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Bachelor Thesis

Management of Gas Delivery Contracts

Oil-indexation versus Hub-based Gas Pricing

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Abstract

The European gas market is in constant change and subject to public interest due to the importance of gas as primary energy source. These days, discussions deal in particular with the organization of the gas market. This work presents and evaluates the two gas delivery and pricing methods that are in particular focus: traditional gas procurement through oil-linked long-term contracts and advanced gas procurement via hub trading marketplaces. Oil-indexed gas prices under traditional gas delivery contracts are claimed to be unjustifiable and the contracts are claimed to hinder competition. However, they provide security of supply and demand. In contrast, trading of gas at hubs with pricing mechanisms based on gas-to-gas competition creates competition, more flexibility and higher market chances and is furthermore promoted by EU regulations. However, it bears greater price volatility risks and hub marketplaces are lacking liquidity. Beyond these procurement approaches, this work examines hybrid forms of these as well as alternatives such as LNG and infrastructural issues and their implications on the gas market development. The thesis concludes by providing an outlook onto the future development of gas procurement. A gradual transition to more competitive, liberalized gas market structures is likely to take place, featuring a coexistence of traditional and advanced gas delivery methods in the near future.

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List of Abbreviations

Bcm	Billion cubic meters
CEGH	Central European Gas Hub
CIEP	Clingendael International Energy Programme
CO_2	Carbon dioxide
Ct	Cent
ECC	European Commodity Clearing
EEX	European Energy Exchange
EU	European Union
HFO	Heavy Fuel Oil
ICE	Intercontinental Exchange London
IEA	International Energy Agency
kWh	Kilowatt hour
LFO	Light Fuel Oil
LNG	Liquefied natural gas
MJ	Megajoule
MTOE	Million Tons of Oil Equivalent
NBP	National Balancing Point
NCG	Net Connect Germany
OTC	Over-the-counter
P.a.	Per annum (English: per year)
PEG	Point d'Échange de Gaz (English: Gas Exchange Point)
PFC	Price Forward Curve
PSV	Punto di Scambio Virtuale (English: Virtual Exchange Point)
TPA	Third party access
TTF	Title Transfer Facility
UK	United Kingdom
US	United States (of America)
USSR	Union of Soviet Socialist Republics

1. Introduction

Energy policy is an omnipresent topic in the news. As one of the most important primary energy sources, gas and the gas industry attract increasing public attention in Europe. One reason for this development is the growing consumption of natural gas and its manifold political implications. Special attention is paid to optimal delivery and pricing methods for gas, ensuring energy security, environmental sustainability and to political entanglements between European countries and resource owners. The European gas market and industry are in constant change, not the least because of ever developing EU regulations. Change in general provokes the discussion about whether such change is desirable or not. This is also the case for the gas industry. These days, discussions deal in particular with the organization of the gas market and thus with the question of identifying the preferable gas delivery method and most suitable pricing mechanisms. Some market participants favor traditional gas procurement through oil-linked long-term contracts, whereas others question the status-quo and wish a transition to more advanced gas procurement via hub trading marketplaces. This thesis addresses exactly this discussion. It presents different designs of gas delivery contracts putting a special emphasis on the respective gas pricing mechanisms. Mastering gas procurement becomes an increasingly complicated task while, at the same time, a deep understanding of gas delivery and pricing becomes more important. For this reason, the present work aims at providing an understanding of the different procurement opportunities with their implications and further provides an outlook how the European gas industry could develop in the future.

The procurement and pricing of gas is a challenge, since many issues and parties are involved. These include, among others, governments and powerful market players who influence the market or customers' essential need for gas, making demand inelastic in some situations. The extent to which gas pricing can be influenced by those who purchase gas is worth to be discussed. Especially European countries' influence on gas pricing can be questioned, since gas markets in Continental Europe have developed based on imported gas and import-dependent countries cannot regulate upstream, but have to cope with the main supply decisions taken by gas exporting countries like Russia. Often, this has far-reaching political implications. In fact, the governments of resource-owning states determine or have influence on the important decisions regarding gas exports through state-owned or state-dominated

companies like Gazprom in the case of Russia, Sonatrach in the case of Algeria or Gasunie in the case of the Netherlands (Energy Charter Secretariat, 2007, pp. 27-28).

Upon first sight, there are two opposing options how gas delivery can be managed and priced: either through traditional procurement via oil-indexed long-term contracts or spot trading of gas on so called hubs. However, the future gas market could also evolve into a hybrid version of these two options or yet another, alternative, gas delivery system.

For many years and still nowadays, long-term gas delivery contracts in which gas prices are linked to oil product prices have dominated gas procurement in Europe. However, new delivery methods surged in the market recently. Amongst other reasons this is due to the fact that EU regulators aim at provoking a restructuring of the gas market into a single European marketplace that features competition and liberalized structures. Namely, these new methods include market-based gas pricing and trading of gas at hubs. The complication of this topic lies in the change of persisting structures, since interests of different market participants clash. New market mechanisms would first need to feature enough credibility to all market parties involved in order to represent a common basis for market transactions. The motivation of the present thesis is to examine traditional and advanced gas procurement and their hybrid forms or alternatives in conjunction with implications about gas infrastructure in order to get an understanding in which direction the European gas market could develop in the future and which concerns are implied for the market participants. Thereby, the discussion is focused on Europe as a whole and does not provide an in-depth differentiation between individual countries.

In order to provide a basis for the discussion of gas delivery contracts, Section 2 gives an overview of the European gas market. The work's main focus lies on examining designs of gas delivery contracts presented in Section 3. These include traditional gas procurement through oil-linked long-term contracts (Section 3.1) and advanced gas procurement via hub trading marketplaces (Section 3.2). After providing the fundamentals and functioning of the respective gas delivery forms, both sub-sections address the pricing mechanism under this procurement method, followed by a discussion of advantages and risks. Having evaluated the opposing main delivery options, the work shows possibilities of gas procurement under hybrid forms of both of the before-presented options (Section 3.3). Furthermore, this sub-section includes alternatives to common gas procurement options as derivatives and liquefied natural gas and outlines their impact on the discussion about the desirable gas delivery form. Section 4 concentrates on gas infrastructure, namely on how it produces further gas price

components and, moreover, on its implications for the afore-mentioned gas delivery contract designs. Subsequently, the thesis turns towards an outlook on the future European gas market (Section 5). Taking the previously discussed topics into consideration, this section evaluates the possibilities of future development. Finally, Section 6 concludes with a review of gas delivery contracts and some implications of the findings for their management.

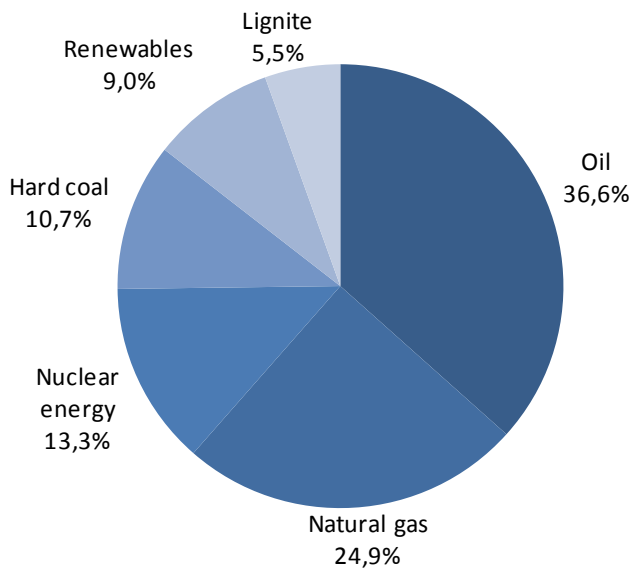
2. Overview of the European gas market

This section serves as foundation for the following sections of the work. It gives a basic understanding of the European gas market. An introduction of the characteristics of gas as a primary energy source (Section 2.1) is followed by an overview of the global gas reserves (Section 2.2) and a short examination of the current gas market situation and regulatory environment (Section 2.3). The focus lies in providing information relevant to the topics in the remainder of the work, whereas a detailed description of all market characteristics is beyond the scope of this work.

2.1 Fossil fuels: Natural gas

Natural gas belongs to the most important primary sources of energy. It constitutes about 24% of the world consumption of primary energy (BP, 2010, p. 41). In the EU, gas holds with 25% a similar share of primary energy consumption as shown in the following figure.

Figure 1: Primary Energy Consumption by fuel (EU27)

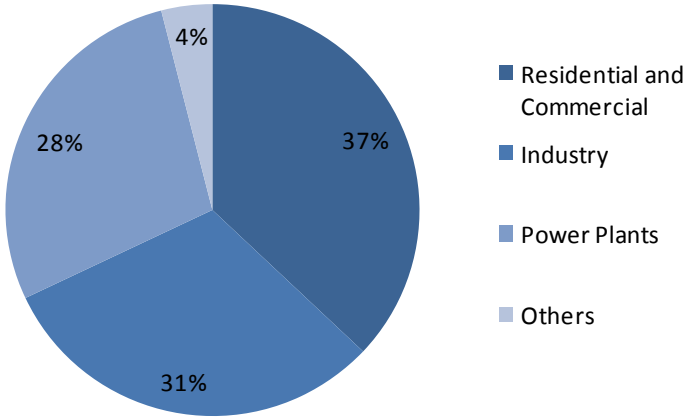


Source: Own illustration based on Eurostat (2010, p. 2)

In Europe, gas is mainly used for heating in households and commercial spaces on the one hand and for heating for industrial purposes on the other hand. Apart from that, gas is increasingly used for power generation and to smaller extents in hybrid applications with

renewable energies and for transportation (Eurogas, 2008). The shares of natural gas sales to the different sectors are depicted in the following figure.

Figure 2: Natural gas sales by sector



Source: Own illustration based on Eurogas (2009, p. 6)

The share of natural gas in the European primary energy demand is expected to rise up to 27-29% by 2030, an increase mainly attributed to higher gas sales for power generation. In contrast, gas sales in the residential and commercial sector are expected to rise only moderately until 2015 and then fall again to current levels until 2030 (Eurogas, 2010, pp. 5-8).

Natural gas can be of two different types, H-gas (high) or L-gas (low). They differ in their calorific value and contain different amounts of methane, which is the main component of gas. H-gas contains more methane (with 87-99% by volume) than L-gas (80-87% by volume), which in turn contains more nitrogen and carbon dioxide. Under atmospheric pressure, gas has an energy density of 35-35 MJ/m^3, only one thousandth of the energy density of oil, but still a higher one than coal. The density is the ratio of mass over volume. Putting natural gas under pressure, energy density can be increased. Cooling natural gas down to about minus 162°C, it can be liquefied and thus transformed into liquefied natural gas (LNG). The energy density of liquefied natural gas (LNG) is higher (about half the one of oil) than the one of natural gas. Gas and oil are easier to handle than coal, but oil and coal are transported and stored with less specific costs than gas and thus easier applied in trading on spot marketplaces. At least, natural gas can be stored in contrast to, for example, electricity, which is important when used for heating due to seasonality in gas demand. Because of the low energy density, transportation and storage costs are high for gas. For transportation and

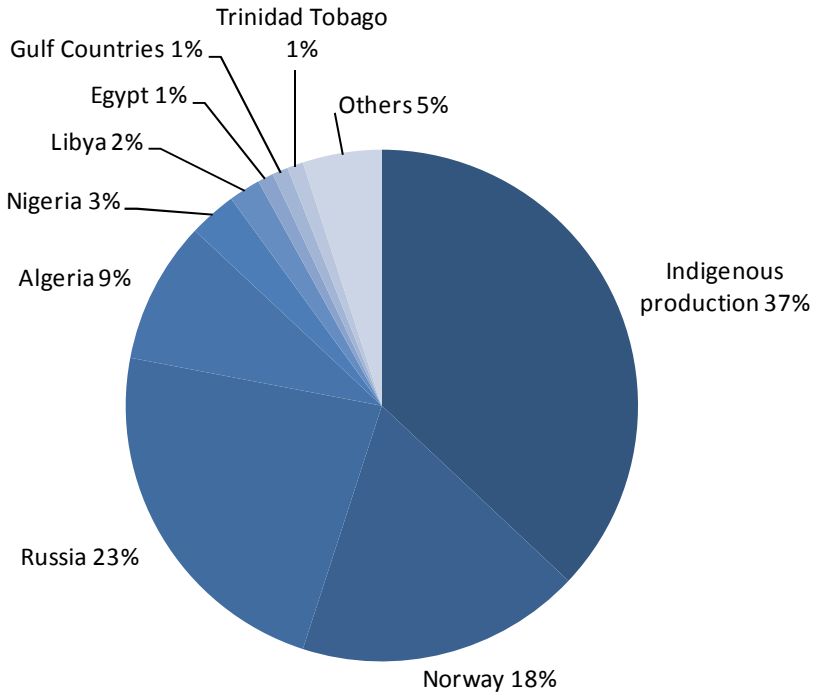
distribution, natural gas, as gaseous aggregate, requires a fixed pipeline infrastructure. This makes specific costs particularly high. Due to high infrastructure costs, most gas markets are still regional in character (Energy Charter Secretariat, 2007, pp. 35-59). But the easy handling and control of gas makes it popular as a means of distributing energy. Besides, natural gas produces low emissions of CO_2 and low levels of pollutants, above all in contrast to oil and coal (Eurogas, 2008, p. 3). This makes natural gas particularly important in the future for a sustainable energy development in Europe. Because of these advantages the use of natural gas is expected to increase further and its importance for the European energy market is augmenting. Especially its role for the development of a sustainable energy future for Europe will be significant (Eurogas, 2010, p. 5).

2.2 Global gas reserves

Natural gas is found in underground reserves. Gas reserves in Europe are not very abundant, but still more frequent compared to oil reserves. The world's gas reserves are concentrated in manly a few countries. At the end of 2009, Russia pertained 23.7% of the world gas reserves, Iran 15.8%, and Qatar 13.5%, while other countries' reserves did not exceed 4.3% (BP, 2010, p. 22). Since Europe does not have great gas reserves, gas in Europe is mostly imported. Thus, it is dependent on other countries' gas supplies. As shown in the following figure, in 2008, 63% of the EU's[1] gas needs were imported and the number is still expected to rise significantly in the coming decades. The main part of imported gas in 2008 was obtained by Russia (23%), followed by Norway (18%) and Algeria (9%) (Eurogas, 2009, p. 7).

[1] EU27, Norway not included

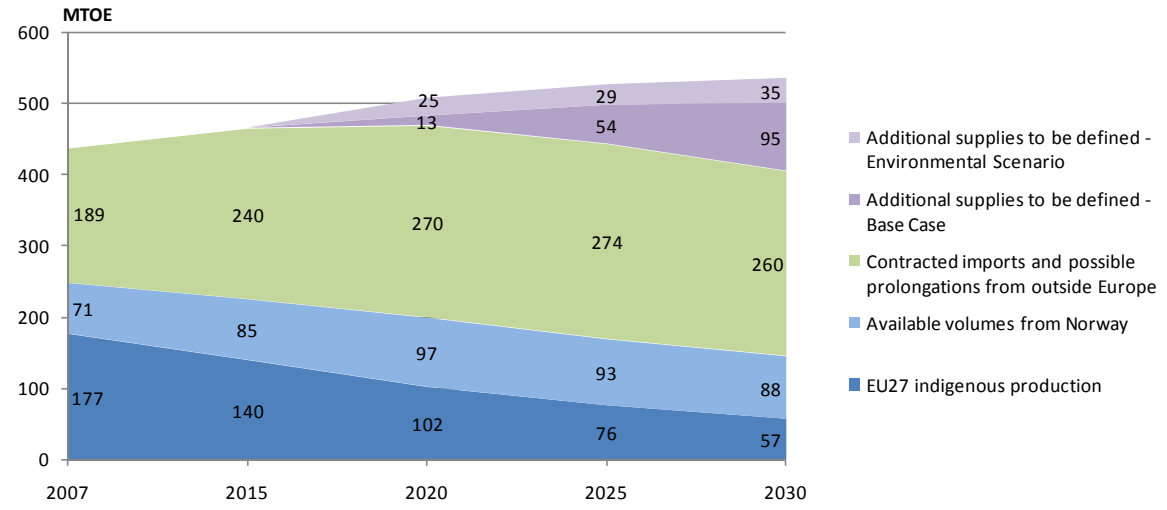
Figure 3: EU27 gas supplies



Source: Own illustration based on Eurogas (2009, p. 7)

In general, gas demand is increasing in Europe, whereas indigenous production is declining. Unexpectedly, demand declined in 2008 and especially in 2009 as a consequence of the financial crisis. Still, it is expected to grow between 14% and 23% in the EU until 2030. Consequently, in the future even more of Europe's gas needs will have to be imported. Expectations are that until 2030 the European gas market (including Norway) will need around 70% of its gas from regions outside Europe (Eurogas, 2010, p. 9). Figure 4 (see next page) summarizes the outlook for Europe's gas supply until 2030.

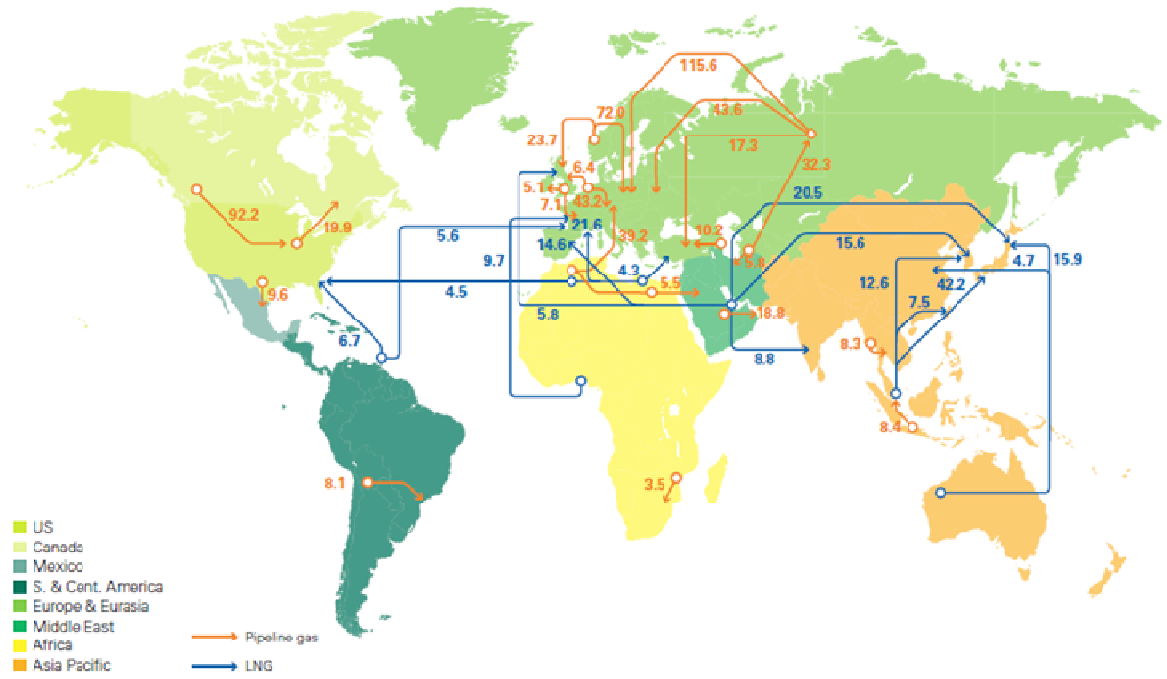
Figure 4: European gas supply outlook



Source: Own illustration based on Eurogas (2010, p. 9)

The world's main gas producing countries are the United States with 19.2% and the Russian Federation with 19.0% of the world gas production. The most important exporting countries are Russia, Norway and Canada. Countries that import the most are Japan, the United States and Western European countries like Germany, Italy and France (International Energy Agency (IEA), 2010, p. 13). The following figure depicts the world's major trade movements.

Figure 5: Major gas trade movements (in Bcm)



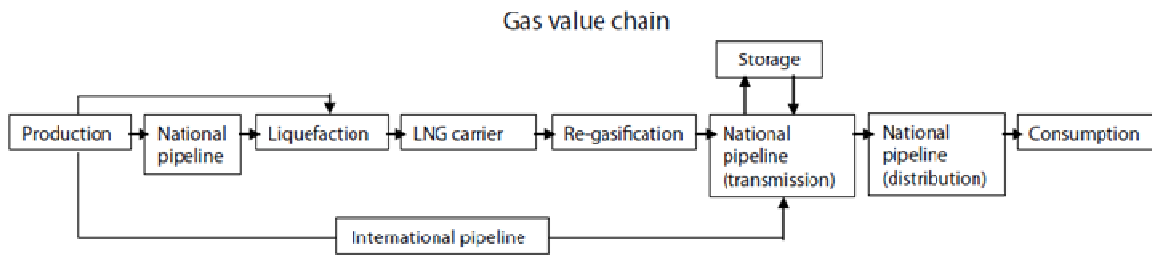
Source: BP (2010, p. 31)

Many of the European imports come from super-giant fields. Gas fields are categorized as super-giant when there is more than 30 trillion cubic feet (850 Bcm) of gas recoverable (Energy Charter Secretariat, 2007, p. 235).

2.3 Market situation and regulation in Europe

The European gas market has been in a constant change in recent years. Figure 6 (see next page) shows a typical value chain for European gas markets for both natural gas and LNG. The gas has to pass several steps until it comes from the producer to the consumer. Amongst these are international pipelines or LNG facilities, possibly storage facilities and national pipelines for transmission and distribution. Major market players involved in the value chain are producers and exporting countries, transporters, importers or wholesalers, distributors and consumers. This work places emphasis on the importer, wholesale and distributor level and thus indicates explicitly when discussing gas delivery between end-consumers and their suppliers (e.g., municipalities).

Figure 6: Gas value chain



Source: Energy Charter Secretariat (2007, p. 37)

Since natural gas markets depend on installed infrastructure like pipelines and storage facilities which make the markets quite inflexible, they are typically of local or regional character. In Europe, gas markets used to be separate for each country. However, since a couple of years, efforts are undertaken to change the circumstances of the European gas markets and the industry. Changes are introduced by regulation at EU level, followed by national laws. The general trends of these changes and regulations are presented here in short, whereas details, where necessary, are mentioned in the respective following sections.

For import-dependent countries, thus for most European countries, upstream regulation is difficult to realize because of the dependency. However, downstream regulation can be executed. These are technical, commercial and regulatory activities linked to the consumption, like concessions for the sale of gas, access to infrastructure and legal, organizational and management unbundling of integrated gas companies (Energy Charter Secretariat, 2007, p. 208). The main objective of European regulations is to create a single European gas marketplace and open it to competition. National gas markets should be liberalized and made more efficient, flexible, liquid and competitive. The EU regulators' primary concern is making energy affordable and providing a good investment climate through gas supply at reasonable prices (Clingendael International Energy Programme (CIEP), 2008, p. 17).

The path of EU regulations began in Continental Europe in 1998 with the First Gas Directive (98/30/EC), abolishing import monopolies and introducing gradual market opening and accounting unbundling for integrated companies. In 2003, the Second Gas Directive (2003/55/EC) was adopted, because the liberalization process was progressing only slowly. It prescribed full market opening, regulators on national level, regulated third party access (TPA) and legal and management unbundling of integrated companies. The Second Gas

Directive is complemented by the Gas Regulation, which expands on some of the issues introduced in the Directive (European Commission, 2007, p. 29).

Prior to regulation, the gas market was characterized by incumbent wholesalers (integrated companies) who sold gas to the end-user and executed the different steps on the value chain as imports, transportation and distribution. The structure of the market could be described as bilateral oligopoly, because both on the export and on the import side only few market players were active (Niehörster & Waschulewski, 2009, p. 79). That is why EU regulation prescribes legal, operational, management and accounting unbundling of integrated companies, in order to achieve that monopolies are dissolved and de-integrated companies operate only on one step of the supply chain and consequently, competition per step enhances. Apart from unbundling, another main remedy introduced in the regulations is third party access. Regulated TPA obliges the system operators to ensure that access to the system is non-discriminatory and prescribes that the tariffs for using the system are approved by the respective regulatory authority. Under this concept, tariffs and conditions for access to the system have to be published ex-ante. Only new infrastructure might be exempted from TPA so that TPA rules do not hinder investments (European Commission, 2007, p. 85). According to the Gas Regulation, fair access to networks requires furthermore capacity congestion management procedures based on a use-it-or-lose-it principle and when capacities are not used, a functioning secondary capacity market (European Commission, 2007, p. 31).

The regulations definitely brought changes to European gas markets and introduced some competition, but did not reach their objective of market liberalization and complete market opening to competition. First of all, in most European countries the former incumbents still have strong market positions and control the market. Despite unbundling provisions for integrated companies, new entrants face major difficulties to get access to infrastructure. Long-term contracts between the former market players still hinder new entrants from participating in the market. Secondly, within Europe insufficient cross-border sales and infrastructure are available to foster competition or indicate a transition to a single European gas market. Thirdly, there is a lack of transparency and information asymmetry about access to infrastructure and gas price formation, which would be necessary to ensure a level playing field and trust into the market (European Commission, 2007, pp. 7-9). Furthermore, the EU regulations still have to be better implemented in the member states. Some of the member states even reduce the effectiveness of the regulations intentionally in their own interest. Consequently, regulations are not uniformly incorporated in the European gas market

(International Energy Agency (IEA), 2008, pp. 26-27). In order to address these shortcomings a Third Energy Package has been approved in 2009, effective March 2011, which is supposed to accelerate the liberalization process through ownership unbundling and enforcement of already existing measures (Melling, 2010, pp. 46-48).

Since the EU regulations aim at creating a liberalized and competitive single European gas market, eventually the discussion is about which gas delivery method and, related to that, which pricing mechanism should be applied. When the market is supposed to be restructured and persistent structures are changed, different interests of the different market participants clash together. Firstly, there are the resource-owning and producing countries and the upstream industry with resource rent maximization interests, secondly the wholesalers, midstream businesses, merchant resellers and traders, and thirdly there are the downstream market and distributing companies and finally the customers. The new market mechanisms must feature enough credibility so these participants with different interests find a common basis for market transactions (Clingendael International Energy Programme (CIEP), 2008, pp. 3-4).

3. Designs of gas delivery contracts

This section presents different possibilities of how gas can be purchased and how gas prices are derived under these possibilities. Initially, the first sub-section (Section 3.1) describes traditional gas procurement through oil-linked long-term contracts, followed by the examination of advanced gas procurement via hub trading marketplaces (Section 3.2). The final sub-section (Section 3.3) deals with hybrid forms of the traditional and advanced gas procurement options and alternative gas delivery methods like LNG (Section 3.3.5).

3.1 Traditional gas procurement through oil-linked long-term contracts

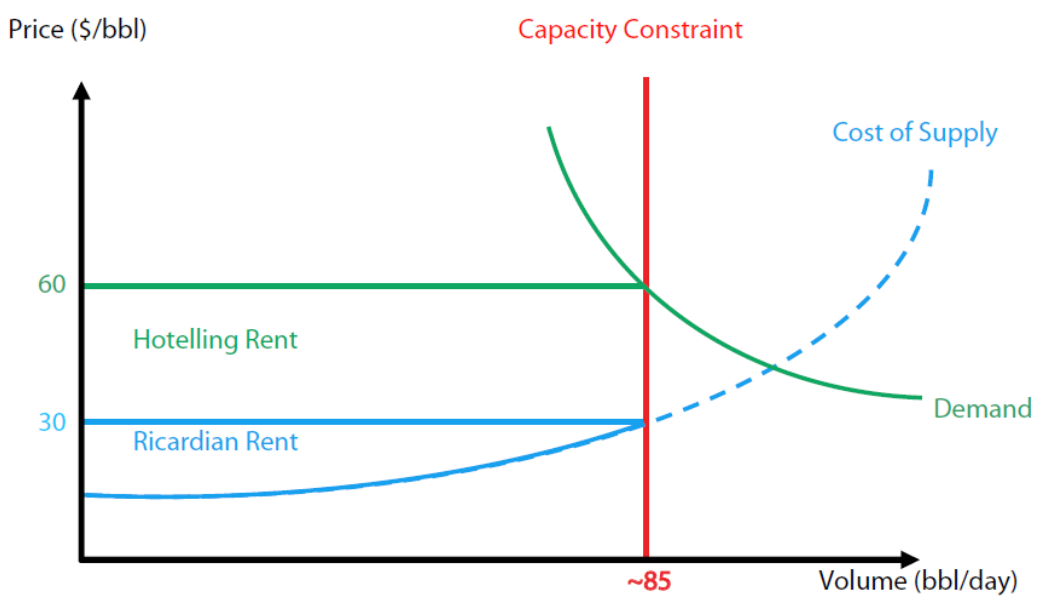
Long-term supply contracts represent the traditional way of purchasing gas in Europe. At the moment, these continue to be the dominant delivery contracts. The concept is prevalent throughout all levels of the gas value chain: from the producers, importers, distributors, municipal gas suppliers up to the end-customer. This section presents the fundamentals of such long-term contracts, highlights some historical facts and describes price setting mechanisms. It also sheds light upon the risks and advantages of such contracts.

3.1.1 Fundamentals of traditional gas procurement

The concept of oil-linked long-term contracts has its origin in the Netherlands. The Dutch government introduced the concept of replacement / market value pricing and long-term contracts for its Groningen field. By doing so, they replaced the until then dominant principle of cost plus pricing for natural gas. The Dutch concept of gas pricing has been adopted in most European (mainly Continental Europe) gas delivery contracts. Prices are not linked to the production, transportation and distribution costs with a cost-plus pricing method anymore, but prices are linked to alternative fuels, so called substitute fuels. The method evolved out of a competitive perspective meaning that the upper price limit for gas results from the competition with substitute fuels. This leads to a concept of prices that are based on the replacement value in the importing country. Gas should be priced on a level where it is unprofitable or too risky for the customer to switch to an alternative fuel in conjunction with the necessary investments. Ideally, there should be just enough incentives to not switch to alternative fuels (Möller, Niehörster, & Waschulewski, 2005, p. 458). Consequently, the price

is determined by the costs of these competitive fuels. The link is being made even when the alternative fuels display considerably different prices. Most common alternative fuels to gas are heavy fuel oil (HFO), light fuel oil (LFO)/gasoil and sometimes coal (Niehörster & Waschulewski, 2009, p. 80). In Europe, the gas price in long-term supply contracts is predominantly linked to oil products. Mostly, supply is based on imports from giant or super-giant gas fields. Usually, the main interest of the gas exporting countries is to maximize their resource rent without losing competitiveness to other fuels justified by the depletion of their finite resources. For this interest, the concept of replacement value pricing is the best suiting option (Energy Charter Secretariat, 2007, pp. 27-28). As the objective of oil-linked long-term contracts is to exploit the maximum gas rent, two different rents can be distinguished: the Ricardian and the Hotelling rent. The Energy Charter Secretariat (2007) defines the Ricardian rent as "the difference between the production costs of a marginal unit and a unit produced at more favourable cost and / or a rent stemming from the costs resulting from the distance to the market" (p. 234). The Ricardian approach takes into account the greater capital spending and technological development that is needed when resources become more difficult to exploit. Resource rents are considered to result only from cost differences between different production sites. Thus, this approach argues from a cost-based gas-pricing system point of view. In contrast, the Hotelling rent is defined as the "difference between the cost of producing a marginal non-renewable (energy) resource and its value in the market, when production is restricted and the supply and demand curves do not meet" (Energy Charter Secretariat, 2007, p. 231). This means that the Hotelling approach emphasizes the limits on resources and represents the basis for a replacement value gas-pricing system. It describes the depletion path for a finite resource and thus, the Hotelling rent shows what a resource owner gets for the depletion and what the customer is willing to pay, in addition to the marginal costs of production. The following figure illustrates both Ricardian rent and Hotelling rent (Energy Charter Secretariat, 2007, pp. 45-46).

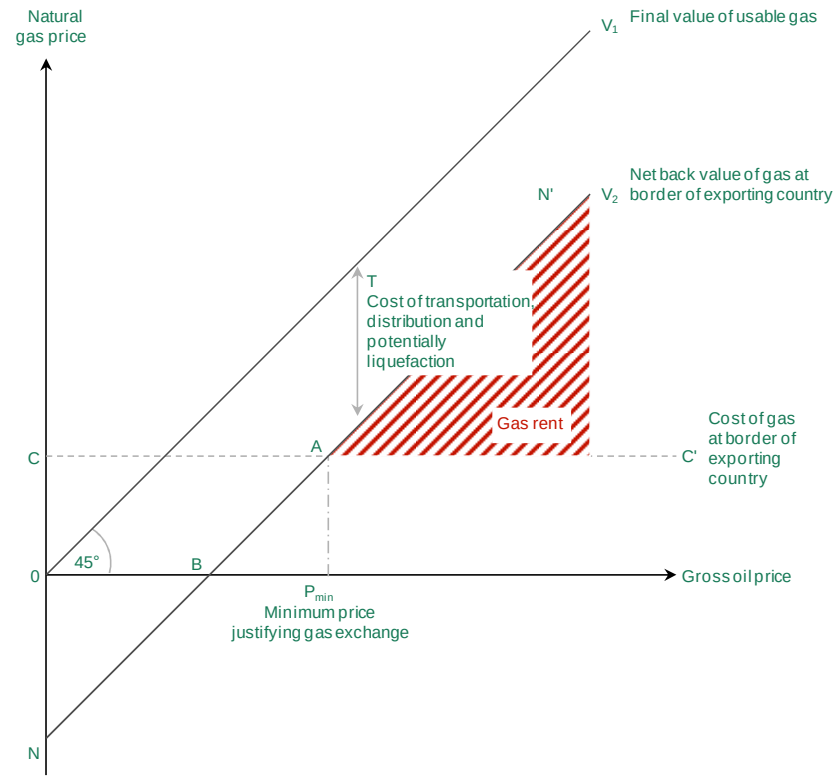
Figure 7: Ricardian Rent and Hotelling Rent: Rents of Gas Production



Source: Energy Charter Secretariat (2007, p. 46)

The gas rent for the gas producers and exporters in conjunction with the oil-indexation and resulting gas prices can be depicted as in Figure 8 (see next page). The value of gas, calculated as the replacement value, increases with the oil price (graph V_1 or V_2 for the netback value), whereas the cost of gas (C) remains constant over oil price increases. The minimum gas price is on the intersection point A of the gas price function (graph of the netback value) and the costs. Gas price rises above this intersection point, respectively minimum price, create the gas rent.

Figure 8: Gas rent for resource owners



Source: Own illustration based on Percebois (2009, p. 21)

3.1.2 Pricing principles under oil-linked long-term contracts

As stated before, the oil link is embedded in long-term contracts. The link to substitute fuels is made according to a certain pricing formula. The pricing arrangement is also referred to as netback value concept since the gas price is "calculated on the basis of the value of competing energies backed to the border of the buyer's country by deducting the costs of transportation and distribution of the buyer" (Energy Charter Secretariat, 2007, p. 152). According to this concept, the base price of gas is re-calculated at regular time intervals in accordance with the price development of the substitute fuels. Calculating the price with the netback value concept, the delivery point and the reference point for the price can be different (Energy Charter Secretariat, 2007, p. 152).

The pricing arrangement for gas in long-term gas delivery contracts is usually split into two components. A capacity-dependent component, the capacity charge[2] and the component that achieves the linkage to substitute fuels, the actual energy price[3] (Niehörster & Waschulewski,

[2] German: Leistungspreis
[3] German: Arbeitspreis

2009, pp. 80-81). The capacity charge is the annualized charge per unit of the settled capacity (in ct/kWh p.a.). It either has to be paid for the ordered or de facto daily respectively hourly capacity or it is arranged as a fixed amount per year. This charge is, amongst others, for the transportation and service and is indexed, for example, to the development of wage levels or producer goods prices. Regarding the energy price component, one typical pricing formula for the gas price (p_m) applicable in month m, is a function of the starting gas price (p_0) plus the price development of substitute fuels compared to the reference month. In the following example, the common competitive fuels Light Fuel Oil (LFO) and Heavy Fuel Oil (HFO) are used, as it was the case in traditional replacement value formulae. The price formula can look as follows (Energy Charter Secretariat, 2007, p. 154):

$$p_m = p_0 + 0.60 \times 0.80 \times 0.0078 \times (LFO_m - LFO_0) + 0.40 \times 0.90 \times 0.0076 \times (HFO_m - HFO_0)$$

0.60 and 0.40 are shares of gas market segments competing with respective fuels, in this case LFO respectively HFO. These shares do not have to reflect the shares of the fuels in total energy use. 0.80 and 0.90 are called the "pass through factors", because they indicate how much of the risk and reward of the price development is shared between seller and buyer. Since the numbers are close to 1, most of the risk and reward goes over to the seller. The numbers 0.0078 and 0.0076 are the technical equivalence factors. These are utilized to convert the units of prices for fuel into units of gas price. In the present formula, oil is indicated in metric tons and the price in Euro/t, whereas gas is indicated in kWh and the price has to be converted into Euro ct/kWh. The terms $(LFO_m - LFO_0)$ and $(HFO_m - HFO_0)$ represent the competing fuels in the gas pricing formula. LFO, respectively HFO, are the prices or quotations of light, respectively heavy, fuel oil. LFO_o and HFO_o are the prices for the starting month 0. LFO_m and HFO_m are the prices for month m. (Energy Charter Secretariat, 2007, p. 154).

Usually the base price p_m is pegged to the oil products with a time lag and, for the substitute fuel prices, average values over a specified time period are adopted. A common rule for the price link is the 6/3/3-rule. In order to calculate the prices for the substitute fuels, their average price over the past 6 months is calculated with a time lag of 3 months and these prices are then valid for 3 months (Berg, 2009, p. 30). For example, in order to calculate the gas price for January 1 of a certain year, the average value of the prices of the substitute fuel from the months of April until September of the preceding year would be calculated. The gas price would then be valid for three month and calculated again on April 1, July 1 and October 1.

There exist plenty of variations of this rule, e.g., the 6/1/3, 3/1/3-rule or 3/3/3-rule. The mechanism always remains the same. The first term in the formula, $p_{o,}$ represents, as stated before, the starting price of gas in month 0. It reflects the netback to the point of delivery and is determined or negotiated by the contract parties. The base formula for it is: "Replacement value minus costs to bring the gas from the delivery point to the customers minus marketing incentives" (Energy Charter Secretariat, 2007, p. 155). LFO-linking is usually used for medium and smaller buyers like small industrial or commercial customers and households. It can also be used in contracts with re-distributors such as municipalities, which have themselves primarily customers with small gas consumption or customers using the gas for heating. Contrarily, the commonly used alternative fuel for gas of larger (mainly industrial) customers is heavy fuel oil. If re-distributors with a greater share of LFO-linked contracts, themselves have many industrial customers, their suppliers often concede a industrial tranche, where the share of industrial customers gets linked to heavy fuel oil and the rest stays pegged to light fuel oil. This reduces the re-distributors' purchasing costs. The gas price formula for power generation is mainly linked to coal and also to heavy fuel oil. The reason for these typical links lies in investment costs. Investments in facilities that operate with HFO or coal are significantly higher than those that operate with LFO, but HFO and coal prices are lower than LFO prices. Consequently, the operation with HFO and coal is only cost-effective with an appropriate scale and utilized capacity. The pricing formula gets always adapted to the respective customer. Thus, for larger customers the share of HFO would be increased (Niehörster & Waschulewski, 2009, pp. 80-81).

If market conditions change, adaptations to the pricing formula can be made. For example, the shares of substitute fuels in the pricing formula can be changed in order to reflect the development in the competitive situation of gas. Alternatively, the substitute fuel itself can be changed. Furthermore, other components such as inflation, spot gas prices or fixed prices can be included in the formula. Nowadays, the pricing formula contains up to ten different components (European Commission, 2007, p. 102).

3.1.3 Typical contract design

This part of the section gives an idea of common terms and clauses in oil-indexed long-term contracts. They are subject to a changing regulatory environment and a changing gas market in general.

i. All-inclusive and full supply delivery contracts

Usually, long-term contracts are shaped as all-inclusive contracts that cover the complete needs of a customer. The full supply is contracted for a specific time period based on a determined price. The contract and the price include gas expense, transportation, service, storage, thus the access to capacities, and taxes (Berg, 2009, p. 28).

ii. Duration and volume

As the name already reveals, the here-presented gas delivery contracts are concluded on the long-term. That is to say they are signed usually for a period of about twenty years. The length of the contracts is supposed to balance the investments in gas delivery infrastructure. Moreover, the duration is a logical consequence of the import from giant gas fields which usually lead to large volume contracts in the order of 5-10 Bcm/year. Through the long-term supply obligation, the seller commits a certain amount of gas reserves and gas delivery capacity (Energy Charter Secretariat, 2007, p. 152). Duration and volume of the gas delivery contracts always depend on the location the gas is purchased from. For instance, when gas in Continental Europe is purchased over the Interconnector, a pipeline linking Bacton in the UK with Zeebrugge in Belgium, volumes are smaller and with a shorter-term (10-15 years) than contracts with for example Russia (Energy Charter Secretariat, 2007, p. 126). Especially in recent years, adaptations regarding shorter duration and smaller volumes have been made, to comply with regulations that endeavor to unify the European gas market and to make it more flexible.

iii. Take-or-pay clauses

Most oil-linked long-term gas contracts feature take-or-pay clauses. Via a take-or-pay clause, the buyer is contracted to pay for a minimum volume of gas, regardless of actual off-take. (Energy Charter Secretariat, 2007, p. 149). The minimum pay is supposed to guarantee the supplier payback for his investments and a minimum resource rent.

Through take-or-pay clauses the risks of gas delivery are distributed between supplier and purchaser. On the one hand, the buyer assumes the marketing risk, since he has to market a specified volume and thus secures the supplier against the volume risk, i.e. risk of sharp deviation of demand from supply. On the other hand, the seller or the exporting country takes the risks and chances of price development via the concept of replacement value pricing

(Energy Charter Secretariat, 2007, p. 143). Also, he assumes the upstream risks when producing gas including geological risks and transportation risks (Konoplyanik, 2010, p. 13).

iv. Destination clauses

The destination clause is a contractual instrument for preventing re-exports. Since the use of the replacement value concept for pricing gas leads to different netback values at the exporting country's border for different customers, there is an opportunity of arbitrage on the buyer's side. Moreover, different transportation costs to different customers result in different netback values. According to the Energy Charter Secretariat (2007) arbitrage in the gas market means "making use of price differentials between two locations or two points in time" (p. 227). Consequently, arbitrage opportunities are created when a producer sells its gas "at the same point to different countries with different replacement values, and / or where the producer grants a rebate to compensate for transportation costs incurred by the buyer to bring its gas to the market" (p. 156). In order to prevent the buyer from making use of these arbitrage opportunities, a destination clause is often incorporated in the oil-linked long-term gas delivery contracts. Such a clause forbids the buyer to re-sell his purchased gas to another country and making use of price differentials in different markets. This enables producers/exporters to receive the maximum resource rent (Konoplyanik, 2010, p. 14). However, these destination clauses have been argued against by the European Commission, because they are supposed to interfere with competition in the European gas market and thus infringe upon European competition law. Many exporting countries have agreed to drop the destination clause from future contracts. This development contributes to more flexibility of the delivery point (Energy Charter Secretariat, 2007, p. 156).

v. Price review clause

Contracts usually allow for renegotiations through regular price reviews. In oil-linked long-term contracts, gas is priced according to the replacement value principle for a long time period. As a countermeasure, it should be possible to adapt the pricing formula if circumstances in the market change that are beyond the control of the parties involved. For example, the replacement values could change because of new technologies or market growth. Moreover, the prices and the mix, i.e. the shares of the replacement fuels can change. Each party has the right for adjustments of the price provisions. Often, the price review clause in the contract includes the right of each party to refer the matter to arbitration if no agreement can be found in negotiations (Energy Charter Secretariat, 2007, pp. 149-155).

3.1.4 Advantages of traditional gas procurement

Questions often raised in conjunction with traditional gas procurement are whether the oil-price link is still adequate, and whether the long duration of gas contracts is reasonable. There are advantages of oil-linked contracts that suggest these questions to be unsubstantiated.

i. Certainty: security of revenues and security of supply

The most outstanding advantage of oil-indexed long-term contracts is that they provide certainty. On the one hand, the supplier can secure his revenues over a long-term, especially through the take-or-pay clauses. On the other hand, the customer has the certainty of getting the needed deliveries of gas over a long time horizon. Given Europe's gas import-dependence from a few sources, oil-linked long-term contracts secure the gas supply for the European market over a long time horizon. An opposing argument is that spot gas prices provide a higher security of supply, since they respond to the forces of gas supply and demand and reflect shortcomings in supply. Oil-linked prices in contrast logically follow the development of the oil market. However, in the case of Europe, the dependence on the gas exporting countries' actions is very high, so as to making oil-indexed long-term contracts the better provider of security of supply. This way, exporting countries are contractually bound to deliver gas for the next twenty to twenty-five years according to predetermined pricing formula which is linked to the oil price. In addition, oil reserves are even scarcer than gas reserves and thus could provide the mentioned signals for shortcoming even earlier than spot gas prices. (Clingendael International Energy Programme (CIEP), 2008, pp. 12-13).

ii. Encouragement of investments

As stated before, the duration of gas delivery contracts provides suppliers with certainty about revenues over a long term and the oil-indexation provides them with a great resource rent. That is the reason why gas producers and exporting countries usually favor long-term gas delivery contracts. These permit to easily amortize investments related to the gas infrastructure, for example exploration and transport. A further advantage of long-term contracts is therefore that they encourage important investments in infrastructure in the gas market. Still, one has to be aware that along with the increasing interconnection of the gas market in Europe, the interest in long-term contracts is decreasing, since multiple possible routes are available. Even without long-term contracts securing gas load, it is quite unlikely that there are serious risks of building a pipeline that will not be used in the end (Percebois, 2009, pp. 23-24).

iii. Tendency towards stable prices

The indexation of the gas price to the price of oil with a predetermined pricing formula, lowers risks for the purchaser of the gas, since the producer (the resource-owning state) takes over the price risk. This means that the gas purchaser on the import level is guaranteed that the gas prices he can offer on the end-user market stay competitive with substitute fuels. In exchange, the importer takes over the volume risk. Furthermore, the indexation takes place with a smoothing of the alternative fuels' prices in order to attenuate price volatility. Namely, without the indexation gas prices would be more volatile. One clear advantage is that one never has to comparatively pay more for gas than for alternative fuels (Energy Charter Secretariat, 2007, p. 147).

iv. Persistency and durability

Oil-linked long-term contracts' have a proven robustness over the time they have been in use. They were able to cope with major oil-price shocks, the Cold War, the fall of the Berlin Wall, the dissolution of the USSR and they endured regulatory changes imposed to the EU gas market so far (Energy Charter Secretariat, 2007, p. 24).

v. Transaction costs

One can also argue in favor of oil-linked long-term contracts with transaction cost theory: When risk management costs of market interfaces become too high, these transaction costs can be reduced by creating long-term contracts. This is the case because long-term contracts feature bilateral relationships between few players. Consequently, risks and rewards have to be shared between fixed counterparts (Energy Charter Secretariat, 2007, p. 43).

vi. Low complexity

Another advantage of the traditional gas procurement can be seen in the low degree of complexity it is featuring. There are clear contract parties and the management of the gas procurement requires comparatively little effort and administrative expenses.

3.1.5 Risks from oil-indexed gas prices and long-term contracts

As there exist advantages for gas delivery via oil-indexed long-term contracts, this procurement form also holds risks.

i. Unjustifiable gas price rise due to oil price increase

In general, the gas price set in a free gas market could be lower than the gas price linked to substitute fuels. The pegging of gas prices to the oil price hinders the development of the gas spot market. The historical reasons for oil indexation (e.g., making gas competitive to other fuels) are outdated and not justifiable anymore, because by today a separated gas market has developed. Moreover, the reserves-to-production (R/P) ratio for gas is higher than for oil. Since oil depletion is taking place at a faster rate, the gas price should not be linked to the price of oil. Oil depletion should not make gas more expensive. Furthermore, an oil price shock, for example, increases gas prices even though the shock has no relation to the gas market. Since the link to oil prices is usually done with a time lag, the gas prices react only with a time shift to oil price fluctuations. It would make more sense if the gas price was connected to the foundations of the gas market and would not carry the risks of the oil market (Percebois, 2009, p. 25).

ii. Marketing risk and dependence from being caught in a long-term agreement

As indicated before, the buyer takes over the volume risk because of the take-or-pay clauses. He can be contractually bound for twenty years or more to take or pay the gas deliveries and thus faces the forecasting and marketing risks. Also, the gas purchaser is dependent on a single supplier for a long time. One risks not being able to participate when gas becomes cheaper on the market or not being able to exploit arbitrage possibilities when, for example, liquefied natural gas (LNG) adds flexibility to the market (see Section 3.3.5 for further explanations). That is to say, with oil-linked long-term contracts gas purchaser risk not having the possibility to optimize their procurement.

iii. Applied pricing formula

With traditional long-term contracts, the buyer can be bound for about twenty years to a specific pricing formula. During that time market patterns can change tremendously and the original formula can become unrealistic over time. To circumvent the risk to pay an unrealistic, not market reflecting gas price, regular price formula reviews are very important and the ability to make changes must be ensured.

iv. Risk of foreclosure

A risk especially EU regulators are concerned about is the risk of market foreclosure implied in traditional gas procurement, especially because the long-term contracts constitute entry

barriers for new market entrants and thus hinder the development of a competitive liberalized gas market. Particularly, the long-term contracts between incumbent importers and producers deprive new market entrants of direct gas procurement from the producers (European Commission, 2007, p. 66). EU regulations implemented to foster competition and spot trading constitute a risk of relying too much on oil-indexed long-term contracts since a competitive gas market is developing. Market actors cannot participate in this market when bound to a long-term agreement with take-or-pay and destination clauses.

3.1.6 Changes in traditional gas procurement

In recent years, gas market patterns are changing a lot. The EU regulations trying to foster a competitive liberalized gas market do have an impact on the traditional gas procurement form. In Germany, for example, the Federal Court of Justice declared two contracts with pricing formulae which contained only a link to LFO to be invalid because they only represent the reality of the oil market lacking the link to the gas market and other primary energy markets (Exner, 2010). Furthermore, regulators question particularly the longitude of the long-term delivery contracts and their negative effect on competition, as well as destination clauses that are prohibited today. As a result, the changed circumstances in the market such as regulatory efforts and higher competition entail adaptations to the original long-term contracts. These adaptations include modifications to the pricing formulae, the term, volume and a higher level of flexibility regarding the delivery point.

New pricing formulae will become more complex. The gas price is linked to a broader range of substitute fuels and other components like inflation and also contains indexation to actual gas spot prices. In the UK, for example, the gas price is mainly linked to spot gas prices (40.1%), followed by general inflation (16.5%) and LFO (16.2%). In Continental Europe the gas prices are still mainly indexed to LFO and HFO, but are likely to adopt the UK approach in the future (European Commission, 2007, p. 103).

Pricing formulae must adapt to the greater complexity of the gas market as it becomes more interconnected. They have to adjust to the greater intensity and range of price fluctuations of substitute fuels. In order to achieve this, time intervals between price reviews are reduced, as well as the reference period in the formulae and the time lags (Konoplyanik, 2010, p. 30).

That is a signal showing that the market is becoming more liberalized – at least to some extent. However, only in 2006 Gazprom, for example, prolonged its traditional delivery

contracts with customers in Continental Europe with terms until 2027 to 2036 (Energy Charter Secretariat, 2007, p. 158).

3.2 Advanced gas procurement via hub trading marketplaces

This section presents an alternative to traditional gas procurement through oil-linked long-term contracts: the advanced gas procurement on marketplaces called hubs. It describes fundamentals and prerequisites of advanced gas procurement, and examines the gas pricing mechanisms under gas-to-gas competition. Moreover, advantages and risks from trading gas on hubs are outlined.

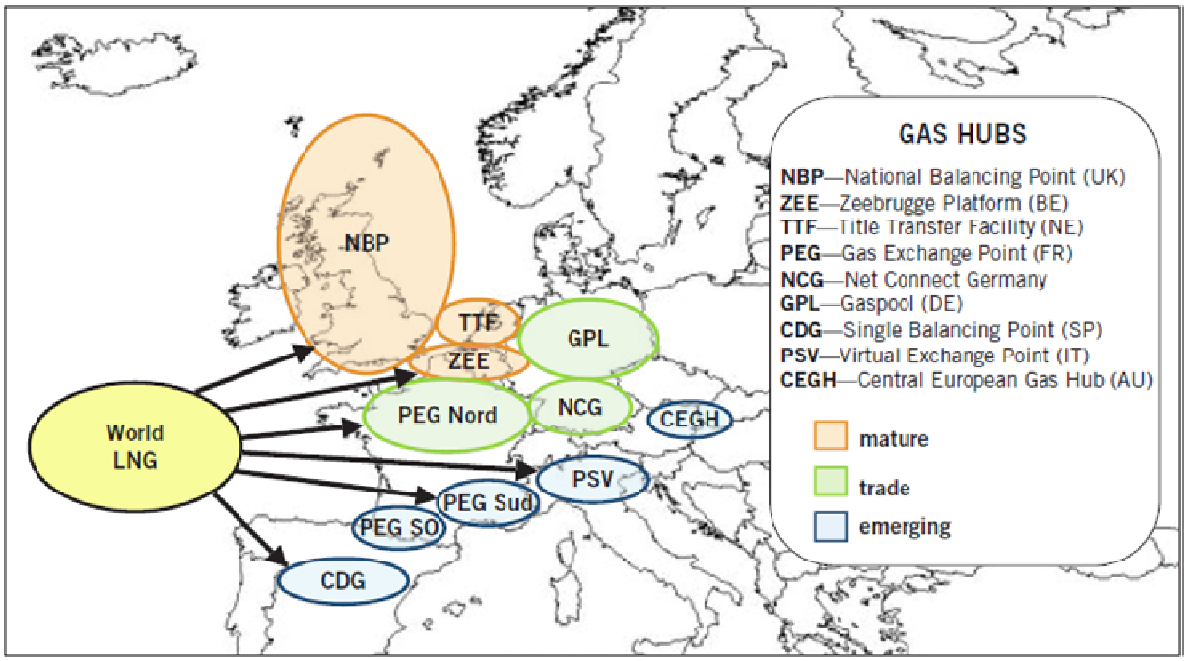
3.2.1 Fundamentals and prerequisites of advanced gas procurement

As outlined in Section 2.3, EU regulators are trying to change the traditional gas market structures in Europe by market regulation. Most European governments consider oil-linked long-term contracts as outdated and favor traded markets. Their declared objective is to enforce a transition from long-term contracting with gas prices linked to oil product prices to a restructured, highly efficient gas market with competitive gas-to-gas competition pricing. The objective is to ensure gas supply at the lowest cost due to an optimal allocation of resources and investments. According to the CIEP (2008) "in a fragmented, competitive market, gas trade is needed to efficiently deal with imbalances in the market, in which it forms a quick and easy-access marketplace to trade surpluses and shortages via standard contracts for standard products" (p. 9). Along with the introduction of such easy-access trading marketplaces, gas could ultimately become a commodity (Niehörster & Waschulewski, 2009, p. 82). The trading marketplaces for gas are so called hubs. A trading hub is the delivery point and can either be a single market point where several pipelines physically interconnect as the Henry Hub in the US or an entire market area at a hypothetical point, a so called virtual hub, as the National Balancing Point (NBP) in the UK (International Energy Agency (IEA), 2008, p. 46).

In addition to the NBP in the UK, trading hubs have also been established in Continental Europe as shown in Figure 9 (see next page). Hub marketplaces are constantly developing and growing. The major ones are in Zeebrugge in Belgium, the NCG (Net Connect Germany) in Germany and the TTF (Title Transfer Facility) in the Netherlands, PEGs (Point d'Échange de

Gaz) in France, the PSV (Punto di Scambio Virtuale) in Italy and the CEGH (Central European Gas Hub in Baumgarten) in Austria.

Figure 9: The Status of European Gas Hub Development



Source: Melling (2010, p. 24)

The creation of gas hubs was supposed to be followed by a restructuring of the gas market as a whole, which has yet to come. If the import-dependent European countries strive to weaken the producing countries' influence and create a united European marketplace, competition and liquidity in the gas market have to be fostered. Liquid markets develop transparency in the market, by price discovery and instruments to hedge risks, and actual trading can come into existence. In order to turn the gas market into a liquid market, a marketplace is needed where real transactions take place as a reference point. If storage and transportation costs are not too high, different marketplaces that are close to each other can be treated like one large marketplace, which corresponds to a virtual hub. In order to develop the market into virtually one single system, the network system has to be sufficiently interconnected. The more producers are in the market, the higher are competition and liquidity likely to be. When smaller fields start producing gas as well, which historically only happened after large fields had been exploited, it might be observed that producers become more numerous and foster more financial transactions. Still, one should notice that the crucial factor is the market share, not the number of producers (Energy Charter Secretariat, 2007, p. 61). The restructuring of the European gas market, turning it into a liquid, hub-based marketplace has not succeeded

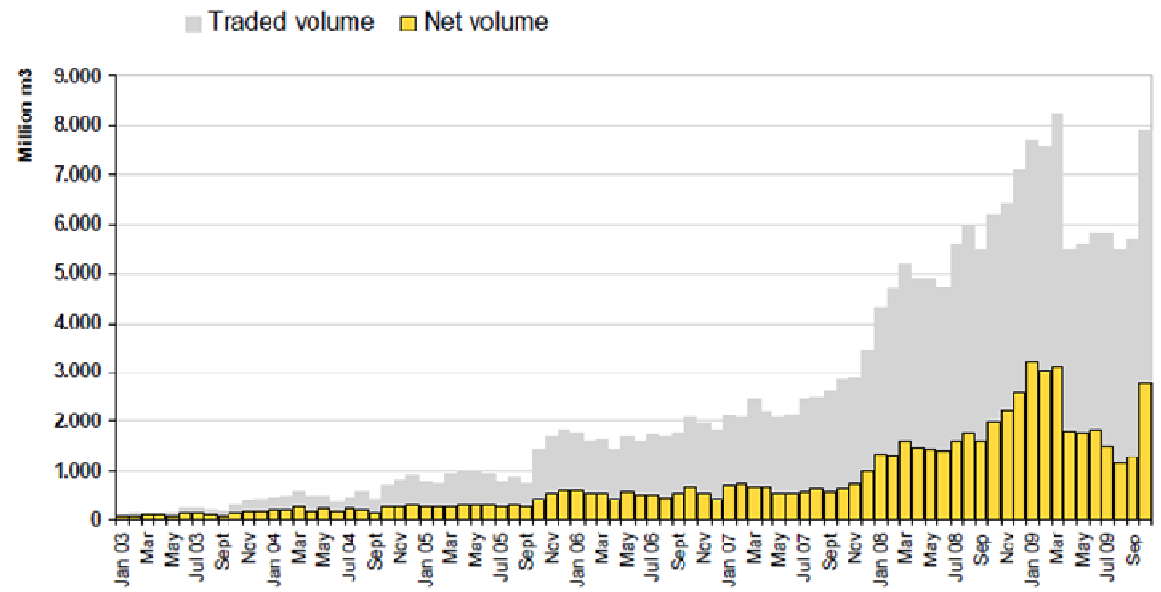
completely so far. This is shown by the still prevailing use of oil-indexed long-term contracts and missing liquidity on the hub marketplaces.

An indicator for the liquidity of a market is the so called churn rate. It is the ratio between traded volumes and actual physically delivered volumes. A market is usually considered being liquid when it has a churn rate of about 15 or higher. The hubs in Continental Europe like Zeebrugge, Bunde and TTF all have a lower churn than 10, which indicates their low liquidity levels (Energy Charter Secretariat, 2007, p. 101).

Still, the US and the UK serve as examples that the model of a liquid gas market with gas pricing derived from gas-to-gas competition actually works under the necessary conditions. In both North America and the UK, the gas markets can be regarded as being liquid. In these markets gas is traded as commodity. The churn rate in the UK moves around a level of 15 to 10, which is at the edge to a liquid market, compared to a level of 100 at Henry Hub in the US. The question arises how the UK was able to become a liquid hub-based gas market and which necessary conditions the market in Continental Europe has to fulfill to become one as well. One important factor is regulation. The regulation path in the UK began in the mid 1980s, when the government started the liberalization process of its gas market by privatizing British Gas, a gas monopoly company, and promoting competition. The transportation system was changed into an entry-exit-system. This means that the whole UK transportation system is operated as one notional trading place, the National Balancing Point (NBP), within which gas can be traded freely (Energy Charter Secretariat, 2007, p. 22). Moreover, higher competition was achieved by requiring third party access on the transition system and thus, giving competing suppliers access to customers. The development of a liquid market in North America took place because hubs were created by industry in appropriate locations. Generally spoken, prerequisites for liquid hub-based markets were favorable both in the UK and in North America. The development in both regions was based on own resources and domestic gas production and characterized by supply via medium-sized to small gas fields. Furthermore, there are many players in the market participating in competition and the market is characterized by a more elastic demand due to high gas utilization and demand in power generation. Although, currently many of the stated important circumstances for a liquid market are different in Continental Europe than in the UK, it is still possible that Europe develops likewise in the future (Energy Charter Secretariat, 2007). As stated in Section 2.3, in Continental Europe efforts have already been made to create similar conditions as in the UK by regulation. These regulations have not yet been implemented fully or did not show the

entire anticipated outcome, but nevertheless reached some objectives. Hub marketplaces developed in Continental Europe and their trading volumes increased immensely over the past years as depicted in the following figure exemplary for the TTF hub.

Figure 10: TTF monthly traded gas volumes (Jan 2003 – Oct 2009)



Source: Hall (2010, p. 6)

A requisite for a well functioning hub trading place is the ability for the market participants to manage volume risk. According to the IEA (2008) the supplier can mitigate the risk "either by the use of storage or by having a customer base of a size and mix that matches the supply characteristics; similarly, a gas consumer will manage his volume risk by purchasing flexibility services from his supplier, or by having access to storage himself" (p. 46). Thus, flexibility and liquidity play a crucial role, as well as access to transportation capacities and nearby storage facilities at a hub marketplace. Access should be granted through full TPA, meaning that capacities for transportation and storage have to be accessible on the short-term.

When the gas market develops into a spot market where gas can be purchased in the short-term and where liquidity rises, a further question to address is about the trading method at the gas hub. Trading can take place OTC or on an exchange. Usually, OTC is the favored method, because margins and fees of the exchange can be prohibitive for small market players and OTC is more flexible for instance when a market participant mis-trades. Moreover, companies often like to know with whom they are dealing. Still, both trading methods indicate the healthiness of a market and normally develop simultaneously (Boddy, 2010, p. 8).

Spot contracts for natural gas are exemplary for the EEX day contracts or weekend contracts when delivery takes place over a weekend. The gas is traded day ahead, two days ahead, weekend ahead, and so on, thus the prices traded on hubs can be indicated as day-ahead, 2-day-ahead, weekend or month-ahead. For a day-ahead product for example, the delivery takes place the day after the settlement (European Energy Exchange (EEX), 2010a, pp. 17-19). Furthermore, intraday trading with within-day gas prices was introduced recently in order to create an accepted reference price for the gas market. Delivery takes place the remaining hours of the gas trading day with a lead time of three hours. This increases flexibility in the gas market tremendously (European Energy Exchange (EEX), 2010b).

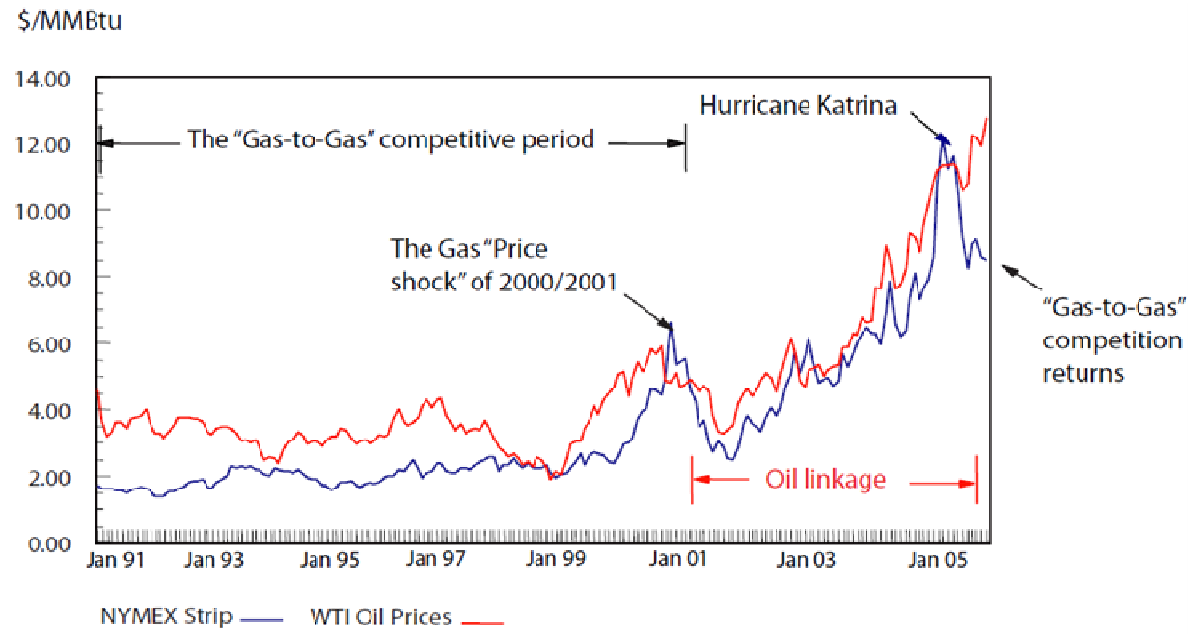
3.2.2 Gas pricing mechanisms

When conditions for liquid hub marketplaces are met, gas prices are determined by gas-to-gas competition. Since the markets are supposed to yield maximal efficiency, the prices emerge as spot prices through a balance of demand and supply created by trading at the hubs. Thus, prices are not pegged to oil product prices over contracts, but follow their own path, that is to say they develop individually with their own pricing mechanism. An important feature of hubs are market signals. Prices react to market signals and market fundamentals, while decisions, so called standardized rent taking decisions, are made by private players. The market framework is given by government, but decisions are not directly influenced by it (Energy Charter Secretariat, 2007, p. 100).

However, it has to be taken into account that, although gas prices follow a development of their own in the short run, they are not completely independent of oil prices. Historical data shows, that gas prices feature a long-term average correlation to oil prices over a period of three to five years (Villar & Joutz, 2006). This result can be explained by the fact that in the short-term customers cannot easily switch between different energy sources in order to react to movements in fuel prices. On the longer term, however, particularly customers from the industrial and power generation sectors are able to chose and switch between competing fuels. Since the industrial sector will make a choice between oil products in gas, it can be expected that the long-term correlation between their prices continues. However, since the share of the power generation sector in gas consumption rises and this sector's fuel choice would be, essentially, between coal and gas, it could slightly weaken the relationship between gas and oil prices on a longer time horizon (Clingendael International Energy Programme (CIEP), 2008, pp. 9-10). In the following figure (Figure 11) one can see the relationship between oil

and gas prices exemplary for the liquid US market. The still present correlation of the gas and oil price is clearly visible over the long-run. It is further observable that gas prices are usually below oil prices. There exist small periods, as in 2006 for example, when gas prices have broken free of oil. During this time the market has been fully satisfied and demand in gas reacted to higher oil prices.

Figure 11: Comparison of gas to oil price: The pattern of Henry Hub gas prices[4]

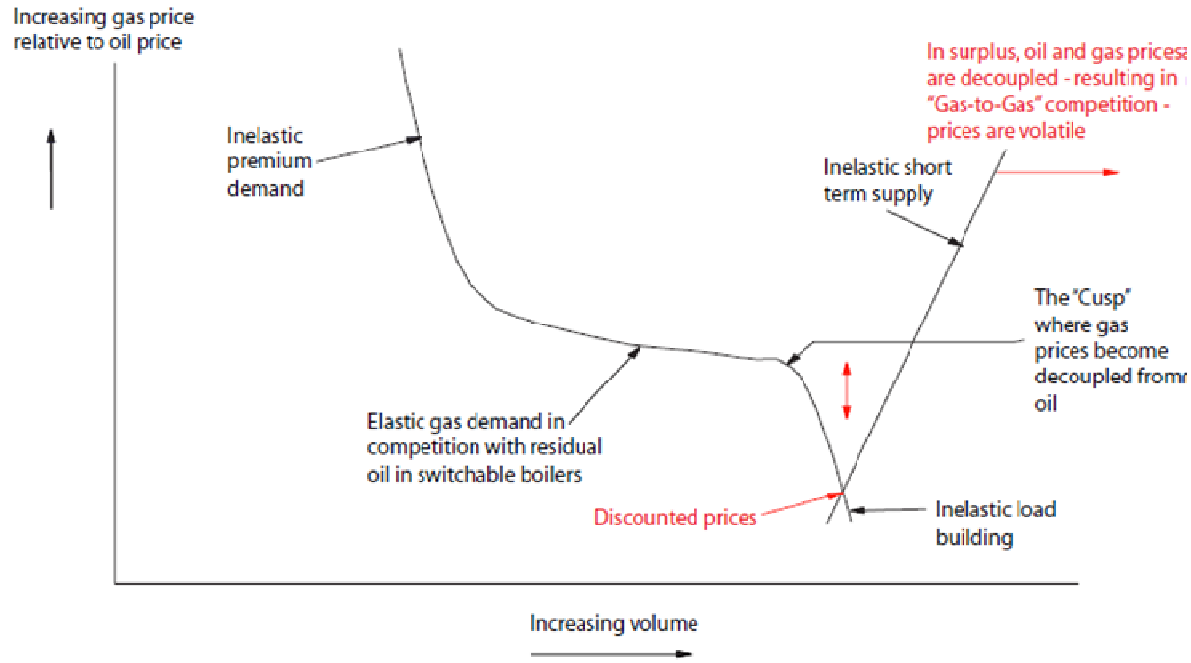


Source: Energy Charter Secretariat (2007, p. 121)

Gas-to-gas competition pricing and the still existent indirect oil-linkage can be explained in more detail by fundamental supply and demand economics. The theoretical commodity pricing approach expects supply to rise with higher prices and demand to fall with higher commodity prices. The resulting commodity price is determined by the intersection point of the demand and the supply curve. At this point, the market-clearing point, price demand and supply are in balance. However, this concept is more complex for gas, amongst others, because there are different elasticities for different parts of the market and because of the competition of substitute fuels (Energy Charter Secretariat, 2007, pp. 121-122). In Figure 12 (see next page), a realistic concept of the supply-demand-curve for gas and thus its price formation is shown.

[4] Based on the NYMEX 'Strip' Price = average 'strip' price of Henry Hub futures contract

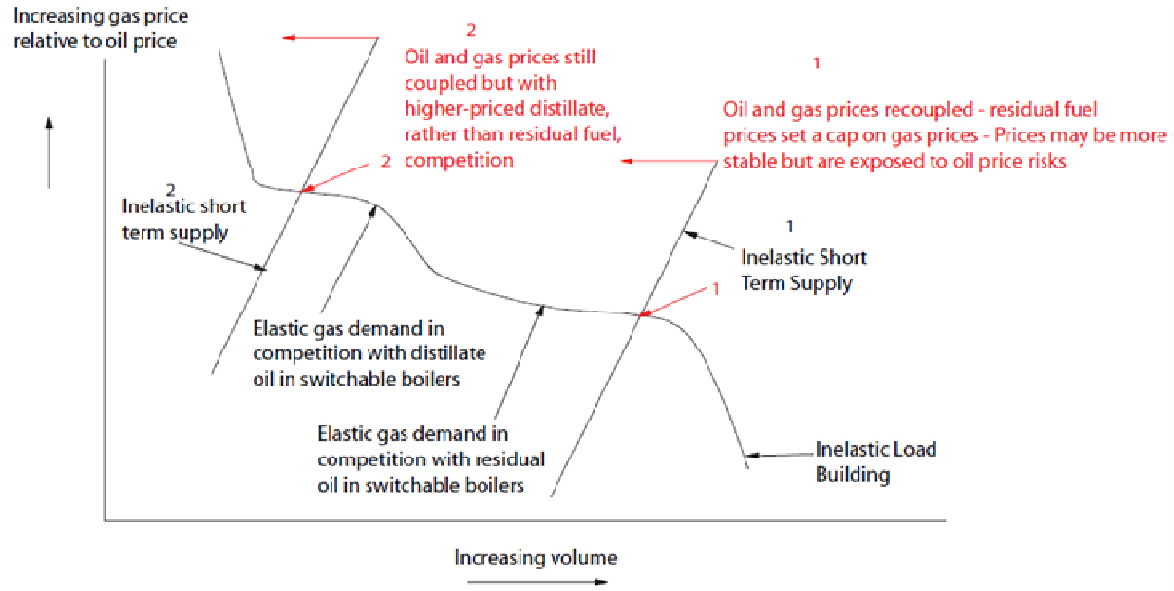
Figure 12: Gas Supply/Demand Curve: A market in gas-to-gas competition



Source: Energy Charter Secretariat (2007, p. 122)

Short-term supply is rather inelastic. Demand, in contrast, is only inelastic in supply surplus when the customers who wish to use gas can do so and the suppliers cannot build additional gas loads through price discounting fast enough. At this point, there is discounted price behavior in the market and oil prices do not matter (Energy Charter Secretariat, 2007, p. 122). However, when the market tightens, competition for short supply raises prices to a plateau where they are in competition with residual fuel oil (HFO) price levels (Condition 1 in Figure 13 on the next page). Then the prices of oil and gas are recoupled and the competition between oil and gas prices potentially starts to set a ceiling on gas prices. Figure 13 further shows that if the market tightens even more and supply volumes decrease, residual fuel oil switching capacity is exhausted and gas prices increase to the level of distillate oil prices (Jensen, 2003, p. 1). Exemplary for the US, prices have tended to move between the residual and distillate fuel oil parity.

Figure 13: Short-term Supply/Demand Curve: Oil-to-gas competition restored



Source: Energy Charter Secretariat (2007, p. 123)

On the plateaus, gas demand is elastic and reacts to movements in oil prices. In the US, these reactions take place in the short-term since dual firing capacity and thus switching between fuels in the short-term is a more common feature in the US gas market, but is on the decline there as well. In Europe, advantages of fuel price differentials and movements are not taken immediately but in the longer run (Energy Charter Secretariat, 2007, pp. 122-123). The reduced possibility to switch between oil and natural gas in the short-run could lead to periodically substantially different dynamics in gas pricing. Short-term prices for natural gas are ultimately driven by exogenous and transitory factors that have an impact on gas demand and/or supply. First, such a factor can be seasonality. Gas consumption is seasonal, since gas is still mainly used for heating, whereas the production is not. Consequently, demand for natural gas is higher in winter than in summer and gas is stocked in summer for use in winter, which results in higher gas prices in the winter months than in the summer months. Second, extreme weather can be an influencing factor for gas demand when extreme temperatures change normal heating and cooling behavior and thus pressure prices. Third, it is possible that the amount of gas in storage is above or below the seasonal norm and thus depresses or lifts the gas price. Last but not least, disruptions of production can occur due to hurricanes, for example, and as a consequence limit supply and boost gas prices (Brown & Yücel, 2008, p. 48).

3.2.3 Advantages of gas procurement via hubs

When gas is purchased on hub marketplaces and when gas prices are based on gas-to-gas competition and influenced by exogenous factors this can surely bear risks for the market players, but also have huge advantages, which are presented in the following.

i. Flexibility

One of the most outstanding advantages of advanced gas procurement via hubs is the flexibility gained in the gas market through spot trading and short-term contracts, which is also the ultimate objective of EU regulations. This leads to a market where gas can constantly be purchased or sold. "Failure to supply under a contract can be remedied by the acquiring gas from the spot market. In the same way, consumers could decide to sell their supplies on the spot market rather than use it themselves, depending on the season and their alternatives", (Clingendael International Energy Programme (CIEP), 2008, p. 13). Thus, hub trading has the advantage over oil-linked long-term contracts to secure against volume risks. If quantities the customer ordered differ from those actually needed, the customer can purchase or sell those quantities short-term on the spot market. Though, necessary condition for such flexibility is a liquid market.

ii. Transparency

A further advantage of hubs is that spot prices offer more transparency. When trading takes place on an exchange even full transparency is offered (for instance in futures quotations). Transparency enables hedging and for the customer comprehensible pricing. Although at times the prices might be higher when they are hub-based rather than pegged to oil prices, they can be regarded as fair prices set by market interaction and enhance market participants' confidence in the market.

iii. Price level

In general though, hub prices have been below the level of oil-linked gas prices in recent years. In a liberalized, more united gas market, the prices for the end-customer are subject to more competition and thus often fall below those predetermined in oil-indexed long-term contracts (International Energy Agency (IEA), 2008, pp. 7-8). Market participants can take advantage of price arbitrage opportunities and benefit from low spot gas prices instead of being bound to long-term agreements. However, it has to be taken into account that the effect

that higher liquidity and lower competition in the market will decrease prices does not always hold true.

iv. Procurement optimization

Hub marketplaces and spot trading of gas give the possibility to trading participants to optimize their gas delivery. Along with more price volatility risks (see Section 3.2.4), they also have higher market chances. A liquid gas market enables diversification of gas procurement and supply portfolios and therefore facilitates hedging risks. Portfolio optimization possibilities in connection to hub marketplaces are presented in Section 3.3.3.

v. Encouragement for investments

The advantage of oil-linked long-term contracts to encourage investments can also be stated as an advantage of hub-based pricing in the sense of market mechanism. If the market is liberalized and liquid enough, it likewise encourages investments through market forces. The market forces indicate where investment is needed and encourage more investors because these investors can participate in the benefits. This means that in a functioning market, investments in infrastructure will eventually pay back.

vi. Functioning market mechanisms

Gas trading on hubs enforces general market mechanisms instead of having the market in the hands of a few incumbents and referring prices to another market, the oil market. The market forces result in more competition, market participants being closer to market and increased efficiency. Gas prices at hubs can be used as a pricing reference for valuing gas in different kinds of contracts, since the price for gas delivery at a specific location and a specific date is derived from the balance of supply and demand at a hub (Leykam, 2008, p. 8). In addition, through the balancing of supply and demand, hub markets enhance the efficiency of the use of the gas and the supply system (Clingendael International Energy Programme (CIEP), 2008, p. 25).

vii. Virtual hub system

At virtual hubs gas can be traded for a whole network area with several entry and exit points at which the gas can be delivered. Trading within the market area is independent of a particular delivery point, which means that the gas just has to be injected at one of those points and can be withdrawn at any of the exit points after it was bought at the hub. Charges do not differ for these different locations and thus trading of the gas at this hub marketplace

can take place freely between different parties for a single price (International Energy Agency (IEA), 2008, pp. 53 - 54).

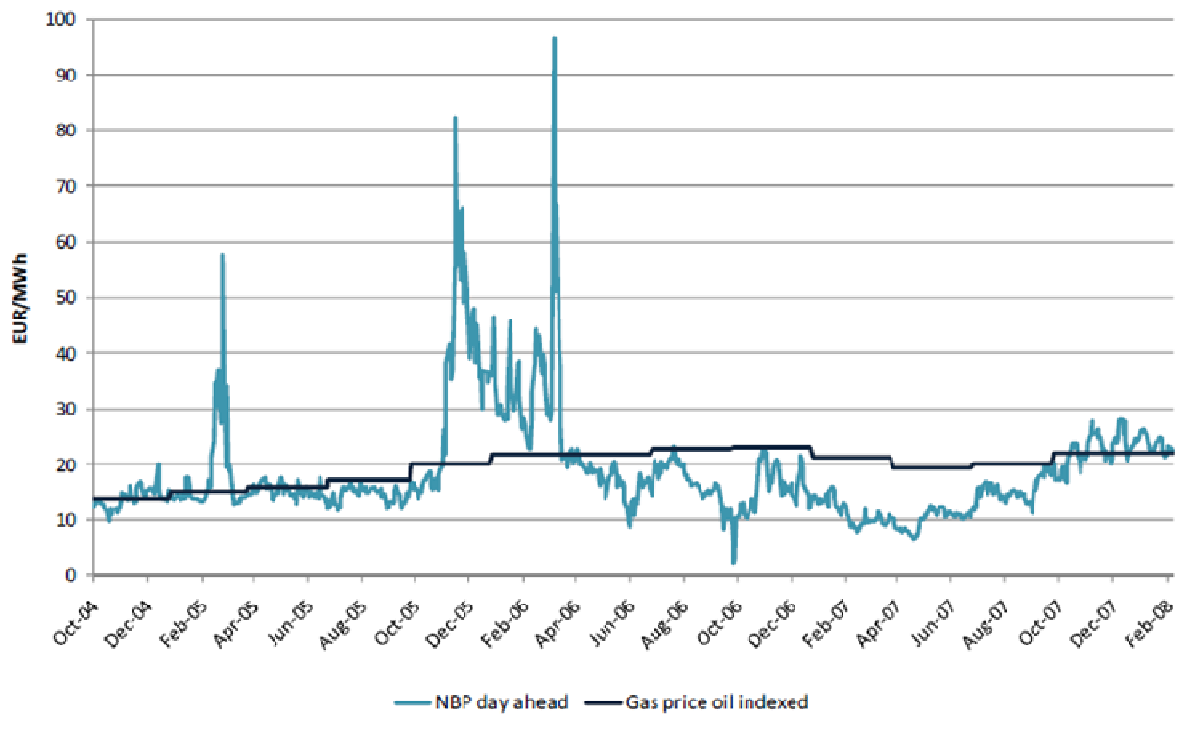
3.2.4 Risks from trading gas on hubs

Trading on spot markets always bears several risks. This section addresses the risks encountered when trading gas over hubs and thus, when relying on prices based on the gas market.

i. Price volatility

Trading gas over hubs exposes the market participant to higher risk. Gas price volatility on the sport market is certainly higher than the price volatility of oil-linked gas prices in traditional long-term contracts as shown in Figure 14. Day-ahead or month-ahead gas prices at a hub marketplace fluctuate more than time-lagged, averaged oil-indexed gas prices, since spot prices on traded markets are influenced more deeply by supply or demand pressures or bottlenecks and seasonality, overall by exogenous factors.

Figure 14: Gas price volatility: Oil-indexed price versus NBP Day-ahead



Source: IEA (2008, p. 44)

Volatility of traded gas prices is not only higher than volatility of oil-linked prices, but also higher than volatility of oil product prices and other commodity prices, caused by the prevailing use of gas for heating purposes. This makes demand more inelastic and not only spot prices, but gas prices in general follow seasonality and external influences like weather patterns to a greater extent. This is intensified by the fact that storing gas is more difficult and more costly than storing oil. Another reason for more volatile gas prices is the less flexible transportation system in the gas market compared to the oil market. Caused by lower transportation flexibility, changes in supply or demand have bigger effects on prices in the gas market (Clingendael International Energy Programme (CIEP), 2008, pp. 10-11). Gas supply shortages lead to significant price increases, as it happened for example in the sharp price spike in the UK in the winter of 2005/2006, when North Sea production decreased while demand increased and storage capacity was not available (Energy Charter Secretariat, 2007, p. 103). Nevertheless, there is the possibility for market operators to hedge gas price risks with financial derivatives as highlighted in more detail in Section 3.3.4.

ii. Dependency on market players

Since gas markets are more local and regional in comparison to the global oil market, traded gas markets are likely to be more dependent on and influenced by major market players as it is the case for oil markets. Thus, concluding supply contracts based on gas spot prices might expose other market players to the actions of the major market players to a great extent (Clingendael International Energy Programme (CIEP), 2008, p. 15). Furthermore, when trading gas does not always entail physical delivery, the gas industry is exposed to actions of market participants who enter the trading marketplaces for gas just out of financial interests and speculations.

iii. Political implications and crisis resilience

A high risk is furthermore government involvement in the gas market and thus political implications. In the gas market, importing countries are more dependent on the producing countries than in the oil market. Due to high specificity of gas transportation via pipelines, gas imports are not flexible but drawn from only few producing countries like Russia. Consequently, when gas prices are not contractually bound to oil prices, importers are exposed to possibly sharp price changes caused by political power games. For example the Ukraine crisis showed how Russia can execute power on the European gas market. In 2005/2006 and again in 2009 Russia interrupted its gas supplies to Europe passing through the

Ukraine for several days. Except in Italy, the impact on European gas prices was limited due to the oil-indexation in long-term contracts (Clingendael International Energy Programme (CIEP), 2008, p. 13). However, gas prices based on the actual gas market would have been more susceptible.

iv. Market liquidity risk

Relying on a traded market, customers and suppliers face the risk that the marketplace could be insufficient liquid. Consequently, there might be open trading positions that cannot be closed. It is then possible that customers' demand is not satisfied or that suppliers end up with a surplus of gas and suffer financial losses. That is to say, procuring gas over not perfectly liquid trading hub marketplaces, one faces the risks of short-term supply shortages, capacity constraints, counterparty risks and unclosed positions and thus has not the security of supply respectively demand as in long-term contracts where delivery volumes are long before booked and assured.

v. Uncertainties regarding infrastructure

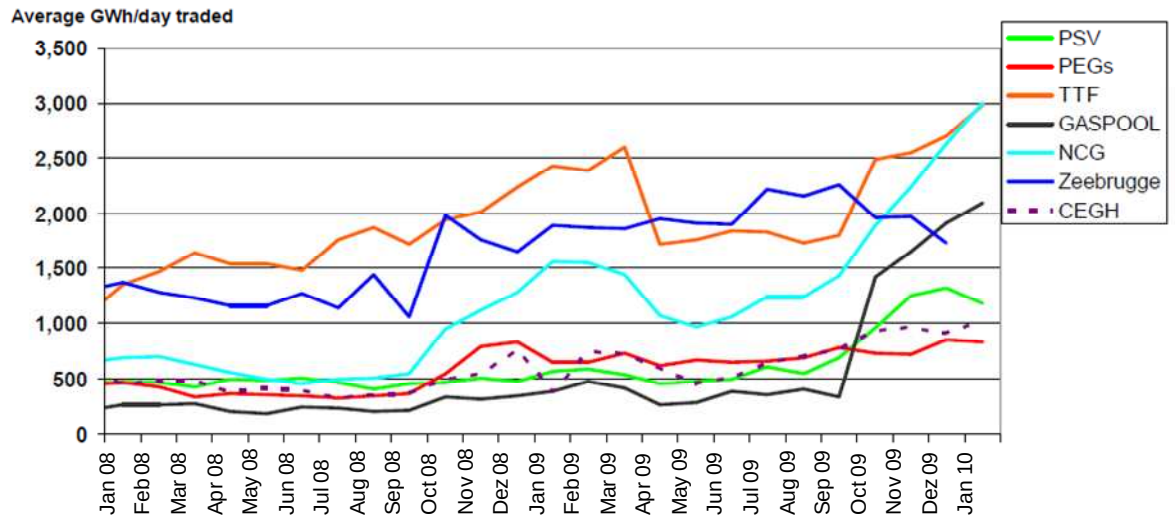
Similarly, the short-term market leads to general uncertainties regarding infrastructure. With long-term contracts for gas delivery in use, it was common to agree over transport and storage capacities also on the long-term. When trading gas with focus on shorter terms, it has to be possible to access infrastructure on the short-term. Terms and conditions for access have to be adjusted. Section 4 deals with the relevant adjustments that are necessary for a hub market in order to function (e.g., the entry-exit-system). If infrastructure capacities are not accessible on the short-term, market participants face the risk that gas delivery over hubs may not be possible due to constraints in capacity.

3.2.5 Latest development of advanced gas procurement

The Continental European gas industry seems to be on the way to a liberalized gas market. The EU regulations already introduced the entry-exit-system, mandatory TPA and compulsory organizational, legal, management and accounting unbundling of integrated companies. This should enhance the liquidity of the gas market and foster the development of the gas market to a single European gas market (Energy Charter Secretariat, 2007, p. 165). The measures are increasingly implemented on national level. However, great national differences in regulation still exist and need to be resolved. The regulatory efforts, aiming at turning the European gas market into a competitive marketplace, where procurement takes

place mainly over hubs, are regarded as not being overly successful, because the concept of long-term contracts is still prevailing. Still, these efforts have fostered the development of spot gas trading places. Especially in the last year, gas trading on hubs increased significantly, also on Continental European hubs as shown in the following figure. Only at the Zeebrugge hub, trading did not increase in the last year, in contrast to the years before.

Figure 15: Hub Volume Development (Jan 08 – Jan 10)



Source: Boddy (2010, p. 5)

Apart from regulations, the fact that gas consumption for power generation is increasing in Continental Europe has also an impact on the gas market structures. The power generation sector is strongly uncomfortable with the traditional oil-indexed long-term contracts, because of the volume risks that have to be taken for a long time horizon and prices that do not reflect the actual gas market. Since this sector is growing and becoming more important in the gas market and since its demand exhibits high price elasticity, it can exercise power on the whole industry and might thus foster the liberalization path to a traded gas market (Melling, 2010, pp. 36-37). On the other hand, Europe is becoming more and more import dependent. Also the UK faces the problem of increasing demand and declining own resources and North Sea production, thus becoming an importer as well. This makes exporting countries more powerful and further regulations might be insufficient to provoke a complete transition to a competitive single European gas market. However, hybrid gas procurement forms are already prominent in the gas industry and last but not least, alternative delivery options like LNG could play a crucial role in changing the European gas market.

3.3 Hybrid forms of gas procurement and further alternatives

Many hybrid versions of or alternatives to the afore-presented two gas delivery contract options exist in the gas industry. This section presents a selection of the most common possibilities. These include gas delivery contracts with fixed prices, structured gas procurement and active portfolio management. Furthermore, Section 3.3.4 highlights the use of derivatives in gas markets. Subsequently, the impact of the growing LNG market on the gas industry is examined.

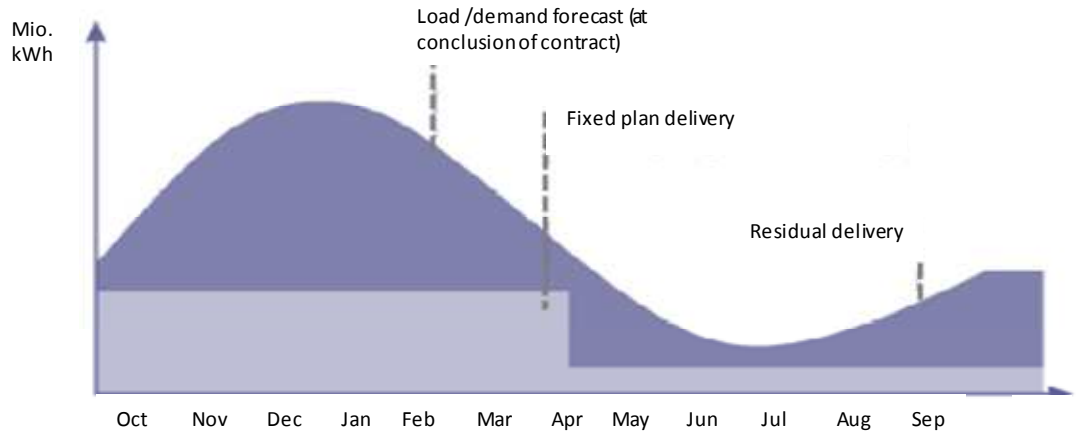
3.3.1 Full supply contracts with fixed prices

A relatively new popular concept for gas delivery contracts are contracts with only a short term of about two to three years that contain a fixed price for gas, but also include the full supply for customers as in all-inclusive oil-linked long-term contracts. Demand is very high for such contracts and thus, there are more and more suppliers offering them. It gives the buyer planning certainty, budgeting certainty and no price risk (Berg, 2009, pp. 28-29). This method is useful to adopt when current gas price levels are low and gas and/or oil prices are expected to rise. Not only is the fixed price a new development, but also that the term of contracts tends to be shortened more in the gas industry became popular in recent years.

3.3.2 Structured gas procurement through fixed plans and residual gas delivery

A further method for gas procurement is to structure the procurement into different contracts for fixed gas delivery amounts (in the following called “plans”) and a residual delivery. The fixed amounts can be separated into an annual plan, seasonal plans, quarter plans, monthly and daily plans. The volume of these plans aligns with the minimal demand of gas during the term of the respective contracted plan, beginning with the annual plan (Micke, Niehörster, & Waschulewski, 2006, p. 113). The price could be fixed or linked to oil product prices, depending on the term of the contract. It is possible to divide the procurement of the different plans over several suppliers. The residual delivery is not fixed but describes the difference of total demand and the amount of gas included in the fixed plans. The customer contracts the whole annual demand load over one supplier, whereas the residual demand, less some fixed plans, can also be purchased from other suppliers (Wiegelmann, 2009, p. 13). The following figure depicts such a division of the gas delivery.

Figure 16: Structured gas procurement: Fixed plan & Residual delivery



Source: Own illustration based on Wiegelmann (2009, p. 13)

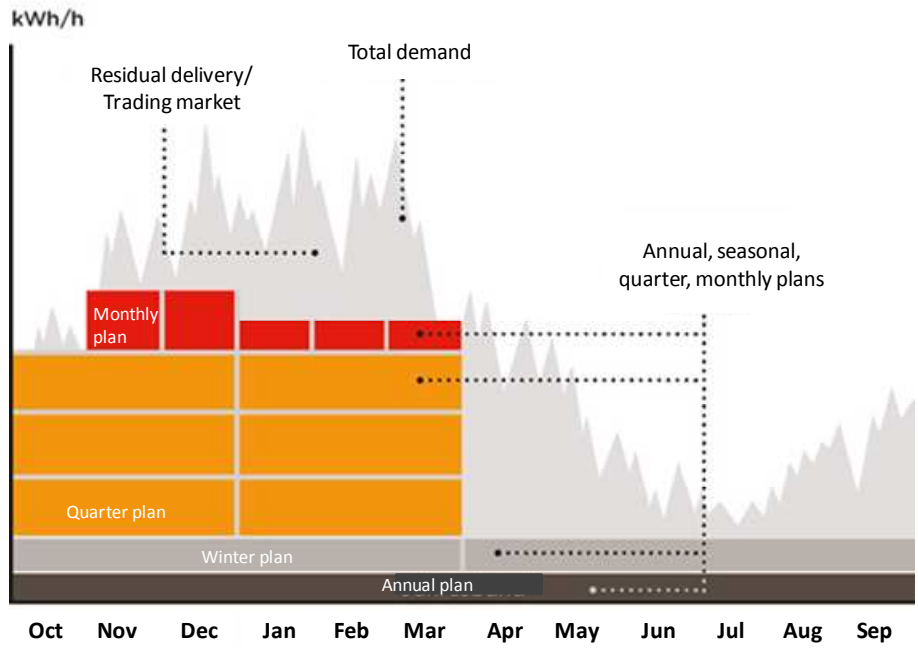
The annual fixed plan could be shaped as a traditional oil-linked long-term contract and the shorter plans could be linked to spot gas prices for example.

There exist different options how to structure the gas delivery. The market for structured products is increasing. Suppliers offer several possibilities, which are directed to the customer and his needs. The customer gains greater flexibility through the structuring. Structured gas procurement is a delivery method, especially local suppliers and end-customers prefer.

3.3.3 Active gas procurement through portfolio management

Active portfolio management is structured gas procurement in its most distinctive form and again means the combination or mix of different purchasing methods and products. For example one can contract a fixed plan over a long-term contract, some shorter term fixed plans dependent on seasonality and clear peaks and seasonal demand with spot gas trading on hubs (OTC and/or exchange). Also storage can be included into the product mix and physical or financial derivatives in order to hedge price risks. The objective often is to divide the load into as many standardized products on hubs or exchanges as possible and reasonable.

Figure 17: Active portfolio management



Source: Own illustration based on Enovos (2010)

The above figure shows the division of gas demand into different plans. These plans do not have to be traditional contracts. One could also, for example, settle the annual plan with futures, which are going to be described in Section 3.3.4, and balance peaks with trading on the spot gas market. The mix of different products is subject to the risk profile of the buyer. Active portfolio management gives the possibility of a good risk management. One can diversify suppliers, delivery places, delivery dates, price indexation and contract durations, and thus create the perfect mix for one's needs. Through the use of derivatives in the product mix, it is possible to further hedge against price risks, as explained in the next part of the section.

Active portfolio management can also include the use of storage. One possibility is to settle annual, quarter and monthly plans in contracts and balance residual demand or surplus with storage. In the summer months, surplus amounts of gas contracted with the plans are injected in storage facilities for the lower summer prices, whereas in the winter months, when demand exceeds the contracted fixed amounts in the plans, the stored gas can get withdrawn to balance the peaks. Another possibility is to minimize storage as much as possible and thus also assume daily plans to balance open positions on the spot market and only use little storage for the amounts that still have to be balanced. This creates greater flexibility, but

impedes to exploit the lower gas prices in summer through storage (Micke, Niehörster, & Waschulewski, 2006, pp. 113-114).

Apart from hedging risks, advantages are the great flexibility of active portfolio management, the high cost transparence and the ability to plan. Structuring the gas delivery takes seasonality into account. However, one has to observe the market permanently. Since a lot of know-how and market access is needed, the concept of active portfolio management is rather suitable for the wholesale levels. End-customers are usually not able to manage the complete structured gas procurement themselves. Nevertheless, they have the possibility to outsource their portfolio management. Consequently, also a market for gas procurement consultancy is arising (Berg, 2009). This new situation requires suppliers to position themselves more competitive in the market, since customers can participate in products and prices of different marketplaces and sources (Wiegelmann, 2009, pp. 19-20).

3.3.4 Derivatives

Derivatives represent another important gas delivery method. A derivative is an "asset whose value derives from that of some other asset" (Brealey, Myers, & Allen, 2006, p. 996), the so called underlying. Usually, the derivatives are used with a mix of other products, as in the active portfolio management described above. Market participants can make use of derivatives in order to hedge their price risk. They are traded on a derivatives market like forwards, futures or options or traded bilateral like swaps.

i. Derivatives Market

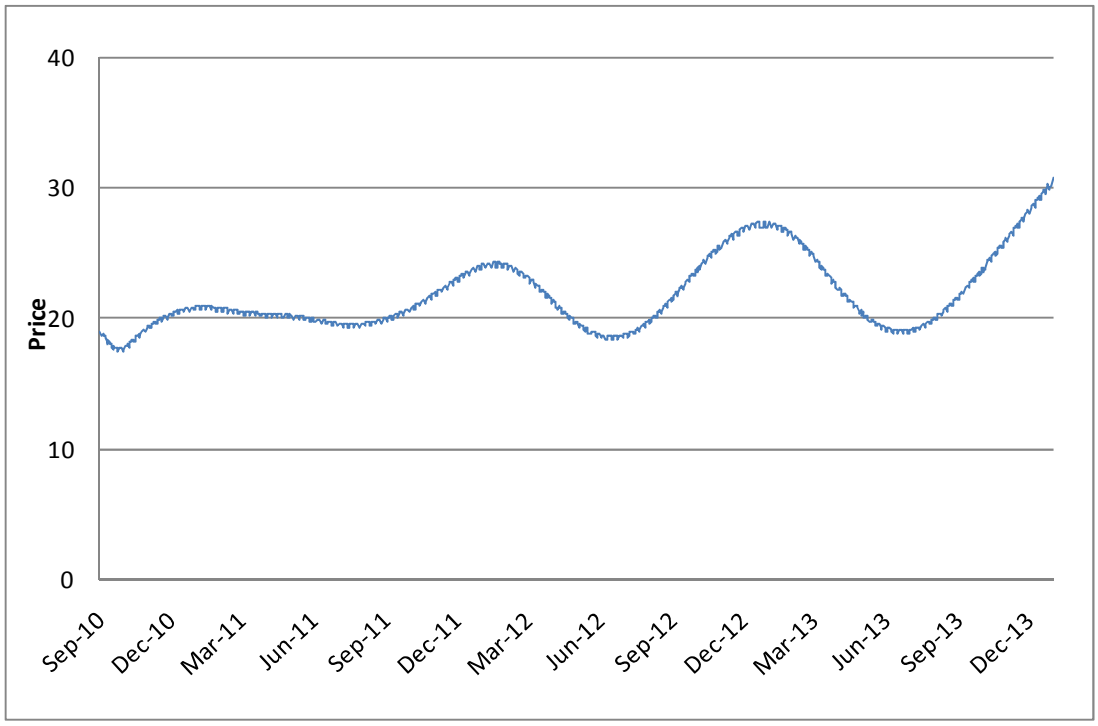
Typically, the derivatives market is a financial market where trading of financial products takes place, although final settlement can also be physical, whereas on a spot market actual goods are exchanged for money. Products traded on the derivatives market in the gas industry include forwards, futures and options. They can be followed by a physical settlement or financial settlement. For energy derivatives specifications for physical settlement are more complex (e.g., delivery point, delivery period or date).

A future contract is "a contract to buy a commodity or security on a future date at a price that is fixed today. Unlike forward contracts, futures are generally traded on organized exchanges and are marked to market daily" (Brealey, Myers, & Allen, 2006, p. 998). In Europe, futures are for example traded on the Intercontinental Exchange (ICE) in London or the European Energy Exchange (EEX) in Leipzig. Forward contracts contain the same concept as future

contracts, but are traded OTC. When entering such a contract for gas, the price for which the gas is obtained in the future is already fixed today. Thus, one could for example hedge against the volatile gas price risks of hub trading of gas.

The forward prices for gas with different maturities produce the price forward curve. The PFC shows present prices for gas in the future and can be regarded as anticipation of future gas spot price development. Figure 18 depicts such a forward curve until end of 2013 for the NCG, indicating anticipation of increasing spot prices.

Figure 18: PFC for NCG (anti-cyclical regime) by Aug 31, 2010 (9/2010-12/2013)



Source: Own illustration based on data of the Institute of Operations Research and Computational Finance (ior/cf-HSG) (2010)

Options are a similar concept as forwards and futures. But they include the right to execute the contract at maturity, not the obligation. The buyer (long position) of the option has to pay a premium to the seller (short position) for that right. There exist different option types. Call options include the right to buy the underlying, whereas put options include the right to sell the underlying on (or before in the case of American options) a specified exercise date at a specified exercise price, the so called strike price (Brealey, Myers, & Allen, 2006, pp. 994,1003). The holder of a call option would only execute the option at maturity when the spot price on that date is higher than the before specified strike price. If the spot price falls below the strike price, the call option holder would only pay the premium for the option, but

not execute it and buy the gas for the lower spot price. On the contrary, the holder of a put option would only execute it when the spot price falls beyond the strike price.

When the derivatives are not executed with a physical settlement, but with a financial settlement, only netting of payments takes place. The holder of a future would receive the difference between the price of the underlying and the specified exercise price at the exercise date if the underlying spot price is higher and would have to pay the difference when the exercise price is higher than the spot price of the underlying. This method could be used as well to hedge against price risks. A market player, who purchases gas based on a fixed price, but sells it at a price linked to the oil price, could hedge against the risk of falling oil prices by taking a long position in a forward with the oil price as underlying. If the oil price falls, he would receive less from selling gas, but would receive the equalization payment of the forward contract, because the underlying price exceeds the specified exercise price. If, in contrast, the oil price rises, he would receive more from selling gas, but had to pay the equalization payment of the forward contract, that is to say the difference between the specified exercise price and the price of the underlying. Thus, in fact he hedges against losses and profits.

ii. Fixed-for-floating swap

Swaps are concluded bilateral. In a fixed for floating swap two parties exchange payments with reference to a total volume over a specified period of time. Often one party of the swap is a bank institute. The buyer of the swap pays a fixed price to the seller whereas the seller pays a variable payment to the buyer. Here, the variable payment can be linked to the spot gas price or substitute fuel price (Wittig, 2007, p. 33). A fixed-for-floating swap is a good instrument for hedging against price volatilities. A customer who purchases gas on the spot market over a hub can pass on his variable paying obligations for the gas to the selling party of the swap and in exchange pays a predetermined fixed payment. In the end, this customer in fact purchased gas for a fixed price and thus, hedged against the price risk of volatile gas on a hub. Also in the case of a swap only netting of payments is applied. In case the spot price of the underlying is higher than the fixed strike price, the buyer of the swap receives the difference from the seller and vice versa.

iii. Evaluation

Overall, derivatives are a good instrument to hedge against price risks in gas delivery contracts. They can hedge against substitute fuel price risks when the gas price is linked to

competing fuel prices, but also against gas price risks when gas is traded on hubs and the market players face volatile gas-to-gas competition prices. However, these concepts are only applicable in combination with a well functioning spot trading market for gas. Explicitly, high liquidity is required in the market in order to function well. Since hub marketplaces for gas are not very liquid in Continental Europe, the derivatives market with gas as underlying cannot be very liquid either. Thus, a market player who wishes to trade in derivatives faces the risk of not finding counterparty. However, efforts are being made to reduce that risk, for example by further uniting the European gas market. A clearing house, the European Commodity Clearing (ECC) was created by the EEX in order to have a joint clearing and settlement place for trading at exchanges and OTC in Europe and reduce the counterparty risk (Maibaum, 2009, pp. 24-25). Furthermore, transparency and access to short-term transportation capacity is required.

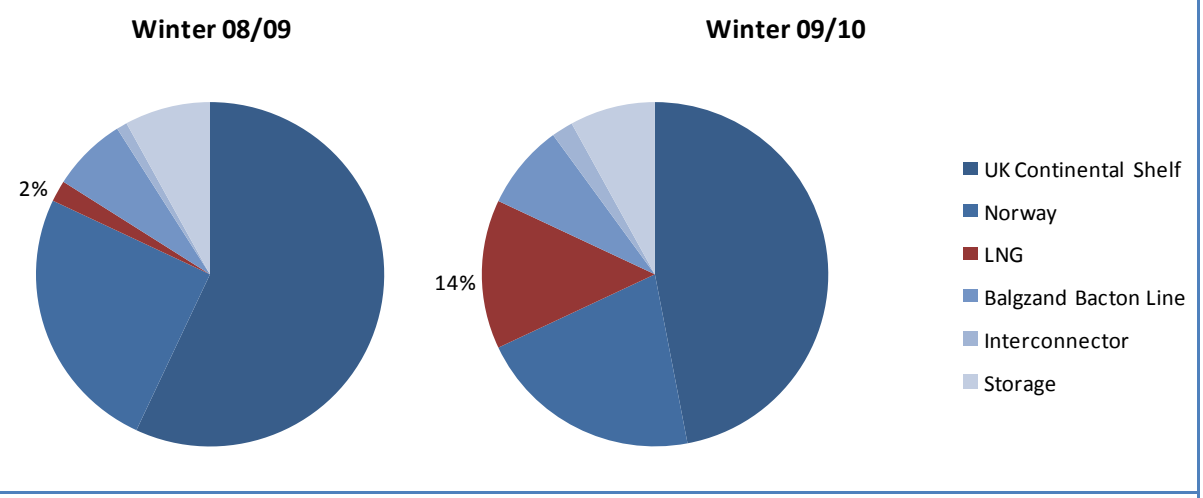
3.3.5 Liquefied natural gas (LNG)

Another option to purchase gas is to purchase it as liquefied natural gas (LNG) instead of natural gas. Using LNG is not exactly an alternative to the question of whether purchasing gas over long-term contracts or on a hub marketplace, but addresses the same question with different implications than natural gas and influences the whole gas industry. This is the reason for it being mentioned here.

Liquefied natural gas originates when gas is cooled down to minus 161°C. LNG has the advantage of a 600 times greater energy density than its gaseous form and is thus easier to handle, to transport and to store. Instead of using pipelines, LNG can be shipped in specially constructed ships, also to distant market. However, the investments necessary to liquefy, ship and re-gasify LNG are tremendous (Energy Charter Secretariat, 2007, p. 35). A LNG project consists of several investments allotted to the supply chain. Rogers (2010) describes the supply chain as comprising “the upstream gas field development and pipeline transportation to the liquefaction plant where processing and cryogenic cooling converts it to a liquid. The LNG is stored in insulated tanks adjacent to a loading jetty where it is transferred to an LNG tanker. On arrival at a receiving port on the destination market coast, the LNG is transferred to storage tanks prior to re-gasification and entry into the market distribution system”, (Rogers, 2010, p. 3). Associated investments are highly capital intensive and revenues cannot be realized before completion of the project. Still, economies of scale are outstanding in the LNG industry and in Europe this LNG infrastructure gradually exists. Once the infrastructure

is built up, gas transport is made easier. LNG industry is increasing all over the world at the moment. In 2008 LNG made up about 13% of the gas net-imports from non-European countries in Europe, whereas the other 87% were imported over pipelines (Eurogas, 2009, p. 8). Although, it is not expected to reach the levels of traditional natural gas supply over pipelines, its shares in supply are growing rapidly, as shown in the following figure exemplary for the UK.

Figure 19: LNG growth in UK gas supply



Source: Own illustration based on Boddy (2010, p. 10)

To compensate the risks of high investments related to LNG infrastructure, the dominant delivery system in the LNG industry in Europe have been long-term contracts which prices were linked to oil prices as in the natural gas market (Energy Charter Secretariat, 2009, p. 7). Since the natural gas market is becoming more flexible, the LNG industry is under pressure to develop into a more flexible market, too. The Energy Charter Secretariat (2007) states that "LNG contracts, which until the 1990s were even less flexible than pipeline contracts, now provide more flexibility with regard to off-take obligations and destination. As costs have decreased, so a larger number of shorter-term LNG deals have developed. Especially in the UK, oil-indexation in the contracts is exchanged for linking to hub market indicators. However, long-term contracts continue to dominate LNG trade and a global LNG spot market has not yet developed" (p. 34). But buyers of LNG are small customers who are sensitive to price competition instead of the large players of the natural gas industry. Consequently, sellers started to adopt the so called "self-contracting" with their own marketing affiliates or venture partners. In the traditional contracts the seller was often a production joint venture and thus a group selling to specific customers. In self-contracting, however, at least one of the partners in the venture contracts with the venture group and sells independently to smaller re-sellers or

end users, thus acting as a wholesaler and taking the marketing risk for the contracted volumes. This mechanism has the advantage that the seller can incorporate these self-contracted volumes in his portfolio and sell them to any terms he wishes with destination flexibility (Energy Charter Secretariat, 2007, pp. 175-183). "Despite the continuing reliance on long-term contracts, these changes in contracting patterns have made the LNG market increasingly flexible. The new flexibility has come about in two ways – (1) a small, but growing, short-term market, and (2) the growing importance of "self-contracted" volumes" (Energy Charter Secretariat, 2007, p. 182). Not only because of a growing short-term market and self-contracting has LNG become flexible. Once the necessary infrastructure is built up, LNG transportation with ships is very flexible regarding the destination in contrast to transportation via pipelines. This advantage could make LNG helpful to manage the risks of purchasing natural gas over hubs. Gas prices on traded markets are exposed to higher volatility, amongst others because of missing storage capacity and inflexible transportation. Peaks could be balanced by flexible LNG supplies on a short-term basis (Energy Charter Secretariat, 2009, p. 22). The increasing flexibility enables arbitrage of prices among market regions, the reason why LNG is regarded as a factor that may lead to the creation of a global gas market. Above all, the US market and Atlantic Basin market are in the focus of the LNG industry recently. Since these gas markets are based on spot prices, this might lead to more flexible contracts and interaction with US spot prices in the whole industry and could make spot markets for gas transfer over to Europe (Clingendael International Energy Programme (CIEP), 2008, p. 16). Consequently, although, long-term contracts are also dominant in the European LNG industry, the impacts this industry has on the natural gas market are of high importance. Through LNG, gas sources farther away can be reached, which would not be possible with natural gas pipelines. This makes more supplies of gas available and thus creates competition for the powerful natural gas producers like Russia. Apart from Russia, important suppliers for liquefied natural gas are amongst others Qatar, Iran, Algeria, Yemen, Angola, Peru and Nigeria (Energy Charter Secretariat, 2009, p. 10). One has to consider however, that also reserves from more distant locations are exhaustible. It is not the case that the European gas market will face surplus in supply due to trade in LNG. The short-term market for LNG might increase rapidly, but long-term contracts still remain dominant also in this industry. It has to be questioned to what extent LNG, and thus the possibility to diversify the gas supplies, is able to create a global gas market.

4. Gas infrastructure and additional price components

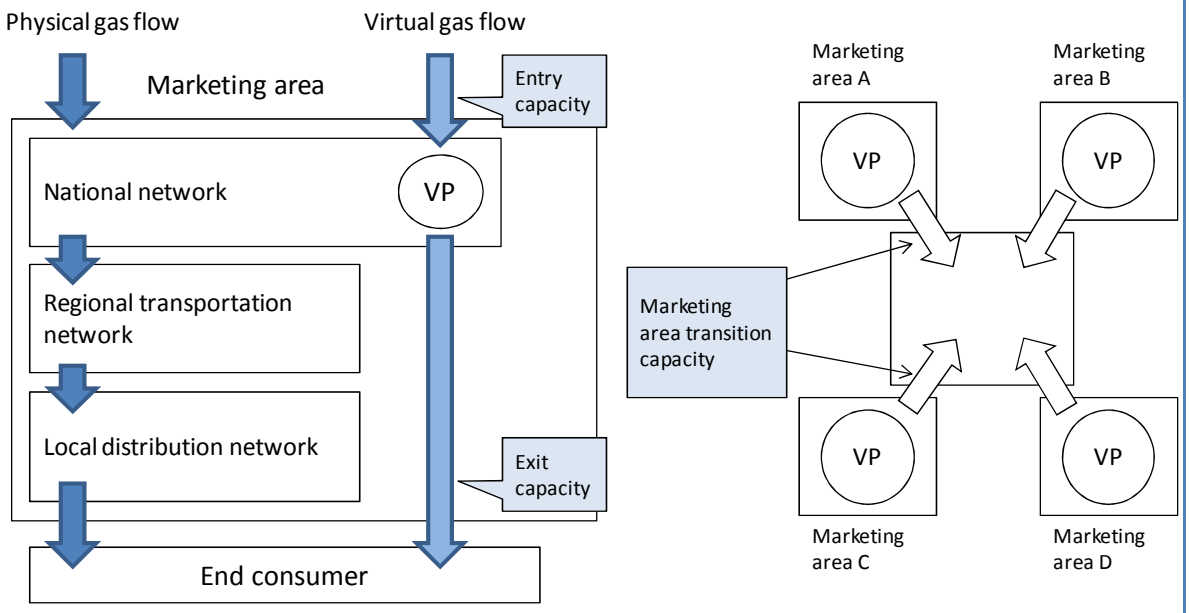
Beyond the pricing of the commodity gas itself, further factors influence gas prices. These include infrastructure costs like network access, transportation and storage costs as well as additional price components such as taxes. These factors additionally influence the choice of the before-presented procurement form. In this section, these supplemental price components are presented and issues about the infrastructure are exposed. These include transportation and network access (Section 4.1), storage (Section 4.2), balancing regimes (Section 4.3) and taxes (Section 4.4). The infrastructure issues are examined particularly with regard to their impact on the gas price and the right choice of a gas delivery agreement, whereas technical details are not highlighted.

4.1 Transportation and network access system

Transportation and transmission issues are very important since the gas often has to be transported long ways from the exploitation fields to the different European gas marketplaces. Infrastructure has to be built up and transport capacities have to be provided. This setting makes a regulation of network access necessary.

One concern is how to arrange access to the gas network and its tariffing. It has yet been mentioned that the so called entry-exit-system from the UK is now transposed to most European Countries by EU regulations (Energy Charter Secretariat, 2007, p. 165). This model imposes a charge only on the entry point of the gas into the network of a certain marketing area and a charge for the exit point instead of tariffing for example from point to point a supplier or distributor changes, which would impede concurrence on the gas market (Energy Charter Secretariat, 2007, p. 129). Figure 20 (see next page) shows the concept graphically. Regarding transportation capacities, the old point to point system required the booking of capacities from a specific injection to a specific withdrawal point of the network, whereas the entry-exit-model separates transportation and commodity trading. Capacities for injection to the network can be booked independently from capacities for withdrawal and within the marketing area flexible use of the capacities is possible. For solely trading gas within the marketing area no special booking of capacities is necessary (Heuterkes & Janssen, 2008, pp. 6-7).

Figure 20: Entry-Exit-Model



Source: Own illustration based on Wiegelmann (2009, p. 3)

Efforts are being made to reduce the number of different marketing areas, because marketing area transitions are subject to several entry and exit contracts and capacity constraints. With only a few marketing areas the access to network capacities would be facilitated, which is crucial to enable competition and the operability of the market (Heuterkes & Janssen, 2008, p. 7). Consequently, the advantage of the entry-exit-model is that it helps creating greater gas marketplaces and thus fostering competition. It could enable a development to a more liquid gas market and the step away from long-term gas delivery contracts. The entry-exit-system makes gas hubs virtual gas hubs, where trading for the market as a whole takes place. Consequently, this concept already incorporates the idea of trading gas on hubs. Furthermore it is supposed to add transparency and efficiency to the network access.

As mentioned in Section 2.3, third party access (TPA) to transport capacities has to be granted according to the EU Second Gas Directive. Without implementing TPA, a hub marketplace cannot be liquid enough. As long as capacity constraints in the grid prevent this implementation, a transition of traditional gas procurement to gas trading on hubs is unlikely to happen (Energy Charter Secretariat, 2009, p. 22).

A tremendous influence on the gas procurement method and gas prices has the transportation infrastructure itself (that is to say transportation pipelines) and transportation costs. Gas transportation is very costly because of the low energy density of gas and requires high

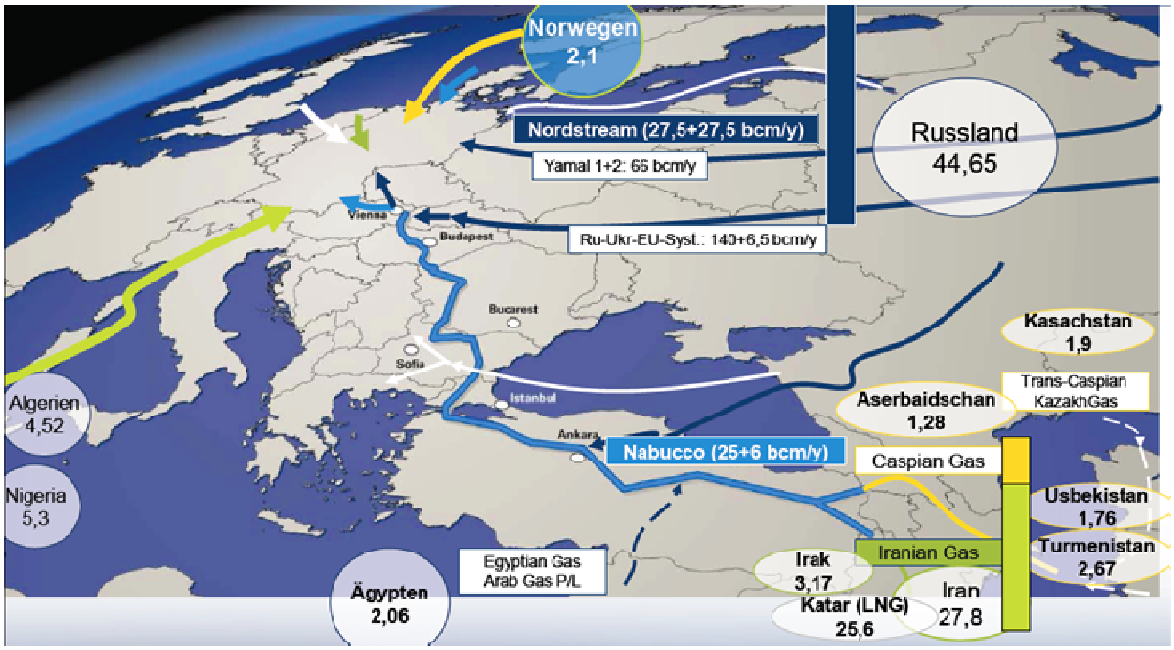
investments. Specificity of investment is often high and the longer a pipeline, the higher the costs it incorporates, thus there are huge transportation cost differentials. For these reasons long-term gas delivery contracts are often preferred by the investors in order to assure their return on investment and economic viability with remedies as take-or-pay clauses and assured high capacity utilization or load factor of the pipelines. But on the other hand, in contrast to hub gas prices, oil-linked gas prices do not provide market signals or economic incentives to invest in new supplies, pipelines or storage infrastructure. Making investment decision on the basis of an analysis of the gas market is not possible anymore, due to the more and more competitive and fragmented market structure. Spot prices, however, can provide guidance for gas infrastructure investments. Still, the CIEP (2008) argues that "for gas the forward curve on traded markets is generally not long enough to fulfill such a role for the significant investments, which in the gas industry characteristically take a very long time to be realized" (p. 12). But that does not mean that with regard to transportation investments only oil-linked long-term contracts would make sense. With gas procurement over hubs capacity utilization and the load factor would be very likely to be high as well. Moreover, in a liquid gas market capacities could also be sold on a secondary market for capacities for third parties.

Specific transportation costs for LNG are also high. However, the specificity of the LNG transportation is lower than for pipeline transportation, which leads to higher flexibility, since LNG tankers could for example be re-directed to different destinations and thus, long-term contracts are not necessarily required for that reason (Energy Charter Secretariat, 2007, p. 205).

Furthermore, transportation infrastructure can be helpful in developing an interconnected European gas market and to overcome national borders, which affects the pricing issue of gas. For example the Interconnector that connects the liquid UK gas market in Bacton with the Continental Europe gas market in Zeebrugge, leads to arbitrage trading for contractually unbound volumes in the short or medium term (Energy Charter Secretariat, 2007, p. 130). New pipeline projects (e.g., the Nabucco project or the Nord and South Stream pipelines) are supposed to enable new gas supply ways. Nord Stream is a pipeline through the Baltic Sea that will connect Europe directly with the Russian gas reserves and provide significant amounts of transportation capacity (BDEW Bundesverband der Energie- und Wasserwirtschaft e.V., 2009, p. 8). The South Stream pipeline is going to bring gas from Russia via South East Europe in order to avoid transit through the Ukraine so that Russia's dependence on transit countries diminishes and a crisis, as in the Ukraine in 2005/2006,

cannot have great effects in the future. However, it makes the European gas market even more dependent on Russia as gas exporting country. The Nabucco pipeline, in contrast, is anticipated to give Europe access to new gas supplies by bringing gas from Central Asia. It is supposed to reduce Europe's strong dependence on Russian gas supplies and thus to foster competition also on the import level (Flauger & Stratmann, 2010, p. 4). Figure 21 depicts the reserves the Nabucco pipeline would give access to. The Nabucco pipeline along with increasing LNG spot supplies could enable more diversified gas supplies in Europe and thus contribute to a liberalized gas market.

Figure 21: Illustration of the Nabucco project (proved gas reserves in bcm)



Source: Hall (2010, p. 14)

4.2 Gas storage

A very important feature of gas is that it can be stored in contrast to electricity for example. The most important instrument for providing flexibility in the gas market is storage (Borowka, Butterweck, & Katz, 2008, p. 13). Storage can be used to balance supply and demand differentials. Small amounts of gas can be stored in small superficial facilities. But large amounts are usually stored underground in aquifers, depleted reservoirs or salt caverns. Aquifers are water-bearing rock formations where gas can be injected and stored because of the solubility of gas in water, whereas depleted reservoirs are waterless rock formations, often depleted gas fields, whose pore spaces serve as storage place (Borchert, Hasenbeck,

Jungbluth, & Schemm, 2009, p. 281). Finally, salt caverns are underground cavities that are formed by injecting water into salt domes, thus dissolving the salt. By pressure, gas can be injected into and withdrawn from these salt caverns (Wingas & EWE, 2008, pp. 10 - 11).

A certain amount of cushion gas always has to remain in the storage facility in order to maintain a minimum level of pressure, whereas the rest of the total possible volume can be injected and withdrawn as working gas. Injection and withdrawal rates have restrictions. Possible withdrawal rates diminish with sinking working gas, because pressure in the cavern falls. On the other hand, injection costs rise when the storage facility is filled and pressure is high (Borchert, Hasenbeck, Jungbluth, & Schemm, 2009, p. 281). Due to the low energy density of gas, storage costs are high in general. Storage charges for the storage user are composed of several components. Usually, they include a fixed charge for the reservation capacity and a variable charge. The variable charge includes a charge for system services, energy costs of the injection (compression) and a charge that depends on the ratio of the working gas volume to the withdrawal rate (Spitz, 2009, p. 26).

Storage is used to balance seasonality, balance short-term differentials between supply and demand and thus provide better security of supply and to help market players to manage their volume risks. As in winter demand for gas is higher than in summer, production capacity in summer can be shifted to the winter by storage. In addition, gas prices in summer are below those in winter and thus, the market participants can make use of this price differential through storage. Furthermore, storage is used to structure the gas delivery for gas portfolio management as before-described in Section 3.3.4. It helps for example marketers to build a flexible portfolio, because they can better react to fluctuating demand. This peak-shaving service makes storage crucial for hub gas marketplaces, where market players need the ability to react to fluctuations in supply and demand in particular. Therefore, hubs should have access to storage to a large extent. However, the CIEP (2008) argues that the use of storage serves as risk management tool only for the short-term in spot markets, “it still does not provide the time horizon to justify investments in storage for seasonal load balancing” (p. 16). On the other hand, oil-indexed gas prices cannot either provide information for the gas markets which investments can be considered as justified as could gas prices based on gas-to-gas competition.

So far, access to storage has been granted by long-term agreements and long-term reservations with the consequence of foreclosure of the access to storage for third market players. Sometimes the booked storage is not even fully used and vertically integrated

incumbents try to prevent investment into new storage capacity in order to hinder competition. For these reasons the European Commission (2007) asks for a European perspective on future storage demand and requires third-party access to storage as for the transportation system (p. 66). Especially unused capacities should become accessible to market participants for example through secondary trading in natural gas capacity. When gas is procured through oil-linked long-term contracts, traditionally the supplier is in charge of storage. When gas procurement is supposed to happen over hubs, long-term storage reservations have to be abandoned or at least an adequate amount of storage has to be accessible on the short-term. If hub trading works successful, like in the UK, all its different elements and steps are separated into stand-alone transactions mainly OTC: the trade itself, the shipping, access to the network, the storage and the balancing (Clingendael International Energy Programme (CIEP), 2008, p. 5). For this reason flexible storage products have to be available. Explicitly, not only bundled services with predetermined amounts of working gas and injection and withdrawal rates should be offered, but also unbundled services where injection rate, withdrawal rate and working gas can be booked separately on the short-term (Gazprom Germania GmbH, 2010). This creates the need for even more storage capacities. In salt caverns smaller amounts of gas can be stored than in pore space storage places, but they can be used more flexible, because of better injection and withdrawal power. Thus, it is advisable using pore space storage for seasonal demand differentials and salt caverns for short term peak-shaving (Borowka, Butterweck, & Katz, 2008, p. 13).

Summing up, storage and transportation profoundly influence gas procurement costs and opportunities. The cost of storage and transportation and their availability have a great impact on whether oil-linked long-term contracts prevail for gas delivery or a transition to hub gas trading takes place. The European gas market can only develop into a flexible, competitive, liberalized marketplace if flexible storage capacities are made accessible and third party access can be guaranteed. In order to treat different marketplaces as one large, unique, interconnected one (a virtual hub) transportation and storage have to be easy and closely accessible at appropriate cost.

4.3 Balancing regimes

Balancing is another important feature of the gas procurement process. Although the details of balancing regimes go beyond the scope of this work the topic is addressed briefly in the following.

The market can experience imbalances when physical gas demand and supply vary more rapidly than it is possible to take commercial action. In gas markets, imbalances are normally occurring events, thus network operators need enough flexibility to keep the pressure of the system within its physical constraints. In order to prevent high balancing costs for the system operator, the market design should provide incentives to all major market participants to have balanced portfolios (International Energy Agency (IEA), 2008, p. 54). In fact, if network users are not able to balance the amount of gas being injected into the network with the amount being withdrawn by their clients, they have to buy gas from, or sell it to, the system operator with implicit penalty charges. However, small tolerances of being out of balance are usually allowed (European Commission, 2007, p. 245). In Europe, the balancing is organized in two different ways regarding the balancing period. First, daily balancing requires every shipper to have a balanced portfolio of flows into and out of the system by the end of the day. This method is preferred by most network operators. Second, few countries, like Germany and the Netherlands, apply hourly balancing. This method is claimed to represent an entry barrier for new entrants however, because it requires a substantial portfolio of hourly flexibility (International Energy Agency (IEA), 2008, pp. 54-55). According to the European Commission's Sector Inquiry (2007), priority should be given to trading of imbalances amongst shippers. This would reduce balancing payments significantly on the one hand, but require a liquid marketplace on the other hand (p. 256). Nevertheless, the creation of balancing markets and the resulting need to trade on a daily basis provokes increasing demand for hub-based trading services (Stern, 2007, p. 231).

4.4 Taxes and public fees

A further component of gas prices are taxes and public fees. These are additive constants to the prices. Their share of the gas price is significant. For example, in Germany, in 2010 30% of the gas price for households was comprised of taxes and public fees. The greatest part of these taxes and public fees are value added taxes, followed by taxes on natural gas. Smaller amounts were imposed as proportionate mining royalties and concession levy (BDEW Bundesverband der Energie- und Wasserwirtschaft e.V., 2010). Within the EU substantial differences of gas taxation still exist (Energy Charter Secretariat, 2007, p. 165).

5. Outlook: Options for managing gas delivery

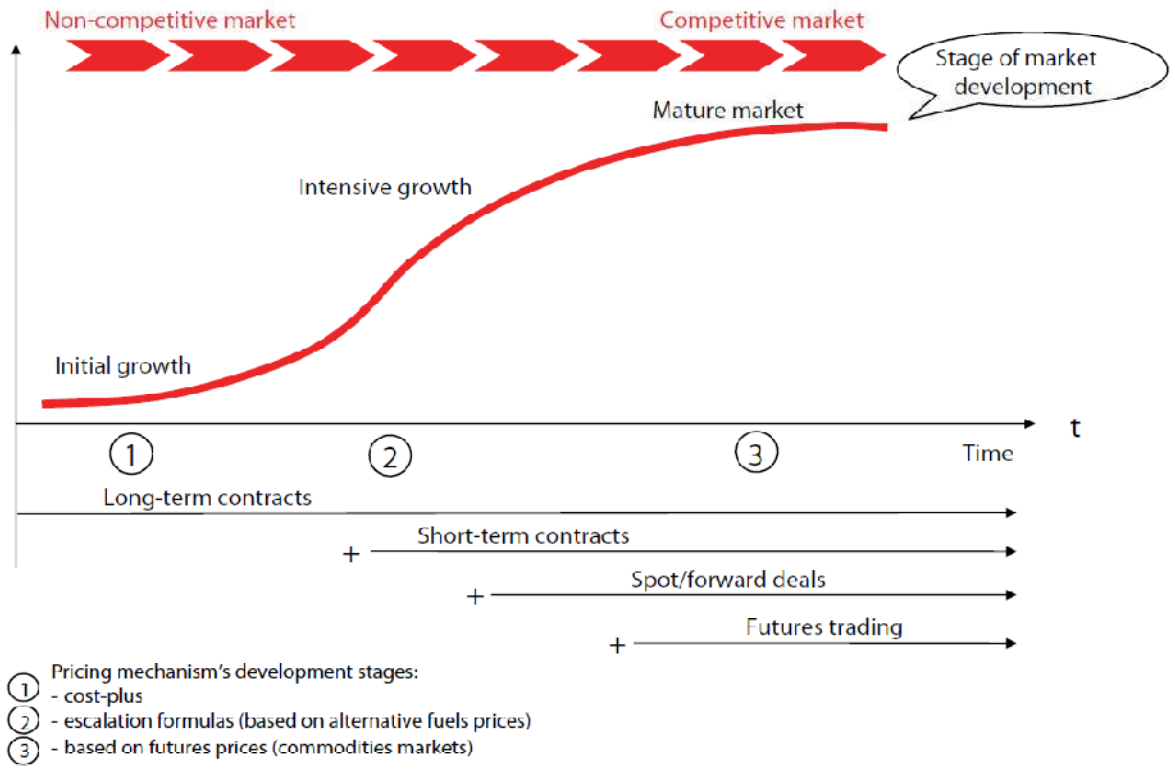
Compiling the knowledge of the relevant issues and possibilities for gas procurement from previous sections, the following part addresses the question which option is to be favored and how the market is likely to develop. Here, concepts and details from the previous sections are put into relation with each other. The most recent developments are addressed and evaluated.

In order to realize a wider adoption of modern gas procurement mechanisms certain prerequisites are to be fulfilled. Firstly, the gas spot market has to become sufficiently liquid and transparent to enable such mechanisms. Secondly, the new pipeline projects as well as LNG imports have to diversify the gas supply and make the market more competitive, less dependent on single players and add new capacities. If those prerequisites are achieved, the highest chances for good gas procurement seem to lie in a good risk management approach where gas is procured over hubs. This procurement form requires hedging against price volatility, either through derivatives as hedging instruments or through an active portfolio management approach where different options are combined. The optimal strategy for gas delivery depends on the desired risk exposure of the buyer and the supplier, since, for example, trading on the spot market allows superior performance but may also entail exceptionally bad performance.

Eventually, the question remains whether it is really possible that a complete transition to gas procurement over hubs will take place. Alternatively, is it more likely that oil-linked long-term contracts stay the dominant gas delivery method, most certainly with adaptations to the pricing formulae and terms, while hubs remain a side effect and spot markets are only used for balancing of small amounts of gas?

According to the approach shown in Figure 22 (see next page), a transition from long-term contracts to a competitive spot market would be the logical path for the gas market.

Figure 22: The Dynamics of Gas Markets Development



Source: Energy Charter Secretariat (2007, p. 60)

The first steps of this development have been undertaken in the European gas market and thus the development seems to follow this dynamic at first sight. However, it is highly arguable, if in the case of the European gas market a mature competitive market will result in the end. It is not possible to predict with certainty how the European gas market will develop in the future. One can only weigh reasonable explanations against each other. Uniquely a pricing system that is accepted and trusted by all market parties will be able to establish itself and bring transactions to take place. For hub marketplaces, that means that in order to be accepted and trusted, the pricing system needs to be functionally adequate and to provide sufficient certainty of creating a credible, liquid marketplace with independent pricing systems where transactions and investments can take place (Clingendael International Energy Programme (CIEP), 2008, p. 15). Experts' opinions on the probability of a transition to a marketplace with such a pricing system differ widely.

Konoplyanik (2010) argues that oil-linked long-term contracts will, in the long-term, remain the dominant gas delivery contracts in Europe, since they are the basis of international trade in gas and the only possibility for stable and secure gas supplies. He further argues that contractual structures are diversified nowadays, but that the new procurement methods are

only added to the existing long-term contracts and do not substitute them. A full transition to traded market places is unlikely to happen, since especially market players upstream favor oil-linked long-term contracts which provide them with a great resource rent and ensure pay-backs for their investments. Producers see no justification to make investments in markets that are in transition, especially, if they are not assured being able to fully participate in the benefits because of market liberalization and increasing competition. Thus, it is argued that since investments are important, the European gas industry cannot wish a discontinuation of traditional long-term contracts. Furthermore, since exporting countries favor traditional gas delivery contracts and have great influence on the gas import-dependent European gas industry, importers and wholesalers see themselves bound to the traditional procurement form. It is clear that they will pass on the same contract designs downstream, at least with medium-term contracts and similar prices. Gazprom, for example, already prolonged the long-term contracts with European importers with expiry-dates between 2027 and 2036. Consequently, for the close future a full transition to a European traded gas marketplace cannot be expected, above all since also the UK is becoming import-dependent now (Energy Charter Secretariat, 2007, p. 174). What is more likely to change in the close future are the terms of the gas delivery contracts. First of all, the duration of long-term contracts of twenty to thirty years becomes outdated and unjustifiable, because the duration of investment projects, with which the long duration of the contracts was often justified, is diminishing (Konoplyanik, 2010, p. 18). Secondly, the high volumes contracted are lowered, more flexibility is added through restricted destination clauses and pricing formulae change (Energy Charter Secretariat, 2007, p. 144). Konoplyanik (2010) argues that as long the European gas market is still characterized by low and insufficient liquidity prices cannot be based solely on gas-to-gas competition, because it bears too many risks. Pricing formulae will rather adjust to changes in the gas industry environment as already stated in Section 3.1.6. There will be a broader range of gas substitutes to which the gas price is linked. Also shares of actual gas-price indexation will increase in the formulae. Furthermore, active portfolio management is an option that is becoming more and more popular, for example in Germany, which also does not turn down traditional oil-linked long-term contracts, but adopts partly market-based pricing of gas through the combination of different products (Konoplyanik, 2010, p. 31).

In general, one can notice that although experts often negate the possibility of a transition of the gas market into a traded market with spot and futures quotations for gas, they mostly refer to current circumstances and do not state that they consider the transition to be impossible in the future. Although EU regulations did not reach their ultimate objective of a complete

transition to a liquid trading gas marketplace, trading on hubs increases, because changes to the gas industry through mandatory TPA, introduction of the entry-exit-system and mandatory organizational, legal, management and accounting unbundling of incumbent gas corporations have been introduced. Main arguments in favor of the traditional long-term contracts often mention the investments these contracts ensure and the powerful resource-owing states that prefer them. With regard to investments it is important to state that they would also pay back to the investor when gas is traded at hubs, if the market were liquid enough. In general, many arguments against advanced gas procurement via hubs end up with the fact that the hub marketplaces have insufficient liquidity. Thus, the important question is whether hubs in Continental Europe can become liquid enough so that their pricing mechanisms are trusted and accepted by all market parties and a transition to short-term trading can take place. According to the Energy Charter Secretariat (2010), the necessary conditions for the transition into a liquid gas market are believed to be known (TPA and unbundling of integrated companies to increase competition), but it remains unclear what the sufficient conditions for a successful transition would be (pp. 165-166). What definitely might add flexibility to the market and thus also liquidity in the future is the emergence of increasing LNG spot trades in Europe. Producers in general, but especially of LNG, start to reserve some of the infrastructure capacities to short-term trade and thus adding liquidity on short-term gas markets and giving opportunity of arbitrage (Clingendael International Energy Programme (CIEP), 2008, pp. 19-20). In general, diversification of gas resources adds flexibility and, moreover, diminishes the power of single resource-owning states as Russia. LNG gives access to resources further away and thus the before isolated rather regional gas markets in Europe, become interconnected through rising trade in LNG. Arbitrage possibilities between the European, the North American and the gas market Far East can lead to some convergence of the gas prices (Clingendael International Energy Programme (CIEP), 2008, p. 21). In addition, the Nabucco project, if realized, will bring gas from other resource-owning states to Europe. The new capacities and the so gained flexibility will increase liquidity of trading markets if not all capacities are reserved to long-term contracts. Moreover, the process of the European gas markets becoming more interconnected and growing closer will surely continue. Although the development of a single European gas marketplace is not foreseeable in the close future, the European gas markets already influence each other more and more. In this regard, EU regulations about TPA and unbundling actually can contribute. In Germany, the reduction of marketing areas already facilitated hub trading and will add more liquidity to hubs if continued further as well as drive market integration. Taking all this into consideration, one

can notice that there is, above all, the need for infrastructure to foster trading at hubs. This holds true because access to transportation and storage and only small differentials in their respective costs, combined with the possibility to easily change between destinations and sources, offers the flexibility to transfer price signals and integrate the gas market (Energy Charter Secretariat, 2007, p. 203). Consequently, the liquidity of gas spot markets depends a lot on how much of the capacities is given access to as spot capacities. At the moment, the provision of spot capacities is only slowly beginning, but might well be increasing in future years. Access to flexible gas needs to be granted particularly through close storage capacities, which remains a problem for now, but can be resolved in the future (Stern, 2007, p. 231).

Furthermore, it is also possible that the pressure for a transition to hub trading will arise from downstream. End-users might favor spot trade when more competitors are entering the market on the supply level. Gas hub prices have already been below oil prices for long enough to initiate pressure from end-users for hub markets which will be forwarded all the way upstream to the producers (Boddy, 2010). Moreover, Stern (2007) argues that the link of gas prices to oil product prices loses its rationale and justification. This is due to the diminishing possibility of end-users to substitute oil products for gas. First of all, in the short-term customers do not have the incentive and capability to switch between the two fuels. And second, incentives for customers are likewise low to build up new plant and equipment in order to switch the fuels in the long-term. Especially, new gas-burning equipment is designed to burn gas only and would lose efficiency when used with oil products (pp. 222-223). Besides, the rising share of gas consummation of the power generation sector will show its consequences in the next years. Since for the power sector oil products are no alternative to gas, the oil-indexation of gas prices results meaningless (Clingendael International Energy Programme (CIEP), 2008, p. 20). Power generators rather want to trade on liquid spot and futures markets, where they do not have to make long-term volume commitments through take-or-pay clauses. For this reason they invest in markets where market-priced gas is available (Melling, 2010, p. 52). Another factor that leads to increasing demand for hub-based trading is the creation of balancing markets and the need to trade on a daily basis related to it (Stern, 2007, p. 231).

Finally, developments in the last two years brought change to the gas industry that might have a longer lasting effect. As a consequence of the world financial crisis beginning in 2007, gas demand began to decline significantly in September 2008, leading to oversupply in the gas market. First, LNG supplies increased in Europe due to weak markets in the US and Asia

Pacific and better prices for the suppliers in Europe. While oil-indexed LNG supplies increased only moderately in 2009, market-priced supplies increased substantially. Second, spot gas volumes available on hubs in general increased in these years. Although the increase was only modest, it contrasted with the reduction in demand. These volume increases were raised not only on the producer-wholesaler level, but also to a large extent by oil-indexed volumes that have been re-sold on the spot markets. Second-tier players took market share away from incumbents (Melling, 2010, pp. 41-45). This was possible because of better access to infrastructure and the increase in spot supplies, which caused unprecedented peaks of liquidity at trading hubs and low spot gas prices (Eurogas, 2010, p. 9). Melling (2010) further states that although flaws and constrains on liquidity are still remaining, improvement in market access by new players and thus competition was achieved throughout 2009 (p. 48).

Whereas some years ago, few industry experts expected a soon change in the dominant role of oil-linked long-term contracts, the oversupply of gas in 2009 and new spot gas supplies had the result that for the first time incumbent wholesalers could not control the situation. This situation in the end of 2009 suddenly opened different ways in which the gas market could develop. But the oversupply issue was relieved due to a cold winter in 2009/2010. Moreover, producers and wholesalers introduced contract re-negotiations. A link to spot market gas prices was included in the contracts, but only for the three years to come. By doing so, they defend against the lower spot prices of new competitors and assured oil-linked long-term contracts to stay prevalent by emphasizing that the spot gas price link is only temporarily and that oil-linked long-term contracts will remain the base concept. However, there now could surge pressure from the wholesalers' customers for market-based pricing, stressing oil-indexed pricing mechanisms. If oversupply and low demand continue more years and spot market suppliers gain volume and market shares, producers and wholesalers will need to make concessions about flexible volumes or prices. It is further possible that producers react to the shrinking market share of wholesalers by increasingly selling to traders or second-tier players directly. With the shrinking power of incumbent wholesalers, the EU and regulatory bodies are becoming increasingly powerful (Melling, 2010, pp. 50-70).

In the end, also these recent developments will not promote an outright revolution in gas delivery contracting structures. But they make expectations higher that a gradual evolution away from traditional gas procurement to traded markets is likely to continue. Oil-indexed long-term contracts are very probable to remain in Europe for some time to come in a situation where both concepts, oil-linked long-term contracts and market-based trading on

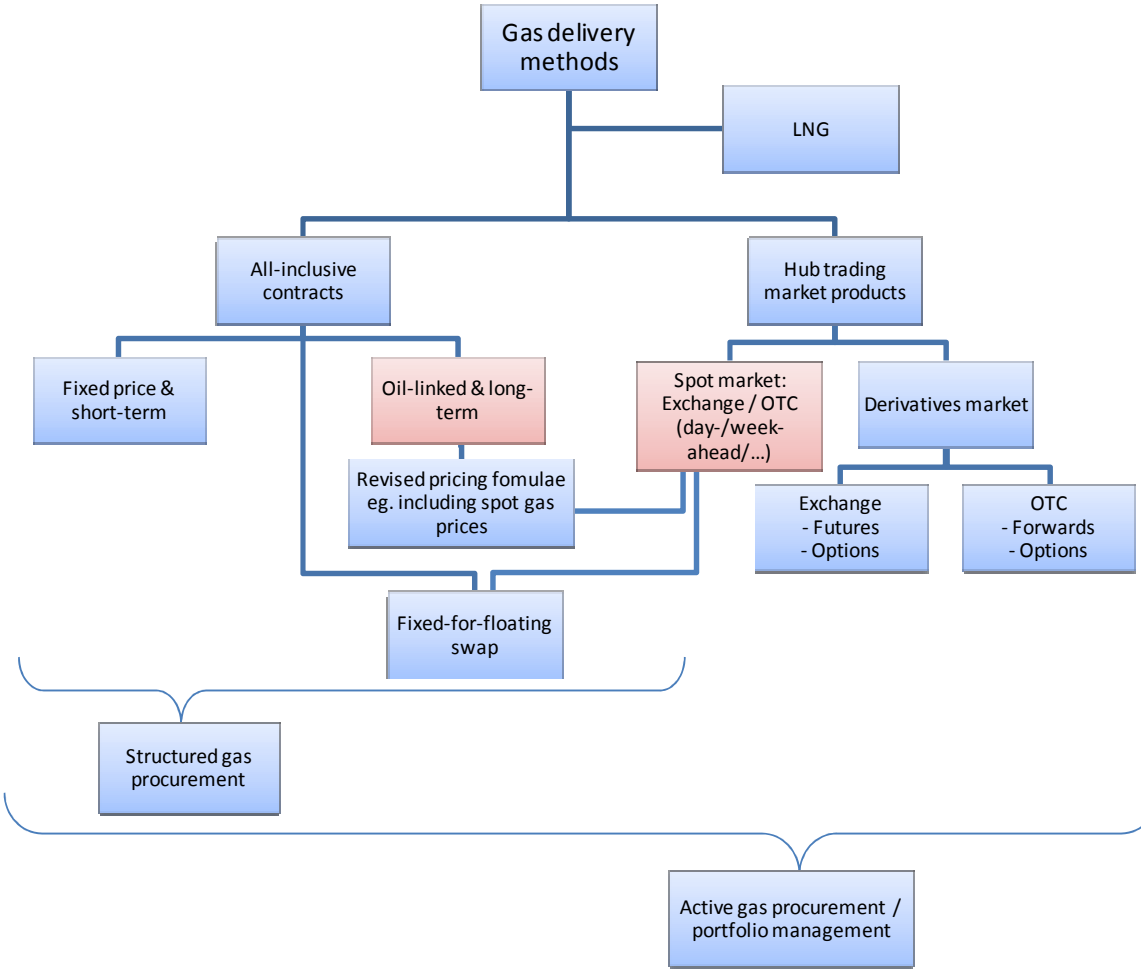
hubs, will coexist. In the long-term, however, it is possible that traded markets increase in liquidity and gain overhand as gas price-drivers in Europe, especially because of the rise in gas demand for power generation.

The outcome of the evolution of the European gas industry remains an open question. The next years, from 2010 onwards, will mark many changes and bring important answers to that question.

6. Conclusion

The preceding discussion of gas delivery contracts has shown several options of gas procurement. Figure 23 summarizes all presented gas delivery methods.

Figure 23: Summary of gas delivery methods



Source: Own illustration

Two opposing gas procurement forms are in special focus: traditional gas procurement through oil-linked long-term contracts and advanced gas procurement via hub spot trading marketplaces. The traditional gas delivery contracts are still prevalent in Continental Europe. They provide producers with a significant resource rent and European importers with security of supply. However, this procurement form hinders competition. Under these contracts, the gas price is derived from a certain pricing formula that links it to oil product prices. Yet, this oil price link is claimed of being unjustifiable and new pricing formulae include a more complex mix of price links to several fuel prices and additional components like inflation.

With the objective of creating a single European gas market subject to more competition, EU regulators prefer advanced gas procurement. This means trading gas on hubs at spot prices that are derived from gas-to-gas competition and thus reflect the actual gas market situation rather than referring to the oil market. On the one hand, this procurement form enables competition, more flexibility and higher market chances, but on the other hand it bears greater price volatility risks. Trading activity at European hubs is increasing, but still lacking a sufficient degree of liquidity. Hybrid forms of the two presented procurement options are particularly prominent at the moment. These can be contracts with shorter terms and a fixed price or contracts which pricing formulae include a link to spot gas prices at hubs. Structured gas procurement includes fixed specified bands of gas delivery and residual amount delivery including different products and contract designs. Active gas procurement or portfolio management is a more distinctive form of structured gas procurement and aims to include as many standardized products as possible in its product mix. LNG represents a further alternative for gas procurement, but with different implications. It exhibits the same structural procurement options as natural gas, i.e. all-inclusive contracts and hub trading, but is able to interconnect global gas markets because of its different, more flexible shipping characteristics. Consequently, new supply markets are made accessible through LNG and spot gas price mechanisms in the US could possibly influence European gas prices. This implies for the European gas market that traded volumes at hubs may increase and add flexibility as well as liquidity to the traded markets.

In order to evaluate the development of gas delivery contracts in Europe, infrastructural issues have to be considered. High infrastructural costs and their high specificity cause gas markets to be of rather regional nature. Encouragement of important investments is supposed to be achieved more likely by oil-linked long-term contracts. However, traded markets can also give incentives for investments and with the necessary conditions achieved. Such incentives include, for example, the creation of an entry-exit-system for network access and regulated third party access to transportation and storage capacities. Therefore, infrastructural issues do not necessarily contradict spot trading of gas at hubs anymore. Particularly, sufficient accessible storage can be a remedy to add liquidity to hub marketplaces.

To conclude, the development of the European gas market is open and not accurately predictable. However, it is certain that, though still dominated by oil-linked long-term contracts, the European gas market now stands on the edge of a new development. Whether a complete transition to spot trading of gas at liquid hub marketplaces is going to take place

and, even more, until when this could happen is unforeseeable. Certain is the fact that a gradual development towards a more liberalized gas market is going to take place. While oil-linked long-term contracts will not disappear completely in the near future, the oil-link per se and long durations of contracts will lose importance. In the coming years, the gas market will thus be characterized by the coexistence of both, traditional gas delivery contracts and advanced gas procurement forms.

How fast and to which extent competition will enter the gas markets, if European marketplaces grow closer and whether market-based gas-to-gas competition prices will ever gain overhand in the gas market will be exciting to observe over the next years and will, also in the future remain a central interest to the public.

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Eigenständigkeitserklärung

„Ich erkläre hiermit,

- dass ich die vorliegende Arbeit ohne fremde Hilfe und ohne Verwendung anderer als der angegebenen Hilfsmittel verfasst habe,
- dass ich sämtliche verwendeten Quellen erwähnt und gemäss gängigen wissenschaftlichen Zitierregeln nach bestem Wissen und Gewissen korrekt zitiert habe."

New York, November 22, 2010

Caroline Faisst