Investing in gas and electricity corridors in Europe

An analysis of the investment conditions

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Abstract
Presented are analyses of the conditions under which as necessary identified investments in gas and electricity corridors are to be realised. Last years the investments in different gas and electricity connections between countries and suppliers and consumer markets are postponed. Clearly an in-depth analysis of causes are useful with a view on the in the medium and long-term envisaged enhancements of gas transport capacity in Europe. In this report the focus is on an economic and regulatory perspective regarding the conditions important for investors to invest in gas and electricity supply transport connections between countries. In this report all relevant economic, regulatory and policy conditions for gas and electricity corridor investments are presented and discussed. Finally on basis of analysis policy and regulatory measures for improving these investment conditions in the next decade are formulated. The report consisting of a Part A: Investments in gas corridors and a part B: Investments in electricity corridors, together with other reports in the ENCOURAGED project was used as input for a final report to the European Commission.

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Executive summary

This report presents the analysis of barriers of investing in gas and electricity corridors or more general the gas transport and electricity transmission infrastructure connecting markets across Europe. Last years the investments in different gas and electricity connections between countries and suppliers and consumer markets are postponed. Clearly an in-depth analysis of causes are useful with a view on the in the medium and long-term envisaged enhancements of gas transport capacity in Europe. In this report the focus is on an economic and regulatory perspective regarding the conditions important for investors to invest in gas and electricity supply transport connections between countries. Report is subdivided in a Part A: Investments in gas corridors and a part B: Investments in electricity corridors.

Improving investment conditions for Gas corridors

Background

Gas corridor investments are only undertaken when there is a structural need for the new corridor and when market and regulatory risks are either minimised or sufficiently hedged through hedging instruments.

The impact of risk on projects' sustainability is fundamental for their implementation and completion. The different 'risk positions' of gas corridor investors or operators is crucial (see Table S.1). For example, operators with a large market share on the wholesale market are better able to cope with investment risk. The three categories are the following: exporter promoted projects (e.g. Nord Stream), importer promoted (e.g. Medgaz) and midstream promoted (e.g. Galsi and Nabucco). *Exporter* and *importer* promoted projects are relatively the least difficult to complete due to their ability to reduce investment risks, respectively through a large market shares and financing capacity of investors.

Table S.1 *Main characteristics of import projects by category*

	Exporter promoted	Importer promoted	Midstream promoted
Exporting companies	Leader	Partner	Partner/not involved
Importers (incumbents)	Partner	Leader	Partner/not involved
Private producers/shippers	Partner (sometimes)	Partner	Leader/Partner
Entrants	Very rare	Partner	Leader/Partner
Number of partners	Small	Small	High
Vulnerability to market risk	Low	Low	High
Type of regulatory risk	Few risks	Incumbent market share	Third party access
Main political dimension	International relations	Security of supply	Competition

Source: OME.

The most difficult to realise are 'midstream promoted' projects, which are aimed at penetrating more markets rather than consolidating a downstream or upstream-based position. This category is more prone to investment risk and may require a political support given that these projects promote competition and diversity of supply. An example of the fact that political involvement can be an efficient facilitator for investment is the GALSI project, wherefore at a visit of Mr Prodi in Algiers, November 15, 2005, some shipping contracts were signed between Sonatrach and Italian partners, including Enel and Edison, booking three quarters of the capacity. So the project has therefore shifted from 'midstream' promoted to both 'exporter' and 'importer' promoted corridor.

When considering the investment issues in gas corridor development, an additional distinction between corridors connecting the EU with neighbouring regions and corridors internal to the EU market is very important. The focus in the summary is on the gas corridors connecting the EU with its neighbours, but realising EU internal corridor investment is equally important due to downstream - upstream interdependency. Furthermore 'midstream-promoted' projects can be developed under a *regulated* operating regime or a *merchant*-operating regime.

Realisation of regulated gas investment projects is generally more impeded by policy and regulatory risks, whereas the realisation of merchant gas investment projects suffers more from market risks. Below we focus on improvements regarding so called *midstream* investment projects, which are crucial for gas supply security in Europe in the medium and long term.

Policy and regulation

Regarding the institutional context of gas corridor project we need to distinguish between (1) the liberalised European gas markets where gas market activities are unbundled with separate transport companies dealing with gas corridor issues, and (2) the vertically-integrated markets with large government-backed monopolists in the neighbouring regions. The latter type of institutions generally favour a merchant-based investment approach

Market risks

Market risk in general refers to the risk of not being able to recover the cost of investment during the economic lifetime of the gas corridor. Gas corridors developed under a regulated regime are less exposed to market risk since regulation effectively passes-through the investment costs to end-consumers. 'Merchant' gas corridors have a much larger exposure to market risk.

In either regime, regulated or merchant, the risk of 'wasted' public or private money can be reduced by improving the reliability of the information signals used in preparing an investment business case. Improving the price signal for investment decision-making on commodity and capacity markets can be achieved by enhancing competitive market elements and introducing market-based mechanisms. However, enhancing investment information signals alone cannot do the job. Remaining market risks need to be sufficiently dealt with through risk-mitigation strategies. The signals for investment in new gas corridors can be improved by market deregulation, increasing competition (i.e. reducing concentration), implementation of unbundling and harmonisation of gas market rules, improving transparency on the network capacity allocation etc.

In addition a large issue for the viability of new gas corridors is *the need for upstream and downstream network connections.* In other words, the benefits of new gas corridors can be largely dependent on a parallel development of downstream and upstream corridors. *Coordination on a regional level* through regional EU coordinators would therefore reduce any risks and uncertainty on sufficient connections with other projects. There is an important dependency between international gas corridor investments and national network investments.

Policy and regulatory risk

Policy and regulatory risks relate to the uncertainty in current government policy and regulation and to uncertain future developments in policy and regulation. Policy and regulation directly impact the ability of investors to recover gas corridor investment. Differences in national energy policy and regulation influences the price differential between two countries and hence the trading and arbitraging profits accruing to the investor.

An important regulatory issue for the development of gas corridors to the EU and inside the EU is the *uncertainty with regard to the conditions of the merchant investment (exemption from third party access conditions)*. Uncertainty in this respect leads to unnecessary delay and investment risk for gas corridor projects. Furthermore, the impact of national and EU internal gas network investments on the realisation of gas corridor investments should be recognized in legislation and taken into account in regulatory procedures, for example related to TPA exemptions.

Concerning policy and regulatory risk in countries neighbouring the EU there can be large uncertainty with respect to the degree and speed of further economic development, energy policy reforms and political considerations. This type of risk could be relieved by providing a long-term regulatory framework that promotes transparency and non-discrimination from the side of the EU, and the joint elaboration of the EU government with neighbouring countries' governments on a common framework for infrastructure investments. These initiatives should replace the need for bilateral negotiations on the regulatory framework for individual infrastructure projects.

Risk mitigation strategies

The liberalisation of the European gas market following the consecutive gas Directives has decreased the ability of gas market actors to hedge investment risks in this manner substantially. Vertical integration between gas production, transmission, distribution and trade is only limitedly allowed (legal unbundling requirements) within the EU. Without proper risk-mitigation instruments at their disposal, gas corridor investors will refrain from investing.

Risk-mitigation can be achieved through varies strategies.Although the relevance of long-term contracts (*contractual hedging*) in gas network investments within the EU has decreased in importance and the nature of the contracts has changed with regard to pricing and negotiation clauses, *it will remain a cornerstone for future gas corridor investments*. However, this does not exclude opportunities to include more competitive elements into these contracts and into the procedures that lead to the signing of such contracts. An important concept is this respect is 'open seasons', where all market parties are allowed to express interest in project participation. This brings in competition in the preliminary phase of infrastructure investment projects, but without endangering the risk-mitigation effect of long-term contracts.

Financial hedging strategies are considered to be suitable hedging instrument for well-developed liberalised markets, but the current EU gas market is *not sufficiently* developed yet. Market concentration and market liquidity remain important issues to be solved.

Organisational hedging trough vertical integration is a useful strategy for the hedging of the investment risks associated with corridors to the EU. Investors in EU and national corridors however can hardly enter into such an organisational hedge due to unbundling requirements. Since the arguments for unbundling are still highly valid we conclude that vertical integration is not considered to be a hedging instrument within the EU. But organisational hedging through horizontal integration is an effective risk-sharing instrument. This instrument is widely applied in gas corridor investments through joint ventures or consortia. This will remain to be an important instrument in the future. Applying a diversification strategy potentially reduces risks irrespective of the type of gas corridor. However, characteristics internal to the firm can limit the availability of this type of hedge (e.g. firm size) instrument.

Concluding remarks on gas corridors

In the striving for realisation of priority gas corridors, the market view as envisioned by the EC and the traditional characteristics of the gas industry need to be effectively aligned. This means that the current gas markets should be fully allowed to assist gas corridor investors in preparing business cases through clear, stable and transparent information signals for investment. This potentially reduces the risks associated with investments. At the same time, traditional instruments used for hedging of market risks such as long-term contracts remain highly important for the realisation of gas corridors. However, these instruments should more and more reflect the need for competition on the European level. In addition, EU legislation and regulation should explicitly recognize the interdependency between EU external and internal national projects. Establishment of European coordinators would be an important improvement in this respect.

Improving investment conditions for Electricity Corridors

Background
In general, electricity corridors refer to high voltage transmission infrastructure designed for long-distance transportation of electricity. We define three different electricity corridors:
1. Corridors between the EU and neighbouring countries,
2. Corridors between EU member states,
3. Corridors within an EU member state.

The main focus in the ENCOURAGED project is on the energy corridors between the EU and neighbouring countries, but the other two corridor types need also to be taken into account in the analysis since their realisation influences the cost-benefit of investments of the first type of corridors strongly too. Below we briefly discuss the most relevant investment barriers and risks for investors and recommendations for improving the investment conditions for the connection projects.

Policy and regulation
Policy and regulation with respect to electricity corridor investments differs between the EU and neighbouring countries. Whereas the EU adopts a 'free market' approach, the majority of neighbouring countries take a more regulated top-down approach with a larger role for public institutions in electricity market decision-making. The latter to a lesser extent rely on market-based mechanisms for electricity market operations. The dominant regime for electricity corridor investment in the EU is currently a regulated regime in which a transmission system operator (or a joint-venture of TSOs) is responsible for system operations, and where transmission tariffs are regulated. Under exceptional circumstances, electricity corridor investments are undertaken under a non-regulated, i.e. merchant regime.

Investment barriers
Potential barriers for investment are the high costs of initial electricity corridor investments and the financing of the project. The barrier of *high costs of initial investment* mainly concerns electricity corridors with DC technology. Compared with AC transmission lines, DC transmission lines are much costlier. An important reason to choose a DC over an AC based electricity corridor between two countries is the non-synchronisation of neighbouring electricity systems. This implies that this barrier is a *de facto* barrier for especially electricity corridors between EU countries and neighbouring regions.

The *financing* of electricity corridors is not considered to be a barrier for electricity corridor investment inside the EU, where majority of electricity corridors is expected to operate under a regulated regime. Moreover, the proceedings of cross-border inter-connector capacity auctions have created large investment funds for TSOs. The real issue on the funds is how to effectively re-invest these into the network. The risks for electricity corridors with neighbouring regions, which are more suitable for merchant operation are much larger, which implies a potential barrier in the financing of these projects.

Market, policy and regulatory risk
The risks that can be associated with electricity corridor investment are market, policy and regulatory risk. The relevance of these barriers and risks varies with the *type of electricity corridor*.
Market risk in general refers to the risk of not being able to recover the cost of investment during the economic lifetime of the electricity corridor. Electricity corridors developed under a regulated regime are less exposed to market risk than corridors developed under a merchant regime since regulation effectively passes-through the investment costs to end-consumers. 'Merchant' electricity corridors have a much larger exposure to market risk.

Policy and regulatory risks relate to the uncertainty in current government policy and regulation and to uncertain future developments in policy and regulation. Policy and regulation directly impact the ability of investors to recover electricity corridor investment. For example, policy on electricity generation (support programs for green electricity, vision on nuclear electricity generation) influences the price differential between two countries and hence the trading and arbitraging profits. If it concerns a 'Merchant' connection a potential investor is depending on these variable profits. Concerning policy and regulatory risk in countries neighbouring the EU one can think about the large uncertainty posed to investors by the degree and speed of further economic development, energy policy reforms and political considerations in neighbouring countries.

Risk mitigation opportunities

Market risk and more specifically *price and volume risk* can, theoretically, be mitigated or reduced via three differing strategies: (1) financial hedging, (2) contractual hedging, and (3) organisational hedging. The availability of hedging strategies is especially important for merchant based projects, including electricity corridors between EU and non-EU countries.

Opportunities to *financially hedge* investment risks in electricity corridor investments exist but are limited. Power exchanges across the EU offer futures or forward contracts that can provide a more reliable and stable pricing information to the investor and thereby relieving the risk exposure of a project.

Contractual hedging offers good hedging opportunities, especially for investment projects on corridors with the EU neighbouring regions. However, this implies exemption from default EU regulation on access to transmission networks. In allowing an increasing use of long-term contracts lays the danger of limiting the potential for competition. After all, the shorter the long-term capacity contracts, the more scope for short-term capacity allocation and wholesale market competition. This 'disadvantage' of long term contracts can be compensated by implementing market-based allocation of these contracts, for example through auctions.

Organisational hedging can have two faces: (1) vertical integration and (2) horizontal integration. Vertical integration by combining either electricity transmission and generation, or electricity transmission and trade is not considered an option within the EU due to policy of *unbundling.* Horizontal integration however offers more risk-reducing potential. By entering a joint-venture, two neighbouring TSOs can share and allocate costs and risks of electricity corridor investment. Electricity corridor projects between an EU and non-EU member state generally involve 'joint-venture-like' arrangements between a TSO (from the part of the EU) and a vertically integrated national electricity company (from the side of the neighbouring country).

Concluding remarks on electricity corridors

Improvement of investment conditions for electricity corridors can be achieved through actions aimed at the provision of clear investment signals, or via support for risk-mitigation instruments. Investments in new electricity corridors will only be undertaken when there is a structural need for the corridor. The structural need for new corridors is best given my market-based information signals that are undistorted by for example market concentration, market captivity, differences in regulation, etc. This counts for both intra-EU electricity corridors as well as electricity corridors between the EU and neighbouring countries. In addition, increasing coordination could enhance the value of both regulated and merchant electricity corridor projects. Market risks as mainly associate with merchant electricity corridors can best be mitigated through long-term contracting (in case of merchant projects) or entering joint-ventures (both merchant and regulated projects). In order to minimise the negative impact of long-term contracting on wholesale market competition full attention should be given to inserting competitive elements compatible with these long-term contracts.

1. Introduction

1.1 Background of research

In several official Communications and publications the European Union (EU) has repeatedly emphasized its role as a force for stability and a sustainable development in Europe and formulated as key energy policy objectives for the EU:

- Enhance security of energy supply,
- Strengthen the internal energy market,
- Develop sustainable energy markets.

According to many studies for the European Commission (EC), official EU energy scenarios and the Green Paper[1] the dependency of the EU-27 on gas supplies from neighbouring countries is expected to increase from 40% to 70% or more in 2030. Consequently the role of current and future neighbouring countries in the development of the energy markets of the EU, as they are the main gas and oil suppliers and often key transit counties of oil and natural gas to the EU is increasing. But not only the EU imports of oil and gas will grow significantly in the next decades, also electricity exchanges and perhaps in later periods the hydrogen supply from neighbouring countries might also increase in the long term. In this manner these countries will also benefit of the Internal Market and become a part of actions of the EU to integrate the energy markets from the EU and its surrounding countries.

The European Commission also promotes in particularly the development of an effectively functioning electricity and gas transmission infrastructure within the EU and between the EU and its neighbouring countries by earmarking interconnection projects of trans-European importance (TEN-E programme). Most of the projects cross several national borders or are of importance to several EU Member States and neighbouring countries. The Trans European Energy Networks are integral to the European Union’s overall energy policy objectives, namely increasing competitiveness in the electricity and gas markets, reinforcing security of supply, and protecting the environment.

The first set of guidelines for trans-European energy networks was adopted by the Council and the European Parliament in June 1996[2]. They have been amended several times to reflect developments in the internal market for electricity and gas supplies[3]. The new guidelines issued in 2003 set out priority projects which chiefly concern the security of supply and the competitive operation of the internal energy market[4]. Twelve priority axes were identified, seven electricity interconnections and five natural gas pipelines.

Last year, the priority of this programme was enhanced due to international developments and on 24 July 2006, the Council adopted the Commission proposal for a revision of the Trans-European Energy (TEN-E) Guidelines, confirming the favourable vote of the European Parliament in second reading in Plenary on 4 April. In this resolution certain projects of European interest were given a top priority with respect to funding[5]. A European coordinator can be appointed to specific projects (or parts of projects) of European interest which encounter implementation difficulties. The coordinator will be tasked with facilitating and encouraging

1 A European Strategy for Sustainable, Competitive and Secure Energy-COM(2006) 105, 8 March 2006.
2 European Parliament and Council Decision of 5 June 1996 (1254/96) establishing a series of guidelines on trans-European networks in the energy sector.
3 Amendments have been made through Commission Decision (97/548) of 11 July 1997; and Decision 1741/1999 of the European Parliament and of the Council.
4 Decision No 1229/2003/EC of the European Parliament and of the Council of 26 June 2003.
5 Directorate-General for Energy and Transport, MEMO/06/304, 24 July 2006.

cooperation between the parties concerned and ensuring that adequate monitoring is carried out. With respect to cross-border sections of infrastructure, the concerned Member States need to exchange information regularly. Joint coordination meetings are to be held to ensure the harmonisation of public consultation procedures and carry out project evaluation. If delays occur then the Member States have to report on the reasons behind these delays.

In short the integration of the European Energy System can only be achieved by building the necessary energy infrastructure and connections between the national systems, avoiding energy islanding of some EU regions or countries and facilitate energy trading between countries. Consequently sufficient energy connections and connection capacity are a key condition for realising the overall EU energy policy objectives of a competitive, efficient and sustainable Internal Energy Market and Energy Supply Security for consumers. However to meet these goals one must realise that gas and electricity infrastructures usually last a very long time and take a relative long time to be built, consequently one can say for developing efficient infrastructures for energy transport one needs a long term vision on the developments shaping and driving the infrastructure. Particularly if more countries and different systems (infrastructure crossing/connecting different national borders) need to be connected an in depth analysis of the long term key drivers such as socio-economic and technology changes, trade-offs and barriers, which are shaping the infrastructure in the next decades, is of the utmost importance.

1.2 Objective, scope and structure of report

The objective of this report is to provide insight into the conditions under which large gas and electricity infrastructure projects are realised. Although specific EU policy has been directed at the integration of electricity and gas markets and the connections between the EU and neighbouring countries, we observe a gap between the desired amount of infrastructure investment, and the realised amount of investment. We try to explain this observed gap by pointing to the barriers and risks of large investment projects.

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

The structure of this report is as follows. Considering the differing nature of gas and electricity corridors, this report contains two separate parts. *Part A* deals with the investment conditions for *gas* corridors, whereas *Part B* deals with the investment conditions for *electricity* corridors. Notwithstanding the different nature and characteristics of gas and electricity corridors, the approach chosen in each part is similar. This implies a more or less identical structure of each part. The first section of each part provides background information on corridor issues. It considers corridor typology, presents relevant policy and regulation and discusses relevant market actors. The second section of each part lists and discusses the main barriers and risks for corridor investment. The barriers and risks discussed here are either economic or regulatory. Thereafter, the third section focuses on the options for market actors (investors) to deal with barriers and risks. The fourth section summarizes and concludes. In addition some policy implications and recommendations are suggested.

Part A: Investments in gas corridors

2. Gas corridors and policy and regulation

This Section aims to provide context to the issues to be discussed in Sections to follow. Here we give a characterisation of gas infrastructures and define gas corridors (2.1), discuss the relevant actors and stakeholders relevant in gas corridor realisation (2.2) and describe the policy and regulatory context (2.3).

2.1 Gas infrastructure characterisation and gas corridors

The value chain of the natural gas market consists of various activities. Figure 2.1 schematically depicts the gas market activities and highlights the activities related to the long distance transport of gas.[6] The infrastructures needed to perform these activities are the main focus of this part of the report.

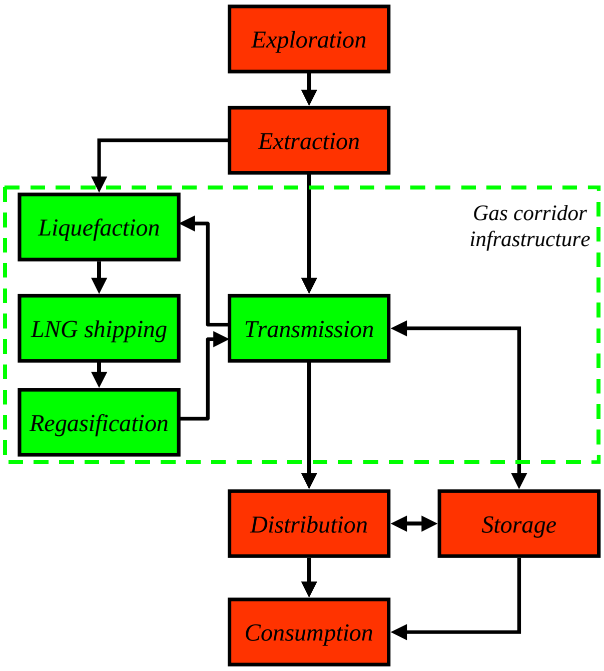

Figure 2.1 *Schematic representation of the activities in the gas market value chain*

The physical infrastructures needed to perform these tasks encompass long-distance and high pressure pipelines (also sub-sea), compressor stations, gas injection facilities, gasification terminals, liquefaction terminals and gas conversion stations. With long-distance pipeline we refer to onshore pipelines with a pressure of between 60 to 80 bar.[7]

Gas infrastructure investments can encompass maintenance, upgrade of current interconnection, and new interconnections ('Greenfield' investments). The investment decision-making for each type of investment is different with respect to impact on current business. For instance, refraining from maintenance investment has a short-term impact on the technical ability of existing pipelines, whereas a deferral of investment in new pipeline connections results in foregone revenues. In discussing the investment conditions for gas infrastructure the focus is on network

6 Note that the figure does not depict the *quality conversion* of natural gas, an activity that theoretically can be delivered at any stage of the gas value chain.

7 Hence, we refrain from addressing infrastructure investments in regional transmission and distribution grids (which operate between 1 and 8 bar, and about 30 to 100 mbar respectively).

capacity expansion through existing and new interconnections. Hence, investment decision-making on maintenance investments is neglected.

Important for the remainder of this part of the report is the following categorization of investments in gas infrastructure (Table 2.1).

Table 2.1 *Classification of gas corridors*

Type	Name	Description	Example
1	*International* corridors	Gas infrastructures from neighbouring regions to the EU border.	Nabucco, NEGP, GALSI
2	*EU* corridors	Gas infrastructure across EU borders	UK - Netherlands interconnector, Poland - Germany corridor
3	*National* corridors	Gas infrastructure within one EU member state	National network expansion/upgrading projects

This categorization is primarily based on prevailing jurisdiction behind investment and operational decision-making surrounding the gas infrastructure. The main goal of the Encouraged project is the identification and assessment of *International gas corridors* (Type 1 corridors). Hence, the focus here is on this type of infrastructure's investment conditions. The *European and national corridors* (Type 2 and 3 corridors) are analysed to the degree that investments in these types of infrastructures are dependent on the realisation of International gas corridors. This dependency works in both directions.

Illustrations of this dependency are the following projects. In Southern Europe, the GALSI pipeline between Algeria and Italy was developed. But in order to accommodate the gas flow caused by this new pipeline connection, investments in the national Italian transmission network were required. Turning the argument around: in order for the GALSI project to be successful (which implies the serving of end-consumers in Northern Italy and further north into Europe), the national upgrades were a necessity. This is a clear example of dependency investment projects in type 1 and type 3 corridors. Another example is the proposed LNG receiving terminal projects in the Netherlands on the Maasvlakte near Rotterdam. This project aims to supply gas to Dutch and German end-users. Therefore, capacity expansion of both the Dutch transmission network and Dutch - German border capacity is necessary. This is an example of a type 1 corridor project being dependent on both type 2 and type 3 corridor projects.

In Esnault *et al.* (2006) a different classification for gas corridors is chosen. They distinguish between (1) exporter promoted corridors, (2) importer promoted corridors, and (3) midstream promoted corridors. This classification is based on the business strategy of the gas market actors. Export promoted projects are developed in the context of a long term approach, with the objective of covering long term import requirements defined as the difference between domestic demand and production trends. Importers promoted projects are developed by incumbents to secure their supply and strengthen their market position. Finally, mid-stream promoted projects are developed on a "pure" market based approach, generally by small operators and new entrants. All three project types fall in the category of International corridors, and are all of merchant type. We however, also look into corridor projects inside the EU and the relationship between international corridor projects and EU internal corridors (Type 2 and 3).

As mentioned above, the focus in this report is on the realisation of type 1 corridors, International corridors from neighbouring regions towards the EU border. This implies that issues on EU and national corridors are only discussed when relevant for the realisation of international corridors.

Summary

In this Subsection we introduced a categorization of gas corridor investment projects. The focus of this project is on International corridors towards the EU border (Type 1 corridors). Gas infrastructure projects involving EU and national corridors (Type 2 and 3 respectively) are analysed to the degree relevant for the realisation of the International corridors. EU and national corridors can be further specified according to the regulatory regime applicable. Here we distinguish between corridors operated under a *regulated* and *merchant* regime.

This distinction is important with regard to the degree of risk associated with the gas corridor project, the instruments available for the mitigation or hedging of these risks, the relative profitability of the gas corridor project, and the government policy recommendations we draft on the successful realisation of new gas corridors.

2.2 Policy and regulation on gas corridors

2.2.1 Policy and network regulation in EU

Relevant principles for the operation and investments in gas transport are laid down in the Gas Directive (EC, 2003) and Regulation 1775 (EC, 2005) on access conditions to the gas transport network. This legislation states that gas transmission system operators are obliged to let third parties enter the network on a non-discriminatory basis against transparent and fair conditions, the so-called third party access (TPA) requirements.

The default regime applied to infrastructure investments and laid down in the Gas Directive (EC, 2003) is the *regulated regime*. Infrastructure projects under this regime are subjected to strict third-party access (TPA) and cost-based tariff regulation. This kind of infrastructure projects are generally developed by the owners of the national gas networks, the transmission system operators (TSOs). When it concerns a cross-border connection, two neighbouring regions jointly develop the project.

Within the Gas Directive, it was acknowledged that the regulated approach might not provide sufficient investment incentives in specific infrastructure projects. Therefore, the Directive allowed for the merchant regime in which, under specific conditions, a project can be exempted from TPA regulation. It was stated that market based regimes are exception rather than rule. Indeed the number of projects awarded an exemption are limited. Amongst the exempted projects are one pipeline connection (the pipeline between the Netherlands and the UK) and several LNG receiving terminals (for example the Brindisi and Isle of Grain LNG terminals).

The typology of corridor investments in Table 2.1 was based on jurisdictional differences. Investment conditions for the distinguished type of corridor projects differ as well. Following above discussion the corridor typology presented earlier needs to be extended to the *type of regulation* applicable to the corridor projects of type 2 and 3: regulated regime or merchant regime.

2.2.2 Policy and regulation in neighbouring regions

The degree of energy market reform and gas market liberalisation varies over neighbouring countries. For example, Norway’s energy policy is quite similar to EU Energy Directives (IEA, 2005) and EU candidate country Turkey is currently undergoing substantial energy sector reform, i.e. EU Energy Directives implementation (IEA, 2006b). The current state of energy policy and regulation in the Mediterranean countries (Algeria, Egypt, and Libya) is described in IEA (2006a).

In addition, bilateral agreements exist between the EU and neighbouring countries that address energy policy issues and often includes assistance. For example, in September 2005 an agreement was signed between the EU and Algeria that also involved energy sector co-operation (IEA, 2005).

The development of International gas corridors, are generally developed under conditions similar to the infrastructure investment projects undertaken in Europe *prior to liberalisation*. These types of projects are developed in close cooperation with the incumbents of neighbouring countries. These incumbents are often vertically integrated monopolists with large government backing. The rules under which International gas corridors are developed resemble the 'old European gas markets'.

For an extensive discussion on the international *political* conditions in Europe for gas corridor investments we refer to Luciani (2006). It presents an overview of international agreements relevant for gas corridor investments. The focus here is on economic and policy and regulatory aspects of gas corridor investments.

2.3 Actors involved in gas infrastructure investments

A number of gas market actors have a role in the realisation of gas corridor investments. These are: national transmission system operators (TSOs) (2.2.1), vertically integrated gas companies (2.2.2), gas traders (2.2.3), national governments and regulators (2.2.4), and gas consumers (2.2.5).

2.3.1 National TSOs

Network operators consist of incumbent TSOs or new merchant TSOs. Although unbundling of gas trading and gas transmission activities is required within the EU, a vertically integrated company with both activities still exists in neighbouring regions. The TSO is wholly owned by national or regional governments (e.g. Dutch TSO Gas Transport Services), is partly privatized (e.g. Belgian TSO Fluxys) or is completely private (e.g. UK TSO National Grid Company). European TSOs generally operate under tariff or revenue regulation. Under these types of regulation TSOs are incentivised to operate as efficient as possible. In that sense, profit maximisation is the goal, conditional on system security conditions or other public service obligations being met. A number of European TSOs still operate under cost-plus regulation. Efficiency incentives under this type of regulation is much weaker

2.3.2 Vertically integrated gas companies

We need to distinguish between public and private vertically integrated gas companies. However, the clear difference between both is sometimes hard to make. Direct and indirect political influence on the gas company's operational and investment decision-making can be substantial although the company might have a private character. Therefore, the profit motive might sometimes co-exist with social motives (e.g. national industry development, employment, 'cheap energy' etc.). Privately operated gas companies generally maximise profits. They might see strategies involving moves downstream or upstream as a way to capture more market value and increase profits (Esnault *et al.* 2006) discussing more extensively deals with the perspective of gas company's business strategies regarding infrastructure investments.

2.3.3 Gas traders

Energy traders are important actors in the price formation process on gas exchanges and the hedging of price risks. In arbitraging in time and geographically they increase the relevance and usefulness of price signals for possible gas infrastructure investments. Gas traders purely strive for profit maximisation.

2.3.4 National governments and regulators

European and national governments set the general framework in which investments are undertaken, amongst a property rights regime and investment conditions. As representatives of citizens they are assumed to aim for the maximum welfare of the nation. In achieving this goal, instruments are manifold and include industrial policy, environmental policy and competition policy. As mentioned earlier, this might involve direct participation in gas market activities through public shareholding or regulation. The regulator is responsible for the drafting of operational Codes that fall within the relevant national and international laws in the field. These codes need to be approved in parliament. Thereafter, the regulator has the task to monitor compliance.

2.3.5 Gas consumers

The role of the small-consumers in transmission investment issues is limited. Their primary role is to obtain sufficient gas to meet their needs against as low costs as possible. By 'expressing' their need for (additional) gas, they provide the first incentive for additional transmission capacity. The price elasticity of demand of small consumers is relatively low.

Large consumers in industry or the energy sector generally have higher price responsiveness. In addition, they are better able, due to economy of scale advantages, to bargain on natural gas deals. Therefore, prices for large consumers are more elastic and signal the potential need for additional supply and investment. Their aim to minimise energy costs is identical to that of small consumers, but whereas they have only limited instruments to meet this goal, large consumers have additional instruments such as vertical integration upstream and large-scale trading.

2.4 Summary

This Section provided a background for the analysis in the remainder of this document.

Gas corridors refer to the infrastructure needed to transport gas over long distances involving 'piped' gas or LNG. Investments in gas corridors encompass investment in all physical facilities needed to perform the transport function. In addition, gas corridor investment refers to either expansion of existing gas corridors or expansion of the network with new corridors (Greenfield investments).

We introduced a categorization of gas corridor investment projects. The focus of this project is on *International corridors towards the EU border* (Type 1 corridors). Gas infrastructure projects involving EU and national corridors (Type 2 and 3 respectively) are analysed to the degree relevant for the realisation of the International corridors. EU and national corridors can be further specified according regulatory regime applicable: we distinguish between corridors operated under a *regulated* and *merchant* regime. This distinction is important with regard to the degree of risk associated with the gas corridor project, the instruments available for the mitigation or hedging of these risks, the relative profitability of the gas corridor project, and the government policy recommendations we draft on the successful realisation of new gas corridors.

Regarding the institutional context of gas corridor project we need to distinguish between (i) the liberalised European gas markets where gas market activities are unbundled with separate transport companies dealing with gas corridor issues, and (ii) the vertically-integrated markets with large government-backed monopolists in the neighbouring regions. The latter causes gas corridors of type 1 to be largely developed according to 'old' gas industry rules.

Relevant gas market actors/investors briefly described were (1) national TSOs, (2) Vertically integrated gas companies, (3) gas traders, and (4) national instruments in influencing implementation of gas corridors.

In the next Section we turn to the barriers and risks that may be associated with gas corridor investment. In the analysis of barriers and risks we take into account the aspects mentioned in this introductory Section.

3. Investment conditions for gas corridors

This section discusses investment conditions for gas corridors. We distinguish between *investment barriers* (3.1) and *investment risks* (3.2).

3.1 Investment barriers

3.1.1 High capital costs of investment

The transport of gas is a business with high capital intensity. In addition, investments in gas infrastructure have economic lifetime surpassing 25 years. 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 illustration purposes, Table 3.1 presents a selection of gas infrastructure projects with associated capacity and (projected) investment costs (Esnault *et al.* 2006). Note that all projects mentioned in this table are International gas corridor projects (Type 1).

Table 3.1 *Overview of exemplary gas infrastructure projects including estimated investment costs*

Project	Description	Capacity [bcm/yr] [a]	Investment [M€] [a]
Greenstream	Gas pipeline from Libya to Italy	8	800
Nabucco	Gas pipeline from Turkey through Bulgaria, Romania and Hungary, to Austria	20-25	4600
NGEP	Pipeline connection between Russia, via Baltic sea (Finland) to Germany.	45	4000
Langeled	Pipeline connecting Norwegian oil field Ormen Lange with the UK-shore	22-24	1000
Zeebrugge terminal	Extension of existing LNG terminal	4.3	165
GALSI	Gas pipeline from Algeria to Italy	8-10	1200
Medgaz	Gas pipeline connecting Algeria and Spain	8-10	1300
Mugardos	LNG receiving terminal in Galicia, Spain	3.6	347
Brindisi	LNG receiving terminal in Italy	8	390

[a] Source: CEER (2005) and Esnault *et al.* (2006).

The level of gas infrastructure project costs is dependent on the type of project. The reason for this is the cost of project financing. In general, International gas corridors (type 1) and regulated EU and national corridors have a larger public actor involvement. In type 1 projects, governments might back the project with ‘cheap loans’ or otherwise. Investments in regulated corridors, undertaken by regulated TSOs generally have lower costs of financing than the market-based investments in merchant corridors. 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 ability to hedge through contractual or other arrangements. Again, this will depend on the type of corridor projects concerned. Therefore, we turn to the options to hedge gas corridor investment risk in Section 3.4. A combination of high costs of investment and limited availability of hedging instruments provide a *de facto* barrier to investment. This might specifically concern relatively small market actors and new-comers on the market.

3.1.2 Restrictions on investments

A potential barrier to infrastructure investment projects is legal restrictions on foreign direct investment (FDI) in certain countries. This substantially limits the potential investor candidates for a specific investment project. To a lesser degree, the same type of obstacle exists when foreign ownership of gas assets is limited with domestic actors being required partners. In fact any additional investment limitations potentially discourage investments. Although the transfer of capital is free within the EU, a considerable number of governments in neighbouring regions have imposed limitations of some kind on foreign investments. For example, Russia only rarely allows partial ownership of gas assets: it is only when relatively minor stakes are involved that FDI is allowed, and then only in partnerships with local partners.

For countries in the Middle East and in Northern Africa, it is usually the case that foreign companies are only allowed a role in gas infrastructure investment in collaboration with a national oil or gas company (so-called ‘local content’ rule). An example of this is the proposed gas pipeline between Algeria and Italy via Sardinia (the GALSI pipeline). A consortium of Sonatrach, Edison Gas, Enel, Wintershall and Eos Energia constructs this pipeline. More specifically, Algeria adopted a new hydrocarbon law in 2005 that enables increased foreign participation gas sector investments (IEA, 2005). FDI was already allowed through production-sharing agreements (PSAs) and participation contracts with national company Sonatrach. The same goes for FDI in Egypt where 20-year during PSAs are the rule. In addition, Egyptian investment law ensures equality of treatment and full profit transfer.

Although regulation on domestic company involvement in gas projects undertaken by foreign companies limits the ‘degrees of freedom’, it also has advantages. Through an ‘obliged’ joint venture, policy and regulatory risk may be decreased and market risk shared. In Section 4 we turn to strategies to hedge investment risks and deal more extensively with ‘organisational hedging’ though joint-ventures.

3.2 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 infrastructure link or there should be sufficient arbitrage potential within the lifetime of the investment (CEER 2004). The recovery of costs is different for regulated corridor investments and merchant investments. Under a regulated regime investment costs are recovered through (i) regulated cost-plus tariffs, (ii) regulated transmission tariffs (price cap regulation), or (iii) through regulated revenues from transmission activities (revenue cap regulation).

Different types of investment risks should be distinguished (Table 3.2). Market risk encompasses price and volume risk: adverse movements in gas prices and gas demand potentially causing insufficient remuneration of investment costs. Remuneration is also threatened by unexpected or unanticipated changes in governmental 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 3.2 *Overview of type of investment risks*

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 and cost overrun
Financial risk	Change in interest rate

The risks discussed below mainly address the categories of *market risk*, *regulatory risk* and *macro-economic risk.*

3.2.1 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 liberalised markets, structural demand for new gas supplies is signalled by wholesale price developments. Increasing gas commodity prices on the spot market or forward market indicate an increasing scarcity of the product. This theoretically triggers investments in new gas production and transmission facilities. However, this mechanism may fail due to price distortions and consequently give inefficient price signals for investment. Here we discuss three sources of price signal distortions: (1) captive markets (regulated prices), (2) market dominancy (highly concentrated markets) and (3) insufficient harmonisation of market and policy and regulatory design.

1. Regulated prices

Regulation of retail prices prevents the demand response mechanism. In other words, the retail price is not ‘allowed’ to function as a coordination mechanism between demand and supply. This implies that end-consumers are not able to signal their willingness to pay for additional gas supplied by retail companies, and, higher up the value chain, gas traders and producers. This gives rise to uncertainty to market actors higher in the value chain.

This has an impact on investors in all types of gas corridor projects, except for the type 3 corridor projects. The volume risk associated with International gas corridors (type 1) originates from both the origin country and destination country. Price regulation in the origin country gives uncertainty on the future availability of gas supplies for export, whereas price regulation gives uncertainty on the future need for gas imports in the destination country. An example of this risk is the regulated gas price in Russia and 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.

The same type of volume risk is applicable to *merchant* EU gas corridors. The fixing of gas retail prices prevents potential investors to properly assess the arbitrage and trade potential of a new pipeline connection. Examples of EU countries with (partly) captured markets are France and Finland. *Regulated* EU gas corridors are less subjected to this risk because regulation provides remuneration of investment costs.

2. Market power

A second source of inefficient price signals for investment is prices prevailing in non-competitive markets. Dominant market parties active on the gas wholesale market, possible former incumbents in the case of EU countries, might have ability to withhold capacity and as a result prices would be higher than under ‘normal’ competitive conditions. Again, this market imperfection prevents markets to reflect the market value of the commodity gas. Instead, the market dominance of one or a limited number of parties gives rise to so-called scarcity rents.

Note that this market imperfection can only be observed in wholly or partly liberalised gas markets. Hence, this phenomenon is mostly observed within the EU. The gas markets of neighbouring countries in Northern Africa and the Former Soviet Union are generally captive markets with vertically integrated monopolists controlling the complete value chain.

This implies that International gas corridors only exhibit this type of risk from the side of the *destination* country, namely a European member state with a potentially dominant market position. This risk is most prominent in EU gas corridor investments (type 2) where both captive markets and market dominance can be an issue on both sides of the border.

3. Insufficient harmonisation of market and policy and regulatory design
Differences in national policy and regulations can cause a price differential between two regions. The price differential can trigger gas corridor investment. However, since the price differential is not based on fundamental market characteristics the project is subjected to considerable risk. Convergence in market design or policy and regulatory design over time negatively affects the potential for arbitrage profits and hence the recovery of investment costs.

Examples of differences in market and regulatory design are: vertical integration of gas market activities, the type of unbundling implemented, price controls, attitude/interpretation towards TPA exemptions, and market rules on imbalancing, regulatory procedures and congestion management methods.

Within the EU strict implementation of the EU gas market directives by all member states brings harmonisation of policy and regulation closer. However, the speed of implementation and the degrees of freedom left in elements of the Directive potentially prevent sufficient harmonisation of member state policy and regulation from gas 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 translating the Directive into national legislation. 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 powers of the regulatory authority.

Regulated versus merchant gas corridors
Regarding type 2 gas corridors we need to distinguish the impact of mentioned risk through demand and supply uncertainties in regulated and merchant investments. The volume risk under regulated investment is passed through to end-consumers under current cost-plus and incentive regulation regimes. The investors in the regulated gas corridor investment are allowed a 'proper' return on investment over their regulated asset base (RAB). In the case of 'wasted' investments (investments of which the costs are not recouped within the projected economic lifetime of the investment project) are socialized into transmission tariffs and paid by all end-consumers.

Overview
Table 3.3 gives a rough indication of the (possible) distortion of price signals as trigger for investment. 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 gas corridor investments, and hence, assess investment profitability

Table 3.3 *Price distortions and market dominance in selected number of countries*

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

Source: EC (2005), IEA (2005), IEA (2006).

3.2.2 Distorted transmission capacity price signals

Not only distortions in gas wholesale prices (commodity prices) can give rise to improper price signals for investment. A lack of proper pricing of gas transmission capacity congestion prevents efficient price signalling for investment.

Theoretically, scarcity of existent transmission capacity on a pipeline connection should raise the price of capacity rights for this connection. When demand for capacity rights exceeds physical capacity, the pipeline is said to be congested. The price of capacity rights then includes marginal cost *plus* congestion rent. The height of the congestion rent signals the need for additional capacity and gas shippers' willingness to pay for expansion of capacity. The need for additional capacity could be met by either investment in current pipeline expansion or by investment in a new 'parallel', potentially competing pipeline. Transparent, non-discriminatory and market-based-allocation of capacity rights fulfils this signalling function for investment.[8]

In practice however, capacity rights allocation is not always transparent and not always market-based. Hence, it can be difficult for potential gas corridor investors to assess the market value of new gas corridors.

The allocation of capacity rights in International gas corridors (*type 1*) is generally, non transparent, discriminatory and non-market-based. The gas corridor investment itself is financially

[8] Market-based allocation methods include auctioning (McDaniel 2003) and nodal or zonal pricing.

based on long-term contracting with a small number of gas market parties with an informational advantage with regard to costs and valuation of capacity and capacity rights. On the one hand, this makes it inherently more difficult for ‘third parties’ to assess the market value of new parallel gas corridors, but on the other hand one has to acknowledge that the long-term contracting conditions in the first place have incentivised investors behind existent gas corridors in the first place. Here we touch upon a trade-off between the need to at least trigger investment in the first place (security of supply), and the impact of non-competitive and non-transparent conditions to trigger this investment on cost-efficiency of outcomes on the other hand (affordability). We turn back to this issue when discussing long-term contracts in the next Subsection.

The above line of reasoning can be illustrated by the example of the gas corridors from Russia to the EU border (Energy Charter Secretariat 2006). Capacity of these pipelines is allocated on the bases of long-term contracts against unknown prices. Capacity utilisation is not known. These gas corridors are not subjected to third party access. Moreover, conditions at which gas is transported through these pipelines is non transparent. In Russia, Gazprom, through subsidiaries, holds the exclusive right to export to neighbouring regions. Although it is currently impossible for foreign investors to undertake infrastructure investments in Russia, disclosure on the operating conditions might assist investors considering investments in competing infrastructures. An example is the corridor investments from the Caucasus and Caspian Sea region through Turkey towards EU borders. Turkey is envisaged to become a large transit country for gas from the Caspian basin, Africa and the Middle East. Currently, gas transmission and transit tariffs need approval by the Turkish regulator EMRA. How to deal with congestion in the national network has not been worked out so far (IEA, 2006).

Within the EU, only a small share of pipeline interconnection capacity (EU gas corridors, of *type 2*) is allocated through a market-based allocation mechanism. The dominant allocation methods used are cost-based instead of market-based and apply either a first-come first-served (fcfs) approach or pro-rata approach. Both approaches have in common that capacity is allocated on other criteria than willingness to pay, namely, first customer and total capacity bookings for fcfs and pro-rata respectively. The ability to trade capacity rights on the secondary market needs to be mentioned. Capacity rights acquired through aforementioned approaches can be re-sold on the secondary market. However, the secondary market might suffer from low liquidity (insufficient number of interested parties) and non-transparency. Again, the risk dealt with here mainly concerns the merchant interconnections and not the regulated interconnections. The risk for the latter is passed-through to end-consumers via gas transmission tariffs.

Market-based allocation methods can be applied to national gas corridors (*type 3*) as well, dependent on the transmission capacity pricing system (Brattle 2002). For example, an entry-exit pricing system where each injection and off-take point in the national gas network has differentiated prices is compatible with a market-based allocation method such as auctioning or nodal pricing.

Table 3.4 presents an overview of capacity allocation methods adopted in EU and some neighbouring countries.

Table 3.4 *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
Belgium	First-come, first served
Czech Republic	First-come, first served
Denmark	First-come, first served
Estonia	First-come, first served
France	First-come, first served, Capacity goes with customer
Germany	First-come, first served, Capacity goes with customer
Hungary	Auction
Ireland	First-come, first served
Italy	Pro rata
Latvia	n.a.
Lithuania	n.a.
Luxembourg	n.a.
Netherlands	First-come, first served
Poland	First-come, first served
Slovak Republic	First-come, first served
Slovenia	n.a.
Spain	First-come, first served
Sweden	First-come, first served
United Kingdom	Auction
Belarus	No TPA
Libya	No TPA
Morocco	No TPA
Russia	No TPA
Tunisia	No TPA
Turkey	First-come, first served
Ukraine	No TPA

Source: EC (2005), IEA (2005), IEA (2006).

Implementation of market-based allocation schemes such as auctioning is limited to the UK (Neuhoff and McDaniel 2004) 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 (McDaniel 2003, McDaniel and Neuhoff 2002, Newberry 2003). 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.

3.2.3 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 will be 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 neighbouring 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. realised gas demand determining gas price) or costs (e.g. gas production costs) negatively impact the investment decision. The economic theory studying the effect of uncertainty on investment behaviour is decision-making under uncertainty or real option theory (Dixit and Pindyck 1994). Applications to infrastructure investments include Saphores et al. (2004).

The importance of the above observations for recommendations on policy actions is the following. A reduction of important energy policy uncertainties (CO_2 policies, power 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 price-responsive, 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. The yearly gas supply outlook for the winter period in the UK, produced by regulator Ofgem, is a good example of such.

The relevance of above line of reasoning differs over the gas corridor types. The International gas corridors (*type 1*) generally exhibit lower volume risk because gas producers are directly involved in the projects. For example, Gazprom is developing the NEGP, Sonatrach developed the GALSI pipeline to Italy and Statoil developed the Langeled pipeline to the UK. The volume risk of EU gas corridors (*type 2*) is linked with both demand and supply uncertainty. On the demand-side there is the issue of the share of gas-fired electricity generation in total generation capacity that influences the future profitability of a new gas corridor. On the supply-side there is the issue of finding sufficient gas supply (either reserves or import) to transport through the gas corridor. The impact of this type of risk for EU-internal national gas corridors (*type 3*) is negligible. Again, this volume risk is not present under regulated investment due to directly cost pass-through to end-consumers

3.2.4 Insufficient coordination investment projects

Whereas the responsibility for infrastructure investments within and between EU regions was formerly (in pre-liberalisation era) by the public, vertically integrated gas supplier and network owner, the Gas Directive now allows both public and private investments in gas infrastructure. Centralised coordination by one actor is now replaced by a decentralised coordination by different actors. Outside the European borders, private investment will remain the rule. For the EU as a whole in order to optimally benefit from new gas corridors, investments ‘downstream’ of the corridor often other grid investments will be needed to enable consumers to benefit from increased supply. So a gas corridor investment might only be profitable if also coordinated with and upon agreement on the down-stream investments. Hence, coordination of gas corridor investments with investments downstream is highly required. This can also include coordination 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.*2006). 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 located inside the EU on distant from the EU borders. The earlier presented example of LNG terminal development in the Netherlands can be re-called in this respect. One specific planned LNG terminal 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 realised. In addition, gas corridor projects impact gas transport networks across borders. Both upgrade costs and benefits of new corridors may be incurred by neighbouring countries. Both the gas corridor investors as well as national regulators need to take these ´externalities´ into account. Only then will the added value of new gas corridors be maximised for society as a whole.

3.2.5 Policy and regulatory risk

Regulatory risk has two aspects that influence the investment decision-making process. First, there can be *uncertainty on the outcome* of an in advance known and possibly transparent regulatory procedure. Second, there is general risk of fear for unexpected *changes* in policy and regulation.

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 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 types of required studies are 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 analysis of improving investment conditions. Therefore, the focus here is on the TPA exemption procedure.

Focus on TPA exemptions

The issue of granting TPA exemptions is limited to gas infrastructure projects that are completely or partly located within EU territory. The issue of exemption granting is not a ‘yes or no’ decision only.

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 operator of the infrastructure. The criteria under which exemption is granted are listed below:

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 exemption being granted or not;

3. Legal separation from TSOs:
   The new infrastructure must be owned by a legal entity that is independent of the owners 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.

The first criterion 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 supply. 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 on 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. Therefore 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-subsidisation of merchant activities with regulated revenues. Criterion five builds further on the first criterion. 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 authorities, 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 judgement 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 complex decision-making process. *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 the investment decision-making process in general.

TPA regulation outside the EU

Outside the EU, TPA regulation is less common. While Turkey has implemented TPA regulation, other neighbouring countries have not. The majority of current gas corridors have rather non-transparent operating and access conditions. We already described elements of this feature in Subsection 3.2. Implementation of TPA regulation will be challenging for a number of neighbouring countries. Fore mostly because its governments have little stakes in implementation or lack the capability.

An example is provided by Russia. Currently there is a discussion on the desirability of TPA on Russian gas transmission lines from 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 these with Central Asia and the Caspian Sea regions.

Coordination between gas corridors and infrastructure regulation
Previously, we identified the risk of investment projects being insufficiently coordinated. There is also a regulatory component present in this problem: 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 designed to at least not discourage gas corridor investments? There is a co-dependency between the gas corridor investment and the regulated investment: realisation of one infrastructure project is crucially dependent upon the realisation 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 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.

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 types of regime changes can occur on an EU, international or national level. Reasons for sudden changes in legislation can be manifold, and may not be based on (economic) rationale. 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. An example is the Russian-Ukrainian gas crisis in January 2006 (Stern, 2006).

Country specific investment risk as a barrier for investment
Country risks relate to country specific developments in the business environment that influence the profitability of investments. Among possible developments with negative effect on the business climate are expropriation, currency inconvertibility, (changes in) tax regime, (changes in) FDI incentives, (changes in) investment laws, macro-economic management (inflation, currency depreciation etc.) and *force majeur* events (e.g. war, hurricanes, and floods).

Market reforms in the energy sector involving privatization of energy utilities, unbundling of market activities, introduction of competition and abolishment of price controls will generally be beneficial for the ability of country's to attract capital from the world market. General good economic management regarding exchange rate, inflation and interest rate will have a positive impact on credit rating developments.

3.2.6 Transit risk
A majority of gas flows pass trough more than one other country than the country of destination. For this transit of gas, countries can impose a transit charge or fee. The actual transit fee for the right to transit gas through a country varies and is highly dependent upon bargaining between suppliers and transit countries. 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 before building the connection.

In practice, this does seem to have occurred in the case of Russian gas transits through Ukraine. But actually, this ‘bargaining’ situation is even more complex due to the fact that Ukraine is almost fully dependent on Russia upon gas supplies. Transit fees in North-African countries vary between 6 and 9% of gas throughput (Energy Charter Treaty 2006). In addition, consider the following 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% (Luciani 2006).

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, the ‘transit only’ pipelines are rarely observed. A special case seems to be the Algerian gas transit through Tunisia to Italy (EMG). The reason of this is political as well as economic. If transit countries themselves have considerable gas consumption, the political pressure to tap into any new pipeline investments running through the country is high, even in the case where existing supply contracts are sufficient in covering gas demand for some time to come. The goal of diversifying gas supply obviously adds to this pressure. In addition, a transit pipeline is an economic opportunity for national transmission companies to expand operations.

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 on 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.

3.3 Summary and conclusions

In this Section we discussed the risks and barriers associated with gas corridor investments, and their relevancy for distinguished type of corridors.

We argued that *market distortions* on the gas wholesale market give rise to volume risk. Regulation of gas wholesale prices and market dominance in the gas wholesale market prevent the market from providing efficient price signals for investment in gas corridors. This type of risk is primarily associated with International and EU gas corridor investments (type 1 and 2 corridors). Moreover, it mainly concerns the merchant gas corridors as the risks for regulated gas corridors are socialised and not generally incurred by the investor.

In practice, the *design of gas transport capacity allocation* gives rise to insufficient and inefficient price signals for infrastructure investment. International (type 1) and the majority of EU gas corridors (type 2) lack proper price signals for investment. This gives rise to price and volume risks for merchant gas corridors, both International and EU.

Uncertainty of demand and supply developments cause volume risks for investors in International and EU gas corridors that do not fall under a regulated regime.
An important characteristic of the gas market is the interdependency between the consecutive elements in the gas market value chain. This includes the connection between gas corridors towards the EU and internal EU corridors.

Based on the discussion of investment risks, we observe that the International gas corridors (type 1) are the most costly and most risk prone corridor investments. Despite improvements in market design investors behind these projects should have sufficient risk mitigation instruments available when considering investments. In the next section we will assess the available risk mitigation strategies and discuss their impact on the gas corridor investment decision. Without proper risk mitigation, insufficient gas corridor investment will be undertaken.

Inside the EU, the need for risk mitigation instruments seems a less dominant issue. However, removal of distortions in market design and implementation of market-based allocation methods can enhance the value of price signals for investment. By increasingly reflecting market value for building additional gas corridor capacity, the risk for private investors not to recover investment costs (in merchant projects), and the risk of public investors to 'waste' public money can be reduced in our opinion.

4. Investment risk mitigation instruments for gas corridors

In the previous Section we identified and elaborated on various types of investment risk and noted that gas corridor investments do not materialise when the investment risk for the investor is too high. To counter investment risks, investors need to have risk mitigation instruments or strategies available. In this section we assess the risk mitigation strategies available to gas corridor investors.

We discuss *four* risk mitigation strategies:

- hedging of investor's risks through financial markets (*financial hedging*) (4.1),
- hedging of risks through long-term contracting (*contractual hedging*) (4.2),
- hedging of risks through vertical integration (*organisational hedging*) (4.3),
- hedging through diversification (4.4).

4.1 Financial hedging

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

We observed that trading on gas exchanges within Europe and in its neighbouring 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 4.1 presents figures on observed liquidity for the largest European gas exchanges. In the neighbouring regions of the EU, gas markets are generally not liberalised and thus have no gas exchanges.

Table 4.1 *Liquidity on major European gas exchanges*

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

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.

Conclusion and implications

Given the small number of gas exchanges in the EU and the low liquidity on these exchanges we need to conclude that presently financial hedging is not a viable option in the hedging of investment risks. This concerns both the International gas corridors (type 1) as well as the EU and national gas corridors under the merchant approach (type 2B)[9]. However, the potential of this hedging instrument for the near future for both gas corridor types differs. While we might see a further hub development in the EU, for example as a result of decreasing hub dominance by incumbents (EC, 2006) and increase in LNG supplies (IEA, 2004), gas hub development in the EUs neighbouring countries is not likely. This implies that investors in merchant EU gas corridors might see opportunities to financially hedge their investment risk in the future. Although hub development in destination countries could partly provide investors in gas corridors towards the EU a partial hedge, they should to a higher degree reside to other risk mitigation strategies. Crucial for further hub development are (i) the development of competition on the wholesale and retail market and (ii) an increased participation of former gas trade incumbents on gas exchanges. There is a role for EU competition policy here. But also, stimulation of LNG investments and LNG trade on a spot market basis could further boost gas hub development in the EU.

4.2 Contractual hedging

For illustrative purposes we first discuss the role of long-term contracts in the pre-liberalisation era. Thereafter, in discussing the situation in a liberalising European gas market we need to make the distinction between the use of long-term contracts inside and outside the EU (i.e. related to gas corridor investments to the EU border).

Long-term contracting before liberalisation

Long-term contracting of both commodity and transmission capacity was one of the main features of the pre-liberalisation era. With liberalisation came the pressure for higher efficiency levels across the gas value chain and the drive for more competition. From this perspective, long-term contracts were an obstacle for the development of competitive pressure: gas commodity 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 investment 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 time 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.

'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 liberalisation 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. *Open season* procedures are an important concept in this respect. 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 interest and commit to future capacity rights. This enables the project initiator to reap the benefits of economies of

[9] Note that we concluded in the previous Subsection that *regulated* gas corridor investments are less prone to investment risk. The risk associated with these investments is more prominently related with regulatory risk, which is the focus of Section 4.

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.

Today long-term contracts between gas suppliers and gas traders have changed with regard to certain key 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).

Long-term contracts and gas corridor investments

Within the EU long-term contracting to back infrastructure investments is only allowed in an exceptional case: the case of *merchant gas corridors*.

In these types of investments, *open season procedures* seem to have large potential in combining on the one hand competition in the pre-investment period and security of investment remuneration after the investment. Although it is true that new entrants are not able to directly obtain capacity contracted out to others, there is a chance of any new entrant to be involved in the project from the open season period onwards. On the other hand, investors in *regulated investments*, for example the national TSOs, are allowed to contract out capacity forward to a maximum of 5 years.

In addition, *use-it-or-lose-it (uioli) conditions* apply, although enforcement of these conditions can pose problems. The problem here is hoarding of capacity (e.g. contracting capacity without using it). The costs of contracting more capacity than strictly necessary does not outweigh the benefits obtained through the non-availability of this ‘extra capacity’ to competitors. Costs of transmission capacity rights are relatively small compared to overall gas wholesale prices. This is a problem that has to be addressed in the context of increasing effective gas market competition.

Investments outside the EU (type 1) generally rely on long-term contracts and will remain to do so in the near future. Also here, open season procedures could be a welcome element in the process towards transparency of the gas corridor investment decision. However, the EU lacks the jurisdiction to enforce this feature in EU external contracts while producers’ countries interests in this issue are different. Implementing open seasons would hurt their position as ‘rent extractors’. The same line of reasoning applies to the idea of re-selling capacity to third parties on a secondary market.

Conclusions and implications

In liberalised gas markets, there is still a strong need for long-term contracts for capacity rights. The nature of long-term contracts has changed since the start of liberalisation: contracts have become shorter, more flexible and contain more different pricing and renegotiation clauses. Notwithstanding the positive impact of long-term contracts on the risk position of the investor, it seems sensible to incorporate open season procedures in the preliminary phase of gas infrastructure investments and more actively facilitate a secondary market for capacity rights. Both options enhance competitive pressure while not hindering the risk hedging impact on the investor. Implementing and developing these instruments is feasible for merchant EU and national gas corridors, but the potential for International gas corridors (type 1) is fairly limited.

4.3 Organisational hedging

We discuss two types of organisational hedging: vertical integration and horizontal integration / cooperation (joint ventures etc.).

4.3.1 Vertical integration

Organisational hedging may be described as internalising investment and operational risks by 'moving' up- or downward in the value chain. The economic motivation for organisational hedging is the high transaction cost of covering the aforementioned risks in the market compared with the costs of covering these internal to the firm[10].

The options for gas market actors *within the EU* to hedge market and investment risks through vertical integration have been limited since unbundling was required in the first Gas Directive. Here we are talking about organisational hedging between trading and transmission (and distribution activities).

The gas market actors *outside the EU* can still undertake organisational hedging, between *producing*, transmission (outside the EU) and trading activities.

Vertical integration within EU

In the pre-liberalisation era commodity trading and accompanying infrastructure requirements were coordinated within a vertically integrated incumbent. In other words, vertical integration reduced exposure to investment risks and as such had positive effects on gas corridor investments.

By no means, however, are we suggesting a return to a vertical integrated industry structure, because vertical integration of especially trading and transmission activities can seriously damage competition on wholesale and retail markets. Reason for Gas Directives to strive for unbundling of operations was the opportunity for strategic behaviour and the potential barriers created by 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 activities.

European gas corridor investors, and more specifically merchant operators, could reduce investment risks through participation in gas corridors upstream.

Table 4.2 shows the degree of unbundling of gas trading and gas transmission activities in EU member states.

[10] The focus here is on organisational hedging involving gas infrastructure. Examples such as a downstream gas trading company acquiring upstream gas producing assets to hedge investment and operational risk are not considered here.

Table 4.2 *Unbundling of transmission and trading in selected number of EU and non-EU countries*

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

Source: EC (2005), IEA (2002), IEA (2005), IEA (2006).

Vertical integration and International gas corridors

The majority of non-EU countries have not reformed their gas markets. Hence, unbundling of gas transmission and trading activities is not an issue. In fact, their industry structure resembles the European pre-liberalisation era with vertically-integrated monopolists.

Investors in gas corridors operating outside the EU (*type 1*) are still able to hedge investment risk by acquiring downstream assets (gas trading companies, gas-based electricity generators etc). The current moves of Gazprom towards Western European gas market companies could also be seen in this light.

4.3.2 Horizontal integration

Horizontal integration refers to cooperation between to gas market actors operating on the same level in the value chain. A common form of horizontal integration in energy markets is a joint-venture agreement, or consortium agreements. Horizontal integration does not reduce overall investment risk of a gas corridor project but investment risks are shared amongst the cooperating partners. Horizontal integration is widely applied in gas corridor projects and remains an important risk-sharing instrument in the future.

Conclusion
Risk mitigation through classical vertical integration is hardly an option for investors in *merchant* EU gas corridors since a strict legal unbundling policy is implemented by the European Commission. Legal unbundling still allows for a partial hedge, but does not resemble the impact of vertical integration as was common in the pre-liberalisation period. Moreover, several EU member states have gone further by implementing ownership unbundling.

On the one hand, in the past 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 incumbent companies to behave opportunistically at the expense of new competitors, implying that a more flexible stand towards vertical integration might come at the expense of gas market efficiency and, hence, higher end-user prices. This is exactly the argument for unbundling of gas trading and transport activities.

Allowing non-EU companies to move downstream in the European gas market therefore can have two different effects. On the one hand, by controlling the majority of the gas market value chain, these companies can acquire a larger share of the rents and this might have negative welfare effects for the EU. On the other hand, the *risk mitigation hedge* reduces investment risks, and therefore stimulates the International gas corridor development.

Organisational hedging through creating consortia or joint-ventures in order to develop gas corridors is a successful and widely applied *risk sharing* mechanism.

4.4 Hedging through diversification

The fourth principal risk mitigation strategy is diversification of risks. This strategy is different in nature than the previous three instruments. First, diversification can only mitigate so-called project specific market risk and not systemic risk. Second, the availability of this strategy is dependent on the internal characteristics of the firm that implements it. For example, larger firms can more easily diversify their risk than small firms (e.g. new entrants).

An illustrative example of diversification of investment risks associated with gas corridor projects is the strategy deployed by Gazprom. Instead of depending on one large gas corridor to the EU for its gas exports, several 'parallel' pipelines have been realised and might be realised in the near future (the NEGP project).

An example internal to the EU is the participation of Fluxys in the new EU gas interconnection between the UK and Netherlands. Since, Fluxys also operates the Belgian transmission network that gives access to the first UK - continental European pipeline connection; it diversifies investment risks associated with the national transmission network with participation in the second UK - continental European connection.

4.5 Conclusions on options for hedging

In the pre-liberalisation period, contractual hedging and organisational hedging were important risk mitigation strategies. The liberalisation 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 not 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 liberalised markets, but the current EU gas market is not sufficiently developed yet. Market concentration and lack of market liquidity remain important issues to tackle and resolve.

The importance and nature of long-term contracts used to backup International gas corridor investments might decrease or change when the potential for other hedging instruments increases. Two possible developments could realise such a shift. On the one hand, further development of gas hubs could see an increase in the potential for *financial hedging*. This holds for both EU internal merchant gas corridors and, albeit to a lesser degree, for International gas corridors (type 1). On the other hand, the ongoing market developments regarding EU external gas producers acquiring downstream assets (for example gas traders) seem to increase the value of *organisational hedging as an instrument*.

Currently, *financial hedging* of investment risks in not considered an option due to a too limited number of gas hubs and their relative lack of liquidity. However, in the future this instrument can become more important from risk mitigation perspective. *Contractual hedging* is only an option for EU external gas corridors (type 1) and the exempted EU gas corridors (merchant corridors). *Organisational hedging trough vertical integration* could as far as allowed be a useful strategy for International gas corridors (type 1). Investors in EU and national corridors however can hardly enter into such an organisational hedge. This is only in case where legal unbundling between transmission and trading activities is required instead of full ownership unbundling. Special cases are *merchant* gas corridor projects where the merchant is in fact a legally separated entity of the TSOs the corridor aims to connect.[11] This participation reduces the volume risk of the merchant project. Organisational hedging through horizontal integration is an effective risk-sharing instrument. This instrument is widely applied in gas corridor investments in the form of joint-ventures or consortia. This will remain to be an important instrument in the future. Applying a *diversification* strategy potentially reduces risks irrespective of the type of gas corridor. However, characteristics internal to the firm can limit the availability of this type of hedge (e.g. firm size).

[11] This is for example the case for the Netherlands - UK interconnection (BBL) where the Dutch TSO GasTransportServices (GTS) is one of the merchant investors through a legally separated entity (De Joode 2006).

5. Summary, conclusions and policy recommendations for gas corridors

5.1 Summary and conclusions

Introduction

This part of the report addressed the conditions under which gas corridor investments are implemented. The gas market actors willing to invest in gas corridor expansion need to deal with barriers and risks associated with the investment. What are the type of barriers and risks they face, and what are their strategies in dealing with them? The *first* aim of this report was to identify the barriers and risks and analyse whether policy or regulatory actions can remove the barriers and reduce or mitigate the risks. The *second* aim of this report was to assess the ability of gas corridor investors to deal with this risk and analyse whether policy or regulatory actions can increase the 'inventory' of risk mitigation instruments at the disposal of investors. By removing barriers and decreasing risk of gas corridor investment projects on the one hand, and stimulating opportunities to deal with risk on the other, the investment conditions for gas corridor investment can be improved. The barriers and risks assessed in this report have an economic background; for a discussion on (geo-) political barriers and risks of gas corridor investments we refer to a report by Luciani (2006).

Gas corridors

Gas corridors refer to the infrastructure needed to transport gas over long distances involving 'piped' gas or LNG. Investments in gas corridors encompass investment in all physical facilities needed to perform the transport function. In addition, gas corridor investment refers to either expansion of existing gas corridors or expansion of the network with new corridors (Greenfield investments).

We introduced a categorization of gas corridor investment projects. We distinguish between international gas corridors towards the EU (Type 1 corridors), gas corridors between EU member states (Type 2 corridors), and national gas corridors within an EU member state (Type 3 corridors). The focus of this project is on *International corridors towards the EU border* (Type 1 corridors) but the other gas corridor types are important to include in the analysis since different gas corridor type projects are *co-dependent*. Hence gas infrastructure projects involving EU and national corridors (Type 2 and 3 respectively) are analysed to the degree relevant for the realisation of the international corridors. EU and national corridors can be further specified according regulatory regime applicable: we distinguish between corridors operated under a *regulated* and *merchant* regime. This distinction is important with regard to the degree of risk associated with the gas corridor project, the instruments available for the mitigation or hedging of these risks, the relative profitability of the gas corridor project, and the government policy recommendations we draft on the successful realisation of new gas corridors.

Policy and regulation

Regarding the institutional context of gas corridor project we need to distinguish between (1) the liberalised European gas markets where gas market activities are unbundled with separate transport companies dealing with gas corridor issues, and (2) the vertically-integrated markets with large government-backed monopolists in the neighbouring regions. The latter causes type 1 gas corridors to be largely developed according to 'old' gas industry rules.

The default regime under which gas corridors within the EU are developed is the regulated regime where an independent TSO is responsible for gas network operations and where transmission tariffs are regulated through either cost-plus or incentive-based regulation. Only in exceptional cases are gas interconnectors or LNG terminals developed under a merchant regime.

Investment barriers
Potential barriers for gas corridor development are (1) high costs of initial investment, and (2) restrictions on foreign investment. Firstly, the high initial costs and the asset-specificity character of gas corridors investments poses large investment risks. Without proper mitigation instruments to hedge this risk, the high investment costs up front can become a barrier. This goes for all types of gas corridors but mostly for international gas corridors *towards the EU***.**

Secondly, neighbouring countries through which the gas corridors are developed can pose restrictions on foreign investments, for example by requiring joint operations with local companies. This is not necessarily a disadvantage since it enables risk sharing. In addition, cooperation with local companies might reduce the policy and regulatory risk associated with the project since adverse and unanticipated changes in either policy or regulation now impact local actors and communities as well.

Market and policy & regulatory risk
The risks associated with gas corridor investments are either market or policy & regulatory risk. The relevance of these barriers and risks varies with the *type of gas corridor*.

Market risk in general refers to the risk of not being able to recover the cost of investment during the economic lifetime of the gas corridor. Gas corridors developed under a regulated regime are less exposed to market risk since regulation effectively passes-through the investment costs to end-consumers. ‘Merchant’ gas corridors have a much larger exposure to market risk.

In either regime, regulated or merchant, the risk of ‘wasted’ public or private money can be reduced by improving the reliability of the investment signal provided in liberalised gas markets. Improving the price signal for investment decision on commodity and capacity markets can be achieved by enhancing competitive market elements and introducing market/based mechanisms, but this does not completely remove market risk. However, it can substantially assist gas corridor investors in their assessment of the structural need for, the market value of, additional gas corridor capacity. Potential for improvement of the price signal for investment stems from: (i) regulated gas markets or (partly) captive markets, (ii) market concentration in liberalised gas markets, (iii) insufficient harmonisation of market design (differences with respect to degree of unbundling, market rules, regulatory codes etc.), (iv) non-transparency in price formation and capacity availability, and (v) non-market based gas corridor capacity allocation mechanisms.

In addition coordination between different gas corridor investments on either national, regional or supra regional level can increase the value of investment projects to both the investor and society. Gas corridors have a large regional impact and development of certain projects highly influence the viability of other proposed projects. An important dependency here is between international gas corridor investments and national network investments.

Policy and regulatory risk relates to the uncertainty in current government policy and regulation and to uncertain future developments in policy and regulation. Policy and regulation directly impact the ability of investors to recover gas corridor investment. Differences in national energy policy and regulation influences the price differential between two countries and hence the trading and arbitraging profits accruing to the investor. Concerning policy and regulatory risk in countries neighbouring the EU there can be large uncertainty with respect to the degree and speed of further economic development, energy policy reforms and political considerations.

Risk mitigation instruments
Market risk and more specifically *price and volume risk* can, theoretically, be mitigated or reduced via three differing strategies: (1) financial hedging, (2) contractual hedging, (3) organisa-

tional hedging, and (4) diversification. The availability of hedging strategies is especially important for merchant based projects, including gas corridors between EU and non-EU countries.

Currently, *financial hedging* of investment risks in not considered an option due to a too limited number of gas hubs and their relative lack of liquidity. However, in the future this instrument can become more important from risk mitigation perspective. But this will require more developed gas exchanges. *Contractual hedging* is only an option for EU external gas corridors (type 1) and the exempted EU gas corridors (merchant corridors). *Organisational hedging* trough *vertical integration* is, far as allowed, a useful strategy for the hedging of the investment risks associated with International gas corridors (type 1). Investors in EU and national corridors however can hardly enter into such an organisational hedge due to unbundling requirements. Since the arguments for unbundling are still highly valid we conclude that vertical integration is not considered a hedging instrument within the EU. Special cases within the EU are merchant gas corridor projects where the merchant investor is in fact a legally separated entity of the TSOs the corridor aims to connect.[12] This participation reduces the volume risk of the merchant project. *Organisational hedging* through *horizontal integration* is an effective risk-sharing instrument. This instrument is widely applied in gas corridor investments in the form of joint-ventures or consortia. This will remain to be an important instrument in the future. Applying a *diversification* strategy potentially reduces risks irrespective of the type of gas corridor. However, characteristics internal to the firm can limit the availability of this type of hedge (e.g. firm size).

Final conclusion
We conclude that there are considerable opportunities for policy-makers and regulators alike to improve upon the investment conditions for investors in interconnections between EU and non-EU countries. Removing wholesale market distortions (e.g. market concentration, market captivity etc.) if present and implementing market-based mechanisms where appropriate can assist gas corridor investors through enhanced information signals for investment. This counts for both intra-EU gas corridors as well as gas corridors between the EU and neighbouring countries. In addition, increasing coordination could enhance the value of both regulated and merchant gas corridor projects. Market risks are mainly associated with merchant gas corridors can best be mitigated through long-term contracting (in case of merchant projects) or entering joint-ventures (both merchant and regulated projects). In order to minimise the negative impact of long-term contracting on wholesale market competition full attention should be given to inserting competitive elements in these long-term arrangements.

Below we derive specific government policy and regulatory actions.

5.2 Policy recommendations

The implementation of gas corridors within the EU or between the EU and neighbouring countries, either regulated or merchant, can be facilitated by policy makers and regulators through: (1) removing or decreasing market and policy & regulatory risk, and (2) improving the options for investors to mitigate or remove market risk. This might be achieved as follows.

Decreasing market risk
Market risk, i.e. the risk of non-recovery of investment costs due to adverse price or volume developments can be reduced by removing anti-competitive elements in current gas markets and by implementing market-based allocation mechanisms where appropriate. Both type of actions can enhance market transparency and increase the value of prices (both for commodity and capacity) as signals for gas corridor investments. This does not remove all uncertainty on investment recovery but can facilitate the investment decision-making process. It positively affects

[12] This is for example the case for the Netherlands - UK interconnection (BBL) where the Dutch TSO GasTransportServices (GTS) is one of the merchant investors through a legally separated entity (De Joode 2006).

investment decision-making for investors in both regulated and merchant gas corridor projects. In the former case it can prevent wasteful investment spending of public money. In the latter case it can prevent the loss of private money.
Some of the specific actions are already stated as European policy. In that case, the importance of this action is again stressed and asks for completion and/or overall implementation in the EU of Directives, guidelines etc such as on:

1. *Liberalising gas prices* for *all* end-consumers;
2. *Countering market concentration* on wholesale and retail markets;
3. *Harmonisation* of regulatory codes and market rules;
4. *Transparency* of price formation and gas corridor capacity allocation processes, through (further) development of gas exchanges (spot and forward markets).

Developments in gas transmission markets (e.g. among each other competing gas corridors, national network upgrades) can significantly affect the recovery of investment costs and hence the viability of a proposed gas corridor project, whether merchant or regulated.

5. In order to invest efficiently and effectively in gas corridors an *increasing coordination* across borders on interconnection investment projects is recommended.

More precisely coordination should involve national regulators and transmission system operators. To the degree that coordination is already present; an analysis on the added value of institutionalisation in terms of authority, responsibilities of the coordination processes is recommended. More centralised coordination on supra national level will increase the public value of gas corridor investments and furthermore create a more stable investment climate in Europe. For a start, coordination can be arranged on regional level.

Minimising policy & regulatory risk

An adagio that is already well-known and needs to be repeated here is that the governments' most important tasks is to provide a stable and transparent policy and regulatory framework with appropriate degree of commitment. Short-term unanticipated changes in energy policy or energy regulation are detrimental to investors' confidence to make a proper return on proposed and undertaken investments stretching over a much longer period.

6. National governments should envisage the importance of *long-term policy and regulatory commitments*, for example by communicating and committing to a *clear vision* on the future energy system.

Options for risk mitigation

The most appropriate strategies for the hedging of market risks are contractual hedging (long-term contracts) and organisational hedging through vertical integration. In addition, financial hedging could gain in importance as a risk mitigation strategy.

Long-term contracts are appropriate for especially the gas corridors toward the EU (merchant projects) and, in exceptional cases, for gas corridor development within the EU between neighbouring countries. But when allowing investors to hedge risks through long-term contracts, the impact on competition in the European and national gas markets needs to be carefully assessed. With competitive energy markets being one of the main goals of the EU, every type of long-term contracts need to be analysed on its restrictive impact on competition in every segment of the gas value chain, crossing borders. A social cost-benefit analysis could assist regulators and investors in this respect.

7. In Article 22 conditions on TPA exemptions for gas corridors an explicit role should be given to *social cost-benefit analysis*, with specific focus on objectives security of supply and competition.

Introduction of competitive elements in the different stages of entering and operating under a long-term contract is recommended. An example of such a concept is the 'open season' procedure for merchant gas corridor projects.

8. 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.

Organisational hedging *through vertical integration* is only practiced by non-EU based gas market actors involved in gas corridor investment projects between EU and non-EU member states. Unbundling of gas trading and network activities prevents the use of the vertical integration strategy within the EU. The main argument for implementation of unbundling, its potential negative effect on wholesale market competition, is still highly valid. Hence, a return to 'bundled' gas firms is not recommended by us.

Organisational hedging through *horizontal cooperation* is a valid strategy for all types of gas corridors: merchant or regulated, inter-EU or international.

The value of financial hedging instruments in covering investment risks associated with gas corridor investments is currently limited. This can be enhanced through stimulation and facilitation of gas hub developments.

9. Facilitate and stimulate gas hub development.

Role of TSO in merchant projects

A specific issue that needs to be addressed is the participation of TSOs in merchant gas corridor projects. Whether it concerns a gas corridor between neighbouring EU countries or a gas corridor between the EU and one of the neighbouring countries, there is the risk of conflicting interests. When a TSO owns and operates both the national transport network and a merchant corridor connected to this network and owned by the same TSO through a legally unbundled business unit, the TSO might have reasons to behave strategically in operational and investment decisions. In this case, legal unbundling might not be sufficient in guaranteeing fair market outcomes. In the regulatory assessment of merchant projects, this danger should be acknowledged and investigated.

10. Regulators should be aware of the danger of conflicting interests when TSO take a share in merchant gas corridors. When the risk of such occurring is high, exemption of default regulation should not be given.

Part B: Investments in electricity corridors

6. Electricity corridor characterisation

This Section provides background to the analysis in consecutive Sections. We define the concept of electricity corridors (6.1), describe current policy and regulation regarding electricity corridors (6.2), and discuss the relevant actors in the realisation of electricity corridors (6.3).

6.1 Electricity infrastructures and corridors

Electricity market value chain

The electricity value chain can be separated into different activities. Figure 6.1 presents the basic value chain of the electricity market and highlights the activities related to electricity transmission. The focus in this part of the report is on the infrastructure needed to perform this activity.

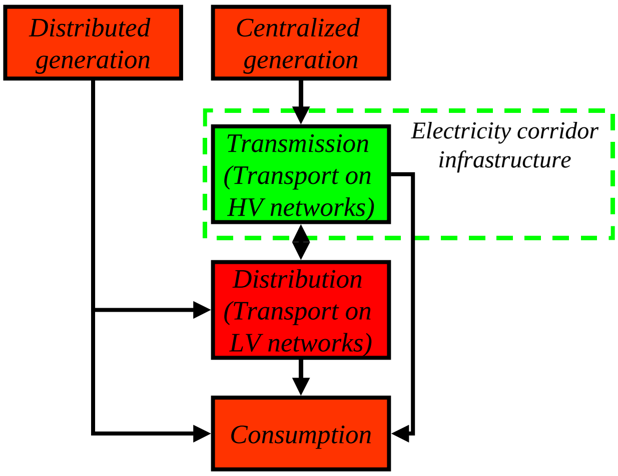

Figure 6.1 *Schematic representation of electricity market value chain*

The transport of electricity occurs on two different levels, the *transmission* level and the *distribution* level. Transmission infrastructure is used for the long-distance transport while distribution infrastructure transports electricity over shorter distances within a region. The transport of electricity through a transmission network occurs under *high voltage* levels (EHV, 110 kV or higher) whereas transport of electricity through a distribution network occurs under low voltage levels. The exact voltage levels for the performance of these activities may vary from country to country.

Electricity corridor categorisation

Historically, regional separated low voltage distribution networks have gradually evolved to national interconnected low voltage networks with higher voltage connections, and much later into international networks with high voltage transmission interconnections across borders.[13] When referring to electricity corridors we refer both national and international *transmission* infrastructure. In the analysis of investment conditions for electricity corridor investment we use the following categorisation (Table 2.1).

[13] For a description of this process we refer to Van Werven en Van Oostvoorn (2006).

Table 6.1 *Categorisation of electricity corridors*

Type	Name	Description	Example
1	*International* corridors	Electricity transmission infrastructure *between an EU member state and neighbouring country*.	(i)Netherlands-Norway interconnection (NorNed), (ii) Morocco - Spain interconnection
2	*EU* corridors	Electricity transmission infrastructure between *EU member states*	(i) UK-Netherlands interconnection (BritNed), (ii) Estonia-Finland interconnection (Estlink)
3	*National* corridors	Electricity transmission infrastructure *within a EU member state*	National infrastructure expansion/upgrading projects

In international transmission infrastructures we distinguish between (i) infrastructures between the EU and a neighbouring region, and (ii) infrastructures between EU member states. The reason for this distinction is the difference in jurisdiction regarding the infrastructure.[14] In the remainder of this part of the report we keep a close eye on this categorisation when discussing investment conditions and policy recommendations. Different type of electricity corridors might require different economic conditions and require different policy and regulation.

Technical dimension of electricity corridors

Interconnections between two separated electricity networks may make use of an alternating current (AC) or direct current (DC). AC connections can only interconnect *synchronous electricity systems*, that is, electricity systems with identical frequency and phase. DC connections can also be used to connect *non-synchronous electricity systems*. In discussing electricity corridors and conditions for electricity corridor investment the distinction between these two types of systems is highly relevant. Firstly, because (under sea) DC connections are much *more expensive*, and secondly, because the electricity flow through a DC link is *controllable* (and electricity through an AC link is not).

6.2 Policy and regulation on electricity corridors

6.2.1 Policy and regulation in the EU

The general EU approach towards energy markets is based on price liberalisation and reliance on market mechanisms, and is laid down in the 2003 Electricity Directive (EC, 2003). National or EU electricity corridor investments can be undertaken under two different regimes: a *regulated regime* or a *merchant regime*.

The default regime on electricity infrastructures, both transmission and distribution networks, is the *regulated regime***.** In order to prevent infrastructure owners from charging monopoly prices, the prices on infrastructural services are regulated. In addition, to prevent conflicting interests of electricity market actors, transmission and distribution operators are not allowed to own electricity generation facilities nor perform electricity-trading activities. Instead, network operators are required to offer capacity to third parties (third party access regulation). TPA allows new entrants on the generation and trading market to enter. The pricing of services provided by electricity infrastructures can be either market-based or cost-based. Cost-based pricing methods include rate-of-return regulation and incentive regulation, while market-based methods involve some form of auctioning of electricity transmission capacity.

[14] See Subsection 2.3 on the policy and regulatory background of the different types of infrastructure.

The *merchant regime* is considered to be exceptional and was only introduced after concerns of underinvestment in electricity infrastructure that followed the first electricity Directive in 1996 (EC, 1996). The main discussion was on the impact of strict TPA and pricing regulation on investment incentives. To provide an additional stimulus for infrastructure investment, this separated merchant regime was installed. This regime allows new infrastructure investment projects to operate without TPA and pricing regulation, given that a number of conditions on the impact of the investment project on market functioning and security of supply, are met.

6.2.2 Policy and regulation in neighbouring countries

The European approach towards organisation of energy markets, which is based on price liberalisation and reliance on market mechanisms, is generally different from the approach of the majority of neighbouring countries. Instead, most of the neighbouring countries adopt an administrative approach were energy prices for end-consumers are set by the administrator, often at artificially low levels.

The EU developed several initiatives to promote the EU approach of competitive prices, unbundling etc in neighbouring regions. Amongst these are: (i) the Innogate program, (ii) the European Neighbourhood policy (ENP), and (iii) the Energy Community Treaty.

The generally diverging approaches in EU and neighbouring countries can cause a number of barriers and risk for investment in corridors itself. This will be pointed out in the remainder of the report on several occasions.

6.3 Actors involved in electricity corridor investments

A number of electricity market actors have an important role in the realisation of electricity corridor investments. These are: national governments and regulators (6.3.1), national transmission system operators (TSOs) (6.3.2), vertically integrated electricity companies (6.3.3), and electricity traders (6.2.4). We will discuss their role and interests in electricity corridor development.

6.3.1 National governments and regulators

European and national governments set the general framework in which investments are undertaken. As representatives of citizens (consumers and producers of electricity alike) they are assumed to aim maximisation of welfare for society (a theoretical concept). In achieving this goal instruments from several policy fields are available. The most important policy fields for our analysis are competition and energy.

The key objectives of EU governments in energy market developments and more particular electricity transmission are threefold: (1) affordability, (2) security and reliability of supply, and (3) sustainability. With the development of electricity corridors the first two are of most concern. Developing electricity corridors affects the electricity market on both accounts. Larger and more electricity corridor capacity on the one hand increases the potential for competition on wholesale market, and consequently raise efficiency, and on the other hand can make the electricity system more reliable.

Governments can take different approaches in serving public interests. With respect to electricity transmission, the principle approach in the EU is to assign a, dominantly government owned, TSO the task of network reliability while enforcing efficiency in performance of this task through regulation of tariffs of revenues. In neighbouring regions investment-decision making lies more direct with government or governmental institutions.

In the European approach, a regulator has the task to monitor compliance with electricity legislation by TSOs. The regulator has a very direct role in assessing new electricity corridor projects on their eligibility for 'merchant' investment under Article 7 of the Electricity Directive. In this assessment and in taking the final decision, public interests of security of supply and affordability (through competition) play an important role.

It is important to note that the specific EU member state countries' interest is not necessarily aligned with the overall European interests. The impact of new electricity corridor investments with respect to cost, benefit and risk allocation can vary from country to country.

6.3.2 National TSOs

National TSOs are the owners and operators of the electricity infrastructure within EU member states. The main task of TSOs is to *maintain network reliability* at all times and undertake any investments required to guarantee future network reliability. The main task of this actor is vital for the functioning of the electricity system as a whole. Since the public interest in the performance of this task is very high, TSOs are in majority *publicly* owned through government shareholding. TSOs are also appointed to optimise on cross-border electricity flows, i.e. remove congestion at the national borders. When developing cross border electricity corridors (e.g. EU and international electricity corridors), the investment is generally undertaken by a joint venture of neighbouring TSOs. Hence, *TSOs are important actors in national, EU and international electricity corridors*. The interest of TSOs is not limited to the maintaining of reliability. Since they are subjected to regulation, there is also an interest in designing an *affordable electricity infrastructure*, i.e. increase efficiency of infrastructure operations.

The incentives to strive for system efficiency depend on the type of regulation to which the TSO is subjected. EU member states have a certain degree of freedom to choose for different regulatory regimes[15]. The type of regulation influences the investment decision-making by TSOs. Here it is important to note that a TSO has no internal incentive to remove bottlenecks on cross-border electricity corridors.

6.3.3 Vertically integrated electricity companies

In the pre-liberalisation era, electricity market activities were all integrated in one company. In Europe, the liberalisation process implied separation of these activities of these companies, but in neighbouring countries vertically integrated national companies are the dominant feature. The interests of a vertically integrated electricity company covering generation, transmission, distribution and trading activities differ with the degree and type of public involvement TSOs have. When public involvement is as high and direct as for example in Northern African companies, other motives than profit maximisation may play a larger role in operational and investment decisions.

An integrated company striving for profit maximisation can benefit from the fact that decisions on investment in the one activity affect profits from the other. For example, low investments in electricity corridor capacity limits competition on the electricity commodity market and hence increase company profits.

Since political motives seem to be important in electricity sector decision-making in neighbouring countries, the development of electricity corridors between the EU and neighbouring countries cannot be analysed without taking into account political motivations as well.

[15] The three basic regulatory regimes are (i) cost-plus regulation, (ii) revenue cap regulation, and (iii) price cap regulation.

6.3.4 Energy traders

Energy traders are important actors in the determination of price formation on electricity exchanges and the hedging of price risks. In arbitraging in time and space they increase the reliability of price as a signal for possible new grid interconnections. These are interested in fair and transparent design of policy and regulation and market rules.

6.4 Summary

This Section provided a background for the analysis in the remainder of this part of the report.

We defined three different electricity corridors according to geographic scope: (1) international electricity corridors (corridors between EU countries and neighbouring countries), (2) EU electricity corridors (corridors between EU member states), and (3) national electricity corridors (corridors within an EU country). Corridors refer to high voltage transmission infrastructure designed for long-distance transportation of electricity.

Electricity corridors have an important technical dimension: the long-distance transportation of electricity may be at *alternating current (AC)* or *direct current* (DC). In contrast to AC transmission equipment, DC transmission equipment is more *costly*. In addition, electricity flow of DC transmission connections is more *controllable* than AC transmission connections. These differences have implications for the conditions for electricity corridor implementation. These are addressed in the section on market barriers and risks (Chapter 7).

Policy and regulation with respect to electricity corridor investments differs between the EU and neighbouring countries. Whereas the EU adopts a 'free market' approach, the majority of neighbouring countries take a more administrative approach with larger role for public institutions in electricity market decision-making. The latter do not rely on market-based mechanisms for electricity market operations.

The dominant regime for electricity corridor investment is a regulated regime in which a transmission system operator is responsible for system operations, and where transmission tariffs are regulated. Under exceptional circumstances, electricity corridor investments are undertaken under a non-regulated regime, i.e. merchant.

Electricity market actors briefly described are (1) national governments & regulators, (2) TSOs, (3) Vertically integrated electricity companies, and (4) energy traders. Each has different interests in electricity corridor development and has different mechanisms in influencing implementation of electricity corridors.

In the next Section we turn to the barriers and risks that are generally associated with electricity corridor investment. In the analysis of barriers and risks we take into account all the aspects mentioned in this introductory Section.

7. Investment conditions for electricity corridors

This section discusses investment conditions for electricity corridors. We distinguish between *investment barriers* (7.1) and *investment risks* (7.2).

7.1 Investment barriers

7.1.1 High capital costs of investment

Electricity transmission is a capital-intensive business with long investment lead times.[16] Total costs of investment encompass costs of fixed assets, permits, feasibility studies, rights-of-way, ground and preparatory work, the pylons and conductors and other equipment and their assembly, engineering and labour and finance costs (ICF 2002) while the realisation time for new transmission capacity is 10 years or longer (KEMA 2004). For illustration of the amount of investment costs involved in interconnecting electricity transmission systems we refer to Table 7.1 and Table 7.2.

Table 7.1 *Costs for constructing transmission lines over flat land*

	[k€/km]
Single 380kV overhead line	251
Double 380kV overhead line	402
Single 220 kV overhead line	168
Double 220 kV overhead line	269
400 kV underground cable	2,008

Source: ICF (2002)

Table 7.2 *Investment costs for limited number of electricity transmission interconnection projects*

Project	Description	Capacity [MW]	Investment [M€]
NorNed	Undersea *HV/DC* cable between the Netherlands and Norway	700	600
Estlink	Undersea *HV/DC* cable between Estonia and Finland	350	110
Italy-Greece Link	Undersea *HV/DC* cable between Italy and Greece	500	137.5
SwePol Link	Undersea *HV/DC* cable between Sweden and Poland	600	300
North Sea Interconnector	Undersea *HV/DC* cable between United Kingdom and Norway	1200	1000
San Fiorano - Robbia	Double *AC* circuit line connecting Italy and Switzerland (400 kV) over land	3120	60
Melloussa - Puerto de la Cruz	Undersea *AC* cable connecting Morocco and Spain	700	115

Source: De Jong and Knops (2006), Knops and De Jong (2005) and Vailatti *et al.* (2006).

These sums of investment costs entail substantial financial risks. In the absence of sufficient options for mitigating these risks, the high level of investment costs might hinder infrastructure development, because market-based lenders will be cautious in providing project financing.

[16] This section is partly is based on a report ECN-C-06-006, by Van Werven and Van Oostvoorn (2006).

7.1.2 Financing electricity corridors

Funds acquired for electricity infrastructure project are from different sources. Firm equity (internal financing) generally provides the largest share of investment within the EU, with the remainder originating from debt (external) financing of either public or private actors. Among the external financers are public institutions such as the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD) and the European Union on the one hand, and private investment banks on the other.

The EU supports electricity infrastructure through a number of channels: (i) the TEN-E program, (ii) the European Regional Development Fund (ERDF), (iii) external policy programmes (Phare, Tacis, Meda and Synergy), and (iv) European Investment Fund (EIF) loan guarantees. The EIB can provide debt financing up to 50% of the total investment costs. Cesi et al. (2005), in a research commissioned by the European Commission concluded that about 39% of electricity infrastructure financing is provided by equity and about 37% by commercial bank loans (Figure 7.1). The role of EIB financing apart from contributions to feasibility studies seems to be limited. A public list on energy sector investment support of the EIB shows that the majority of support is given to smaller-scale energy sector projects.

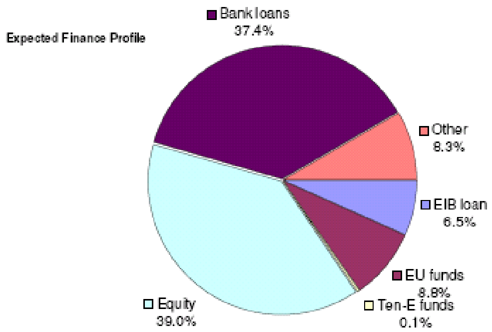

Figure 7.1 *Expected finance profile of future electricity infrastructure investments*
Source: Cesi et al., 2005.

EU-support through the aforementioned channels is focussed on preliminary technical and feasibility studies. Table 7.3 gives a brief sample of electricity corridor support.

Table 7.3 *Overview of electricity corridor projects that have received financial support from the EU*

Corridor	Description	Year	Investment support [€]
Italy - Slovenia	Interconnection 400 kV Okroglo (Slo) - Udine (It): Strengthening the interconnection on the Italian North - eastern border, between Italy and Slovenia, and increasing of the transmission capacity of Italian - Slovenian corridor.	2005	467,630
Fyrom - Serbia and Albania-Montenegro	Study for new 400 kV interconnection lines between Fyrom - Serbia and Albania - Montenegro	2002	290,000
Spain - Morocco	Reinforcement of the Spain Morocco Submarine Electrical Interconnection across the Straight of Gibraltar. Feasibility studies: (Network studies, marine survey, basic engineering studies, environmental Impact Assessment)	2001	1,127,000
Greece - Turkey	Electricity interconnection Greece - Turkey. Evaluation and feasibility study (Phase 1) Technical and environmental study (Phase 2).	1999-2000	545,000
Greece - Bulgaria	New electricity interconnection Greece-Bulgaria. Preparatory, economical and technical feasibility and environmental impact studies.	1996	450,000

Source: EC 2006b.

There is a difference between the way that EU member states and non-member states financially support electricity corridors. Especially in the Middle Eastern and Northern African countries, governments tend to co-finance large energy sector investments (IEA, 2005). In addition, electricity investment projects in Northern Africa may receive financial support from the African Development Bank (ADB) or World Bank (WB).

On the whole, financial support schemes for electricity corridor investment should be a stimulus for further electricity corridor investments. This is confirmed for example the TEN-E funds in its 2004 evaluation (EC, 2004). But, as acknowledged in the same study, the existence of these facilities can also cause additional procedural delays. An increase in available funds with the various supporting institutions could stimulate further corridor development, but cautiousness is warranted since it is economically proven that too much public financing of private projects could crowd-out public investment. In other words, public money is sometimes invested in projects that would have gone ahead in any case.

An important source for future electricity corridor investments in the EU are the funds acquired through auctioning of transmission capacity on cross-border connections. Currently, the majority of interconnector capacity within the EU is allocated through auctioning. When electricity connections are congested, auctioning provides the owners of the interconnection (generally TSOs) congestion revenues.

However, congestion revenue funds cannot be freely re-invested in the electricity network by TSOs. They are required to use congestion revenues only for investment into projects aimed at relieving congestion. In a number of EU countries we observe still expanding congestion revenue funds without new investment projects being proposed. The reason for this seems to be that a large share of revenues is acquired from interconnections that are not structurally congested. Consequently, a business case for expansion of the interconnector proves non-viable. What to do with these funds? Should TSOs be allowed to invest elsewhere in the network or should the funds be redistributed to the users of the system? This is an issue that is not yet dealt with in research.

7.2 Investment risks

In general, investments are hampered by uncertainty with respect to the ability to recover investments. In order to recover investment costs, there should be a fundamental demand for the transmission link or there should be sufficient arbitrage opportunities (CEER 2004). The recovery of costs is different for regulated corridor investments and merchant investments. Under a regulated regime investment costs are recovered through (i) regulated cost-plus tariffs, (ii) regulated transmission tariffs (price cap regulation), or (iii) through regulated revenues from transmission activities (revenue cap regulation).

Different types of investment risks should be distinguished (Table 7.4). Market risk encompasses price and volume risk: adverse movements in electricity price differences and electricity demand may decrease the recovery of investment costs. Recovery of investment costs can also be decreased by existing uncertainty 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 counterparty default.

Table 7.4 *Overview of type of investment risks*

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 and cost overrun
Financial risk	Change in interest rate

The risks discussed below mainly address the categories of *market risk*, *regulatory risk* and *macro-economic risk.*

7.2.1 Inherent electricity market characteristics

The market for electricity in general and for transmission of electricity in particular exhibits certain characteristics that cause a fundamental uncertainty in the recovery of investments, and hence a market risk. These characteristics are: (a) physical laws of Kirchhoff and Ohm, (b) lumpy investment and high asset specificity (c) the substitutability of transmission with generation.

(a) A fundamental uncertainty in the demand for the interconnector investment projects concerns the degree of *loop flows*. Loop flows result from the fact that electricity flows through electricity networks according to the physical laws of Kirchhoff and Ohm, which results in physical flows deviating from the contracted flows. However, *this only applies to AC electricity corridors*: the electricity flow on DC links is controllable. The amount and direction of loop flows is hard to predict. This phenomenon can even result a reduction of net transmission capacity after capacity expansion.

(b) Electricity transmission is *capital intensive*, exhibiting a high share of fixed costs.[17] This implies a large scope for economies of scale: when investing one would rather invest in a large 'chunk' of cable at once and not incrementally over some period. In addition, electricity networks have *high asset specificity*: once constructed, electricity infrastructure cannot be transferred in an economic way. These two product characteristics mean investment risk is high and therefore lead *risk averse* investors to generally wait with electricity network investments for a certain time, even though market price differentials might already justify the investment. By delaying the investment decision for some time, additional information can be required regarding the structural price differential between the markets.[18] In general, DC links are much costlier than AC links, which implies that the problem as described here is more persistent with DC links. With respect to the type of electricity corridors suffering from this problem, there is a distinction in international corridors between non-synchronous and synchronous electricity systems. Electricity corridors between non-synchronous systems are operating on a DC, making them more prone to the risk caused by the described characteristic.

(c) The fact that in some cases, *electricity generation and electricity transmission can be substitutes* means that (expected) electricity generation developments are very important in investment decision making on electricity corridors. A price differential between regions could be relieved by building (or increasing) interconnector capacity between the regions or by investing in additional electricity generation units in the region with the highest electricity price. This means that potential investors need to closely observe developments in electricity generation investments in both markets, much as mothballing or upgrading of existing units or the building of new units.

Policy implications

The negative impact of these electricity market characteristics on electricity corridor investment is substantial, but options for reducing it are limited. Sophisticated network models can simulate the electricity supply system and provide insights into the impact of new electricity corridor investment upon electricity flows but the real impact will be hard to predict due to the dynamic behaviour of the electricity market. It should be noted that the problem of economic underperformance of a new electricity corridor as a result of unanticipated electricity flows is more severe in areas with meshed electricity networks. Electricity networks at the rim of the EU are generally less meshed than for example the Western-European electricity network. The negative impact of investment characteristics of electricity transmission (lumpiness and asset specificity) cannot be removed. Regarding the third characteristic of substitutability, a case for closer coordination in regional electricity markets and between neighbouring regions should be made. This will increase the chances for investment projects that maximise the region's private and public welfare.

7.2.2 Distorted commodity price signals

Electricity corridor projects, in order to be profitable, need a stable revenue stream that is based on *structural demand* for (additional). In liberalised markets, structural demand for new corridor investment is signalled by wholesale market price developments. Increasing electricity prices on the spot or forward market indicate. This theoretically triggers investments in electricity corridors. However, this mechanism may fail due to price distortions and consequently give inefficient price signals for investment. Here we discuss three possible sources of price signal distor-

[17] This is a different issue than the high capital costs of investments presented in the previous Subsection. Here we refer to a high capital intensity of investments as opposed to other inputs, whereas the previous Subsection focuses on the high *absolute* capital costs.

[18] Martzoukos and Teplitz-Sembitzky (1992) show the impact of demand uncertainty for transmission capacity within a real-options framework. They find that in the face of demand uncertainty, it is more efficient to invest in distributed generation units then transmission assets, acknowledging its substitution possibilities.

tions: (i) captive markets (regulated prices), (ii) market power (highly concentrated markets) and (iii) insufficient harmonisation of market and policy and regulatory design.

1. Regulated prices

Regulation of retail prices prevents the demand response mechanism. In other words, the retail price is not ‘allowed’ to function as a coordination mechanism between demand and supply. This implies that end-consumers are not able to signal their willingness to pay, which prevents electricity corridor investors from assessing the need of additional electricity corridor capacity based on *market value*.

2. Market power

Secondly, inefficient price signals for investment can result from non-competitive markets wholesale markets. Electricity companies dominating the power exchange might have ability to set prices higher than would prevail under ‘normal’ competitive conditions. Again, this market imperfection prevents markets to reflect the market value of electricity, and the resulting market value for gas corridor expansion. Instead, the market dominance of one or a limited number of parties gives rise to so-called scarcity rents.

Note that this market imperfection can only be observed in wholly or partly liberalised electricity markets. Therefore, this problem is only relevant for electricity corridor projects involving countries outside the EU (international electricity corridors).

3. Insufficient harmonisation of market and policy and regulatory design

Differences in national policy and regulations can cause a price differential between two regions. The price differential can trigger electricity corridor investment. However, since the price differential is not based on fundamental market characteristics the project is subjected to considerable risk. Convergence in market design or policy and regulatory design over time negatively affects the potential for arbitrage profits and hence the recovery of investment costs.

Examples of differences in market and regulatory design are: vertical integration of electricity market activities, the type of unbundling implemented, price controls, attitude/interpretation towards TPA exemptions, market rules on imbalancing, regulatory procedures and congestion management methods.

Within the EU strict implementation of the EU Electricity directive by all member states brings harmonisation of policy and regulation closer. However, the speed of implementation and the degrees of freedom left in elements of the Directive potentially prevent sufficient harmonisation 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 (EC, 2005) confirms the differences in implementation speed and the different choices made in translating the Directive into national legislation. 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 powers of the regulatory authority.

Overview

Table 7.5 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 non market-value reflecting electricity prices, but reasonably shows the potential. We observe that a majority of countries potentially suffers from price distortions either through uncompleted market opening, price regulation or market dominance. This inherently makes it more difficult for electricity corridor investors to assess the real demand for new investments.

Table 7.5 *Potential existence of electricity price distortions in selected number of countries*

Country	Price distortion through price regulation	Market dominance (share of 3 largest electricity producers) [%]
Austria	No	54
Belgium	Yes (only for households)	95
Denmark	Yes	40
Finland	Yes (only for households)	40
France	Yes (for all small users)	96
Germany	Yes (ex ante approval)	72
Greece	Yes	97
Italy	Yes	65
Netherlands	No	69
Spain	Yes	69
Sweden	No	40
UK	No	39
Estonia	Yes	95
Latvia	Yes	95
Lithuania	Yes	92
Poland	Yes	45
Czech Republic	Yes (only for households)	76
Slovakia	Yes (only for households)	86
Hungary	Yes	66
Slovenia	Yes (only for households)	87
Belarus	n.a.	n.a.
Ukraine	n.a.	n.a.
Turkey	Yes (for all small users)	85
Algeria	No	100
Morocco	No	n.a.
Egypt	No	100

Source: EC (2005), IEA (2006), IEA (2005).

A considerable number of EU and neighbouring countries *do not have a market-based pricing mechanism* installed for either electricity commodity trading or transmission capacity allocation. Within the EU, the Western-European power exchanges are the most developed. The absence of power exchanges is most eminent in neighbouring countries in Eastern Europe and the Mediterranean region. For neighbouring countries in the Mediterranean region, it seems that electricity prices are not cost-reflective (IEA, 2005). The IEA estimates that for example Egypt, Libya and Algeria's residential electricity prices are below the long-run marginal cost of supply.[19] This signals the problem of average domestic prices being insufficient signals for transmission investment. In addition, large vertically integrated companies that own generation, transmission and distribution assets characterise the energy markets in these countries.[20] Knops et al. (2001) provides an overview of the alternatives.

The significance of this distortion for investment in energy corridors however is limited. In general, a lack of transparent and reflective pricing signals will discourage merchant based investment, but investment under a strict regulatory framework as agreed upon neighbouring countries at the EU's borders has different drivers. The primary driver of the latter type of investment is integration and security of supply (Van Werven and Van Oostvoorn 2006).

[19] Potential reason for this phenomenon is the relative cheap fuel input prices for electricity generation.

[20] However, some countries have showed a move to more liberalised energy market. For example, Algeria adopted a new energy law in 2002 that contains industry restructuring through unbundling of electricity market functions.

7.2.3 Distorted transmission capacity signals

Explicit market-based valuation of current transmission capacity on electricity interconnections is beneficial for the determination of the investment risk of new investment projects.

Market-based pricing of electricity transmission can assist potential interconnector investors in determining the market potential for additional investment. When current interconnection or corridor capacity is not commercially available, market value derivation by third parties is difficult, thereby increase the risk of new investments. When interconnector capacity is commercially available, the method used to allocate transmission capacity determines the efficiency of the investment signal. The main allocation methods currently used within the EU is explicit or implicit auctioning (ETSO 2006). This theoretically provides market actors the market value of additional capacity and hence, an efficient price signal for investment.
However capacity allocation on interconnections outside EU jurisdiction generally uses non-market based allocation methods. The main feature of non-market-based allocation methods is that they allocate capacity rights on other basis than economic valuation. In other words, capacity rights will not generally be obtained by the parties that put the highest value upon them (willingness to pay). This hinders new interconnector investments since the economic value of these connections is difficult to derive.

7.2.4 Uncertain demand and supply uncertainties

The value of interconnector investment in the long-run is co-determined by the differential in portfolio generation costs and demand patterns between the two to be connected countries. Uncertainties in future generation asset portfolio or electricity demand translate into economic risks of the proposed interconnector investment risk. For examples of countries with technology specific generation portfolios we refer to Van Werven and Van Oostvoorn (2006). Uncertainty regarding the future development of generation portfolio's relevant for electricity corridors are the penetration of nuclear generation capacity in a number of EU countries and former Eastern European countries, the development cost of renewable energy sources such as photo-voltaic (PV) technology and penetration in African countries' generation portfolio and the extend to which either gas or gas-fired electricity is exported from neighbouring region's is exported to the EU. The latter is an uncertain development on the demand-side and can be related to optimal design of the electricity supply system as a whole: should we import gas to produce electricity domestically, or should we import electricity directly. This depends on a large number of factors such as environmental regulation, transmission distances, electricity transmission technologies and the differential costs of transmission losses for electricity and gas in these countries.

7.2.5 Insufficient coordination of electricity corridor investment

Coordination of electricity transmission infrastructure investments is an important issue in two respects. First, the operation and profitability of any new infrastructure transmission project is dependent on the two infrastructures it connects. Secondly, co-ordination is needed between two types of infrastructure investments: the regulated and merchant projects.

First we address the coordination between infrastructure investments. *In a liberalised European electricity market where responsibility of optimal network operations and investments is fractured over so many different actors, the coordination of one another's 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. This is also caused by the inherent electricity characteristics described earlier. These can cause unanticipated network effects. 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.

A good example of regional planning of electricity infrastructure investment is the Nordic market. Nordel, the regional body for cooperation between the TSOs of Norway, Sweden, Denmark, Finland, and Iceland develops investment plans for the Nordic region. This involves a coordinated plan in which bottlenecks in the system are assessed. In addition, the costs and benefits of separate investment projects that could relieve the identified points of congestion are assessed on a regional and country-by-country basis. The final step in the coordinated investment approach is a political challenge since investment projects will create some winners and losers, even though the region as a whole might benefit from the project. This requires independence and impartiality of the involved TSOs and the public bodies backing them (IEA, 2005).

The coordination process regarding investments in cross border interconnections on a European-wide scale is not well developed. Although the UCTE does assess the European electricity network on its adequacy to meet demand and conduct feasibility studies concerning the transmission grid, it does not coordinate the investment projects identified in studies. Instead, it aims to provide TSOs with an overview of current network status, investment projects underway; in other words: improves transparency on network developments. However, coordination of system wide optimal investment transmission grid projects is yet a bridge too far. Although, more informal dialogues between neighbouring TSOs on regional electricity network investments do occur presently, it is still difficult to assess whether the generally agreed investment projects are indeed optimal from regional and European perspective too. A possible recommendation could be the institutionalisation of a on European or regional EU level operating body that has both the capacity to assess and identify optimal electricity investment projects and the powers to implement these investment projects. This requires delegation of responsibilities and authority, but nevertheless seems to be the only way to implement optimal decision and implementation process of electricity transmission country connection investments without the potential threat of political (e.g. national) decision-making blurring the picture and delaying the investment project. However, there would still be the problem of how to deal with the existence of mixed participation of both public and private actors in investments. This was the second point to be raised in this Subsection.

In the current liberalised European electricity market, both TSOs and private actors are allowed to invest in electricity infrastructure. Moreover, even TSOs are allowed to participate in private investment projects. This raises the question: under which conditions will TSOs or private actors take the initiative for a new infrastructure investment project? In addition it is questionable whether it is desirable to allow TSOs to operate private interconnector projects since a conflict of interest may arise (IEA, 2005b, De Jong and Knops 2006). TSOs seeing their revenues from the national network regulated could take operational and investment decisions regarding the national network in such a way that would maximise unregulated revenues from the private interconnector investment (e.g. shift congestion towards the border). However, TSOs are the natural candidates for interconnector investments. The main reason for allowing unregulated investments was the perceived problem of underinvestment in electricity infrastructures. The difference in regulatory perspective between regulated and unregulated interconnectors is the degree in which public goals such as reliability and affordability are served.[21] If indeed a conflict of interest is a real threat, a possible solution could be the separation of Transmission Owner (TO) and System Operator (SO). A TSO can be seen as a vertical integration of TO and SO. This type of electricity transmission market design is applied in regional markets in the US, as well as in the UK (IEA, 2005b). Separation of ownership and operations would remove the incentive for strategic behaviour. Furthermore, it would shed a completely different light on the

[21] De Jong *et al.* (2006) deal with the regulatory procedures involved in interconnector regulation and more specifically address the impact of interconnector on social benefits as compared to private benefits.

discussion of public and private transmission owners and system operators. The applicability of this option to the EU case should be further researched.

Conclusion
The importance of above issue is particularly relevant for the implementation of electricity corridors towards the EU. Regional coordination on corridor investments enhances the likelihood of new investment projects to maximally contribute to internal EU electricity market operations and overall consumer welfare. However, there remains the political challenge for reaching agreements on the allocation of costs, benefits and risks of certain electricity corridor investments over countries involved. The creation and institutionalisation of a regional and/or European body that has the authorities' power to guide interconnection investments deemed optimal for the EU as a whole is recommended.

The issue of private or public transmission owners ultimately taking up the investment project remains. In which cases should a corridor investment be regulated and in which cases unregulated? It seems undesirable to give regulatory exemption to projects that would better serve public interests when operated under a regulatory regime. In addition, the question on the potential conflict of interest that arises when TSOs 'go merchant' is not yet solved. A potential solution worth more in-depth investigation is the separation of transmission network ownership and system operations as is practice in the US and the UK.

Keeping in mind the scope of this report, we need to realise that the separation of different infrastructure related activities is hardly a subject in a large number of neighbouring countries. Vertical integration of the complete electricity market value chain is rather rule than exception. Moreover, government influence on electricity market developments, including investments in interconnections, is still very high. In fact, the market design concerning electricity transmission investments in these countries is much more similar to the hierarchical system mentioned earlier on: there is strict centralisation of investment decision-making. Therefore, investment projects connecting the EU and neighbouring regions will very much have a public or/and public private partnership character.

7.2.6 Uncertainty outcome of policy and regulation

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 and regulation of electricity transmission tariffs. The procedures relevant for regional planning and environmental aspects (such as an Environmental Impact Assessment Study) are very important for the time planning of electricity corridor investment projects (construction and operational risk), but seem to have less importance for the economics behind the project. Moreover, the costs of these types of required studies are 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 Electricity 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 electricity 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 in-

volved for the consumer and operator of the infrastructure. The criteria under which exemption is granted are listed below: It might be a useful additional information that these criteria are, according to Article 7 (1) applicable to Direct Current interconnection and shall apply (according to Paragraph 7.2) in exceptional cases to Alternating Current interconnectors.

1. Improved electricity market operations:
   The investment must enhance both competition in electricity supply and security of supply.
2. High investment risk:
   The investment risk associated with the project is such that go-ahead depends on the exemption being granted or not.
3. Legal separation from TSOs:
   The new infrastructure must be owned by a legal entity that is independent of the owners 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. No financing from already received TSO/DSO charges
   Exemptions are not given to existing interconnectors.
6. Functioning of the market:
   The exemption has no adverse effects on competition or effective functioning of the internal EU electricity market or the regulated systems to which the new infrastructure connects.

The first criterion 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 must also be contributed to, which however, seems difficult not being fulfilled by a proposed infrastructure project. The second criterion is related to the competitiveness and size of the project: relatively small infrastructure projects of which the investors might recover investment costs through regulated transmission tariffs without significantly impacting 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-subsidisation of merchant activities with regulated revenues is prevented. The criterion five rules out the possibility of granting exemptions to existing infrastructure. The sixth criterion builds further on criterion one. It aims at a transparent, non-discriminatory and market-based operation of the new infrastructure. De Jong and Knops (2006) developed a conceptual framework on which a decision on granting of TPA can be based (Figure 7.2).

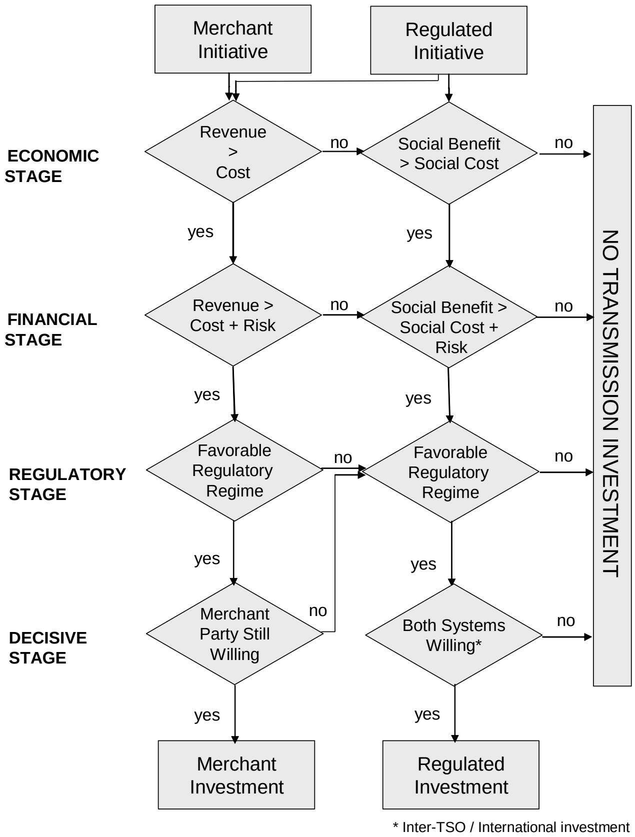

Figure 7.2 *Conceptual representation of the decision-making on electricity transmission investments*
Source: De Jong and Knops 2006.

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 judgement 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. Up until now, no instrument is developed that could assist in this complex decision-making process. *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.

Another potential source for uncertainty on profitability of electricity infrastructure investments in the case where an exemption for a certain period was granted is the regulatory regime that is going to be applied after the exemption period ends. In general the impact of this type of uncertainty on the initial investment decision may be limited since merchant (unregulated) projects will generally aim to recover the incurrent investment costs within the period for which exemption was granted. So far, only one electricity interconnector was granted an exemption (Estlink connecting Finland and Estonia). However, in due time, when the end of the exemption period is in sight the uncertainty on the applicable regulatory regime thereafter could impact decision-making on upgrade investments.

7.2.7 Tariff regulation

The degree and type of uncertainty in transmission tariff regulation depends on the type of regulation applied: cost-plus regulation or incentive regulation.

A *cost-plus* regulatory regime ensures a regulated rate of return on all fixed and operational costs. In this regulatory model the TSO is responsible for drafting of grid expansion plans and the regulator needs to approve expansion plans. The control by the regulator is needed to ensure that TSOs are not over investing in the electricity grid. After all, every investment is guaranteed a favourable rate of return resulting in larger profits for the TSO.[22] Obviously, the uncertainty surrounding remuneration of investment costs is minimal in this type of regulatory regime, but it does create another type of uncertainty. It is uncertain whether the regulator will give approval to the inclusion of certain capital and operational costs. This could pose a problem when certain expansion costs are incurred before plans are presented to the regulator for approval.

A regulatory regime based on *incentive regulation* contains substantially more uncertainty regarding remuneration of costs. In this regime, TSOs are required to pass-through efficiency savings obtained in operational and management costs with a lag of typically three to five years (length of a regulatory period). At the beginning of each period, the regulator announces the required efficiency gains that need to be realised in the next period. In practice this means that TSOs are required to either lower total revenues (revenue cap regulation) or (average) prices (price cap regulation) with a factor X.[23] The X-factor usually depends on efficiency gains obtained in previous periods and identified through application of econometric techniques. Another typical method to identify the X-factor in upcoming regulatory period is to benchmark TSO performance against TSO performance in other countries. Typically, transmission grid investments have a payback time covering several regulatory periods. Since allowed revenue and prices are only certain for one regulatory period at the time of the investment decision, uncertainty can exist on the remuneration opportunities in the remainder of the economic lifetime of the investment. Although the variation in required efficiency improvements may vary over time, they are typically decreasing over time.

7.2.8 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 types of regime changes can occur on an EU, international or national level. Reasons for sudden changes in legislation can be manifold, and may not be based on (economic) rationale. For example, faced with sky-high electricity wholesale prices, politicians might be tempted to force price ceilings upon the market, thereby distorting market forces and information signals for investment in generation and infrastructure capacity. Another issue on which politicians might be sensitive is the acquisition of national distribution networks by foreign companies and severe interruptions in electricity supply for whatever reason.

7.3 Conclusions on investment barriers and risks

Potential barriers for investment are the high costs of initial electricity corridor investments and the financing of the project.

The barrier of *high costs of initial investment* mainly concerns electricity corridors with DC technology. Compared with AC transmission lines, DC transmission lines are much costlier. An important reason to choose a DC over an AC based electricity corridor between two countries is the non-synchronisation of neighbouring electricity systems. This implies that this barrier is a *de facto* barrier for especially electricity corridors between EU and neighbouring countries.

[22] In regulatory economics literature, the overinvestment effect is known as the Averch-Johnson effect (1962).

[23] This is the *CPI (or RPI) - X* rule where revenues or prices are allowed to increase by the rate of inflation minus the required rate of efficiency improvement determined by the regulator.

The *financing* of electricity corridors is not considered to be a barrier for electricity corridor investment inside the EU, where majority of electricity corridors is expected to operate under a regulated regime. Moreover, the revenues of cross-border interconnector capacity auctions have created large investment *funds*. The real issue on the funds is how to effectively re-invest these into the network. The risks for electricity corridors with neighbouring regions are much larger, which implies a potential barrier in the financing of these projects.

The risks associated with electricity corridor investments are either market or policy & regulatory risk. The relevance of these barriers and risks varies with the *type of electricity corridor*.

Market risk in general refers to the risk of not being able to recover the cost of investment during the economic lifetime of the electricity corridor. Electricity corridors developed under a regulated regime are less exposed to market risk since regulation effectively passes-through the investment costs to end-consumers. 'Merchant' electricity corridors have a much larger exposure to market risk.

In either regime, regulated or merchant, the risk of 'wasted' public or private money can be reduced by improving the investment signal provided in liberalised electricity markets. Improving the price signal for investment on commodity and capacity markets by enhancing competitive market elements and introducing market/based mechanisms does not completely remove market risk. However, it can substantially assist electricity corridor investors in their assessment of the structural need, the market value, for additional electricity corridor capacity. Potential for improvement of the price signal for investment lies in (i) regulated electricity markets or (partly) captive markets, (ii) market concentration in liberalised electricity markets, (iii) insufficient harmonisation of market design (differences with respect to degree of unbundling, market rules, regulatory codes etc.), (iv) non-transparency in price formation and capacity availability, and (v) non-market based electricity corridor capacity allocation mechanisms.

In addition, the value of an electricity corridor investment project for society and investor can be largely influenced by other investment projects in electricity transmission and electricity generation. Both can alter the, due to *loop flows*, already unpredictable flow of electricity significantly. This can negatively affect the business case for an electricity corridor investment project. It gives rise to an increasing uncertainty on a project's usefulness.

Policy and regulatory risk relates to the uncertainty in current government policy and regulation and to uncertain future developments in policy and regulation. Policy and regulation directly impact the ability of investors to recover electricity corridor investment. For example, policy on electricity generation (support programs for 'green' electricity, vision on nuclear electricity generation) influences the price differential between two countries and hence the trading and arbitraging profits accruing to the investor. Concerning policy and regulatory risk in countries neighbouring the EU there can be large uncertainty with respect to the degree and speed of further economic en energy policy reforms.

8. Investment risk mitigation for electricity corridors

In the previous Chapter identified and elaborated on investment risks in general and price and volume risks in particular. In this subsection we discuss the instruments available for mitigation of these risks. Generally, three risk mitigation strategies exist: (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 or horizontal integration (*organisational hedging*). The suitability of these risk mitigation strategies depends on the type of exposed risk. This is dealt with under the various risk mitigation strategies below.

8.1 Financial hedging

Financial hedging involves operations on electricity spot and forward markets, and its derivatives market. Spot and forward market transactions can occur on power exchanges or over-the-counter (OTC) markets. In the remainder we will not make this distinction and refer to them both as electricity trading markets.[24] Trading simultaneously in spot and forward markets could theoretically provide 100% hedging opportunities. However, this option is not available to that degree in practice. First of all, the majority of EU neighbouring countries have not liberalised their energy markets, and consequently do not have an electricity trading market. But even in the case of existing electricity trading markets, three problems can persist. First, spot trade and/or forward trade is not liquid enough to provide the right information signals to the market. Second, market liquidity is sufficient but the market is dominated by one or more market actors, causing potentially distorted information signals to the market. Third, more fundamentally, it is inherently difficult to provide a forward contract for electricity delivery that matches the economic lifetime of investment.

Table 8.1 presents information on the existence of electricity trading markets across the EU and neighbouring countries. From this table it is apparent that the penetration of spot and forward trading in selected countries is low. This is mainly caused by ongoing liberalisation processes in the Eastern European EU member states and the non-liberalised electricity markets in the EU's surrounding regions. Moreover, liquidity on the limited number of existing power exchanges is not in al cases sufficient.

[24] In general, power exchanges are organised market places where market participants trade anonymously whereas OTC markets are organised according to industry practices and industry agreements where trade is conducted bilaterally (EC 2006).

Table 8.1 *Liquidity on EU and non-EU power exchanges*

Country	Spot trade [% of domestic consumption [a] [b]]	Forward trade [% of domestic consumption]
Spain	84	No forward trading
Italy	44	No forward trading
Denmark	43	151
Finland	43	151
Norway	43	151
Sweden	43	151
Austria	3	No forward trading
France	3	6
Slovenia	2	No forward trading
United Kingdom	2	0
Germany	13	74
Netherlands	12	39
Poland	1	No forward trading
Czech Republic	1	No forward trading
Belgium	Starts in 2006 [c]	No forward trading
Estonia	No spot trading	No forward trading
Greece	No spot trading	No forward trading
Hungary	No spot trading	No forward trading
Ireland	No spot trading	No forward trading
Latvia	No spot trading	No forward trading
Lithuania	No spot trading	No forward trading
Portugal	No spot trading	No forward trading
Slovakia	No spot trading	No forward trading
Algeria	No spot trading	No forward trading
Belarus	No spot trading	No forward trading
Egypt	No spot trading	No forward trading
Libya	No spot trading	No forward trading
Morocco	No spot trading	No forward trading
Tunisia	No spot trading	No forward trading
Turkey	No spot trading	No forward trading
Ukraine	No spot trading	No forward trading

[a] Figures for power exchange for period June 2004 to May 2005 (EC, 2006).
[b] Figures for 2004 (EC, 2005).
[c] ww.belpex.be.

Although the forward market for electricity could be very liquid, the problem will persist that the products offered are not suitable to hedge investment risks of electricity infrastructure projects. Whereas the economic lifetime of infrastructure projects exceeds 10 years, the longest forward contract typically available on forward markets are three years ahead. Moreover, the further ahead the forward delivery contract, the less liquid the market.

Conclusion

In general, we conclude that electricity trading platforms' role in risk mitigation of electricity infrastructure investment risk is limited. The only contribution in risk mitigation in the future is on the mitigation of price risks. By entering long-term forwards or futures, investors can virtually lock-in anticipated returns on investment. However, given the specific electricity commodity characteristics it is doubted whether this will become the case in the future. However, further development of spot and future trading on power exchanges will be beneficial for electricity infrastructure investments through the provision of efficient price signals for investment, as was discussed in Subsection 7.1.2. Therefore, it is recommended that the EC and members states optimally facilitate the trading of electricity and stimulate the development of more liquid power exchanges. This can be reached by strict and quick implementation of current European electricity market legislation and the removal of differences in market rules such as timing of gate closure and market imbalance arrangements (Van Werven and Van Oostvoorn 2006).

8.2 Contractual hedging

The second approach in risk mitigation is entering into long-term capacity rights contracts. Different types of risks which either the buyer or the seller wants to mitigate can theoretically be included in contracts. Typically, long-term capacity rights contracts are volume related and include price clauses. This makes contracts in principle a suitable hedge for both price and volume risks. In the pre-liberalisation era, the approach was widely used in electricity interconnector investments within the EU.

However, since the start of European energy market liberalisation, long term contracts for import and export capacity are exceptional. Due to their negative impact on wholesale market competition, their use has been discouraged. Default regulation of electricity infrastructure in the EU is based on TPA and pricing conditions. Article 7 of the Electricity Directive however allows specific investment projects to be exempted from these conditions.[25] It basically allows electricity corridor investors the freedom to recover investment costs on own conditions, e.g. including long-term contracts.

The challenge is to find a contractual arrangement that meets the need for the investor to recoup investments on the one hand and at the same time not distorts or limit the energy market to function competitively. A potential could be the re-instalment of long-term contracts with innovative elements included with respect to the process towards signing of the long-term contract. For example, analogous to the 'open season'[26] procedures in the natural gas market, long-term contracts could be envisaged to be the result of a competitive process where all interested parties (including new market entrants) are involved. This is a possible solution that needs to be researched more in depth.

8.3 Organisational hedging

A third approach in risk mitigation is organisational hedging. We discuss two types of organisational hedging: (1) vertical integration and (2) horizontal integration.

Vertical integration
Vertical integration was a dominant phenomenon in the pre-liberalisation era were generation, transmission, distribution and trade were integrated in one electricity company. Vertical integration *decreases* investment risk associated with electricity corridors.

However, in the process of liberalisation of energy markets, the existence of vertically integrated electricity companies were considered an obstacle in realising effective wholesale and retail competition. Vertically integrated electricity companies could provide unfair competition for non-integrated companies by, for example, frustrating network access.

Several types of unbundling exist: (i) accounting, (ii) legal, and (iii) ownership. The impact of each type of unbundling on the development of wholesale market competition might is different. The same goes for the impact on the potential for risk mitigation. The stricter the type of unbundling required, the less potential for risk mitigation through vertical integration.

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[25] So far, only one electricity infrastructure was exempted under Article 7 of the 2003 Electricity Directive. This is interconnection between Estonia and Finland (Estlink).

[26] 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.

In order to further stimulate electricity wholesale market competition, the 2003 Electricity Directive (EC, 2003) required EU member states to legally unbundled trading and network activities and allowed for further-going ownership unbundling. Among the EU countries and new accession countries, all have adopted some kind of unbundling. The majority has opted for the minimum legal unbundling whereas a minority adopted ownership unbundling (Denmark, Italy, The Netherlands, Spain and the UK). Outside the EU unbundling of transmission and trading activities is rare. More in general electricity transmission activities in EU's neighbouring countries are often still integrated within a national electricity company that spans the whole electricity value chain.[27] From a risk mitigation perspective, this seems beneficial for infrastructure investments, but as soon as liberalisation starts off in and competition starts to develop, an unbundling of activities within the former incumbent seems essential.

Horizontal integration

Horizontal integration refers to cooperation between to electricity market actors operating on the same level in the value chain. A common form of horizontal integration in energy markets is a joint-venture agreement. Horizontal integration does not reduce overall investment risk of an electricity corridor project but investment risks are shared amongst the cooperating partners. Horizontal integration is widely applied in electricity transmission market in varying forms and remains an important risk-sharing instrument in the future.

Conclusion

The options for organisational hedging through vertical integration are rather limited within the EU due to strict unbundling requirements. However, legal unbundling, as in contrast with further going unbundling can still provide a partial hedge in the sense that it integrates profits from transmission and trading activities. A full ownership unbundling would put an end to this. There are fair reasons to strive for any type of unbundling, but the trade off between

In neighbouring regions, the option of an organisational hedge still exists. In addition, participation of TSOs or private actors in corridor investments is still allowed in most cases through legal subsidiaries.

8.4 Conclusions on options for hedging

The opportunities to *financially hedge* investment risks in electricity corridor investments seem limited. The hedging of the price risk of infrastructure investments is only possible for much shorter time periods than the economic lifetime of the projects (up to three years ahead). The further development of financial instruments could increase this potential but the length of potential derivatives is unlikely to increase. Moreover, the potential for financial hedging of investments in electricity corridor investments between EU and non-EU regions seems relatively small since forward and future markets, when existent, are deemed to have too low liquidity.

Contractual hedging seems to be the most promising risk mitigation strategy from the strategies discussed. It could be a fruitful approach in covering both volume and price risks. It is stressed that contracts in this respect do not need to be restrictive on competitive forces since instruments like auctions cause contracts to emerge under competitive conditions. The limitation however could again be the period over which electricity capacity can be contracted long-term. These will not match the economic lifetime of infrastructure investment projects and consequently never fully cover price or volume risk. Analogous to the transmission network capacity allocation in the natural gas market (open seasons), long-term capacity rights contracts could successfully be combined with competition at specific stages before entering the contract.

[27] Notably exceptions in this respect are Turkey and Egypt who adopted legal unbundling.

Organisational hedging through vertical integration can be used in mitigating both price and volume risks to the degree of unbundling required between electricity trading and transmission activities. The stricter the type of unbundling required, the more limited are the options for organisational hedging of risks associated with electricity corridor investments. Ownership unbundling for example would not leave any room for organisational hedging. Organisational hedging through horizontal integration based on for example cooperation agreements and joint-ventures are a widely applied instrument in the current electricity transmission market. Although these types of mechanisms do not decrease overall investment risk, the sharing of risks can reduce the barrier for electricity corridor investments.

9. Summary of conclusions and policy recommendations for electricity corridors

9.1 Summary of conclusions

Introduction
Part B of the report addressed the conditions under which electricity corridor investments are implemented. The electricity market actors willing to invest in electricity corridor expansion need to deal with barriers and risks associated with the investment. What are the type of barriers and risks they face, and what are their strategies in dealing with them? The *first* aim of this report was to identify the barriers and risks and analyse whether policy or regulatory actions can remove the barriers and reduce or mitigate the risks. The *second* aim of this report was to assess the ability of electricity corridor investors to deal with this risk and analyse whether policy or regulatory actions can increase the 'inventory' of risk mitigation instruments at the disposal of investors. By removing barriers and decreasing risk of electricity corridor investment projects on the one hand, and stimulating opportunities to deal with risk on the other, the investment conditions for electricity corridor investment can be improved. The barriers and risks assessed in this report concern the economic conditions; for a discussion on (geo-) political barriers and risks of electricity corridor investments we refer to a separate report by Luciani (2006).

Electricity corridors
Electricity corridors refer to high voltage transmission infrastructure designed for long-distance transportation of electricity. We define three different electricity corridors:
1. *International* electricity corridors (corridors between EU and neighbouring countries).
2. *EU* electricity corridors (corridors between EU member states).
3. *National* electricity corridors (corridors within an EU country).

Electricity corridors have an important technical dimension: the long-distance transmission of electricity may be at *alternating current (AC)* or *direct current* (DC). In contrast to AC transmission equipment, DC transmission equipment is more *costly*. In addition, electricity flow of DC transmission connections is more *controllable* than AC transmission connections. These differences have implications for the conditions for electricity corridor implementation.

Policy and regulation
Policy and regulation with respect to electricity corridor investments differs between the EU and neighbouring countries. Whereas the EU adopts a 'free market' approach, the majority of neighbouring countries take a more administrative approach with a larger role for public institutions in electricity market decision-making. The latter to a lesser extent rely on market-based mechanisms for electricity market operations. The dominant regime for electricity corridor investment in the EU is currently a regulated regime in which a transmission system operator (or a joint-venture of TSOs) is responsible for system operations, and where transmission tariffs are regulated. Under exceptional circumstances, electricity corridor investments are undertaken under a non-regulated regime, i.e. merchant. Summarising, (i) national electricity corridors within EU member states are generally regulated, (ii) electricity corridors between EU member states are mostly operating under a regulated regime and in a small number of cases operating under a merchant regime, and (iii) electricity corridors between the EU and neighbouring countries can be considered to be largely merchant-based.

Investment barriers
Potential barriers for investment are the high costs of initial electricity corridor investments and the financing of the project.

The barrier of *high costs of initial investment* mainly concerns electricity corridors with DC technology. Compared with AC transmission lines, DC transmission lines are much costlier. An important reason to choose a DC over an AC based electricity corridor between two countries is the non-synchronisation of neighbouring electricity systems. This implies that this barrier is a *de facto* barrier for especially electricity corridors between EU and neighbouring countries.
The *financing* of electricity corridors is not considered to be a barrier for electricity corridor investment inside the EU, where the majority of electricity corridors is expected to operate under a regulated regime. Moreover, the proceedings of cross-border interconnector capacity auctions have created large investment *funds for TSOs*. The real issue on the funds is how to effectively re-invest these into the network. The risks for electricity corridors with neighbouring regions are much larger, which implies a potential barrier in the financing of these projects.

Market and policy & regulatory risk
The risks associated with electricity corridor investments are either market or policy & regulatory risk. The relevance of these barriers and risks varies with the *type of electricity corridor*.

Market risk in general refers to the risk of not being able to recover the cost of investment during the economic lifetime of the electricity corridor. Electricity corridors developed under a regulated regime are less exposed to market risk since regulation effectively passes-through the investment costs to end-consumers. 'Merchant' electricity corridors have a much larger exposure to market risk.

In either regime, regulated or merchant, the risk of 'wasted' public or private money can be reduced by improving the reliability of the investment signal provided in liberalised electricity markets. Improving the price signal for investment decision on commodity and capacity markets can be achieved by enhancing competitive market elements and introducing market/based mechanisms, but this does not completely remove market risk. However, it can substantially assist electricity corridor investors in their assessment of the structural need for, the market value of, additional electricity corridor capacity. Potential for improvement of the price signal for investment stems from: (i) regulated electricity markets or (partly) captive markets, (ii) market concentration in liberalised electricity markets, (iii) insufficient harmonisation of market design (differences with respect to degree of unbundling, market rules, regulatory codes etc.), (iv) non-transparency in price formation and capacity availability, and (v) non-market based electricity corridor capacity allocation mechanisms.

In addition, the value of an electricity corridor investment project for society and investor can be largely influenced by other investment projects in electricity transmission and electricity generation. Both can alter the, due to *loop flows*, already unpredictable flow of electricity significantly. This can negatively affect the business case for an electricity corridor investment project. It gives rise to an increasing uncertainty on a project's usefulness In future years.

Policy and regulatory risk relates to the uncertainty in current government policy and regulation and to uncertain future developments in policy and regulation. Policy and regulation directly impact the ability of investors to recover electricity corridor investment. For example, policy on electricity generation (support programs for 'green' electricity, vision on nuclear electricity generation) influences the price differential between two countries and hence the trading and arbitraging profits accruing to the investor. Concerning policy and regulatory risk in countries neighbouring the EU there can be large uncertainty with respect to the degree and speed of further economic development, energy policy reforms and political considerations.

Risk mitigation opportunities
Market risk and more specifically *price and volume risk* can, theoretically, be mitigated or reduced via three differing strategies: (1) financial hedging, (2) contractual hedging, and (3) organisational hedging. The availability of hedging strategies is especially important for merchant based projects, including electricity corridors between EU and non-EU countries.

Opportunities to *financially hedge* investment risks in electricity corridor investments exist but are limited. Power exchanges across the EU offer futures or forward contracts that can relieve a project's risk exposure. However, the time span of these products is too short compared with the economic lifetime of electricity corridors and liquidity of these traded product may be too low to provide risk insurance. Concerning electricity corridors between the EU and neighbouring countries, financial hedging is hardly an option at all since prices in neighbouring countries are generally not market-based.

Contractual hedging offers good hedging opportunities, especially for investment projects on corridors with the EUs neighbouring regions. However, this implies exemption from default EU regulation on access to transmission networks. In allowing an increasing use of long-term contracts lays the danger of threatening competition. The negative impact of such arrangements can be compensated by implementing market-based allocation of these contracts, for example through auctions. Additional opportunities to safeguard competitive elements in merchant projects are the six conditions for granting a TPA exemption as laid down in Article 7 of the EUs Electricity Directive. Two specific conditions in this Article need to be addressed. Firstly, a more explicit role for social cost-benefit analysis can assist the national and European regulatory bodies in the assessment of the impact of the proposed investment project on security of supply and affordability (competition). Secondly, the potential role of a *public* TSO in *merchant* projects through legally separated business units is questionable.

Organisational hedging can have two faces: (1) vertical integration and (2) horizontal integration. Vertical integration by combining either electricity transmission and generation, or electricity transmission and trade is not considered an option within the EU due to policy of *unbundling*. Horizontal integration however is offers more risk-reducing potential. By entering a joint-venture, two neighbouring TSOs can share and allocate costs and risks of electricity corridor investment. Electricity corridor projects between an EU and non-EU member state generally involve “joint-venture-like” arrangements between a TSO (from the part of the EU) and a vertically integrated national electricity company (from the side of the neighbouring country).

Final conclusion

We conclude that there are considerable opportunities for policy-makers and regulators alike to improve upon the investment conditions for investors in interconnections between EU and non-EU countries. Removing wholesale market distortions (e.g. market concentration, market captivity etc.) if present and implementing market-based mechanisms where appropriate can assist electricity corridor investors through enhanced information signals for investment. This counts for both intra-EU electricity corridors as well as electricity corridors between the EU and neighbouring countries. In addition, increasing coordination could enhance the value of both regulated and merchant electricity corridor projects. Market risks as mainly associate with merchant electricity corridors can best be mitigated through long-term contracting (in case of merchant projects) or entering joint-ventures (both merchant and regulated projects). In order to minimise the negative impact of long-term contracting on wholesale market competition full attention should be given to inserting competitive elements compatible with these long-term contracts.

Below we derive specific government policy and regulatory actions.

9.2 Policy recommendations

The implementation of electricity corridors within the EU or between the EU and neighbouring countries, either regulated or merchant, can be facilitated by policy makers and regulators through: (1) removing or decreasing market and policy & regulatory risk, and (2) improving the options for investors to mitigate or remove market risk. This might be achieved as follows.

Decreasing market risk

Market risk, i.e. the risk of non-recovery of investment costs due to adverse price or volume developments can be reduced by removing anti-competitive elements in current electricity markets and by implementing market-based allocation mechanisms where appropriate. Both type of actions can enhance market transparency and increase the value of prices (both for commodity and capacity) as signals for electricity corridor investments. This does not remove all uncertainty on investment recovery but can facilitate the investment decision-making process. It positively affects investment decision-making for investors in both regulated and merchant electricity corridor projects. In the former case it can prevent wasteful investment spending of public money. In the latter it can prevent the loss of private money.

Some of the specific actions are already stated as European policy. In that case, the importance of this action is again stressed and asks for completion and/or overall implementation in the EU of Directives and guidelines such as on:.

1. *Liberalising electricity prices* for all end-consumers;
2. *Countering market concentration* on wholesale and retail markets;
3. *Harmonisation* of regulatory codes and market rules;
4. *Transparency* of price formation and electricity corridor capacity allocation processes, through (further) development of electricity exchanges (spot and forward markets).

Developments in the electricity transmission markets (e.g. among each other competing electricity corridors, national network upgrades) or electricity generation markets (e.g. for new large-scale investments) can significantly affect the recovery of investment costs of a proposed electricity corridor project, whether merchant or regulated.

5. In order to invest efficiently and effectively in electricity corridors an *increasing coordination* across borders on interconnection investment projects is recommended.

More precisely coordination should involve national regulators and transmission system operators. To the degree that coordination is already present; an analysis on the added value of institutionalisation in terms of authority, responsibilities of the coordination processes is recommended. More centralised coordination on supra national level will increase the public value of electricity corridor investments and furthermore create a more stable investment climate in Europe. For a start, coordination can be arranged on regional level.

Minimising policy & regulatory risk

An adagio that is already well-known and needs to be repeated here is that the governments' most important tasks is to provide a stable and transparent policy and regulatory framework with appropriate degree of commitment. Short-term unanticipated changes in energy policy or energy regulation are detrimental to investors' confidence to make a proper return on proposed and undertaken investments stretching over a much longer period.

6. National governments should envisage the importance of *long-term policy and regulatory commitments*, for example by communicating and committing to a *clear vision* on the future electricity system (e.g. role of nuclear generated electricity, future design of the ETS, etc.)

Options for risk mitigation

The most appropriate strategies for the hedging of market risks are contractual hedging (long-term contracts) and hedging through either horizontal or vertical integration.

Long-term contracts are appropriate for both inter-EU electricity corridors (merchant projects) and EU-neighbouring country electricity corridors. But when allowing investors to hedge risks through long-term contracts, the impact on competition in the European and national electricity markets needs to be carefully assessed. With competitive energy markets being one of the main goals of the EU, every type of long-term contracts need to be analysed on its restrictive impact on competition. Introduction of competitive elements in the different stages of entering and operating under a long-term contract is recommended.

7. In Article 7 conditions on TPA exemptions for electricity corridors an explicit role should be given to *social cost-benefit analysis*, with specific focus on objectives security of supply and competition.
8. The market-based instrument of *auctioning* can be implemented as an allocation method for long-term contracts allowed under Article 7 merchant corridor projects.

Organisational hedging *through vertical integration* is only practiced by non-EU based electricity market actors involved in electricity corridor investment projects between EU and non-EU member states. Unbundling of electricity trading and network activities prevents the use of the vertical integration strategy within the EU. The main argument for implementation of unbundling, its potential negative effect on wholesale market competition, is still highly valid. Hence, a return to 'bundled' electricity firms is not recommended by us.

Organisational hedging through *horizontal cooperation* is a valid strategy for all types of electricity corridors: merchant or regulated, inter-EU or international.

Role of TSO in merchant projects

A specific issue that needs to be addressed is the participation of TSOs in merchant electricity corridor projects. Whether it concerns an electricity corridor between neighbouring EU countries or an electricity corridor between the EU and one of the neighbouring countries, there is the risk that losses in the merchant project need to be compensated later with public money. European legislation requires legal unbundling between the operators of the merchant electricity corridor and the neighbouring public TSOs in order to prevent conflict of interest or cross-subsidisation. It is unclear what happens when TSO subsidiaries turn to their holding company in dire times. Will public shareholders come to the rescue?

9. Legislation should be amended to prevent a call for public money when risky merchant projects turn to their public holding company (TSO) when financial losses occur.

With the aim of clarifying the role of the TSO in electricity corridor development it could be advocated that a larger role for regulated investment in corridors by TSOs is necessary. The basic assumption is that TSOs have full information on new electricity corridor investments requirements in the coming years. The exact need for extension of electricity corridor capacity between countries can be determined and approved in cooperation with the neighbouring TSO. When the socially desired electricity corridor is defined, *auctioning* of this project would test whether *private investors* herein see business opportunities. Private investors (or consortia of private investors) will, theoretically, bid up until the market value of the project. A successful bid will be awarded with a merchant regime (exemption from TPA). When no bids are received, the joint TSOs will operate and invest in proposed project within a regulated regime. Given that TSOs should not be allowed to participate in such a bidding process, no conflict of interest, cross-subsidisation or risk of public money being wasted can occur.

10. Investigate the option of auctioning electricity corridor projects with a large role for TSOs in identifying necessary projects.

Congestion revenue funds

The current auctioning of electricity corridor capacity, especially in North-Western Europe causes large revenues for TSOs. Regulation on the conditions on how to spend the funds acquired differs from country to country. Whereas the one country allows the TSO to spend on cross-border capacity expansion only, the other country allows TSOs to spend on internal network capacity expansion as well.

The problem in the current design of only auctioning cross-border capacity is that it does not signal the exact location of congestion. For example, an internal network link can be congested, but since internal capacity is not allocated on a market-based method, the cross-border linkage is *treated as being the congested point*. When the purpose is to relieve congestion in general, TSOs should be allowed to invest in the national network too. At the same time this creates issues on conflict of interests and cross-subsidisation. Key question remains: "*How can we stimulate TSOs to optimally remove network congestion in either national networks or on cross-border corridors"?* The informational advantages of TSOs compared with regulators is considerable. Mechanisms for the regulator to bridge this information gap are scarce, but the TSO needs to convince the regulator that the project proposed is the most efficient solution (from society's perspective) to relieve congestion. This could be undertaken by explicit social cost-benefit analysis of at least two projects: one designed for increasing corridor capacity, and one designed for upgrading of the national network, both aimed at relieving the bottleneck that created the congestion revenue funds.

11. More responsibilities for the TSO regarding the identification of the most efficient and cost-effective investment aimed at relieving congestion, with assistance through social cost-benefit analysis.

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Appendix A Technical conditions for gas corridor investments

A.1 Harmonisation of gas quality parameters

The quality of natural gas varies according to its field of origin. After extraction of the gas, a quality treatment of the gas is necessary to confirm to gas quality standards used in transmission and distribution systems. These standards may vary from country to country. The degree to which gas quality can be accommodated in other systems is limited. These issues should be taken into account in the design of new infrastructure projects. However, it is unlikely that gas quality issues will hinder gas corridor investments since costs associated with the gas quality are only minor compared to total investment costs. However, the existence of a network in which quality specifications differ hinders the tradability of gas[28].

EASEE[29], an association of organisations involved with gas in all possible ways is working on a harmonisation of gas qualities at cross-border points. Until 2010, a total of 10 gas quality parameters need to be harmonised, in order to improve the interoperability of European gas transmission. In some instances, this will require investments in handling technology, but in the long-term, the system might benefit from increased harmonisation. Since 2003, a total of 6 'Common Business Practices' (CBPs) have been approved. The EASEE monitors its implementation progress yearly. Table A.1 lists the CBPs approved by EASEE.

[28] One of the organisations that currently deal with quality specification and harmonization issues is Gas Transmission Europe (www.gte.be).

[29] See its website: www.easee-gas.org. The mission of EASEE is "To develop and promote common practices to simplify and streamline business processes between the stakeholders that will lead to an efficient and effective European Gas Market".

Table A.1 *List of approved Common Business Practices*

CBP	Title	Deadline	Summary
CBP 2003-001-01	Harmonisation of units	October 2005	This CBP promotes the use of the same units for pressure, energy, volume and calorific value by all organisations involved in the delivery of gas from the producer to the client.
CBP 2003-002-01	Harmonisation of nomination and matching process	October 2005	This CBP describes a first set of recommendations for the part of the process, which relates specifically to cross-border transportation nominations and involves shippers and TSOs. For reasons of consistency, it should also serve as the core for the communication processes between all other relevant parties involved in the gas chain.
CBP 2003-003-01	Use of Edig@s protocol	Immediate for Edig@s users	This CBP describes the use of the EDIG@S protocol for exchange of business information between parties in the European gas market.
CBP 2005-001-01	Gas quality harmonisation	October 2010 for Wobbe index, relative density and oxygen; October 2006 for other parameters	This CBP recommends natural gas quality specifications to streamline interoperability at cross border points in Europe and describes the recommended gas quality parameters, parameter ranges and the implementation plan.
CBP 2005-002-01	Interconnection agreements	October 2006	This CBP describes the scope of an Interconnection Agreement to be established by two adjacent TSOs, describing how to facilitate interoperability of the grids.
CBP 2005-003-01	Constraints	October 2006	This CBP describes the operational procedures to be applied where constraints arise due to unforeseen restrictions in transmission capacity or due to off-specification gas properties.

Source: EASEE, 2006.

Figure A.1 shows the progress made in implementation of CBPs.

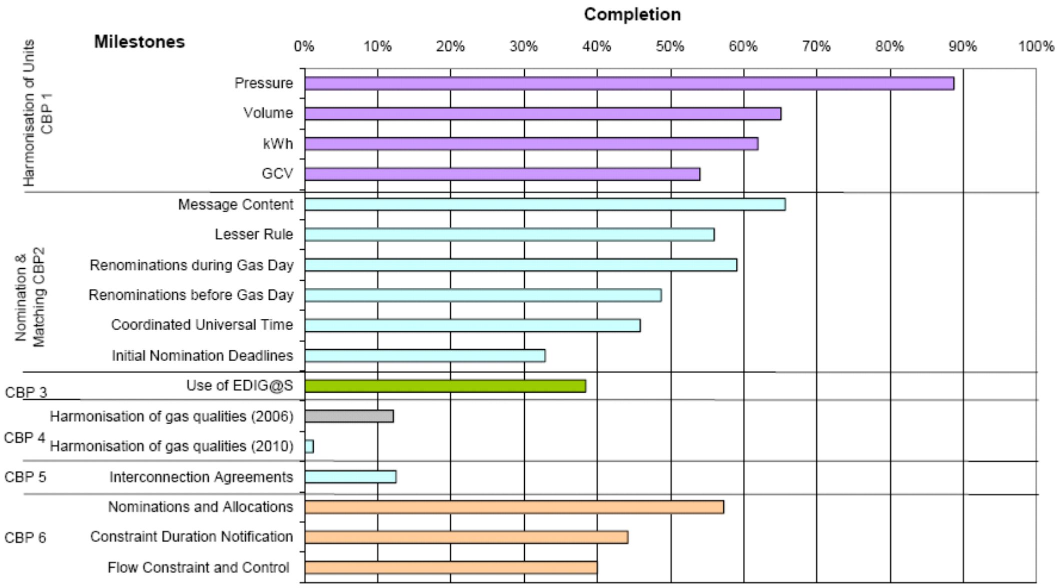

Figure A.1 *Implementation progress of EASEE common business practices*
Source: EASEE, 2006.

Appendix B Overview of gas market actors

Table B.1 *Overview of actors involved in gas corridor investments*

Actor	Sector	Role	Goal	Instrument(s)
Small gas consumer	Private	Gas consumption	Minimise gas costs	Contracting
Large gas consumer	Private	Gas consumption	Meeting energy demand, maximise profit, minimise input costs	Contracting, vertical integration, trading
Gas producer	Private	Gas production and trade	Maximise profit	Production and trade of gas
	Semi-public	Gas production and trade	Maximise profit with reference to specific government targets	Production and trade of gas
	Public	Gas production and trade	Breaking even, safeguarding public values	Production and trade of gas
Network owner	Public (TSO)	Transport gas	Securing transport/delivery of supply, breaking even with costs	Investment in maintenance, infrastructure expansion, providing infrastructural services
	Private ('merchant')	Transport gas	Maximise profit	Infrastructure investment, providing infrastructural services
Bank	Semi-public/ public (e.g. EIB, EBRD)	Provide financing for specified projects	Break-even, facilitating development	Providing financing through public funds
	Private	Provide financing	Profit maximisation,	Investment strategies, lending strategies, consulting on investment projects
Energy trader	Private	Energy trading	Profit maximisation,	Arbitraging between markets (in time, geographical location, product markets etc.)
Regulator	Public	Keeping regulatory oversight, applying national law and codes	Ensuring market compliance with law and regulation	Regulatory codes, penalties
National government	Public	Securing public values	Maximise national welfare	Competition policy, Foreign policy
European government	Public	Idem.	Maximise EU welfare	Competition policy, Foreign policy

Appendix C Overview of electricity market actors

Table 9.1 *Overview of actors involved in electricity interconnector investments*

Actor	Sector	Role	Goal	Instrument(s)
Large electricity consumer	Private	Energy consumption	Meeting energy demand, maximise profit, minimise input costs	Contracting, vertical integration, trading
Small electricity consumer	Private	Energy consumption	Minimise electricity costs	Contracting
Electricity producer	Private	Electricity production and trade	Maximise profit	Production and trade of electricity
	Semi-public	Electricity production and trade	Maximise profit with reference to specific government targets	Production and trade of electricity
	Public	Electricity production and trade	Breaking even, safeguarding public values	Production and trade of electricity
Network owner/operator	Public	Transport electricity	Securing transport/delivery of supply, breaking even with costs	Investment in maintenance, infrastructure expansion, providing infrastructural services
	Private ('merchant')	Transport electricity	Maximise profit	Infrastructure investment, providing infrastructural services
Bank	Semi-public/ public	Provide financing for specified projects	Break-even, facilitating development	Providing financing through public funds
	Private	Provide financing	Profit maximisation,	Investment strategies, lending strategies
Energy trader	Private	Energy trading	Profit maximisation,	Arbitraging between markets (in time, geographical location, product markets etc.)
Regulator	Public	Keeping regulatory oversight, applying national law and codes	Ensuring market compliance with law and regulation	Regulatory codes, penalties
National government	Public	Securing public values	Maximise national welfare	Competition policy, Foreign policy
European government	Public	Idem.	Maximise EU welfare	Competition policy, Foreign policy