CPB Memorandum

CPB Netherlands Bureau for Economic Policy Analysis

Sector	:	Regulation and Competition
Unit/Project	:	A welfare-economic analysis of the Dutch gas-depletion policy
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Number	:	143
Date	:	23 February 2006

Market failures and government policies in gas markets[1]

Abstract

This memorandum analyses the fundamental characteristics of the natural gas market and its consequences for government policies. In the past, the European gas market was dominated by state-owned monopolists but since the start of the liberalisation, privatisation and re-regulation in the early 1990s, the market has fundamentally changed. Nevertheless, governments are still involved in the gas industry, not only in gas exporting countries such as Russia, but also in a country like the Netherlands where the government has imposed a cap on production from the main gas field (Groningen) as well as owns shares in the main wholesale trader (Gasunie Trade & Supply) which has the obligation to accept all gas offered by producers on the small fields. In the main report of this project we present a cost-benefit analysis of the Dutch gas-depletion policy. In this memorandum we explore the natural-gas market more broadly, looking for factors why government intervention may be needed using the welfare-economic approach according to which government intervention should be based on the presence of market failures. After a brief description of the main characteristics of the gas industry, we systematically analyse sources of market failures, such as geopolitical factors, economies of scale and externalities, and finally go into the question which policy options may be chosen to address those market failures.

[1] This memorandum is written as part of the project on Dutch gas-depletion policies (see Mulder and Zwart, 2006). The authors of this memorandum benefited from discussions with representatives of the gas industry and government as well as a number of external of internal colleagues. Of course, the usual disclaimer applies.

Contents

1 Introduction

1.1 Background

Historically, the European gas market was dominated by state-owned monopolists controlling trade and domestic supplies. International trade took place mainly through long-term (i.e. several decades) contracts with take-or-pay clauses, at oil-linked prices. These long-term contracts were considered necessary to give investors certainty about recovering the large initial investments in network and production infrastructure. Supplies to end-users were priced according to the substitution principle, so that gas prices were set according to the market prices of substitute fuels (typically, fuel oil for industrial end users, and gas oil for domestic consumers).

For several years now, the role of government in the gas industry has been subject to debate. This debate was partly induced by the offtake of liberalisation of the European natural gas market. Liberalisation in Europe started in the United Kingdom in the 1980s and 1990s. Competition among gas producers was established and independent traders were introduced into the market. This led to the emergence of short term trades, including the establishment of a liquid spot market[2]. The function of grid management was conferred to an independent company. As a result, gas prices in this country increasingly follow from competition among traders and producers on the gas market, i.e. gas-to-gas competition emerged. At a slower pace, continental Europe is following the British liberalisation process. The process in the European Union is managed through gas regulations, i.e. the European Gas Directives, proscribing non-discriminatory third-party access to the networks in order to accommodate entry by competitive suppliers, and making end user markets contestable for competing suppliers.

The government in the Netherlands, as in many other countries, is still heavily involved in the gas industry. This goes for upstream, midstream parts as well as downstream parts of the industry. At the upstream level, i.e. the production side, the Dutch government participates in exploration, development and production of gas fields, gives private firms licenses to operate, imposes standards for private activities, regulates the commodity market and levies several taxes. At the midstream and downstream side, government intervention consists of ownership of a part of the vertically-integrated joint venture with Exxon and Shell, called Gasunie Trade & Supply. Moreover, local public authorities are shareholders of energy distribution firms.

[2] Due to their long-term nature, contracts including oil-linked prices which have been concluded in the recent past still constitute a significant fraction of gas trades in the British market, see e.g. (ILEX, 2004).

As a result of the fundamental change in the structure of the gas market, Dutch government is reconsidering its role in the midstream and downstream parts of the gas industry. One outcome of this process already is the recently implemented acquisition by the state of the shares of Shell and Exxon in the transmission part of Gasunie (N.V. Nederlandse Gasunie). The participation of the state in the supply part of this incumbent (Gasunie Trade & Supply) has not changed yet but remains likely subject to debate. Another outcome of this process is the proposal of the government to impose ownership unbundling on the energy-distribution industry.[3]

The process of liberalisation and privatisation in European natural gas markets has also generated concerns about the ability of market parties to take those measures which are needed from a societal point of view. These concerns focus in particular on the issue of security of supply.[4] Security of supply issues arise both in the short and the longer term. In the short term, security of supply of gas is related to the ability of the market to deliver gas from a specific quality at any moment in time. In the longer term, the issue of security of supply refers to the exhaustion of domestic resources and dependence on resources in other regions.

1.2 Scope and structure

This memorandum presents a general framework for analysing the role of governments in the natural-gas market. This framework forms the background for our cost-benefit analysis of the Dutch depletion policy (Mulder and Zwart, 2006).

First, we give an overview of the main characteristics of the European natural gas market (Chapter 2). This chapter offers a concise description of the current state of the gas market as well as the developments in this rapidly changing market. Moreover, we give attention to the product characteristics of gas and categorise the market in three submarkets: the network activities (transmission and distribution), the wholesale market for gas, and the retail market.

Afterwards, we analyse what factors may prevent this market from generating socially optimal outcomes, i.e. whether market failures exist (Chapter 3). From a welfare-economic point of view, government policies are advisable if market failures exceed failures of such policies. The possible market failures associated to the gas market are at least partially related to the network characteristics of the sector. Chapter 4 deals with policy options which could solve the market failures in the natural-gas market. Chapter 5 presents the conclusions.

[3] See Mulder et al. (2005) for a cost-benefit analysis of a full unbundling of the energy-distribution industry.

[4] See for instance IEA (2004a), stating that the key question is "whether the market itself will value security of supply and deliver timely signals and competitive incentives for investments to guarantee secure and reliable gas supply all the way to the final consumer."

2 Natural gas market

2.1 Network industry as well as natural-resource industry

2.1.1 Introduction

The natural-gas industry is a network industry like telecommunication and railways as well as a natural-resource industry like the oil industry. The fundamental characteristic of network industries is the presence of a network infrastructure, such as pipelines in the gas industry, tracks in railways and copper lines in telecommunications. This infrastructure, which is an essential link in the chain of activities, benefits from substantial economies of scale (see OCFEB, 2002; CPB, 2004). The fundamental characteristic of a natural-resource industry is the presence of resource scarcity. Moreover, gas as a commodity has two major dimensions: time and quality.

2.1.2 Essential facility

The infrastructure in a network industry forms an essential facility in the industry meaning that the infrastructure is a necessary input for activities of sectors using the infrastructure. Train operators absolutely need tracks to offer their transport services, just as electricity producers need wires to transport power, and suppliers of telecommunication services need an infrastructure such as cables. The essential character of a facility depends, however, on the perspective from which a sector is viewed. In the gas industry gas producers (shippers, traders) could use alternative ways, notably liquefying, to transport gas over long distances if pipelines have not been developed or when (political) risks of pipeline transport are perceived to be too high. A rail operator could use other means of transport, such as buses, if tracks are not available on certain routes.

Strongly related to the essential-facility character of networks is the high level of interdependence between users of infrastructure, i.e., in the case of the natural-gas market, producers, traders and consumers. Consequently, use of the infrastructure requires much coordination in order to prevent unbalanced gas systems, accidents on the tracks or black outs in the supply of power. In some cases, in particular in the telecommunications industry, close links between infrastructure activities and operational activities cause economies of scope making a vertically-integrated firm more efficient than separated firms (see OECD, 2003) In other industries, such as gas and electricity, economies of scope seem to be fairly modest as gas production and gas transport as well as electricity generation and electricity transmission are not jointly conducted activities.

2.1.3 Economies of scale

Network industries are subject to significant economies of scale due to the high level of fixed costs independent of the number of consumers connected, and low marginal costs of extending the network. If investments in a network infrastructure have been made, these costs are mainly sunk, i.e. these costs can not be recovered. The huge fixed costs and the scale effects related to it make it uneconomical to double networks in most countries, i.e. the size of these markets is too small for letting both networks operate on the efficient scale. As a consequence, networks are often natural monopolies.

In the natural-gas industry, natural monopolies exist on the national level, i.e. the transportation network, as well as the regional level, i.e. the distribution network. On the national level, natural gas is transported by a high-pressure transportation network. On the regional level, low-pressure networks constitute distribution networks. The transmission network plays a crucial role in maintaining the pressure of the whole system. Distribution networks are less important for realising system stability but are essential in delivering natural gas to end-users.

On the international level, however, different infrastructures exist for long-distance gas transport. Gas from Russia for Europe is transported through pipelines in the Ukraine as well as Belarus while in the near future gas will also be transported via the Baltic line. These alternative lines make transport less dependent on transit countries. Another example of parallel infrastructure is offered by the pipelines transporting gas from Norwegian gas fields. Norway transports gas through different pipelines to the United Kingdom (i.e. Frigg-St.Fergus, and Zeepipe plus the UK-Belgium Interconnector) and to the continent (i.e. Europipe I and II, Norpipe, Starpipe).

2.1.4 Scarcity of resources

Contrary to other network industries, the natural-gas industry also is a natural-resource industry, like the oil industry and the coal industry, exploiting non-renewable natural resources. These types of industry are fundamentally characterised by the existence of resource scarcity. Economically, resource scarcity refers to the opportunity costs of exploiting natural resources. As current production limits future production, the foregone benefits of future production is a cost of current production. Resource scarcity gives rise to resource rents, being the difference between market price and marginal costs of production (Conrad, 1999). These resource rents co-determine production decisions of producers, i.e. the higher opportunity costs of using a resource, the more suppliers will conserve the resource for future use.

2.1.5 Two dimensions of the commodity: time and quality

The commodity gas has two major dimensions: time and quality (see Box). Gas consumed on different moments cannot be regarded as fully substitutable while gas from different production sources can have different heat contents, which may prevent substitution. Because of these two dimensions of gas - time and quality -, the gas market is divided in many submarkets. This division might hinder competition if the quality-conversion capacity is restricted. In that case, it reduces the number of suppliers in each submarket making it more difficult to achieve a competitive European gas market. A related policy question is to which extent private parties deliver efficient levels of flexibility (the ability to differentiate gas quantities over time) and quality.

Time and quality dimensions of gas

Gas consumers cannot usually store gas on their premises, but take gas from the distribution network as they need it. Since the grids can only safely operate if the pressure remains within a certain bandwidth, this implies that gas injections into the distribution grids should more or less follow end users' consumption pattern. The market for gas therefore has a temporal dimension, so gas for consumption on different days, or even hours, need not be similarly priced[5]. This fact accounts for the relevance of flexibility in gas supplies: there is a value in being capable of adapting the rate of gas supply to the market. This provides a rationale for investment in spare capacity, as well as storage capacity.

The other dimension of gas is its heat content, or quality. As gas is a natural resource, natural variations exist in the precise composition of gas from various production sources, which mainly manifests itself in a variation in heat content of the gas. Consumers of gas, on the other hand, can only safely use gas with heat contents that remain within a bandwidth. Gas can therefore only be injected into the grid if it complies with the quality standards for that specific grid, which implies that gas may have to be blended before it can be used. In practice two main categories are distinguished: high-calorific (H-)gas, and low calorific (L-)gas. H-gas is most widely used, production and consumption of L-gas is only significant for the Netherlands, Belgium, Germany and France, where both gas qualities are used. The L-gas market may be considered as a separate market, although it is related to the H-gas market through so-called quality conversion (blending of H-gas with nitrogen to produce L-gas).

2.2 Gas supply chain

2.2.1 Introduction

The gas market comprises several layers related to the supply chain: transport, production and retail. Accordingly, we distinguish three markets within the gas market: exploration and production (section 2.2.2), the market for domestic transport and distribution (the grid

[5] The situation is not unlike that in electricity markets, although the balancing requirements there are even stricter.

infrastructure) (section 2.2.3), imports and international transport (section 2.2.4), storage (section 2.2.5), trade (section 2.2.6) and the retail market (section 2.2.7).[6]

2.2.2 Exploration and production

Gas production may occur both on-shore and off-shore. Production activity starts with an exploration phase where gas reservoirs are located (using for instance geophysical imaging techniques, and exploration drilling). After economic reservoirs have been found, a development phase may commence, where a number of wells are drilled and the reservoir is depleted. Production usually starts with a high capacity (plateau phase), while as pressure in the reservoir drops the maximum production rate declines. The produced gas is collected into pipeline infrastructure and transported to the main high-pressure grid to be sold onto the wholesale market.

Exploration and production are mainly conducted by internationally operating firms. In the Netherlands, the main offshore operators are NAM (a 100% subsidiary of Shell and Exxon), Total, Gaz de France and Wintershall. In Norway, the main gas producers are Statoil, Norsk Hydro, BP, Exxon Mobil, ConocoPhillips and Shell (MPE/NPD, 2004). Producers active in the United Kingdom, among many others, are BP, Esso, Shell, Amerada, Amoco and Mobil.

2.2.3 Domestic transport and distribution and system services

In this part of the chain, we can make a further distinction between infrastructure for high-pressure long-distance transports, i.e. the transportation grid, and the low-pressure distribution grids connecting the high pressure grid and the final consumers. These grids provide the essential infrastructure needed for other actors to trade among each other and deliver gas to consumers. Because of its natural-monopoly character, these grids are subject to government regulation, requiring them to provide access to other market parties at reasonable tariffs.

Apart from transporting gas, a second function of the grid operator (in particular of the high pressure grid), is to guarantee system integrity. This means that the grid operator is responsible for ensuring that both gas pressure and gas quality remain within safe limits. In practice this is resolved by assigning a short-term balancing responsibility to the system operator, who may reserve part of available line pack capacity (the storage capacity of the network) to balance supply and demand on the short term. The responsibility for system integrity does, however, not mean that the grid operator is responsible for permanently securing deliveries of gas. In the Netherlands, the grid operator (GTS) is obliged to guarantee deliveries of additional gas to

[6] Although production, trade, storage and imports form separate links in the supply chain, these activities are strongly related as all these activities compete on the same market: the wholesale market for gas. So, by the wholesale market, we mean the market for the commodity gas, differentiated by time period as well as quality label.

small consumers below an effective temperature of – 9° Celsius while traders have the obligation to meet gas demand of their consumers above this temperature (see Jepma, 2004).[7]

2.2.4 Imports and international transport

Another source of gas consists of imports from other countries. Imports may occur through pipelines transporting gas from production countries, such as Norway and Russia, to consumption regions in Europe. Other pipelines connect adjacent gas systems (often owned by the gas transport system operators), such as the UK-Belgium Interconnector. Capacity of these lines has a value depending on the price differences between the markets. In practice currently still a large share of this capacity is allocated to incumbent parties, who therefore control the flows between markets (European Commission, 2005). The allocation of the transport capacity may become available to other shippers as these contracts expire which would increase competition on the European gas market (Eurostat, 2005).

For long distances, transport of gas is cheaper in liquefied form, i.e. liquefied natural gas (LNG). Gas is cooled and liquefied in export terminals, transported by ship, and can be regasified in import terminals. Apart from a cost advantage, this procedure also offers greater flexibility, as the ships' destinations can be changed as market conditions vary. LNG trade, therefore, promises to create a more global market place for gas. The importance of imports of liquefied natural gas (LNG) is expected to grow. The IEA (2004), for instance, expects that inter-regional trade will triple up to 2030, mainly through growth of LNG-trade which will grow from 150 bcm in 2002 to 680 bcm in 2030.

A factor the growth of international trade in gas are the quality requirements of national markets versus quality characteristics of gas from different sources. Due to the growing importance of imports in the United Kingdom, gas quality is one of the topical issues in British gas policy. The British is now considering several options to deal with the different qualities of gas, varying from retaining the quality requirements to adapting quality standards for gas appliances. This reassessment is subject to the trade-off between the issues of competition on the gas market and security of supply on the one hand and safety of gas consumption on the other.[8]

[7] "GTS has also the task to "intervene if a supplier defaults on the supply of gas to small-scale users. GTS must in that case oversee any corrective measures as smoothly as possible - if necessary by taking over the supply temporarily - so that the customers concerned can switch to another supplier as quickly as possible in line with the accepted procedure." (website GTS: http://www.gastransportservices.com/gastransport/en/aboutgts/company/services/public_tasks).

[8] See the website of the British Department of Trade and Industry (DTI): www.dti.gov.uk/ energy/ domestic_markets/ gas_market.

2.2.5 Storage

Gas can be temporarily stored, to meet fluctuating demand of end-users in different periods of time (within days or years). Economically, the storage of gas is determined by the costs of storing on the one hand, and the price differences for gas between periods of low and high demand on the other hand. Storage clearly does not increase net supplies to a market over a longer period of time. On short-term markets, however, traders using storage may appear on the supply side of the market. Storage of gas may take place in depleted gas fields, in other subterranean structures such as salt caverns, or, in smaller quantities, in liquid form in high pressure containers.

Many storage facilities have been built in the period before liberalisation as part of the production and transmission system. In the Netherlands, the NAM owns storages in Grijpskerk and Norg (both depleted gas fields) while BP/Amoco owns the storage facility Alkmaar which is also depleted gas field[9]. All these storages are managed by Gasunie Trade & Supply. These storages form a part of the so-called Groningen system, i.e. these storages are used when the Groningen field, which is the main source of flexibility in the Netherlands[10], is not able to deliver the required gas. Some of these facilities are currently opened for third party access. Gas Transport Services manages the LNG peak shaving storage nearby the port of Rotterdam.[11] One also observes new entrants to the market investing in storage capacity, such as the Dutch energy firm Nuon which is building storage facilities in the northern part of the Netherlands (Zuidwending; together with GTS) and on the German side of the border (Epe).[12]

2.2.6 Trade

As we have mentioned in the introductory chapter, gas markets on the European continent are in a transition from the pre-liberalised market organisation to a market more similar to what one can observe in other commodity markets (although the gas market has its own peculiarities, i.e. it is resource constraint and characterised by networks, as is described above). Where trade used to be dominated by long-term, customised contracts between state monopolists, one currently sees the emergence of markets for shorter term standardised gas contracts, including spot markets where daily contracts for gas are traded. On these markets, gas suppliers may be the producers themselves, but also traders selling gas from storage facilities, or imported gas. The latter may come from neighbouring markets connected by pipelines, but also gas transported by ship, in liquid form, from more distant regions of the world. These changes do not imply the

[9] The Alkmaar storage is not suitable for delivery of daily swing but is designed for seasonal flexibility.

[10] Groningen is also an important source of flexibility for neighbour countries (see IEA, 2004a). Using this field as the key source of flexibility, the Dutch gas system is designed to meet severe winters which are defined in terms of the ‘1976 winter’ and a ‘minus 17 degrees Celsius day’.

[11] The LNG-peak shaving storage is not available for the market as the system operator (GTS) uses this field for meeting its reliability-of-supply obligations (NMA, 2005).

[12] See http://www.beurs.nl/nieuws/artikel.php?id=87499&taal=NL.

disappearance of long-term contracts but merely changes in conditions in these contracts, e.g. shorter terms (8-15 years in stead of 20-25 years), smaller volumes, higher flexibility and other price indices (such as electricity pool prices and spot gas prices) (see IEA, 2004a).

2.2.7 Retail market

The final category in the supply chain is formed by the retail market. End-users do not directly participate in the wholesale market, except for some very large consumers such as electricity generators. As far as the markets for smaller consumers have been liberalised, competing retail companies act as intermediaries between wholesale markets and end users, by bundling time-varying gas supplies (adapted to the consumers' demand) and services. Consumers are usually billed according to aggregate gas use, as metering does usually not allow for a distinction between gas used at different moments.

In the restructured market, consumers increasingly have incentives to respond to changes in gas prices by adapting their demand. Of particular importance in this respect are the electricity generation companies as these firms will account for the main part of the growth in the consumption of natural gas (see IEA, 2004).

2.3 Conclusion on characteristics of the gas market

The natural gas market is the market where the natural gas industry sells the commodity 'natural gas'. This industry has many dimensions as it is both a network-industry and a natural-resource industry. The network-industry character gives rise to regulation issues like access to essential facilities and pricing of using the infrastructure. This holds in particular at the national scale where infrastructure competition is economically not possible while at an international scale several infrastructures exists. The natural-resource character raises the issue of taxation of resource rents. In addition, this character also results in several submarkets as the commodity 'natural gas' is not homogeneous but differs in quality and time.

Moreover, the gas industry consists of a number of activities each belonging to a layer in the gas-supply chain: exploration & production, domestic transport & distribution, imports & international transport, storage, trade and retail. In the past, these activities, except exploration & production were mainly done by fully integrated state-owned monopolies. Now, many different players are active in each layer. Besides (former) state-owned firms also globally orientated private energy companies are active in exploration and production of natural gas while domestic transport and distribution is mainly conducted by national, state-owned firms. Due to the liberalisation of the market, private firms are increasingly active in imports, storage, trade and retail, although also here, public-owned firms are still present.

3 Market failures

3.1 Introduction

The above description of the main characteristics of the natural gas market enables us to analyse potential market failures. What factors cause market outcomes on the (European) natural gas market to deviate from socially optimal outcomes? In this chapter, we provide an overview of the potential failures in the gas market and solutions chosen by market participants to deal with these failures. We will subsequently discuss the existence of market power (section 3.2), externalities (including those entailed by public goods) (section 3.3), other market failures, in particular the problem of asset specificity, the presence of informational problems and the allocation of resource rents (section 3.4). The next sections go into specific issues often mentioned as arguments for government involvement. Here we analyse to which extent security of supply (section 3.5), the limited window of opportunity of production infrastructure (section 3.6) and indirect economic effects (section 3.6) are related to the presence of market failures and, hence, call for policy measures. Section 3.7 concludes.

3.2 Market power

3.2.1 Market power and efficiency

Welfare optimality of competitive equilibrium relies, among other factors, on the assumption of perfect competition. Competition becomes imperfect when the market size of individual producers or consumers is non-negligible, i.e. when these agents' production or consumption decisions have a non-negligible impact on market prices, and this can be used to increase their profits.[13] This potential to profitably affect prices to levels above costs is called market power. Parties having market power may use non-price strategies to increase the influence they can exert on market prices. These strategies usually amount to, one way or another, reducing the size of the market for their product. These strategies may take the form of increasing product diversity, creating switching costs for consumers, erecting barriers to trade through restrictive clauses in supply contracts, or frustrating access to market places by competitors.

In the natural-gas markets, also political factors play an important role because of the still existing influence of governments in the industry and the unequal distribution of the resource over regions and countries.

[13] The relationship between market structure and competition is not straightforward. Not only market size, but many more factors have to be taken into account, such as the elasticity of demand and the degree of product differentiation within the industry.

Exercise of market power reduces total social welfare compared to perfect competition. On the short term, prices that are too high lead to static allocative inefficiency as, from a welfare point of view, too little gas is consumed ("dead-weight loss"). Productive efficiency may be compromised if, as a consequence of distorted price levels, companies invest in techniques and gas production, use of storage and imports that would not be viable under full competition. If, due to reduced competitive pressures, there is too little incentive on parties to innovate, dynamic inefficiency may results. As a result, total welfare is below its optimum.

Market power may result from several sources, such as geopolitical factors (section 3.2.2), economies of scale (section 3.2.3), network externalities (section 3.2.4), legal monopolies (section 3.2.5), restrictions on regional trade (section 3.2.6) and switching costs (section 3.2.7).

3.2.2 Geopolitical factors

Although the European natural-gas market is subject to liberalisation and privatisation, the degree of competition on this market still depends on geopolitical developments. This is mainly due to three factors: the remaining role of governments in the gas industries in major gas producing countries, i.e. Russia, Algeria and Middle-East countries, the view of many countries that politics should guarantee a secure supply of energy, and the increasing import dependence of Europe.

As reserves in EU countries decline, the issue of future security of gas supplies rises on the European agenda. At the current rate of production, reserves of gas from major producing countries, i.e. United Kingdom and the Netherlands, are forecast to dry up over the coming decades. At the same time, gas demand is predicted to continue to grow – in particular as a result of increasing reliance on gas-fired electricity generation – causing a potential supply gap. The IEA (2004a) foresees a surge in net gas imports in the European Union, from 233 bcm in 2002 to 639 bcm in 2030, causing an increase of the share of imports from 49% in 2002 to 81% in 2030.

On a global scale, gas reserves are still abundant. In the near future, the most important suppliers to the EU will be Norway, Russia and Algeria. These countries, which are already playing an important role on the European market, possess huge resources. On longer time scales, it is expected that supplies of liquefied gas, LNG, transported by ship, will become of increasing importance. Relevant production regions range from North Africa (apart from Algeria, also Libya and Egypt), the Middle East, Nigeria, Trinidad and Tobago, to more distant production fields of Norway and Russia. Consequently, in the more distant future the European Union will heavily depend on imports, although the portfolio of gas exporters can be quite mixed giving this region the option to diversify its import risks.

Economic theory of market power and exhaustible resources

In general, market power in commodity markets may be exercised by reducing supply of the product. The relative shortage created by withholding capacity drives up prices, as buyers have to turn to more expensive substitutes for the commodity. In markets for exhaustible resources, such as gas or oil, the situation is somewhat different. While producers of the resource may choose to restrict production at one moment in time, ultimately the total stock of resource is fixed. If extraction costs are low, eventually the total resource will be exhausted, even by a monopolist producer. In this case, total production will be the same for a monopolist and for a competitive producer, unlike the situation for other produced goods where the monopolist will produce strictly less than the competitive player. The only freedom the monopolist has is to change the pattern of production over time.

The question how optimal production for a monopolist differs from competitive production is analysed by Stiglitz (1976). He finds that the rearrangement of production pattern for the monopolist compared to the competitive benchmark depends on both demand form and extraction costs. In the limiting case of constant elasticity demand and no extraction costs, the monopolistic rate of production is in fact identical to the competitive benchmark: a monopolist cannot effectively exercise market power. In reality, one may expect that as prices rise, demand becomes more elastic (since more substitutes become economic). In this situation, the monopolist's rate of extraction will be lower than in the competitive case, so that the monopolist shifts more production to the future. The same holds when extraction costs are non-negligible. This is sometimes phrased as "The monopolist is the conservationist's best friend."

Later analyses have focused on models of oligopolistic markets, mainly in the form of a cartel-versus-fringe model, inspired by e.g. developments on the oil market. In such a market, a cartel of large producers is assumed to decide on joint production, taking into account the reactions to its production decisions by a large number of competitive suppliers. The latter group, the 'fringe', prevents the cartel from acting as a pure monopolist. Depending on the relative stocks of resource and costs of extraction, equilibrium extraction paths may include phases where the cartel produces alone, but price is restricted by the competitive (fringe) price, followed by fringe production, or simultaneous production by fringe and cartel followed by a phase where prices rise to monopolistic levels (see e.g. Withagen and de Zeeuw (1999)).

The enlarged dependency on imports itself poses a threat for security of supply in the sense that supply routes will become longer, and more vulnerable to shocks than is the case nowadays. The growing dependency on imports increases Europe's vulnerability for an abuse of market power by one of the major suppliers, or a coalition of suppliers. A few years ago, the major gas exporters Algeria and Russia started mutual cooperation by establishing the Gas-Exporting Countries Forum (GECF). This platform "strives for market stability" and a "sustainable development of energy industry" (GECF, 2002). However, "no definite conclusion can be drawn as to how market power and negotiation strength will evolve. In addition, the importance of the hard currency revenues earned from gas exports to the economies of the major gas exporters to Europe (…) is so great that these exporters would be reluctant to jeopardise them by adopting extreme commercial or political positions." (Stern, 2002). Nevertheless, execution of increased market power by exporting countries could result in higher import prices for natural gas.

Moreover, in the major gas-exporting countries, governments are heavily involved in gas production, transport and trade, making these activities vulnerable to political issues. As Helm (2005) says, “for the foreseeable future, one company in one country will dominate the European - and therefore- energy scene. That company is GazProm, itself with close political ties to the Russian Government.” In addition, major energy consuming regions, i.e. China, India and United States, political instruments are used to secure the national supply of energy (see AER/AIV, 2006).

Concluding, the growing importance of geopolitical factors affecting conditions on the European natural-gas market will likely affect the outcomes on these market, in particular in terms of (future) prices, which may call for political measures.

3.2.3 Economies of scale

As elaborated in the previous chapter, the gas sector is a network industry: trade takes place mainly over networks of gas pipelines[14]. The high share of (sunk) investments in average costs and the consequently increasing returns to scale, as well as the essential-facility character of the networks, give the gas infrastructure a natural monopoly. Up to a certain level of demand, duplication of networks is not efficient as an intensive use of one network is more efficient than a less intensive use of parallel networks.[15]

The presence of large economies of scale leads to a market structure of local monopolies, as this structure leads to the highest level of productive efficiency. This structure requires a degree of regulation to ensure access for competitors and to realise allocative efficiency. The local character of the monopolies does, however, enable competition on a higher spatial scale, as over longer distances there may be different pipeline routes that connect various markets. As pointed out before, also in the case of offshore gas infrastructure there may be some scope for choice among different gas evacuation pipelines for the few production projects that are close to different systems. Long-distance gas transport increasingly faces competition from transport of LNG by ship. In addition, in the long run some scope for substitution to other energy sources exists which restricts the market power of the gas infrastructure.

Economies of scale play a role in other activities in the gas market as well. In decreasing order of magnitude one has firstly gas storage, gas blending (quality conversion), and gas import

[14] In international (long-distance) trade, the importance of shipping of liquefied natural gas is increasing, giving rise to a transport structure that will be more flexible than the traditional pipeline dominated gas transports.

[15] This relationship between intensity of use of a network and efficiency is called economies of density. The distinction between economies of scale and economies of density is, however, hardly used outside transport economics. There, economies of scale refers to the size of the network while economies of density refer to the intensity of using a network (see BTRE, 2003). In other network industries, economies of scale refers to both dimensions.

infrastructure, secondly gas exploration and production (where investments are not so much sunk as equipment can to some extent be used on different locations), and finally, gas trading and supply to end users where fixed costs represent only a minor share of total costs.

The economies of scale of storage and infrastructure depend of course on the characteristics of the assets. The fixed costs of a salt-cavern storage, for instance, are significantly above those of depleted gas fields but the time needed for filling and withdrawal is much shorter for the former type of facility making it more suitable for short-term flexibility (see Simmons, 2000). The optimal scale of such caverns is lower than for e.g. depleted gas fields. The dependence on scale of transport infrastructure strongly depends on the length of the pipeline and whether it is onshore or offshore. At distances below about 1000 kilometre, offshore pipeline transport is more efficient than LNG, but at higher distances the large investments needed for pipeline make this type of transport less efficient than LNG. Although LNG-projects still belong to the most expensive energy projects the costs of liquefying, shipping and regasification have decreased by 35 to 50% over the past decade (EIA, 2003).

3.2.4 Market power due to network externalities

Where various parts of the gas chain are vertically integrated, market power deriving from the network aspects may affect entry in other, potentially more accessible parts of the industry. As an example, offshore gas production requires that gas be transported through pipeline infrastructure to be fed into the onshore grid. Restrictive access to these pipelines may constitute a significant barrier to entry in gas production.

3.2.5 Legal monopolies

Another practical barrier is the fact that entry into production is constrained by the availability of the resource, giving a large role to the governments involved. Government regulation, either in the form of (exploration and development) licensing, or by the restriction of activities to a state monopoly contribute to the difficulty of entering the sector. Apart from long-term licenses restricting access, also the presence of other historic long-term contracts (that are pervasive in the gas industry) may limit the opportunities for competing firms to enter the market. As a consequence of these entry barriers, that are partly of historic or legal reasons, in many countries the number of independent operators in the industry is limited.

A perhaps more important driver of current market power may be the historic involvement of governments in the industry, motivated by the natural resource character of the sector, that has resulted in a market structure dominated by few large incumbents per country. The question is whether the strong position of historic state monopolists will still lead to significant market power in the liberalising market. On the one hand it is of relevance how competitively the oligopolists in the market will behave. On the other hand, strategic behaviour of parties with strong local positions may be reined in by competitive pressure from competitors from the outside. Liberalisation may succeed in expanding the geographic extent of the market, firstly within Europe, as cross-border trade expands, and secondly, from elsewhere as the development of global LNG trade takes off.

The gas storage and LNG parts of the industry used to be dominated by the monopolistic incumbent firms, but in the liberalised market this does not need to remain the case. Although the construction of new facilities could be somewhat constrained by available locations, one already observes various initiatives for the construction of new storage infrastructure by new parties. Also in liberalised markets such as the US and UK, storage facilities are owned and operated by competing parties. These facilities effectively compete on the wider wholesale market for gas and gas flexibility with producers and traders. Given the entry barriers, this market still has an oligopolistic structure. The importance of high fixed costs and the resulting high costs for adjustment of installed capacities implies that competition will be closer to quantity competition than to price competition. The scope for exploitation of market power is in general larger when oligopolists engage in such quantity, or Cournot, competition.

3.2.6 Regional restrictions on trade

In the pre-liberalised world, national markets were legally separated, and the state-owned monopolists were in a position to locally exercise market power, in the forms of price discrimination between consumers, barriers to trade among them, and netback pricing based on the closest fuel substitute per consumer category.[16] Liberalisation in principle not only opens the way to competition on national markets (which could be hampered by the existing strong domestic positions of the traditional incumbents) but also between players on neighbouring (European) markets. Prices set by the monopolist would then be replaced by prices resulting from gas-to-gas competition. A necessary condition for this is the availability of sufficient cross-border transport capacity, and the availability of this capacity to competitors.

Currently, the availability of such capacity is limited, as large parts of the existing capacity are assigned, in long-term contracts, to incumbent players (see e.g. Eurostat, 2005, and European Commission, 2005). One may, however, assume that as liberalisation progresses, more competitive methods of capacity allocation will take over, as can be witnessed in the UK, where

[16] In their overview of four decades of Groningen production and pricing policies, Correlje et al. (2000) state that “an essential precondition for maintaining the ‘market value’ principle was, of course, that no alternative supplies of low-priced gas could reach the market - a condition which was fulfilled until recently in the Netherlands and until the 1970s in Europe” and that, as a result “monopoly power was effectively exercised”.

auctioning of entry capacity is now common practice[17] although long-term contracts still play an important role for investments.[18] Regarding the sufficiency of cross-border capacity, efficient investment in transport capacity implies that some degree of congestion (at least in one direction of flows) remains. It is conceivable that in periods when the capacity is fully used, and external suppliers are prevented from responding to further changes in market prices, market power will remain a local (national or regional) phenomenon, while in low usage periods markets are more fully integrated across Europe.

Furthermore, until recently, so-called destination clauses were an important part of export contracts from exporting countries as Russia and Algeria to Europe[19], limiting the possibility of contract partners to resell the gas and thus inhibiting free trade. As these clauses hinder the liberalisation of the gas market, the European Commission has actively pursued the abolition of these clauses but the exporting countries are strongly opposed to such a change in their long-term contracts which give them both financial stability and the ability to charge higher prices (see Finon, et al, 2002)

On a longer time scale, it is expected that LNG will play a much larger role. This will help to create an even wider integrated market, as for instance LNG cargoes on the Atlantic will increasingly be redirected from Europe to the US, or vice versa, as price conditions alter. As IEA (2004) states, “There is an overall consensus that LNG spot trade may amount to 15-30% of global LNG trade.”

Finally, the wholesale sector may be vulnerable to collusion. The intrinsically limited number of countries involved, and the frequent interaction of players on the market place facilitate coordinated effects. The situation is not unlike the oil market, where a number of oil producing countries (partly overlapping with the major gas producing countries) attempt to coordinate production, with varying degrees of success. From a Dutch welfare point of view, insufficient competition in the natural gas market might be in the national interest as it raises export

[17] The auctioning of entry capacity started in the UK in September 1999. McDaniel et al. (2002) conclude that auctioning of entry capacity is an efficient method of allocation when transport capacity is constrained and a “reasonable amount of competition exists in the production and supply markets”.

[18] For instance, long-term commitments for the total capacity of the Bacton-Zeebrugge Interconnector have been made by the so-called IUK-shippers up to 2018. These shippers are entitled to transfer this primary capacity to other shippers by for instance assigning or subletting (a part of) their capacity. (see www.interconnector.com) One of the IUK shippers is BG Group owning a 25% share in the Interconnector. The majority of its capacity has been sublet on medium and long-term contracts but some capacity is retained for short-term sales (see http://www.bg-group.com/international/int-NWE_downstream.htm).

[19] “The clauses allow the supplier to sell gas to different buyers at different prices and conditions at the same delivery point. The destination clauses restrict onward sales and limit the use of gas sales to a contractually-specified geographic market area.”(Konoplyanik, 2005)

prices.[20] International agreements (in the context of e.g. the EU or the WTO) may limit the scope for certain such actions. Also the possibility of retaliation effects of adversely affected parties may reduce attractiveness of explicit use of market power. There may nevertheless be ample scope for use of market power, as for example EU regulation does not necessarily force countries to restrict market power of national incumbents. In addition, coordinated use of purchasing power may be well accepted when faced with cartel behaviour from foreign suppliers. Anyway, one should take into account distribution effects of market power in the welfare-economic analysis of optimal policy.

3.2.7 Switching costs

Presence of switching costs that impede the consumers' choice of supplier affects competitiveness in the retail market. Switching costs may for example derive from in-transparency and the resulting incomplete information on the part of consumers, who may be overly concerned about quality of supply by new entrants. Besides research costs resulting from these in-transparencies, other components of switching costs are transaction costs, contractual switching costs and psychological costs. These barriers would presumably be mainly of importance to smaller end-users, as for large consumers the switching costs will represent a much smaller fraction of their total gas costs. Indeed one can observe that in the liberalised Dutch gas market (as elsewhere) large consumers (such as power producers) play an increasingly important role in the development of an efficient wholesale market. Evidence from the UK indicates that for retail consumers (perceived) switching costs can be sufficiently high to allow for significant margins of price over cost, with only modest opportunities for new entrants to capture part of the market. Although the incumbent retail traders are gradually losing market shares over time, they still have retained an incumbency advantage enabling them to charging significant higher prices than entrants (NERA, 2003).

3.3 Externalities

3.3.1 Definitions

Another kind of market failure consists of production and consumption externalities. Externalities occur if market participants affect welfare of other agents without taking those effects into account. Two groups of externalities exist: production externalities and consumption externalities. Production externalities refer to suboptimal levels of production caused by firms not taking into account some effects of their decisions. If these effects consist of costs, the production externality is negative, resulting is above-optimal level of production.

[20] In principle, total welfare optimisation combined with appropriate compensation payments could make all parties, i.e. producers and consumers, better off compared to the market power outcome. In practice, however, the realisation of such payments may be impossible.

An example may be pollution, where producers do not take into account the costs to society of their activity. Production externalities are positive if other agents unintentionally benefit from production by an agent. Consumption externalities are analogously defined.

3.3.2 Production externalities

Gas production can cause several externalities. Two types of externality derive from its natural resource characteristic. Gas fields have a certain geographic extension and can simultaneously be developed by multiple firms. A single developer would take into account the future value of gas, and spread out production over time. However, when many developers access the same (common) resource, for each of them it is optimal to increase production, since the (opportunity) costs borne by its competitors are external to its own profits. In this way, gas production would be above optimal levels, and resources would be exhausted too fast. This is known as the tragedy of the commons, and provides a rationale for licensing of gas production. Of course, gas producers may also be able to conclude agreements with each other in order to solve this production externality.

The non-renewable character of natural resources might create another externality if markets agents do not take into account the impact of current decisions on future possibilities. Theoretically, producers of natural resources choose the optimal depletion policy by weighing the net benefits of current production versus the (discounted) net benefits of future production. So, “conserving resources is an investment for the future and, as with any other investment, private firms will undertake it if is profitable.”(Helm, et al., 1988). Inefficient depletion decisions might, however, result from uncertainty about future conditions, such as market prices and government regulation. If the government has superior information about those future conditions, intervening in private depletion decisions might be welfare improving, but it is doubtful whether this assumption actually holds.

An externality which can be caused by gas production consists of environmental effects.
In the Netherlands, the surface in several regions in the north of the Netherlands has subsided due to gas production (EZ, 2004). In addition, a number of earthquakes has been caused by these activities. The resulting damage, however, is viewed to be quite small. Besides these general environmental impacts, gas production in the Netherlands can affect ecologically valuable areas as approximately one third of the gas futures is located beneath such areas.

Environmental impacts of mining activities in other regions appear to be significantly higher. In an overview of environmental issues related to the gas and oil industry in the Caspian Sea region, the EIA (2003) mentions a number of severe environmental problems. Discharges and spills from oil and gas drilling, besides waste and emissions from the petrochemical and refining industry, have had "serious impacts on the environments". In a recent newsletter, the Pacific Environment (2005) expresses its worries about the lack of attention within Russian government for environmental consequences of the oil- and gas industry.

3.3.3 Consumer externalities

Consumer externalities exist if consumers do not fully take into account consequences of their consumption choices. This could occur if (small) consumers are not continuously metered, and pay longer term averaged prices for their gas consumption, which are not differentiated to their time of use. In this case, markets for these consumers are incomplete. Consequently, they have neither opportunity nor incentive to respond to temporary changes of the price on the wholesale market. This will result in consumption levels that in general deviate from the welfare optimum. For instance, high prices in the wholesale market or congestion in the infrastructure may arise without changes in the level of consumption by end-users. The first-best solution to this problem is solving the information problem by giving both producers and consumers real-time information on prices.[21]

If such metering is impossible or too costly, the second-best welfare optimum can be achieved by markets if a number of conditions are satisfied (see Joskow and Tirole, 2004). This welfare optimum involves the possibility of controlled disconnection of non-price-sensitive consumers when the price of gas exceeds the (average) value attached to their gas consumption (which is high though not infinite). The costs of guaranteeing reliable gas supply in these situations would exceed the value of lost load, i.e. the value for consumers of having gas. The required conditions for the welfare optimum involve, for instance, absence of price distortions due to market power (as discussed later) or inappropriate regulatory intervention (a government failure).

A further potential external effect in system services involves the balancing of the system: ensuring that pressure of gas in the system remains within safety limits. In a general well-working market, parties contribute to system balancing by responding to time-varying market prices. A problem might, however, occur in the very short run, as was pointed out by Joskow and Tirole (2004) for the case of an electricity market. A provider of short-term flexibility contributes to short-term system reliability by decreasing the risk of large-scale system failure in case of a supply disruption[22]. Such a failure would not only affect his own profits (by not being able to supply gas to customers willing to pay for it), but also prevents other welfare

[21] Consumers might, of course, choose for fixed-price, long-term contracts if they value the benefits of real-time information less than the value of a risk-free contract.

[22] By short-term we here mean within the time span required for demand or other supply to respond to market imbalances. This response may include potential forced controlled interruption of customers.

improving transactions between other market parties. Short-term flexibility therefore has a positive external effect associated to it.

In practice the situation may be somewhat less important for gas markets than for the electricity markets. In electricity markets, this externality motivates the provision of reserve capacity, standing by to accommodate sudden fluctuations in supply or demand. It is the system operator that has to contract these reserves from market players. In gas markets, in practice the system operator is itself a player on the flexibility market, as it is the provider of linepack capacity, the storage capacity of the network itself. As its profits will not so much be determined by market prices, but by regulation, any failure will depend mostly on regulatory structure.

Compared to the power market, a controlled black-out of the system is much more expensive in the natural-gas market. Starting-up delivery of gas after a black-out has occurred gives rise to significant transaction costs as safety considerations proscribe checks of gas flows at all individual exit points. Prices for gas under such forced disconnection of individual consumers will need to rise sufficiently to cover the costs of this operation, as well as the welfare loss to the consumers. Though this is not impossible in principle, it is likely that demand response from larger consumers will generally be more efficient: they will require smaller remuneration and costs of reconnection will be smaller. This demand response may involve active tendering for disconnection contracts by the system operator.

A final positive consumption externality may be argued to be present in consumers' switching behaviour, determining the success of liberalised retail markets. If consumers change supplier in response to price differences, this will not only create benefits to themselves (in the form of lower prices), but will also improve incentives on firm to behave competitively. The threat of sufficient consumer switching will encourage effective competition, to the benefit of all consumers.

3.3.4 Network externalities

Network externalities are production or consumption externalities related to the size of total consumption, e.g. the number of consumers, or total production activities. If network externalities are internalised by market parties, it is not a market failure. A market failure does occur, however, if investors in infrastructure are not fully able to benefit from all positive effects of the infrastructure through contracting, joint ventures or other forms of integration.

From the perspective of consumers, network externalities occur if "one person's utility for a good depends on the *number* of other people who consume this good" (Varian, 2003). This holds in particular for the communications industry where each new consumer raises the value of the system to consumers already present. Comparable positive network externalities appear in the gas industry as new consumers benefit from the extension of gas network (in their region) as it reduces the additional costs for transporting gas to their homes. Analogously, gas producers profit from a network extension as it reduces their costs of bringing gas to the market. After all, in a well-developed network, extending the system to more locations within the same area causes relatively low costs due to the small distances which have to be covered. Large activity in an area makes it attractive to keep exploration equipment near by, and allows for investment of collectively used pipelines to bring the gas ashore. Small gas reservoirs that would not otherwise be developed can be accessed if they are located near larger accumulations of gas that make the investment in the required pipeline capacity worth while.

Negative network externalities arise if aggregated demand, resulting from many individual decisions made by consumers, raise the load of the system so much that supply is unable to follow and, hence, system unbalance results. In the natural gas industry, these kind of negative network externalities can arise during extremely cold weather conditions when aggregate demand exceeds total supply resulting in a black-out of the system. These negative network externalities differ from congestions in other industries, such as waiting lists for medical specialists or customers lining up in a shop, as those local congestions in a network can extend to a large area resulting in total system unbalances.

Besides these externalities, which are directly related to the use of a common infrastructure, other network externalities could occur which are not restricted to the so-called network industries. “Because of increasing returns to scale in production, a greater number of complementary products can be supplied - and at a lower price - when the network grows.” (Tirole, 1988, p. 405). For instance, producers of gas-using appliances benefit from the extension of a natural-gas infrastructure.

Network externalities may also exist in the creation of market places. Using a market place for business makes that market place more attractive for other firms which, in turn, could result in lower transaction costs of doing business. This network externality could hamper development of markets if the fixed costs of starting a market place would be large. In practice this problem seems to be manageable since in liberalised markets such market places do arise through private initiative.

The existence of these network externalities can, however, give rise to free-rider behaviour. Since the level of quality cannot be differentiated among the different users, even if network users could bargain for improved quality of the grids, the outcome would be suboptimal, as users experience a free rider effect of others willing to pay for improved quality. Clearly there is a role here for regulation (see next section).

Related externalities may occur in the area of system operation. Typically, the tasks of the system operator mainly relate to guarding system integrity. Rules devised by the system operator to this end may, however, conflict with efficient market functioning, as the success of market opening will (usually) be external to the (unbundled) system operator’s objectives (depending on regulation).

Another externality lies in gas safety. Gas accidents clearly not only affect the gas operators themselves, but may cause significant damage to society. It may be difficult or costly to arrange for adequate remuneration of those affected by an accident. In practice this will, therefore, require regulation in the form of safety standards.

3.4 Other market failures

3.4.1 Asset specificity and the hold-up problem

Another failure to achieve socially optimal outcomes may derive from difficulties of parties to credibly commit to future behaviour. A particular instance of this, relevant for the analysis of the gas industry, is that of asset specificity and the hold-up problem. The capital intensiveness of this industry requires large upfront investments that investors make in the anticipation of subsequent revenues from use of the equipment. If the investment is specific to the needs of a particular customer, this user of the equipment has an incentive to renegotiate charges for use of the equipment after the investment has been sunk: the specificity of the asset prevents it from being used for other purposes which gives the customer the bargaining power to appropriate part of the benefits of the investments. In addition, the sunk-character make the energy investments vulnerable to changes in future political circumstances (see Helm, 2005). In anticipation of this effect, the investor will be reluctant to make the (efficient) investment: the hold up problem.

A relevant type of specific asset in the gas industry is a pipeline connecting various markets, or a production and a consumption centre. Pipelines involve high capital expenditures, and once the investment is sunk, the asset is highly specific as it can only be used to transport gas between the two connected regions. Such investments will not take place if the investor runs the risk that his transaction partner, that agreed to use the pipeline at a price sufficient to recoup the capital costs of the investor, has an incentive and the possibility to renegotiate this agreement.

Various approaches to solve such hold-up problems are writing enforceable contracts between investor and user of the capacity, vertical integration of both transaction partners or the creation of competitive markets. A standard solution to the hold-up problem is the creation of ex-ante commitment by writing enforceable contracts between investor and beneficiary of the investment.[23] One potential problem is the potential ex-post inefficiency of such contracts, if they leave insufficient room to adapt to changing circumstances. Difficulties of defining complete contracts, i.e. high transaction costs of taking into account all possible contingencies, may be a reason for vertical integration between investor and beneficiary of the investment. In practice, most long-term contracts within the gas industry include provisions for interim renegotiations on specific components.[24] In a global industry such as the energy sector, problems with contracting may also derive from difficulties of enforcing contracts in politically unstable regions. In such cases, agreements between producing and consuming regions, such as Russia and the European Union or individual European countries, may (partly) take away political risks.

If markets at both ends of a pipeline are open to competition, the risk of renegotiation is reduced as the asset is no longer specific to a particular contract party. If any party has access to the gas market at both sides of the pipeline, the (opportunity) value of the pipeline will simply be the price differential between the two markets[25]. Competition also reduces the risk of renegotiation of pipelines, such as Balgzand-Bacton Line (BBL), used for the transport of gas from a producing region to a consuming region: in the presence of sufficient producers (shippers) in the former region and sufficient consumers (traders) in the latter region, the owner of the pipeline is less subject to the risk of hold-up from the side of the users of the pipeline (see also McDaniel, 2003). As Honore and Stern (2004) point out, in the huge Ormen Lange project, connecting a Norwegian gas field to the UK market, shares of gas sold under long-term contracts are remarkably low, as producers rely on the liquidity of the NBP market to be able to sell their gas at competitive prices. The conclusion that competitive markets reduce the risk of opportunism may however be invalidated in the presence of market power in these competitive markets: as Oren (1997) shows, Cournot producers may use their market power to capture the transmission rents.

[23] See for instance the long-term commitments given by the users of the Bacton-Zeebrugge Interconnector (the IUK-Shippers) to use the full capacity of this pipeline up to 2018. These shippers have, however, the option to transfer the right of use to other shippers.

[24] The German import prices which were based on long-term contracts in the period 1990 - 1998, for instance, “displayed a considerable volatility, indicating that the producers are carrying a substantial part of the price risk”. (Asche et al., 2000).

[25] If the price difference even may change sign, possibly additional infrastructure investments would be necessary to accommodate the reverse flows required for arbitrage.

3.4.2 Informational problems and transaction costs

The claim that competitive markets may be an instrument to attain optimal welfare relies on the existence of market prices for all goods involved. In practice, however, prices for some goods are not known, leading to potential market failures, as market participants can only act based on expected prices. In particular in a natural-resource sector such as the gas industry, where a long lead time exist between exploration decision and actual production, expected prices for the long-term future have a large influence on current investment and production decisions. Aggregated levels of gas production could be above or below the socially optimal level due to inefficient valuation of resource scarcity.

The absence of reliable prices is not restricted to these very long-term markets. Currently, several short-term markets are still very poorly developed in many European countries, preventing efficient production and consumption decisions. In the pre-liberalisation era, little differentiation in pricing of gas existed, as all gas prices were set at the level of competing alternative fuels (which is the so-called market-value principle) resulting in maximum profits for the incumbent firms (see Correlje et al., 2000). Introduction of competitive markets, including connection of different national markets, leads to a wider array of contract structures, the development of markets to trade these contracts, and the generation of associated prices. Nevertheless, limits remain on the number of a goods that can be traded, due to transaction costs of product differentiation or due to regulatory limitations. Information asymmetry on the value of non-priced goods leads to inefficient trade as bargaining partners are uncertain of the value their counterpart places on the good (Myerson and Satterthwaite, 1983). Information asymmetry between industry and regulator might also be a cause of market failure as it hinders the determination of efficient prices for access to the infrastructure. Uncertainty over prices and costs may also impose additional transaction costs, leading to market failure elsewhere. A particular example is the case where in-transparency of retail contracts discourages consumer switching, increasing market power for supply companies.[26]

3.4.3 Rent allocation

The allocation of resource rents as a result of market mechanisms need not be a market failure, but generally is a reason for government policy. The value of the products produced by the natural-resource industry follows only partly from the costs involved and mainly from the scarcity of the product. The latter component of the value of the product is called ‘rent’. These rents belong to the owner of the natural resources, generally the state.[27] In order to receive those rents in cash, the resources have to be discovered and exploited, of course. If private firms

[26] According to Pomp et al. (2005), most consumers (70%) value the costs of switching above 75 euro implying that price differences have to be higher before they switch to another energy supplier.

[27] In Norway, for instance, the Petroleum Act establishes that the proprietary act to subsea petreoleum deposits is vested in the state (see MPE/NPD, 2005).

execute these activities, they require compensation for their costs and a remuneration for the risks undertaken.

The distribution of these rents does not so much affect total welfare, but it does influence the distribution between consumers and producers, and the distribution over countries. The former effect can be changed by tax measures, although such measures may distort incentives for the mining industry. The distribution of resource rents among countries directly affects the welfare of individual countries. Countries owning resources may want to make sure that they capture the larger part of the rents these resources offer.

3.5 Security of supply

3.5.1 Introduction

The issue of security of supply is often seen as a responsibility of governments but whether this issue is related to market failures is at least subject to debate.[28] In the absence of market failures, gas market players anticipate that disruptions can occur. In addition, externalities of consumers on the tightness of the markets are internalised in prices. High prices reflecting the value of gas in case of shortages trigger investments to efficiently manage the shortage. In a perfectly functioning market, if a supply incident occurs which reduces the size of available gas to a region, market parties immediately respond to the increase in the price. Traders will deliver gas from elsewhere to the market while consumers will reduce their consumption, or both. A consumer who contracted gas ahead of time but reduces demand may sell his surplus to other users and receive the market price from those market players that are short in gas and value the gas at least as high as the consumer. In the medium term, investments in e.g. increased storage capacity, expansion of import capacity, or an increased flexibility on the part of consumers will take markets to a new equilibrium.

The issue of security of supply may arise when externalities exist: costs or benefits that are ignored by markets in the determination of prices. If private costs are smaller than social costs, consumption or production will be higher than the social optimum. Bohi et al. (1996) view the relationship between oil consumption and imports, on the one hand, and the market power of oil-producing countries, on the other, as a clear example of such a negative externality. A positive externality arises if social benefits exceed private benefits, resulting in a level of production below the socially optimum level. A example of such a positive externality might be

[28] See for instance Toman (1993): “While energy security is seen by many analysts to be a serious policy issue, the literature to date has not provided an entirely convincing argument for the existence of market failures warranting substantial government intervention.”

that profit-maximising firms do not invest in excess production capacity which will rarely be used but which generate a positive social return (Helm, et al., 1988).

3.5.2 Risks on gas market and responses by market parties

Risks on the natural gas market are related to the flexibility of the market to address short-term disturbances and the ability of the market to meet demand in the long term (IEA, 1995). Short-term disruptions on the supply side can have various causes, varying from technical, weather to political.[29] In the long-term, Europe increasingly becomes dependent on import which could cause additional, geopolitical risks (see section 3.2.2).

The importance of market responses to neutralise the effects of a disturbance is shown by events followed by the El Paso natural gas disruption in New Mexico. In august 2000, one of three parallel interstate pipelines blew up, causing the other two to temporarily shut down. This resulted in a 60 percent decrease in the usual 2 billion cubic feet per day flowing from El Paso to the gas markets of Arizona and California, for several weeks in a row. An EIA study (EIA, 2000) into the effects of this disruption concluded that the markets were independently able to make adjustments needed to avoid severe gas shortages as a result of the El Paso disruptions. This was accompanied by soaring gas prices at least temporarily. “The system relied on alternate transportation, gas from storage, or other non-natural gas remedies such as switching to other fuels to supplement the loss of natural gas supplies” according to EIA (2000). All in all, the ultimate effect of this disruption was not significant, partly due to the moderate weather conditions that prevailed at the time of the crisis.

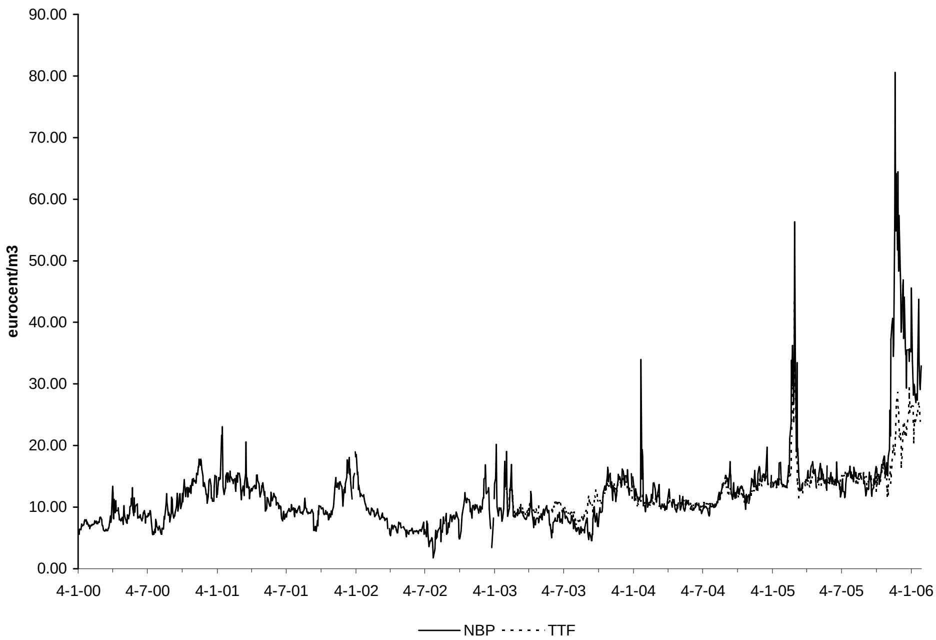
In gas markets such as in the United States and in the United Kingdom, the price mechanism is increasingly playing an important role in matching supply and demand. As a result, liberalised gas markets show very volatile gas prices. This volatility can be illustrated by the day-ahead prices at the National Balancing Point (NBP)[30] in the United Kingdom (see figure 3.1). “As markets are being opened through third-party access, as well as by abolition of state monopolies and exclusive concessions for transport and distribution, competitive markets for gas are emerging and new gas services are being developed. Gas flexibility in its various forms is becoming a tradable service and is valued by the market.”(IEA, 2004a, p. 77)

[29] The probability of a technical failure in the (international) gas network can be significant, but these types of failures are mostly relatively easy to repair. Weather conditions can cause severe tensions in the market. The IEA (1995) mentions the experiences in Canada during the cold winter of 1992/93 and in the USA in January 1994. Recently, cold weather threatened the Dutch transmission system whereby storage facilities had to be used at high capacity in order to continue gas deliveries. Also political events tested the gas system for its stability on a number of occasions, such as disturbances in the transit of natural gas from Russia across Ukraine (see also Stern, 2002).

[30] A UK trading hub. These prices regard natural gas that is sold on a day-ahead basis.

In the United States, regulatory reforms to liberalise the gas market took place in the last three decades, with an initial deregulation of producer prices in response to supply shortages in the 1970s caused by the regulatory price controls then in place (IEA 2004). Gas prices dropped during the 80s and early 90s as a result of the ensuing gas surplus. This trend has reversed, however, and for some time the US now experience significantly higher prices. As IEA states, liberalisation led to increased efficiency, with decreased spare capacities, higher utilisation and ‘just in time’ operations of infrastructure. The market is characterised by IEA as being in a price crisis: “there is no interruption of supply but the available supply is more expensive”. In response to the increasing prices, significant demand reductions took place, both from electricity generators (where switching to alternative fuels occurred), and from industry (partly by relocating outside North America). On the supply side, existing LNG terminals expanded capacity, but also many new terminals are planned (IEA (2004) lists 36 proposed facilities). Although only a minority of these plans will be carried out, LNG is expected to play an important role in the US gas market. IEA concludes that security of supply is not expected to be a problem in the US in terms of balancing supply and demand: “it can be expected that prices will be able to balance supply and demand in North America, both in the short and the long term.” However, high prices and high volatility may be an unsatisfactory consequence of this price mechanism.

Figure 3.1 Day-ahead prices at NBP, United Kingdom, and the Dutch TTF, 2000 - 2006 (January).



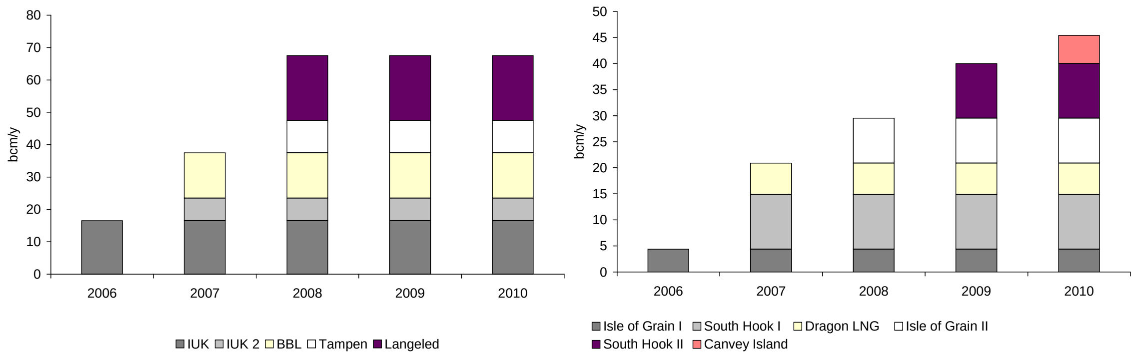
Source: various issues of European Spot Gas Markets, published by Heren Energy.

Also the UK has known a prolonged period of low gas prices after liberalisation. Newbery (2000) describes how the abandonment of the centralised role of British Gas led producers to market their gas independently, bringing more gas to the market and leading to sustained low prices for many years, reflecting the overcapacity that had been built up. Also after the coupling of the British gas market to the continent through the Interconnector between Zeebrugge and Bacton, UK prices typically remained below continental prices, resulting in predominantly exports to the continent.

Recently this situation has been changing. While UK prices in the summer season still remain below continental prices, the UK gas market is sometimes claimed to face a potential shortage in the winters of 2005/06 and 2006/07. Forward prices for gas deliveries in January 2006 rose steeply to around to a peak of around 50 eurocent/m3, before tumbling back to levels of 35 eurocent/m3 (still over double average spot gas prices) (see figure 3.1). Global Insight (2005) notes that “in a period of 2-3 years ..., according to many analysts, supply and demand will be unusually tightly balanced. (...) Many analysts estimate that the UK will enjoy a clear surplus of import capacity by the end of the decade, notwithstanding continued decline in indigenous production.” The last winter was relatively mild, except for a cold spell end of February, leading to prices spiking to 50 eurocent/m3 on occasion (the average winter spot price was only around 15 eurocent/m3). According to Global Insight, in spite of a drop in imports from the Continent during this period, “the UK system coped well with the situation”. For winter 2006, the ministry responsible for energy, DTI, expected sufficient gas to remain available, although demand response would probably be required. Available demand response is estimated at almost 10% of peak day consumption, according to research by DTI and NGT. Winter spot prices in the UK so far have demonstrated a number of spikes (with prices increasing over 60 eurocent/m3) during cold spells, while on average winter spot prices remain above 30 eurocent/m3.

In response to the higher gas prices, a large number of investment projects (LNG import terminals and new pipelines) have been initiated that are expected to come on stream between 2005 and 2008. Global Insight notes that “many analysts estimate that the UK will enjoy a clear surplus of import capacity by the end of the decade, notwithstanding continued decline in indigenous production.” Figure 3.2 shows projected capacities of proposed facilities, which can be compared to total annual UK consumption slightly in excess of 100 bcm. Clearly not all projects can be expected to be completed and run at full import capacity. One scenario may be that the UK will serve as transit country, exporting LNG to continental Europe (Platts, 2005).

Figure 3.2 Proposed investments in the UK in LNG terminals and import pipelines (source: Platts (2005))



The lessons of these cases seem to be that liberalised gas markets so far appear to be able to guarantee matching of supply and demand, and to provoke new investments as a response to the expectation of higher prices. The market paradigm does involve, however, a more substantial role for response of the demand side to temporary shortages, compared to regulated markets. Short-term prices in particular will need to exhibit occasional spikes to call forth such response.

3.5.3 Market failures

Despite the responsiveness of markets to disturbances, as shown in the former section, the question remains whether these responses are optimal from a welfare-economic point of view, i.e. whether markets fail in efficiently dealing with risks and disturbances in energy markets. Do both producers and consumers efficiently respond to the need for flexibility to cope with changes in energy markets? A related issue is to which extent energy consumers take into account costs of their consumption, in particular in relation to geopolitical risks?

Flexibility on the supply side

A key question is whether investments in flexibility by market parties deviate from the welfare-economic level. Liberalisation of markets has put the responsibility of investment in the hands of private firms, that will take their investment decisions based on (expectations of) market prices.[31] In particular, investments in flexibility depend on price levels in the market in periods of gas shortage.

Market participants who are short in real time (i.e. whose contractual obligations to sell exceed their contractual obligations to buy) pay the real-time shortage price for gas. Insufficient security of supply therefore translates, in first instance, to a non-optimal financial risk position of those market participants whose contracts for sales exceed their abilities to source gas under

[31] "The introduction of liberalisation has created uncertainty by removing the all-encompassing, but extremely expensive, provision by the dominant merchant transmission companies against events of low probability but high impact." (Stern (2002)

these circumstances.[32] Market participants not willing to take this risk have the opportunity to shift the risk by concluding longer term contracts and thus closing their short position, thereby raising market prices for such contracts to trigger further investments. If shortage prices reflect actual value of gas, both costs of investing and the consequences of insufficient investments borne by these private parties, and efficient private decision making results in socially efficient outcomes.

Investments in flexibility systems in the liberalised gas market might fall short of the efficient level if market players anticipate that they cannot capture the full benefits of their investments. This may happen if prices do not reflect the full scarcity value of gas. This could be a consequence of incomplete markets, such as the absence of adequate short-term balancing prices, or, for example, when investors fear that the government will interfere by imposing price caps (or creaming off the scarcity rents) if prices soar to extreme values. Conversely, such implicit ‘insurance’ against high prices to a bias in investment towards higher risk alternatives. Moreover, investments may be hindered by uncertainty about future prices (see text box ‘Do market prices signals the need for investment?’).

Do market prices signal the need for investment?

In an ideal market, prices for long-term contracts would reflect market expectations of future supply and demand conditions. Investors in such a market could read off the need for investments well in advance from these prices, and hedge their risks by selling their output through such long-term contracts. Hardly any real market, however, does feature liquid trade in contracts of duration comparable to that of assets in the gas market. Also in liquid gas markets (NBP in the UK, Henry Hub in the US) futures prices do not extend to over five years, and liquidity of forward or futures contracts for delivery over one to two years is typically low (see Global Insight 2005).

Consultant ILEX (2005) analysed whether investment in additional storage capacity in the UK was signalled in 2002, and whether ex post, such investment would have been profitable. ILEX conclude that “the gas market has responded reasonably correctly and efficiently to economic signals; there has not been, even with perfect foresight, any robust commercial case to build a second Rough.” The market response is, however, not perfect, due to the limited signalling value of market prices. Investments are also driven by analysis of market fundamentals, as is witnessed by the large number of investment projects in the UK initiated ahead of the price increase. ILEX doubts whether governments would be able to achieve more efficient outcomes by centrally planning. This energy-consulting company makes, however, an exemption for investments in strategic storage, i.e. storage for dealing with extreme disturbances. The market would like not construct such facilities, but the question remains whether government investments in such facilities would be efficient.

The experiences in the electricity industry do not offer a clear conclusion on the capabilities of liberalised markets to provoke sufficient investment (see text box ‘Incentives for spare capacity in liberalised electricity markets’).

[32] These participants may also be, for example, importers who rely on foreign counterparties that fail to deliver, and who have not successfully arranged for compensation payments in those events.

Incentives for spare capacity in liberalised electricity markets

The most widely known experience in liberalised electricity markets is undoubtedly that of California, where a period of extremely high prices in summer 2000 was followed by a winter with periodic black outs. The crisis cast doubt on the effectiveness of liberalised markets in providing adequate investments. It is noted by Bushnell (2004), however, that black outs occurred in a period when physical capacity was amply available. Rather, insolvency of utilities and their inability to pay the generators triggered a shut down of capacity in winter. As Bushnell claims, this insolvency was caused by a combination of high market power, regulatory policy leading to poor incentives for suppliers to long-term contracts and a freeze of retail rates. In particular the last aspects are specific to the California situation. Bushnell argues that the experience does not provide guidance on whether liberalised markets either naturally fail or would be successful in providing sufficient investment.

In the United Kingdom, the margin of electricity supply over demand was declining after the introduction of a new market framework (see below). The situation was perceived to be particularly tight for winter 2003/2004, but price signals appear to have worked in restoring adequate plant availability. The supply situation for last winter was significantly more comfortable (Ofgem, 2004).

Policy approaches to address security of supply in electricity generation vary. In the United States, various regions, in particular in the North-East, have so-called Installed Capacity (ICAP) markets, where electricity suppliers have to buy sufficient 'capacity credits' from generators. This forms a source of revenues to generators in addition to electricity prices, and contributes to the maintenance of a margin of supply over peak demand. Effectively, the required margin is set by the regulator. Such a system was advocated more generally by the federal regulator FERC in its so-called Standard Market Design, a programme developed after the California crisis.

In some European countries, such mechanisms to stimulate investment appear to be looked upon less favourably. In England and Wales, the so-called Pool, which offered capacity payments in addition to a price for electricity, was abandoned in 2000 in favour of the New Electricity Trading Arrangements (NETA). One of the reasons was that the Pool mechanism turned out to be sensitive to market power in the UK market (Newbery, 2005). In the Netherlands, concerns over inadequate investment in generation were met by the introduction of a 'safety net', providing the system operator with the possibility to contract additional reserves to mitigate damage in case of a system emergency. The system was designed to interfere minimally with ordinary market operation (see Lijesen and Zwart, 2005). However, as producers appear to have responded to the tightening supply situation by increasing investment, it was concluded that implementation of the system was not yet called for (TenneT 2005). Brunekreeft (2005) notes that in Scandinavia, except Sweden, there are no plans for central acquisition of capacity.

Barriers for market parties to efficiently deal with low-risk-high-impact events

It is often noted that liberalised markets impede investments necessary to cope with events of low probability, but high impact. “Markets are largely unable to deal with low probability/high impact events which are best thought of in terms of an insurance proposition: how much are gas consumers – individually and collectively – prepared to pay in order to offset the worst effects of an event which has a very low risk of occurring, but a potentially devastating impact.” (Stern, 2004). Arguments for such statements involve the claim that market players are more reluctant to invest in equipment that is only used in case of emergencies and which has no short-term profitability (compared to the social optimum).

The risk of shortages as a result of a low-risk-high-impact event is in first instance borne by those agents that have no balanced portfolio as a result of the incident. If a pipeline experiences an outage, the importer of gas using the pipeline will face a sudden deficit, and will have to access a substitute source of gas to honour his contractual obligations, or be exposed to an imbalance penalty from the system operator. Either way, substitute gas will be expensive, as normal gas supplies are disrupted, and the price may be set by demand response from higher value gas users. A party facing such risk may either want to insure against this risk by e.g. contracting for back-up gas or investing in storage facilities or demand response contracts with industrial users, or bear this risk himself. In principle this mechanism is at work for any risk, and market parties should be assumed to be able to make an informed decision as to the price they are willing to pay to insure against such risks. However, the main differences between normal risks and low-risk-large-impact events are, firstly, the size of the damages, and secondly, the potential application of ‘force majeure’ conditions.

The size of a large-impact event is by definition such that short-term prices will have to rise excessively to call forth sufficient gas to replace the deficit. This may involve (industrial) users being curtailed, either on the basis of voluntary demand response contracts, or by involuntary disconnection orchestrated by the system operator. In either case prices need to rise sufficiently to repay the lost value to these users. Such high prices can lead to credit problems on the part of the party bearing the risk, especially if the situation holds for prolonged periods. A potential bankruptcy will confer the risk to the contractual counterparty of the party that defaults. While market parties may be expected to take such credit risks of counterparties into consideration in their operations (e.g. by only doing business with financially solid counterparties), it can be argued that smaller end-users who are less well informed should be protected against such default risks. Common solutions could be the institution of suppliers of last resort, who, at a cost, are required to provide the insurance to small consumers, or credit requirements on licenses to supply such consumers.

The second issue is the existence of contractual ‘force majeure’ clauses that are triggered by the events under investigation. Such a clause limits the responsibility of one contract partner under extreme events, and therefore effectively shifts this risk to the contract counterparty. For bilateral contracts among informed market players, this shift of risks is part of the contract and such clauses may be efficient ways to transfer risk to players that are most willing to bear this risk. However, also the balancing rules between shippers and system operator (GTS, 2006) include such clauses, so that effectively the system operator is the ultimate party bearing this (commercial) risk. To insure this risk, the system operator could contract with suppliers for gas under emergency conditions, have backup gas itself, or contract with the demand side. It will depend on the regulatory regime whether under these conditions the system operator has sufficient incentives to invest optimally in spare capacity.

Another factor affecting profitability of investments in flexibility is private parties’ assessment of low-probability-high-impact events in relation to credit risk and force majeure conditions. In the case of large-impact events, the resulting financial transfers may be large and firms may prefer defaulting on their obligations instead of guaranteeing full security of supply, as evidenced in the Californian situation (see text box 'Barriers for market parties to efficiently deal with low-risk-high-impact events'). In the presence of a developed financial infrastructure, allowing credit risks to be redistributed over large groups of financial institutions, however, these risks can be simply dealt with by commercial market players. The situation may be different for small consumers. Here the government might have to play a role, requiring supply companies to insure against defaulting on their small consumer contracts with financially stable parties (e.g. monitored insurance companies). Another effect of events of high impact may be that force majeure clauses may be invoked, ultimately shifting financial risks of supply shortage on the system operator, and, hence, consumers.

A final externality related to investment in short-run flexibility was described in section 3.3.3. Due to the externality of system shortage leading to an uncontrolled system breakdown, the government should also oblige the system operator to contract some spare reserves (as argue in Joskow and Tirole, 2005).

Retail market

The ability of end-users to react on changes in commodity prices depend, among others, on the design of the retail market. Currently, households and small-business consumers are not able to respond to changes in the scarcity on the wholesale market as their consumption at any particular moment is not measured. For this reason they cannot be adequately compensated for reduction in gas use, and hence have no incentive to actually do so. This would result in inefficiently high consumption. The only option available is to centrally disconnect an entire group of such consumers connected to the same section of the network as prices rise above the aggregate value of gas consumption to these consumers. As typically reconnection of small consumers might take several days, the cost of disconnection to them will not be linear, but have a large fixed component. Only if prices are expected to average these costs over this prolonged period, it will be rational to disconnect them. Domestic consumers can therefore not individually choose the price at which they will be rationed. This inefficiency is generally thought to be minor compared to the costs of installing real time meters for each household. In addition, small consumers could specify in the contract with their supplier what will happen in the contingency that they are disconnected in a rationing event.[33]

[33] In the simplest setting, one may distinguish contracts that specify that consumers are paid the (administratively set) disconnection price in this event, and contracts that specify that there is no such compensation (which should therefore command a lower average price). The choice may be left to individual consumers, or these contractual terms may be legally standardised. The real-time price at consumer disconnection (either voluntary or forced) at least equals the value of lost load to these consumers. The disconnected customer is paid the disconnection price by his supplier. If the supplying firm itself, in turn, has contracted sufficient gas, it will sell its excess gas (the gas it does not have to supply to the disconnected consumer) back into the market at the market price, from which it will raise the revenues required to compensate its customers.

Obviously, retail markets do not work perfectly. In the absence of an adequate real time (balancing) market, that is mandated to rise to disconnection prices in case of disconnection, suppliers would not be able to hedge their risks. Again, this could be solved by arranging for a (market based) balancing market, operated by a system operator who is also responsible for deciding on disconnections.

External effects of consumption related to geopolitical risks

The increasing dependence on gas imports of the European Union, including the Netherlands, possibly creates (geo)political risks. As AER (2005) argues, geopolitical risks increase as future gas flows will be more and more affected by political motives. One may imagine that foreign suppliers who are aware of the negative effects on European economy of a curtailment of gas supplies may use this knowledge to obtain political commitments by governments affected. In the past it was considered that dependence on Soviet gas supplies incorporated a strategic risk, but the country has turned out to have been a stable supplier, although recent experiences has renewed doubts about the reliability of this supplier. Some argue that gas disputes between Russia and former satellites are a manifestation of such strategic power. AER (2005) points out that new gas supplies may increasingly come from politically and economically unstable regions, with strong government intervention in production.

To some extent, such political risks of incidental supply shortages are comparable to shortages as a result of technical supply difficulties. Efficient markets will expose market participants importing from unstable regions to price increases as a result of such incidents. A difference with technical problems is that the probability of an incident occurring may be endogenous. Whereas the probability of a technical supply incident does not depend on the damage it causes, the attractiveness of politically motivated threats does change with its effects. Taking measures to reduce such effects (e.g. by keeping strategic storages, or by diversifying supplies) therefore creates an externality.

Hence, consumption of gas causes an externality on security of supply as it raises the import dependence and, hence, the vulnerability of country to geopolitical conflicts (see Bohi et al., 1996). If individual consumers do not take into account the impact of increased individual consumption on total imports, they consume too much from a welfare-economic point of view. To the extent that risks do not depend on levels consumption (e.g. risks of political instability) the risk of increased vulnerability to geopolitical tensions might also be reflected in the price of gas. In that case, this externality is already internalised and does not call for additional policy measures.

Conclusion

Theoretically, markets are able to internalise risk of disturbances in supply and demand. In practice, however, imperfect designs of markets and uncertainty about government policies in case of disturbances might result in non-optimal decisions, such as insufficient investments in flexibility and too high levels of consumption. In addition, markets may not fully internalise the impact of energy use on political vulnerability owning to increased dependence on a limited number of exporting countries.

3.6 Window of opportunity

A specific argument often used to plea for government intervention in the gas industry, at least in the Netherlands, is the limited window of opportunity for offshore activities. As the Dutch Continental Shelf is a mature area, production is expected to decline during the coming ten to twenty years (see EZ, 2004). As fields are depleted, and existing infrastructure is used less and less, this infrastructure is expected to be gradually removed: first the more remote satellite platforms, servicing smaller fields, will be decommissioned, while later on the larger infrastructure will follow. The result is a limited window of opportunity in which to exploit the gas resources in this area. As the remaining fields are too small to warrant investments in new infrastructure (also such investments can be only profitable if many fields are produced at the same time), these fields will never be produced.

The finite window of opportunity in which gas fields on the Dutch Continental Shelf may be developed raises the question whether policy actions are necessary to improve conditions for exploring and developing offshore fields. One reason for a market failure could be the network externalities associated to offshore infrastructure. If the profits for users of infrastructure exceed the costs of keeping the infrastructure operational, but the owner of the infrastructure cannot succeed in getting the required compensation from the users, infrastructure would be removed inefficiently fast. Such a market failure would only exist if insufficient coordination between offshore operators is possible.

The availability of the offshore infrastructure depends on economic considerations of its owners, although environmental regulations also have an impact. Economically, an owner removes an infrastructure if the discounted costs of removing now are lower than then discounted net costs of maintaining it. The costs of removing a production platform range in the Dutch Continental Shelf range from 12 to 35 million euro while the costs of maintaining these platform (mothballing) are estimated at 2 to 4 million euro plus annual variable costs and similar decommissioning costs.[34] The costs of maintaining platforms have to be recovered from

[34] Information submitted by NOGEPA.

the sale of the gas they help produce. In this regard it is important to note that there is a scale effect: since costs for maintenance of the infrastructure are independent of the throughput through the infrastructure, average costs per unit of gas produced are lower as more gas is processed.

One may expect that, whenever this is economic, operators will develop fields in time or invest to keep infrastructure operational. In this case, only non-economic fields risk not being developed in time. This does, however, require that operators can coordinate on such decisions where necessary. If investors in infrastructure are unable to fully reap the benefits of their activities, inefficiencies may arise. In that case, the incentive to invest is lower, and suboptimal investment takes place. However, this effect appears to be small if anything for two reasons: firstly, producers can be effectively charged for use of infrastructure, and secondly, currently the North Sea is a mature production region and no major new investments are to be expected.

The first reason is that competitors using infrastructure can be charged, and do pay, for their use of infrastructure. To gain access to a pipeline (to transport gas onshore from the production platform at sea), users pay access charges that are negotiated with the pipeline owner. Similarly, producers making use of gas treatment equipment can efficiently contract for this service. Also, it is not uncommon that various beneficiaries of specific infrastructure cooperate in the construction and operation of this equipment, so that effectively all benefits are internalised through a joint venture. Moreover, either current users of the equipment, or license holders to areas that may be expected to rely on the infrastructure under consideration, are easily identified and decisions on abandonment of infrastructure can be coordinated with them. If any such area is currently not licensed, it will generally be the last licensee that has best information on the economic viability of that area. The data of past exploration on the area will not always be public, as the owner of the data may have an opportunity to sell these data to new licensees. Also in that case, as the value of those data depends on availability of infrastructure, the previous licensee is the natural counterparty for negotiating extension of the life of the equipment.[35]

The second reason is that the North Sea is a mature gas producing area: uncertainty about gas locations is relatively low, compared to a new area, and major new infrastructure investments are not expected. Of course the same problem may occur in the reverse situation, where existing infrastructure is removed, to save on the costs of keeping the equipment alive. An obstacle to efficient decision making could be an inability to identify those counterparties that may benefit

[35] We understand that in practice, information on the results of previous exploration activity is relativley well known among the industry.

from prolongation of the infrastructure, in order to negotiate conditions for maintaining the platform or pipeline.

Is the government better informed on the prospectivity of the area than private parties?

If the government has better access to data on prospects and future offshore production, it may be in a better position to decide on infrastructure investments than private parties. These could, for instance, remove vital infrastructure sooner than the better informed government would do.

The government does get confidential company data from all firms active on the Dutch Continental Shelf for monitoring purposes. These data are not readily available to all participants. The period of confidentiality differs among countries and among the type of data (such as seismic, exploration and production data).
The reason for confidentiality is that there is a market for such knowledge: geological data can be sold. Firms are able to acquire the data they need to have if they are prepared to pay the price. Knowledge distribution is, therefore, determined by economic considerations. Private network-owing firms can be fully aware of all activities of gas producing firms if they are prepared to pay the price for that information. Of course, governments can enhance the distribution of data by reducing the period of confidentiality, although this reduces the incentive for firms to produce new data.

The scale effect in offshore infrastructure due to large fixed costs do not in itself give a reason for intervening in the market. Although smaller projects that are economic in the presence of infrastructure may be rendered uneconomic once the infrastructure is removed, this is not an inefficiency: also the large fixed costs of maintaining the infrastructure needs to be compensated by the economic profits of the gas produced. If the expected economic profits of future projects do not outweigh the costs of maintaining the infrastructure, keeping the infrastructure alive and producing the fields destroys welfare.

So, the limited window of opportunity is internalised by market parties and does not call for specific policy measures, shifting costs from firms to the state. However, the limited window of opportunity can make measures to decrease total costs more urgent. Such measures can be aimed at improving efficiency of allocation of licenses, and reduction of entry barriers for introduction of new players in the field (see next section on regulation). In this respect, also the maintaining the guaranteed off-take may be interpreted: if the abolishment of the guaranteed offtake gives temporary but significant transition costs, this argument is of more importance than without the constraints imposed by the window of opportunity.

3.7 Indirect economic effects

The impact of gas production on other economic activities in the gas chain is sometimes used as an argument to intervene in the industry. The Groningen field, and in particular its flexibility, for instance is viewed to be a crucial component of Dutch competitiveness of the gas industry (see EZ, 2004; AER, 2005). Reduction of the flexibility capabilities of the Groningen field would reduce competitive advantage[36] of the Netherlands in the European gas market. If the owner of this field ignores this effect, government intervention could be welfare improving. In order to determine a role for government policy, we have to analyse whether markets fail to internalise indirect economic effects.

Macroeconomic effects occur if activities of an industry significantly contribute to an economy. In the past, the Dutch gas industry had considerable macroeconomic effects. According to Weitenberg (1975), assuming an unaffected growth in other industries, the gas industry raised annual economic growth by 0.4 to 0.7%-point over the period 1969-1974. Indirectly, however, the activities of the gas industry had a negative impact on the economy through several mechanisms. The high exports of gas raised the exchange rate of the Dutch currency which had a deteriorating effect on competitiveness of Dutch industry (the so-called ‘Dutch disease’). In addition, the domestic production of gas led to relatively low energy prices which increased not only the use of energy but also the share of energy-intensive industries. The former can be seen as a welfare improvement[37] while the latter had distributional impacts as the new industry had a lower labour intensity.

Firms are able to internalise competitive advantages as these occur within the (gas) market. Firms having competitive advantages, e.g. due to higher productive efficiency, obtain larger market shares than other firms if markets are functioning well. If the latter condition does not hold, e.g. because of restricted international trade, inefficient firms will be able to supply to the market. The market is said to be allocatively inefficient. The internalisation of competitive advantages of firms depends, therefore, on the functioning of the output market. In an efficient output market, firms having the lowest marginal costs take care of supply. The natural gas market may not be an efficient market, as described above. Competition on the wholesale market is hampered by restrictions in infrastructure for transport and quality conversion. Reducing these restrictions will lead to more competition and, hence, take wholesale prices closer to marginal costs.

Indirect economic benefits may also be internalised through intermediate markets or other arrangements giving rise to for instance agglomeration effects. These effects arise if firms located in the same region benefit from economies of scale or scope in shared services, such as

[36] Competitive advantage is related to the relative positions of firms (or economies). A competitive advantage of a country in gas trade means that this country is able to supply gas services at relatively favourable conditions compared to competitors. This concept differs from the concept of comparative advantage which refers to the optimal use of given (natural) resources. If the Netherlands have a comparative advantage in gas trade, it means it should focus more on the gas business than conducting another activity.

[37] I.e., higher domestic consumer surplus, while the net environmental effects were likely smaller due to the reduction in the use of more-emitting fuels, as well as higher domestic producers surplus as imports were replaced by domestic production.

research & development and supplying activities. The gas industry in the Netherlands, just as in countries as Norway, have benefited from such effects. Currently, firms in the north of the Netherlands together with local public authorities, research institutes and others, strive for the establishment of a “Energy Valley” in order to create additional agglomeration effects and, hence, to improve the competitive advantage of the industry. This illustrates that agglomeration effects, though an externality for individual agents, can be internalised by collective arrangements.

Internationalisation of comparative advantages[38] depends on the functioning of input markets. Whether it is efficient to use production factors within the gas industry depends on the benefits of alternative uses, i.e. the opportunity costs. If prices for these factors reflect opportunity costs, the inputs will be used in the most efficient way. If the price for using a depleted gas field is related to the opportunity costs of alternative uses, e.g. for CO_2-storage, decisions made by market parties regarding the use of such fields are efficient. Although government policies affect the use of inputs such as depleted gas fields by environmental and spatial regulation, these markets can not be called inefficient. More generally, prices and supplies elsewhere in the economy (e.g. wages, capital) may not be able to adjust sufficiently fast to accommodate the changed gas prices. Research on such external effects on the economy, reviewed in the context of oil markets (see Bohi and Toman, 1996), however, does not give unambiguous evidence for the presence of such externalities.

Concluding, the rationale for encouraging activities of specific industries like the gas industry can sometimes be found in the presence of market failures, but generally policies focussing on these market failures appear to be more efficient. If, for instance, domestic gas production has positive knowledge spillovers, the net benefits of domestic production would be higher, making this option more favourable from a welfare point of view. If such market failures exist, government intervention can be welfare improving. Such policy, however, can also be directed at solving the market failure, i.e. internalising the benefits of knowledge production, in stead of encouraging domestic production. If domestic gas production (temporarily) reduces unemployment (compared to the no-policy alternative), adaptation costs at the labour market are reduced which is a positive welfare effect. In addition, less social benefits have to be distributed. If this reduction in social-benefit expenditures translates into tax reduction, positive welfare effects can emerge because of the lower tax distortions. Improving the functioning of the labour market, however, appears to be a more efficient policy measure than stimulating domestic production.

[38] Factors giving the Netherlands a relatively advantageous position in the European gas market include the geographical location as well as the presence of many depleted small fields.

3.8 Conclusion on market failures

In this chapter we analysed whether the presence of market failures in the natural gas market call for government intervention. We conclude that several factors make this market sensitive to inefficiencies following from market power. Those factors are in particular geopolitical factors, economies of scale and regional restrictions on trade. The geopolitical factors consists of the growing import dependence on a number of exporting countries and the still large influence of governments in energy markets, both in exporting and importing countries. The presence of huge economies of scale in transport together with regional restrictions in trade give suppliers in regional markets power to charge high prices.

Other market failures which may call for policy measures are externalities related to production. Without these measures, a private gas producer might not fully internalise the effects of its production on other producers (i.e. tragedy of the commons), on future consumption or environment.

The asset specificity can hold-up investment but this market failure can be solved by markets through vertical integration and concluding on long-term contracts. The creation of liquid markets also appears to be a solution for this failure. Long-term contracts and liquid markets also reduce uncertainty about future market conditions. Hence, these potential market failures do not require additional government involvement, except from creating conditions for these contracts and markets.

Although securing the supply of energy is often seen as a major argument for government intervention, evidence on inability of markets to efficiently deal with this issue hardly exists. Markets appear to be able to internalise risk of disturbances in supply and demand. However, imperfect designs of markets and uncertainty about government policies in case of disturbances might result in non-optimal decisions, such as insufficient investments in flexibility and too high levels of consumption, calling for additional policy measures.

Other arguments for government intervention in the gas industry, in particular the limited window of opportunity for gas production and its indirect economic effects, are difficult to base on an analysis of market failures.

4 Government policies

4.1 Introduction

In the presence of market failures, government intervention to correct these failures may be efficient. The mere presence of a market failure is, however, not sufficient motivation for intervention as there is a cost to intervention, including the risk of government failure. Section 4.2 goes into the options for state ownership and structural measures. Section 4.3 focuses at regulatory measures while financial instruments are the subject of section 4.4. Section 4.5 concludes.

4.2 State ownership and structural measures

In some cases efficient resolution of market failures may require direct intervention of the government. In principle such intervention may take the form of the government directly participating in the market through equity stakes in market parties, or of imposing measures on privately owned market parties.

In many gas producing countries, governments still have significant shares in the gas industry. Ownership participation may firstly be a way of rent extraction. As a shareholder, part of the resource rents are directly appropriated. This goal can in principle also be achieved by (various forms of) taxation of revenues. If asymmetric information prevents efficient taxation, direct participation may be a way of decreasing the information gap between private parties and the government.

A second motivation for government participation occurs if public interests deviate significantly from private interests of market players (due to a market failure), and if, simultaneously, the relevant public interest cannot be guaranteed by explicitly contracting with the private parties. If quality of system operation is poorly measurable (for example due to the presence of large information asymmetries), regulation of the private system operator may not be sufficient to achieve optimal quality, and a direct participation of the state in system operations (combined with regulation) would be a better alternative[39].

[39] Notice that this view may not necessarily be correct, given the experiences with private provision of system operations in e.g. the United Kingdom.

State ownership in the gas industry

In Norway, the state-owned Gassco is responsible for the operational management (planning, monitoring, coordination and administration) and development of the transport system for Norwegian gas which is owned by Gassled, a joint venture of the state (38%, via Petero AS) and private companies (MPE/NPD, 2005). The Norwegian state is also involved in exploration, production and trade through Statoil.

In the Netherlands, offshore gas production commonly takes place in joint ventures between private parties and publicly owned EBN. Dutch gas trade is dominated by Gasunie Trade & Supply, a joint venture between oil majors Exxon and Shell, and the state. The onshore transmission system operator GTS is fully publicly owned as of July 2005, and most distribution companies are in public hands as well. The offshore pipeline system is owned by the private firms. Most incumbent retailers, finally, are still vertically integrated with the publicly owned regional network operators, although the government has proposed to fully unbundle these activities.

In the United Kingdom, a large number of private firms own several parts of the offshore infrastructure. The state is neither active in other upstream gas activities. The onshore gas infrastructure is full owned by the private firm National Grid.

In the main exporting countries outside the European Union, e.g. Russia and Algeria, governments are heavily involved in all different stages of the gas industry chain (see section 3.2.2 on geopolitical factors).

Examples of structural regulation are, for instance, the requirement of unbundling (in some form) of network companies from other players in the market to ensure a level playing field, or to ensure competition in the upstream market. Such measures typically address concerns of market power, of either natural monopolists or an oligopolistic industry.

Vice versa, a government may also want to encourage structural links between market parties, for instance to internalise potential network externalities or coordination problems in production activities. In many countries, governments encouraged cartelisation of the gas production sector, in order to stimulate exploration and production activities. In particular in the time preceding market liberalisation, when the use of markets as a coordination device was not available, such cooperative agreements might be considered appropriate to lower the costs of exploration and production.

As mentioned, creating market power in the wholesale market may be an aim of government policy. On the supply side of the market, stimulating market power might be advantageous from a national welfare perspective (of a gas-producing country), although it leads to reductions in aggregate (international) social welfare. Market power need not be restricted to the supply side of the market. The majority of gas consumption is concentrated in a limited number of regions. Coordination on the buying side of the market may be profitable, as consuming countries realise that they may profitably lower market prices by decreasing consumption. The costs of foregone marginal consumption may be more than offset by the gains from the lower price on inframarginal consumption. Implementing such buyer power might, for example, take the form of restrictions imposed on imports, or subsidisation of energy-efficiency technology or competing fuels.

4.3 Regulation

4.3.1 Exploration and production

A measures to regulate depletion is licensing. Licenses appear to be an important instrument to manage the exploitation of the natural resources and to address production externalities imposed on other producers, future consumers or environment. Licenses can also be a source of government failure, for instance if they restrict access of new entrants to an area. This imperfection leads to productive inefficiency (effectively, too high costs of production) and causes welfare loss. Such inefficiency appears to be a rationale for government policy in both the Dutch and surrounding maturing areas. Governments in these countries have taken measures to encourage exploration and production. These measures primarily involve the facilitation of an efficient allocation of exploration and production licenses to companies that can operate at lowest cost, but also aim at e.g. increasing market transparency for existing and new players (see text box "Licensing policies in Norway, the United Kingdom and the Netherlands).

The rationale for such measures lies firstly in the observation that smaller companies may, in some mature areas, be better positioned to extract gas at low cost (e.g. because of lower overhead costs). One may wonder, secondly, why in this case no spontaneous trade of such licenses comes about, as the new entrant should be willing to pay more for the license than the current owner's valuation. In the United Kingdom, the approach to providing default securities for decommissioning liabilities for infrastructure was identified as an important obstacle to asset deals. Potentially, the sale of licenses also negatively affects the revenues on other fields in the current operator's portfolio, making trade less profitable.

Preventing adverse macroeconomic effects, such as adaptation costs and distributional effects caused by changes in international competitiveness of industries, is generally seen as a reason for government involvement in the natural-resource industry. In Norway, for instance, one of the goals of licensing policy is to manage the impact of upstream activities on local communities by reducing the volatility in mining activities.[40] Besides this 'dampening' effect, no other macroeconomic reasons for government policy regarding this industry are convincing economic arguments. Managing the volatility of financial returns generated by the industry can be done by financial measures without changing the production profiles of the industry. In

[40] Part of Norwegian licensing procedures for mining activities is "an impact assessment, covering such aspects as the environmental, economic and social effects of such activities on other industries and adjacent regions" (MPE/NPD, 2005).

Norway, the annual returns for the oil and gas industry are invested in the international stock market, while in the Netherlands, these returns are used to feed an investment fund as well as to pay off national debt.

Licensing policies in Norway, the United Kingdom and the Netherlands

In Norway, mature areas are licensed to companies under the so-called Awards for Predefined Areas scheme. Under these licenses, firms commit to an exploration and production activity schedule, where at predefined moments in time they should decide whether to continue the activities committed under the license, or relinquish the area entirely. “This means swifter circulation of areas and more efficient exploration of mature areas.” (MPE/NPD, 2005). Indeed, new and small and medium-sized companies acquired 50% of 2004 awarded production licenses, while the share of exploration costs accounted for by new companies has grown significantly over the last few years, to 20% of the total in 2004 (MPE/NPD, 2005).

Also in the United Kingdom, efforts are made to encourage activity within existing licenses under the ‘fallow fields’ programme, initiated by government and industry cooperation PILOT. Discoveries and blocks where no significant activity takes place may be identified by the Department for Trade and Industry (DTI) as ‘fallow’, under which status the licensee is required to make commitments to develop activity or sell on the licenses, or, ultimately, the license is to be relinquished (DTI website 2005). The fallow blocks process resulted in a substantial amount of new drilling activity, commitments for work programmes involving a ‘drill or drop’ decision, relinquishment of licenses and relicensing to new licensees of such blocks. To encourage activity, under the licenses work programmes and development plans have to be submitted and approved at fixed dates in order to extend the licenses. ‘Promote’ licenses are targeted at smaller specialised companies: “The general concept of the 'Promote' Licence is that the Licensee will be given two years after award to attract the technical, environmental and financial capacity to complete an agreed Work Programme. The way this is implemented is that each Promote Licence carries a "Drill-or-Drop" Initial Term Work Programme. That means that it will expire after two years if the Licensee has not made a firm commitment to DTI to complete the Work Programme (i.e. to drill a well). By the same point, it must also have satisfied DTI of its technical, environmental and financial capacity to do so.” (DTI website 2005). The Brownfields programme under the PILOT initiative aims at maximising recovery from existing fields. The programme’s recommendations involved improving ‘stewardship’ (where DTI monitors an discusses with operators activity on offshore assets), resolution of decommissioning uncertainties (by devising methods to secure infrastructure decommissioning liabilities that do not act as a barrier to trading assets), industry cooperation in improving supply chain effectiveness, and providing accurate data on the remaining reserves and resources. (PILOT, 2005)

In the Netherlands, since 2003, measures to encourage activity on existing licenses have been taken. The new mining act allows the government to ultimately withdraw licenses for inactive (‘sleeping’) fields. This might result in an increase in the number of transfers of exploration and production licenses among companies (Ministry of Economic Affairs, 2004).

4.3.2 Transport and distribution

Regulation of the infrastructure is widely applied in liberalised network sectors, requiring non-discriminatory access to networks for third parties, as well as restricting tariffs for use of the networks by (various forms of) price and quality regulation. Such regulation may be essential for avoiding market failures caused by market power in networks. Such regulation requires an informed regulator in order to set, for instance, the appropriate tariffs for network access. If those tariffs are set too high, allocative inefficiencies occur. Also externalities associated with safety of gas, both in production and transport, are dealt with by imposing regulation on safety standards

Potential security of supply externalities can be addressed by the installation of an independent system operator, who is charged with balancing the system, guaranteeing the quality of gas, securing the reliability of the transport system.[41] In order to provide short-term reliability to the grid, the system operator imposes balancing rules on the shippers active in the grid, and contracts for flexibility services (or reserves line-pack capacity) to guarantee ability to cope with short run system imbalances. As said above, the grid operator in the Netherlands (GTS) is only obliged to guarantee deliveries of additional gas below an effective temperature of – 9° Celsius while traders have the obligation to meet gas demand of their consumers above this temperature (see Jepma, 2004).

4.3.3 Environment

Environmental production externalities may be addressed by environmental regulations. These regulation may refer to general production conditions but also restrict access to certain locations, such as ecologically valuable areas In the Netherlands, for instance, gas fields beneath the 'Waddenzee', an internationally valuable wetland, can only be drilled from onshore locations. Nevertheless, these activities likely cause some environmental damage. According to the Advisory Commission Waddenzee Policy (Meijer et al., 2004), these costs could be compensated by payments, amounting to 700 million euro, for measures such as development and management of the natural area and management of risks threatening the wetland character. As the impact of mining on the environmentally sensitive areas remain uncertain, despite a number of researches carried out, the Dutch policy regarding these areas follows the 'hands-on-tap-principle' saying that any new information in the future may lead to a change in the policies (EZ, 2004).

As the environmental costs of production in the Northwest-European region appear to be significantly lower than environmental costs related to import from regions like Russia, indigenous production is preferable above imports from the environmental point of view. This conclusion does not imply that encouraging gas production in the former regions is the most efficient environmental policy. After all, favouring domestic production above imports only has a minor impact on the volume of production in regions with less environmental regulations.

[41] According to IEA (2004a), governments should define the role and responsibilities of market players, setting minimum standards for extreme events that must be covered, monitoring investment performance and encouraging conditions for cross-border trade.

Other policy measures, such as transferring knowledge about environmental effects of mining activities, seem to be far more efficient measures.

4.3.4 Security of supply

The externality of energy use on political dependence on a limited number of exporting countries may be addressed by the use of strategic stocks. In the oil market, strategic reserves are employed to decrease the effectiveness of a hold-out, and thereby decrease the probability that such a measure will be attractive to the supplier. The merit of the strategic reserves approach lies in its coordination over many countries. In a regional or global market, shortages of gas by strategic actions by suppliers will have a regional or global nature. Any individual country's efforts to release additional gas will spill over to other countries. Only coordinated response may be sufficient to have appreciable effect, as is shown by Leiby et al. (2002) in a cost-benefit analysis of investments in strategic oil stocks. This implies that only coordinated use of reserves can be effective in mitigating political threats.

The use of strategic reserves in the gas market is, however, much more expensive than strategic oil stocks. "While some of the arguments to ensure security of gas supply are similar to oil, the arguments for establishing stocks and a coordinated stock draw do not apply to gas. Strategic gas storage is much more expensive than oil storage and requires additional substantial investment into a spare transport infrastructure just in case of a disruption, giving a strong incentive to minimise the size of any strategic storage." (IEA, 2004a).

4.4 Financial instruments

A final group of policy measures comprises taxes and subsidies. In particular taxation of resource rents is a significant influence of governments in the natural gas industry.[42] This taxation does not address a market failure but the distribution of welfare. Theoretically, taxation of the natural resource rents must on the one hand leave sufficient incentives to private firms for exploration and exploitation and, on the other hand, distribute an appropriate part of the rents to the state (Neher, 1999). Hence, in theory, the optimal resource scheme taxes only inframarginal projects without affecting investment decisions. Of course, tax schemes can also be used for correcting market failures, e.g. by giving fiscal incentives in order to internalise externalities.

As economic conditions of exploitation alter during its lifetime, the tax regime should be reconsidered frequently although this could create too much regulatory uncertainty for the industry. Theoretically, the more an area approaches maturity, the more depletion costs rise, the

[42] Petroleum fiscal regimes can be distinguished in concessionary systems and contractual systems.[42] The former system allows private ownership to mineral resources while in the latter the state retains ownership of these resources.

lower should be the resource rent tax.[43] This holds, of course, only if the tax is set at the optimal level when depletion took off. “If the fiscal system is directly and accurately targeted on economic rents then investment decisions regarding exploration and development should not be distorted. In practice, however, the great majority of fiscal systems are not directly targeted on economic rents.” (Kemp *et al.*, 1992a). In a study directed at the effects of fiscal terms in a number of countries, including the Netherlands, Kemp et al. (1992) conclude that “overwhelmingly the systems are not well-targeted on economic rents.

Financial measures for the gas industry at the Continental Shelf[44]

Most European countries, including Denmark, The Netherlands, Norway and the United Kingdom, have a concessionary system. In such a system, private firms have exclusive rights to explore and produce at its own risks and expenses.

In the Netherlands, a 50% tax is imposed on new exploration licences after deduction of the 10% uplift. In all production projects, the government agency Energie Beheer Nederland (EBN) carries 40% of the costs and, hence, receives, 40% of the profit made with that project. The profit share refers to the profits of the company after deduction of EBN’s participation. This implies that the government receives 40% of the profit (due the EBN participation) and 50% of the profit of the firms, making governments share in the profit 70%. In the Netherlands, royalties have to be paid on onshore fields only. The Dutch corporation tax is currently set at 34.5% but will be lowered in the near future. This tax is credible against the state profit share implying that any change in the corporation tax does not affect the total tax take (see above).

In the United Kingdom and Norway, royalty payments have been abolished. In Denmark, no royalty is due for new field developments. In Germany, royalties are set at a minimum of 10% and vary among the federal states.

In Norway, the Petroleum Tax is applied at a rate of 50% on income from petroleum production. Uplift is granted for a period of 6 years at a rate of 5%. In Norway, the corporation tax base is rated at 28%.

In the United Kingdom, corporation tax on company’s profits is charged at 30%.[45] Companies now receive a 100% first-year allowance for almost all capital expenditure. In this tax, a ring fence is introduced to prevent profits from oil and gas activities being reduced by losses from other activities. Other components of the British tax on the oil & gas industry are the Supplementary Charge of 20% and, for all fields developed before 1993, the Petroleum Revenue Tax (PRT) which is deductible as an expense against the Corporation tax and the Supplementary Charge.

The marginal tax rate range from 30% in Denmark to 78% in Norway. Germany and the Netherlands have both marginal rates of about 50%, while, in the United Kingdom, the marginal tax for new fields is 50% and on fields paying PRT 75%.

[43] According to the British Department of Trade and Industry (DTI), the British North Sea fiscal regime, for instance, “is kept under continuous review and many adjustments have been made to it to reflect changes taking place in the United Kingdom Continental Shelf” (“Regulatory Regime” at www.dbd-data.co.uk). In order to encourage long-term investment in the North Sea, the British government recently abolished royalty and introduced 100 percent allowance for most investments in the North Sea (message of DTI at www.og.dti.gov.uk).

[44] Source: Gaffney, Cline & Associates (2003).

[45] Source: http://www.og.dti.gov.uk/upstream/taxation.

In jurisdictions incorporating traditional royalty and conventional tax instruments the systems are regressive[46] in relation to oil price". According to these authors, "the inaccurate targeting generally emanates from the absence of a specific allowance for the required return to the investor from the activity of petroleum exploitation."

That impact of taxation on mining activities not only depends on the national system but also on tax systems in other countries as gas firms are global players looking for the best investments options in a number of regions. Consequently, national tax systems are subject to competition between countries in order to create the most favourable tax conditions for gas firms in order to encourage them to exploit domestic resources (see text box "Financial measures for the gas industry at the Continental Shelf").

4.5 Concluding remarks

Above we have described a number of measures which governments can take to address market failures. However, market failures do not necessarily require direct government intervention to solve them as this intervention also causes costs. Government failures can have many faces because of the many options governments have to intervene in markets. Publicly-owned firms or joint-ventures between government and private sector, such as the Dutch Gasunie Trade & Supply, may be effective in conforming the firms' goals to public goals, but this set-up could reduce productive efficiency, both in the short and the longer term. Unbundling of vertically-integrated firms may be an effective measure to enhance competition, but it can also raise significant transaction costs. Finally, taxes on resource rents may be distorting if poorly designed, as is mentioned above.

Market forces themselves may be quite capable of solving many of the market failures that were identified above. For the case of external effects, this point was clearly articulated by Coase (1960) who stated that, when property rights are clearly defined and transaction costs are absent, negotiation by market parties will lead to efficient allocation even in the presence of external effects. The argument is that those affected by the externality can raise their welfare by paying the party that causes the externality, so that effectively the external effect is internalised in his own profit.

[46] Regressive taxes are non-profit based, such as royalties. The lower the profitability, the higher the effective tax rate. Profit-based tax schemes, such as production sharing and profit tax, result in a higher effective tax rate if profitability rises.

Also other market failures may to some extent be corrected by market forces. We already discussed the possibility of integration of firms to resolve some of the hold-up problems. Also externalities may in some cases be internalised by integrating firms whose decisions inflict external effects on each other. Market power may be eroded in the longer run by successful entry by new market players.

This does however not rule out indirect government actions to help market parties resolving such problems. As was mentioned, the “Coase theorem” assumes well defined property rights and absence of transaction costs. The first aspect may clearly involve a role for government, as the guardian of property rights. In the gas market, a relevant example consists of licensing, where the government defines and allocates the rights to explore and produce gas from well defined geographic locations. This effectively deals with the common resource externalities referred to above.

The second aspect is the absence of transaction costs. In reality, efficient negotiations may be prevented by coordination problems. Likewise, a lack of transparency may increase the costs of transactions, or may contribute to a large degree of asymmetric information, leading to deviations from efficient outcomes. Government policy may be directed at improving transparency in the sector, or by facilitating coordination by stimulating the creation of market places. Another example is the efforts that governments make in making the public aware of competition in the retail sector, thus encouraging switching by consumers.

5 Conclusions

In this memorandum we analysed the role for government policies in liberalised natural-gas markets. In the past, the European gas market was dominated by state-owned monopolists but since the start of the liberalisation, privatisation and re-regulation in the early 1990s, the market has fundamentally changed. Nevertheless, governments are still involved in the gas industry, not only in gas exporting countries as Russia, but also in a country like the Netherlands where the government has imposed a cap on production from the main gas field (Groningen), still own shares in the main wholesale trader (Gasunie Trade & Supply) which still has the obligation to accept all gas offered by producers on the small fields. The question we address in this memorandum is why governments should still be involved in the liberalised gas market.

The natural gas industry has many dimensions as it is both a network-industry and a natural-resource industry. The network-industry character gives rise to regulation issues like access to essential facilities and pricing of using the infrastructure. The natural-resource character raises the issue of taxation of resource rents. In addition, this character also results in several submarkets as the commodity ‘natural gas’ is not homogeneous but differs in quality and time of use. Moreover, the gas industry consists of a number of activities each belonging to a layer in the gas-supply chain: exploration & production, domestic transport & distribution, imports & international transport, storage, trade and retail. In the past, these activities, except exploration & production were mainly done by fully integrated state-owned monopolies. Now, many different players are active in each layer. State-owned firms as well as globally orientated private energy companies are active in exploration and production of natural gas while domestic transport and distribution is mainly conducted by national, state-owned firms. Due to the liberalisation of the market, private firms are increasingly active in imports, storage, trade and retail.

Several factors in the gas market make it sensitive to inefficiencies following from market power. Those factors are in particular geopolitical, economies of scale and regional restrictions on trade. Each of these factors might hinder competition resulting in allocative inefficiencies and, hence, call for policy measures.

Other market failures which may call for policy measures are externalities related to production. Without these measures, a private gas producer might not fully internalise the effects of its production on other producers (i.e. tragedy of the commons), on future consumption or environment.

Asset specificity can hold-up investment but this market failure can be solved by markets through vertical integration and concluding on long-term contracts. The creation of liquid markets may also contribute to solving this problem. Long-term contracts and liquid markets also reduce uncertainty about future market conditions. Hence, these potential market failures do not require additional government involvement, except from creating conditions for these contracts and markets, such as legal basis for such contracts (especially internationally).

Although securing the supply of energy is often seen as a major argument for government intervention, evidence on inability of markets to efficiently deal with this issue remains inconclusive. Those market meltdowns that did occur seemed to be related to flaws in market design. Hence, markets appear to be able to internalise risk of disturbances in supply and demand. However, imperfect designs of markets and uncertainty about government policies in case of disturbances might result in non-optimal decisions, such as insufficient investments in flexibility and too high levels of consumption, calling for additional policy measures. In addition, markets may not fully internalise the impact of energy use on political vulnerability owing to increased dependence on a limited number of exporting countries.

Other arguments for government intervention in the gas industry, in particular the limited window of opportunity for gas production and its indirect economic effects, are difficult to base on an analysis of market failures.

Governments have different options to address market failures, varying from ownership, structural measures, regulation and financial measures. However, market failures do not necessarily require direct government intervention to solve them as this intervention also causes costs and market forces themselves may be capable of solving of these failures. Consequently, before implementing government measures, careful analyses of both market failures and government failures have to be made. Such a analysis is conducted in our research into the welfare-economic effects of the Dutch gas-depletion policy (Mulder and Zwart, 2006).

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