CONDITIONS FOR INVESTMENTS IN NATURAL GAS INFRASTRUCTURES[1]

Jeroen DE JOODE [a,b,#], Frits VAN OOSTVOORN [a]

[a] Policy Studies Unit, Energy research Centre of the Netherlands (ECN), the Netherlands
[b] Faculty of Technology, Policy and Management, Delft University of Technology, the Netherlands

Key words: gas supply, gas infrastructure investments, regulation

Abstract

The European Commission (EC) has acknowledged the importance of securing gas supplies from neighboring regions for quite some time. Within the TEN-E program a number of so-called priority gas infrastructure projects are identified. In the research project Encouraged[2] under the EU 6FP, the objectives are (i) to assess the economic optimal energy interconnections and network infrastructure of the EU with and through neighboring regions, (ii) identify, quantify and evaluate the barriers and potential benefits of optimal energy corridors, and (iii) recommend necessary policy measures aimed at realization of optimal energy corridors. This paper deals with the economic conditions for investments in natural gas infrastructures. Herein we focus on barriers for investing in gas corridors and the role of long-term contracts, unbundling of gas trading and transmission activities and the role of coordination on regional level etc. We especially recommend a more strict, swift and uniform implementation of the EU gas Directive amongst which a full ownership unbundling of trading and transmission activities and a larger role for coordination as an instrument for supporting the timely realization of these often large cross borders projects.

1 Introduction

In the past the EU has often emphasized its role as a force for energy stability, security of supply and sustainable development in the Europe, with as key instrument completing the Internal Energy Market and extending the benefits of the Internal Market to its neighbors. On the other hand several of these EU

---

[1] This paper has been developed on the basis of studies conducted within the EU 6FP funded project Encouraged (www.encouraged.info) to be finished December 2006. Note that this work is still in progress. The opinions and ideas presented in this paper do not necessarily reflect the opinions of the project in general, the partners or of the EC. Authors are full responsibility of any remaining errors.

[#] Corresponding author: Jeroen de Joode, Badhuisweg 3, P.O. Box 1 37154 1030 AD Amsterdam, The Netherlands; +31 (0)224 – 56 82 50 (phone); +31 (0)20 – 492 28 12 (fax); dejoode@ecn.nl (email).

[2] Encouraged is an acronym for 'Energy Corridor Optimization for the European Markets of Gas, Electricity and Hydrogen', coordinated by ECN and conducted by key partners such as OME, CESI, FhG ISI, Enviros, IBS, BSREC etc .

neighboring countries play a vital role in the energy supply to the EU, as they are the main suppliers and transit countries of oil and natural gas to the EU. It is expected that in the next decades particularly the gas imports and thereby dependency of the EU on gas supplies from outside the EU will rise substantially to around 70% of more. This enhances the concerns about the adequacy of the gas infrastructure in connecting the EU with these key gas suppliers in neighboring countries in the future. Particularly the building of as necessary identified new gas pipelines, LNG terminals and other gas infrastructures are currently for a variety of reasons postponed or in some cases even cancelled for the time being.

So the main research question addressed here is: *what are the investment conditions under which optimal gas corridor investments are undertaken?* This is an important question since optimal gas corridor investment might not be undertaken in a sufficiently and timely manner due to non-optimal investment conditions or investment barriers. By analyzing the investment barriers that exist for gas corridor investments and recommend policy actions to improve upon investment conditions, an important step towards the implementation of these required investments in energy corridors can be taken.

The conditions for gas corridor investments can be classified in three groups: (i) economic, (ii) policy and regulatory, and (iii) technical. In the paper we address particularly the economic conditions and try to formulate possible measures, policy and regulatory actions to mitigate barriers now hindering investments in corridors. Under the economic conditions for implementation of gas infrastructure investments we discus (1) the high capital costs of investment, (2) the different types of investment risks, (3) options to hedge investment risks, and (4) enhance the co-ordination between public and private actors.

The paper is structured as follows. In section 2 we address the investment risks, in section 3 the different options to hedge these risks and in section 4 we discuss the policy and regulatory uncertainties relevant for investments. Finally in section 5 follow some recommendations to improve the investment conditions.

2 Conditions for gas corridor investments

2.1 High capital costs of investment

The transmission of gas is a business with high capital intensity. In addition, investments in gas infrastructure have economic lifetime covering several decades. Gas transmission is considered to be a business with high asset-specificity: once investment is undertaken, the infrastructure is limited in its use for other purposes. For illustrative purposes Table 2.1 presents a selection of gas infrastructure projects with associated capacity and (projected) investment costs (Esnault *et al.,* Final report Gas corridors in Europe Encouraged project, OME, December 2006 Forthcoming).

Table 2.1 ***Overview of exemplary gas infrastructure projects including estimated investment costs***

Project	Description	Capacity (bcm per year)	Investment (M€)
Greenstream	Gas pipeline from Libya to Italy	8 [a]	8 [a]
Nabucco	Gas pipeline from Turkey through Bulgaria, Romania and Hungary, to Austria	20-25 [b]	4600[b]
NGEP	Pipeline connection between Russia, via Baltic sea (Finland) to Germany.	45 [b]	4000 [b]
Langeled	Pipeline connecting Norwegian oil field Ormen Lange with the UK-shore	22-24[b]	1000 [b]
Zeebrugge terminal	Extension of existing LNG terminal	4.3 [b]	165[b]
GALSI	Gas pipeline from Algeria to Italy	8-10 [b]	1200[b]
Medgaz	Gas pipeline connecting Algeria and Spain	8-10 [b]	1300[b]
Mugardos	LNG receiving terminal in Galicia, Spain	3.6 [b]	347 [b]
Brindisi	LNG receiving terminal in Italy	8[b]	390 [b]

[a] Source: CEER (2005).
[b] Source: Esnault *et al.* (Forthcoming).

The total amount of investment costs implies an investment risk for the operator of the project. The higher the total project investment cost, the higher the potential associated investment risk. Here it is important to note that the high capital costs of investments will lead to investment risks in different degrees, dependent on the availability of proper hedging instruments. Without proper risk mitigation instruments available, high capital costs for investment might prove a too high investment barrier.

2.2 Infrastructure investment risks

In general, investments are hampered by uncertainty with regard to the ability to recoup investments. In order to remunerate investment costs, there should be a fundamental demand for the transmission link or there should be sufficient arbitrage activities within the lifetime of the investment (CEER, 2004). Different types of investment risks should be distinguished (Table 2.2). Market risk encompasses price and volume risk: adverse movements in gas prices and gas demand potentially causing inefficient remuneration of investment costs. Remuneration is also threatened by unexpected or unanticipated changes in policy and regulation. This includes both delayed energy sector reform and change in gas infrastructure tariff and access regulation. Construction risk can involve a delay in construction or overrun of investment costs. Financial risk entails the change in interest rate (borrowing conditions) and risk of counter-party default.

Table 2.2 ***Overview of type of investment risks (De Joode and Boots, 2005)***

Risk	Example
Market risk	Price and demand developments
Regulatory risk	Change in policy or regulation
Macro-economic risk	Change in inflation rate or exchange rate
Construction risk	Project delay
Financial risk	Change in interest rate

From the presented type of risks, market, regulatory and financial risks are the most relevant for the goal in this study. Below, we continue with an elaboration of market risks, i.e. price and volume risks.

2.2.1 Volume risk through distorted commodity price signals

Infrastructure projects, in order to be profitable, will need a stable revenue stream that is based on *structural demand* for (additional) gas supplies. In liberalized markets, structural demand for new gas supplies is provided by the market mechanism of wholesale prices. However, prices might be distorted and provide wrong information signals for investment. There are two types of distorted price signals: regulated prices and prices resulting from highly concentrated markets.

First, it might be the case that *market prices are regulated* (a part of the market is still captured). This withholds consumers the ability to express real willingness to pay for additional supply of gas. This gives rise to uncertainty on both the level of the regulated price as well as the possible developments in regulated prices in the future. A gas infrastructure project might suffer from distorted prices in both the producing country as well as the consuming country. Price distortions in the former imply uncertainty on real value of demand in the home country and therefore indirectly on the amount of gas available for export. Price distortions in the latter give rise to uncertainty on the value of gas supplied.

Examples of the former are the regulated prices in former Soviet countries and Northern Africa. One of the bottlenecks in WTO negotiations with Russia is the level of domestic gas prices for specific consumer groups. Since the future reform of price regulation is very uncertain, the potential for gas export is uncertain as well. In countries such as Egypt, Libya and Algeria, domestic gas prices are distorted through either price regulation of subsidization of specific consumer groups. In some cases, gas prices are estimated to be below economic cost of provision (IEA, 20005). Examples of importing countries that exhibit distorted price signals are France and Finland, where a part of the market is still captured.

Second, although producing or consuming markets' might be fully liberalized, price signals could be distorted due to *the existence and abuse of market power*. Market dominance in retail and wholesale markets could give rise to price levels that do not reflect the real market value of the commodity gas but include an additional scarcity rent.

Table 2.3 gives a rough indication of the (possible) distortion of price signals. The second column indicates whether prices for large customers are regulated. The third column presents the market share of the three largest suppliers on the wholesale market. This does not automatically imply abuse of market power by dominant firms and wholesale gas prices that do not reflect the real market value, but reasonably shows the potential of such happening. It is observed that a majority of countries in this sample potentially suffer price signal distortion, either through uncompleted market opening, price regulation or market dominance. This inherently makes it more difficult for transmission companies to assess the real demand for new interconnection or corridor investments.

Table 2.3 ***Price distortions and market dominance in selected number of EU and neighbouring countries***

Country	Price distortion through price regulation or subsidisation [a]	Market dominance [c] (share of largest wholesale supplier)
Austria	No[b]	80% (3) [b]
Belgium	No[b]	n.a.
Denmark	Yes[b]	97% (3) [b]
Finland	Derogation of Directive	n.a.
France	No[b]	98% (3) [b]
Germany	No[b]	+/- 80% (3) [b]
Italy	No[b]	62% (3) [b]
Netherlands	No[b]	85% (3) [b]
Spain	Yes[b]	73% (3) [b]
Sweden	No[b]	78% (3) [b]
UK	No[b]	36% (3) [b]
Estonia	No[b]	100% (3) [b]
Latvia	Yes[b]	100% (3) [b]
Lithuania	No[b]	92% (3) [b]
Poland	Yes[b]	100% (3) [b]
Czech Republic	No[b]	n.a.
Slovakia	No[b]	n.a.
Hungary	Yes[b]	100% (3) [b]
Slovenia	No[b]	100% (3) [b]
Turkey	Yes[e]	Very high[e]
Algeria	Yes[d]	100%[d]
Egypt	Yes[d]	Very high[d]

[a] For large industrial users.
[b] Source: EC (2005).
[c] Related to wholesale market.
[d] Source: IEA (2005).
[e] Source: IEA (2006).

2.2.2 Price and volume risk through distorted transmission capacity signals

Whereas price distortions for the commodity gas might provide sub-optimal investment incentives, the same goes for the capacity rights of gas transmission. When investment in (capacity upgrades in) parallel pipelines are considered, right information signals on pricing and access conditions of competitive infrastructure is essential. Transparent and, where possible, market-based transmission pricing regimes will generally provide the best information signals for new investors. Potential investors are then capable of deriving the real need for additional infrastructure capacity.

Valuation of existing capacity rights might not reflect real market value because a non-market-based allocation scheme is implemented. Theoretically, economically efficient outcomes are only achieved when the allocation method is fair, non-discriminatory and market-based. However, within the EU, capacity allocation schemes are often based on distributive or corrective approaches such as first-come first served or pro-rata approaches and are often cost-based instead of market-based. Table 2.4 presents an overview of capacity allocation schemes applied in a number of EU and non-EU countries. The allocation method applied most frequently is first-come first served. Its name re-states that the allocation is not based upon the value explicitly brought forward by interested shippers, but on the order of applications received. In a gas transmission market where secondary markets work inefficiently or are virtually non-existent, non-optimal outcomes will emerge.

Table 2.4 ***Transmission capacity allocation mechanisms applied in selected number of EU and non-EU countries***

Country	Allocation mechanism
Austria	First-come, first served, Capacity goes with customer[a]
Belarus	No TPA
Germany	First-come, first served, Capacity goes with customer[a]
Hungary	Auction[a]
Italy	Pro rata[a]
Libya	No TPA
Morocco	No TPA
Poland	First-come, first served[a]
Russia	No TPA
Slovak Republic	First-come, first served[a]
Spain	First-come, first served[a]
Tunisia	No TPA
Turkey	First-come, first served[b]
Ukraine	No TPA
United Kingdom	Auction

[a] Source: EC (2005).

[b] Source: IEA (2006).

Implementation of market-based allocation schemes such as auctioning is limited to the UK and Hungary. Auctioning of transmission capacity theoretically leads to optimal investment signals since scarcity of capacity is valued by the market (De Joode *et al.,* 2006). However, some pitfalls exist. The biggest risk is that an insufficient number of bidders will participate in the auction. This would create large potential for gaming of auction results causing inefficient allocation of existing capacity and inefficient investment signals. Therefore, cautiousness should be taken in implementation of auctioning. Only interconnectors with a sufficient number of interested parties are candidate for auction implementation.

Undisclosed information on pricing and access conditions increase uncertainty on the real market value of additional infrastructure investments.

This is for example the case for gas corridors running from Russia and Eastern Europe to the EU border. Capacity of these pipelines is allocated on the bases of long-term contracts against often-unknown prices. In addition, full capacity may not be fully utilized.

Gas corridors from Russia through Belarus or Ukraine are generally not subjected to third party access. Moreover, conditions at which gas is transported to the EU border is non transparent. In Russia, Gazprom, through subsidiaries, holds the exclusive right to export to neighboring regions.

2.2.3 Price risk through uncertain transit fee regimes

The actual transit fee or government charge for the right to transit gas through a country varies and is highly dependent upon bargaining. In this type of bargaining situations, the economic problem of 'hold-up' is applicable. The hold-up problem pertains in a situation where the commodity considered is highly asset-specific, to such a degree that the government of the transit country or the owner of the infrastructure used for transit will always have an incentive to behave opportunistically. When the pipeline investment is undertaken and is fully operational, both can be tempted to demand a higher fee or charge than agreed upon previously.

For example the Enrico Mattei Gas pipeline (EMG) connecting Algerian gas production facilities with Italy via Tunisia was build in 1983 and operate by Italian gas company ENI. When bargaining with Tunisian government on the transit of gas, the Tunisian government demanded a transit fee of 12%. Suggestions by ENI to consider LNG connection with Algerian gas assets ultimately led the Tunisian government to settle for little below 6%, Esnault *et al.*, Forthcoming

Uncertainty on the impact of gas transit countries' actions upon pipeline operations is further increased whenever the transit pipeline is also connected with the national transmission network. Higher gas off-take than previously agreed upon will give rise to unexpected transit costs for the pipeline owner. This can be countered by explicitly de-linking the transit line from the national grid. However ‘transit only' pipelines are rarely observed.

The pricing of gas transit flows is also an important issue for Turkey, which is envisaged to play a large role as gas hub for hub in gathering gas supplies from the Caspian basin, Africa and the Middle East towards the EU borders (IEA, 2006). The Turkish energy regulator EMRA needs to approve of transit prices. Transit through the Former Soviet Union (FSU) is a special case (Energy Charter, 2006). Pipelines which formerly ran through just one country, there are now located in a large number of countries. A for Europe important intra-FSU transit corridor is Turkmen gas transiting Uzbekistan and Kazakhstan, entering Russia, transiting through Ukraine to finally arrive to the EU border (Energy Charter, 2006).

The most important conclusion regarding gas transit is that there is on the one hand no general internationally (outside EU) agreed upon framework that stipulates gas transit tarification principles and that negotiations on and changes in access and pricing conditions for certain transit routes are non transparent. The Energy Charter Treaty and a draft Transit protocol by the Energy charter do not include *requirements* on tarification issues. Regarding transparency, transit countries should aim for full transparency on current and future tarification principles. This allows gas shippers to anticipate on changes in the level of transit tariffs and consequently reduce uncertainty on future costs of transit.

2.2.4 Volume risk through uncertain supply and demand developments

Besides distorted price signals, planning of transmission infrastructure investments are also hindered by uncertainties in demand and supply developments. In general, the larger the uncertainty with regard to demand or supply indicators, the riskier the investment and the more hesitant investors when considering investments in gas infrastructure.

A typical example of demand-side uncertainty is the often-predicted 'dash for gas' in the electricity sector. In its various World Energy Outlooks in the 1990s, the International Energy Agency (IEA), projected a large increase in consumption of natural gas. However, in consecutive demand projections, the jump in natural gas use was consequently pushed forward in the future. In other words: gas demand was structurally overestimated. One of the major demand uncertainties comes from the power sector. Depending on developments on CO_2 emission reduction policy (and accompanying CO_2 costs) and a revival of large scale nuclear fuelled power generation, demand for gas might still be projected too high.

On the supply-side, the uncertainty of the size of gas reserves is of major importance. However, it seems, up until now that gas reserve estimates have been conservative. In the past 20 years or so, reserve estimates for neighboring regions such as Northern Africa, the Former Soviet Union and the Middle East have been constantly revised upwards due to new assessments of known reserves and new reserve additions.

It is theoretically and empirically proven that uncertainty on either future benefits (e.g. realized gas demand determining gas price) or costs (e.g. gas extraction costs) negatively impact the investment decision. The economic theory studying the effect of uncertainty on investment behavior is decision-making under uncertainty or real option theory (Dixit and Pindyck, 1994).

The importance of the above observations for recommendations on policy actions is the following. A reduction of important energy policy uncertainties (CO_2 policies, vision on energy generation in the future) would improve investment conditions. Moreover, planning of future gas demand would be inherently less difficult if markets are left to do their job. Here we refer to a flexible and free pricing of gas and gas transport capacity rights. In this way, true information signals on scarcity of commodity and capacity improve the efficiency of the investment signal. By making demand for gas, especially with smaller end-consumers, more elastic, the value of the price signal would improve. In addition, a case for monitoring of demand and supply developments in European regions can be made. This would bring up additional information on the time and place of scarcity of gas.

3. Options to mitigate investment risk

Generally, three risk mitigation strategies exist in countering risks mentioned previously: (i) hedging of risks through financial markets (*financial hedging*), (ii) hedging of risks through long-term contracting (*contractual hedging*) and (iii) hedging of risks through vertical integration (*organizational hedging*).

3.1 Financial hedging

In order to hedge the investment risk described above investor can theoretically turn to financial markets. However, due to low liquidity and market domination issues, this is so far not a viable option.

Trading on gas exchanges within Europe and in its neighboring regions is very limited. In the EU, only the NBP in the UK, the Zeebrugge hub in Belgium and the TTF in the Netherlands are of any importance. In addition, gas exchanges exist in Italy (PSV) and Germany (Emden). From data on the amount of trade on these exchanges related to total domestic consumption we observe that trade under long-term contracts is, at the moment, far more important than spot trade. Table 3.1 presents figures on liquidity for the largest European gas exchanges. For comparison, figures for the gas exchange that is considered to be the most liquid in the world gas market, the Henry Hub in the US, is included as well. In the neighboring regions of the EU, gas markets are generally not liberalized and thus have no gas exchanges.

Table 3.1 ***Liquidity on major European gas exchanges***

Country	Gas exchanges	Spot trade % of domestic consumption	Forward trade % of domestic consumption
United Kingdom	NBP/IPE	10 [a]	540 [a]
Netherlands	APX gas/Endex	5 [a]	175 [a]
Austria	Baumgarten	3 [a]	-
Belgium	Zeebrugge	229 [a]	-
Italy	PSV	7% [a]	-

[a] Source: EC (2005).

Forward and futures markets are very important in financial hedging. Within the EU, the only country with a forward/futures market for gas deals is the UK. On the International Petroleum Exchange (IPE) gas futures are traded for 3 years ahead. In addition individual months, quarters and seasons can be traded. For comparison, in the US NYMEX offers natural gas futures for delivery at Henry Hub up to 5 years ahead. The US market, which is considered to be the most liquid gas market, contains a large number of hubs, with the most important one being the Henry Hub.

Assessing the potential for financial hedging as a backing for gas corridor investment the conclusion is that if this is feasible at all, current developments are not encouraging. Spot and forward trade are only minor contributors to total trade and market dominance issues are at play on current gas exchanges. EC

(2006) notes that gas hubs are heavily dominated by incumbent gas suppliers and that total volumes sold by them are only minor compared with supply deals outside the hub. It remains uncertain how large spot and forward market will develop further from their infancy stage. Crucial for further hub development is the development of competition on the wholesale and retail market and an increased participation of former gas trade incumbents on gas exchanges.

On the basis of above observations we conclude that financial hedging instruments for infrastructure investments are insufficiently available in the short and medium term. Furthermore, it may be questionable whether this hedge will sufficiently develop in the future. As long as spot gas trade remains minor, infrastructure investors will need to turn to other hedging opportunities. However, the significance of gas hub notations in natural gas supply contracts as an indicator for wholesale market price may increase gradually.

3.2 Hedging trough long-term contracting

Long-term contracting before liberalization

Since the start of gas market liberalization there has been a debate on the role and desirability of long-term gas contracts in liberalized gas markets. Long-term contracting of both commodity and transmission capacity was one of the main features of the pre-liberalization era. With liberalization came the pressure for higher efficiency levels across the gas value chain and the drive for fair competition. From this perspective, long-term contracts were an obstacle for the development of competitive pressure. After all, gas and capacity contracted on a long-term basis were inaccessible for new market entrants for a significant long period of time. This led the EC to hold a negative stand with regard to the role of long-term contracts.

The long-term contracts functioned as a hedge against commercial risk. The typically long-term contract, a Take-or-Pay (ToP) contract would hedge the volume risk of the gas producer and at the same the price risk of the consumer. The typical gas transmission equivalent of ToP contracts is the Use-or-Pay contract. Both type of contracts guaranteed the investor in gas infrastructure a remuneration of costs plus a decent return on investment. As a hedge for investment risks long-term contracts are a cornerstone of the gas market business. The relevance of long-term contracts for the security of investment and accompanying security of long-term gas supply has been recognized by the EC with the Second Gas Directive (EC, 2003). It is acknowledged that in the future long-term contracting and spot trading will co-exist (IEA, 2004).

'New' types of long-term contracts

In addressing the opportunity to use long-term contracts as a hedge against investment risks a distinction needs to be made between the 'old-fashioned' type of long-term contracts and the type of long-term contracts that have emerged since liberalization kicked in. They can differ with respect to the procedures used to arrive at these contracts, and the elements included in these contracts.

While the old long-term contracts were negotiated bilaterally in very non-transparent manners, the signing of the new long-term contracts occur in more transparent and competitive conditions. An important concept in this respect is *open seasons*. An open season is a period in which the principal initiator of a gas infrastructure investment allows potential future users (including potential competitors) of the infrastructure to express their commitment to future capacity bookings in terms of volumes. This enables the project initiator to reap the benefits of economies of scale and pass them through to the participating shippers and companies. In this sense, even smaller-sized companies are able to deal on a more cost efficient basis. Investors behind the project will see their investments backed by commitments and see their investment risk reduced substantially. Examples of open seasons used in gas infrastructure projects are the BBL and Nabucco pipelines.

Long-term contracts have changed with regard to certain elements: (i) they are becoming shorter, (ii) show more flexible pricing formulas, and (iii) contain periodic renegotiation clauses. The first trend was empirically shown by Neumann and Von Hirshhausen (2005). Pricing formulas do not solely involve oil price linkages but include gas hub prices and electricity exchange prices as well (IEA, 2004).

From the discussion above we infer the following main points. First of all, in liberalized gas markets, there is still a strong need for long-term contracts for both commodity and capacity rights. The nature of long-term contracts has changed: they have become shorter, more flexible and contain more different pricing and renegotiation clauses. Focusing on the long-term contracts for capacity rights it should be noted that competition for this commodity exists by way of open season procedures in the preliminary phase of gas infrastructure investments. In addition, depending on the specific conditions on re-selling of long-term contracted capacity rights competition may arise on secondary markets. The conditions for re-selling of capacity rights largely differ over countries and pipeline and LNG projects but standardization of these conditions would be beneficial for liquidity in this market. All in all, competitive forces can co-exist with long-term capacity rights contract.

Above conclusions apply to EU gas infrastructure investments and gas corridor investments alike. However, institutionalization of strict conditions facilitating secondary markets and open season procedures in the pre-investment phase could be easier than for gas corridors. For gas corridor investments, the Energy Charter Treaty could provide the institutional framework. A less desirable alternative for the EU would be to draft clear guidelines for national governments on the negotiation of bilateral regulatory frameworks for energy corridor investments.

3.3 Organizational hedging

A classical strategy to hedge price or volume risks is to vertically integrate up- or downward in the value chain. This was essentially the case in the pre-liberalization era were commodity trading and accompanying infrastructure requirements were coordinated within a vertically integrated incumbent. In other words, vertical integration reduced exposure to investment risks.

Reason for Gas Directives to strive for unbundling of operations was the opportunity for strategic behavior and the potential threat of vertically integrated dominant companies for new entrants to the market. An important aspect of the unbundling discussion was the 'essential facility' character of transmission infrastructure: to effectively compete in other markets, one has to have access to the transmission and distribution network. When a competitive gas supplier owns both, abuse of market power through monopoly pricing or rejection of capacity requests is likely. Moreover, an integrated company may have no incentives to relieve international congestion or build new interconnection capacity since this would negatively impact his commodity trading operations.

Table 3.2 shows the degree of unbundling of gas supply and gas transmission in selected number of EU and non-EU member states.

Table 3.2 ***Unbundling of transmission and trading in selected number of EU and non-EU countries***

Country	Unbundling of transmission and trading activities	Country	Unbundling of transmission and trading activities
Austria	Legal [a]	Poland	Legal [a]
Belgium	Legal [a]	Czech Republic	No [a]
Denmark	Ownership [a]	Slovakia	No [a]
France	Legal [a]	Hungary	Legal [a]
Germany	Partly legal [a]	Slovenia	No [a]
Ireland	No [a]	Russia	No [b]
Italy	Ownership [a]	Belarus	No
Luxembourg	No [a]	Ukraine	No
Netherlands	Ownership [a]	Morocco	No
Spain	Legal [a]	Algeria	No [c]
Sweden	Ownership [a]	Egypt	No [c]
UK	Ownership [a]	Tunisia	No
Estonia	No [a]	Libya	No
Latvia	No [a]	Turkey	No [d]
Lithuania	No [a]		

[a] Source: EC (2005)
[b] Source: IEA (2002)
[c] Source: IEA (2005)
[d] Source: IEA (2006)

The Gas Directive requires a legal unbundling between transmission and trading activities and allows for further going unbundling (ownership). However, the majority of EU neighboring countries have not reformed their gas markets and thus haven't unbundled trading and transmission. In fact, they reflect the formerly integrated energy companies in pre-liberalized Europe.

Based on above observations, what should we conclude on investment conditions for gas corridors? There are two separate issues: (i) what is the impact of legal unbundling as opposed to ownership unbundling *in EU member states*?, and (ii) what is the impact of unbundled gas companies *in EU neighboring regions?* Concerning the first issue: legal unbundling might not go far enough in countering possible market distortions that result from cross-ownership of trading and transmission activities. The market inefficiencies might still prevent optimal corridor investments to occur. These considerations have led several member states to implement ownership unbundling. The issue might be different for EU neighboring countries though. Considering the goal of optimal and timely gas corridor investment, a vertically integrated non-EU member state counterparty could reduce transaction costs and co-ordination problems that might otherwise emerge.

The discussion above on the role of and opportunities for vertical integration shows that a certain trade-off exists. On the one hand, vertical integration provides a 'natural' hedge for infrastructure related investments implying that, in the absence of well developed other hedging instruments; investments might be stimulated by conditionally allowing vertical integration. On the other hand, vertical integration can induce market parties to behave opportunistically at the expense of competitors, implying that a more flexible stand towards vertical integration might come at the expense of gas market efficiency and, hence, end-user prices. Obviously, decisions with regard to this trade-off are differently made inside the EU and in the neighboring regions. Vertical integration seems to be dominant in countries surrounding the EU.

3.4 Coordination between public and private actors

In a liberalized European gas market where responsibility of optimal infrastructure operations and investments is fractured over so many different actors, the coordination of infrastructure expansions is of eminent importance. On a European level, the responsibility for the expansion of electricity transmission lines rests with national public or private TSOs and private operators of interconnectors. The coordination is not limited to the transparency of national investment plans but also involves a confrontation of several network operators on the optimal expansion from European or society's perspective. The costs, benefits and risks associated with electricity infrastructure investment projects might not be evenly distributed over the involved countries and actors.

For the EU as a whole to optimally benefit from new gas corridors, investments 'downstream' of the corridor investment will often need to occur. In addition, gas corridor investment might only be profitable when investment down-stream is agreed upon. Hence, co-ordination of gas corridor investments with investments downstream is required. This can also include co-ordination with regulated investments by TSOs.

> An example of gas corridor investments requiring national transmission system upgrades is the GALSI pipeline from Algeria to Italy (Esnault *et al.*, Forthcoming). SNAM Rete Gas removed capacity bottlenecks in the North to ease gas transmission from the GALSI pipeline to North Italy and further North. In addition, it provided capacity for other projects such as the Brindisi LNG terminal and a possible new pipeline from Turkey through Greece to Italy.

The necessity of coordination of gas corridor investments with investments in the national transmission system is even higher for projects that aim to supply countries further inland from the EU border. For example, one of the proposed LNG terminals in the Netherlands aims to supply a part of Germany. This requires an upgrade of the network operated by Dutch TSO GTS. For the go-ahead of the project it is vital that additional capacity is realized.

In order for existing European transmission systems to optimally integrate new gas infrastructures clear and transparent procedures need to be implemented. Moreover, transmission policy and regulation needs to be compatible with these types of capacity investment requests. However, there is also a regulatory component present: how do national regulators deal with TSO investments in the national transmission networks that follow from connection to new external gas corridors? or stated inversely how should the regulatory framework be adapted to at least not discourage gas corridor investments? There is a co-dependency between the gas corridor investment and the regulated investment: the one goes not ahead without the go-ahead of the other.

This is a matter of cost and risk allocation. As for the investor of the gas corridor, the TSO needs to remunerate its investments. Regarding the remuneration of this investment, condition 4 of the conditions for granting of TPA exemptions comes into play: the costs of the proposed infrastructure investment need to be levied on the users of that infrastructure. But in the case of upgrading of the national network non-users of the proposed link are also affected. When domestic consumers benefit from the capacity expansion, the Gas Directive states that costs may be passed through into regulated tariffs. Hence, the regulator needs to approve of the new investments' inclusion in the regulated asset base (RAB). Uncertainty regarding the treatment of national transmission infrastructure investments that follow from a proposed gas corridor investment should be reduced to a minimum. Innovative regulation should be developed that properly takes into account this feature.

4. *Policy and regulatory uncertainty*

Regulatory uncertainty has two aspects that impact investment decision-making. First, there can be uncertainty on the outcome of a known and possibly transparent regulatory procedure. Second, there is general uncertainty on unexpected changes in policy and regulation.

4.1 Uncertain outcome of policy and regulatory procedures

Firstly, infrastructure investment projects face a number of regulatory procedures on various government levels in which the timing and outcome of the procedure is uncertain. They relate to environmental regulation, regulation on regional planning and competition. The latter includes regulation on accessibility of transmission infrastructure for third parties. The procedures relevant for regional planning and environmental aspects (such as an Environmental Impact As-assessment Study) are very important for the time planning of gas corridor investment projects (construction and operational risk), but seem to have less importance for the economics behind the project. Moreover, the costs of these type of required studies is often shared with public bodies with public stakes in the proposed projects. An example is the TEN-E program of the EC that co-finances the costs of preliminary economic, siting and impact assessment studies. But the regulatory procedure on the granting of an exemption for TPA provisions of the

Gas Directive is the most important for our purposes. Therefore, the focus here is on the TPA exemption procedure.

Focus on TPA regulation exemption

The issue of granting TPA exemptions is limited to gas infrastructure projects that are wholly or partly located within EU territory. The issue of exemption granting is not a 'yes or no' dilemma.

Various types of exemptions can be granted: exemptions can apply for only a limited number of years or for only part of the total capacity associated with the infrastructure project. In deciding upon the scope of the exemption, regulators need to follow a proportionality principle: the scope of exemption needs to be in proportion with the costs, benefits and risk involved for the consumer and operator of the infrastructure. The criteria under which exemption is granted are listed below (EC, 2004):

1) Improved gas market operations:
   The investment must enhance both competition in gas supply and security of supply.
2) High investment risk:
   The investment risk associated with the project is such that go-ahead depends on the ex-emption being granted or not;
3) Legal separation from TSOs:
   The new infrastructure must be owned by a legal entity that is independent of the own-ers of the transmission systems;
4) Investment costs are levied on users:
   The costs of the new infrastructure are levied on the users of the infrastructure;
5) Functioning of the market:
   The exemption has no adverse effects on competition or effective functioning of the internal EU gas market or the regulated systems to which the new infrastructure connects.

Criterion one aims to prevent a further increase in existent market dominance or the creation of new market dominance. In addition, an improvement of security of supply is strived for. However, it seems difficult to imagine a proposed infrastructure project not contributing to security of sup-ply. An interesting issue to look at is possible changes in project parameters, such as increasing capacity or reverse flow capacity that would result in a higher level of security of supply than would result from original investment proposals. The second criterion is related to the competitiveness and size of the project. Firstly, when the project is considered to be competitive with a number of existing or planned infrastructures, it is less likely that it will create a dominant market position. When the latter is the case, granting an exemption would be detrimental to the functioning of the market. Secondly, relatively small infrastructure projects of which the investors might remunerate investment costs through regulated transmission tariffs without significantly impact the end-consumers. Here the principle of proportionality applies: the type of exemption (regarding length and size) should be proportional to the level of risk associated with the infrastructure investment. Criterion three sees to prevent a conflict of interests between the transmission system operator and the operator of the proposed infrastructure. The fourth criterion aims to prevent a cross-subsidization of merchant activities with regulated revenues is pre-vented. Criterion five builds further on criterion one. It aims at a transparent, non-discriminatory and market-based operation of the new infrastructure. Conditions in this respect relate to capacity hoarding, secondary market trading, and open season procedures.

The most difficult issue is interpretation of the guidelines of TPA exemptions by regulatory bodies, since a number of the conditions for exemption leave room for debate. The most difficult ones are conditions 2, 4 and 5. Condition 2 ('exemption is critical for go-ahead of the project') requires a judgment of the 'degree' of exemption that would justify investment, which is a tricky thing for regulators. A 'too generous exemption' would unnecessarily hinder competition for transmission capacity and consequently negatively affect wholesale competition. Hence, there is a trade-off in this regulatory decision between security of supply and competition (De Joode, 2006). Up until now, no instrument is developed that could assist in this tough decision-making. From investors' perspective, it should be very clear under which conditions, what type of exemptions are granted. This would remove a potential investment disincentive and speed up investment decision-making.

TPA regulation in EU neighboring countries

Outside the EU, TPA regulation is less common. While Turkey has implemented TPA regulation, other neighboring countries have not. The majority of current gas corridors have rather nontransparent operating and access conditions. Implementation of TPA regulation will be challenging for a number of neighboring countries. Fore mostly because its governments have little stakes in implementation of these lacking capability.

An example is provided by Russia. Currently there is a discussion on the desirability of TPA on Russian gas transmission lines prom the perspective of competition on the wholesale level in Russia, but it would greatly enhance investment conditions for the development of new gas corridors, especially from Central Asia and the Caspian Sea regions.

4.2 Unexpected changes in policy and regulation

Secondly, unexpected changes in announced policy and regulation can have large impact on the remuneration of sunk investment costs of existing projects and the profitability of proposed projects. These type of regime changes can occur on a EU, international or national level. Reasons for sudden changes in legislation can be manifold, and may not be based on (economic) ration-ale. For example, governments could use energy sources to wield international political power. In general, this type of risk will result in higher risk premium in project financing, as demanded by external investors. A recent example is the Russian-Ukrainian gas crisis in January 2006.

4.3 Degree of harmonization of policy and regulation

As a general rule, differences in market design and policy and regulation impede structural trade opportunities between neighboring countries. Different market and regulatory designs pose uncertainties for the investor in electricity infrastructure that aims to profit from realizing arbitration between two neighboring countries. After all, changes in the market and regulatory design in the time period in which investors need to recover their money will impact returns on investment, possibly in a negative way. Examples of differences in market and regulatory design are: vertical integration of electricity market activities, degree/type of unbundling, price controls, and attitude/interpretation towards TPA exemptions, market rules on imbalancing, regulatory procedures and congestion management methods. Harmonization of policy and regulation is an issue within the EU and between EU and neighboring countries.

Within the EU strict implementation of the EU electricity market directives by all member states brings harmonization of policy and regulation closer. However, the speed of implementation and the degrees of freedom left in elements of the Directive potentially prevent sufficient harmonization of member state policy and regulation from electricity infrastructure investments perspective. The recent progress report on the creation of an internal electricity and gas market prepared by the EC confirms the differences in implementation speed and the different choices made in the type of implementation. There are differences in market opening, type of unbundling, existence of price controls, public shareholding of transmission networks, balancing rules, transmission network tariff regimes, transmission network capacity regimes, and power and functions of the regulatory authority.

5 Conclusions and policy recommendations

5.1 Conclusions

We have dealt with several conditions for gas corridor investments; these are (1) high capital costs of investments, (2) investment risks, (3) options to mitigate risks, (4) coordination of gas infrastructure projects, and (5) the harmonization of policy and regulation. The following conclusions can be drawn regarding these conditions.

High capital costs of investment potentially increase investment risk. It is important to note that the high capital costs of investments will lead to investment risks in different degrees, dependent on the availability of proper hedging instruments. Without proper risk mitigation instruments available, high capital costs for investment might prove a too high investment barrier. When sufficient hedging tools are available, the high capital costs will pose less of an infrastructure investment barrier.

Regarding the role of **investment risks**, the most important type of risk is market risk. Market risks manifest themselves through price and volume risks. We argued that distortions on the gas wholesale market and the market for gas transmission, cause inefficient information signals for infrastructure investment. In other words, unnecessary price and volume risks emerge. These price and volume risks could be reduced by fully opening gas markets, reduce market concentration in the wholesale market, strive for disclosure of access and pricing conditions, and adopt market-based allocation mechanisms for capacity rights where possible.

The main conclusions regarding the opportunities for **hedging investment risks** are the following. In the pre-liberalization period, contractual hedging and organizational hedging were important risk mitigation strategies. The liberalization of the European gas market following the consecutive gas Directives has decreased the ability of gas market actors to hedge investment risks substantially. Vertical integration between gas production, transmission, distribution and trade is only limitedly allowed (legal unbundling requirements) within the EU. The relevance of long-term contracts in gas transmission within the EU has decreased in importance and the nature of the contracts has changed with regard to pricing and negotiation clauses. Financial hedging strategies are considered to be suitable hedging instrument for well-developed liberalized markets, but the current EU gas market is not sufficiently developed yet. Market concentration and market liquidity remain important issues. An important concept that could contribute to a competitive European gas infrastructures market is open seasons. This brings in competition in the preliminary phase of infrastructure investment projects without endangering the risk-mitigation effect of long-term contracts.

Coordination of infrastructure investments is crucial for optimal realization of gas infrastructures. Firstly, because optimal infrastructure configuration prerequisites a thorough assessment of infrastructure investment impact on a region on the account of costs, benefits and risks associated with the investment. Secondly, infrastructure investments in corridors from outside Europe towards EU border can be co-dependent on EU internal infrastructure developments. Therefore, coordination of various infrastructure investment projects needs to be realized. There is a role to play here for European infrastructure regulation.

Differences in market design and policy and regulation impede structural trade opportunities between neighboring countries. Different market and regulatory designs pose uncertainties for the investor in electricity infrastructure that aims to profit from realizing arbitration between two neighboring countries. Therefore, a **harmonized policy and regulation** within the EU should be aimed at. Differences in policy and regulation, and the potential for these differences in the EU Directives should be looked at very critical.

5.2 Policy recommendations

Based on the discussion of the conditions for gas infrastructures investments and the above conclusions, we recommend the following policy actions.

- Strict monitoring of Gas Directive implementation with focus on preventing and removing **market dominance** by one or a small number of companies is order to realize more reflective gas market wholesale prices;
- Harmonization of infrastructure **tarification, capacity allocation** and capacity management methods;
- Harmonization of policy and regulation with special attention for possibilities in EU Directives to differentiate specific regulatory elements. **Removal of differences** that might hinder efficient infrastructure expansion (such as different degrees of unbundling);
- Implementation of full **ownership unbundling** between trading and transmission activities;

- Ensure efficient compatibility and integration of the **regulatory procedures** for gas corridor investment and resulting investments in national networks through development of innovative regulation;
- Requiring **open season procedures** for new large infrastructure projects and promotion of open season procedures for gas corridor projects where EU legislation is not required;
- Institutionalization of intra-EU and international **co-ordination** between TSOs and regulatory authorities on gas infrastructure projects.

6 References

CEER (2005) Investments in gas infrastructures and the role of EU national regulatory authorities, CEER Position paper, 12-05-2006;

De Joode and Boots (2005), Concepts of investment risks and strategies in electricity generation, ECN report ECN-C--05-061, Amsterdam;

De Joode J. (2006), Gas interconnector regulation - the trade-off between competition and security of supply, Proceedings of the USAEE/IAEE Annual North American Energy Conference 2006, Ann Arbor, MI, United States, 24-27 September 2006;

De Joode, J., H.M. de Jong and L.J. de Vries (2006), Congestion management in meshed gas networks: can the electricity market serve as an example?, Proceedings of the IAEE International Annual Energy Conference 2006, Potsdam, Germany, June 2006;

Dixit, A.K. and R.S. Pindyck (1994). Investment under uncertainty. Princeton University Press, Princeton.

Energy Charter (2006), Gas Transit Tariffs in selected Energy Charter Treaty Countries, January 2006;

Esnault *et al.*, Final report Gas corridors in Europe Encouraged project, OME, December 2006 (Fortcoming),

European Commission (2003), Directive concerning measures to safeguard security of gas supply (2004/76/EC), Brussels;

European Commission (2004), Note exemptions from certain provisions of the third party access regime, Brussels;

IEA (2002) Russia Energy Survey 2002, International Energy Agency, Paris;

IEA (2004) Security of gas supply in open markets: LNG and power at a turning point, International Energy Agency: Paris;

IEA (2005) World Energy Outlook 2005, International Energy Agency, Paris;

IEA (2006) Energy Policies of IEA Countries: Turkey 2005 Review, International Energy Agency, Paris;

Neumann, A., and C. von Hirschhausen (2004), Less Gas to Europe? An Empirical Assessment of Long-term Contracts for European Energy Supply. Zeitschrift für Energiewirtschaft, Vol. 28, No.3, 175-182;