and changes in the politics of oil extraction. This was not always the case.

Within the biggest part of the 20th century, the oil price was strongly regulated. The multinational, private oil companies from Europe or the USA had it firmly in their hands and chose the price for crude oil together. In the early 70s the price for one barrel of oil was nearly equal to the one in the years after the Second World War (Erdöl-Vereinigung, 2005, p. 4).

Due to the high profits of the oil producing companies the producing countries demanded a higher profit-sharing while the companies tried to lower prices because the supply exceeded the demand. To safeguard their interests and to prevent a price collapse, the five most important producing countries founded in 1960 the Organization of Petroleum Exporting Countries (OPEC). In nowadays, the OPEC consist of twelve oil-producing countries: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.

In 1973 the OPEC showed for the first time its real strength. When the Yom-Kippur-War broke out, some members the OPEC boycotted oil supplies to Israel-supporting nations like the USA and the Netherlands (Erdöl-Vereinigung, 2005, p. 4). Additionally, the OPEC decided to end its collaboration with the oil producing companies and to higher the oil price related to the inflation rate. In the following crises the oil price rose by 400% in only six month (compare Figure 3).

The Iranian Revolution in 1979 and the following Iran-Iraq-War in 1980 caused another, even stronger spike in the oil price than the first one (compare Figure 3). A pro-competitive restructuring in the 80s made the oil price fall to 10$ per Barrel.

The OPEC reacted with an introduction of production quotas, but the increasing share of oil producers outside the OPEC and the poor sticking to the quotas by the OPEC itself lead to a weakening of the cartel.

The strong post-millennial price increase is caused by a variety of factors. It reflects less the current supply situation than expectations market participants have. The strong economic growth in Eastern Asia, the anxiety about terror attacks and the extensive capacity utilization of current mining and production capacities can have a strong influence on the future oil supply and cause high oil prices. (Erdöl-Vereinigung, 2005, p. 5)

1.2 Way and Location of Trading (Rasmus)

Crude oil is the world's most actively traded commodity (BBC, 2007). While oil reserves are concentrated at some regions of the world, oil and its derived products are consumed all over the world. The following section introduces the distribution of international oil production and oil consumption and its resulting trade movements. Further, physical and financial structures of oil trading will be examined.

1.2.1 Crude oil as a commodity

In contrast to other commodities crude oil is not traded in common units of measurement but in so-called oil barrels. One oil barrel equals 158,9873litres. The history of this unique scale unit goes back to the discovery of crude oil in the 1860s (Pickert, 2008). Pennsylvanian oilmen were at a loss where to put the oil that was suddenly coming out of the rigs. They then found empty whiskey barrels a suitable solution for oil transportation. Although oil is no longer transported in barrels, the oil barrel remains the official international trading unit for oil.

Crudes from different regions and oil fields also differ in their quality due to the crude's specific chemical composition. The heating value per barrel of different oil brands can vary considerably. Thus oil cannot be considered a perfectly standardised product. To facilitate international trade buyers and sellers have agreed on some benchmark crudes (Pickert, 2008). The most common international benchmark is North Sea Brent that is produced in the Brent field between the costs of Norway and Scotland. Brent is traded at the International Commodity Exchange (ICE) in London. Other oil benchmarks are the US-American West Texas Intermediate (WTI), Dubai Crude, that is traded at the Persian Gulf, and the OPEC basket, which is an average quality of 15 different crudes in the biggest oil producing countries.

1.2.2 Oil Producers and Oil Consumers

In contrast to other energetic commodities, oil resources are distributed unequally over the world. While some regions have oil in abundance and generate prosperity by oil exports, in other regions oil consumption exceeds oil production dramatically, leading to a dependence on oil imports.

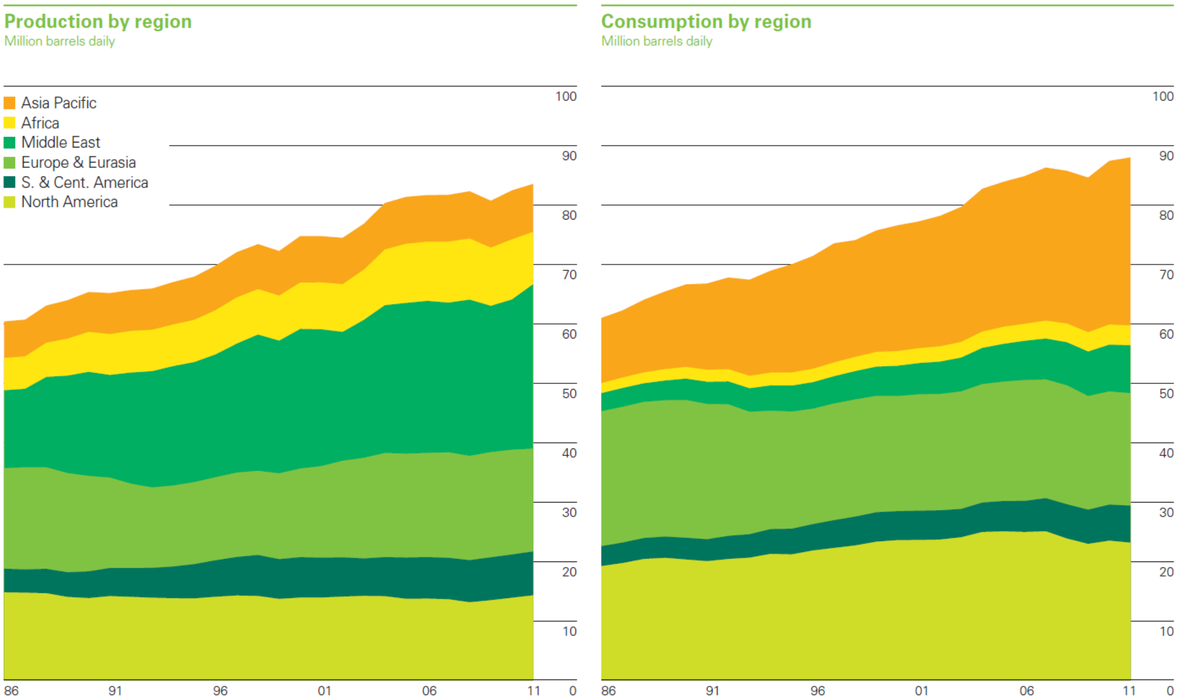

Figure 4: Oil production and consumption by region

Figure 4 identifies the major oil producers and oil consumers. The biggest oil producing region is the Middle East. Here, oil production is much higher than domestic consumption. In Africa production also exceeds consumption due to the very low oil demand in Africa. Another region that has an oil surplus is North America. The region with the highest oil consumption is Asia Pacific. Additionally, oil demand is increasing rapidly in this region. In South America and Europe oil production and consumption is rather balanced, although significant intracontinental differences do exist.

On the European and North American continent overall oil demand decreased in the last decade. The reason cannot be found in a decrease of total energy consumption, but in an increased share of natural gas and renewable resources in the energy system.

That oil consumption is a good indicator for the growth of an economy cannot only be seen in the drastic increase of oil demand in the booming economy of Asia, but also in the low oil consumption and production in the years of the international financial crisis.

1.2.3 Major Trade Movements

As a result from the unequal intercontinental and intracontinental distribution of oil resources as explained in section 1.2.2 considerable oil trade movements become indispensable. The world's major trade movements are illustrated in

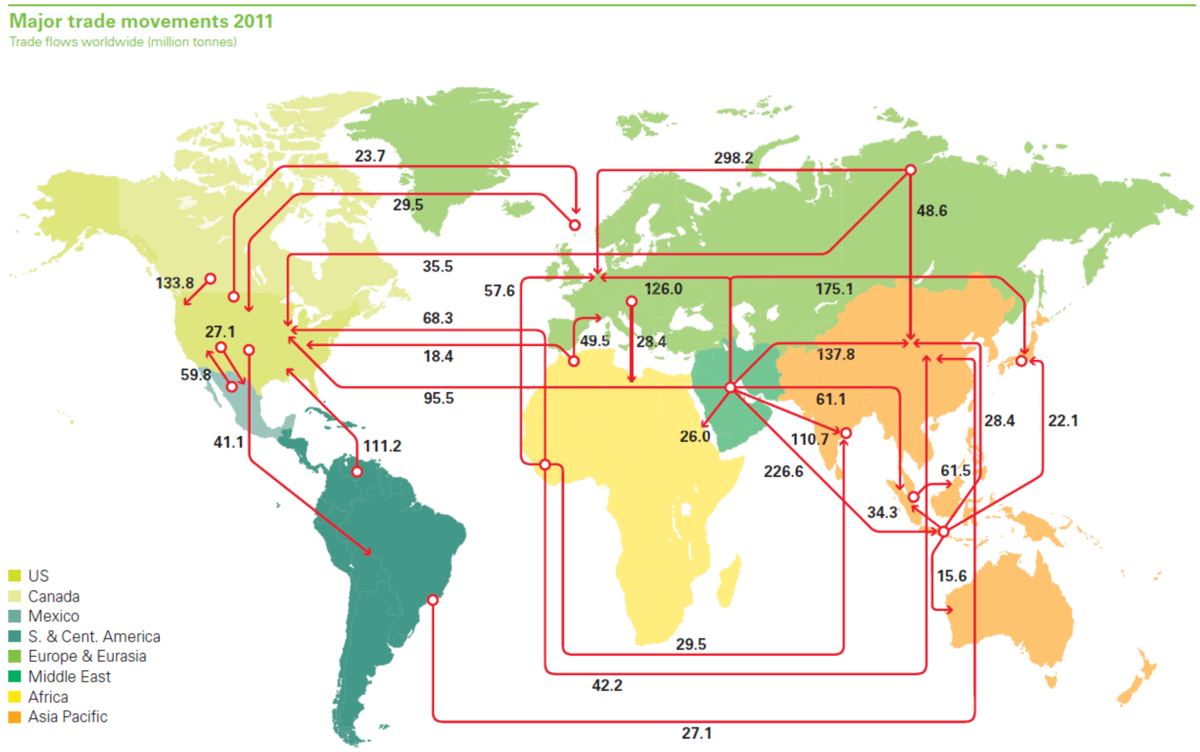

Figure 5: Major Trade Movements 2011 (British Petroleum, 2012)

The Middle East, namely the countries of Saudi Arabia, Iran, Iraq, Kuwait, Qatar, and the United Arab Emirates, can be easily identified as the world's most important oil exporter. But also Russia exports oil to Central Europe, Asia and the US, while Canada only exports oil to the US. Other oil exporters are Nigeria, Algeria, and Angola in North Africa, as well as Venezuela and Brazil in South America. The major oil importing regions are the US, Europe, Central Asia, and Australia.

1.2.4 Oil Exchanges

A big share of world oil is traded at international stock markets. The central international exchanges for oil are the International Commodity Exchange (ICE) in London, the New York Mercantile Exchange (NYMEX), but also the Singapore Mercantile Exchange (SME) (BBC, 2007). The major product that is traded at the international exchanges are future contracts that define binding conditions for oil deliveries and purchases in the future (Erdöl-Vereinigung, 2005). Mostly, you can buy futures for some months ahead, while every other future time is possible. Futures are most important for big consumers that need stable prices and diversified risks. Indeed, price risks for traders have decreased, thanks to the opening of international commodity exchanges (Erdöl-Vereinigung, 2005). On the other hand, this lead to a financialisation of the oil market (Fattouh, Kilian, & Mahadeva, 2012). Oil derivatives are especially attractive for speculators that are more willing to take a risk.

Next to stock market trade, the oil market also experiences over the counter (OTC) trade. Most common are bilateral forward contracts between suppliers and consumers or intermediates that are not traded on international exchanges but are strongly influenced by stock market prices. Oil products are also traded at spot markets, that are located directly at the big international oil ports. The most important oil terminals are found in Rotterdam, New York, Houston, Singapore, and the Persian Gulf. Delivery for contracts on the spot market usually takes place within two weeks.

1.2.5 Oil Transportation

The significant trade movements as seen in section 1.2.3 need for physical transportation of the oil. For the transportation of oil four different means do exist: pipeline transportation, marine transportation, rail transportation, and truck transportation. The better part (62%) of all oil transportation is done by ship (Rodrigue, 2012). More than 3.500 tankers are available on the international oil market. The big advantage of marine vessels is the big amount of oil, that they can carry. The biggest tanker class, the ultra large crude carrier (ULCC) can carry a 2.000.000 barrels, which equals a dead weight tonnage of 250.000 tons. On the other hand, the flexibility of ship transportation is limited.

The pipeline infrastructure for oil transportation is less developed than the gas pipeline infrastructure. Still, the biggest oil pipeline of the world, Druzhba, is bringing Russian oil into Europe. Next to the huge transmission pipelines, there exist some pipelines that bypass tanker routes.

Table 1summarises the characteristics of the different oil transportation methods.

Table 1: Characteristic of Oil Transportation Methods (Bjørnmose, Roca, Turgot, & Smederup Hansen, 2009)

	Pipeline	**Marine**	**Rail**	**Truck**
Volumes	Large	Very Large	Small	Very Small
Unit costs	Very low	Low	High	Very High

Capital costs	High	Medium	Low	Very Low
Flexibility	Limited	Limited	High	Very High

1.3 Major Players (Rasmus)

The major players of the oil market are the oil producing companies that are often characterised by a high vertical as well as horizontal integration. Oil producers can be classed into two types of companies: international oil companies (IOC) and national oil companies (NOC).

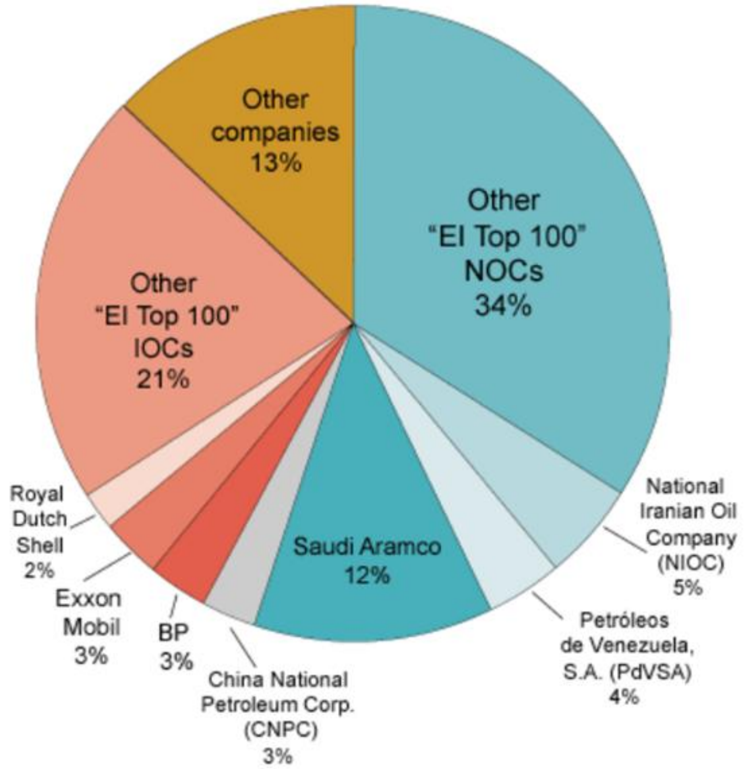

Figure 6: Share of oil production by type of company (Energy Intelligence Research, 2012)

The international oil companies are entirely investor owned. Their primary goal is to increase shareholder value. Investment decisions are based on economic factors. These companies typically move quickly to develop and produce oil resources available to them (EIA, 2012). The biggest international oil companies by working interest production volumes in 2012 are ExxonMobil (6,4 billion barrels per day), BP (4,1 million barrels per day), Royal Dutch Shell (3,9 million barrels per day) and Chevron (3,5 million barrels per day) (Helman, 2012). Figure 6: Share of oil production by type of company Figure 6 clearly shows that the international oil companies do not produce more than one third of world oil. The better part of world oil is produced by national oil companies. National oil companies operate as an extension to the government and support their governments programs financially and/or strategically (EIA, 2012). Due to their public ownership national oil companies can often provide fuels to domestic consumers at prices that are below international market prices (EIA, 2012). Objectives of national oil companies do not necessarily need to be market-orientated. All of the members of the OPEC are national oil companies. Figure 6 indicates the biggest national oil companies: Saudi Aramco (12,5 million barrels per day), National Iranian Oil Co (6,4 million barrels per day), Petro China (4,4 million barrels per day), Pemex (3,6 million barrels per day) and Kuwait Petroleum Corp (3,2 million barrels per day) (Helman, 2012). Besides the fully state-controlled oil companies there are also national oil companies with strategic and operational autonomy. These are for example Petrobas (Brazil) and Statoil (Norway) (EIA, 2012).

The most influential organization on the world oil market is the Organization of the Petroleum Exporting Countries (OPEC). The OPEC currently comprises the countries of Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela. When the oil market was still dominated by multinational oil companies that agreed on prices, high revenues for these companies could be aggregated. To increase their share of the oil gains the five biggest oil nations found the OPEC. Today each OPEC member is periodically assigning an export quota for oil to control the oil market. The OPEC controls about 40% of all international oil trade (EIA, 2012), but even more empowering is the share of world crude reserves that is held by the OPEC. According to Figure 7 the biggest oil reserves can be found in Venezuela, Saudi Arabia, and Iran.

The structure of the world oil market suggests that it is extremely difficult for new players to enter the oil production market. While in the 1960s 85% of all known oil reserves worldwide were fully open to the international oil companies (Businessweek, 2006), that number is now 16%. The remaining part is controlled by state owned companies (3%) and the OPEC nations (81%, see Figure 7) (Littlefinger, 2008). This shows that the market is strongly dominated by the oil exporting countries that will not open their reserves to an open market. Besides from this, it is highly expensive and connected to significant risks to enter the oil market.

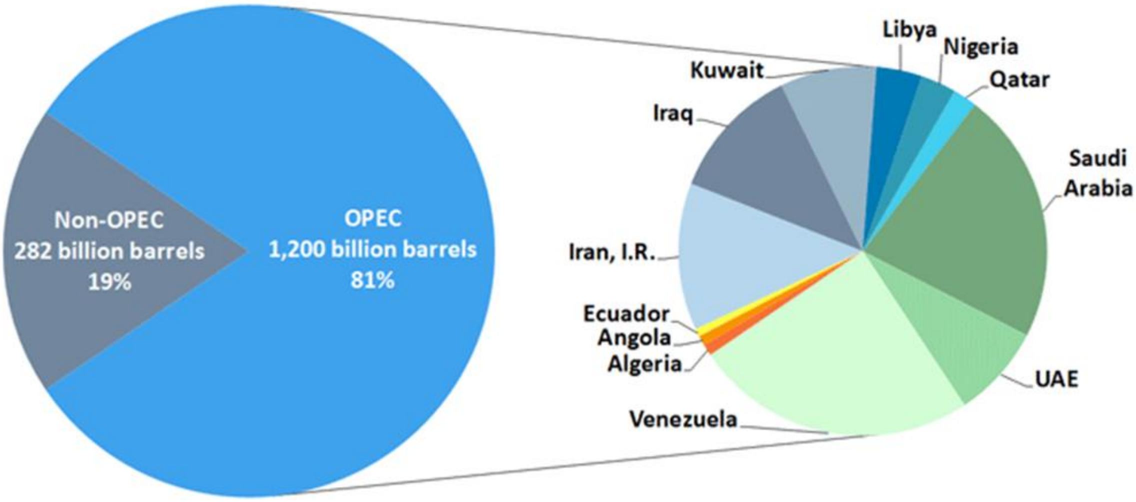

Figure 7: OPEC Share of World Crude Oil Reserves 2011 (OPEC, 2012)

1.4 Linkages to other markets (Tomke)

As we analyzed before, oil has a great impact on the world's economy. Hence there are many linkages to other markets, which are discussed below.

1.4.1 Oil and other types of fuel

At first, the linkages to other energy markets are examined. In Figure 8 the development of the nominal prices of crude oil, natural gas and coal is plotted from the late 80s until now. It visualizes that the oil and gas price have almost the same curve; the ups and downs of the gas price are just a bit delayed. This linkage has historical reasons. When gas was discovered in the end of the 1960s, it was necessary to determine the economic value of it. Therefore it was decided that its price should be based on the price of alternative fuels used in the predicted operating range of gas, which were mainly oil products (GasTerra, 2012).

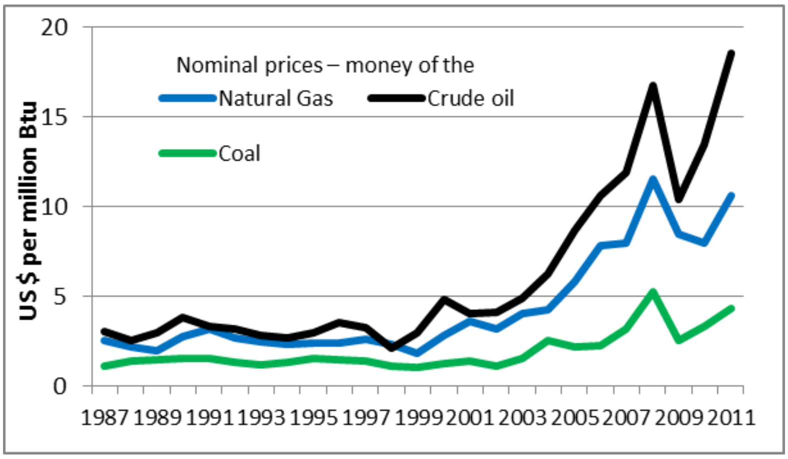

Figure 8: Nominal prices of oil, natural gas and coal in US$ per million Btu, based on (British Petroleum, 2012 [2])

Additionally, the graph shows a linkage between oil and coal price, although this is far less pronounced than the one between oil and gas prices (Figure 9)explains this correlation.

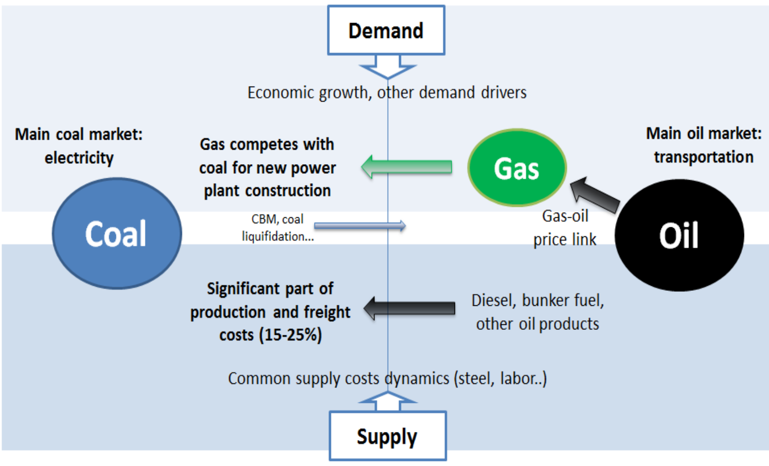

Figure 9: Linkages between oil and gas price, based on (Gasteen, 2007)

At first, there is a number of demanding and supplying drivers that influence every energy market such as economic growth and the common supply cost dynamics, which interact in a similar way with the oil and the coal market. Then, a direct linkage between the two markets can be found since a significant part of the production and freight costs, namely 15-25% (Gasteen, 2007, p. 6)consist of diesel, bunker fuel and other oil products. Although the main oil market is the transportation sector and the main coal market is the electricity production, another strong linkage exists. Gas competes with coal on the electricity market for new power plant constructions. Due to the gas-oil price link oil interacts here indirectly with the coal market. But there is a (less strong) direct linkage on the electricity market between coal and oil as well since 4.6% of the worldwide electricity production is based on oil(International Energy Agency, 2012, p. 24).

1.4.2 Oil and Non-Energy Commodities

“The influence of price volatility in the crude oil market is expanding to non-energy commodity markets.”(Ji & Fan, 2011, p. 273). In Figure 10 the correlation between the food and the oil market is exemplary examined. It shows the index of the food and the oil price over the last twelve years. It is recognizable that the recent high increase in oil prices had quite a strong influence on the food price. Following, the linkage and its development is analyzed.

At first, oil and non-energy commodity markets are linked due to macroeconomic factors such as global recessions and financial crises. But the linkage between oil and food prices has increased over the last decades since the agricultural market was intensified and globalized and fuel use in means of automatized tilling and harvesting methods as well as in transportation needs increased strongly. In terms of intensification it is among others referred to the high amount of fertilizers used which are often made out of petroleum. Additionally,

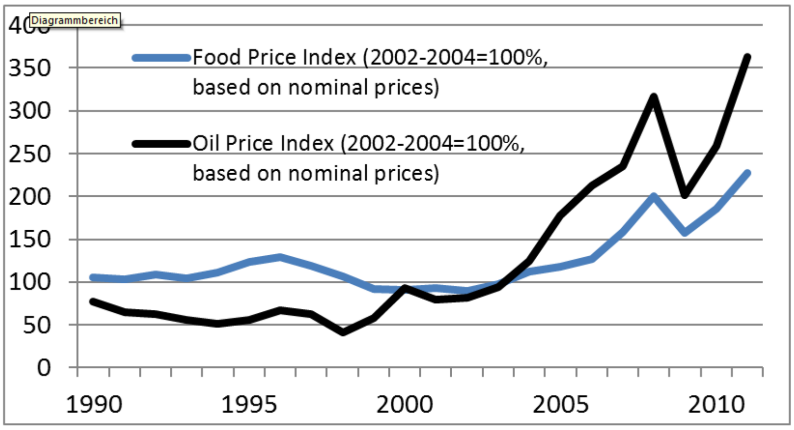

Figure 10: Correlation between food and oil price, based on (British Petroleum, 2012 [2])

their processing is very energy intensive. In Germany, almost 30% of the energy used in the agricultural sector is needed to manufacture fertilizers (Klepper, 2011, p. 21).

Especially in recent times the linkage between food and oil prices has strongly increased due to the substitution of fossil fuels by biofuels (Ji & Fan, 2011, p. 273). When biofuels as energy substitutes for gasoline and diesel are produced from agricultural crops which beforehand were sold on the food market; the food gets more scare and so food prices are more likely to increase.

1.5 Security of Supply (Tomke)

The security of supply is for every energy market of great importance and it becomes an even more important issue if the type of energy used has a finite nature, so as oil has. Hence, the remaining resources and reserves of oil are following examined in more detail.

1.5.1 Finite nature of oil - Resources vs. Reserves

The resources are defined as the actual amount of a mineral that is forecasted to remain in Earth's crust. The reserves are just a tiny fraction of the total resources, namely the one that has a high degree of geological certainty;

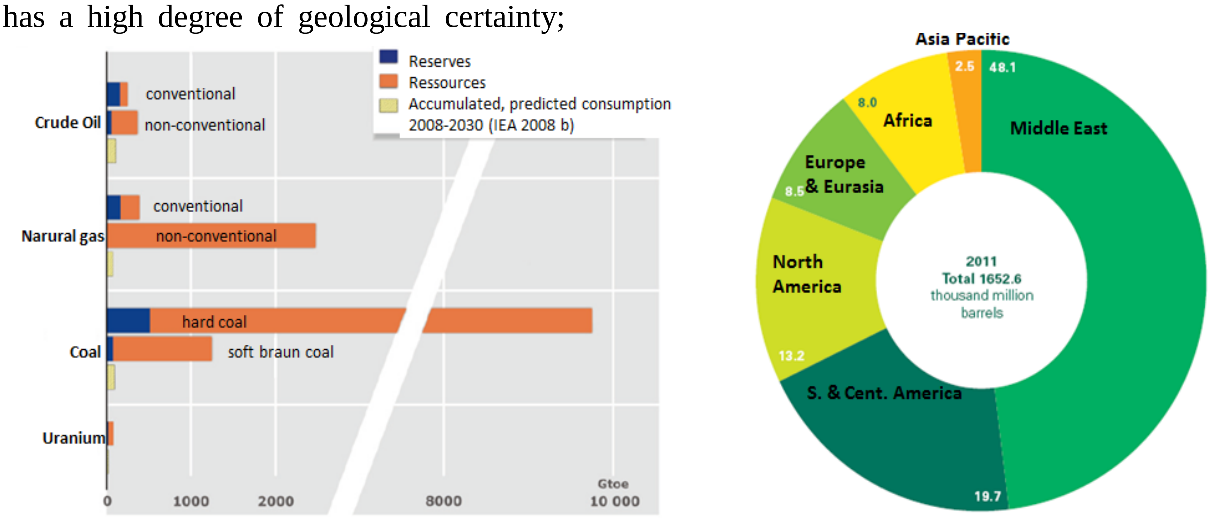

Figure11: a) Oilreservesandresources(Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), 2009, p. 16)
b) Proofed oil reserves 2011 (British Petroleum, 2012, p. 7)

that is expected to be accessible and minable under the current economic and technological conditions.

Oil is the only of our fossil resources that we have already used up for the greatest amount (compare Figure11a). Only 3.9% of the total fossil resources number among to oil; of which 1.6% so called conventional oil and 2.3% are of the type of unconventional oil whereas the share of the total fossil reserves is considerably higher. It accounts in total for 22.7% of which 17% correspond to the conventional type (Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), 2009, p. 11). Currently, as it is defined by the International Energy Agency (IEA) conventional oil is the “category of oil that includes crude oil and natural gas liquids and condensate liquids, which are extracted from natural gas production.[…]Unconventional oil consists of a wider variety of liquid sources including oil sands, extra heavy oil, gas to liquids and other liquids. In general conventional oil is easier and cheaper to produce than unconventional oil.” (International Energy Agency, 2012 [2]). Conditioned to technological developments and increasing oil price, some parts of the now considered as ‘unconventional’ oil might soon by produced. In this respect the mining technology ‘fracking’ is currently of great importance. In this technique, a mixture of sand, water and chemicals is squeezed into the ground to release the shale gas, which is especially Northern America’s hope to an independent oil and gas supply (Schröder, 2012). But the mining of this type of oil is strongly discussed with respect to environmental damages. Political opponents caution against unforeseeable risks. For example could the chemicals squeezed into the ground, which are in part even radioactive, could contaminate ground water and soils. Additionally, this mining technology emits a lot more greenhouse gases than conventional types of mining.

But back to the actual reserves that we have, for how long does the oil last under existing economic and political conditions, with existing technology? This number is expressed in the proofed reserves; those that claim to have a reasonable certainty, normally at least 90% confidence. The world proofed oil reserves at the end of 2011 reached 1652.6 million barrels; which is sufficient to meet 54.2 years of global production (British Petroleum, 2012, p. 7). By far the biggest part of the proofed oil reserves can be found in Middle East: 48.1%. In South and Central America 19.2% and in North America 13.2% of worldwide oil reserves can be found. Europe and Euasia dispose about 8.5%, Africa about 8% and the Asian Pacific region about 2.5% of the global reserves.

If the reserves are scarce, the security of supply gets of even greater importance for the market participants. Hence was in 1974, as a result of the oil disruption of 1973, the International

Energy Agency (IEA) founded to implement a strategy to address oil security issues on an international scale. It is an autonomists unit of the Organization for Economic Co-operation and Development (OECD) that currently has 28 members. “Emergency response is still one of the main pillars of the IEA. […] Every member-state has to hold oil stocks equivalent to at least 90 days of net oil imports” (International Energy Agency, 2007, p. 11).

1.5.2 Supply Disruptions – which factors can unbalance the market?

Since oil became a ruling energy source in the 1950s, several oil supply disruptions happened (compare Short history of the oil price). In the International Energy Agency report “Oil Supply Security” five risks are identified, which involve the danger to throw the market out of balance. First, **demand growth** plays a major role. This parameter is estimated to grow by 1.3% per year until 2030. Secondly, the **concentration of the oil supply** has to be mentioned. The oil production is forecasted to concentrate in an ever-shrinking group of countries with large reserves. This concentration is likely to “increase the global vulnerability to a disruption and heighten the risk that these countries could use their market dominance to impose higher prices” (International Energy Agency, 2007, p. 20). Further, the transportation lanes of the oil produced in Middle East, where currently the biggest share of the oil is produced and where almost half of the economically suitable reserves can be found, are along very vulnerable maritime routes in terms of closures due to accidents, piracy, terrorist attacks or war. Additionally, the **concentration of the oil use in the transport sector** will higher the vulnerability of the market to a supply disruption because no significant alternative fuel source yet exists; oil is not easily substitutable by another good. This concentration enhances the low price-elasticity of short-run demand and supply. The **capacity** of the oil market supply infrastructure is a key factor to keep the market in balance. Spare capacity in the supply chain would provide flexibility when the market is faced with unforeseen outages and would reduce the vulnerability of the supply and lower the pressure on prices. Finally, the phenomenon of “resource nationalism” and **uncertain investment climates** is mentioned as a risk an increasing risk on supply disruptions. Many oil producing companies focus on their national markets and make foreign investment and technology uptake difficult. Hence the fear that investment in capacity expansions might be insufficient to meet future demand rises.

1.6 Oil as a Political Instrument (Rasmus)

Due to petroleum’s low price elasticity and the strong interdependencies on the world oil market, oil has often been used as an instrument to implement political interests. This paragraph shall introduce a recent issue where oil trade agreements have been used to reach a completely different goal: the western sanction against Iran. Since the first of July 2012 no oil imports from Iran are allowed to enter the European Union. The sanctions also include oil transportation and tanker insurances for Iranian oil. The US has introduced similar sanctions against Iran. The goal behind the sanctions is to put political pressure on Iran to stop their nuclear program, because the US and the EU fear that Iran is working on nuclear weapons secretly. The Western nations can risk to put an embargo on Iran because only small percentages of their oil imports come from Iran. On the other hand, a high share of Iran's oil exports goes to these countries. The embargo does not only lead to a decrease of Iranian oil exports. Even more frightening for Iran is the attack of their currency. As a result of the embargo, less currency, such as the US dollar, is coming into the domestic market. Since the beginning of this year the rial has lost 50% of its value against the US dollar (Bozorgmehr, 2012). As people try to sell their rial for dollar on the street exchange, which is widely followed in Iran, the inflation accelerates. Since the Iranian government has tried to ignore the sanctions and not given up their nuclear program, the European Union launched a second step of sanctions, when, on October 15, they announced a ban on all transactions between European and Iranian banks. As a reaction Iran threatens to stop oil exports to the world, which could result in an increase of world oil price. Today, the future development of the conflict cannot be foreseen. It can be stated, that the international oil market is everything but a perfect market. Instead, the market is characterised by significant market imperfections, when international dependencies are utilised to enforce political goals. The oil market has strong implications for international politics and vice versa.

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2 The Coal Market (by Evagelos Giannopoulos and Heiko Voss)

2.1 What is Coal (Evagelos Giannopoulos)

Coal is one of the most common fossil fuels in use in the modern world together with oil and natural gas. Its main characteristics describe it as a solid, carbonaceous, solid rock which is able to be burned. Its primary substances are carbon, hydrogen, oxygen, nitrogen and lesser amounts of sulfur. Other traces of elements can be found according to the area where the mining takes place. (Survey, 2005, p. 2)

There are four main quality categories of coal: lignite, subbituminous, bituminous and anthracite. Out of them anthracite is the hardest and contains more carbon thus having higher heat value. Lignite on the other hand is the softer form available and contains less carbon. (Survey, 2005, pp. 2-3)

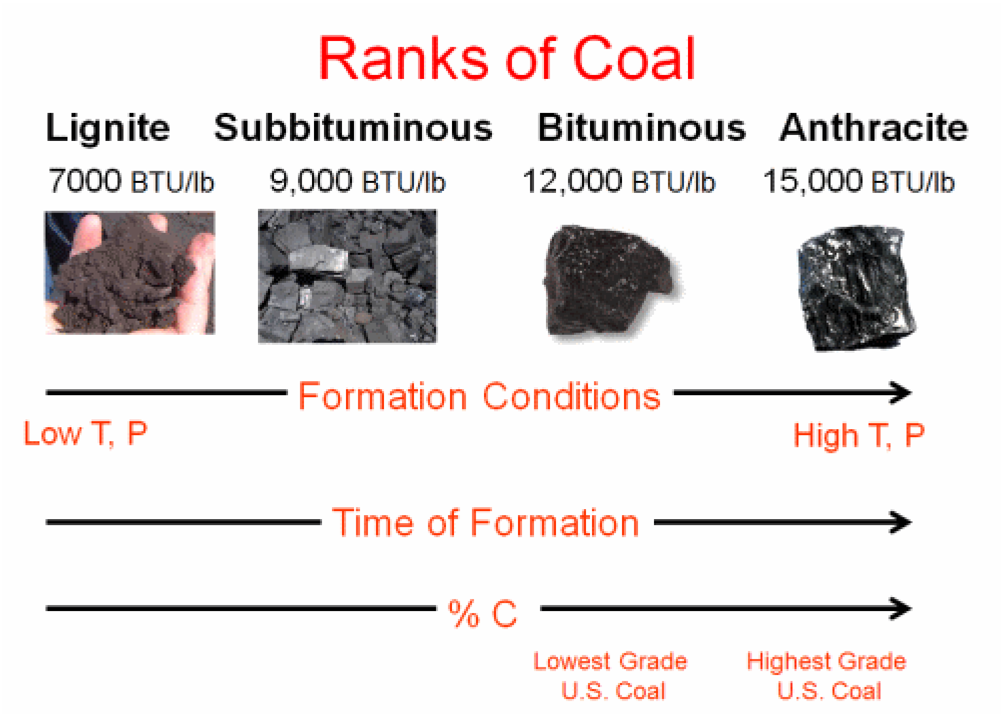

Figure 12: Energy efficiency of various coal forms in relation to time and conditions of formation (http://stlenergy.org/?p=487)

Most of the coal present in earth was formed at around 300 million years ago during the Carboniferous period, although there are also 'younger' parts formed between 55 and 100 million years during the Paleocene Epoch. (Survey, 2005, p. 3). The main deference between coal and oil is that oil was mainly formatted in the depths of the seas but coal on the contrary was created in shallow waters and swampy areas where the amount of pressure was much lower. The mechanism however remains the same in principle. As the flora was dying, their remains were sunk to the lower levels of the ground thus creating layer upon layer which eventually become what we know as fossil fuels. (www.ket.org/trips/coal/agsmm/agsmmhow.html)

2.2 History of Coal (Heiko Voss)

The usage of coal reaches back centuries in the past. Already 400 AD the romans were using coal as a source of energy. In the Middle Age coal mining in England and first incidents of international trade in Europe were recorded in chronicles (WCI, 2009, p. 19). The industrial revolution initialized the break-through of coal as source of energy on a large scale, caused by the invention of the steam engine by James Watt in 1769. In 1882 the first coal fired power plant supplied electricity to a few houses in New York (WCI, 2009, p. 19). Exports of coal from the US to Canada, South-America and Europe started around the same time and experienced ups and downs during the World Wars, correlated with industrial activities (Andelin, Niblock, Johnson, Kevin, Beil, & Wade, 1981, p. 34). After the First World War with the treaty of Paris in 1951, the European Coal and Steel Community (ECSC) was founded, representing the importance of the resource coal at that time and being one of the predecessors of the European Union and later a part of its three pillars (europa.eu, 2010).

In the 1960s coal lost its popularity to oil, as oil was more flexible to be used in the emerging transport sector. Since then, oil has become the largest primary source of energy of the world (compare The Oil Market, Figure 1). Although there has been a rising concern about coal’s pollution problem and technologies like carbon dioxide capture and storage (CCS) are highly controversial, coal is again a very popular source of energy as the following sections will demonstrate.

2.3 Present status and size of the market (Evagelos Giannopoulos)

Coal is a major player not only in the production of electricity (steam coal), but also in the metallurgy and cement industry (coking form) and through its gasification process it can help in the cheap production of hydrogen for use in the fuel cells technology. (Survey, 2005, p. 2) Nowadays coal provides 30,3% of global primary energy needs and generates 41% of world’s electricity. (Association, Coal matters, May 2012, p. 2)

Despite the fact that coal is one of the big emitters of CO_2 in the atmosphere and someone would expect that its use in accordance to the Kyoto protocol agreement should have been limited in the last 20 years, figures show that this is hardly the case. The total coal production in 1990 was 4677Mt, in 2010 7201Mt and 7678Mt in 2011. (World Coal Association) The huge rise in numbers can be easily explained by the entrance of China in the World Trade Organization in the beginning of the previous decade, a fact that skyrocketed its energy demand. In this country alone coal industry provides work to 5 million people. (Elegant/Zhangjiachang, Mar 2. 2007) Worldwide the market involves transactions of around 475 billion €. Coal is mined in 50 countries and is used in over 70. (World Coal Association)

2.4 Major players (Evagelos Giannopoulos)

As we saw in the history section, coal was always associated with a nation's industrial development and that certainly provides a hint concerning today's status about the major players in this market. As of 2011 the major producers were China (3471Mt), USA (1004Mt), India (585Mt), Australia (414Mt), Indonesia (376Mt), Russia (334Mt), South Africa (253Mt), Germany (189Mt), Poland (139Mt) and Kazakhstan (117Mt). (Association, Coal facts 2012, 2012, p. 1) The following diagram is revealing of the worldwide situation:

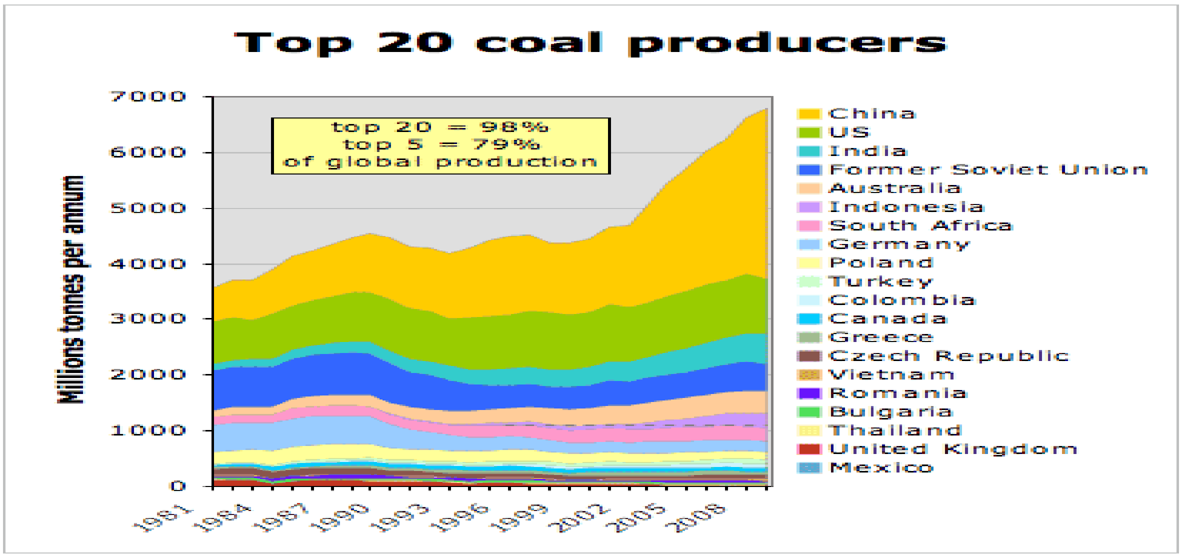

Figure 13: Top 20 coal producers. (Mearns, 2010)

As far as the main consumers are concerned the situation is more or less the same with the noticeable add of Japan, a major industrial force with minimum internal raw material availability.

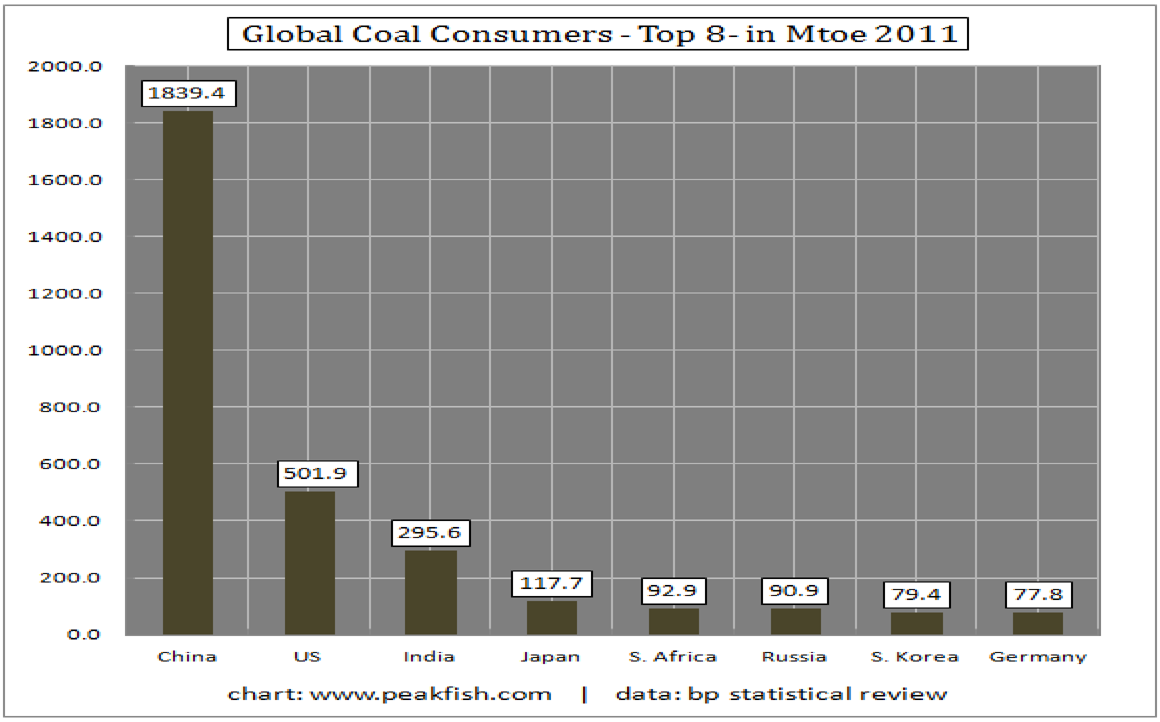

Figure 14:Top 8 consumers (Peak fish, 2012)

Of course someone has also to mention the major private companies involved in the global market. The top 10 is: ABM InvestamaTbk PT (Indonesia), Abterra Ltd. (Singapore), Acacia Coal Ltd (Australia), Adani Enterprises Ltd.(India), Adani Enterprises Parent Ltd. (India), African Energy Resources (Guernsey) Ltd. (Australia), Agritrade Resources Ltd (Hong Kong), AJ Lucas Group Limited (Australia), Allegiance Coal Ltd (Australia), Alliance Holdings GP, L.P. (United States).(Directory of Public Companies in Industry: Coal, 2013) The above mentioned companies in their majority deal only with the trade in its all, from the mining process to the transportation to the final consumer. What is perhaps most revealing of these data is the fact that Australasia seems to dominate the market indicate a swift to the center of industrial productivity in the current century.

2.5 Way and location of trading (Heiko Voss)

Coal is today the most important global energy source for electricity generation. South Africa, Poland and China are the leading countries in using coal for power generation with 93%, 92% and 79% respectively (International Energy Agency, 2012 [2], p. 16). Poland uses its reserves of lignite, contributing with a share of 38% in their energy mix. South Africa and China solely rely on hard coal in contrast.

Only 15% of the globally extracted coal is traded internationally (WCA, 2012). Often the production and consumption of coal takes place in the same or nearby location with only short transporting distances. In the following only the global traded coal will be considered, as local trade is very site specific amongst the different countries and is therefore hardly accessible.

2.5.1 Physical trading in two basins

In 2011 1142 million tons of coal was traded internationally. 75% of the traded volume is attributed to steam coal, used for electricity generation. 24% of traded volume is attributed to coking coal that is commonly used for producing steel. Lignite only accounts with a minority of 1%.

Steam coal is traded over larger on a regular basis. The main trading locations are separated into two geographical territories: the Atlantic and the Pacific basin. The Pacific market currently has a share of 70% (VDKI, 2012, p. 22). The remaining 30% are attributable to the Atlantic market and are primarily driven by the European demand for coal. The top exporting and importing countries reflect the high share of the Pacific market with its major exporters Indonesia and Australia and major importers China and Japan (Figure 15). The contribution of the top exporters is striking. In 2011, 90% of international trade resulted from their activities.

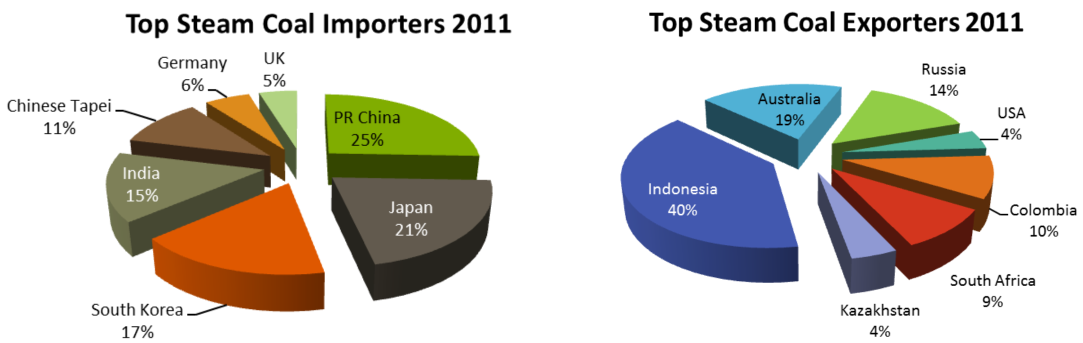

Figure 15: Top Steam coal exporting and importing countries 2011, based on (WCA, 2012)

Indonesia and Australia also export across the basins into the Atlantic region, especially when freight prices are low as it is the case since late 2008. Until now the declined freight rates remain at a low level (see *Freight* in next paragraph).

The global seaborne trade flows of hard coal are shown in Figure 16. The arrows not only reveal main trading routes, but also the largest consumers and producers (see Major Players). For the Atlantic basin the influence of Colombia and South Africa is especially important. South Africa has unique trading location between the two basins. If it was formerly trading mainly in the Atlantic basin, the up surging demand in Asia results in a gradual behavioral change.

Figure 16: Main Trade Flows in Seaborne Hard Coal-Trade 2011 (VDKI, 2012, p. 21)

2.5.1.1 *Freight*

From production to consumption are different means of transportation necessary, taking influence on the price that coal is offered. On land conveyors and trucks cover short distances. Trains and barges are important for longer land routes. The international seaborne trade is dominated by three kinds of vessels with different cargo volumes: Capesize(up to 180.000 t), Panamax (up to 80.000 t), Handymax (up to around 60.000 t) (Wlecke, 2006).

The freight prices have seen many changes in the last ten years. In summer 2008, due to the financial crisis, freight rates reached an overall maximum higher than 85 US$/t (Figure 17).

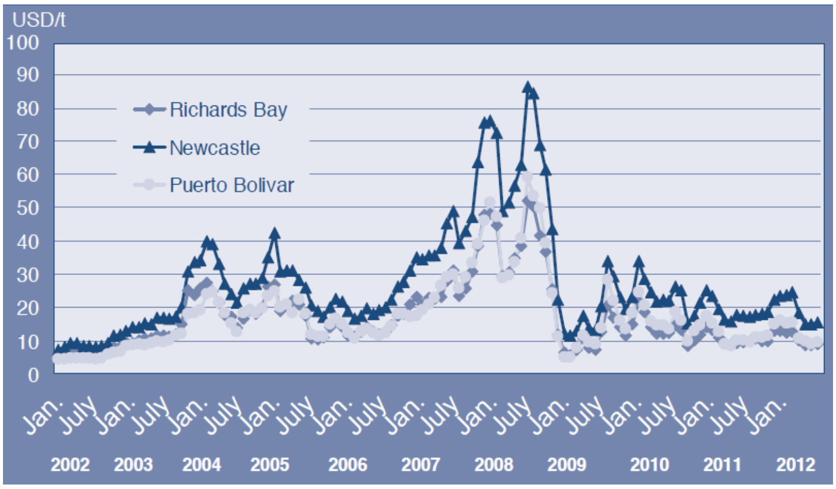

Figure 17: Freight rates (capsize) of hard coal (spot) to the ARA ports (VDKI, 2012, p. 28)

Usually, for the European market the coal delivery from Richards Bay (RB) to ARA (Amsterdam-Rotterdam-Antwerp) is taken as a benchmark. After the freight rate crash in 2008 prices seemed to recover, but up to today they remain very low at around 10 US$/t, for the RB-ARA route. This is mainly owed to the overcapacity of ships acting in the market (VDKI, 2012, p. 28) what is dumping the prices and also the margins of shipping companies.

The freight influence on the total coal price is site specific, as the example of a Russian mine in Figure 18 visualizes. Here, especially landward transportation by rail is noteworthy, accounting for 35% of the final delivery price. There are dependencies on the oil price in the transportation and in the mining sector, affected by the state of technology used and means of transportation chosen. Considering that seaborne freight rates are currently low, they don't contribute much to the total coal price a power plant operator pays.

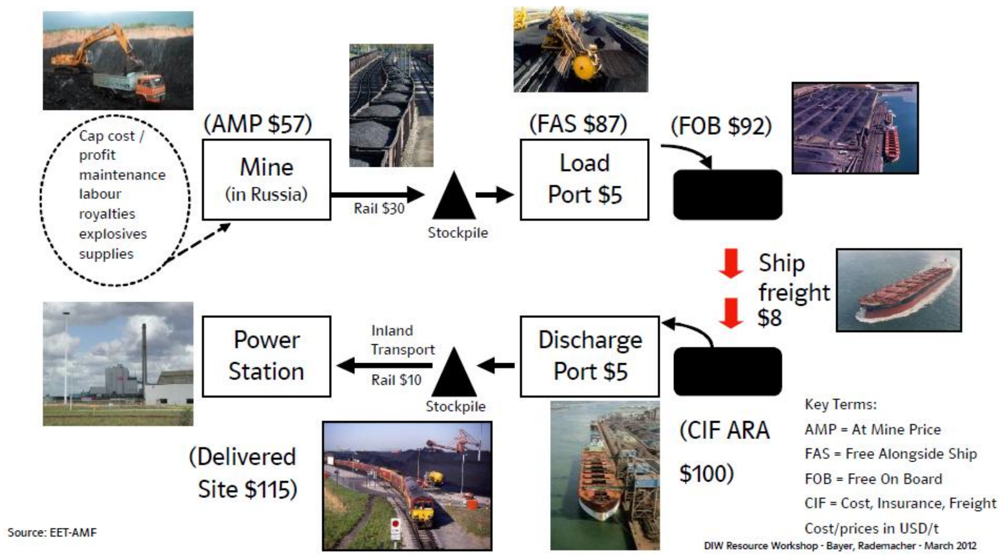

Figure 18: Coal logistics chain - pit to power station at the example of a Russian mine in February 2012 (Bayer & Rademacher, 2012, p. 3)

In coal trading relevant prices are for commonly stated as:

- FOB (free on board) where the buyer has to arrange the shipping himself
- CIF (cost, insurance, freight) what includes all cost, including freight and insurance
- CFR (cost and freight) where the seller arranges the shipping, but without insurance

2.5.1.2 Recent developments - Trading of Coal with lower quality increased

Thermal coal used for electricity generation is not a homogenous product and can differ significantly in e.g. ash content, moisture and of course in its calorific value. How well a coal fired power plant can cope with different coal qualities depends on its characteristic fuel spectrum (Bayer & Rademacher, 2012, p. 5).

Recently, in the Asian region a growing amount of coal of lower quality was traded (VDKI, 2012, p. 11). The same could be observed in the Atlantic basin and encouraged new trading agreements, allowing wider calorific ranges for “Newcastle” and “Richards Bay 3” down to 5500 kcal/kg and ash content of up to 23% (formerly limits: 6000 kcal/kg and 14% ash).

2.5.2 How is coal traded?

Coal has been a typical OTC (over the counter) product for a long time. OTC today still prevails, but since 2006 the European Energy Exchange (EEX) in Leipzig and IntercontinentalExchange (ICE) in Atlanta offer futures and therefore placed coal also on the international exchange market (RWE, 2007, p. 47). This makes it very interesting for capital investors to participate in trading coal for hedging or speculation purposes. The prices formerly set by OTC business gets more and more influenced by activities on the exchange (VDKI, 2012, p. 25).

2.5.2.1 Exchange

In the US, Central Appalachian coal futures and options can be traded on the New York Mercantile Exchange (NYMEX) that belongs to the CME Group. The ICE offers the same product and a wide additional range of coal futures and options, for example: Richards Bay, Newcastle, Powder River Basin and more (ICE, 2013). At the EEX in Germany only Richards Bay and Amsterdam-Rotterdam-Antwerp coal is traded.

Trading units and volumes differ in the particular exchanges. At NYMEX the amount of 1550 tonnes is the minimum contract size (CME Group, 2013). At ICE and EEX the lowest tradable size is 1000 tonnes. The price at all three exchanges are stated in US$ per ton.

2.5.2.2 OTC clearing

In a regular OTC trade there are no standardized contracts. Two parties agree to a deal bilaterally and therefore have the full counterparty risk. The removal of that risk has been a growing concern in OTC trading and makes OTC clearing more attractive. With the help of OTC clearing the removal of counterparty risk as well as standardization of contracts is now given for coal.

OTC clearing for coal derivative products is offered for example from EEX where OTC cleared coal futures can be traded (EEX, 2013) or also from NYMEX through the CME ClearPort with a wide range of clearing services for thermal and coking coal futures and options (CME group, 2013).

2.5.3 Prices and Indices

Most of the OTC contracts are made on basis of a price index. Price indices represent the value of coal, e.g. in US$ per ton, that is traded at a specific geographical location.

The most important of those are the API2 and API4, especially for the European market. The API 2 is CIF ARA, what means cost, insurance and freight is included at the harbours of Amsterdam, Rotterdam or Antwerp. API 4 is a FOB price (see Section *Freight*) defined at the terminals of Richards Bay, in South Africa. By subtracting API 4 from API 2 it is possible to calculate the shipping costs to ARA. Recently, VDKI (2012, p. 25) raised the question, if API 4 is still suitable as an index for the Atlantic market, as it remained higher than the API 2 through price distortions due to Asian activities in Richards Bay.

In the Pacific basin the API 5 and 6 dominate the contract settlements. These indices refer to coal free on board from Newcastle in Australia. They differ in the restriction of the calorific value.

Globally, the main indices where 90% of coal derivative contracts are settled against, are the API2, 4, 5, 6, 8 and API C1(Argus/IHS McCloskey, 2012). These indices are determined to 50% by surveying market participants and to 50% by executed contracts in the respective area, on a daily basis. There are also other indices available, but with less influence than the above mentioned. Examples are (VDKI, 2012, p. 25):

- Indonesian Sub-bit Marker (US$/t)
- NW Europe Steam Coal Marker (US$/t)
- Asian Steam Coal Marker (US$/t)

2.5.4 Chinas Role as the largest arbitrage trader

Since 2009 the influence of Chinas export and import behavior changed significantly. With price advantages of coal from Indonesia, Russia and Australia over their local supplies, China massively imported coal as Figure 19 shows. The price arbitrages resulting from different prices of coal at Guangzhou influences the Chines import behaviour. Between Aug-09 and Apr-10 there has been a positive price difference in all three coal supplies, telling that foreign coal could be sold at a lower price than the domestic.

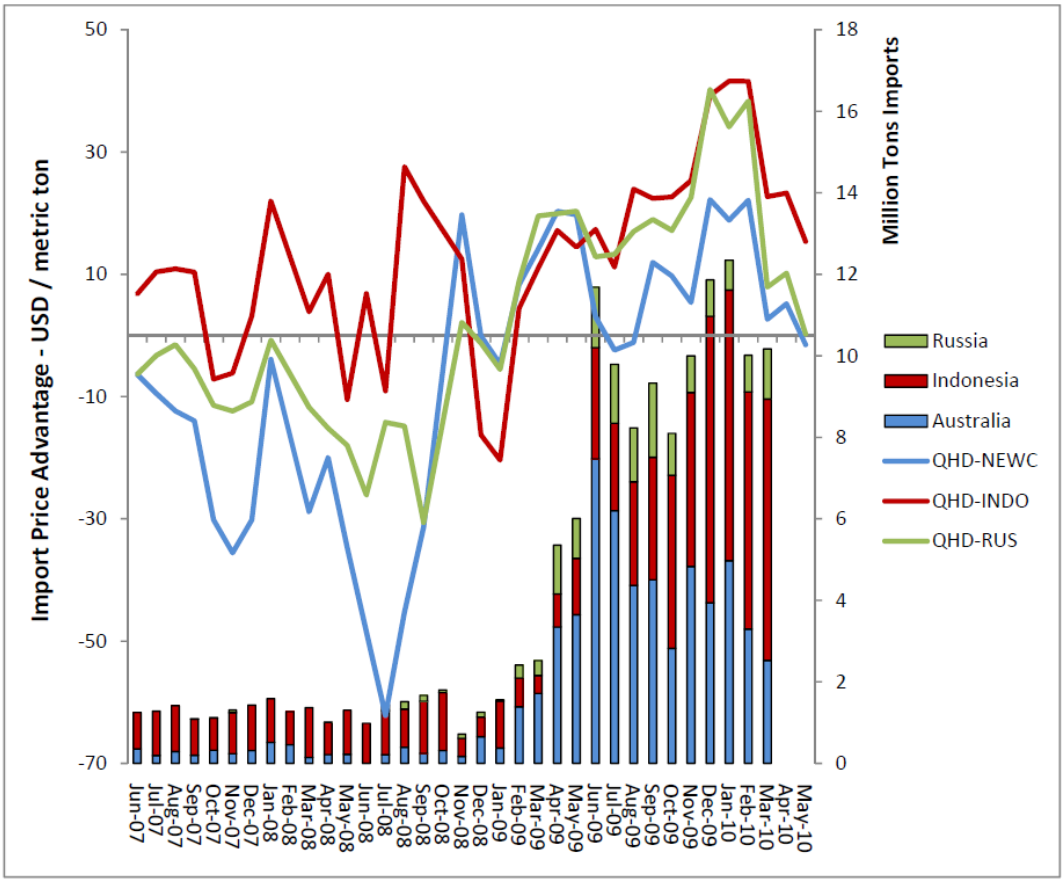

Figure 19: Linkage of coal import patterns in China due to price advantages in Guangzhou (Morse & He, 2010, p. 14)

The impact of China on to the global market is tremendous. Morse & He (2010) indicate that they will act as cost minimizer by importing huge amounts when prices are low enough. China can buy up to 15-20% of the global coal volume, what links the global price to Chinas domestic prices as a result (Morse & He, 2010, p. 20).

2.6 Technical restrictions (Evagelos Giannopoulos)

Despite the fact that as we saw coal is a major contributor to energy production there are also major technical restrictions in its exploitation. In difference to oil and natural gas which can be exploited even in underwater deposits and in depths of several kilometres under the surface of the earth that is not the case for coal. After almost two centuries of mining coal the current trend is that approximately 60% of it is mined underground (deep mining) and 40% on the surface (opencast mining). (World Coal Association).

That happens for two main reasons. The first is the elimination of available surface deposits. Thus it is required to dig deeper and costlier and with less efficiency as far as the total amount of coal is concerned. The second one is the increasing environmental awareness. Opencast mines leave a scar on the face of the earth and only the visual disturbance of local communities is enough reason to proceed to underground mining especially in developed countries. Underground mining involves two main methods: room-and-pillar and longwall. In the first one a series of 'rooms' have to be constructed with pillars made of the same coal seam that it is exploited and it can be up to 40% of this amount. The second one is about the mining of corridors from 100m to 350m while special hydraulic equipment supports the roof. (World Coal Association).

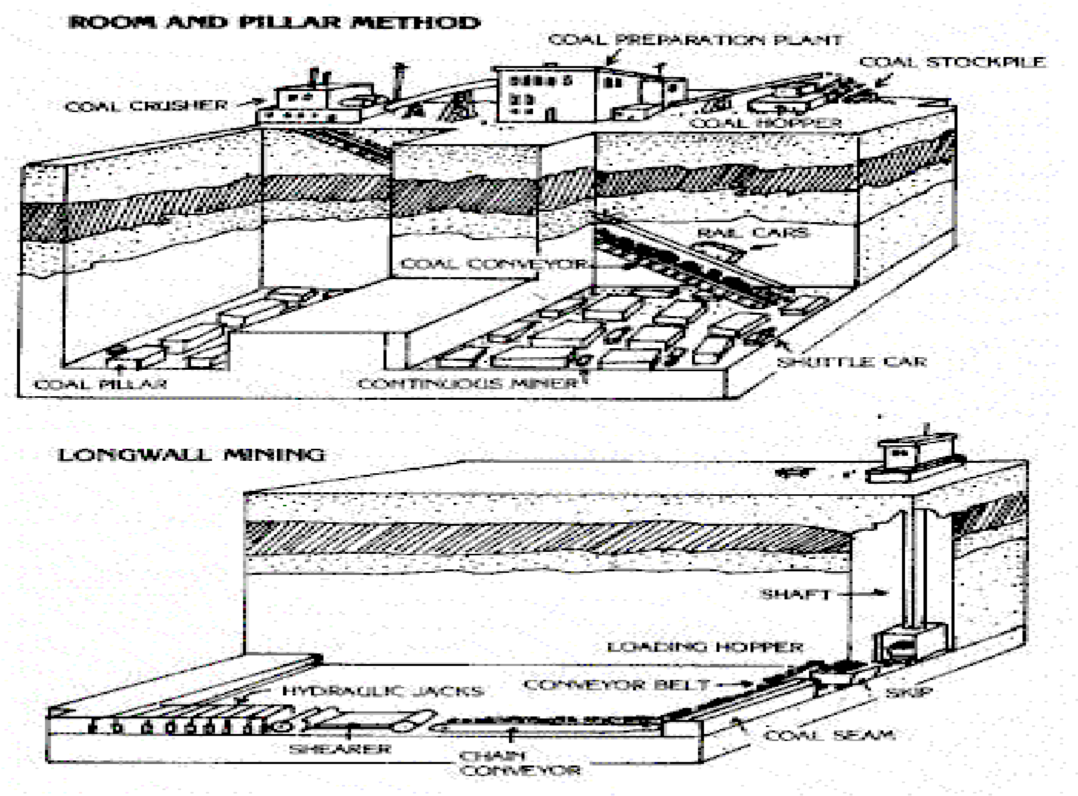

Figure 20:>Principles methods of underground mining (Foundation, pp. 2-3)

In order all these to happen successfully it is necessary for a company to employ specially trained workers and equipment and among others to ensure their health and safety. This is a significant improvement from conditions in the previous centuries when coal miners were often the victims of accidents and diseases (e.g. Coal workers' pneumoconiosis). (Macnair, 2011)

One more parameter is that because of the fact that coal has a solid form it can not be transported through pipes, although in the USA (Nevada-Arizona) there is such an installation, like oil and natural gas, thus leaving only traditional methods available like special trains, highway trucks, barges and ocean ships. That is perhaps one more reason why the majority of the consumer industries are often situated near the production mines like in the Ruhr area in Germany. (Coal transportation)

2.7 Barriers to entry (Evagelos Giannopoulos)

Judging from the above we can say that coal industry is highly capitalized. It requires the introduction of special machinery, trained workforce, construction of safe mines, exploration of new sites, high transportation costs. Perhaps all these could have been dealt with effectively if the climate towards coal production was a little more favorable. In many countries especially after the implementation of the Kyoto Protocol there is a trend for stricter environmental laws as far as emissions are concerned and that has definitely a serious impact on stakeholders who wish to invest in this industry. (research, The New Zealand coal industry, p. 2)(Strellec, 2000, pp. 7-11).

In this climate nobody has to neglect the strong opposition that modern societies express towards these mines especially opencast ones. Therefore the current trend for new sites is for them to be located in remote areas. It is characteristic the case of Australia where the low density of its population has provided her with the opportunity to become the largest export coal country. (Today in energy, 2011) In the USA the current trend is to step away of new coal fired power plants although all may implement coal gasification technologies and turn to natural gas especially after the development of economically viable shale gas technology. (Mufson, 2007)(Junkins, 2010)

One other parameter that prevents new investment in the area is the use of CDMs (Clean Development Mechanism) in developing countries especially China and India in cooperation with companies in the industrialized world. (Chandler, Michael Lazarus and Chelsea, 2011, pp. 2-4)(Power, 2011). The issue is that especially in China the emission rights are treating by the government as a national resource available to the global market and the main case is the strict state control upon the programs and upon the stakeholders which allows little room to participation in a company and promoted generally the simple trade of the rights derived from the project. (Liptow, December 2008, p. 25)

2.8 Linkages to other markets (Evagelos Giannopoulos)

As seen before, coal corresponds to a serious percentage of the power production market so it is widely recognized that its price has volatility depending on the other available fossil fuels, namely oil and natural gas. Apart from that its large contribution to the metallurgy industry has also an impact on the price trend of these commodities.

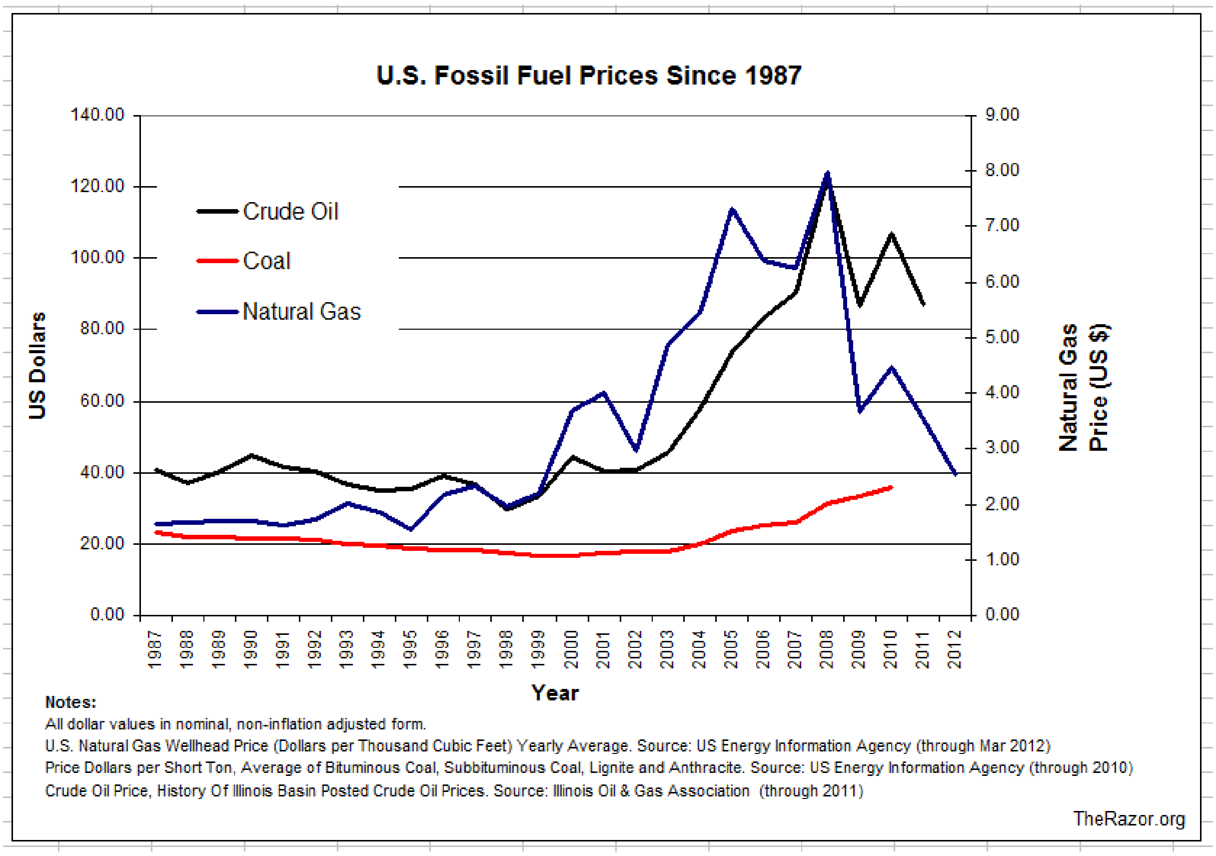

Figure 21:Relationship between fossil fuel prices

Due to the regionalist characteristic of the market and its closed way of trade we can see that coal does not follow the extreme change pattern of the other two fossil fuels.

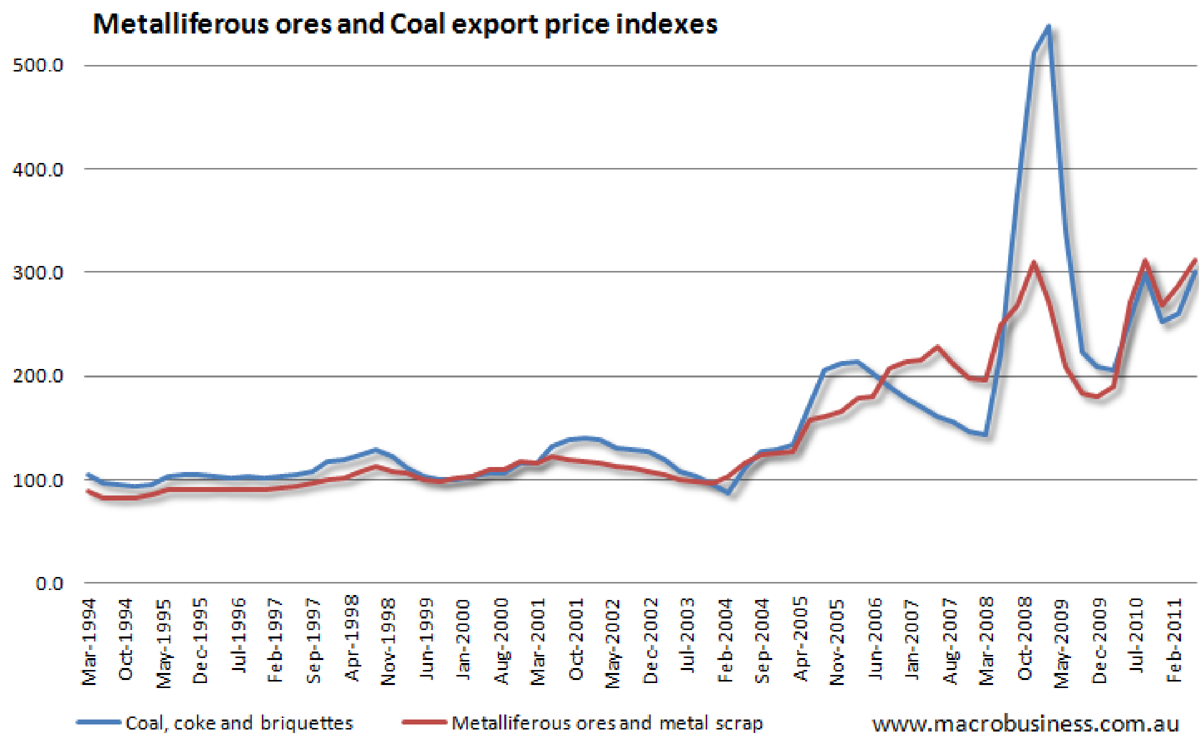

Figure 22: relationship between metal and coal prices

In the above diagram is more than obvious the relationship between coal and metal prices which follow the same pattern with the exception of the period of end 2008 – beginning 2009 when the financial crisis caused severe anomalies in the prices of many commodities.

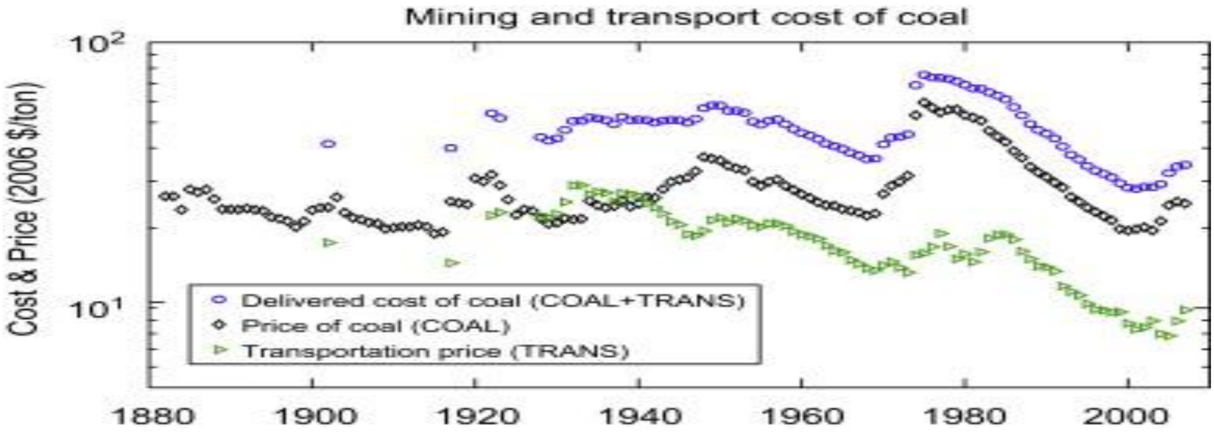

Figure 23:relationship between transportation and coal prices (James McNerneya, b, J. DoyneFarmerb, c, Jessika E. Trancik, June 2011)

In this last diagram it is clear the impact of the transportation prices upon the coal price itself. Someone has to bear in mind that coal and ore are the heaviest commodities transported around the globe. It is therefore quite reasonable why there is such a relationship.

2.9 Security of supply (Heiko Voss)

Long-term and short-term availability are major concerns when examining the supply security of an energy commodity. Additionally affordable price levels and price volatility, transport routes and limitations, number, arrangement and behavior of market players and the locations of resource deposits respective distribution and political stability are of great importance.

2.9.1 Resources and Reserves or how long does coal last?

Coal has the highest security of supply of all conventional fuels. It principally can be said that coal is cheap, revealing lower price levels than oil or natural gas at all times (Oil Section, Figure 8). It has been proved that coal reserves and resources are well distributed all over the world (Figure 24). There is of course no absolute equality between the single continents and countries. The USA possess the largest amount of reserves with 226 Gt (31% of global share), followed by China (25%), India (10%), Russia (9,4%), Australia (6%) and the Ukraine (4,4%). (DERA, 2012, p. 25). The Asian region without Russia, but including Australia has the biggest hard coal potential (7219 Gt of resources), followed closely by North America (6875 Gt). The Commonwealth of Independent States takes the third place with 3007 Gt. This seems huge compared to a production rate of 6,3Gt in 2010, but resources if subtracted by the reserves, are not (yet) economically extractable.

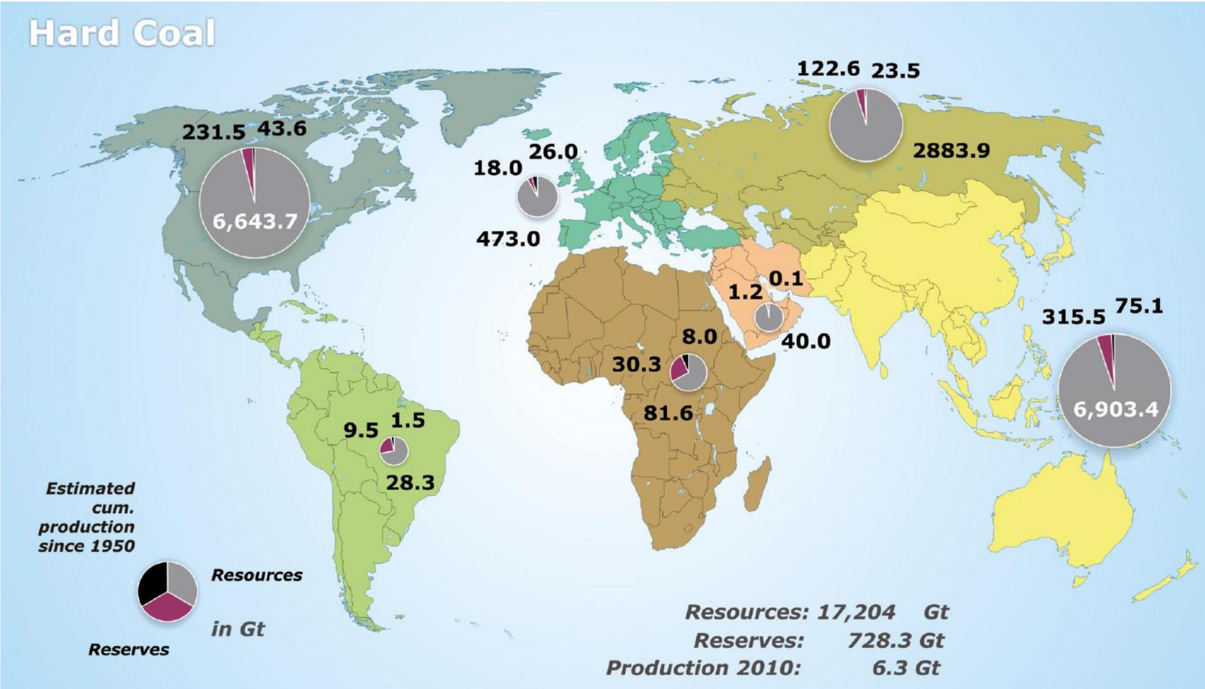

Figure 24: Regional distribution of hard coal 2010, (DERA, 2012, p. 26)

Reserves-to-production ratio

The global reserves-to-production ratio reveals that under current conditions coal will last 112 more years (BP, 2012, p. 31). Its competitors, natural gas and oil, have less years left with around 64 and 54 years respectively (BP, 2012, pp. 7,21). But attention should be paid here: analyzing the trend line how the reserves-to-production ratio developed during the last 20 years clearly exhibits that the ratio is not constant and declines faster than just the annual reduction of one year (compare BP, 2012, p.31, graph “History”).

2.9.2 No serious hazards to coal supply

For coal, compared to the other energy commodities, no cartel, no OPEC or any similar structure exists. Neither is there a major risk of instable regions supplying vast amounts of fuel, as it is the case for e.g. oil supplies from the Middle East. The coal market in general is bound to supply and demand (RWE, 2007, p. 37) Volatility can be a concern as in the case of the year 2008, where a “triple supply shock and freight shortage” (IEA CCC, 2011, p. 10) was the result of a skyrocketing demand in China, flooding in Queensland and power failures in South Africa.

Coal in electricity generation is a suitable source for base load production. It can be stocked easily and its trading routes are considered safe (WCA, 2011), as piracy hotspots like Somalia’s cost or the Bay of Bengal are not of crucial importance. A large amount of suppliers act in the market and there are still big opportunities left for exploration, thus affirming coals superior availability. Coal can actually be described as the backbone of development of many developing and threshold countries as current trends, e.g. in China and India, show (The New York Times, 2012). It is only questionable to what price for society and environment we want to use coal?

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3 The Gas Market (by Lusyana and Isabelle Stein)

3.1 Liberalization of Gas Market (Lusyana)

Nowadays natural gas, a clean energy source, has an increasingly important role in meeting global energy demand. Like crude oil, natural gas is explored, produced, transported and delivered to end user. In the past, the structure of natural gas industry was under regulation but since the mid-1980's it has evolved dramatically (NaturalGas.org). The main goal of deregulation of the natural gas industry was to liberalize natural gas production, trading and supply, the industry segments with the biggest potential to operate as competitive markets. Furthermore, another major goal was to improve the regulatory oversight of pipeline transportation and distribution, which is dominated by natural monopolies. Natural monopoly in pipeline transportation and distribution calls for economic regulation to prevent the incumbent utility from exercising its market power and promote economic efficiency.

Figure 1 describes the development stages of competitive natural gas markets in US from vertically integrated natural gas industry to unbundled industry. Vertically integrated natural gas industry had only one market and the structure was very straightforward. Natural gas and transportation services were sold as a "bundle" to the end users. In this market, government controlled almost all aspects of business and intervened gas companies in their operations and investment decisions which often led to distorted prices, inefficient operation, and deteriorating infrastructure. Regulation of natural gas industry in US led to natural gas shortages in the 1970s due to excessive regulation of gas producers (Juris, 1998).

In 1985 the introduction of open access to interstate pipeline transportation or unbundling supply from transportation had been begun and it encouraged the emergence of gas market as a new segment of the industry.

Then, the transformation of wholesale market into fully competitive market was completed in 1992 (Juris, 1998). The unbundled industry and retail competition creates two distinct markets: the transportation market where participants trade transportation services for delivering gas through the pipeline system, and the gas market where participants trade natural gas as a commodity.

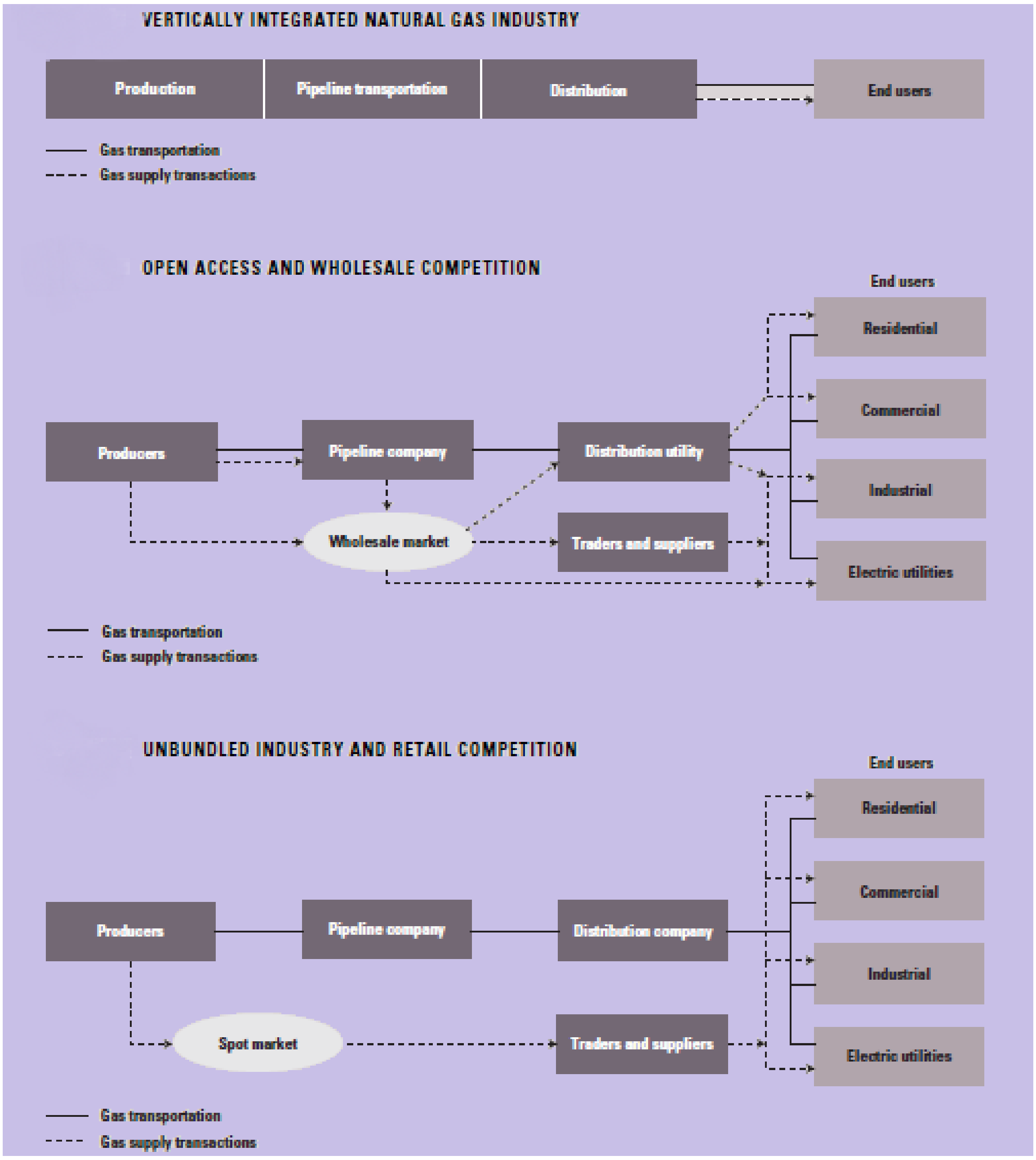

Figure 25: Markets in the natural gas industry (Juris, 1998)

Since the inception of market deregulation, other segments such as natural gas storage, metering and meter installation, pipeline construction, and system balancing emerge in natural gas industry. Moreover, natural gas transactions are mostly arranged by gas marketers, which buy and sell natural gas on behalf of producers, distribution companies, and large consumers.

The increasing complexity of transaction in gas market as well as transportation market creates the use of intermediaries and spot market. The spot market is used to concentrate trading in central location so that gas supplies and pipeline capacity are easily accessible.

Today most gas trading takes place in spot markets at major market centers and hubs on interstate pipelines (figure 2).

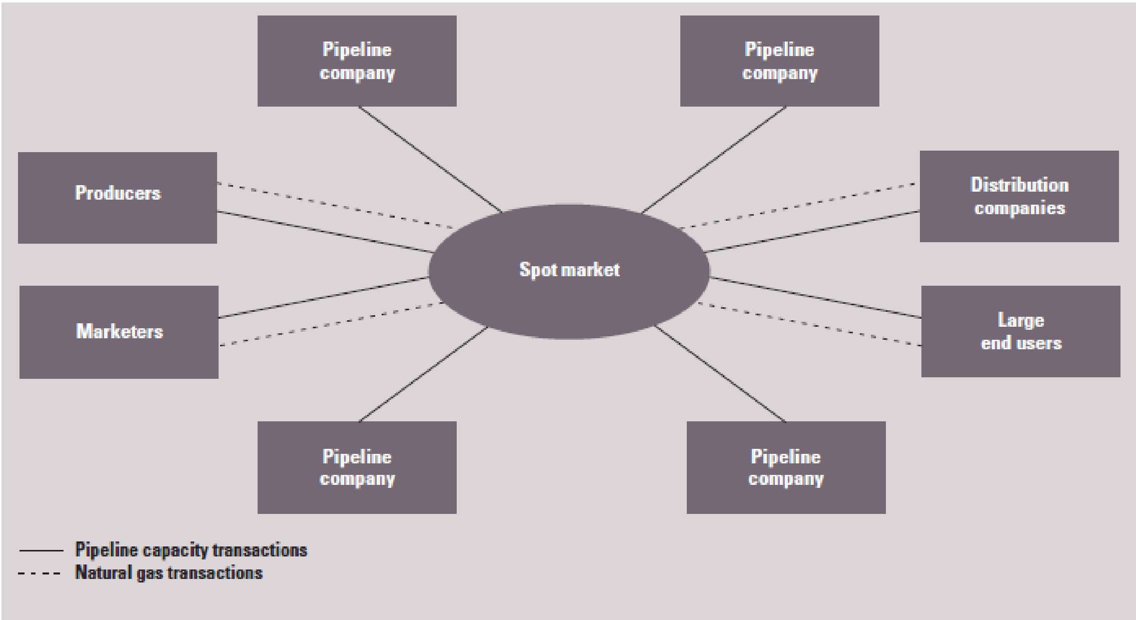

Figure 26: Trading in market centres and hubs (Juris, 1998)

Among marketers and other players in the wholesale gas market, hubs have become very popular. Typically, hubs can be jointly operated by several companies which own the interstate pipelines. By using hubs, the market players can acquire natural gas from several independent sources and ship it to several different markets. This eliminates the need to contract natural gas and pipeline capacity all the way from the wellhead to the consumption site. Instead, to reduce costs and diversify supply risks shippers can combine supply routes across several hubs.

3.2 Natural Gas Transportation (Lusyana)

Usually location of producers and consumers of natural gas do not coincide, therefore it is required an extensive and elaborate transportation system to deliver natural gas from producing regions to consumption regions. Transport of natural gas takes place either in the gaseous state via pipelines or in the liquefied state as LNG in special tankers. The selection of transportation method depends on the special requirements of the consumer country, its economic policy, basic requirements and increasingly also on environmental aspects. So far, pipeline still dominates the international gas trade to transport natural gas between countries or continents. It is estimated that LNG only accounts for approximately 22% of international trade or only 5.6% of world natural gas demand (IEA & CEDIGAZ, 2003) but the share is expected to increase as the LNG trade grows.

Transport as LNG has the advantage of greater flexibility, as it is not bound to a rigid piping system with fixed starting and end points as for pipeline transport. If no direction clauses have been contractually stipulated, LNG-tankers can operate between any loading facility and landing terminal. This also provides the possibility of establishing a larger spot market for natural gas. On the other hand, the LNG trade is tied to the oceans, which results in two large markets in the Atlantic and Pacific area. For delivering the LNG market, fields close to the coast or offshore-fields are preferable (Babies, 2012).

In determining natural gas transportation method, the calculation of most economic transportation for a given supply route is necessary. Distance and the volumes transported are the key factors. Pipelines are usually feasible and more economic for short distances. For LNG-transportation, the liquefaction of natural gas requires already considerable amounts of energy. For this reason, the specific transportation costs for short distances are significantly higher than for transportation via pipeline. Figure 3 below shows liquefying natural gas and shipping it via ocean transport becomes cheaper than transporting natural gas in offshore pipelines for distances of more than 700 miles or in onshore pipelines for distances greater than 2,200 miles (Center for Energy Economics).

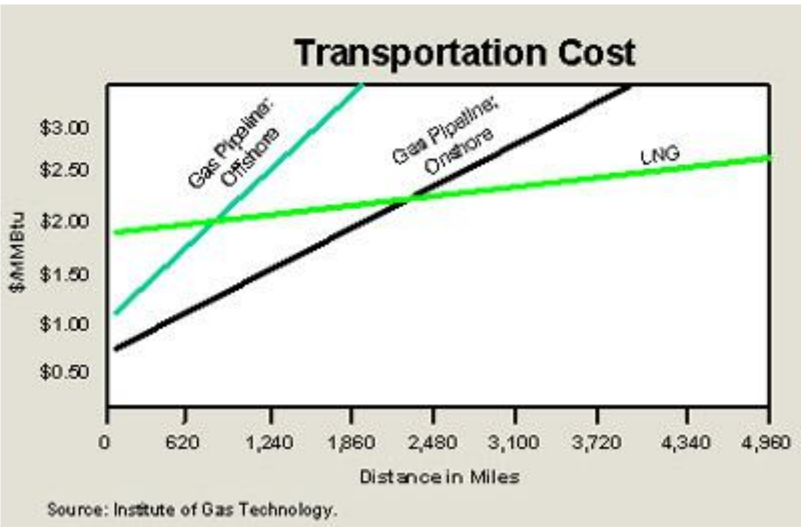

Figure 27: Transportation cost (Center for Energy Economics)

3.3 Way and Location of Trading (Lusyana)

This chapter discusses more detail about the way and location of natural gas trading.

3.3.1 Way of Trading

In natural gas market there are two primary types of natural gas trading: physical trading and financial trading. These two parts have different purposes, but the relationship is very close. Physical natural gas market is comprised of transactions which involves buying and selling the physical commodity. On the other hand, financial market involves derivatives and financial instruments in which not necessary for physical delivery. In fact, it has been estimated that the value of trading that occurs on the financial market is 10 to 12 times greater than the value of physical natural gas trading(NaturalGas.org).

The contracts traded in the financial gas market are aimed to minimize the price risk in the natural gas spot market. Financial gas contracts also serve as an instrument for speculation and price arbitrage in the gas market. Due to the heterogeneity of market player needs, financial gas contracts are highly variable. There are four common types of derivatives contracts: forwards; futures, options and swaps (Chui, p.5).

- *Forward and future* contract is an agreement to buy or sell a specified quantity of natural gas at a specified price with delivery at a specified date in the future.
- *Options contracts* have two types: call and put options. Call option gives the purchaser the right to buy a specified quantity of natural gas at a particular price. Similarly, put option gives the buyer the right to sell natural gas at a specified quantity and particular price before a certain future date.
- *Swaps* are agreements between two counterparties to exchange a series of cash payments for a stated period of time. The periodic payments can be charged on fixed or floating interest rates, depending on contract terms. The calculation of these payments is based on an agreed-upon amount, called the notional principal amount or simply the notional.

3.3.2 Location of Trading

Generally, trade is centered in three distinct regional gas markets: North America, Europe (including Russia and North Africa) and Asia with links to the Persian Gulf. Each region has a different market structure depend on the degree of market maturity, the sources of supply, and other geographical and political factors. Furthermore, natural gas prices are determined in these regional markets in different ways.

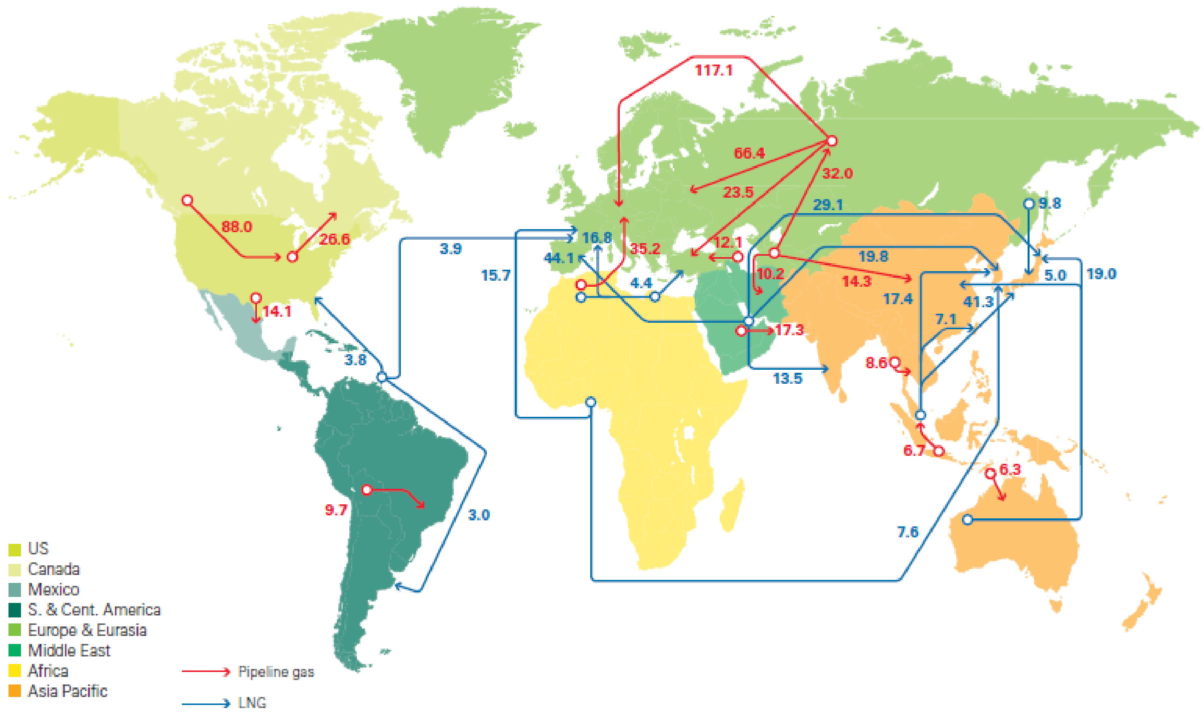

Figure 28: Global natural gas trade movements 2011 (British Petroleum, 2012)

Figure 4 shows natural gas trade flows in the world. North Africa has a pipeline option to the European Union and an LNG option to the United States. For short distances, such as linking Libya to Italy or Algeria to Spain, the pipeline option will be preferred. For longer distances, Nigeria to Europe, the two options compete. However, so far only the LNG option has been developed (IEA & CEDIGAZ, 2003, p.14).

For Middle East the pipeline option might give more advantages to supply Turkey and Europe onwards. A link is already operating between Iran and Turkey. Exports to Pakistan by pipeline may also be considered. For political reasons, currently LNG is the obvious export route for Middle East gas to India. In addition, with lower costs for LNG, the Middle East is well-placed to supply LNG to OECD Europe, OECD Pacific, and even OECD North America. Qatar is a frontrunner on this in expanding its LNG plants. Iran is also planning to export LNG.

In Asia/Pacific, due to geographic considerations, LNG dominates. The pipeline option should emerge in the medium term. Certainly, new links between neighbouring countries could in the long run enable the development of an integrated gas grid in the region. In the Indian Sub Continent, although pipe option should be certainly the more economic, political considerations so far have impeded this development and favoured the LNG option (IEA & CEDIGAZ, 2003, p.14).

3.4 Technical Restrictions (Lusyana)

The natural gas market is largely affected by factors related to the supply or demand. This chapter focus on these factors such as storage of natural gas, geographic and political, high seasonal demand, hurricanes, etc.

1. Storage of natural gas

   Natural gas, like many other commodities, can be stored for later consumption for an indefinite period of time in natural gas storage facilities. Natural gas storage facilities constitute an important part of a safe and flexible natural gas supply. Not only for guarantee the consistent availability of natural gas, e.g. in case of supply interruptions, but it also for buffering daily and seasonal supply and demand fluctuations on the natural gas markets.

2. Geographic and political factors

   The geography is related to the Right of Way (ROW) of pipelines. A pipeline right-of-way is a strip of land over and around natural gas pipelines where some of the property owner's legal rights have been granted to a pipeline operator. Since pipelines may transit many countries or region, it might generate dispute. Moreover, the number of parties involved in a multi-national pipeline project can slow project development considerably and political instability in host or transit nations raises security of supply issues. Also, cross-border pipelines must invariably comply with multiple and dissimilar legal and regulatory regimes, further complicating pipeline construction and operations (MIT, p.147).

3. Hurricanes

   The Gulf Coast accounts for 40 percent of the U.S. natural gas production. After the hurricanes in 2005, natural gas flows from the Gulf were basically cut in half (About.com). For safety reasons, many of the platforms and pipelines have to be shutdown if a hurricane is in the neighbourhood. This, of course, takes supplies off the market and causes prices to jump.

4. High seasonal demand

   The demand for natural gas is varies over time and high seasonal demand. In the short-term, weather is the greatest influence on natural gas demand. Since natural gas is the predominant fuel for space heating, colder weather can significantly increase residential and commercial sector natural gas consumption.

3.5 Major Players (Isabelle Stein)

To determine the major players in the gas market there are different features of companies, which need to be considered. One feature is the company's position in the gas chain. Companies can be mainly in the Upstream- or Downstream Business or they can be vertically integrated. Also the company's technological development differs. Some companies are technological highly developed while other companies have their focus in other branches. Another feature is the international presence. Some companies are real global players, while others do mainly act in one country or one continent. The companies can also have different degrees of diversification. Ownership is the last feature, which will be mentioned. Gas companies can be public or private owned. By considering these features, the global players can be subdivided into three clusters (Gilardoni, p.139 et seqq.):

- The "Big Sisters"
- Major utilities
- State owned companies

Those clusters will be described in detail in the following sub-chapters.

3.5.1 The "Big Sisters"

The "Big Sisters" are companies that are fully integrated in the marked. They are integrated in all stages of the industry: Exploration, production, trading, marketing and sometimes transportation. Usually there are well known by the consumer through their gasoline stations. They are experts in the E&P (exploration and production) sector (upstream business) and sell their products word wide (petrostrategies.org). Those companies are usually oil and gas companies (Gilardoni, p. 139). Historically they have been oil companies. When natural gas was explored in the 1960's they had the know-how and the technology to enter the gas market as well. Those companies are very large companies, which have a very high turnover, usually more than $100 billion. They are listed at the stock exchange market and globally operating.

Although those companies are vertically integrated, they have usually their focus in E&P and in the wholesale phase and just have a strategic minority stake in transportation grids (Gilardoni, p.140). In the LNG business most of those companies are mainly present in the liquefaction and shipping, they are rarely present in regasification (Gilardoni, p.140).

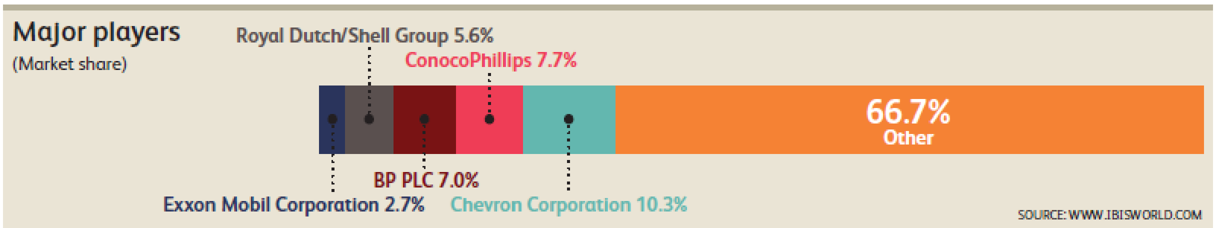

Figure 29: Major Players in the Gas Market

Companies that belong to that cluster are: Exxon Mobile Corporation, Royal Dutch Shell Group, BP PLC, Conoco Philipps, Total and Chevron Corporation. Those companies are world-wide well known and one of world's biggest companies (forbes.com).

3.5.2 Major utilities

The major utilities are also important players in the gas business. Those are mainly in the downstream phase (Gilardoni, p.8). Through the tough competition in the gas market, those companies are more and more moving upstream to strengthen their position in the midstream and upstream phase. Goal is a vertical integration (Gilardoni, p.154). One example is RWE's small share in the Snohvit LNG project in Northern Norway (rwe.com).

The main job of utilities is to supply gas to end customers. Historically they have long term contracts (LTC) for gas purchase (Gilardoni, p.8).

Major players in Europe are e.g. ENI, Suez-Gas de France group, E.ON and RWE. Their future strategy is to secure the access to the gas sources by building pipelines or LNG infrastructures, additionally they want to increase their E & P activities and develop co-operation with the companies that control gas fields. Another goal is horizontal expansion in the downstream phase (Gilardoni, p.154).

3.5.3 State-owned companies

As the name already tells, those companies are owned by the state. Usually those states own and control gas reserves (Gilardoni, p.8). In those cases there is a huge interlink of national politics and corporate strategies. Most of the companies have their focus on the production phase; others are also strongly present in the midstream phase like transportation. Just few companies are in the downstream business (Gilardoni, p.8). Although those companies are very powerful, since they own the resource, they are dependent on other companies. Major players are: Gazprom, Sonatrach, Qatar Petroleum and Nigerian NNPC. Those companies are not homogenously integrated in the market: Some companies are just focused on the gas supply like Qatar Petroleum and Nigerian NNPC. Other companies prefer technological independence and want to enter the profitable downstream market like Gazprom and Sonatrach (Gilardoni, p.162 et seqq.).

3.6 Barriers to entry (Isabelle Stein)

The gas market is very capital intensive. Especially companies in the upstream-business need much capital to explore the gas, for the production and also for technological know-how. Additionally the risk of gas exploration is very high. A lot of research has to be done until gas can be explored. Another problem is that there is no guarantee in an exploration that it is successful. Furthermore, you need either the control of the reserve or access to the gas reserve or access to the gas in a later phase to be a player in the market, which is not that easy as well. Another problem is that there are often long term supplier agreements e.g. German utilities have often long term contracts with e.g. Gazprom. Gazprom wants long term agreements to secure their pipeline investments. The utilities want security of supply (referenceforbusiness.com). Therefore it is difficult to break the chain of these dependencies.

Additionally the competition in the gas market is very high. This leads more and more to a vertical integration of companies (Gilardoni, p. 154) which makes it even more difficult for a company to enter the market.

To sum it up, in the gas market there are:

- ✓ Control of resources
- ✓ High capital intensity
- ✓ Supplier agreements
- ✓ High risk of gas exploration
- ✓ High competition
- ✓ Vertical integration is common

All in all the market barriers in the gas sector are very high (referenceforbusiness.com).

3.7 Linkages to other markets (Isabelle Stein)

3.7.1 Linkage to the gas market

There is a huge linkage between the oil and gas market. In both markets are often the same players. Many companies are both gas and oil companies. There are similarities in exploitation, e.g. offshore platforms, consumption side, costs of E&P and application (Gilardoni, p.1).

It is possible to foresee the gas sector with the oil sector. This is due to a historical linkage between oil and gas. In the gas sector were always big infrastructure investments because a transportation grid system was needed. To secure those investments but also the supply for the customer, LTCs were made. In those long term agreements the natural gas price had to be defined: The gas industry, as it is today, has started in the 1960's through on- and off-shore gas exploitation in the Netherlands and on the UK. At that time gas had to find its position in the market. Therefore the question came up how to price gas (oilandgasuk.co/uk). As solution a market value analysis was used (MVA). In the MVA gas is valued to other fuels. This was done by considering the capital costs, operating costs, tax, environmental costs and transmission charges. They found out that gas, might substitute oil most likely because of its similar application (oilandgasuk.co/uk). Therefore is oil in most of the cases the best alternative fuel (BAF) for gas but also a combination of different BAFs can be applied. This is the reason why gas was priced to oil. This made it for consumers indifferent to choose between oil and gas (oilandgasuk.co/uk). This BAF indexation was and is usually used for LTCs between gas producer and gas buyer.

Although there are many similarities between oil and gas, there are also many differences: The industrial applications of oil and gas differ. Oil is mainly used as a fuel in the mobility sector, rarer in heating or electricity production (depending on the country). Gas is more likely used for heating and electricity production than as a fuel in the mobility sector, but which is also possible through gas into liquids (GTL) (oilandgasuk.co.uk). But up to know gasoline is more common in the mobility sector than natural gas.

Also the environmental impacts of oil and gas differ. Natural gas produces less CO2-emissions than oil. The transportation requirements are neither the same. Gas is transported in pipelines or has to be liquefied to be shipped while oil can be shipped without any processes.

In addition the reserves are divergent. Oil is much scarcer than natural gas. Therefore, the oil price will most likely increase massively in the future and the price increase might no longer be justified for the gas market (Gilardoni, p.131). In addition, the LNG market develops fast. There are more LNG hubs in Europe and the spot prices have been in the last years much lower than the German Border Price (GDP) (IEA, p.23). Those disparities lead to the question, how long the long term contracts (LTC) with oil link will last.

Producing and exporting countries do of course not like the idea of breaking the oil gas linkage (Gilardoni, p.131). The oil-gas linkage guarantees those countries the security of their investments in infrastructure. Since those companies like Gazprom and Sonatrach own the gas pipelines and have the control, they have the bargaining power. The question is, how long this will last under the fact, that natural gas will more and more be transported via LNG than pipelines. Several years ago, it seemed quiet unrealistic that the oil- gas linkage will break within the next decades. The last years have shown that investments in unconventional gas, especially in the USA, and the expansion of the LNG business have lowered the natural gas price (IEA, p. 15). In liberalized markets (UK, US) the gas price fell from USD 13-14 per MBtu in mid-2008 to 4 USD per MBtu in April 2009. Prices in markets linked to oil were slower to fall from their peaks (EIA, p.22). In spring 2009, spot prices were half oil-linked contract prices (EIA, p.22).

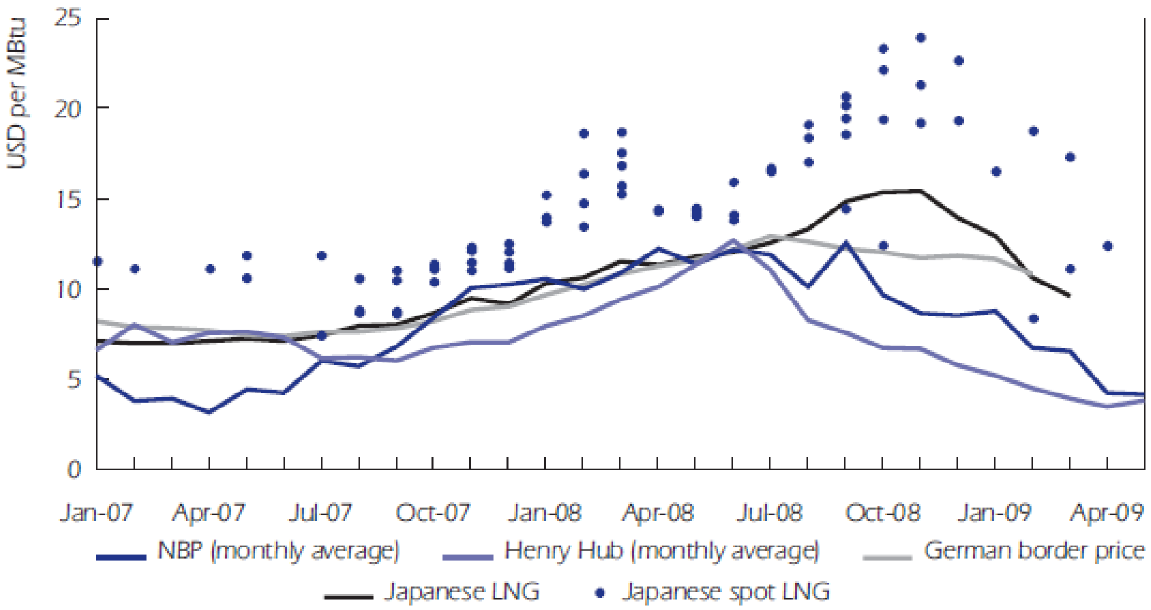

Figure 30: International Gas Prices 2007-2009, IEA

This graph illustrates the different gas prices. It becomes clear, that since summer 2008 prices in the liberalized markets (NBP and Henry Hub) are much lower than in countries which have oil-linked LTC (GBP and Japan).

If spot prices are high, companies most likely tend to use the flexibility of their contract and buy more spot gas (and less oil-price-contract gas) (IEA, p 25). In future, they might also prefer having the gas price linked to the gas-market rather than having it linked to the oil-prices. One criticism of linking the gas to hub prices is that prices might be more volatile than an oil-gas-link (oilandgasuk.co.uk). This volatility is most likely reasoned by the lack of liquidity at most hubs, which concern seller and buyer. Their fear is that prices can be manipulated because of the poor liquidity.

Time will show how long the oil-gas linkage and LTC will last. Already now, utilities are demanding that LTCs are priced to spot levels (Stern, p.33).

3.7.2 Linkage to the coal market

Gas and coal are both important fuels for electricity production. Therefore those two fuels do also compete in the market, if a new power plant is planned. In addition, the coal price can also be used to price gas in LTC (in combination with oil).

Additionally, changes in the gas market can influence the coal market e.g. US's exploration in shale gas. Countries that planned to import to the US have to find other buyers and prices went down. Before the shale gas exploration the US had to import gas. Now, the gas reserves are sufficient to cover the needs and to substitute coal, because shale gas is even cheaper than coal. Therefore the US exports the coal instead (Higgen, 2012).

Time will show how long the oil-gas linkage and LTC will last. Already now, new LTC are for a shorter period than they had been before.

3.8 Security of Supply (Isabelle Stein)

To estimate the security of supply of natural gas it has to be considered that natural gas is a fossil and scarce resource. First of all it needs to be regarded how long those scarce resources, especially the reserves will last.

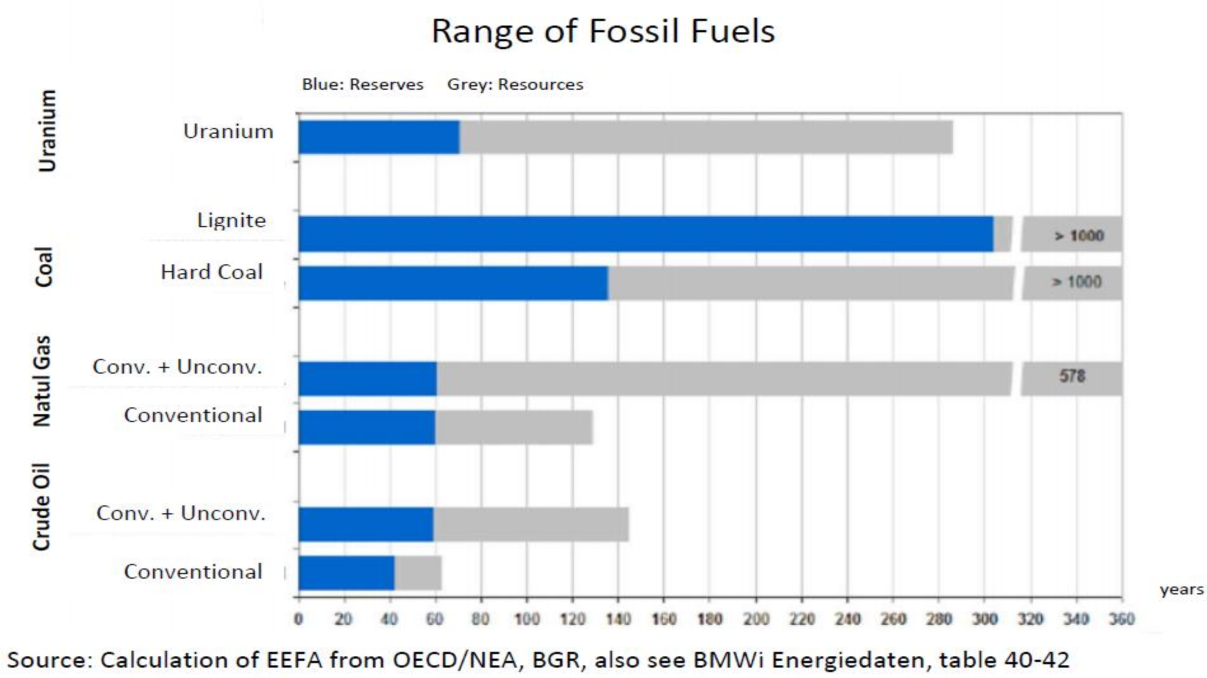

Figure 31: Range of Fossil Fuels

The calculation is sourced on 2007. Since then the US has massivly started the exploration of unconventional gas by fracking. This figure was made before then, therefore it needs to be assumed that the reserves of conventional and unconventional gas are now bigger than they were estimated in this figure. If the current consumption stays the same it is assumed that the reserves will last for another 75 years (worldenergyoutlook.org). The problem is that the worldwide consumption will most likely further increase (worldenergyoutlook.org).

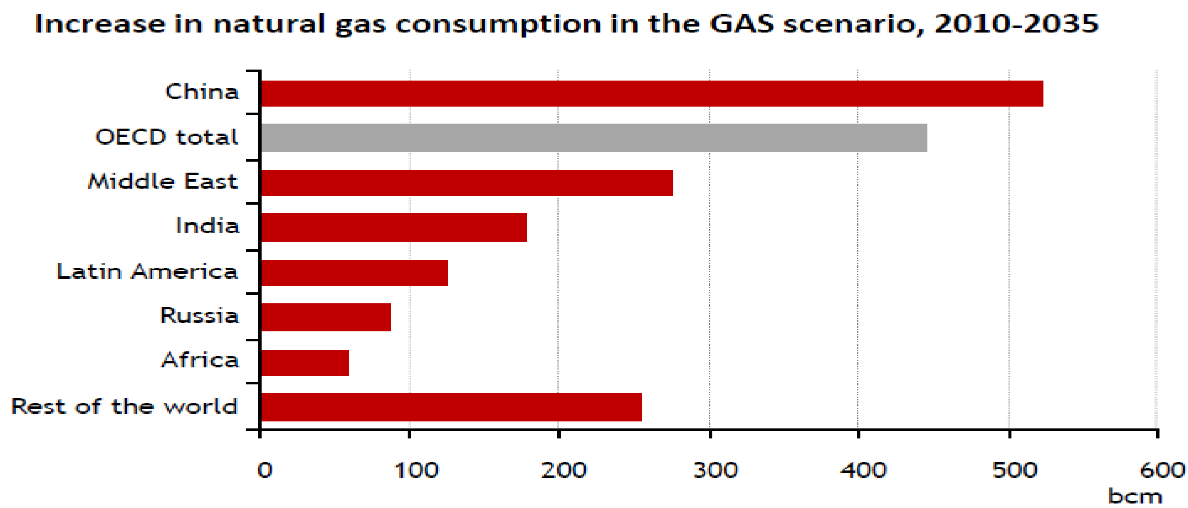

Figure 32: Increase in natural gas consumption, worldenergyoutlook

As the figure shows the increase in gas consumption is mostly due to the massive growth of China, India and the Middle East. In addition the gas consumption has increased the last 30 years, while coal and oil consumption has decreased (Gilardoni, p. 40). The main reason is that natural gas is often used to substitute oil in electricity generation. Additionally natural gas is generally more often used in electricity production because of its low CO2-emissions compared to other fossil fuels like coal or oil (Gilardoni, p. 40). As soon the CO2-certificates get more expensive, more likely power plants will run with gas instead of oil and coal. The scarcity of the resource in combination with the increasing demand will be one future challenge for the security of supply.

Another problem for the security of supply is that a save infrastructure for gas supply is needed.

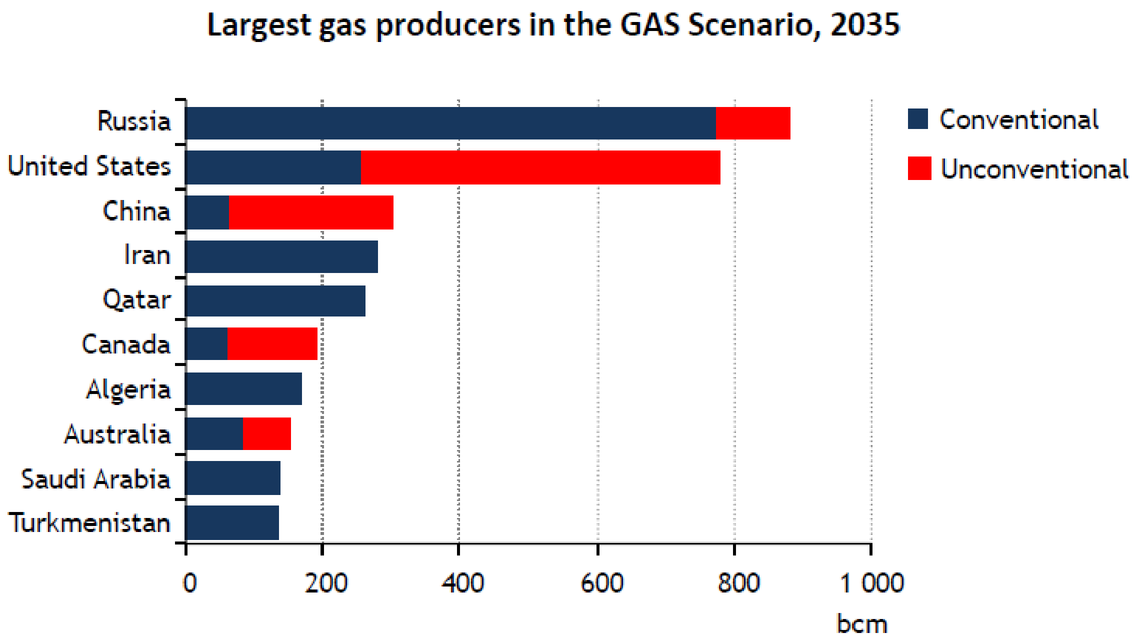

Figure 33: Largest gas producers, worldenergyoutlook

The grafic shows that the Russian Federation, the US, China, Iran, Saudi Arabia and Qatar control a large share of world's gas reserves. Many of those countries manage their reserves on their own through state owned companies (Gazprom, Qatar Petroleum). Especially if a country is mainly supplied by one country via pipeline the dependence on this country is massive. Therefore international policies are important for the security of supply. To give an example from Europe: 30 % of EU's consumption is imported from Russia via pipelines. Another 10 % are imported from Algeria, also via pipelines. Since there are more pipelines built and planned (North Stream, South Stream), Russia’s share in the European gas market might increase and so the dependencies on Russian gas (Gilardoni, p. 4 et seqq.).

In addition, the graphic shows that Russia has by far the most reserves; most of them are conventional gas. Especially China and the US have mostly unconventional gas. One problem of using unconventional gas (often by fracking) are huge environmental impacts (tagesspiegel.de). One problem for Europe is that there are just a few countries with a lot of reserves and most of them are located outside Europe. The LNG business has to expand to have a more flexible gas infrastructure (Gilardoni, p. 5).

One of the biggest problems of security of supply are tensions in or in-between states. The last years have shown that, that there were conflicts which insecure the gas supplies. The Iraq war, Iran developing a nuclear industry, no internal stability in Nigeria, tensions in the Middle East (Gilardoni, p. 131) or the Russia-Ukraine gas disputes are examples (IEA, p.35). The dependencies on those fragile states might be one the future challenges for policies but also in the security of supply.

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4 The Electricity Market – Overview (by Lasse Girolstein and Lars Bargiel)

4.1 History of the electric market (L. G.)

Fifteen years ago it was unthinkable to change the electricity supplier in most of Europe. The power supply even in liberal economies was a core responsibility of the state and accordingly much of the production of electricity and energy networks were in the state hands. But even faster, was the start at the behest of the European Union, from the mid-1990s with the liberalization of the national electricity grids.

In particular, the European Union decided to:

- distinguish clearly between competitive parts of the industry (e.g. supply to customers) and non-competitive parts (e.g. operation of the networks)
- oblige the operators of the non-competitive parts of the industry (e.g. the networks and other infrastructure) to allow third parties to have access to the infrastructure
- free up the supply side of the market (e.g. remove barriers preventing alternative suppliers from importing or producing energy)
- remove gradually any restrictions on customers from changing their supplier
- introduce independent regulators to monitor the sector.

(ec.europa)

The starting point of this development was a EU directive of December 1996, which is still influential in the energy market in Germany and in other EU countries.

But on the one hand out of respect for the companies in the power supply, which could operate until then as a monopoly provider, on the other hand because of structural differences in the power supply in the different States, the directive started February 1999 step by step and the latest date for full implementation was the July 2007. Unlike other EU countries, but hand in hand with Great Britain and the Scandinavian countries, Germany was not using the possibility of the transition time until the full opening of the electricity market. For example, in Germany the electricity and the gas market have been open since the late 1990s to 100 percent. (Bacher)

With the implementation of the EU directive on the liberalization of electricity markets in 1998, the established regional monopolies in Germany ended after more than six decades. Any electricity consumer can ever since, regardless of the location, choose their electricity supplier and power generation freely, transmission and distribution have been legally separated. But never the less, ten years after the opening of the market competition protectors, Monopolies Commission, the EU Competition Commission, the Agency and the Federal Cartel Office still notice an firmly oligopoly on the German electricity market.

The four largest electricity supplier (RWE, E.ON, Vattenfall, EnBW) as shown in Figure34have their high stakes in the electricity generation capacity and through links with other market players, having a very large influence on the markets. The "Big Four" were and still are dominated through subsidiaries in the German electricity distribution networks, two of them even in transmission networks. (AEE)

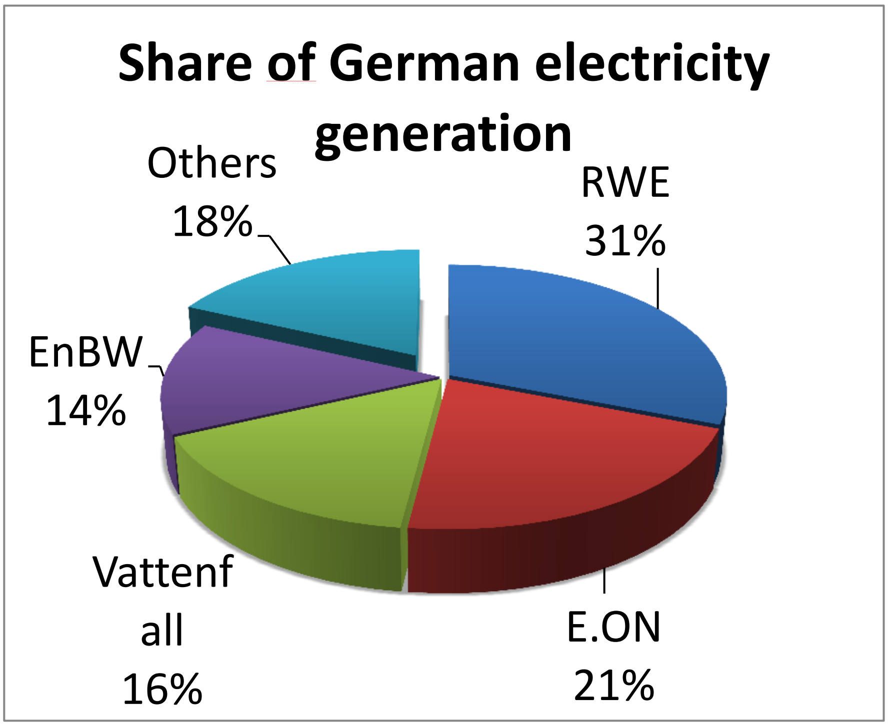


Figure34: The four largest electricity supplier (RWE, E.ON, Vattenfall, EnBW) [(AEE)]

- E.ON had to give away 5,000 megawatts (MW) of its own generating capacity cause of a process of the EU Commission in 2009 about a inflationary withholding.
- Vattenfall and E.ON have sold their transmission networks in early 2010 to independent operators.

Although these are the first steps towards a more efficient competition. Even though the competition is still very limited, through the continued high level of market concentration in the electricity generation capacity and the economic interdependence among distribution networks with partial absence of regulation.

There for Germany is still far away from a smooth functioning of the interplay between supply and demand. The barriers to entry for new market entrants are high, so that the lack of competition ultimately promotes higher electricity prices.

[(AEE)]

4.2 Costs of the electric market (L.G.)

Every electricity consumer pays over his electricity bill, the production, transport and distribution of the amount of electricity consumed by him as well as various taxes and fees. The cost of electricity depends on several factors. These include different fuel and capital costs of the electricity generating plants and the relation between supply and demand on the electricity exchanges. The consumer electricity prices also include taxes and fees and the cost of power distribution.

Not shown in the price of electricity and pointed out in figure … are the external costs of electricity. These are the costs of climate, environment, health and material damages caused by the particular type of power generation. Also including subsidies and research funds for the respective power generation are not factored in the current price, but provide additional social costs. (Fraunhofer)

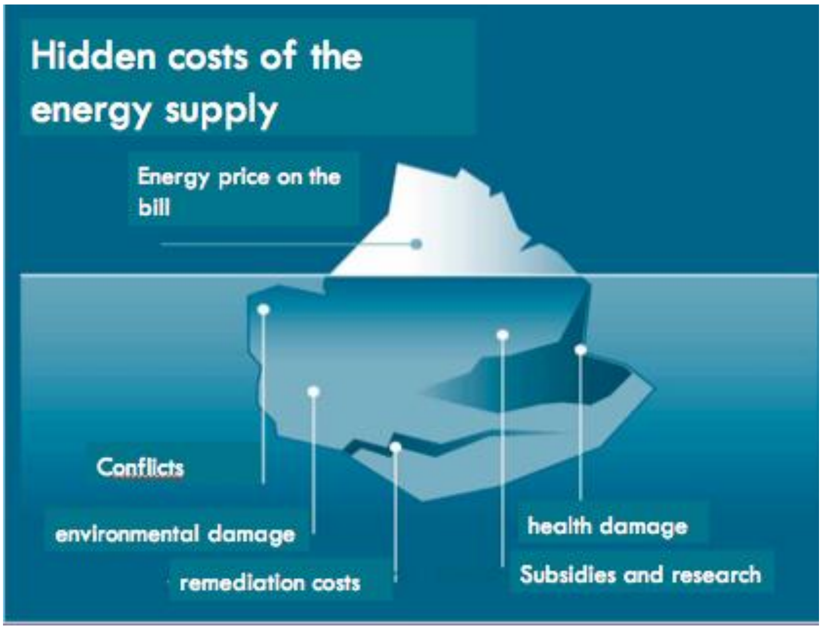


Figure35 Hidden costs of the energy supply (AEE)

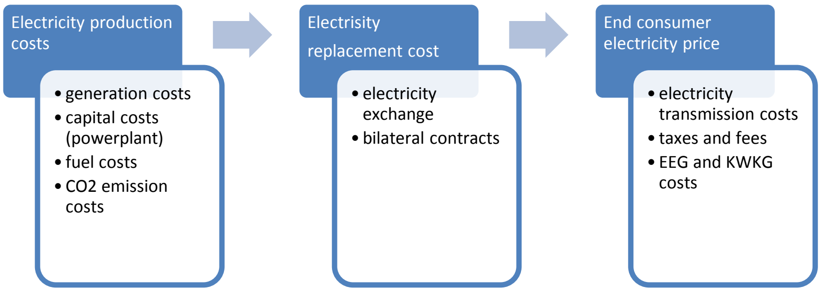


Figure36: Electricity composition

The figure(1) shows the formation of the electricity costs from the electricity production costs till the Consumer electricity prices.

The electricity procurement costs exist dry from the electricity generation costs as capital costs for the power plant, fuel costs, any costs of CO2 emission rights, and operating and maintenance costs.

The current replacement **cost** will depend on the price on the electricity exchange or in the bilateral contracts agreed between producers and purchaser.

The **end consumer price of electricity** is significantly higher than the current market price, since they include other components such as the cost of electricity transmission, taxes and fees as well as costs from the Erneuerbare-Energien-Gesetz (EEG) and Kraft-Wärme-Kopplungsgesetz (KWKG). [Energie in Deutschland; KostenPreise in Deutschland]. To be distinguished are still the tariff customers and wholesale customers with lower prices cause of reduction in taxes and license fees as well as reduced rates of (EEG) and (KWKG) [(Fraunhofer) (BWT)

The pure power production costs (also: power generation costs) for a kilowatt hour of electricity will is greatly depending on the energy source, type and age of the electricity plant. Particularly favorable for example, is a kilowatt hour of electricity produced in an existing and depreciated nuclear power plant. More or less around 1.5 to 2.5 cents per kilowatt. Also cause a nuclear power plant saves costs at the emission rights, although greenhouse gases are released during the energy-intensive production of nuclear fuel from uranium, but it does not emit CO2 in electricity generation itself. (Fraunhofer)

Power plants that burn fossil fuels in the electricity production and thereby emit greenhouse gases must pay for the produced CO2 after the European emissions trading rights.

The Figure37 and Figure38show the electricity production cost of new power plants which started or starts operation in 2010/2020.

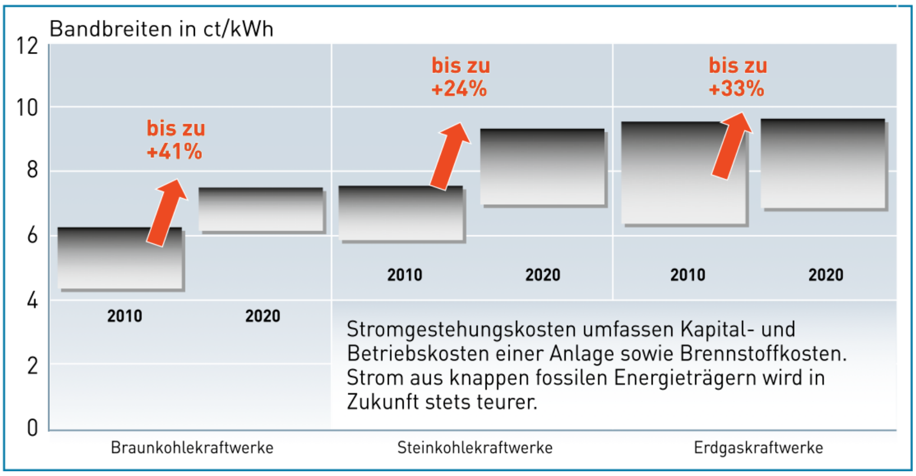


Figure37: Electricity production (AEE)

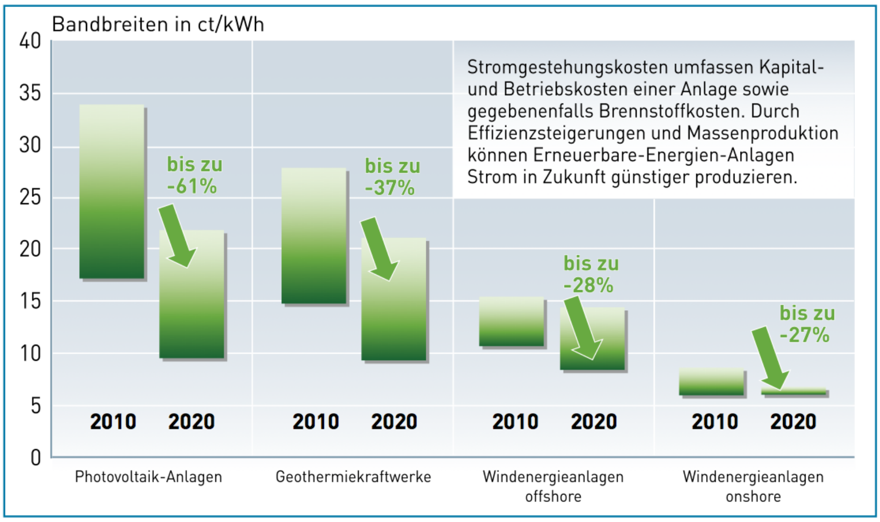


Figure38: Electricity production costs of renewables (AEE)

While the capital and operating costs for new power plants that use fossil fuels, remain at a relatively low levels, the rising fuel costs and the rising cost of emission rights a getting a increasing proportion of their electricity costs. Assuming a continuously steady upward trend in fossil fuel costs and a steady price of CO2 emission rights the increasing costs of electricity could go up to 41 percent till 2020.

At the same time a significant reduction of production costs of renewable energy systems is expected. Improved production techniques and innovations in the systems enable higher efficiencies there for higher electricity income from the investments at the same or lower costs.(Fraunhofer)(BWT)

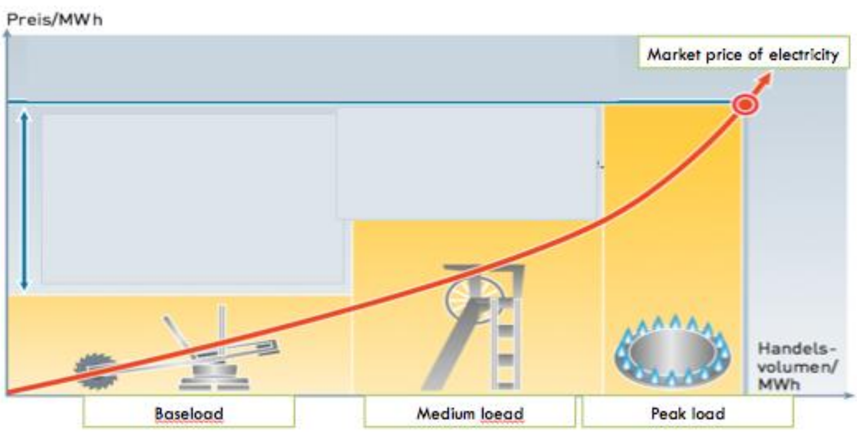


Figure39: Market price of electricity (AEE)

The basic principle in the formation of the electricity exchange price: The electricity market price is derived from the set order of power plants, the so-called merit order. The demand will initially operate with the cheapest power plants, then come the next more expensive power plants and so on. As higher the demand as more expensive medium and peak load electricity (for example from coal and natural gas power plants) will be required. The most expensive electricity from the different power plant, which comes to use in order to fill the last bit of the demand, the so-called marginal plant (in this case natural gas turbine) determines the market price which than will be the same price for all electricity power plants. Depending on the marginal power plant, the operator of the cheaper power plants, are getting than high profits. This effects mainly the plans which produce at very low electricity costs as nuclear and Brown coal power plants.(AEE)

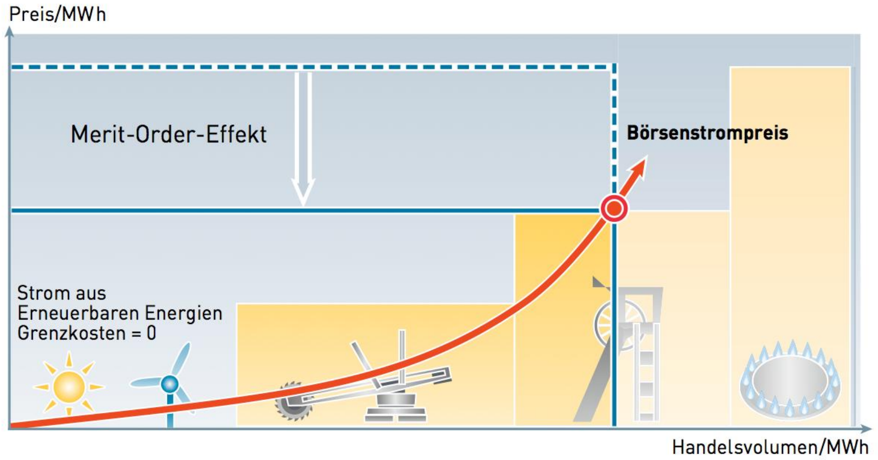


Figure40: Merit-Order-Effekt (AEE)

If electricity from renewable energy plants is fed in the grid it increases the supply of electricity and reduces at that time the demand for expensive average and peak load electricity from coal or natural gas power plants. Therefor the expansive peak load electricity's are less needed which reduces the respective electricity market price.

This so-called merit order effect reduced the electricity replacement cost in Germany 2009 of 0.6 cents per kilowatt hour or in total of around 3.1 billion euros true renewable Energies. This means that the energy-intensive industries which buy at the exchange market are even more relieved than they are being levied through the EEG surcharge.(AEE)

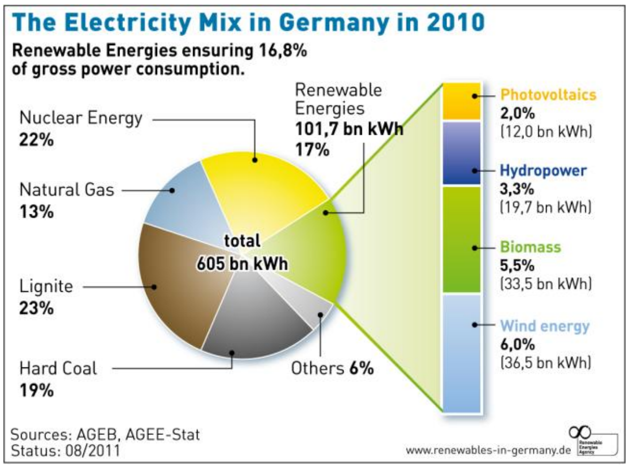


Figure41: The Electricity Mix in Germany in 2010 (AGEB)

In 2010, fossil resources and nuclear energy provides the largest share of Germany's electricity. 42.7 percent of the electricity is derived from either brown coal or hard coal. Nuclear energy is used for the generation of 22.7 percent of the electricity. Further 13.0 percent of the electricity are supplies through natural gas and 1.9 percent are from petroleum products. Therefore a total 80.3 percent of German electricity mix is derived from fossil fuels or nuclear energy in 2010.

The role of renewable energy in the electricity mix is clear: The market share is increasing constantly. 2010 already 17 percent of German electricity comes from the renewable obtained. 15 years ago, their share was just to 4.4 percent. (AGEB)

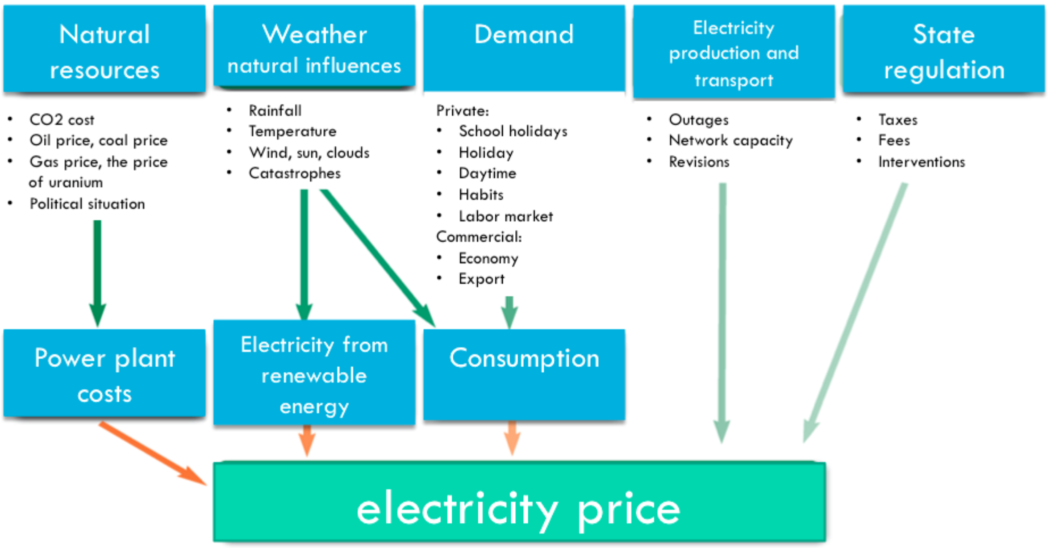


Figure42: Electricity price dependencies

Influencing factors of the electricity price are shown in figure …

These figure highlights again though how many factors the price will be influenced and why therefor the price is as hard to be forecasted. The influencing factors of the electricity price are:

1. Natural resources and therefor the Power plant costs
2. Weather (natural influences) on the one hand with electricity from renewable energies and on the other hand with the consumption
3. Demand over the consumption
4. Electricity production and transport
5. State regulations

(BWT)

4.3 How the electricity market works?(L.B.)

Trading electricity is defined as the activity of a company to buy or sell electricity on the wholesale market. Indistinguishable from trading electricity are the sales activities in the retail market, where products for consumers, mostly as full supply contract with power usage and schedule management, are deducted. Basically, it is differentiated between the "Over The Counter" Market, the direct trading between two parties and the indirect power trading at the "Stock Exchange"(ECORYS, 2008).

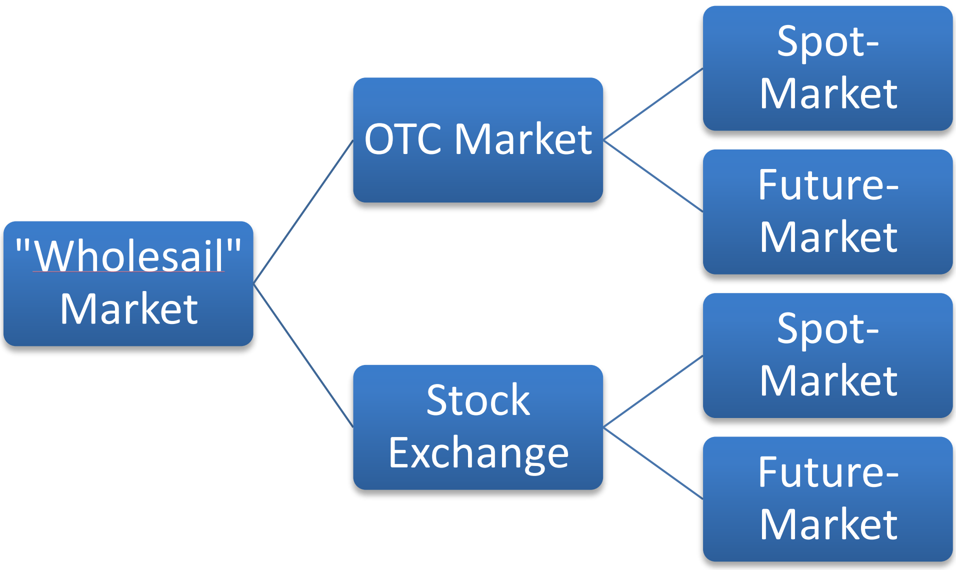


Figure 43: Overview of Wholesale Power Markets (Ecorys)

In general there are three main parties on the electricity marked which are shown in the picture below. On the one hand, there is the production side, there are the power plants like coal- or gas fired power plants. Of course the amount of renewable energy power plants is also a strongly growing part of the power generation. On the other hand there are the consumers. Big production plants, trade and commerce and the households are part of the power consumption. In between there is the transmission and distribution grid which defines the third part. This part connects supply and demand on the electricity market(epexspot.com, 2012).

In addition to the main parts of the electricity market there is the financial aid. The financial flow covers the whole market, from the generation of power, along the grids to the consumer. This financial part inbetween is called the wholesale power market. This marked contains two different markets: First the “Over the Counter”-Market (short OTC-Market) and second the “Stock Exchange”, in Central Europe called the European Power Exchange (short EPEX-Market). Many companies, energy supplier, big consumers with their brokers operates on these two markets and to trade power and negotiate power contracts. These two markets will be specified in the following chapters (epexspot.com, 2012).

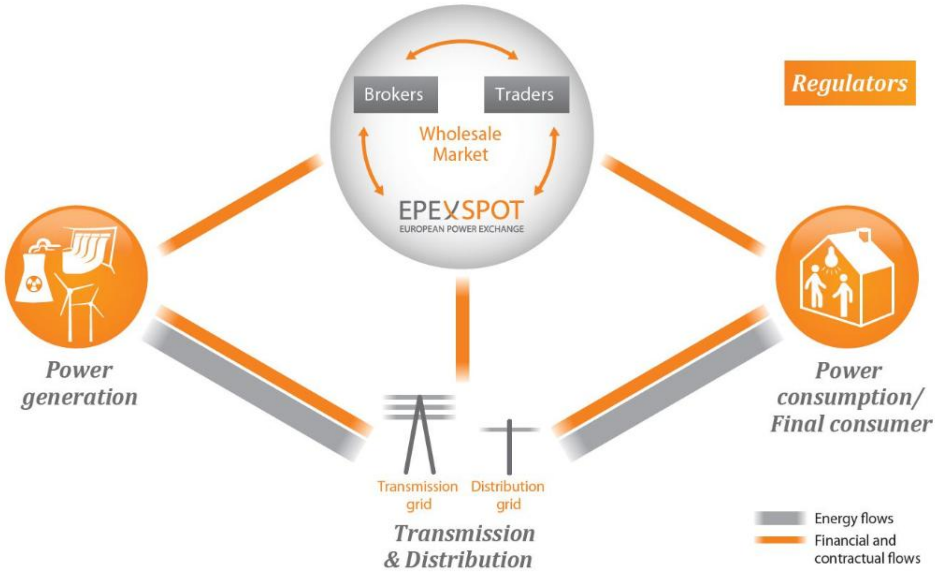


Figure 44: EPEX SPOT in the Power Market (EEX)

4.3.1 The OTC Market

The "Over The Counter" trading means financial transactions between market participants which are not transacted on the stock exchange. The OTC-Contracts are direct contacts between energy suppliers and consumers, for example a contract between the "Stadtwerke Flensburg" and the "FlensburgerBrauerei". Regularly these contracts are long term contracts which are below the market prices. The OTC deals are not published, so the market size can only be assumed, but until now the OTC-trading amount makes up the part on the electricity marked(wiwi.uni-muenster.de, 2008)(ECORYS, 2008).

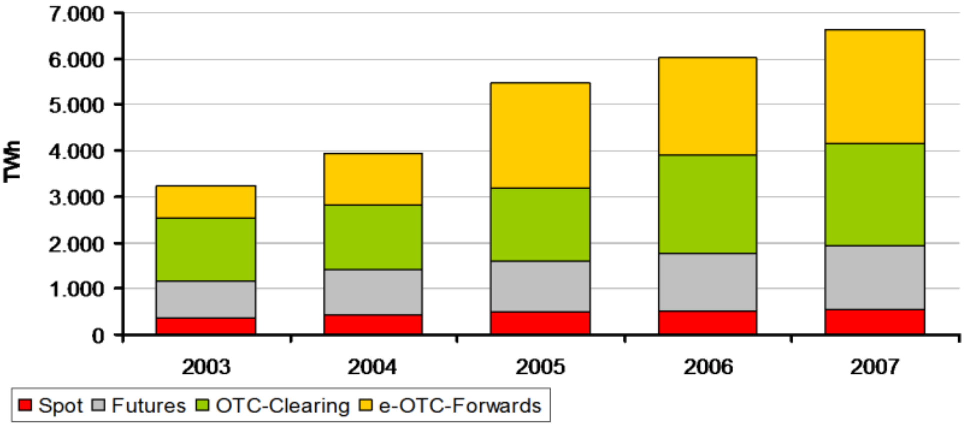


Figure 45: Trading Volume of Power in Europe (UniMünster)

4.3.2 European Power Exchange

While the OTC-Market is moreover the market for long-term security of power generation and consumption, the spot market is used to optimize the production of supply and demand for the next day.

First of all The "European Power Exchange" (EPEX SPOT SE) is a market for short-term wholesale electricity in Germany, France, Austria and Switzerland. The EPEX was founded in 2008. It connected the two power spot markets Powernext and European Energy Exchange. The EPEX SPOT SE operates the power spot markets for short-term power trading in Germany, Austria, France and Switzerland.Furthermore the two countries Germany and Austria form a common price zone. These four countries together represent about a third of Europeans electricity consumption. Today the EPEX-Market counts more than 200 members(epexspot.com, 2012).

Market Areas	Volume 2012 in MWh	Average Base-Price 2012 / 2011Euro/MWh
DE/AT	245 268 525	42,60 / 51,12
FR	59 282 499	46,94 / 48,89
CH	16 677 944	49,52 / 56,18

Figure 46: Trading Volume and Prices on the EPEX SPOT (EEX)

However, the EPEX-Market is an exchange place, where members send their orders, regularly Megawatt hours (MWh), to buy or to sell electricity. The EPEX SPOT matches these orders to build the price which is the power price for all members. Not only the EPEX-Market but also the OTC-Market is mainly influenced by these prices. In 2012 round about 339 Terawatt hours (TWh) was traded. The average base price in 2012 on the Day-Ahead Market for Germany and Austria was 42,60 €/MWh which can be seen in the table above(epexspot.com/de/presse, 2013).

4.3.3 Day Ahead and Intraday Market

The basic load on the EPEX SPOT Market is shaped by derivative markets for France, Germany, Austria and Switzerland. Long- and mid term contracts generate the base load beside the OTC-contracts. The Day-Ahead Market regulates the short term contracts for each next day which is illustrated in the following figure. If, for example a supplier forecasts a lack of power production, the company can order some Megawatt hours to fullfill the demand. The prices for tomorrow are traded today. These are calculated by the offer and demand curves. In Germany and Austria the Marked is called Physical Electricity Index (short PHELIX). At the PHELIX are prices for each hour of the next day calculated which are influenced by supply and demand. Today the prices at this Market are mainly influenced by the weather, caused by the big amount of renewable energy power plants in Germany. Since 2010 the EPEX SPOT also publishes the ELIX which is the “European Electricity Index”. The ELIX functions like the PHELIX, but build the prices for Europe(epexspot.com/de/presse, 2013)(ECORYS, 2008).

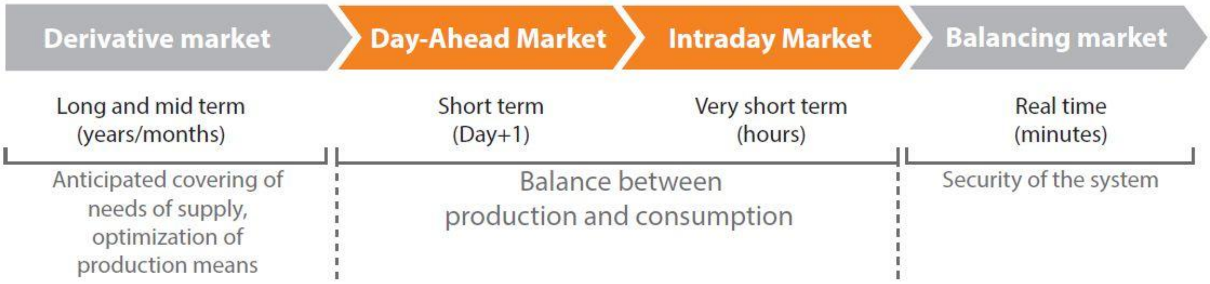


Figure 47: Timeline of the Power Market (EEX)

The Intraday Market started after the closure of the Day-Ahead Market (Figure 5). This market was created 2010 to better react inbetween the trading day to balance production and consumption. Gaps between Power and Prognosis or a power plant breakdown can be regulated by these very short term contracts. The German electricity exchanges allow deals up to 45 minutes before the delivery. At the OTC Market power can be traded up to 15 minutes before delivery if it is in the same control area and if it is an emergency case(Berken, 2012).

Last but not least there is the important Balancing Market. This Market, also called operating reserve, ensures the security of the power system. If an unpredictable incident happens, for example if a generator goes down, the system operator has capacity available in seconds to meet the demand. In addition gas fired power plants or pumped storage hydro power stations are available for short term impendence matching. Alternatively, if there is no other solution, special power customers can be kicked out of the grid by load control(next-kraftwerke.de, 2012)(Weißbach, 2009).

But what about structure and organization of the electricity market, and how does the transmission and the distribution between production and consumer work?

4.4 Transmission and Distribution (L.B.)

As already pointed out, the electricity market consists of three main parts: Power production, power consumption and the transmission and distribution grid. The last chapter outlined the “above standing electricity market”. In this chapter, the structure and organization of the transmission and distribution grid will be explained.

Power or electric current is produced by various conventional power plants (nuclear, gas, coal, etc.) or it is alternatively produced by water, wind, solar, biomass, etc. and transported through the grid to the consumer. For the organization of transmission and distribution different actors and steps are necessary. Power plants convert various forms of energy into electrical energy. The generation of electrical energy is just one part of the object in the power supply. The complete chain of electricity from the production to the consumer includes four different steps from the extra high tension grid (at the big power plants) to the low tension grids (at the households)(dolceta.eu, 2011).

1. Extra High Tension Grid (380 – 220 KV)

   The pure transmission system takes the power generated by the power plants to distribute it nationwide on transformers. For example in Schleswig-Holstein, the TenneT TSO GmbH takes over the operation of this power transmission system.
2. High Tension Grid (110 KV)

   Transformers reduce the voltage from the extra-high-voltage network to distribute the power in different regions like metropolitan areas or large industrial plants. The high-voltage grid in Schleswig-Holstein is operated by E.ON Netz GmbH.
3. Medium Tension Grid (10 - 30 KV)

   It is used in the power distribution of the low voltage network or institutions such as government, industry, small businesses and schools.
4. Low Tension Grid (230 – 400 V)

   The low-voltage systems provide individual dispersion to the final consumer, over the local network the current reaches households and small businesses(sh-netz.com, 2012).

These four areas of transmission and distribution connect supply and demand. The Grid also builds the physical boarder on the electricity market, because the power lines are limited. In Germany there are four transmission network operators who are responsible for the extra high tension network. The main job of Tennet, Aperion, 50Hertz and Transnet is to transport the power over big distances, but also preserve the Network stability (left figure). The four big network operators and also all other grid operators allow all market participants a non-discriminatory market access. Otherwise the companies could take advantage of their natural monopoly. The network providers are not paid for the sale and trade of electricity, but they are paid for thedisposal of the networks. The operators get a payment from the power plant operators to pass the electricity from the power plant to the consumer(dolceta.eu, 2011)(Weißbach, 2009).

Figure48: Transmission Operators (Wiki)

4.4.1 Major Players

When we talk about the Major Players on the German electricity Market we mainly talk about Eon, RWE, EnBW and Vattenfall as clearly shown in the next diagram (statista.com, 2012). It shows the share of the net electricity supply of the "Big Four" in 2011 in Terawatt hours (TWh). With 359,3TWh these four concerns owns 83 % of the marked share. The other market participants like small "Stadtwerke" and some other traders don't have a big influence.

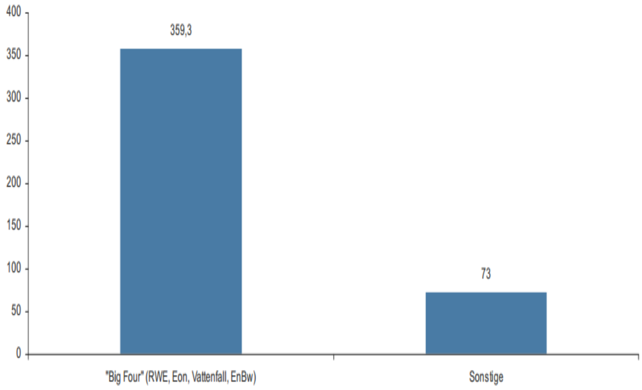
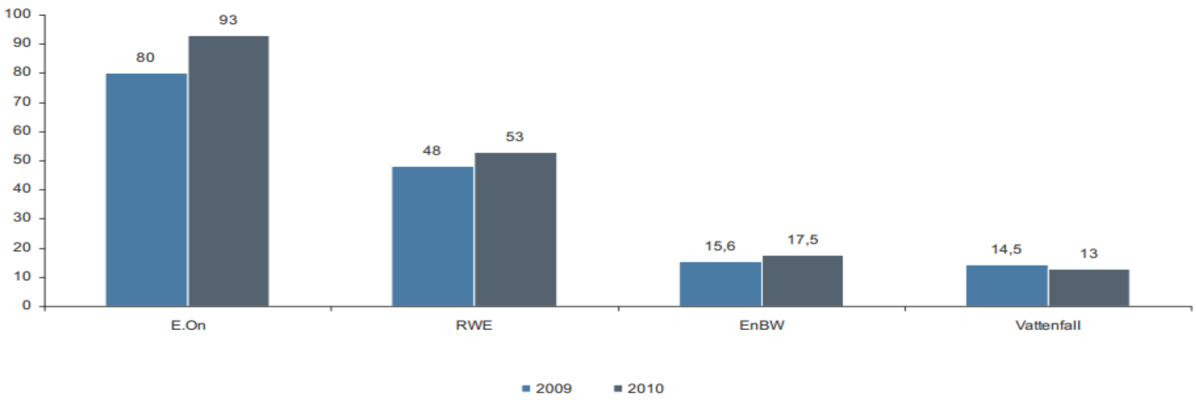


Figure 49: Electricity Supply in Gemany (statista)

In Europe only a handful energy concerns are dominating the supply of Western Europe. The top concern is the German supplier Eon with a turnover on 92,8 billion Euro in 2010. Eon is followed by GDF Suez from France with a turnover of 83.5 billion Euro and Enel from Italy with 71,1 billion Euro. On the fourth, sixth and seventh place of the biggest European electricity suppliers there are RWE, Vattenfall and ENBW. The next diagram shows how the market shares in Germany are weighted by their turnover in Million Euro(statista.com, 2012).

Figure 50: Market shares of the Electricitc Supplier in Germany (statista)



4.4.2 Linkages to other electricity markets

The European Energy Exchange is located in Paris (France) and Leipzig (Germany). It connects France, Germany, Austria, Switzerland but also other countries like Denmark, Sweden, Poland, Czech Republic and the Netherlands for example. All these different electricity market are linked together – and they are trading with each other.

With the focus on Germany and its electricity Import-Export-Balance two weeks from 21.12.2023 to 03.01.2013 were analyzed. To have a look on the trading between Germany and its neighbor counties the data from the "Entsoe Transparency Platform" were interpreted(entsoe.eu, 2012/2013).

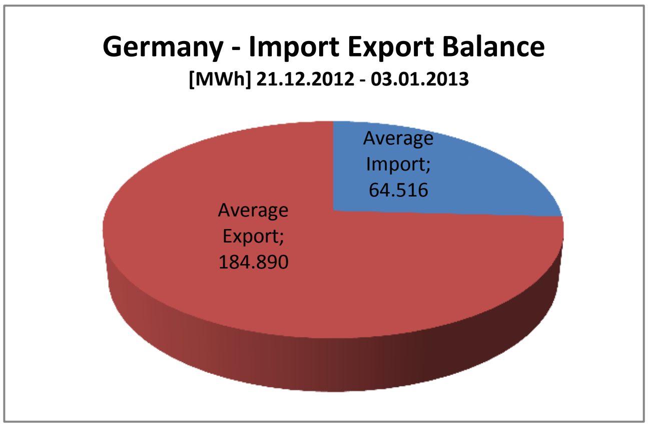


Figure 51: German Import Export Balance (entsoe)

In these two weeks the Import-Export-Balance of Germany becomes clear. Of course the balance varies a bit over the year, but in this case Germany had an average import of 65 GWh and an average Export of 185 GWh per day. With this number it becomes obvious that Germany is an electricity exporting country. The balance is round about 25% import to 75% export.

But which times Germany imports power, and from which countries? Germany is in general an electricity exporter, but at all grid connections to the surrounding countries there are more or less big current exchanges. Definitely most of the German power imports are coming from France. They sometimes supply the south of Germany because the German north-south transmission grid doesn't have enough capacities for supplying the south and second because of cheap prices of their nuclear power production. The second biggest importer is the Czech Republic with same reasons like France. The third biggest importing country is Denmark, but they import more power from Germany(entsoe.eu, 2012/2013).

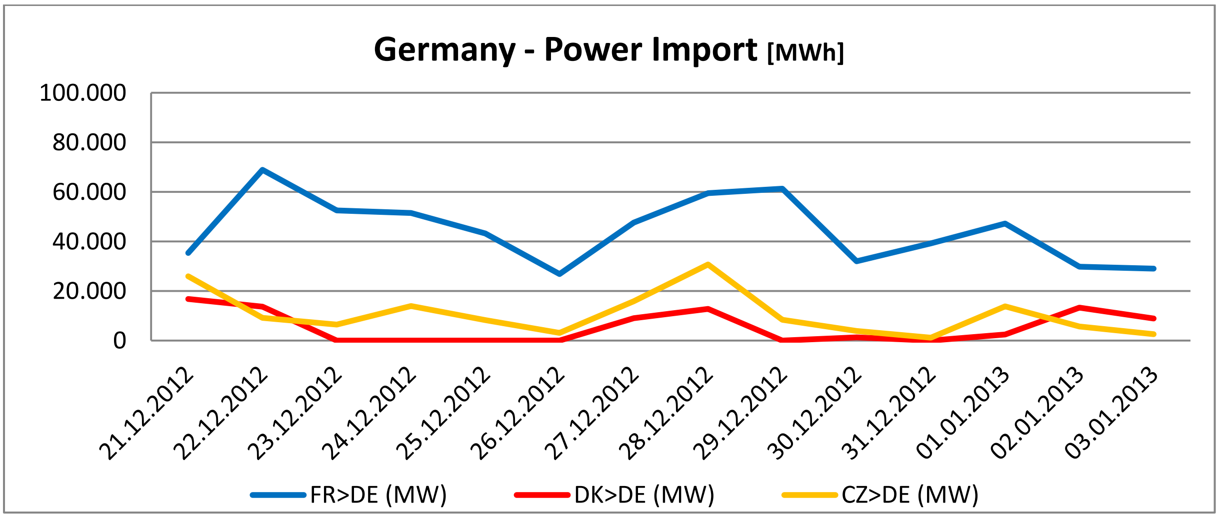


Figure 52: Germany - Power Import (entsoe)

As mentioned above, Germany is an energy exporting country. The biggest part of these exports goes to the Netherlands in the analyzed timeframe. But also Germany exports energy to Austria, Denmark, Poland and the Czech Republic – the other exports are negligible(entsoe.eu, 2012/2013).

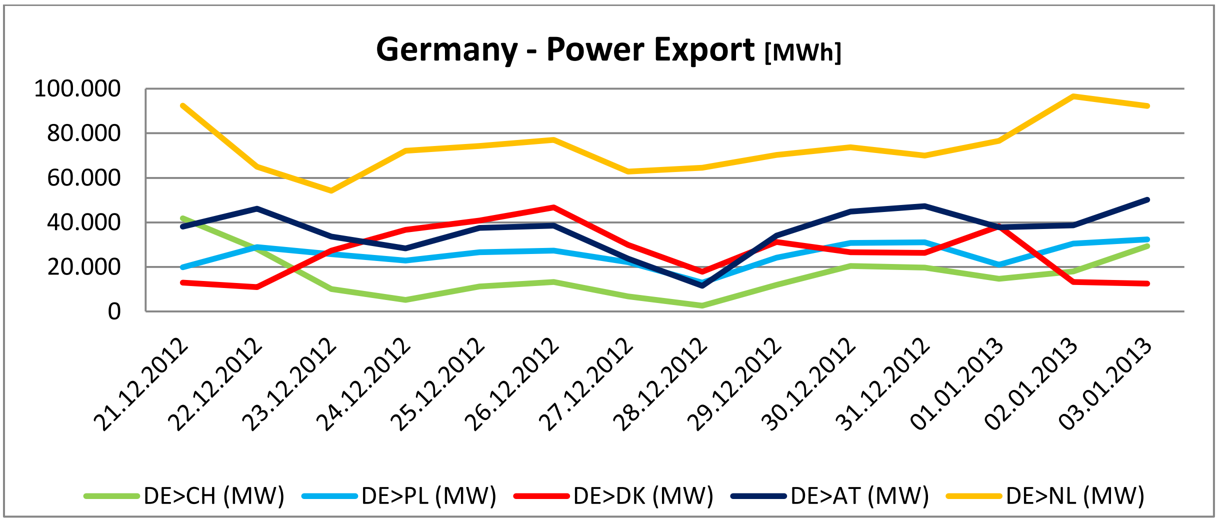


Figure 53: Germany - Power Export (entsoe)

The last diagrams show the import and the export in MWh for the timeframe from 21.12.2012 to 03.01.2013 – but the imaged graphs are more or less representative for a year in Germany – depending on the weather. The biggest influence on the electricity market, since the power production of renewable energies grows up, has the weather. Naturally, the electricity demand follows the seasons and the temperatures. However, the supply side is much more influenced by the weather, because of the big solar energy production, and the big part of the wind energy production. The renewable energies have a big influence on the energy imports and exports. If it is windy or sunny in Germany, they export, if not it is the other way around(entsoe.eu, 2012/2013). The weather conditions also have the largest influence on the prices of the electricity market – in the near future this market and these Import-Exports-Balances will change obviously caused by the renewable.

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5 The Electricity Market – Technical Realization (by Marian Bons and Nicolas Bernhardi)

5.1 Introduction (Marian)

Chapter 4 treated the main aspects of the electricity market. Electricity market players can use different methods of trading and can buy diverse products. They can trade directly with each other or they buy or sell electricity at the electricity stock exchange. However, a technical infrastructure is needed which is capable of physically fulfilling all transaction.

This chapter deals with the technical realization of the electricity market. The market structure is described and the financial accounting of energy is illustrated. Furthermore, the technical basics of the electricity grid in Germany and Europe are shown and the use of balancing energy and control energy is explained. All these aspects are dealt with in the context of historical development of the electricity market. Finally, the expected future development and its consequences for the electricity market and the security of supply are analyzed.

5.2 Historical development – Liberalization process

The electricity market is composed of four different sectors: production, transmission, distribution and sales. In the 1990s, the electricity market in Europe was characterized by vertically integrated electricity utilities which were active on all four sectors. These utilities used their own grid for electricity transmission and could claim high network charges for the grid access from other companies. The resulting low competition led to increasing electricity costs for consumers.

Electricity transmission and distribution are natural monopolies, because an increasing number of grids would lead to higher costs for the consumers. On the other side, competition between electricity producers is economically reasonable (Liebau, 2012, p. 9). Beside an efficient market design, the requirement for a functioning market is the efficient regulation of the grid (Liebau, 2012, p. 1). In 1996, the European Parliament and the Council of the European Union reacted and implemented on proposal of the European Commission the EU Directive 96/92/EG which aimed at building a European internal electricity market. Therefore, the EU Directive determined that the EU member states have to regulate the grid and offered the decision between a negotiated and a regulated grid access (EU Richtlinie 96/92/EG, 1996, §§ 17, 18). With the implementation of the EnWG 1998, Germany transposed the EU Directive into law. The markets for production and sales were opened and the negotiated grid access was chosen (Stäck, 2008, p. 53) to avoid the implementation of a regulation agency and to negotiate the mass of different grid access possibilities (Binnebessel, et al., 2008, p. 53f.).

The technical guidelines were defined in different grid codes (see section Transmission Code) and the commercial regulations for the grid usage were implemented with the Associations' Agreement I in 1998. The Associations' Agreement I gave recommendations and basic conditions for the individual negotiations between grid user and grid operator concerning grid access and network charges. It aimed at increasing the competition for the supply of electricity and reaching competitive electricity prices. To achieve these aims, the grid usage and network charges should be free of discrimination and not influenced by the ownership of the grid. The recommendations for the calculation of network charges were based on the costs of the grid operator and for each contract on the distance between the points of injection and withdrawal (Verbändevereinbarung I, 1998). This distance based network charge calculation required single contracts for each transaction and hence was counterproductive for mass customer business and short term transactions (Stäck, 2008, p. 53).

Due to criticism and experience, the Associations' Agreement II was implemented in 1999. Every grid user needed now only two contracts, one for the grid access and one for the usage of the grid, which were valid for all its transactions. The mechanism for network charge calculation was now independent of the single transactions. The grid user paid a network charge which gave him access to the whole grid enabling short-term transactions and the formation of stock exchanges. The cost-based network charges were paid to the distribution grid owner and partly passed to the downstream grid operators. To guarantee competitive prices, the network charges should be cost-efficient and comparable to network charges resulting under rational operation management. These efficient network charges should be identified by comparing the costs of different grid operators. Furthermore, balancing groups were implemented to allow an effective usage of control energy (see section Control Energy) and the cost distribution to the causers of imbalances (see section Balancing Groups / Operation Schedule Management) (Verbändevereinbarung II, 1999).

In 2002, the last adjustments were implemented with the Associations' Agreement II Plus. The contract for grid usage was scrapped and the mechanism for network charge calculation was improved. The grid operators were classified in 18 different structure classes to allow a reasonable comparison of network charges. For each class the upper 30% of the band of network charges were identified and the grid operators claiming network charges of that amount had to prove the appropriateness of them (Verbändevereinbarung II Plus, 2001). Unfortunately, the price limit incentivized the grid operators with lower network charges to increase them to the limit. Furthermore, the Associations' Agreement was not legally binding so that many grid operators did not publish their network charges at all. Besides the positive effect of an increasing competition and lower electricity prices, the transparency of the charges was still low and the share of discrimination high. The reduced effect of self-regulation was reflected by many interventions of the German Federal Cartel Office (Binnebessel, et al., 2008, p. 56f.).

In June 2003, the European Parliament and the Council of the European Union published on proposal of the European Commission the EU Directive 2003/54/EG. Its main aim was to accelerate the liberalization process, the unbundling of vertical integrated utilities and to open the markets completely what had already happen in Germany (EU Directive 2003/54/EC, 2003). Moreover, due to the criticism of the European Commission that the Associations' Agreements offered the potential for inappropriate high network charges (Binnebessel, et al., 2008, p. 58), the Directive allowed only the regulated grid access model (§ 23) forcing Germany to implement a regulatory agency. In 2005, Germany transposed the EU Directive into law with the implementation of the "Energiewirtschaftsgesetz" (EnWG) 2005 containing the general conditions for grid access and network charges and the StromNZV and StromNEV. The latter two regulations contain specific elaborations and are based on the Associations' Agreements. The regulatory agency "Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen" (BNetzA) had to ensure the competition by unbundling and regulation of the grid while maintaining security of supply. Its main operation was the regulation of individual network charges. In the beginning, the BNetzA used a cost based calculation of network charges (Binnebessel, et al., 2008, pp. 57-59). Therefore, grid operators had to hand in their costs and appropriate network charges were calculated by adding a defined margin onto the efficient costs. However, a problem occurred by defining the efficient costs which would be the result of perfect competition. Regarding this problem, cost based calculation offers no real incentive for cost reductions. Therefore, since 2009, the BNetzA uses additionally an incentive based calculation (Binnebessel, et al., 2008, pp. 65-67) which is defined in §§ 21 and 21a EnWG (EnWG, 2012).

The detailed calculation of the network charges is included in the StromNEV (StromNEV, 2011). As implemented with the Associations' Agreement II, the calculation of the yearly network charge is still based on the efficient costs of the grid operator and independent of the transactions (§§ 4, 15, 17). The costs have to be determined with §§ 4 to 11. Following § 27, the grid operators are obliged to publish their network charges and they are classified with § 24 into 18 structure classes regarding their grid voltage level, their sales density and their area of operation (east or west). The BNetzA can then compare costs, revenues or network charges of the grid operator of one structure class as defined in § 22. Due to the cost based network charge calculation, the BNetzA is allowed by § 21a EnWG (EnWG, 2012) to incentivize the grid operators to reduce costs by setting the network charges. In fact, nowadays, the network charges are highly regulated and the grid operators are supervised by the BNetzA, e.g. they are obliged by § 17 StromNZV (StromNZV, 2012) to publish grid relevant data like electricity withdrawals from the grid, load curves, load peaks and grid losses. This increases transparency and enables the regulatory agency to define possible cost reductions and to incentivize the grid operators to realize them.

5.3 Financial and structural aspects for trading

The structure of the electricity system and the financial accounting of the physical trades are directly correlated. The structure of the grid defines the basic conditions needed for enabling trading whereas an efficient design of the grid can only be reached with the right financial conditions.

5.3.1 Stability of the grid

The liberalization process aimed at creating an efficient, competitive market. Besides that, the security of supply which is interconnected with the stability of the grid must be ensured. § 12 EnWG (EnWG, 2012) states that one of the tasks of Transmission System Operators (TSOs) is their contribution to a reliable and secure electricity supply system in their control zone and thus to the security of supply in the whole grid zone. As one can see in Figure 54a, the European grid is divided into five different grid zones. The basic frequency is 50 Hertz (Hz). Due to imbalances between demand and supply, the frequency fluctuates. The resulting frequency is equal everywhere in one zone for each point in time. On the one hand, the bigger the zone, the lower the frequency changes if production and consumption do not level out in one control zone. On the other hand, imbalances between production and consumption in one control zone influence the frequency of the whole grid zone.

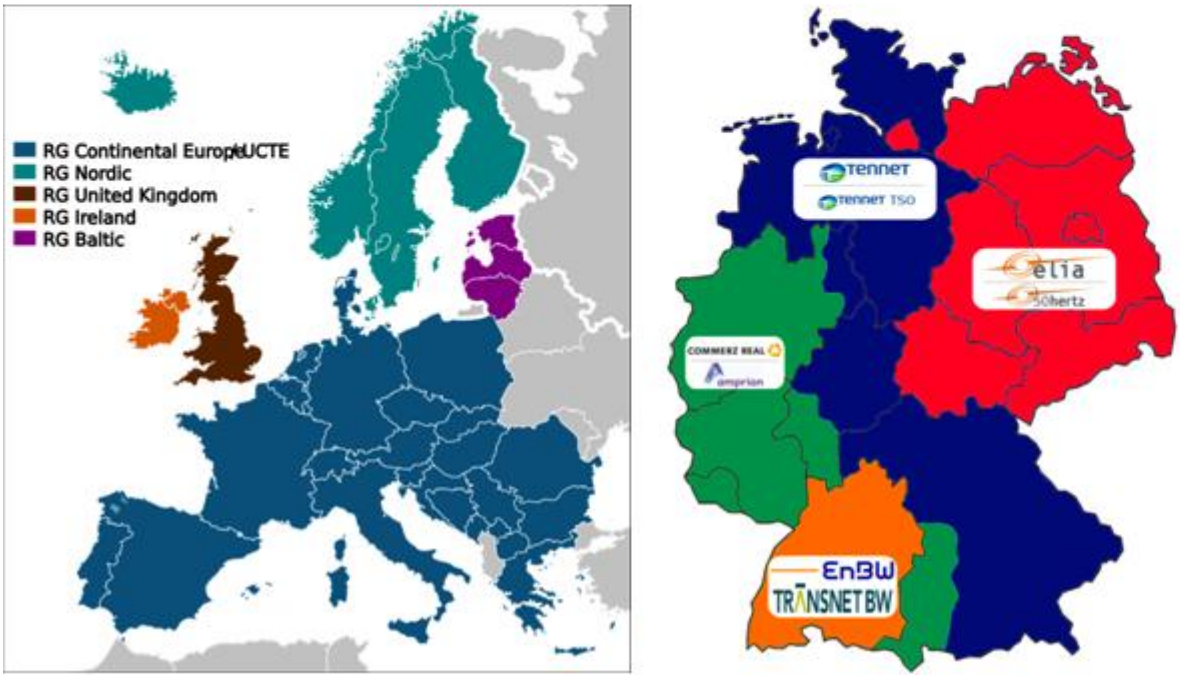

Figure 54: a) European TSO Organizations (Regional Groups) b) German TSOs (Wikipedia, 2012)

As one can see in Figure 54b, Germany is divided into four control zones operated by four different TSOs. Following § 13 EnWG, each TSO has to eliminate a fault in his control zone by either grid based measures or market based operations. The latter one concerns mainly the usage of control energy which represents the adaption of production and/or consumption. TSOs have to organize balancing markets and they must balance in the most efficient manner. Furthermore, close cooperation between TSOs is required (ACER, 2012, p. 12). These requirements are also established by law in § 22 EnWG. Moreover, this paragraph obliges the TSOs to put control energy out for tender in a non-discriminating and transparent way. The TSOs are not allowed to offer the balancing services themselves. They are obliged to acquire them from balancing service providers (ACER, 2012, p. 12). The costs for control energy have to be defrayed by the grid users (StromNZV, 2012, § 8).

5.3.2 Balancing Groups / Operation Schedule Management

Regarding § 4 StromNZV, every point of injection or withdrawal has to be part of a balancing group and every grid user must be in one balancing group. These balancing groups, which can be compared with virtual energy accounts, have to be formed in one control zone and a balancing group manager has to be defined by the grid users. He is economically responsible for imbalances between injections and withdrawals. The aim of balancing groups is to enable transactions and to minimize imbalances (EnWG, 2012, § 3 10a.).

Control energy can only be used efficiently, if production and consumption of energy are known. Therefore, the TSO has to be informed of all physical transactions in the future (Liebau, 2012, p. 23). Every balance group manager has to hand in a balanced operation schedule of its balancing group for every quarter hour of the day. This operation schedule contains the prognosis for consumption and production as well as transactions between balancing groups (entso-e, 2010, p. 8f.). The conditions for operation schedule management are defined in § 5 StromNZV. Hence, all operation schedules should be balanced to allow a balanced control zone and all schedules for the next working day must be handed in until 14.30. However, the balance group manager can change the operation schedules until a quarter hour before its realization time – referred to as gate closure time. If a power plant fails, the TSO has to compensate the failure for four quarter hours including the quarter hour when the failure occurred. Afterwards, the responsible balancing group manager has to level out the failure, as one can see in Figure 55.

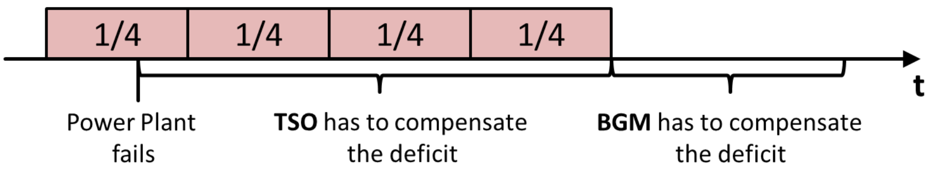

Figure 55: Responsibility for a power plant failure (Own creation)

After gate closure time, the TSO has to calculate the control energy needed to balance out the difference between production and consumption (StromNZV, 2012, § 8). Furthermore, he measures the real flow and the deviations from the operation schedules (Dähne, 2005, p. 8). The advantage of the balancing group system is that surpluses in some balancing groups can cover losses in others. Thus, the free electricity flow in the grid offers the possibility to use control energy in an efficient manner and act against the absolute imbalance. Hence, balancing energy could flow without the use of control energy and thus without costs. If secondary or tertiary control energy had to be used, the balancing groups with imbalanced accounts have to cover the costs (StromNZV, 2012, § 8). Therefore, the TSO calculates the balancing energy price (BEP) for every quarter hour.

$$BEP = \frac{expenses - revenues}{positive\ control\ energy - negative\ control\ energy}$$

In general, the BEP is positive. In this case, the balancing groups with a negative account have to pay the BEP per energy unit to the TSO whereas the balancing groups with a positive account gain the BEP per energy unit from the TSO. The amount of money remaining at the

TSO equals the costs he had for using secondary and tertiary control energy (Liebau, 2012, pp. 50-53). Alternatively, the balancing group manager can compensate the imbalance in his balancing group at the after-day market until 16.00 the next working day (StromNZV, 2012, § 5(3)).

All in all, the system of balancing groups is the virtual transformation of the physical energy flow. Due to the fact that electricity does not "flow" in an AC-grid, the injections and withdrawals are measured representing the transactions between specific traders. Moreover, this system leads to an efficient use of control energy and allows balancing groups to level out each other.

5.4 Technical Realization (Nicolas)

5.4.1 Transmission Code

Besides the commercial regulations, specific technical guidelines are defined in various grid codes to ensure the stability of the grid. For the technical realization of the electricity market and the efficient use of control energy, the "Transmission Code 2007" is from importance. This Code contains the network and system rules of the German TSOs. These rules form the legal basis for the grid usage and comprise the technical and economic conditions for both, the TSO's and the grid users.

The "Transmission Code 2007" is a revision of the "Transmission Code 2003" that was derived from the negotiated grid access (see section Historical development – Liberalization process). An additional background of the "Transmission Code 2007" is formed by the rules of the "UTCE Handbook" and the manuals that are developed by the association of the grid operators (VDN). (Berndt, et al., 2007, p. 7).

The legal framework for the Transmission Code is based on different regulations and laws of both, Germany and the EU. Most important are among others

> *"[...] the EC Regulation 1228/2003 on conditions for access to the network for cross-border exchanges in electricity on an international level [Q4] including the guidelines on congestion management [Q4] and the Second Act revising energy industry legislation of 07 July 2005 (EnWG Energiewirtschaftsgesetz (Energy Industry Act)) [Q1] and the relevant regulations based the Directive 2003/54/EC concerning common rules for the internal market in electricity [Q3] as well as the*

> *Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz - EEG) [Q6].”* (Berndt, et al., 2007, p. 7)

The Transmission Code’s main topics are dealing with the implementation of the TSOs’ system responsibility with the cooperation of the distribution system operators (DSOS), the conditions of the grid connection and grid utilization, the definition of system services and the operational planning of the grid management (Berndt, et al., 2007, pp. I-IV).

5.4.2 Control Energy

Since neither the demand for electrical energy nor the production is fully predictable and the electricity grid is not capable of storing the energy there is a need to balance the over- respectively underdemand. This is one of the tasks of the TSO’s (Amprion GmbH, et al. (a)). As already described in the section Balancing Groups / Operation Schedule Management the resulting energy accounts of all balancing groups are ascertained quarter-hourly. The costs for leveling out the total imbalance of the complete control zone are paid by the balancing group managers with unbalanced accounts (StromNZV, 2012, § 8).

5.4.2.1 Technical background

In an electrical grid the demand of active power always has to be met by the contemporaneous provision of the same amount of active power. If there is a deviation of demand and supply the rotational speed of the systems synchronous generators will increase or decrease. This effect can be indicated by the electric frequency of the system since it is directly proportional to the synchronous speed of the generators. Hence, if there is an over demand of electricity the frequency of the grid drops, if there is an under demand it rises. The goal is to keep the frequency always at the set point of 50Hz.

Since it is technically not possible to store bigger amounts of electrical energy, the production system must be flexible enough to meet the fluctuations in the electricity grid. Therefore control energy is used. (Union for the Coordination of Transmission of Electricity (UCTE), 2004, p. A1-2)

The control energy is distinguished in three different kinds due to the way and the point in time it is activated (Amprion GmbH, et al. (b)). These different types of control energy will be described in the following part.

5.4.2.2 Primary Energy

In the case of a frequency drop in the electricity grid the primary energy is the first control energy that is activated. It is controlled and activated automatically via a measurement of the grid frequency and has to be fully activated after 30 seconds. The amount of primary energy a power plant feeds into the grid is proportional to the grids frequency deviation in comparison to the set point of 50 Hz. This regulation also works vice versa so that a power plant of the primary reserve throttles its output in case of an increase in the grids frequency.

The primary energy is provided solidarily by all TSOs of the UCTE network. The overall capacity of primary energy that has to be available in the UCTE area is defined as 3000 MW (Bundesnetzargentur (BnetzA) (a), 2011, pp. 5-6).

Every power plant with a nominal power production above 100 MW has to be capable of supplying primary energy. For this primary energy ± 2 % of the nominal active power has to be available. The primary energy supply must be held up for at least 15 minutes (Berndt, et al., 2007, p. 18).

5.4.2.3 Secondary Energy

The secondary control energy cuts in after 30 seconds and is supposed to supersede the primary energy completely after five minutes to further stabilize the frequency and to ensure the availability of the primary energy control again. As distinguished to the primary control energy the secondary control energy has to be available within the control area of the responsible TSO in order to maintain the energy balance of every single control area. Power plants that offer secondary control have to be online connected to the TSO’s automatic frequency controller. By this the TSO has the possibility to regulate the secondary control energy within its control area (Berndt, et al., 2007, pp. 40-41).

5.4.2.4 Minute Reserve

If there is a longer lasting deviation of demand and supply the minute reserve control energy supersedes the secondary control energy. In earlier times it was accessed by telephone by the control area’s TSO. Since the 07/03/2012 it is has to be automatically switched on via an online connection between the TSO and the supplier. If the minute reserve is required within the first 7.5 minutes of a time slice of the time schedule (15 min) it has to be switched on within the same time slice. If it is required after the first 7.5 minutes it first has to operate in the following 15 minutes. The minute reserve operates always for full quarter-hours (Bundesnetzargentur (BnetzA) (c), 2011, pp. 2 and 5-7 and Amprion GmbH, et al. (c)).

5.4.2.5 *Tendering control energy*

Following § 22 EnWG (EnWG, 2012), the TSOs have to publicly tender the three different kinds of control energy. The German TSOs accomplish this regulation with the common internet platform www.regelleistung.net.

For the primary control energy the announcement has to be published weekly, since the activation of the primary energy is done automatically and solidarily across the control areas. The acceptation of a tender is accomplished according to the kilowatt-hour rate of the different offers. The minimum capacity that can be offered is ±1 MW but there is the possibility of pooling different production plants in order to accomplish this constraint. (Bundesnetzargentur (BnetzA) (a), 2011, pp. 2-3) By this regulation also renewable energies and other smaller production plants are able to contribute to the primary energy control. Of course these production plants then need the required technical installations in order to control them automatically.

The announcement for the secondary control energy has to be published weekly as well. The tender is divided into two time slices: The first time slice is from Monday to Friday, 8 am to 8 pm, the second time slice is from Monday to Friday, 8 pm to 8 am, as well as on weekends and on public holidays. The acceptation of a tender is accomplished according to the price of the offered capacity. For the pricing of the demanded secondary energy a merit order list is rendered from the capacity prices of the power plants that won the tender. The lowest offered capacity that is accepted is ± 5 MW, but also here a pooling of different power plants is possible (Bundesnetzargentur (BnetzA) (b), 2011, pp. 2-3).

For the minute reserve the announcement has to be published daily. The minute reserves' tender is divided into 6 different time slices, ergo every time slice lasts for four hours. Also here the acceptation of an offer is accomplished according to the price of the power plants capacity and a merit order is rendered that finally derives the price of the demanded minute reserve. For the lowest offered capacity of the minute reserve and the pooling applies the same as in the case of the secondary control (Bundesnetzargentur (BnetzA) (c), 2011, pp. 2-3).

The aim of the different pricing procedures is to always get the lowest price for control energy in order to keep the consumer prices as low as possible while still maintaining the security of supply.

5.4.2.6 Cost distribution of control energy

Figure 56 illustrates the cost distribution for the different kinds of control energy, as it is described in § 8 of the German StromNZV (StromNZV, 2012). According to this paragraph the costs for the primary control (which is activated automatically) as well as the costs for the provided capacities of the secondary control and the minute reserve have to be borne by the TSOs. The control energy costs for the actual demanded energy have to be borne by the perpetrators, which in this case are the balancing group mangers with an unbalanced account. The TSOS have to charge the balancing group managers by the incurred costs on quarter-hourly bases (StromNZV, 2012). By this approach there is an incentive for the balancing group managers to always have a balanced account on quarter-hourly basis.

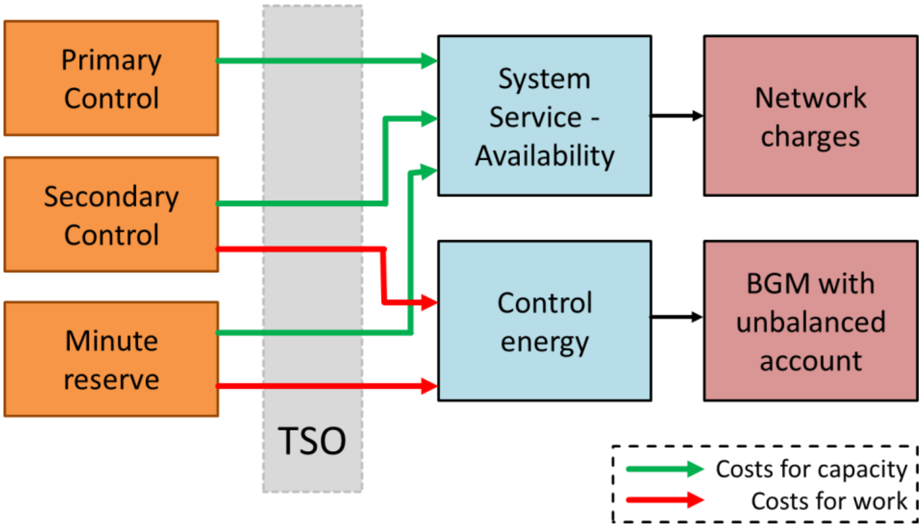

Figure 56: Cost distribution of the control energy (Own creation on basis of Roon, 2007, p. 18)

5.4.3 Development of the future production and demand

As it became obvious in the previous parts the German electricity market was subjected to some major changes during the past 15 years. However it is questionable if these changes will be adequate in order to face the futures changes of the electricity system.

Some of the future changes have already been decided by todays German policy makers: In June 2011 the German government decided the nuclear phase out for 2022, while the newest revision of the German EEG assigns that 80 % of the German energy consumption in 2050 shall be covered by renewable energies (Amprion GmbH,et al. (d) 2012, p. 12). These two decisions have a major impact on the future electricity market.

Figure 57 shows the result of a modulation for the residual load of the year 2016, based on calculations with the modeling software "renpass" (developed by the University of Flensburg) and assumptions from the scenario B of the German grid development plan (Netzentwicklungsplan). The residual load shows the demand minus the production by solar energy, wind energy and biomass.

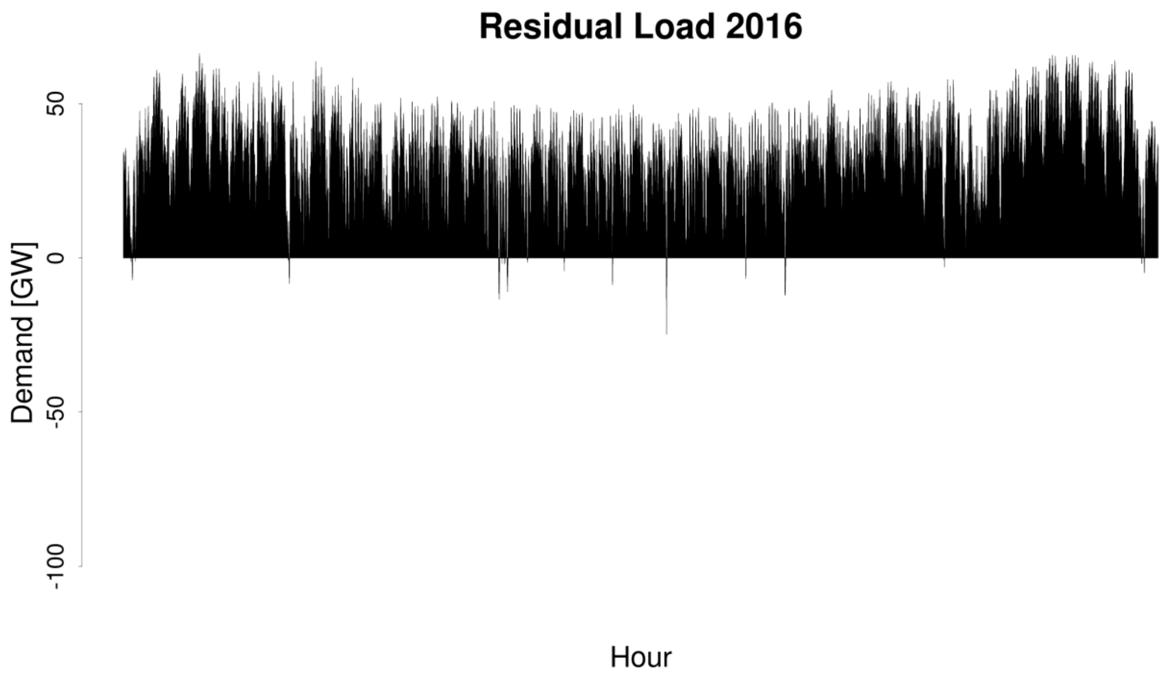

Figure 57: Modeled residual load for the year 2016. Source: Own graphic.

As one can see in the graph, there are only very few times during the year with an overproduction of electricity. The residual load is still highly characterized by the demand. Figure 58 shows the same graph for the year 2040. In this graph the impact of the rising amount of renewable energies in the grid becomes quite obvious. As one can see there are many times where there is an overproduction (negative residual load). Also the spread between the high and low peaks become much bigger. This means a higher demand for both, positive and negative, control energy in future. This effect is intensified by the low predictability of renewable energies which makes deviations from the planed schedule more likely. Also these high fluctuations require a better power distribution system, which can carry the high amount of energy.

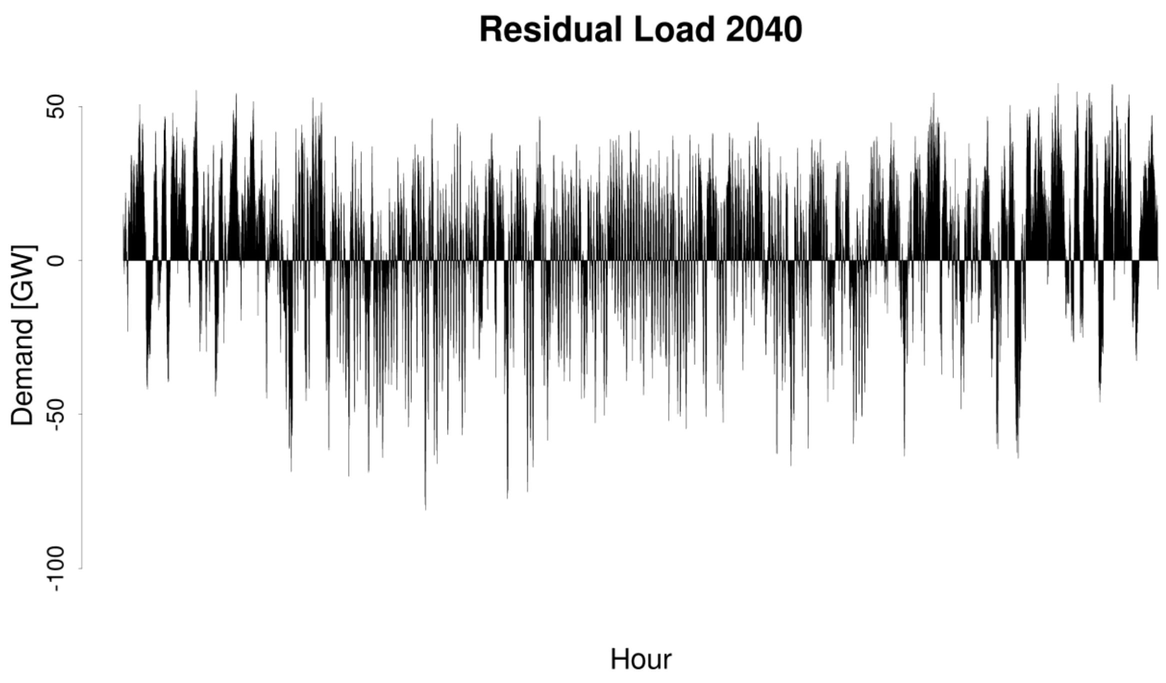

Figure 58: Modeled residual load of the year 2040. Source: Own graphic

5.4.4 Adaptation of renewable energy systems

In order to overcome the problem of a higher control energy demand the conventional energy system will have to change while also the renewable energies have to be more adjusted to the demands of tomorrows energy market.

That means that the renewable energies will have to be able to offer certain system services that are offered by the conventional power plants at the moment. A first approach toward this idea is the German regulation on system services for wind turbines (SDLWindV, 2009). According to this regulation wind turbines have to offer certain system services by today. This includes for example the reactive power supply or the “low voltage ride through” (SDLWindV, 2009, § 2).

However the remaining question is if this can be enough in order to balance the fluctuations of both, the demand and production side of the energy system. If the idea of system services is taken one step further a possible idea is to make the renewable energies participate at the control energy market. Big wind farms and photovoltaic fields could operate in power limitation mode in order to leave surplus capacities open when they are required or, the other way around, lower their production in times of low demand (Verhaegen, 2006, p. 6).

However the incentives for such a behavior are not given at the moment since the German subsidies are purely output based. Also this approach would not help to support the energy system in times of low wind or solar capacities. For balancing these times more storage capacities will be needed.

5.4.5 Adaptation of the existing electricity system (Marian)

The rising share of renewable energies requires a change of the existing system as well. To guarantee the security of supply in the future, changes in the grid structure and in the market structure need to be made.

5.4.5.1 Grid structure changes - extensions

As one can see in Figure 57 and Figure 58, the increasing share of renewable energies leads to higher fluctuations in the German electricity production. Before the liberalization process, in times when renewable energies had a negligible impact on the electricity production, the fluctuations in production were mainly caused by the adaptation to the fluctuating consumption. Therefore, the electricity “flows” could be easily foreseen and were limited. Nowadays, with an increasing installed capacity of renewable energies, new grid points with high possible electricity feed-in emerge. Possible, because renewable energy plants like photovoltaic systems and wind energy turbines are dependent on the weather conditions and have thus a fluctuating energy output. However, the respective distribution grid must be expanded to cover the highest possible feed-in or the feed-in must be limited.

Furthermore, new power plants are not restricted to the areas with an uncovered demand. Therefore, wind energy is installed in the regions with a high mean wind speed to maximize the output. Hence, the wind energy has to be transported to the areas with a high demand which requires besides the local expansion of the distribution grids the expansion of the transmission grids.

Unfortunately, there are two mechanisms, discussed above, that are partly counterproductive for incentivizing grid operators to expand their grid or increase the demand for grid expansions. Firstly, electricity trading leads to a competitive market and reduces the costs for the end-user. However, trading increases the effect described above. Energy is not produced where it is needed which increased the capacity requirements of the grid.

Secondly, network charges are based on the method of incentive regulation with a revenue cap (EnWG, 2012, § 21a). Thus, the grid operator can increase its margin only by reducing its costs which is comparable to a disincentive for the grid expansion as long as the grid operator is not forced to improve his grid (e.g. EEG, 2012, § 9).

In a system mainly based on renewable energy, a well developed and maintained grid is essential to level out regional fluctuations. However, grid expansions are cost-intensive. Hence a well-planned configuration of the production sector can reduce them. Furthermore, changes in market structure can reduce the demand for grid expansions as well.

5.4.5.2 Market structure changes – capacity market

The development of the electricity market will lead to an increasing demand for power plants which level out the fluctuations of renewable energies. In the long-term, power plants are needed that are able to change their output fast, like gas fired power plants. Figure 58 illustrates the high fluctuations of residual load. The control energy market can level out imbalances, but only in the timeframe between gate closure time and physical delivery (Liebau, 2012, p. 37).

Following economic theory, the electricity price must offer incentives for new power plants. Scarcity should lead to increasing prices and offer incentives for investments. The basis for this effect is that the price for the security of supply would be completely included into the electricity price (Liebau, 2012, p. 35f.). Furthermore, the planning and realization of building a power plant is time-intensive and thus delayed.

Investments in power plants are long-term investments and need a constant political environment (Liebau, 2012, p. 37). Fast changes in the structure of the electricity market like the nuclear phase out can harm the expected revenues and thus increase the risk for new investments. Furthermore, power plants which shall be used to cover the demand only in high load times are dependent on the low periodicity of these times and the electricity price during these times. Both factors are highly unpredictable and lead to a high risk of investment.

One instrument which could cover the risk for these plants and offer new incentives for these power plants is the capacity market. In a capacity market, power plants are paid for the provision of installed capacity like in the control energy market, but the payments are guaranteed for the long-term. There are two main concepts which have to be distinguished.

The first concept is the selective capacity market. In this market only the market players which fulfill certain requirements are paid. Therefore, specific technologies can be supported, e.g. regarding their efficiency, flexibility or CO_2 emissions. The Ecofys Germany GmbH analyzed for the German Federal Environment Agency that selective capacity markets can distort the competition. Supporting new power plants could affect the profitability of old power plants. Thus, new power plants could push old power plants out of the market and decrease the effect on the total installed capacity (Nicolosi, M., 2012, p. III).

The second concept is the complete capacity market in which all market players get paid for the capacity they provide. However, this system does not implicitly lead to new investments. For example, the Nord-American market PJM used this concept and only 3.3% of the payments were used for the construction of new power plants (LBD Beratungsgesellschaft, 2011, p. 29).

All in all, an intervention into the market structure is necessary to give incentives for investments in new capacities. However, the concept and configuration are crucial factors for the success of the system. A capacity market leads to long-term security for power plant operators but failures in the system would have long-term effects as well.

5.5 Conclusion (Nicolas)

The Different regulations of the EU and Germany have started a liberalization process of the electricity market during the past years. Due to the higher competition in the market and the unbundling of the vertical integrated grid utilities lower network charges for the grid users could be reached. Also the control energy market got more transparent during this time. Beside the obligation to publicly tender the needed capacities for control energy also the boundaries for entering this market (minimum offered capacities) were reduced.

Balancing groups, that are a major part of trading energy today, depict the physically energy streams in the electricity grid and enable the cost efficient use of control energy. By these changes the German electricity marked moved from a system that was controlled by four monopolists in earlier years to a very open and transparent platform for trading electricity. Also the liberalization pushed alongside other German policies the development of the renewable energies. However this development can be harmful for the stability of the electricity grid and thus threaten the security of the future energy supply. Therefore, the renewable energies need to be adapted to the system requirements, for example by offering system services or maybe also control energy while the electricity grid has to be extended and improved in order to transport the increasing electricity streams. In order to make all this happens also the market structure and the future policy will have to change again to support the necessary changes with the right incentives.

It became clear throughout the paper, that political decisions, whether they are taken by the EU or Germany, have a very big influence on the electricity market. In the end the remaining question is if the German electricity system is able to change fast enough in order to adapt to the new tasks that are required in future and if the security of supply can be maintained. However the past shows that changes are possible.

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6 Emission Trading under the Kyoto Protocol (by Federico Posada and Jesus Alejandro Gonzalez)

6.1 The Green House Emissions problem (Federico)

Since mid 19th century, the Green House Gases (GHG) emissions, especially the carbon emitted by burning of fossil fuels has increased more than ten times (Johnson 2010), as it is show in the next Figure 59. This big quantity of pollutant gases sent to the atmosphere is beyond the limits of the earth to absorb them.

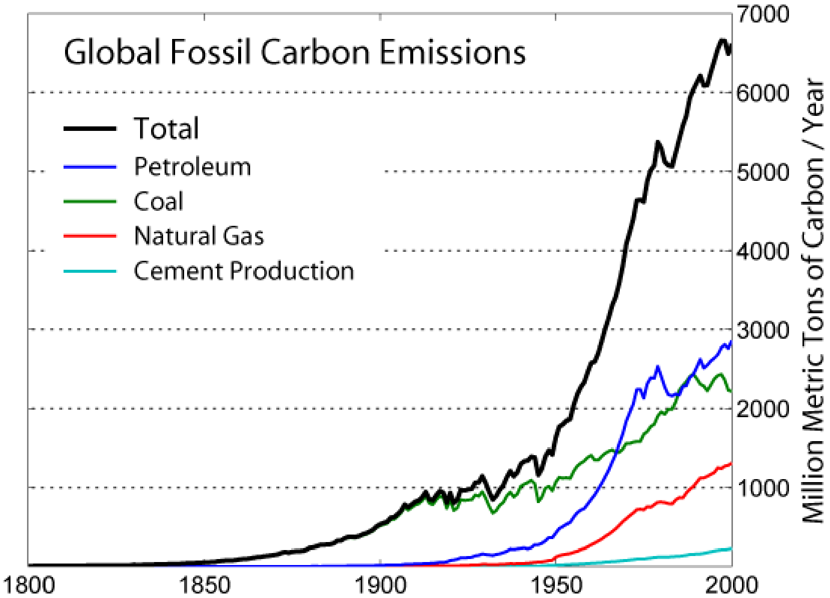

Figure 59: Global total metric tons of carbon emitted per year and highlight the sources. (Johnson 2010)

As the National Aeronautics and Space Administration (NASA) from the US have reported, the last decade is the warmest (NASA 2012) since 1880 when they start to have any kind of records about. As it show in the Figure 60Figure 2 the average global temperature hasn't stop to increase in the last century.

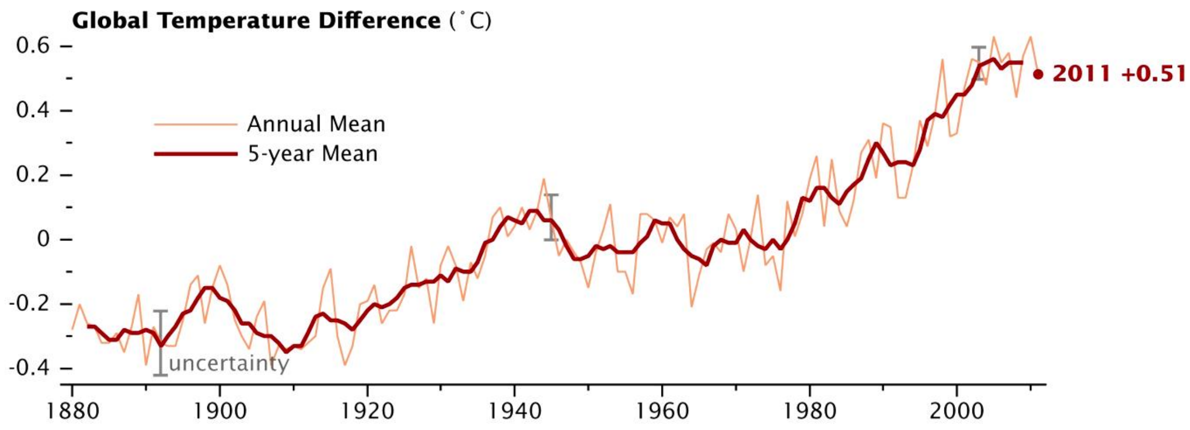

Figure 60: Global temperature differences. (NASA 2012)

NASA reports that nine of the top ten of the warmest years happened in the 21st century (NASA 2012). This is directly related with the curve of emissions which have over passed the safe level of 350 PPM (CO2Now.org 2013) in 1988 and continue increasing. As a particular note, when the presentation about this topic was made in November 2012, the CO2 level in the atmosphere reported for October 2012 was 391 PPM approx. This value for December 2012 was 394 PPM approximately (CO2Now.org 2013).

With this uncertain future in front, the United Nations, in 1997 call for the 3rd Conference of the Parties or COP (UNFCCC 2012), looking for an international agreement to reduce the emissions. (Wikipedia 2013)

6.2 The KyotoProtocol (Federico)

The Kyoto protocol was the result of the negotiations to reduce the GHG emissions during the COP 3 in Kyoto, Japan. Adopted on 11 December 1997, it has entered in force on 16 February 2005 (UNFCCC 2012).

This protocol is linked to the United Nations Framework Convention on Climate Change and, in the first round, commits the European community and 37 industrialized countries for reducing their greenhouse gas (GHG) emissions by 2012 to level of 1990 (UNFCCC 2012).

In December 2012, during the COP 18 at Doha, Qatar; the Kyoto protocol adopted an amendment extending the period of action of it to 2020. (UNFCCC 2013) This modification changes some aspects as:

- Some countries which are not longer considered as economies in development, have increased the list to 41 countries committed with the Protocol. The countries committed are: Australia, Austria, Belarus, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, European Union, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine and United Kingdom of Great Britain and Northern Ireland.
- This list includes Russia, Japan and New Zealand who announced that they won't accomplish the GHG emissions target but they will continue in the protocol. In other hand, Canada announces his complete retirement from the protocol at the end of 2012 (UNFCCC 2013).
- The USA was included in the first list in 1997, but they never signed the protocol and they were excluded of the list at Doha. (UNFCCC 2013)
- The general target was slightly reduced for all countries. (UNFCCC 2013)

Additional, this protocol establishes some tools to help the countries to achieve the GHG emissions reductions objective, which are collect "The Kyoto Mechanisms" (UNFCCC 2012):

- Emissions trading – known as "the carbon market"
- Clean developmentmechanism (CDM)
- Joint implementation (JI).

Those mechanisms require a Command and Control approach to avoid fake information or undercover emissions (UNFCCC 2012). Problems as the abatement cost, as it is show in Figure 61, which change from one country to another, promotes the use of different mechanisms to get Carbon units.

6.2.1 Emissions Trading(Federico)

Also called "cap-and-trade", is one of the three Kyoto mechanisms, based in a market approach in which an Annex I Country may transfer or acquire carbon units to or from another Annex I Country. This market is very strict and the Annex I country interested in participate, must meet specific requirements to participate in the emissions trading scheme. (Carbon Planet 2012)

This mechanism gives an "open market" scope to the GHG reductions, providing economic incentives for achieving reductions in the emissions of pollutants. To achieve this objective, a recognized authority sets a limit or cap on the amount of pollutants that may be emitted; this limit is set in units. Any extra unit emitted means that this country has to buy the right to do it from other country that has saved emission units. Also, any extra unit saved or not emitted means that this country can sale it to another that need. For example in theFigure 61it is possible to see that Germany is saving carbon units (green area) and Sweden is emitting more that allowed (green area), so Germany can sale part of his right to emit GHG and Sweden can buy this right from Germany. This is called "Carbon Market" and is traded in "Carbon Credits" or "Carbon Units". One carbon unit is equal to one tonne of CO2 emitted. (UNFCCC 2012)

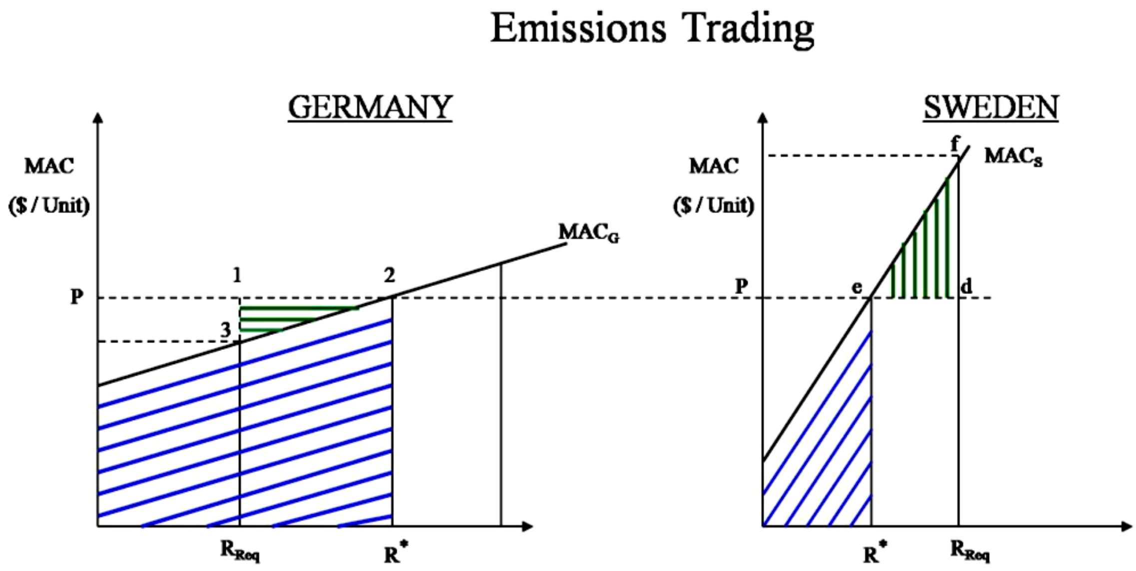

Figure 61: Marginal abatement cost for Germany and Sweden as example. (Wikipedia 2012)

According with the abatement method, it exist different kinds of carbon units (UNFCCC 2012):

- AAU: Assigned Amount Units, those are the units given by the Kyoto Protocol to each of Annex I countries.
- RMU: Removal Unit, those are the units got thru the Land Use, Land-Use Change and Forestry (LULUCF) system.

- ERU: Emission Reduction Unit, those are the units got thru the Joint Implementation (JI) mechanism.
- CER: Certified Emission Reduction, those are the units got thru the Clean Development Mechanism (CDM).

6.2.2 Land Use, Land-Use Change and Forestry (LULUCF)(Federico)

According with (UNFCCC 2012), the Land Use, Land-Use Change and Forestry is “a greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities.”

The LULUCF is direct involved in the use given by man to the land. If a forest is cut, this has impacts on the global carbon cycle removing part of the capacity of earth to absorb the GHG, especially carbon, from the atmosphere, generating an impact over the climate (Wikipedia 2012). As result of this, the Kyoto Protocol accepts that, restoring this absorbing capacity, the country or organization involved will receive the equivalent in Carbon Credits (UNFCCC 2012). This method can be combined with the mechanisms established in the protocol to develop projects at international level(Wikipedia 2012).

This is not consider as one of the mechanism of the Kyoto Protocol, but its application gives carbon units called “Removal Unit” (RMU) and as inventory is an essential part of the Kyoto Protocol (UNFCCC 2012). For those reasons the LULUCF can be consider a practical tool to support the implementation of the different mechanisms.

6.2.3 Joint Implementation (JI)(Federico)

This mechanism is defined as projects to reduce the emission in an Annex I country financed by another Annex I Country. In other words, one country who is committed to reduce its emissions invests in emissions abatement in another country also committed to reduce. (UNFCCC 2012)

This is very useful for countries in which is too expensive mitigate or reduce the emissions. In this way, they can invest in other countries and get the credits from them. This mechanism gives carbon units called “Emission reduction unit” (ERU). (UNFCCC 2012)

One particularity of this mechanism is that is divided in two Tracks (UNFCCC 2012)

- ***Track 1:***The host party can verify the emissions reduction without assistance of any other party or organization. This is possible only if the host party fulfill all the eligibility requirements and then, the host is authorized to, with additionality, issue the ERUs (UNFCCC 2012)

- ***Track 2:***The host party cannot verify the emissions reductions on an autonomous way. To accomplish this requirement and issue the ERU's, is required a verification made by a third independent part accredited by and according with procedures approved by the Joint Implementation Supervisory Committee (JISC). Once the independent entity has finished the audit, the host country is authorized to issue the ERU's.(UNFCCC 2012)

A host Party which meets all the eligibility requirements may at any time choose to use the verification procedure under the JISC (Track 2 procedure). In this case, the cost of the carbon credit will be higher because the expenses of the verification, called "transaction cost" (A. Michaelowa 1998). Later in this document, the transaction cost will be discussed.

6.2.4 Clean Development Mechanism (CDM)(Federico)

This mechanism consists in to get carbon credits, called "Certified emission reduction" (CER) thru the development of reduction emissions projects financed by Annex I countries in Non Annex I countries. In other words, countries committed to reduce their emissions invest in projects to abate emissions in countries that are not committed (UNFCCC 2012). As in the Joint Implementation, the Annex I country can abate emissions in a cheap way, reducing emissions or improving the GHG absorbing capacity in a developing country. (M. J. Michaelowa 2005)

The abatement of emissions must be additional to what could occur. Those projects must be registered and approved by the national authorities. Additionally, the mechanism is supervised by the CDM Executive board. (UNFCCC 2012)

This mechanism can be considered as an effective way to transfer technology; knowledge and investments to developing countries.

6.2.5 Transaction Cost(Federico)

Also called "costs of production" (Chadwick 2006). It is the cost of implementation of the Kyoto protocol mechanisms. (Woerdman 2000)

Those costs include GHGs reduction and legal and administrative processes and are categorized in (Chadwick 2006):

6.2.5.1 *Search costs:*

Those are the costs related with the search for an appropriate location to develop the project (Chadwick 2006).

6.2.5.2 *Negotiation costs*

Those are the cost "involved in determining and securing mutually acceptable terms of trade" (Chadwick 2006).

6.2.5.3 *Approval costs*

Those are the costs related with the paper work required to validate the project with both parts and with the UN office. (CDM Executive Board, etc.) (M. J. Michaelowa 2005).

6.2.5.4 *Monitoring costs*

Those are the costs related with the supervision and audits to the project. (M. J. Michaelowa 2005)

6.2.5.5 *Enforcement costs*

Costs related to "enforcing the terms of the exchange, usually in the form of legal fees and taxes that support the judicial system or other conflict resolution mechanism." (Chadwick 2006)

6.2.5.6 *Insurance costs*

Those are the costs related with liabilities, risk insurance and compliance. (Woerdman 2000)

Those costs are real and important for the normal development of the abatement mechanisms, because to assure their effectiveness, it is necessary to have somebody who can share information, enforce contracts and resolve disputes. The most important is to try to keep the costs as low as possible to guarantee the financial feasibility and a cost-effective price for CO2 emissions abatement. (Chadwick 2006).

According with (Chadwick 2006) "few practitioners believe that a system of exchangeable credits, that represent the absence of mostly invisible GHGs in the atmosphere, could function without some credible monitoring and verification system, and this system is unlikely to be costless".

The transaction cost affects the mechanisms in two ways:

- *At development of the project:* Here are included most of the costs explained before. In this point is in which a project can be cancel because the cost and affects directly the projects developers. (Chadwick 2006)
- *At the carbon units trading:* When the carbon units are trade in the market. Thos costs are more standardized and can be know before the project starts. (Chadwick 2006)

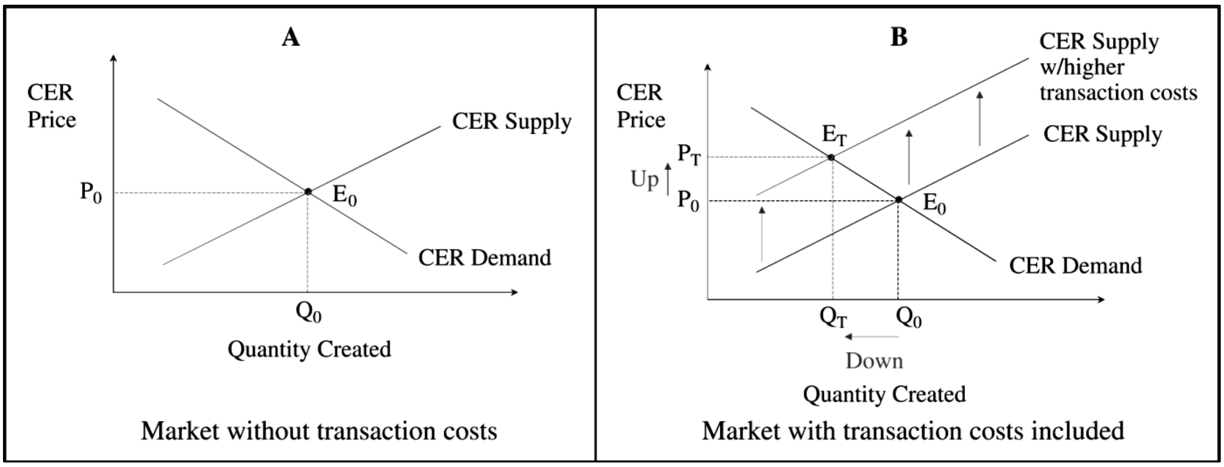

Figure 62: Influence of transaction cost in the market. (Chadwick 2006, p261)

Those costs are undesirable, in the Figure 62it is possible to see how those cost affect the equilibrium of supply and demand; affecting the profitability of projects, its viability and discouraging their execution(Chadwick 2006). In Table 2, it is possible to see how the transition cost could be an important percentage of the total project cost. For example in this case, the Swedish activities implemented jointly projects. Transaction cost represents almost 20% of the total cost. In some cases this is enough to make unviable(M. J. Michaelowa 2005).

Table 2: costs as a share of total costs, by start year. (M. J. Michaelowa 2005)

	Transaction costs as percentage of totalcosts (number of projects in brackets)	
Start year	Energy efficiency projects	Renewable energy Projects
1993	16.8%	18.3%
1994	16.8%	12.9%
1995	28.8%	14.7%
1996	20.1%	14.3%
1997	20.0%	12.3%
1998	12.7%	14.0%
Average	**20.5%**	**14.4%**

If the transaction cost is not kept as low as possible, the integrity of the emissions trading scheme is in danger.

Finally, a collateral effect of the transaction costs and the whole mechanism system is called the „*hotspot*“. That refers to the allowance to pollute thru buying credits for some industries or countries in that the abatement cost is too high. The hotspot problem appears when countries with high abatement cost relax their positions about local GHG emissions because they are compensating all those emissions in other countries, concentrating the emissions in specific regions and the abatement in others different. (Morag-Levine 2007)

6.3 Baseline Definition (Alejandro Gonzalez)

Baseline is essential for the implementation of the Kyoto Mechanisms that have been mentioned before, such a CDM and JI; although is not an easy task due to the large number and uncertainty of the variables that make the baseline.

As a first approach to understand the concept of baseline, the definition of it is:” The baseline is the emission of greenhouse gases that would occur without the intended project activity or policy intervention. Represents the emissions associated with a business-as-usual scenario.” (TSF Green 2012)

As mentioned in the definition is the business as usual scenario, which in other words says how much greenhouse gases will be emitted if nothing is done to reduce them. When a project is implemented, no matter trough which mechanism, the first step is to define the baseline and then define how much is the project is going to help to reduce the emissions whit in its scope, this reduction is defined as additionally.

How much is the project helping to reduce the emission is additionally, it is also defined as:

“For Joint Implementation and Clean Development Mechanism projects, emissions reductions must be additional to those that would otherwise occur. Additionality is when there is a positive difference between the emissions that occur in the baseline scenario, and the emissions associated with a proposed project.” (TSF Green 2012)

Figure 5 shows the data for the U.S where the blue line called Reference it’s the baseline for the total emissions of the country, then there are some other colour lines that represents the levels of different scenarios in reference the 1990 emission level. The additionality of a specific project contributes can only be determined once the baseline has been assessed.

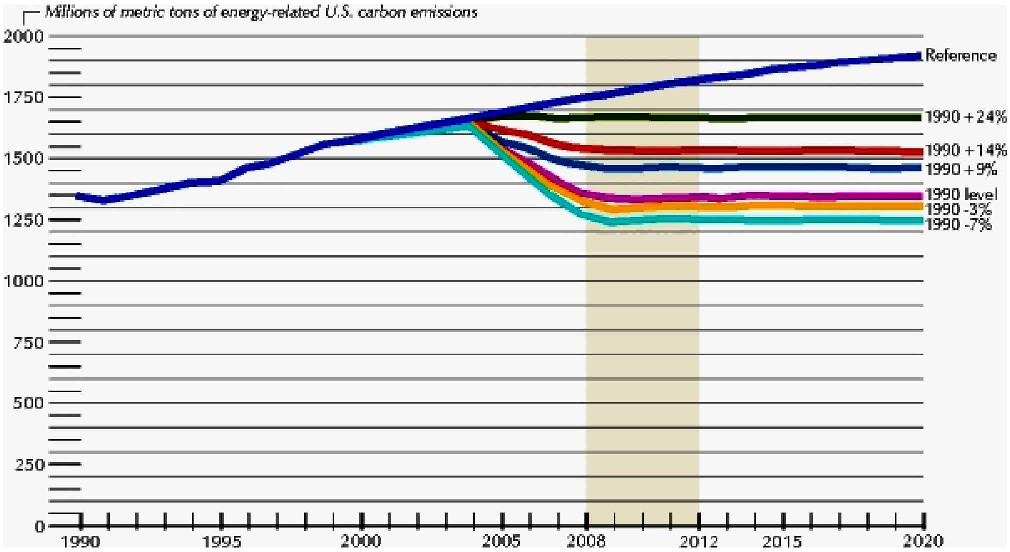

Figure 5: Millions of metric tons of energy related U.S. carbon emissions

6.4 Baseline determination (Alejandro Gonzalez)

The Kyoto protocol main objective is to reduce the total greenhouse emissions to a -5%

Various approaches can be taken in order to define the baseline but various approaches can be taken to determine the baseline, but the approach must be justified as part of the project validation process.

A baseline has to be determined for a specific project or group of projects, the UNFCCC has developed a database were all the approved methodologies used for baseline determination, are available for reference. Some projects are quite well developed and well know (such as micro hydro power generation), therefore they have a standard methodology based on experience of similar projects.

For specific and non-standard projects sometimes new methodologies have to be developed which causes the project to increase it cost. If a specific an approved methodology is unclear or ambiguous, request for clarification can be submitted and clarified. (UNFCCC-a 2012, 6)

The database is arranged in their scope and the mitigation activity of the project. Under scope we find the Energy sector which is divided in the following:

1. Energy Generation
2. Energy Supply

3. Energy Consumption

a. Industrial

b. Residential

c. Transport

(UNFCCC-a 2012, 7)

Once the scope categorization is done, then a categorization in terms of mitigation activity is applied, that states what is the nature of the project. The different types of projects are covered under the following:

1. Renewable Energy

2. Energy Efficiency

3. Fuel Switch

4. GHG destruction

5. GHG avoidance emission

6. GHG removals by sinks

(UNFCCC-a 2012, 7)

Depending on the project type, and the scale of it four main methodologies can be found:

AM - Approved Methodology

ACM - Approved Consolidated Methodology

AMS - Approved Methodology for Small Scale Projects

ARAM - Aforestation and Reforestation Approved Methodologies

(UNFCCC-a 2012, 9)

Whether a project is implemented on a standard methodology, a new methodology or any of the above methodologies, the process of setting a baseline has to follow some criteria.

A baseline shall be established:

1. On a project-specific basis and/or using a multi-project emission factor.

2. In a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and key factors.

3. Taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector;

4. In such a way that emission reduction units (ERUs) cannot be earned for decreases in activity levels outside the project activity or due to force majeure.

5. Taking account of uncertainties and using conservative assumptions.

(UNFCCC 2006)

6.5 Baseline Implications (Alejandro Gonzalez)

The determination of a baseline has a lot of implication due to the complexity of the process and the uncertainty of the variables involved a third but not less important is fraud.

This is due to the fact that the Emission Reduction Units (ERU´s) are accredited for the implementation of the Kyoto mechanisms based on the reduction of emission between the baseline and the measured emissions with the implementation of the project. Therefore the bigger the gap between baseline and the measured emissions; the bigger the profit. This can lead to some frauds.

Among the issues that arise due to the determination of the base line we can find the following:

6.5.1 Cheating

Investors and host of the CDM and JI projects have the same goal in mind, to maximize the emission reduction through the project, which at the end it is shown as a profit maximization. Therefore it is possible for them to overstate the possible emission reduction.

To prevent cheating some recommendations are to agree on a methodology to calculate where the emission levels of a country would be without the project. A single standardized methodology for designing forecasting models and amassing data would be required, to be drawn up by the scientific and technological advisory subcommittee of the UNFCCC. (A. Michaelowa 1998, 82)

6.5.2 Forecasting Uncertainty

Different methods are being used producing highly different results. The main problem is that the emission levels, for the baseline, have to be forecasted for the entire life time of the project, which in the case of sequestration projects can take up to a century; forecasting emission levels in such a long period of time will be pure guesswork. (A. Michaelowa 1998, 82)

One of the main sources of information for the determination of baselines is the IPCC; but the difference between their Scenarios are highly variable, which makes even small projects, within a scope of 5-10 years, hard to define their baseline. (A. Michaelowa 1998, 83)

6.5.3 Political distortions of baselines

The problems to determine a country related baseline, can be used a political lever when this baseline is overstated. Evidence has been found that some countries tend to do so, in order to underline a negotiating position that offers high reduction from the overstated baseline. These country baselines can eu used to lure investors to invest in their country, and therefore benefiting from them. At the end not only the greenhouse gasses reductions are not achieved and the problem continues. (A. Michaelowa 1998, 84)

6.5.4 Median base line

When a new power generation project, with low emission factor, is going to be implemented it is hard to define which technology it is going to replace, since the project is not replacing something that was in place. For this scenario the baseline should be calculated on the country´s energy mix, which can underestimate the possible reductions. This can create a low profitability when the baseline is set to conservative and the emissions reductions are more, the project will only get paid by the qty stated in the project documentation. (A. Michaelowa 1998, 84)

6.5.5 The “no-regret” projects

“No-regret” projects are the ones that have a social benefit, most of the times these projects are implemented by countries, because their externalities benefit the whole population, pollution reduction projects are common for these types of projects.

The issue arises in the economist community to define if these projects should be included in the base line of individual projects that have a private investor behind and is looking forward to maximize his profit. Some argue that there are no “no-regret” projects, that otherwise they would have been already implemented, and some others say that somewhere between 10%-

30% of today´s GHG emissions can be avoided with this kind of projects. (A. Michaelowa 1998, 83)

6.6 After Kyoto Scenario (Alejandro Gonzalez)

The Kyoto protocol had an expiry date of 31st December 2012, which before this date it created a lot of uncertainty about the continuity of the protocol and therefore of the mechanisms to reduce emissions.

The seventeenth Conference of the Parties (COP 17) to the United Nations Framework

Convention on Climate Change (UNFCCC) took place in Durban, South Africa in December 2011, where agreements regarding the continuity of the Protocol were achieved. (World Bank Institut 2012, 45)

In short terms three were the main agreements that surfaced as a result of the COP 17

1. The Kyoto Protocol will see a Second Commitment Period (2013-2017 or 2020)

2. Launch of the Green Climate Fund to scale-up long-term climate finance to developing countries.

3. Provision for a roadmap toward a global legal agreement on climate change by 2015 (the “Durban Platform”)

(World Bank Institut 2012, 45)

For the current paper is only important that the Protocol will see a second period and the launch of the “Durban Platform”.

6.6.1 Kyoto Protocol: Second Commitment Period

With the agreement that the Kyoto protocol will see a second period under “provisional application”, which means that will entry in force with pending ratification of the parties, it will give time to prepare the proper substitution: “The Durban Platform”.

This second period starts the 1st of January 2013 and concludes at the end of 2017 or 2020 (yet to be decided) and it is still pending to define the quantified emission limitations or reductions objectives (QERLOs). In other terms the objectives per country in GHG reductions were to be defined when the source was printed. This second term gives continuity and legal certainty to the implementation and development of the Clean Development Mechanisms (CDM). (World Bank Institut 2012)

The parties expected to ratify the second commitment are: 27 EU States, Croatia (upon ascension to the EU), Norway, Switzerland, Iceland. In the other hand Canada decided to withdraw from the Protocol in late 2011 and was effective in December 2012; Japan and the Russian federation remain signatories of the Protocol but they have decided not to participate in the second period. Australia and New Zealand are still pending to confirm they participation (World Bank Institut 2012)

6.6.2 The Durban Platform

The Durban platform is a roadmap to provide a global legal framework agreement on climate change by 2015 that will be applicable for all parties' signatories of the agreement. It also acknowledges that more ambitious targets of GHG reductions have to be implemented, in order to mitigate climate change. (World Bank Institut 2012, 47)

The Durban platform recognizes that changes have to be made to the current KP to be successful in the reduction of emissions; it identifies the need to ensure progress on other key negotiating issues, namely adaptation, finance, technology development and transfer, transparency of action, and support for capacity building. Two of policies that aim to address these issues, which have already shown some progress are: the continuation of the CDM reform and the development of new market mechanism. (World Bank Institut 2012)

Regarding the CDM reforms that aim to make it more efficient and effective, increase the impact of the project, use of standardized baselines and the use of simplified additionality approaches; Carbon capture a sequestration are also available for CDM eligibility. (World Bank Institut 2012)

The biggest changes in the CDM implementation are Standardization and Streamlining administrative procedures

1. Standardization

    •Replace individual analysis by pre-approved values or assumptions

    •Create sector specific base lines emission factors andadditionality

2. Streamlining administrative procedures

• Merger of two procedures to handle post-registration changes into one step Eg; deviations from the monitoring plan and project design changes

6.6.3 New Market Mechanisms

The new market mechanisms led to various approaches, which not only includes the opportunitiy to access financial resources from the markets in order to increase cost-effectiveness and to promote mitigation actions. (World Bank Institut 2012)

The various approach is oriented to include: also no-market based projects, as well as GHG crediting programs that have been developed outside the UNFCCC and the establishment of new market mechanisms (NMM), that still have to be developed by the Conference of the parties. (World Bank Institut 2012)

The guideline for the development of the NMM is based on the following premisses:

1. Stimulate mitigation across broad segments of the economy (i.e., go beyond a project-by-project approach)
2. Safeguard environmental integrity
3. Ensure a net decrease and/or avoidance of global GHGs
4. Assist developed countries to meet their mitigation targets
5. Ensure good governance and robust market functioning and regulation

(World Bank Institut 2012)

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7 The European Emission Trading Scheme (by Johannes Pelda and Michael Haß)

7.1 Organization of the European system (Michael)

The European Union Emission Trading System (EU ETS) was implemented in 2005 as a mechanism to reduce emissions of carbon dioxide (CO_2). Ever since the system was expanded in 2008, it also considers other common greenhouse gases such as methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbon (cfc) and sulfur hexafluoride (SF_6).Besides the 27 EU member states, the EU ETS is also in operation in Norway, Iceland, and Liechtenstein. Emissions of more than 11,000 power stations and energy intense industry plants (e.g. combustion plants, oil refineries, iron and steel works, as well as cement, glass, and paper industries) with an installed power capacity above 20 MW are subject to the ETS. Thereby, 50 percent of the member states' CO_2 emissions and 40 percent of the member states' total greenhouse gas emissions (including CO_2) are covered by the EU ETS (compareFigure 63) (European Commission: Emission Trading System, 2012).

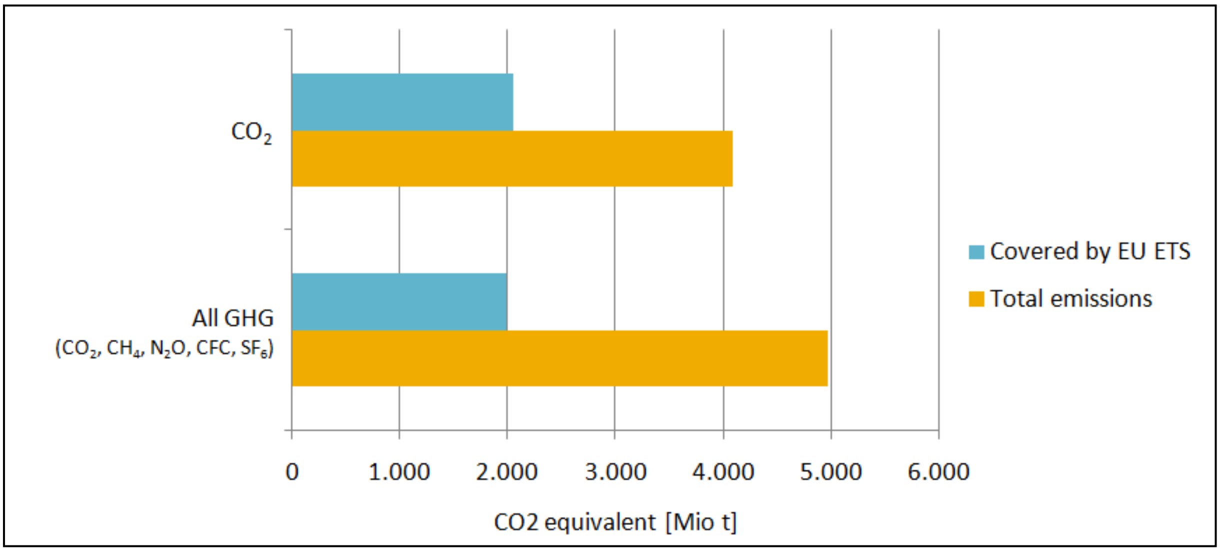


Figure 63: EU ETS cover ratio of member states' emissions* in 2008 (own illustration, based on (European Commission: Emission Trading System, 2012)); *=not including Norway, Iceland and Liechtenstein

The European system works on the "cap and trade" principle. All affected companies with an installed power capacity above 20 MW receive emission allowances. At the end of each year companies have to surrender a quantity of allowances which covers their own emissions. If a company has fewer permits than it emitted, fines will be imposed. Furthermore, emission allowances can be traded amongst the companies. For example, a company that reduces its emissions may sell not required permits to another company that emits more than it keeps allowances. The cap limits the total number of allowances available and ensures that they have a value. It will be decreased over the years to assure that stated emission reduction targets as from the Kyoto protocol will be achieved.

Within certain periods the mechanisms of the EU ETS are revised to evaluate the systems' efficiency and undertake corresponding adjustments if necessary. Up to now, three phases can be distinguished; phase one from 2005 to 2007, phase two from 2008 to 2012, and phase three which started recently in the beginning of 2013 and which will last until end of 2020. Due to some changes in the regulations, the three phases are also called trading periods.

In the following, the three main steps of the system; determining the amount of total allowances, allocating the allowances, and trading allowances will be described in more detail.

7.1.1 Determination of allowed amount of emissions

As a first approach to determine the total amount of emission allowances each member state has to create a national allocation plan (NAP) and report it to the European Commission. The NAP comprises a list of all the nation's affected installations and their required amount of allowances. The European Commission will than assess the NAPs, based on criteria set in the Directive on Emission Trading(Directive 2003/87/EC of the European Parliament, 2003). For instance, it is checked if the proposed total quantity of allowances is in line with a member state's target from the Kyoto Protocol. The proposed amount must also be in accord with potential, including the technological potential, of emission reduction. Furthermore, there must not be any discrimination, unequal treatment, or preference of certain companies or sectors. Another requirement of the plan is to suggest measures how new entrants can begin participating in the Commission's scheme in the member state concerned. Moreover, clean and energy efficient technologies need to be taken into account in a nation's allocation plan (Directive 2003/87/EC of the European Parliament, 2003). The European Commission has the possibility to reject a member state's NAP if it thinks one of the named or of the several other criteria of the Directive is not considered sufficiently. In this case the member state has to work over the plan and to face up to the Commission's assessment again.

7.1.2 Allocation of allowances

Basically, there are two different options for allocating the emission permits: auctioning and free allocation. The member states agreed on allocating the major share of allowances for free, at least in the beginning. The idea behind is, that within the context of international competition certain energy-intense industries should not be put at an economic disadvantage. The engagement in reducing emissions of different countries varies tremendously and even amongst developed countries cannot be assumed similar. Furthermore, this measure aims at obviating the so called “carbon leakage”. It describes the effect of companies shifting their production to other countries with fewer restrictions on greenhouse gas emissions to avoid costs related to climate policies.

As a result, not less than 95 percent in the first phase, and 90 percent in the second phase were given to the industry at no charge. Whether the remaining share of 5 respectively 10 percent was auctioned or allocated freely as well, was decided by each country itself.Figure 64 gives an overview of the extent of auctioned permits.

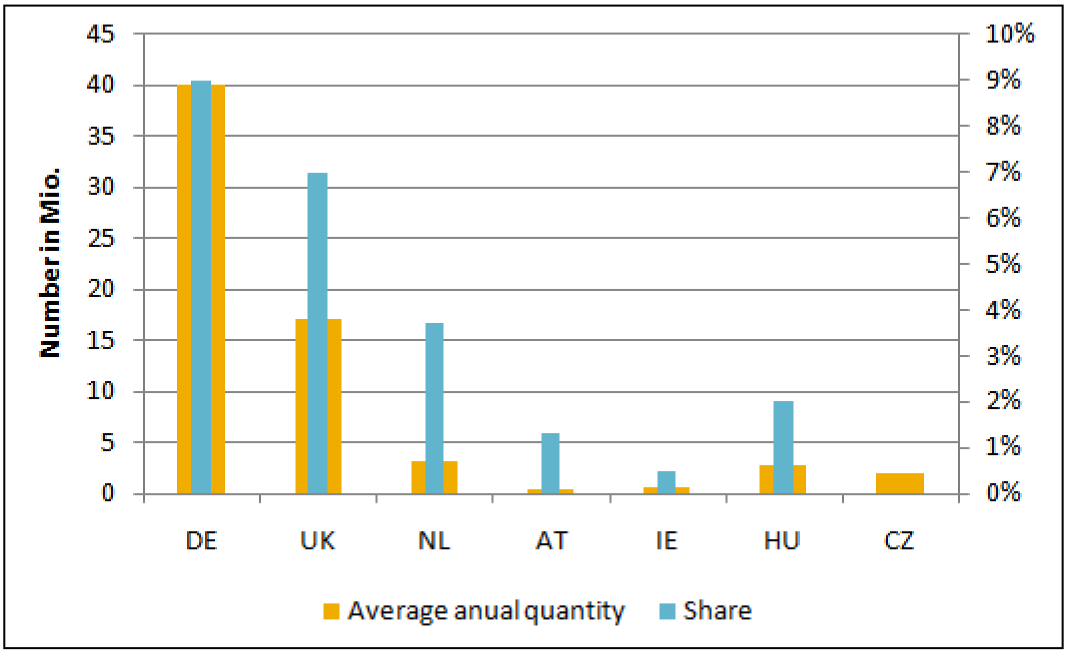


Figure 64: Auctioned emissions for several member states(own illustration, based on (European Commission: Emission Trading System, 2012))

In terms of total numbers Germany auctions the largest amount of allowances. It is by far the largest emitter in Europe and therefore allocates the most permits. However, the blue bar indicates, that Germany also auctions the biggest share of permits. With nine percent it is close to the stated maximum of ten percent, whereas other countries, e.g. Ireland and Czech Republic sell less than one percent.

7.1.3 Trading the allowances

In principle, anyone can trade in the carbon market. However, mostly, energy companies and industrial companies which are obliged by the EU ETS trade with emission permits. Besides other, rather national platforms, the European Energy Exchange (EEX) has established itself as the common transitional auction platform.

7.1.4 Lessons learned

Especially, for the principle's first two steps, determining the required amount of allowances followed by their allocation, there were some lessons learned during the first trading period that brought some changes for the second phase. For instance, did the member states find the national allocation plans too complex and struggled to provide the required information. On the other hand, the European Commission had to assess 30 differently designed national allocation plans, which was a time-consuming process. Therefore, standardized processes and documents were created to make the NAPs simpler and more transparent.

Furthermore, the emission cap turned out to be set too high. That is, supply of emission permits exceeded demand, so the amount of allowances needed to be reduced to make the system work at all.

7.1.5 Functioning of the EU ETS

The system comprises a centralized Union registry which ensures the accurate accounting of all allowances. Comparable to a bank, the registry keeps track of the ownership of allowances held in electronic accounts, the annual verified emissions, and their reconciliation. Moreover, it logs all transactions amongst accounts and ensures that they are consistent with the EU directive and the ETS rules. The main types of transactions are creation, free allocation, auctioning, trading, surrendering for compliance, and finally deletion of allowances (European Commission: Emission Trading System, 2012).

A crucial factor for the functioning of the system is the so called "compliance cycle" (see Figure 65). According to an approved monitoring plan, companies need to monitor their emissions transparent, consistent, and accurate, to subsequently report them to the European Commission. The whole process of monitoring and reporting will be verified by an accredited verifier. Eventually, an equivalent amount of allowances will be surrendered from the companies' account in the registries.

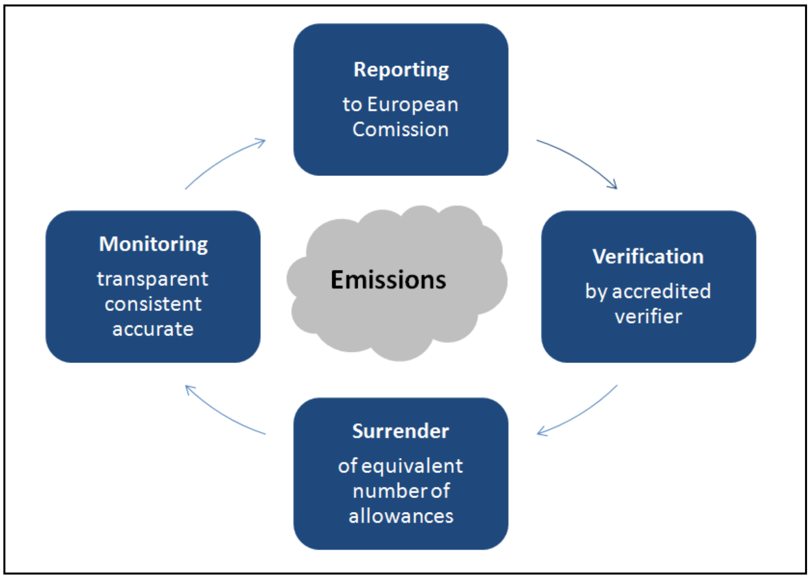


Figure 65: Compliance cycle of the EU ETS (own illustration)

To motivate emitters to keep enough allowances to cover their emissions, the European Commission will penalize additional emissions with a fine. During the first phase a company had to pay 40 € per additionally emitted tone and 100 € during the second phase. In addition, the required amount of permits for the surplus emissions needs to be bought afterwards. That is, paying the fines does not save a company from buying the required amount of allowances. This is important to avoid gaps, for example when prices for permits increase enormously and exceed the penalty prices.

7.2 Implementation of the EU directive in Germany (Johannes)

In consequence of the Kyoto-Protocol from 1997 the government of Germany committed to reduce the “Kyoto-Gases” by 21 percent regarding 1990 till 2012 latest. Additionally, the German economy enrolled to decrease their emission of “Kyoto-Gases” by 35 percent regarding 1990 till the year 2012 (http://www.umweltbundesamt-daten-zur-umwelt.de).

Thirteen years later, the EU directive 2003/87/EG was passed. To convert this directive into German law, the federal cabinet enacted the first national allocation plan (NAP I) within the Greenhouse Gas Emission Allowance Trading Act (TEHG) on the 31st of March 2004. The first NAP was valid for the so called first trading period from 2005 to 2007. Within the national allocation plan I all sectors had to reduce their emission by about 2.91 %.

Based on the NAP the Allocation Ordinance (ZUG) defines the total amount of CO_2 emission certificates, concretises the allocation of the certificates, and includes the aim of emission of the industrial and energy sector, the traffic sector, homes and commerce sector and trade as well as service sector. For each year of the period of NAP I, all installations receive as much emission permits for free as they will have emission in the considered year. If an installation is emitting more than it has got emission permits, a penalty has to be paid (Bundesministerium für Umwelt, Nationaler Allokationsplan für die Bundesrepublik Deutschland 2005-2007, 2004).

Along the TEHG the Federal Environmental Agency (UBA) and its German Emissions Trading Authority (DEHSt) enforces the Project Mechanisms Act (ProMechG) in September 2005. The Project Mechanisms Act is the national foundation to generate credits for emission reductions that are achieved through projects in the framework of Joint Implementation and Clean Development Mechanism. These credits can be used for EU emissions trading (Project Mechanisms Act, 2005).

In the year 2006 the second national allocation plan (NAP II) was passed for the trading period from 2008 to 2012.This time the amount of CO_2 permits for each sector was determined on the basis of the average CO_2 emission in the years from 2000 to 2005. Furthermore, the NAP II considered sectors differently: A company which is in an international competition has to reduce its emissions by 1.25 percent. Inefficient coal or lignite power plants have to reduce their emissions by 15 percent and so forth (Bundesministerium für Umwelt, Nationaler Allokationsplan 2008-2012, 2006).

To obtain the average amount of CO_2emission for not yet covered emitters, the federal cabinet additionally adopted the Data Collection Ordinance 2012 (DEV 2012). This law was the basis to collect data of companies’ amount of emissions which have not been determined so far.

Overall, the NAP II is stricter than the NAP I. In the NAP II the emission trading shall pay more contribution to climate protection. Therefore, the NAP II has got a cut in the overall amount of tradable emission permits from 499 million tons CO_2 per year down to 482 million tons CO_2 per year. Additionally, special rules were removed as well as less combinations of allocation are possible: This shall lead to a higher transparency. Also other changes in the NAP II shall fulfill the requirements which were set by the EU due to failures in the NAP I (Bundesministerium für Umwelt, Nationaler ALlokationsplan II - Eckpunkte und Vergleich mit NAP I, 2006).

7.2.1 Competences of the Greenhouse Gas Emission Allowance Trading Act

The provisions of the TEHG are administrated in the building of the federal environmental agency. Due to the regulative framework it is responsible for the capping, monitoring and reporting system of emission trading. Furthermore, it allocates the emission permits and manages the accounting system.

7.2.2 Influences on the Greenhouse Gas Emission Allowance Trading Act

In addition to German´s aim of the cost efficient reduction of greenhouse gases, the TEHG also agreed to economic requirements. Therefore, the lawmaker made sure that the German economy is still competitive to the international market. Furthermore, they tried to strengthen the industrial location of Germany by stimulating investments and innovations. The German politic challenged the lawmakers to ensure the energy supply of Germany and further a reasonable pricing by the energy supplier (Bundesministerium für Umwelt, Nationaler Allokationsplan 2008-2012, 2006).

7.3 Situation in Germany

7.3.1 Share in CO_2 emissions in Germany

The federal environmental agency of Germany defines four sectors of CO_2 emitters:

- Energy sector
- Homes and small consumers
- Traffic
- Industry and commerce

These sectors represent the overall CO_2 emissions. The allocation of the overall CO_2 emission to the different sectors is shown in Figure 66.

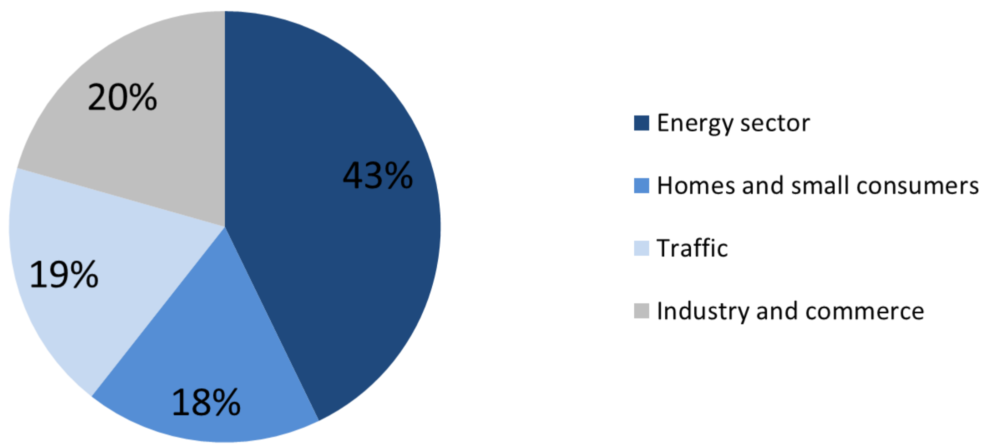


Figure 66: Share in CO_2 emissions in Germany by sector (http://www.umweltbundesamt-daten-zur-umwelt.de)

The energy sector has got a remarkable share in emissions. Here the government tries to reduce the emissions by installing new, clean technologies and increasing efficiency. The funding of renewable energy sources within the EEG law shall also ensure that more power comes from renewable energy sources. However, since Fukushima the government is finally forced to shut down nuclear power plants. The loss on electrical power shall be compensated by mainly offshore wind parks, and coal power plants. The so called “Desertec-project” aims to use thermal solar power in the Sahara which can be delivered to Germany either by gas pipe lines or high-voltage transmission.

Homes and small consumers are reducing emissions by several approaches. Thereunder better heat insulation of homes and the trend towards gas fired furnace reduce their share in CO_2 emissions. Combined heat and power systems increase the efficiency of energy production and also create a more flexible energy supply.

Industry and commerce sector is urged to develop more efficient processes to reduce their greenhouse gas emissions. Germany’s biggest logistic service “Deutsche Post”, for example, offers CO_2 neutral distribution. Overall, industrial installations have got many special rules and freedom of emitting greenhouse gases. The start of the third trading period will bring changes and more stimulation to develop more environmental friendly processes and thus reduce CO_2 emissions.

The civil transport sector has some programs to force the use of renewable energy sources. The German railway company “Deutsche Bahn” has established green cards which support the development of renewable energy sources by using the services of “Deutsche Bahn”. The price increase in cars, such as their maintenance as well as fuel costs, makes private car sharing more attractive. Also services like “Mitfahrgelegenheit”, which help to use cars to full capacity, can lower cars´ emission. Further programs will also enhance the efficiency of transport and thus reduce the greenhouse gas emission in this sector.

7.3.2 Allocation of permits in Germany

As seen in Figure 67, there are altogether more permits for the sectors than their total emission.

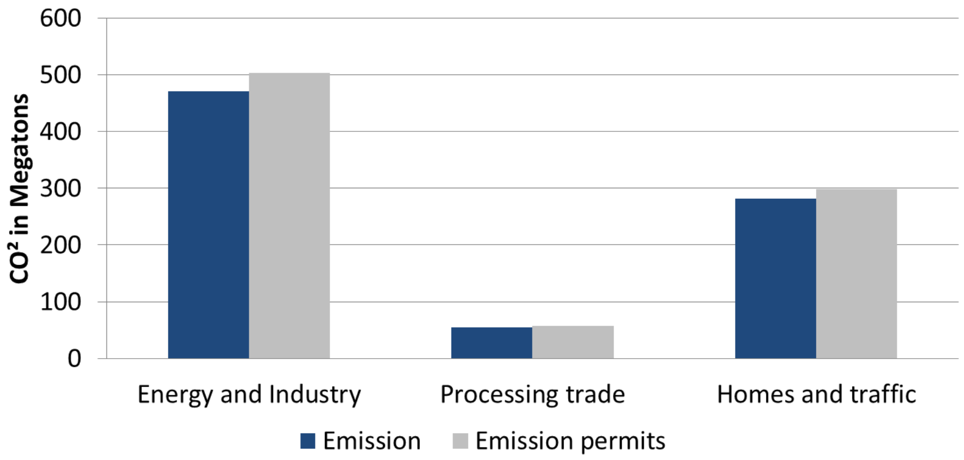


Figure 67: Allocation of permits in Germany following the NAP II (Bundesministerium für Umwelt, Nationaler Allokationsplan 2008-2012, 2006)

As mentioned in chapter 7.1 the permits are allocated to individual companies based on average emission within the period 2000 to 2005. The average emission is calculated by taking all companies in the same field into account. Consequently, only heavy emitters will be forced to reduce their emissions by the NAP II. For heavy emitters it is in terms of finance more logically, taking into account future development, to reduce emissions by new technologies. Buying additionally permits will be more expensive at the end, if tradable permits start to be scarce goods.

How the overall emission budget of 972 million tons of CO_2 equivalent is broken down to tradable emission permits shows Figure 68. The permits for emission trading cover about 55 percent of total emissions of Germany.

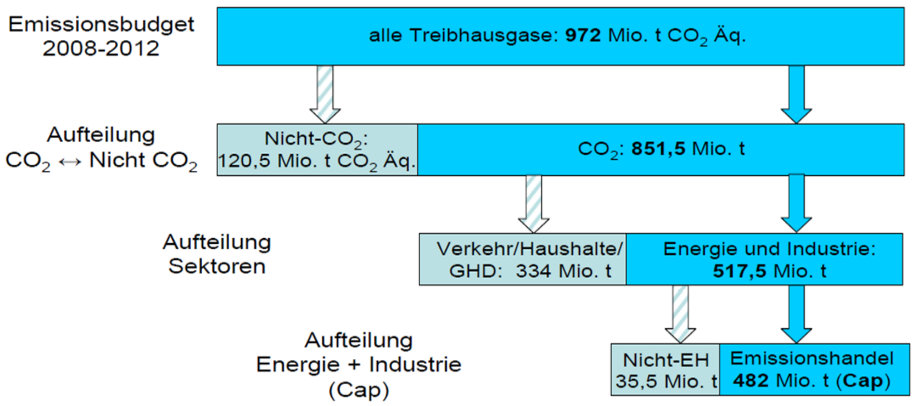


Figure 68: Allocation of the total amount of emissions for the year 2008-2012 (Bundesministerium für Umwelt, Nationaler Allokationsplan 2008-2012, 2006, S. 19)

7.3.3 Achievements of the Greenhouse Gas Emission Allowance Trading Act

In the year 2011 the emissions in Germany were about 917 million tons. To come up to the Kyoto-aim the average amount of emission must not exceed 974 million tons per year from 2008 to 2012. In this period the limit was underrun by 154 million tons, altogether (http://de.statista.com/, 2012). In the year 2010 a slight increase of emissions is recognizable. This is namely due to the economic pick-up and the frigid weather condition (http://www.umweltbundesamt-daten-zur-umwelt.de, 2012). Overall, emission of greenhouse gases was reduced by 24% till the year 2010. Figure 69 shows the declining greenhouse gas emissions in Germany since 1990.

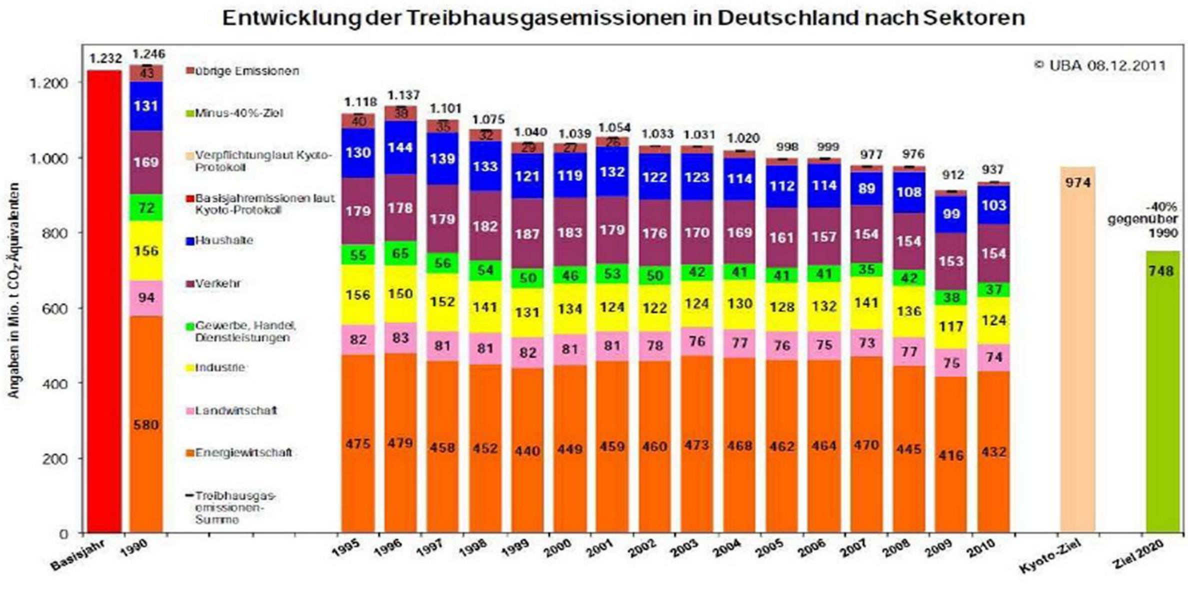


Figure 69: Development of the greenhouse gas emissions in Germany(http://de.statista.com/, 2012)

It is said that the main reason of this declining trend were the economic changes in East-Germany as a consequence of the fall of the iron curtain in the year 1989. In East-Germany the energy production changed dramatically. Old coal power plants were shut down or equipped with advanced technology. Unfortunately, nuclear power plants were also built in Germany to ensure energy supply. Also other effects of German policies are seen in Figure69: Emission of waste industry decreased by 72% due to less landfill and advanced capture of methane. The CO_2 emission of houses declined due to funds of heat insulation and the obligation of private homes to install new and more efficient firing. In the energy sector further development towards renewable energy sources perform less CO_2 emissions. A main driver was the EEG which supported renewable energy systems financially (http://www.umweltbundesamt-daten-zur-umwelt.de). In the year 2009 the CO_2emissions of Germany show a lower level. Despite of a higher annual, average temperature in the year

2009 (Wetterdienst, 2009), mainly the world economy crisis was responsible for the low CO_2 emissions in Germany. On the one hand the crisis reduced the demand on electricity. Thus the energy sector emitted 7.7 % less CO_2. The emission of the industry sector, on the other hand, dropped nearly 9 %. Consequently, the overall emission was 27 % lower than in the year 1990 (Schmitt-Roschmann, 2009).

7.4 Development of emissions and emission prices (Michael)

7.4.1 Emission reduction

In 1990 the base year of the Kyoto protocol, the EU 15 emitted 4 265 Mio t of CO_2 equivalents. In 2009 it have been 3 724 Mio t, which equates to a reduction of about -12.7 %. That is the stated goal according to the Kyoto protocol of a reduction rate of -8 % could be even exceeded. The emissions of the EU 27 summed up to 5 589 Mio t of CO_2 equivalents in 1990 and 4 615 Mio t in 2009, which equals a development of – 17.4 %. The numbers for all 30 EU ETS member states are slightly higher (5 642 Mio t in 1990, 4 670 Mio t in 2009). They are graphically displayed in Figure 70. The EU 27's target for the year 2020 is a reduction of -20 % compared to the Kyoto base year (most chose 1990). With respect to the already achieved reduction rate this target will be fulfilled most likely (Umwelt Bundesamt, 2011).

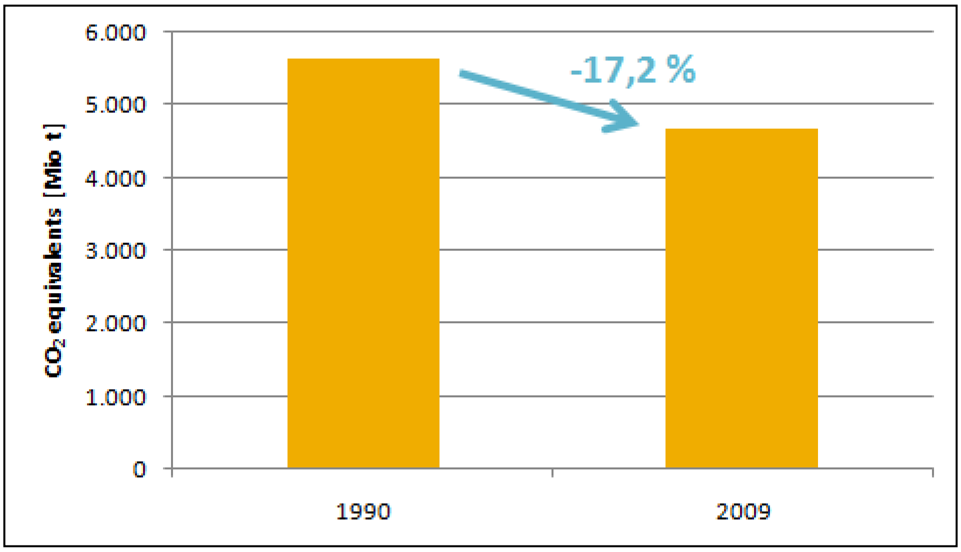
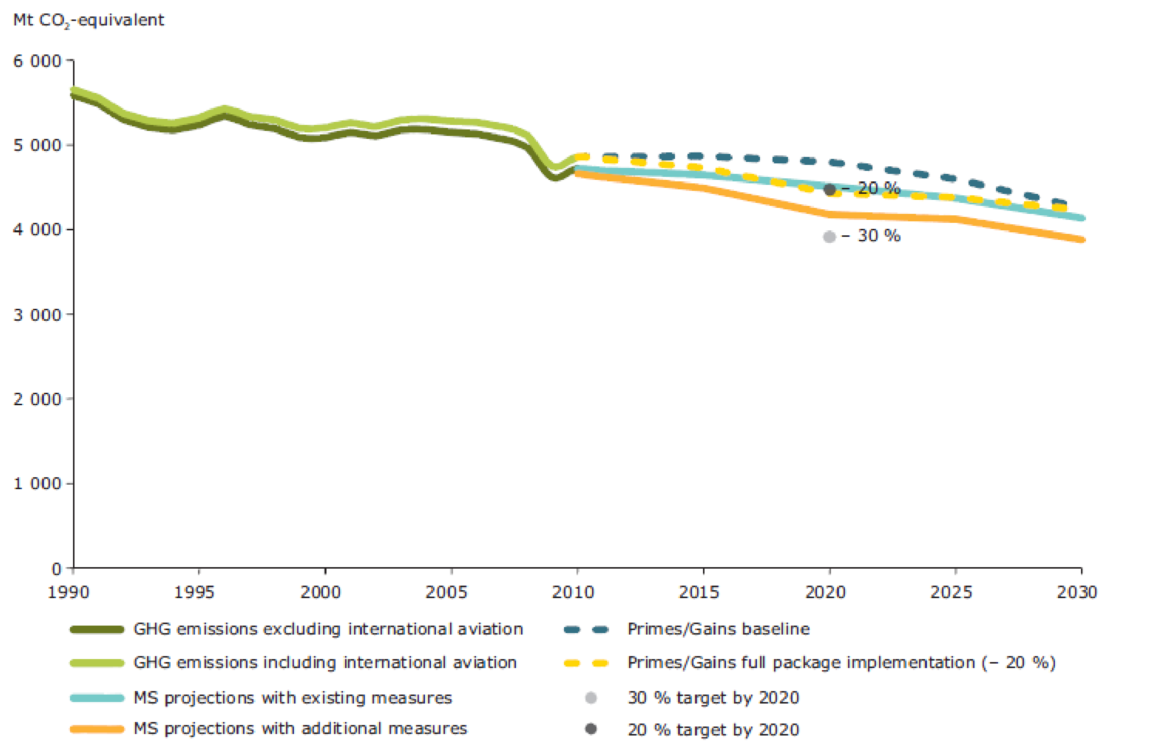


Figure 70: Emissions 1990 compared to 2009 for all EU ETS member countries (Own illustration based on (European Environmental Agency, 2011b), (European Environmental Agency, 2011a))

A more detailed historic development as well as trends of the EU GHG emissions can be derived from Figure 71.



Note: Member State projections do not include emissions from international aviation. Such emissions are included in the Primes-Gains scenarios.

2025 and 2030 projections based on information provided by 12 Member States. For other Member States, 2030 projections were gap filled using the 2020–2025 and 2020–2030 relative trends available from the Commission's scenarios based on the Primes and Gains models.

Figure 71: Trends and projections of EU total GHG emissions (European Environmental Agency, 2011b, S. 12)

Due to the world financial crises the 2009 values were below the expected development. However, according to the trend the 2020 target of a reduction of -20 % can be reached with existing measures.

The emissions of 1990 compared to 2009 by EU ETS member state are shown in Figure 72. The highest reduction rates have been achieved in the Baltic States and other Eastern European countries. This can possibly explained by the implementation of higher environmental standards across the industries after the end of the Soviet Union. However, their contribution to overall emissions is rather small. But also the largest emitters amongst Europe, Germany and UK, reached quite high reductions (-26 % for Germany and -27 % for UK).

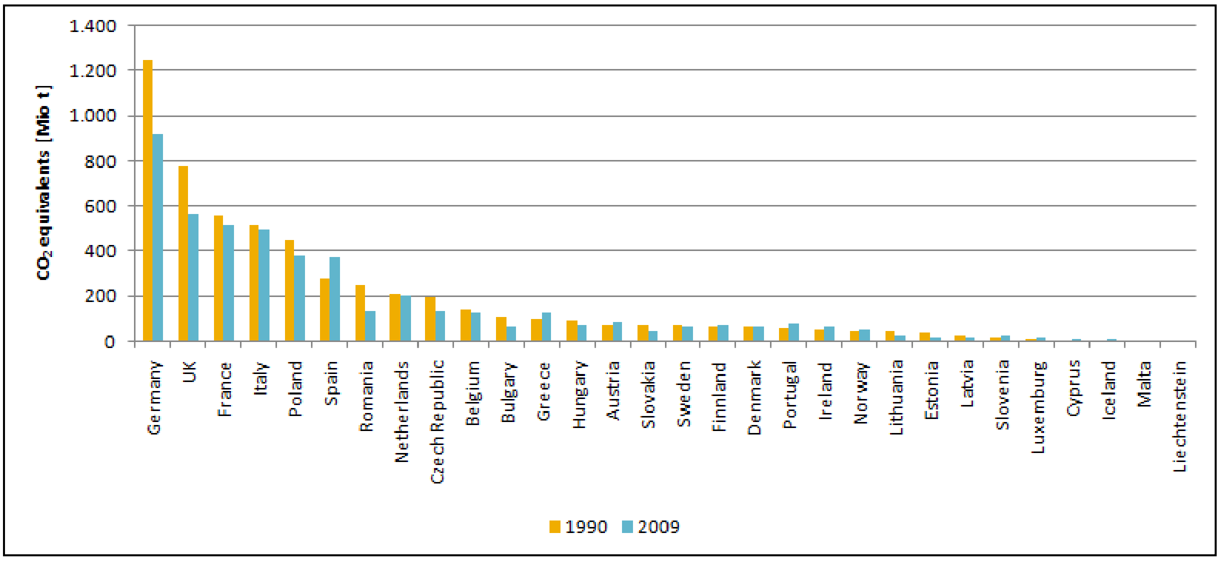


Figure 72: Emissions 1990 compared to 2009 for EU 27 plus Norway, Iceland and Liechtenstein (Own illustration based on (European Environmental Agency, 2011b), (European Environmental Agency, 2011a))

With respect to the member state's industries' different development status the reduction targets amongst the countries varies broadly. Because of the burden sharing some states, e.g. Greece, Ireland, Portugal, and Spain are even allowed to increase their emissions until 2020. That is other countries have to reduce their emissions more dramatically so that the overall European target can be achieved.

7.4.2 Price development

Since most of the allowances are allocated for free their price is mainly influenced by supply and demand. Figure 73 shows the price development at the EEX in € per t CO_2 from the beginning of the EU ETS implementation.

Figure 73: Price development for EU Emission Allowances (European Energy Exchange, 2013)

As can be seen, there is a major price drop towards zero at the end of the first trading period in 2007. The reason for this sudden price decrease is a lack of market transparency. Whereas the overall cap for emissions is known at any times, the current aggregate amount of total emissions is not. Actually, the price drop occurred when first data about cumulated emission amounts were published. At that time it was clear, that the amount of available allowances exceeded the required allowances by far. A similar, though less dramatic trend can be seen towards the end of the second trading period. The main cause for the over-allocation is the allocation method: The distributed amount was mainly estimated based on historical data, neglecting e.g. efficiency improvement and technical development. Nowadays, at the start of the third trading period the price per ton is at about five Euros, which is on a rather level. To improve the ETS’ efficiency in terms of emission reduction, the European Commission has to revise allocation processes and also consider other measures for the reduction of allowances.

7.5 Outlook (Johannes)

The European Union has decided to establish a cap and trade system. In contrary to other systems like carbon taxes, where a certainty regarding emission prices is given, the cap and trade system has the possibility to give certainty regarding emission´s quantity. Furthermore, participants are enabled to use units from another system for compliance purposes. Also a linkage to other compatible ETSs like the Austrian ones, the Swiss ETS or the ICAP is given.

7.5.1 Improvements of the national allocation plan III

The NAP II revealed several mistakes which will be corrected in the NAP III. Firstly, the industry and heating sector are evaluated by taking benchmarks of emission into account. The benchmarks are based on the efficient 10 % of an installation of an industry in Europe. If the company meets the benchmark, they will get all the permits needed for free. Installations that do not meet the benchmark will have a shortage of allowances and the option either to lower their emissions (e.g. through engaging in abatement) or to purchase additional allowances to cover their excess emissions. This system of benchmarks will not have the effect of providing more free allocation to the highest emitting installations anymore. Furthermore, the benchmarks show feasibilities in terms of low-carbon production. Secondly, same rules will apply across all EU member states. Thirdly, the NAP III does not allocate the majority of allowances for the power sector for free, anymore. Additionally, the cap of emissions in the EU will decrease by 1.74 % per year with begin of the third trading period. The NAP III auctions permits to energy intensive industries starting with 20 % in the year 2013 and ending with 70% in the year 2020. It is planed that all permits shall be auctioned from the year 2027 on. Additionally, Europe fund investments into new, high efficient power plants up to 15 % of the investment costs(Loon, 2012).

7.5.2 Other new regulations to reduce CO_2 emissions

Besides existing laws and regulations such as the ECO tax or funds for modernization of building to zero emission houses and better heat insulation other regulations and laws will be enacted in Germany to push further down CO_2 emissions.

Flights are taxed since 2011. Based on the “Luftverkehrsteuergesetz” (LuftVStG) the flight companies are charged for each person they transport. The tax depends on the country the flight is going to. This additional tax shall function as ecological steering concerning the noise and pollution produced by the flight. Further efforts aim to tax the amount of emission concerning noise and pollutant for each plane. This tax could have an effect on pollution around the airport and a more ecological impact. Flight companies will be forced to renew their aircraft fleet towards more efficient and cleaner airplanes (www.umweltdaten.de, 2012).

Cars with low fuel consumption shall get tax support. A car´s emission tax is also in debate. Combined with bicycle programs it can reduce the emission in the traffic sector predictably. Further mandatory blending shall also help to lower the CO_2 emissions. Additionally, renewable fuel sources shall substitute fossil fuel where it is useful and possible. However, this will harm other countries by clearing their forests to grow energy crops. The substitution of fluorinated chemicals is another way to reduce the emission of greenhouse gases (Bundesministerium für Umwelt, Nationaler Allokationsplan 2008-2012, 2006).

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